JOURNAL OF THE TRANSACTIONS

OF

THE VICTORIA INSTITUTE.

VOL. XXXII.

JOURNAL OF

THE TRANSACTIONS

OF

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OR,

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EDITED BY THE SECRETARY

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CONTENTS.

**** The Institute's object being to investigate, it must not be held to endorse the various views expressed at its meetings.*

PREFACE.

THE lamented death of the late Hon. Secretary, Captain Petrie, who entered into his rest on Saturday, 21st July, has made it necessary for other hands than his to prepare for publication the accompanying volume, No. XXXII, of the *Transactions*, which it is hoped will be found not less interesting and instructive than those which have preceded it. By the sad event above referred to, the VICTORIA INSTITUTE has lost the services of one to whom its present prosperous condition and useful career are largely due; and on the occasion of the Anniversary Meeting of the Institute on Monday, the 16th July, while Captain Petrie was lying on what proved to be his death-bed, the President, Sir G. G. Stokes, and one of the Vice-Presidents, Sir Joseph Fayrer, both took occasion to bear warm and eloquent testimony to the value of his services to the Institute. Subsequently, at the first meeting of the Council, at which Commander G. P. Heath presided, the following resolution was adopted:—

"The Council at their Meeting on Monday, July 23rd, have to express their sincere sorrow at the decease of the Hon. Secretary, Captain Francis Petrie, who for a period of over thirty years conducted the affairs of the Institute with great judgment and unfailing courtesy; and they desire to offer their respectful condolence to Mrs. Petrie and family."

(Signed) G. P. HEATH, *Chairman.*
EDWARD HULL, *Hon. Treasurer.*

The above Resolution doubtless expresses in a few words the general feeling amongst members and friends of the Institute regarding Captain Petrie's character as a sincere Christian and a warm friend, and renders it unnecessary for me here to add another word, as these personal qualities are well known to all who had the privilege of his acquaintance.

Letters expressive of interest in the various subjects dealt with by the Victoria Institute are received from distant parts of the world from time to time, and have been referred to in preceding pages of the *Transactions*. But the expression of such interest on the part of a distinguished member coming from Canada, namely, the Bishop of Minnesota, during the discussion on the paper of Professor McKenny Hughes (1st May, 1899) must have been peculiarly gratifying to those who were present on the occasion. The Bishop is reported to have said: "It is a very great pleasure for me to be present at this meeting; for although I have been one of your members for many years and have taken very great delight in reading all the papers that are published by the Institute, this is the first time I have had the pleasure of being present." This statement was followed by a very interesting account regarding the characters of the great Indian tribe of the Algonquins, amongst whom much of the Bishop's life and labours are passed.

The subjects dealt with in the present volume will be found to be exceedingly varied, embracing those which come under a wide range of investigation. Under the head of BIOLOGY, we have papers by Mr. J. W. SLATER and Dr. WALTER KIDD; under BOTANY, papers by the late Dr. WOOLLS on the Australian flora; under PHYSICAL GEOGRAPHY and GEOLOGY, papers by GRANT BEY and Professor HULL; under ETHNOLOGY, a paper by the Rev. M. EELLS on "The Worship and Traditions of the Islanders of the Pacific Ocean," and Professor McKENNY HUGHES on "Nationality"; under PHYSICS, a paper by Dr. MACDONALD on "Human colour sense"; under MENTAL PHILOSOPHY, two papers by Dr. SCHOFIELD;

and under the subject of BIBLICAL THEOLOGY two papers by Professor MACLOSKIE and Rev. Dr. DUNS. Several of these papers have for various causes been delayed in publication, and several must for want of space stand over for the next volume.

EDWARD HULL, *Acting Secretary.*

ANNUAL GENERAL MEETING

HELD AT THE HOUSE OF THE SOCIETY OF ARTS, MONDAY, JULY 16, 1900.

The President,

Sir GEORGE GABRIEL STOKES, Bart., LL.D., Sc.D., F.R.S.,

IN THE CHAIR.

The PRESIDENT.—Ladies and gentlemen, I am sure we all very much regret the absence of one face here with which we are familiar—viz., that of our indefatigable Hon. Secretary, Captain Petrie. I am sorry to say he is ill, and it would have been madness for him to have attempted to be present on this occasion. I got, when I came here, a letter from Mrs. Petrie in which she stated that he wished me to apologise to the meeting for his absence. I think none of us can fail to be struck with the extreme care with which he has attended to all the business of the Institute, and we all deeply regret that he is not able to be with us to-day. I believe I may say that this is the first anniversary which he has missed.

Letters expressing regret at their inability to be present have been received from Lord Lichfield, the Bishop of Wakefield, the Dean of Llandaff, Archdeacon Sinclair and others, to which I may add one that I received myself, before I left Cambridge, from Lord Kelvin. I had hoped that he might have been able to be present at this meeting, but he is obliged to go to Edinburgh.

Captain Petrie used to read out extracts from the Annual Report. In his absence I will read a few passages.

Progress of the Institute.

1. In presenting the THIRTY-FOURTH ANNUAL REPORT, the Council is glad to be able to state that the position of the Victoria Institute has been maintained, although somewhat affected by those adverse influences which are now felt by nearly every interest and society.

2. The Institute has been greatly aided in its work by an increase in the number of those in the highest walks of science who cordially co-operate with it, and also by the help accorded by the Members and Associates both at home and abroad. Without their steady support not only would all progress become arrested, but much ground already gained would be lost.

The Institute would be greatly aided by each individual Member and Associate interesting their friends at home, abroad, and in the colonies in it. Considering the tendency of modern popular thought there is a special need for its work being carried on as at present, under the auspices of those leading men of the day who have associated themselves with the President.*

3. The following is the new list of the Officers and Council:—

President.

Sir George Gabriel Stokes, Bart., LL.D., Sc.D., F.R.S.

Vice-Presidents.

The Rt. Hon. Earl Halsbury, P.C., F.R.S., The Lord High Chancellor.
The Ven. R. Thornton, D.D., *Archdeacon of Middlesex.*
Sir Joseph Fayrer, Bart., K.C.S.I., F.R.S.
W. Forsyth, Esq., Q.C., LL.D.
Alexander McArthur, Esq., J.P., D.L.
W. H. Hudleston, Esq., M.A., F.R.S.
Sir H. Acland, Bart., K.C.B.
The Most Rev. the Archb. of Armagh suggested (elected life member December, 1868).

Trustees.

D. Howard, Esq., D.L., F.C.S.
Rev. Preb. H. Wace, D.D.

Hon. Auditors.—J. Allen, Esq.; General G. S. Hallowes.

Council.

Hon. Sec.—Capt. F. W. H. Petrie, F.G.S.

E. J. Morshead, Esq., H.M.C.S. (*For. Cor.*)
William Vanner, Esq., F.R.M.S.
His Honor Judge Waddy, Q.C.
Rev. J. H. Rigg, D.D.
H. Cadman Jones, Esq., M.A.
Rev. W. Arthur.
Rev. J. Angus, M.A., D.D.
*D. Howard, Esq., D.L., F.C.S.
Rev. F. W. Tremlett, D.D., D.C.L., Ph.D.
*Rev. Preb. H. Wace, D.D.
Rev. Chancellor J. J. Lias, M.A.
*Gen. G. S. Hallowes.
Capt. Creak, R.N., F.R.S.
Rev. F. A. Walker, D.D., F.L.S.
T. Chaplin, Esq., M.D.
Rev. Canon Girdlestone, M.A.
Professor E. Hull, LL.D., F.R.S. (*Hon. Treas.*)
T. G. Pinches, Esq., M.R.A.S.
The Ven. Archdeacon Sinclair, D.D.
Dr. Gerard Smith, Esq., M.R.C.S.E.
Commander G. P. Heath, R.N.
Rev. Canon Tristram, M.A., D.D., LL.D., F.R.S.
Rev. G. F. Whidborne, M.A., F.G.S., F.R.G.S.
General Geary, R.A.
Count Della Rocchetta.
Dr. Walter Kidd.

* *Ex officio.*

4. The Council regrets to announce the decease of the following supporters of the Institute, containing as it does

* The tendency of the Victoria Institute's work has been to bring about a truer appreciation of the results of scientific inquiry, and those results have been to demonstrate that there is an absence of opposition between Science and Religion. The Institute was founded, not for the purpose of proving that current science and revelation are in accord, but to examine science generally, and more especially any theories which are alleged to contradict Revelation.

There are too many who seek to make every passing phase of scientific research and enquiry square with Revelation, and are alarmed if they are unsuccessful, ignoring the fact that science is always advancing, and therefore must ever be changing its aspects; and again, that mistakes may be made in the interpretation of the words of Revelation.

the names of many exceptionally prominent men in very varied spheres of usefulness:—

J. G. Barclay, Esq., *L.M.*; W. F. Browell, *M.*; General Sir A. Cotton, K.C.S.I, *M.*; Rev. W. David, *H.C.M.*; Sir J. W. Dawson, C.M.G., F.R.S., *M.*, whose nearly thirty years' membership was among the greatest honours of the Institute, to the Proceedings of which he contributed both papers and numerous "notes" and "opinions"; Colonel J. Francis, *A.*; Colonel T. A. Freeman, *M.*; Surg.-General Sir Charles A. Gordon, K.C.B., Q.H.P., *M.*; Dr. S. Gordon, M.D., *A.*; His Excellency Dr. R. H. Gunning, M.D., LL.D., F.R.S.E., *V.P.*, Grand Dignitary of the Order of the Rose, Brazil, Vice-Patron, Founder of the Gunning Fund £500 (Dr. Gunning's name will ever be associated with the Institute as one of its most earnest benefactors); General G. Hutchinson, C.B., C.S.I., *A.*; Rev. E. C. Ince, M.A., *M.*; Rev. T. Ladds, M.A., *M.*; Hon. J. M. Langston, *L.A.*; Professor J. Legge, D.D., *C.M.*; Rt. Rev. C. Graves, D.D., Bishop of Limerick, *A.*; H. Minchin, Esq., M.D., *A.*; A. Muller, Esq., M.D., *A.*; Rev. H. Muller, *A.*; A. V. Newton, Esq., an old and much valued member of Council, *F.M.*; Surg.-General S. Partridge, I.M.S., F.R.C S.E., Hon. Surg. to the Queen, *M.*; Rt. Hon. J. P. Wilde, Lord Penzance, P.C., *M.*; H. M. Rowe, Esq., *M.*; Rt. Rev. Bishop T. N. Staley, D.D., *M.*; Rev. J. Wood, *H.C.M.*; Rev. W. Wright, D.D., *H.C.M.*

F.M. Foundation Member. *A.* Associate.

5. The following is an approximate statement of the changes which have occurred:—(*See* sec. 6).

	Life Members.	Life Associates.	Annual Members.	Annual Associates.
Numbers on June 2, 1898	61	51	365	882
Deduct Deaths	3	1	8	7
,, Retirements	—	—	—	32
			— 0	— 39
			357	843
Joined to July 19, 1898	—	—	7	18
	—	2		
	58	52	364	861
	110		1225	
Total		1335		

Finance.

6. The Treasurer's Balance-sheet for the year ending December 31, 1899, duly audited, shows total receipts £1,016 17*s.* 2*d.* The amount invested in $2\frac{3}{4}$ per cent. Consols is £1,365 18*s.* 9*d.* A change has been made in the auditors, General G. S. Hallowes, a member of Council, being now appointed to succeed one who was not on the Council.

Special.—The Council desires to urge the very great importance of all subscriptions being remitted during the first half of the year (Bye-law III, 3).

Adherence to the rule on this point would remove a serious difficulty in the management of the Institute, and a cause of no small care and anxiety to the Council. Forms for the payment of the subscriptions through a banker are kindly used by a large number of Members and Associates, and may be had at the office.

MEETINGS.

The meetings of the Institute have been well attended.

The subjects taken up during the session have been :—

MONDAY, DECEMBER 4, 1899.—"Pictorial Art among the Australian Aborigines." By R. H. MATHEWS, L.S. *Illustrated.*

MONDAY, JANUARY 1, 1900.—"Some Remarks on Sub-oceanic Terraces and River Valleys, especially off the Coast of France." By Professor I. LOBLEY, F.G.S.

In which Professor LOBLEY confirmed the researches and deductions of Professor E. HULL in his paper read last year on those evidences of great physical changes in past times.

MONDAY, JANUARY 15.—Notes on some important subjects brought before the Congress of Orientalists, meeting at Rome in 1899. By THEO. G. PINCHES, Esq., M.R.A.S.

Mr. PINCHES reviewed much valuable matter brought before this Congress to which he was the Institute's accredited delegate.

MONDAY, FEBRUARY 5.—An address on "Moab and Edom." By Major-General Sir C. W. WILSON, K.C.M.G., K.C.B., F.R.S., R.E. *Illustrated.* (*The first of a set of Special Subjects.*)

MONDAY, FEBRUARY 19.—"Sub-oceanic River Valleys of the West African Continent and of the Mediterranean Basin." By Professor E. HULL, LL.D., F.R.S.

In which the author showed that the Congo River valley was continued to a great depth under the ocean, as in the case of the river valleys of Western Europe. Dr. Hull's researches lead to an explanation of the cause of the Glacial Epoch.

MONDAY, MARCH 5.—J. ZIMMERMAN, D.D., on "The Coins of the Ancients."

In which the author pointed to many instances of the value of coins in throwing light on historical facts.

MONDAY, MARCH 19.—"Springs of Character." By A. T. SCHOFIELD, M.D.

MONDAY, APRIL 2.—"Thalassographical Notes on the North Sea." By CAVALIERE JERVIS, F.G.S., Royal Museum, Turin (following on Dr. HULL's paper on "The Submerged Terraces and River Valleys bordering on the British Isles"). (*See* "Transactions," vol. xxx.)

This paper afforded instances of the evidence of those influences which brought about physical changes.

MONDAY, APRIL 9.—(Monday, 16th, being Easter Monday) "Points in Egyptian History." By Rev. F. A. WALKER, D.D., F.L.S.

A valuable attempt to clear up points of high interest in Egyptian history.

MONDAY, May 7.—On "The Being of God." By the Ven. W. MACDONALD SINCLAIR, D.D.

MONDAY, MAY 21.—Preb. H. WACE, D.D., on "Ethics and Religion" (a paper on an aspect of modern thought.)

MONDAY, JUNE 18.—On "Eolithic Flint Implements." By Rev. ASHINGTON BULLEN, B.A., F.G.S.
MONDAY, JULY 16.—The "ANNUAL ADDRESS."

7. *The Journal of Transactions.*

The Queen has again graciously added the last volume of the Transactions to Her Majesty's Library.

The thirty-second volume of the *Journal of Transactions* will shortly be issued. It will contain the subjects brought before meetings of the Institute and discussed, together with the communications received from Members in the country and abroad, who have added to the value of those discussions by sending in communications on the subjects considered.

The careful correction of the papers, discussions, and communications, by their respective authors, often involving repeated communications even with distant lands, and references to the views of other investigators who have made the subjects treated matters of research, is at times a cause of delay in the publication of the Journal containing them, but the result is to give the Volume of Transactions the character of a finished work. From time to time Members of the Institute and others have expressed their high sense of the value of the Transactions of the Institute, inasmuch as they *contain not the views of any one person only, but the well-considered opinions of many*, resident in various and even distant parts of the world. This system, carried on by a competent body, gives a value to the treatment of the several subjects beyond that which any individual author could give.

8. *Spread of the Work and Useful Influence of the Institute.*

Not many years ago the issue of the Annual Volume was considered to complete the work of the Institute, but of late the wish to make further use of the matter it contains has had valuable results:—

First, Members and Associates at home, in India, and elsewhere, make use of the papers in the Journal as lectures, or as the basis of such, in their several localities, often corresponding with the Institute in regard to the preparation of such lectures.

Secondly—Some Members and Associates secure the translation and circulation of portions of the Journal in the various countries in which they reside. Such translations have been made in many countries of Europe, South

America, and India; and now from China and Japan, the importance of securing translations has been strongly urged.

Thirdly—Some home, foreign, and colonial public libraries and institutions are regular purchasers of the Journal, and Members and Associates have sought to encourage this practice in their respective localities. The need of so doing has been pointed out by many Members, since it is by no means unusual, especially in the Colonies, to find in public libraries books arguing that Science and Revelation are at variance. The Journal of the Institute has been spoken of as specially suited as a corrective to such erroneous views. In India and elsewhere some have obtained the Journal or copies of the People's Edition, and placed them in local reading rooms for the use of English-speaking natives and others.

This year, 1900, papers on an increased number of subjects have been added to this Edition, lists of which have been sent to the Members.

9. A SPECIAL FUND.

This fund (to which both Members and non-Members can contribute) has been founded to advance the influence of the Institute, and to forward the circulation of *The People's Edition.*—Last year a Member proposed to give £50 to it if nine others would give a similar sum to raise the amount to £500. The offer is now renewed.

10. *The People's Edition.*

This consists of twelve papers—written by men of eminence in such a style that they may be comprehended by all—reprinted from the *Journal of Transactions.* The Edition was started by some members in the year 1873, and first attracted attention in other quarters to the importance and need of works of the kind. The pamphlets often contain the objections and criticisms brought forward in discussing the subjects, as many home and foreign correspondents have urged the value of including these. They are published in neat covers, and are sold at a nominal price (sixpence), and single copies are supplied *gratuitously* or at cost price, at the office, to all individual lecturers against infidelity, including those of the London City Mission, the Christian Evidence Society, and similar bodies.

11. *The Gunning Fund.*

This fund was founded by His Excellency Robert Halliday Gunning, M.D., LL.D., F.R.S.E., &c. It at first consisted of a bond of £500, the interest on which was paid by Dr. Gunning to further the work of the Institute. The Executors will shortly pay the bond to the trustees of the Institute.

12. *China and India.*

The Institute has lately had a most pressing call from China, urging the usefulness of its transactions there, and has communicated with a large circle throughout China and Japan. (The Archdeacon of Shanghai—an old Member—speaking of the requirements of China, says, "I have turned to the Transactions of this Society as a treasure of untold importance.")

The Institute is now receiving further appeals from Japan, where it has long had several Members.

The cost of such work falls on the "Special Fund," which it is imperatively necessary should be revived so as to enable the Institute to carry forward its much-needed and most useful operations.

13. *Conclusion.*

In conclusion the Council desires to express its thankfulness for the success thus far of the Institute.

The importance of its work has been recognised by loyal support from its Members in all lands. They realise that an Institute conducted by such men as the President of the Institute (Sir G. G. Stokes), the Lord High Chancellor of England (Earl of Halsbury), Lord Kelvin, and other leaders of thought, devoting their time voluntarily to carrying on the Institute's work, is one which is potent for good results in banishing that spirit of unbelief which has professed to be founded on science.

G. G. STOKES,
President.

SPECIAL FUND.

A foundation member offers £50 if nine others will give a like sum this year, so as to carry out the intention of Section 9.

FORM OF BEQUEST.

I give and bequeath to the Trustees or Trustee for the time being of THE VICTORIA INSTITUTE, OR PHILOSOPHICAL SOCIETY OF GREAT BRITAIN, to be applied by them or him for the purposes of the said Society, the sum of £ if so intended "free of legacy duty." And I declare that the receipt of the Trustees or Trustee for the time being of the said Society shall be a good discharge to my Executors for the said legacy.

ANNUAL BALANCE-SHEET, *from* 1st *January to* 31st *December*, 1899.

RECEIPTS.	£	s.	d.	£	s.	d.
Balance from 1898				45	1	9
2 Life Associates				21	0	0
Subscriptions :—1 Member, 1896	2	2	0			
1 ,, 1897	2	2	0			
2 Members, 1898	4	4	0			
165 ,, 1899	346	10	0			
5 ,, 1900	10	10	0			
1 Member, 1901	2	2	0			
1 ,, 1902	2	2	0			
1 ,, 1903	2	2	0			
7 Entrance Fees	7	7	0			
1 Associate, 1894 ..	1	1	0			
1 ,, 1895 ..	1	1	0			
5 Associates, 1896 ..	5	5	0			
15 ,, 1897 ..	15	15	0			
34 ,, 1898 ..	35	14	0			
382 ,, 1899 ..	401	2	0			
12 ,, 1900 ..	12	12	0			
2 Members and 1 Associate paid 2*s*. 6*d*. short ..	5	2	6			
				877	13	6
Dividend on £1,365 18*s*. 9*d*. 2¾ p.c. Consols				36	6	0
The Gunning Fund				20	0	0
Donation to Special Fund (H. C. Dent, Esq.)				1	1	0
Sale of Journals				36	14	11
				£1,016	17	2

EXPENDITURE.	£	s.	d.
Printing, Editing, and Publishing	150	13	9
Postage	70	7	2
Binding	33	4	6
Reporting	25	4	0
Typewriting	0	3	6
Stationery	25	19	3
Advertising	15	2	8
Expenses of Meetings	12	9	6
Travelling	10	4	9
Clerk—Salary	78	0	0
,, Extra	24	4	6
Rent	180	0	0
Housekeeper	1	4	8
Coal and Light	7	14	3
Library	30	11	7
Hon. Sec.	210	0	0
Insurance	0	12	0
Bank Charges	0	13	6
Sundries	4	6	4
Subscriptions paid in error	2	2	0
Balance Cr.	133	19	3
	£1,016	17	2

We have examined the Balance-Sheet with the Books and Vouchers, and find a Balance in hand of £133 19*s*. 3*d*.

JOHN ALLEN,
G. S. HALLOWES, Major.-Gen. } *Auditors.*

1 May, 1900.

The Ven. R. Thornton, D.D. (Archdeacon of Middlesex).—I have the pleasure of bringing forward a motion to which I am sure you will consent—viz., that this Report be received.

It is a most satisfactory Report—more so perhaps than in the present state of things we could have looked for. It seems that there is no very considerable balance on the wrong side, which is always satisfactory, especially at the present time, when balances, I find, have a tendency to be much on the wrong side.

I desire to move that this Report be received.

I wish also to move that the thanks of the members of the Institute be presented to the Council, the Hon. Officers and Auditors for their efficient conduct of the business of Institute during the past year. What such an Institute would be without such a Council as it possesses I do not know. Probably it would be removed from the face of the earth! But there is one member of the Council who I think has had more influence, perhaps, than any in advancing the interests of the Institute, viz., our Hon. Secretary.

We all, I am sure, greatly regret that his state of health is such as to prevent his attending and taking part with us at this meeting, and I sincerely hope his health will be restored, and that he may be permitted once more to engage in those labours connected with the Institute which have characterised him so long.

Captain Heath.—I beg to second that.

The resolution was then put to the meeting and carried.

The President.—I will now ask Professor Hull to be so good as to deliver the address which he has kindly prepared as the Annual Address for the Institute. It is a subject of very great interest, viz., "On our Coal Reserves at the Close of the Nineteenth Century." (Applause.)

Professor Hull, LL.D., F.R.S., then read his address as follows:—

OUR COAL RESERVES AT THE CLOSE OF THE NINETEENTH CENTURY. BEING THE ANNUAL ADDRESS OF THE VICTORIA INSTITUTE FOR 1900.

By Professor EDWARD HULL, LL.D., F.R.S., F.G.S.

AT the invitation of the President, Professor Sir George G. Stokes, to deliver the Annual Address this year, I have selected for my subject "Our Coal Reserves at the Close of the Nineteenth Century," as it is one to which public interest has been recently directed. This is owing to two causes—first, the general rise in the price of coal, which touches the pocket of every householder, be he rich or poor; and second, the remarkably increased production of our coal mines, which reached, in 1899, the unprecedented figure of 220,085,000 tons,* being about eighteen millions of tons over that of the previous year.

Is it to be wondered at that with such a rapid increase of production, and such a quantity extracted from British mines, those who take an interest in the commerce and manufacturing industries of this country should ask themselves, "For how long a period can our coalfields bear such rapid depletion?" For, be it observed, the quantity raised is more than double that of Germany, which is the largest producer amongst the Continental States, and is only equalled, or approached, by the production of the United States of America, whose coal resources are largely in excess of our own.†

Reverting for the moment to the historical aspect of the question, it will be in your recollection that in 1866 a Royal Commission, under the presidency of the late Duke of Argyll, was entrusted with the task of reporting on the quantity of

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* *Return issued by the Board of Trade*, April 9th, 1900.

† *Board of Trade Returns*, p. 4. The output of Germany is stated to be (1899) 101,622,000 tons, that of the United States 218,376,000 tons.

coal remaining to be worked in the British coalfields, and the probable period for the duration of the supply, and in 1871 the Report of the Commission was issued, dealing with these and other cognate subjects in a very exhaustive manner. Many eminent geologists and gentlemen connected with the coal industry gave evidence, and the names of Murchison, Prestwich, Ramsay, Hussey Vivian, and Woodhouse, amongst others, afford a guarantee for the ability with which the subject was treated. But I have on several occasions maintained, and still maintain, that the returns of the Commissioners regarding the quantity of workable coal were excessive, chiefly because very thin seams were included which I consider to be unworkable at great depths. But as regards the output of coal it is a remarkable fact that in 1870 the quantity raised was only about one-half that of the year 1899, so that in less than thirty years the output has doubled,* a fact little foreseen by the Commissioners, and thus reducing the estimated period of duration of our supplies by one-half.

Let me here explain that in speaking of "the duration" or "exhaustion" of our coal reserves, these terms are only used in a conventional sense. The "exhaustion" of our coalfields is an event out of the question, as long as there are seams of coal at depths of over 4,000, 5,000, or even 6,000 feet—because it may be impossible to work them. The practical exhaustion will be reached when, owing to increased depth and expense of mining, to actual diminution of supply and other causes, the cost of coal will tend to become prohibitive; and our manufacturing industries will be heavily weighted as compared with those of other countries where coal is more abundant and easy of access. The approach of such a period is seriously apprehended by many observers. Mr. Ellis Lever, in a letter to the *Pall Mall Gazette*,† has expressed the opinion that before the year 1950 "there will be such a coal famine in Great Britain as will paralyse our railways, gasworks, iron and steel, cotton and chemical, and all other industrial undertakings." On the other hand, Mr. H. C. Peake, the President of the Institution of Mining Engineers, in his recent address takes a less pessimistic view of the

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* The quantity raised in 1873 was 110,431,192 tons, *Mineral Statistics, U.K.*, collected by the late Mr. R. Hunt.

† April 10th last.

situation, but at the same time acknowledges that "it behoves us to take stock of the position."* It may, however, be inferred from articles which have recently appeared in several mining journals and the public press that much anxiety is felt with regard to the question of our coal resources; and there is a widely expressed desire that Her Majesty's Government should institute fresh inquiries into the problem of the coal reserves of the British Isles.

One of the most important questions for our consideration in reference to our coal industry is that of the export of this mineral to foreign countries. As long as coal is raised from the mines and made use of at home, we are all agreed that there should be no artificial limitations placed upon its exploitation, because it is being used for the general benefit and prosperity of the country. But it by no means follows that foreign countries should have equal facilities for its use with ourselves; or at least that they should not be made to contribute something to those material resources of which they are depriving us when they help to deplete our coal reserves. To this question we shall return; meanwhile, let us see to what extent we are exporting coal from British ports.

We find from the Board of Trade returns just issued, that in the year 1898, the quantity of coal exported from the United Kingdom amounted to 48,268,000 tons, which is nearly one-fifth part of the total output. This includes of course the quantities supplied to our colonies, dependencies, and foreign depôts or coaling stations as well as those sent to foreign countries; and which are, therefore, to some extent utilised by our Royal Navy and merchant ships; but coal for the use of steamers engaged in the home or coasting trade is excluded from these returns. The following are the quantities, amounting to a total of 37,607,000 tons, which were exported to Continental ports from the United Kingdom in the year 1898:—

France	11,713,000 tons.
Belgium	2,758,000 „
Germany	5,820,000 „
Austria-Hungary	6,004,000 „
Italy	4,432,000 „

* Address delivered on June 14th last, before the members at the rooms of the Geological Society.

Spain	.. .. ..	1,441,000 tons.
Sweden	.. .. ..	2,458,000 „
Russia	.. .. ..	2,981,000 „
	Total	37,607,000 tons.

We shall not be far wrong if we assume that the quantity exported to these countries in the past year, 1899, amounted to forty millions of tons, and I wish to call special attention to this point.

Now the question arises. What benefit does this country AS A STATE derive from the continuous outflow of this natural product so essential to her prosperity and the position she occupies as a great manufacturing and commercial centre? Doubtless the State benefits by the profits of the coal-owners who export and sell the coal to the foreigners; but it seems only reasonable that the latter, who are benefited by the sale of the mineral, should contribute something towards the prosperity of the country from which the mineral is derived. For, recollect that coal is not a commodity which, like animal or vegetable substances, can be reproduced. Once extracted from the ground it cannot be restored; and thus foreign countries, which in many cases have little claim to our generosity, and are (as they have a right to be) absolutely selfish where their own interests are concerned, are helping to deplete our mineral resources—in other words, to drain the life-blood of our commerce and manufactures. I hold, therefore, very strongly the view that in the case of such products of Nature as coal and petroleum, the country which produces them has a claim, or lien, upon them beside that of the owner of the soil under which the minerals are found; and if this be so, the State as such has a right to be recouped for the benefit of the whole community. In the case of the owner and the utiliser, this is done through taxation on his profits; so that he is in a worse position than the foreigner who uses the mineral, but pays no tax for the benefit of the country from which the mineral is drawn. On these grounds it seems to me that an export duty on coal from this country to Continental States may be advocated and defended; and the amount should not be less than five shillings per ton, payable at the port where the coal is shipped. If we take the export to Continental States at 40 millions of tons (as shown above), an export duty of five shillings would amount to £10,000,000 per annum, which might go to the relief of our increasing taxation, or form a sinking fund with the same object in view. In any case it would to some extent help to recoup the State for the drain on her mineral resources. Lord Salisbury has recently expressed his astonishment at the patience with which the public bear the burdens of taxation imposed upon them; and I venture to think that if our Continental neighbours could be made to contribute towards the relief of these burdens to the extent of ten or twelve millions sterling, the result would be hailed with gratitude. Nor do I believe that such a duty would have an appreciable effect in diminishing the output from the mines. In the first place forty millions of tons is only a small proportion (less than one-fifth) of the total output; and in the second, the use of our best steam coal is of such prime importance to Continental States, especially for their fleets, that an additional charge of five shillings a ton would be no impediment to their demand for it. In support of this view it may be observed that the average price of coal in these Continental States is higher than in the United Kingdom; for while in this last named, the price in the year 1898 was 6*s.* 4½*d.* per ton, in Germany it was 7*s.* 4½*d.*, in France 9*s.*, and in Belgium 8*s.* 9½*d.* per ton, in Britain it was about 5*s.* 6*d.* per ton; so that by comparison of averages the price of British coal with an export duty of five shillings would not be increased to the full extent for these countries above that of their own averages.

I do not therefore fear that a small export duty such as is here suggested would injure the foreign coal trade, while on the other hand it would benefit the country generally; nor can I admit for a moment that it violates the principle of Free Trade taken in its legitimate sense; for in the words of a recent writer, Free Trade is not a law, but a "variable expedient."

I now come to consider the question of a Royal Commission. It is urged in several quarters, and amongst members of Parliament especially by Mr. D. A. Thomas, the representative of one of the principal mining districts in Wales, that Her Majesty's Government should be asked to appoint a second Royal Commission for the purpose of ascertaining what is our real position as regards our coal reserves. It is now about thirty years since the first Commission held its investigations, and, as we have seen, the increase of consumption since that period has been remarkable—I might even say, phenomenal.

The close of the nineteenth century seems a fitting time for such an inquiry. This century marks a special epoch in the history of our race, and in this history is included discovery of the operations of Nature, and the increase of mechanical inventions far beyond that of any other age. It is the epoch of railway locomotion, of steam navigation, of manufacturing industry such as the world has never before seen—and all these industries have to depend for their sustenance on COAL—the only great source of power, as far as we know, available in the British Isles. The subjects which a Coal Commission for 1900 would have to investigate would not necessarily be so large or elaborate as those undertaken by the Argyll Commission of 1871, as some points have been already practically settled and need not be reopened. But those which in my view would require investigation are somewhat as follows :—

First. In the words of Mr. Thomas's proposed resolution it would be necessary "to investigate the quantity of coal available for naval, commercial, and other purposes contained in the coalfields of the United Kingdom." For this subject the results obtained by the Argyll Commission would form the basis of inquiry.

Second. The next subject would be the area and resources of the concealed coalfields (that is, those coal-producing strata covered by newer formations). This subject was handled by the Commissioners of 1871, but since that time there has been much additional light thrown upon it—by fresh boring experiments south in the midland districts and south of the Thames valley—from which more accurate information might be obtained.

Third. The third subject is one suggested by the terms of Mr. Thomas's resolution, namely, "to report whether any means should be taken to prevent the too rapid exhaustion of coal, and to preserve it for the use of British subjects." This would include the question of an export duty on coal; but it is one of much wider scope.

Fourth. Another subject might be an inquiry how far an additional rise in the price of coal would place our manufacturers at a disadvantage as compared with foreign countries and encourage the import of coal from America and other coal-producing countries.

There may be other subjects which a Royal Commission might see fit to investigate, but the above appear to be the most evident, and worthy of attention. For myself, I consider that such a commission ought to be constituted in the near future. Its investigations cannot fail to be of interest, and may prove of the greatest importance to the whole community.

And now, before I conclude, I must add a few words regarding the Society whose anniversary we are here assembled to commemorate. The Victoria Institute has well maintained its position as a means for diffusing knowledge of very wide scope, and calculated to interest, not only the general public, but the specialist in various branches of science and literature. In the forthcoming volume of *Transactions* will be found papers dealing with physical and biological subjects; with those touching on historical, mental, and moral aspects of man and appealing to our most sacred affections and beliefs; while, lastly, there are those of a more purely scientific character. The discussions, also, are often of great interest, and their publication with the papers afford opportunities for those living in distant countries, or unable to attend the meetings, to make known their views on the questions raised by the authors of the papers. For these reasons the Institute seems to occupy a position of value, and supplies a want amongst the learned societies of the Kingdom; and we would welcome additional Members and Associates, as well as fresh communications of a nature embraced within the scope of our objects.

Discussion.

The Rev. Canon Girdlestone, M.A.—It has been assigned to me to propose a vote of thanks to Professor Hull for his most instructive address:—

We are all interested in the subject of coal, even although we are rather at this time suffering from too much heat. I don't know how far Professor Hull's address will influence the coal market, but we shall all be most grateful to him if the result of his address should be that the coal merchants should draw in their horns. I do not know how that may be; I am afraid we must not be too expectant on this topic; but I think we all welcome the suggestion that coal purchased by foreigners of us should be very highly taxed (hear, hear), so that we might expend the ten or twelve millions so raised in the construction of weapons of precision, to use against them if needed. Coal is at the root of all manufactures, and when you consider the various manufactures that go on in this country, I think you will come to the conclusion that they are all affected by the price of coal. People say, "Why not substitute electricity?" But how are we to get our electricity? When you push the matter back, in order to generate electricity you must have coal.

One other thought has often struck me, and I should think other people. It is sometimes said that we imagine too freely that the earth and its contents were made for man and that all things would be quite as useful, somehow, if there were no men. But take the case of coal. There are many definitions of man; but I think we may add this—that man is a coal-consuming animal! I do not know that any other animal is! I was born in the black country of South Staffordshire, and have been down in a coal mine many times. If you want to point to something that lies near the surface of the earth, which ministers to the necessities of man, and man alone, you will point to coal and you would say, "Why is it that this coal exists? How is it that we have this storage of heat beneath the surface of the ground?" It is undoubtedly because He, who founded the earth and established it, knew what would be needed for the human race, and so ordered that this coal should be provided against the time when it was needed; and so the heat that was stored up, untold ages ago, is now given forth again from the combustion of coal for the benefit of the age, for which, I think, we may thank the Creator.

I have great pleasure in proposing a vote of thanks to Professor Hull for his most valuable address.

Professor Logan Lobley, F.G.S.—I have great pleasure in seconding that. We all know that for a considerable time Professor Hull has been of great service to the Institute, and has brought before the Institute subjects of great importance and of exceedingly great interest. He has written a number of papers on subjects which have attracted considerable attention, both of the scientific world and (what I may call) the lay world outside; but perhaps he has exceeded those efforts by bringing before us to-day the subject of the reserves of coal in this country; for, as Canon Girdlestone has justly said, it is a subject that appeals to all people and is of the greatest importance, not only to the present inhabitants of the country, but the future.

With respect to Professor Hull's political proposition I need not say anything; but with respect to the general reserves of coal in this country, we may say that we have a very large reserve of coal—much larger than most people imagine, not a very great distance from London—putting out of sight altogether the coal south of the Thames; there exists in the middle of the county of Warwick an enormous store of coal at a very easy accessible distance from the metropolis. There are large stores of coal to the north-west and also in the north, which, as Professor Hull calls them, are "concealed stores" of coal, but yet to the knowledge of geologists, they are there; and they are substantial sources of fuel only awaiting the operation of mining to make them of use to the community. But there is one species of coal that we ought to prize exceedingly, and that is the semi-anthracite, or steam coal. That is limited, in great measure, to one area of the British Islands, and for that store of fuel we should have a special care and any proposition for its preservation, or economical use, ought to meet with the most generous support. The other coals, bituminous coals generally, are common to France, Belgium, and other parts of the earth; but the store of semi-anthracite, in the South Wales coal fields, is of great price, and we should set the highest possible value on it and should economise its use and exportation for future time.

On these grounds I think you will all agree with me that our heartiest thanks are due to Professor Hull for his address to-day. (Applause.)

The vote of thanks was then put to the Meeting and carried unanimously.

Professor HULL.—Mr. President, ladies and gentlemen, I thank you very much indeed for the vote of thanks you have given me. I have spoken so much already that I do not intend to detain you any more to-night.

Sir JOSEPH FAYRER.—There is one duty that still remains before we separate, and I ought to congratulate myself that that duty devolves upon me. It is to ask you to return your thanks to the President, Sir Gabriel Stokes, not only for what he has done for us this evening, but for what he has done for us for some years past—for the influence which he has exercised over this Institute —for the prestige he has conferred upon it for doing so much to place the Society in the prominent position for which it was originally intended. It was founded for the purpose of diffusing knowledge—not of special kinds of knowledge as opposed to religion, for there is no such opposition—none whatever (hear, hear); but it is to teach the truth (that is science), and under the influence of such men as Sir Gabriel Stokes, Lord Kelvin and others whose names I have heard mentioned, it is impossible that such an Institute should do anything but good and should succeed. I have watched its growth for many years and am deeply interested in it. I have seen the steady development and the improvement of the Institute, and I am proud to belong to it. I think it is doing most excellent work. It is diffusing that knowledge which is so much needed throughout the world generally that I believe we owe many thanks to those who founded it, and more thanks still to those eminent men who, like the President, preside over it.

It is not necessary for me to make any further remarks on the subject. It is quite sufficient that I name the man. I call upon you to return a vote of thanks to Sir Gabriel Stokes—that most eminent man of science—who presides over this Institute.

Professor HULL.—I have great pleasure in seconding the resolution, in which I heartily concur. I consider the Institute owes a great debt of gratitude to the President, not only for his presence this evening, but for the way in which he comes, year by year, from Cambridge, at personal inconvenience, to preside at our Ordinary and Special Meetings such as this to-night. Therefore I heartily concur in the vote of thanks.

The resolution was then put and carried.

The PRESIDENT.—I must express to the members of the Institute my hearty thanks for the vote that has just been passed. I confess that my labours in the cause of the Institute are hardly those which a President might be expected to accomplish. In excuse for that I have only to say that in the first instance I live a good distance from London, and in the second place I have a good many "irons in the fire." I am sure I deeply feel how much of the little that I have been able to do has depended on the labours of our indefatigable Hon. Secretary, whom we regret so much not to see amongst us on the present occasion.

The session of the Institute has now come to an end. We do not meet again till towards winter, and we all hope, when the time comes for us to reassemble, we may again see the face of Captain Petrie, to whom the Society owes so much.

I will not detain you any longer with words of my own, but thank you once more for the kind manner in which you have recorded your vote of thanks.

Sir Joseph Fayrer having warmly eulogised the services of Captain Petrie, the Meeting then closed.

Postscript.—The hope expressed by the President, and shared by all those present, was not destined to be fulfilled. Captain Petrie expired peacefully at his residence in Campden Hill on Saturday, July 21st, regretted by all those who had the privilege of his acquaintance both at home and abroad.—E. H.

1*st September*, 1900.

ANNUAL MEETING.

SIR G. G. STOKES, LL.D., F.R.S., PRESIDENT, IN THE CHAIR.

THE UNITY OF TRUTH.

Being the Annual Address of the Victoria Institute for 1899.

By the RIGHT HON. SIR RICHARD TEMPLE, Bart., G.C.S.I., etc.

Read June 19th, 1899.

§ 1. MR. PRESIDENT, LADIES AND GENTLEMEN:—I shall at once take up the words of the last speaker, Mr. Howard. He said that truth must prevail, and the more we study it, the more we shall find it will prevail. That will be the burden of my discourse to you this afternoon.

I admit, when I was first asked to do myself the honour of addressing you, I was in doubt, after consulting your learned and accomplished Secretary, Captain Petrie, as to what sort of subject I should choose, but then I referred to the letter that I had received from my old Parliamentary friend your very distinguished President, Sir George Stokes, and I observed that he said in his letter that the object of this Society, or Association, is to show how one set of truths must be consistent with another set—that both truths, if they are such, must coincide, and that therefore the Scripture being, as we firmly believe it to be, absolutely true on divine authority, the results of all this science and learning, if true, as I believe they are, must agree with Scripture.

Now that is the text upon which I shall address you, with your permission, this afternoon. I wish to say that the more we pursue research steadily, and learned investigation by scientific methods, the more shall we have confidence in the literal value of the truth of every word of Scripture. Now if we have not done so already it is simply because those sciences have not advanced far enough, or what is still more probable, we have not studied the Scripture sufficiently well —we do not know enough of the Bible and all that relates to it. I well remember the day, and many of you in this room must remember it, when we were timidly apprehensive as to whether our sacred Scriptures would stand at least verbally, word for word, the test of learned science and inquiry. We were prepared to take refuge in generalities—that some things must be taken on trust and that others we must admit to be unintelligible, which we might understand on the other side of the grave, but should never do so in this life, and the like. Now I do not want to take refuge in any of those convenient subterfuges. I wish to show this afternoon to a certain point, at least, that the more we study and understand the words of Scripture the more we shall perceive its absolute truth. Of course it is an enormous subject, and I can only touch on an important fringe of it, and you will be able to judge how far what I say is sufficient to prove my proposition.

Now in the first place, let me point out to you that there is a Society called the Palestine Exploration Society, of which I myself was, for a long time, one of the Vice-Presidents. I say that Society, by its surveys and examinations on the spot and the like, has done more to spread and to confirm the faith of Christians in their own Bible than anything that has been done since the translation of that Bible into the vulgar tongue. Among other things it has had to identify names. When we were young I suppose there were very many names of places in the Old Testament and many in the New Testament which were quite unknown, and which had never been identified. I have been in one of the caves near Bethlehem right under the site of the Nativity, where St. Jerome laboured for half his life. His object was to identify a great number of Scripture names of places. Apparently in the first, second or third centuries of Christianity no Christians knew more than a few names in the Scriptures, which were to be found on the spot, in the Holy Land, and St. Jerome set himself to work and ascertained some hundreds, and a few more were ascertained by the Crusaders. Then for a long time research seemed to go to sleep, and it was reserved for us to continue the exploration. Now I suppose they have identified several hundred names within my time and several hundred names still remain to be identified, but no doubt we shall ascertain all before we have done with it.

Now do you understand how this is done? Let me show you the process. I recollect riding along a road in Palestine and I stopped a man and asked him in the rough Syriac Arabic dialect, which I knew enough of to ask him, what was the name of that mountain just in front of me. He looked suspiciously at me for a moment. I said, "I am going to ride further on—you just tell me the name." I knew the name, but I wanted to see what he would say, and he at once gave me the original name of the mountain. We have the name in the Bible, but it has been altered. You have accomplished engineers going about that meet the shepherd of a goat-herd, or a cow-herd, and they ask him, "What is the name of this valley?" Then they hear something and they take it down as giving a clue to the sacred site.

One of our most successful exploration surveyors when walking about a jungle of weeds that grew near the shore of the Lake of Tiberias said to a man who was digging about for roots, "Is there any name to this place where we are?" He said, "There is no particular name—we say Keraza." The surveyor said, "Is there nothing to mark the place?" "Well," the man said, "I do not know, but under these weeds and things and this mass of herbage you will find some stones of all sorts." The surveyor did not say much more, but he looked at the stones and a clue was given which has led to the interesting discovery of the city of Chorazin of which our Lord spoke when He said, "Woe unto thee, Chorazin, woe unto thee, Bethsaida, for if the mighty works had been done in Sodom and Gomorrah which have been done in you, they had repented, sitting in sackcloth and ashes, but it shall be more tolerable for Sodom and Gomorrah in the judgment than for you."

Now it is remarkable the extent to which these ancient places keep their names. Let me run over a few of the particular ones—Hebron, Jericho, Bethel, Jerusalem and Bethlehem and Jacob's Well, the well from which the woman came to draw water. So also Dothan where Joseph was sold into slavery, and so with Jezreel and Nain and Magdala of Mary Magdalene. Now I need not, in speaking to a highly intellectual audience, more or less expert, say what a mighty confirmation this gives to Holy Writ. I ask antiquaries, "Can you point to any other writings that will stand such a test as that?"

Next let me take a few localities to show you how this accuracy is confirmed, and I am referring to a period of not less than 3,500 years ago at least—possibly more. First, let me refer to the ridge. You are aware that there runs through the Holy Land, what geologists call a dorsal ridge, a regular backbone to the country. Some 3,500 years ago or more Abraham, the patriarch, with Lot his relative, were walking along this ridge and Abraham said, "Let us divide the land between us; if you like to take the left hand you can and I will take the right, or I will take the left and you the right." Now Lot thought, when he looked round, that he would like to take the left side, that was no doubt facing south-eastwards and looking towards the valley of the Jordan. Abraham said, "Well, in that case I will take the right." I have been there and seen exactly how the thing happened. You understand that the dorsal ridge of limestone is so situated that standing there you can see pretty well into the valley of Jordan and the gardens of Jericho. Of course Lot could have done that and he saw that it was very good. He looked on the other side, on the right, and saw nothing but rocky kinds of hill like the waves of the sea, and just at the end there was the blue Mediterranean. Of course there is a fruitful tract between these hills and the Mediterranean, but all that Lot saw was the expanse of hills and the strip of the blue Mediterranean, and he naturally said, "I will go to the left—I will go to all the rich gardens of the Jordan."

Now you see how the transaction happened. That has been verified word for word. What other book in the world would stand such a test as that? Take the case of Hebron. We are told that going out from the camp near Hebron on the fatal morning when Sodom and Gomorrah were destroyed—that from those hills of Palestine looking across the Dead Sea, Abraham saw the doomed cities burning. You may go to that place exactly where Abraham was and judge for yourselves whether he could see the cities burning or not. There may be a doubt as to the exact situation of those cities; but you can see the general position from that place. If you ride over the site you will find signs of conflagration and bituminous formations and actual combustion which are visible to-day, and there the doomed cities were, and I comprehend that before this convulsion of nature occurred they were surrounded with fertility, and were steeped in luxury and wickedness of all kinds.

Then again take the case of Shiloh. Shiloh apparently was at about the, or up to, the tenth or twelfth century quite well-known. The Crusaders knew it and they thought the place so important that they built a little chapel there, but it was off the road and on a secluded bridle-path, and no one noticed it. Centuries passed away and the general impression was that the city of Shiloh was unknown; but now it is as well known as any place in the world. Palestine surveyors naturally looked to the exact words of Scripture and they knew from the Bible, as if they had been under marching orders, how they were to march north and then turn eastward and then take the line towards the village Labona, and stop short of that and look for Shiloh. Those directions were just as simple as any directions you would get in asking your way about the streets of London. But people did not go to Scripture for their knowledge, and they searched about in their own indiscriminate way. At last somebody did it, and sure enough they found it. No other side of Palestine fulfils the description required of the city of Shiloh. It required a lower plateau where the whole nation might encamp—people who would attend the Annual Festival of the Jews, where many thousands of persons might encamp and in the middle of that is a low hill—a plateau on which would be placed the Ark of the Tabernacle where the priests would be. This site of Shiloh exactly answers it. There are the plateaux. Can you find stronger confirmation of your belief in Scripture than that? You are told again in the book of Joshua that when the Jews began to be organised, Joshua determined to have the Divine Commandments read to all the people. They were to be read on the side of the valley (between Gerizim and Ebal) and on the other side the people were to give their responses, and the law was read. The question arose could you do that in that particular locality—could you place the priests on one side and the people on the other side and be able to hear the word and be able to answer? You can! I have tried it myself. On one side the very words were read out in the English translation and you could hear the response. Now I ask cultured persons, is not this an astonishing proof of the narrative?

Take another case, the case of the river Kishon. Everyone remembers the story of Barak and Deborah. Many may have an indistinct impression how the catastrophe occurred. But how did the battle begin, and how does the narrative fit in with the locality, I should say average people hardly know. But would you be surprised to hear that if you go to the spot you can follow out the whole details of it? There the Jewish infantry were placed on the top of Tabor in front of you, thence charged down upon the loosely-organised host of Sisera, just as Scripture says. Then there followed the catastrophe, for there came a tremendous hailstorm at the time of the battle, which made Kishon almost impassable. You say how did that happen? It happened very easily. The rainfall is often extremely fierce and by the precipitation of drainage the river fills in a very short time. I have myself seen a great rainfall over Kishon. I think I could have ridden through almost anything on my bay horse of Damascus breed, but that day the crossing was so difficult that I quite realised what the fate of Sisera must have been. There is that military battle that occurred 3,500 years ago! The situation can be identified better than that of any one of the battlefields of ancient Greece.

One more example—I do not want to fatigue you, but I might go on for ever. There is the case of Jacob's Well. Everybody remembers the parable of our Lord at the well when the woman came up to draw water. She came from the village Sychar, the name of which still survives. There is a well which has been built over, and long dried up and a chapel placed over it by the Crusaders, but the Palestine Exploration people have thoroughly cleared it out and ascertained that below the débris a well exists, and have found the marks on the stone of the rope and the vessel by which the water used to be drawn. Read carefully in St. John's Gospel the conversation between our Lord and the woman, and you will find that after a certain amount of conversation of a very spiritual character, which is the foundation really of a great deal of the spiritual nature of our religion (the woman had led a dissolute life and our Lord evidently knew it and gently reproached her), she said to Him, "Sir, I perceive that Thou art a prophet." and she asked Him if God is to be worshipped in that mountain. Now there had been no previous allusion to a mountain. She wanted, of course, to gain a sectarian advantage, as a Samaritan, against a Jew; but the point is this that she suddenly said to our Lord, "Sir, I perceive that Thou art a prophet," and asks Him whether God is to be worshipped in that mountain or in Jerusalem. Was there a mountain immediately within sight? Of course there was, immediately overhanging, a magnificent limestone formation with the outline standing out against the eastern sky. Why did she say "this mountain"? Because on the top of it was the Samaritan Temple the ruins of which you may see to-day. So you perceive the woman, looking at the mountain, saw the tower at the top, and that reminded her of her sect, so she said to Christ, "Sir, is God to be worshipped in this mountain or in Jerusalem?" Imagine how the thing comes before you. I have stood there on that spot where our

Lord's attention was drawn by her to the outline of the mountain. How can you have a better testimony than that of the verbal accuracy of the Gospel narrative? I contend that if you pursue this mode of inquiry with proper learning and diligence, not only by reading books, but by going to the spot and understanding for yourself, as a surveyor or scientific man would do, you would find ample confirmation of every word of Holy Writ. (Applause.)

Now I will give you three examples of the same kind in regard to the parables. I beg to make the general assertion that every detail of the parables was taken from objects immediately before the eyes of our Lord and His disciples and those who heard the parables. I cannot stop now to go through every parable; but I roundly assert that I can show that in every one of them; and I will give you three striking instances.

Take the case of the parable of the silver. Now the accuracy of that parable depends on whether or not women were in the habit of constantly wearing their silver round their necks, or on their wrists or their arms or about their breasts. Was it so? Yes, undoubtedly it was. And how do we know it? Because there are hundreds of women there now who do the very thing, and when you see them you can realize the force of that parable. I will give you another single case—take the parable of the sower and the seed. You know that was the subject which the last great English painter whom I may call the immortal Edwin Long ever painted—the great imaginative painter of our generation. The point of the parable is this. The seed is sown on four or five different kinds of land, each kind being specifically described and very different from the other. There is the thorny ground, the stony ground or inferior ground, and the good ground that yields seed a hundred-fold. There is no doubt, from the words of Scripture, where that parable was delivered. It was certainly delivered on a certain part of the shore of the lake of Galilee. Was there any ground of that kind just about there? What made our Lord choose a parable from this particular phenomenon of nature? Was there any such ground there? Yes, there was, and there are very few other places where you see that particular ground in that part of Palestine, and it is there to-day. You may see it yourself. That parable was undoubtedly delivered at that very place. That gives a wonderful notion of the verbal accuracy of the Holy Narrative.

Then there is the parable of the Good Samaritan. Recollect it all depends on violent robbery with wounding. Is there any road of that kind? It is almost certain that the parable was delivered during our Lord's last march up to Jerusalem within about a week of His Passion and Crucifixion. He was marching from Jericho towards Jerusalem —the most solemn of all the marches that He took on earth, and it is almost certain that in that part of the road this parable was delivered. Up what road would our Lord have to march? Why, by this very road. It was then called "the Bloody way," and it has been a bloody way up to recent times, until we had British Consuls and officials of that kind at Jerusalem. Robberies used to be frequent, and it had a bad name, but I believe now those robberies have ceased. Of course the robberies supplied material for the parable. Then look at that which gives the point to the parable. This man was robbed and wounded and left in a miserable condition on his back in the road. We know the road in such a place was very rough. The point of the parable is this:—the man was left on the pathway in a miserable plight, and two persons came along. The first one does not quite like the look of this wounded, half-dead body, so he passes by on the other side. Then the priest comes and he likes the look still less, and passes by on the other side also, and then comes the good Samaritan. What do you mean by the "other side"? If it is a narrow pathway, just enough for one person to walk at a time, then the words of Scripture would not apply. He could not walk on the other side. He must pass close to the body. But the real locality is not so. There is a trickling stream running down in the middle of a deep ravine, and it has a pathway on one side and a pathway on the other side, and if any one is so minded he may easily step across the stream if he wants to go to the other side, and this is exactly what they did, and I never realised how accurate the Scriptural words are until I understood these features. I appeal again to educated people—are not these wonderful instances of the verbal accuracy of the words of Scripture?

Now some object that a great many things bearing on the deliverance of the Jews from captivity are couched in highly romantic and poetic language, even in the record in the Psalms of the wonders vouchsafed by God to the Jews. Patriotic hymns of that kind might be and have been sung by people in England for mercies vouchsafed to them on many historic occasions, and that was done by the Jews. But are not these intelligible? It has been assumed, from the want of local and scientific knowledge, that these narratives are unintelligible, and no narrative has astonished people more than the passage of the Red Sea.

Need we say that that is miraculous? We have found that in certain states of the wind at the north end of the Red Sea, near which the Egyptians must have crossed from that part of Egypt, the waters of the sea are driven back for several miles. When you hear that, it amounts to a scientific fact—it is very intelligible and you see how the thing happened.

There occurred at that moment and at that juncture some tremendous wind that drove back the sea, and the Israelites saw there was a dry passage and a short cut for them. They were terribly pressed for time, with their pursuers behind them, and they rushed across and made good their passage. The wind abated and the sea began to flow back on the return of the tide and caught the Egyptians in their pursuit. I see it in my own mind as clearly as though I had seen it with my eyes.

Take the case of the Dead Sea. People assume that fire and brimstone and hail tempestuously rolled down from Heaven. That is a very good description; but of course it was by some extensive combustion of the fiery bituminous elements in the earth, of which the traces are seen there to-day.

Take the other case of the Jordan. The only passage for the Ark of the Covenant was over the river Jordan. I daresay that many have assumed that to be miraculous, because no one could understand how they could have got across dry-shod particularly at that time of the year. It is a narrow river no doubt comparatively, but deep, and they could not understand how, by any natural process, the Jews could have crossed dry, and yet they did so cross. I take that with a sure and certain belief in the accuracy of every word of Scripture. It was said there must have been a miracle; but in our days we quite see how it happened. The Jordan at that time and at subsequent times had been liable to convulsions in its bed. Every physical geographer knows it is the most extraordinary river on the face of the globe, and is liable to those convulsions, and many have happened since. Mark you the Scriptures never said that the river was banked up at the place where the Israelites crossed, but the water was banked up like a wall at a place called Zaretan, which is about twenty-five miles to the north. Do we require a miracle for that? There are those places in the Jordan, and the Jews very probably took that opportunity of crossing when the river happened to be dry, and they had not a moment to lose. They had to cross quickly and such things have happened in modern times. There was not necessarily a miracle in the case; but it was a most providential occurrence or the Jews otherwise would never have crossed. In modern times troops have succeeded in crossing rivers near the sea at a certain state of the tide when the river bed would be dry for a brief while. The way it happened on this wonderful occasion on the Jordan is usually understood by those who take the trouble to consider; but when we were very young, these things were understood as miracles, and they are now more exactly understood through scientific investigations, and wonderful confirmation is thus given to the verbal accuracy of the Scriptures.

Of course there are supremely important miracles in Scripture which must be accepted as such. But there is no need to make lesser events miraculous which can be scientifically explained.

Thus I make good this part of my proposition this afternoon by describing places I saw only the other day.

Now all false religions—every religion except our own—will ignore the scientific spirit. I lay down that proposition. I know what Hindooism and Mohammedanism are, and what Buddhism and other religions are. That applies not only to them, but also to mediæval Christianity. I assume it is only in modern times that the scientific character of the Scripture has been recognised. It is only of late that the scientific spirit has been acknowledged in Scripture. Indeed, Scripture has been presented to us by Almighty divine power as an open book which we have to read, mark, learn, and inwardly digest. We are to apply our intellects, to search, to understand, and then we shall see how true the Scripture is in regard to everything we learn by science and research. Now that is what we may call the scientific spirit in Scripture. Let me give you some instances of what I mean. I suppose if you asked our Astronomer Royal at Greenwich he would say of the luminous bodies—stars or nebulæ, whatever you like to call them, I am not sure that I know the latest scientific terms for them—that no one could give a fair idea of the number. The more they improve each optical instrument the more they discover fresh stars and it seems to be simply an illimitable universe. I do not suppose it was so well understood when I was young, but it is beginning to be understood more and more now. We were told that 3,500 years ago in Scripture. If you look in Genesis you will see an expression used to set forth a great nation. It says they shall be as numerous as what? As the grains of the sand on the sea shore and as the stars in the heavens. That is the shadow of scientific fact which science is showing us day by day to be true. Then take certain passages in the book of Job; look at the 26th chapter, in which it says that "God hangeth the earth upon nothing." I think if that could be referred to Sir Isaac Newton he would say that it was a distinct foreshadowing of the theory of gravitation 3,500 years before it was demonstrated scientifically in modern Europe. Now take the verse following that, which states, "He bindeth up the waters in his thick clouds." There are several professors here who know the meteorological system of nature, and I ask them whether that does not perfectly describe what happens in the case of a monsoon in India when there is a mighty evaporation from the Indian Ocean which is caught up into the mighty clouds, and these vapours are wafted hundreds and hundreds of miles from the ocean for the service of man?

Now take the 28th chapter, and amongst others it is a wonderful chapter containing astounding statements—most of them of a geological or mineralogical character, and no doubt every one of them will be more and more verified as science increases; but it says: "As for the earth out of it cometh bread: and under it is turned up as it were fire." I believe that is one of the theories of geology, that inside the earth there is fire. We were told that 3,500 years ago in the Bible. I ask you to look at your Bibles and refer to the 38th chapter of Job, where God spoke out of the whirlwind, and see whether there is not there a marvellous description of the physical phenomena of nature, but which have been described with a sublimity more than human and an eloquence more than mortal. That is what I call an inculcation of the scientific spirit in mankind by divine authority. Now I ask you to compare this scientific spirit inculcated by Holy Writ with the defective knowledge in Christian times, at the time of Galileo and Christopher Columbus. It is that scientific spirit which false religions ignore while modern science ascertains truth, and if science is true it must agree with Scripture, and we find it is so. The more we study the more we learn on this subject.

There is one more point I should like to refer to in regard to sanitation. At the time of the Social Science Congress at Huddersfield in Yorkshire where I was the President, a sermon was preached to them by a reverend gentleman who told them they could not do better, if they wished to study the principles of sanitation, than refer to many passages in the book of Numbers, and more particularly in the book of Leviticus, where they would find many principles of sanitation propounded 3,500 years ago, and they have been more or less carried into modern practice and impressed upon our fellow countrymen. I should like to ask any medical man who has been engaged in, I will not say the elimination, but in the isolation and limitation of the Bubonic Plague at Bombay, whether he could, on the whole, devise a better system of sanitation than that propounded by Moses for the limitation of leprosy in those days? This is the scientific spirit derived from Scripture and applied in a most practical manner to the most humane of purposes.

I should like to say one word in conclusion on the scientific part of the subject. One interesting portion of science surely is natural history. I should wish anyone to observe not only the number of plants and flowers mentioned in Scripture, but animals, especially in Leviticus, and the description and classification of various kinds of beasts. I consider it a wonderful instance of classification, and I doubt whether it would be better done in these days.

So much then for all the points of science, learning and research which verify Scripture. I feel that time is passing and that I have trespassed too much on your patience; but I had intended to show you how, while on the one hand the Holy Scripture answers all these tests, no other Scriptures do. Apply these tests by which Holy Scripture is confirmed and verified, to any other religion in the world, and the religion in question is scattered to the four winds of Heaven—not a word can stand—its geography cannot, nor its philosophy nor its science—nothing will bear the light of modern science, not even Mohammedanism. Sir William Muir, who is the greatest living authority on the subject, will tell you that of all books the most unintelligible is the Koran of Mohammed. I believe I have secured your careful attention to this momentous matter, but you may take it from me, as one who knows what these religions are, that no book on earth will stand the test that our Bible will. I do not pose as a man of science or of learning, but as a man of some knowledge from his own investigations, from his own eyesight and observation of the subject of which he is talking, and I hope what I have said may strengthen your faith. (Applause.) I recollect when, by invitation, I was standing by the open grave of Darwin in Westminster Abbey and the solemn anthem was being sung, "Blessed is he who getteth knowledge." That is the sum total of my address to you this afternoon. Let us get that knowledge as Darwin got it, and the more we learn, the more we study, the more we inquire, the more we know, the better shall we understand the words of Scripture as the one thing upon which we are to base all our happiness on earth, and all our hopes in the life beyond the grave. (Loud applause.)

A vote of thanks to Sir Richard Temple, moved by Sir Joseph Fayrer, F.R.S., and seconded by Professor Edward Hull, F.R.S., was unanimously carried.

Afterwards the following address, signed by the Lord Chancellor, was presented to the President.

TO

SIR GEORGE GABRIEL STOKES, BART.,
LL.D., D.SC., F.R.S.

WE, the Vice-Presidents, Council, Members and Associates of the Victoria Institute, desire to offer our most sincere congratulations to you, our President, on the occasion of the Jubilee of your tenure of the Lucasian Professorship of Mathematics in the University of Cambridge.

WE shall not attempt to enumerate your varied and valuable achievements in different branches of science, but will confine ourselves to expressing our deep appreciation of your labours in the field of Natural Religion. It has strengthened the faith of many to find that one so well able to judge as yourself has not found Religion and Science antagonistic, but you have in many instances—notably in your Gifford Lectures—either given able and convincing expositions of their harmony, or have clearly demonstrated the wisdom of a suspense of judgment till the advance of human knowledge may enable solutions to be discovered for problems as yet unsolved.

WE trust the Victoria Institute and its high objects may long have the advantage of your Presidency, and that every blessing may be vouchsafed to you, to Lady Stokes, and to your family.

(Signed) HALSBURY.

VICTORIA INSTITUTE,
June 19*th*, 1899.

F. W. H. PETRIE, CAPT.,
Hon. Sec.

ORDINARY MEETING.*

PROFESSOR H. L. ORCHARD, M.A., B.SC., IN THE CHAIR.

The Minutes of he last Meeting were read and confirmed; the Chairman then called on Mr. Slater to read his paper.

LIFE AS COMPARED WITH THE PHYSICAL FORCES. By J. W. SLATER, Esq., F.C.S., F.E.S.

THE question is often asked, "What is Life?" and to this inquiry the most profound thinker and the most careless and superficial dullard, whether of the "classes" or the "masses," is equally unable to give a reply. We may, indeed, heap up words which merely darken counsel and obscure what they profess to explain.

2. We are often asked whether life is a principle or an agency like the so-called "physical forces," or as they are now more generally named, "forms of energy."

3. Is life at all comparable to heat, to light, to electricity, to magnetism, to chemical, or to mechanical action? Some persons tell us that all these forces are merely certain modes of motion acting under peculiar conditions upon matter. If this is the case, and if life is one of them, then a living organism also is merely matter set in motion. Let us examine this doctrine.

4. The first great difference which we can recognize between life and the physical forces is this; we can measure any of

* February 20th, 1893.

these physical forces by their manifestations; but we cannot measure life by its manifestations. We can measure light with great accuracy. We can compare one source of light with another, and thus ascertain the luminous power of the sun, of Sirius, of an arc-lamp, a glass lamp, a gas burner, a candle, or an aurora borealis. We can show how many candles we should have to group together for their united radiance to equal that of the sun.

5. In like manner we can measure heat. We can find the temperature required for melting any of the metals or for boiling or evaporating away any liquid. We can determine the quantity of heat which can be obtained, for instance, by burning one ton of coal, of any determined composition.

6. We can measure the power of a magnet, or of the electric current produced by a dynamo, or by a galvanic battery of some known construction. Most easily of all we can measure mechanical power, or the motion which it produces.

7. But can we make any similar determination or measurement with life? Can we, for instance, say whether there is more or less life in a child or in a grown man, in a microbe or in a whale, in an ox or in an oak tree? Some of these, and of many similar questions which might be framed, strike us at once not merely as unanswerable, but as absurd.

8. You might, perhaps, say that there is more life in a man than in a hedgehog. The man will live longer, travel faster and further, and exert more power in various directions than can the hedgehog. He is a greater weight of living matter—a point which some people take as a standard. But give the man a score of Spanish flies, and he will die in torment. Give the hedgehog a similar dose and he will eat them without injury, and in his manner he will ask for more. In short, his life resists and overcomes an agency which destroys the life of man.

9. We might, perhaps, fancy so swift, powerful, and heavy an animal as the African buffalo must contain more life than a man. Not so; let man and buffalo be each bitten by a Tsetse fly. The buffalo will shortly perish, but the man will experience no more inconvenience than he would from the bite of a gnat.

10. Or again we might think that the quantity of life in an ox would be almost immeasurably greater than that in the spore of a microbe. Yet the spore will resist degrees of cold and heat much more than sufficient to kill the ox.

11. We see further difficulty in finding a measure for life if

we compare a mammal with a bird on the one hand and with a reptile on the other. Both these two live longer than mammalia. But whilst the bird breathes more rapidly and abundantly than the beast, whilst its blood circulates more rapidly and has a higher temperature than that of the beast, the reptile deviates in the opposite direction. The bird, it may be said, differs from a lump of stone more widely than does the beast, but the reptile differs less. What then is the standard according to which life could be measured?

12. A further difference between life and the physical forces, or modes of energy, is that we can convert the latter into each other. But we can effect no such transformations with life. Let us take an instance; a lump of coal contains, stored up, a quantity in proportion to its weight and its quality. If we burn it, this chemical energy is converted into heat. If we allow this heat to act upon the boiler of a steam engine the heat is converted into mechanical motion. These transformations are not arbitrary in their quantity but quite definite.

13. We may go further: if we use the mechanical power to make a coil of wire revolve between the two poles of a magnet the mechanical power is thus transformed into electricity, which again by certain arrangements can be made to appear as light (arc-light). Similar transformations backwards and forwards can be effected in different directions. We can convert heat directly into light. We can transform motion into heat as in the well-known process which ensues if the axle of a wheel in quick rotation is not supplied with any lubricant to reduce the friction. We convert mechanical power into electricity by rubbing a piece of glass or amber with rough dry silk—the manner in which electricity was first observed.

14. But can we transform any one of these forces or agencies —call them what we please—into life? No; life as we know it, can certainly exist only between certain limits of temperature, probably at the outside between $-100°$ to $+300°$ Fahrenheit. If we reduce the temperature still lower all forms of life die out as do most long before reaching this lower limit. If we heat living beings too strongly they also cease to exist. Some of the spores of microscopic organisms can resist a temperature exceeding that of boiling water. But very few of the larger and more highly developed animals and plants can bear a heat exceeding 120° or below 10° Fahrenheit.

15. Yet this fact that life can exist only between certain limits of temperature gives us no right to infer that heat *is* life. We may heat matter—even organic matter—to the most varied degrees, but if we thoroughly exclude all germs of life it remains inert and dead. The manifestations of life and of heat touch each other, but they are not mutually convertible. Others—especially quacks—tell us that electricity is life, but they fail to produce any decisive evidence in support of their hypothesis.

16. It is again said that light is life. In reply, we may be content to point out that multitudes of living beings, both plants and animals, exist and multiply in absolute darkness, for which, indeed, they seem especially adapted.

17. We come now to a capital distinction. We may start heat, light, or motion afresh where nothing of the kind has previously existed. We may descend to the furthest accessible point in the Blue John Cavern at Castleton, where no light has penetrated since the present order of things took its rise. If we have provided ourselves with a box of matches and a candle we shall find it quite as easy to strike a match and to light a candle as on the surface of the earth, where the sun's light visits us every day (except in London). Or let us find some place where no electric current is traceable. Yet by rubbing a stick of sealing-wax or a cake of gutta-percha with silk, or catskin, we obtain electric sparks. In short, any of the physical forces can, so to speak, be started afresh.

18. How is it with life? Our great anatomist Hunter said, "all life comes from the egg" (*omne vivum ex ovo*), or in other words, there is no life without pre-existing life, be it in the form of egg, seed, or spore.

19. Experiments have been made without end to obtain life from inanimate matter. Virgil gives a receipt for creating a swarm of bees from the carcase of a bull. Insects generally were supposed to arise spontaneously out of dust, water, or refuse of any kind. It will scarcely be believed that good old Rösel, Jan Swammerdam and other naturalists of the old time had to show how moths, butterflies, beetles, bees, etc., were produced from eggs, to trace these creatures through their successive stages of growth and development, and to prove that they no more originate spontaneously than do horses or men. Errors die hard. When it was shown that insects are procreated by antecedent insects the believers in spontaneous generation retreated to more obscure regions. It

was urged that infusoria and microbia were self-begotten. The experiments made in this direction by Pouchet and others seemed at times to be successful; but on closer examination some flaw was always present. The air is not free from the spores of microscopic vegetation, nor even from the ova of minute animalcules. The surfaces of the apparatus used in such experiments, glasses, forceps, stirring rods, etc., are coated with them; the water and even the mercury used are not free from life. Pasteur and Tyndall have made many experiments with every precaution, and have again and again found Hunter's law verified—"no life without antecedent life."

20. The trial is being daily made in commerce on a gigantic scale. The Australian mutton, heated for a sufficient time to a temperature high enough to destroy the germs of life, at once plunged into tins similarly heated and at once soldered up, remains sound,—that is lifeless. In a few rare cases where such tinned meats have been found bad on opening, it has appeared that there was some little flaw or chink in the metal or the soldering through which air might enter. And where air does so enter it carries along with it the germs of life.

21. The experimentalists who have endeavoured to originate life afresh have all been guilty of an error in principle, which would have vitiated their results even if apparently successful. They operated upon animal and vegetable matter, milk, blood, juices of meat, decoctions of hay, etc. Now all these substances presuppose the existence of life. They have never fairly attempted to originate life from mineral matters! Hence their most skilful experiments have been in principle null and void. Before we can show the origin of life we must be able to produce it in matter which is not merely lifeless, but which is not a product of life, and which as far as we know has never been quickened. No attempts in this direction are recorded in the scientific journals. I must confess that when a youth I spent some time in experiments of this kind. I am now by no means disposed to renew the attempts. If man were able to call into existence some being which has no place in nature, it might prove to be the germ of some pestilence more dreadful than any yet known.

22. There are persons who tell us that if we can only bring protoplasm into spontaneous motion the great problem of life will have been solved. *If!* we have long ago been told

that there is much virtue in an *if*. Those who make this suggestion merely show their want of acquaintance with protoplasm. This substance has never yet been found except in plants or animals, living or dead. Search the inorganic world through and you will not find it. The chief source for it is in a fungus known as *Ethalium septicum*, growing on the heaps of spent bark thrown out from tanneries. It is not a simple substance. It does not consist chiefly of albumen or gelatine. It is composed of no fewer than forty-five constituents, namely, plastine, myosine, peptone, peptonoid, pepsine, mecleine, letheine, guanine, sarcene, xanthene, ammonium carbonate, paracholesterine, traces of cholesterine, ethalium resin, a yellow colouring matter, glycogen, a non-reductive sugar, oleic, stearic, palmitic, butyric and carbonic acids, glycerides and paraglycerides of the fatty acids, calcium stearate, palmitate, oleate, lactate, oxalate, acetate, formiate, phosphate, carbonate, and sulphate, magnesium and potassium phosphate, sodium chloride, iron (in some unknown state), and water! How are all these substances (many of which are in themselves very complex and are to be obtained only from pre-existing plants and animals) to come together and to combine? By chance? Protoplasm is, in fact, not the cause but a consequence of life. And when we have it before us how are we to set up in it those molecular motions which we recognise in living beings? As a half-way step towards animation I have taken the unimpregnated eggs of female moths and have exposed them to different temperatures, to different rays of light, to feeble electric currents, to the action of magnets, to gentle mechanical movements. But all these methods proved vain The eggs dried up and became decomposed, and on microscopic examination they were found not to have taken the slightest step towards life.

23. We are sometimes told that at one time men of science doubted the possibility of forming organic compounds artificially until Woehler produced urea from dead matter, and that we may, perhaps, some day be able to manufacture not merely organic matter but actual organisms. It will be soon enough to consider this case when it shall have arisen. Up to the present day chemists have produced artificially secondary products, excretions, pigments, results of decomposition; but they have never obtained any of the primary compounds in which life seems to inhere. Much less have they produced organisms, organised structures, of whatever

degree. When they shall have done this,—when they can show us, in the receiver, a globule which assimilates outside matter, grows, displays irritability, reproduces itself, and dies, their claims may be sure of a fair examination. But it is surely unphilosophical to take into account evidence which has never yet been brought forward.

24. In fine the more we observe, experiment, and study, the more we are disposed to conclude with Moses, Hunter, and Darwin—who all substantially agree on this point—that life has not sprung up spontaneously on the earth, but that it has been originated by a Higher Power. We may safely say that this power cannot have been the god of Comte and the Positivists, Human Nature in the abstract.

Discussion.

Dr. R. C. Shettle.—I think that Mr. Slater has done good service by reading a paper before this Society on "Life as compared with the Physical Forces," because it paves the way for the investigation and discussion of this great problem, animal life; and the mode in which the various phenomena are elicited by the animal body, from the motion of a muscle to the evolution of mental power, is a subject to which I have for many years devoted a very large portion of that leisure time which I could snatch from the active practice of my profession; and this must be my excuse for occupying the attention of this meeting for a short time in reply to Mr. Slater's remarks.

I think that a careful perusal of the paper, justifies the remark that the author has taken what may be called the negative view of this great question. I say "great question," because a little consideration must show that it is a question which involves, directly or indirectly, all the best interests of man both in this world and in the world to come. At the same time, it is a question which is often avoided because of the difficulties which have to be surmounted by anyone who ventures to enter upon it. Mr. Slater has reminded us that we can measure light, heat, electricity and magnetism, but that we cannot measure life; and again, he has told us that whilst we can convert the physical forces into each other, we can effect no such transformations with life. In passing

I may remark, however, that "will-power," one of the strongest manifestations of life, is directly capable of being measured by the contractile power of the muscles. A third point of difference upon which Mr. Slater comments, is that life can only exist between certain limits of temperature; and again, if I am not wrong in my interpretation of his remarks, he suggests that because it cannot exist outside those limits, it is not of the nature of a physical force. Another distinction upon which great stress is laid is that whilst we can "start heat, light or motion afresh where nothing of the kind has previously existed," we cannot start life, for "there is no life without a pre-existing life, be it in the form of egg, seed, or spore." I think that there is no one present who would for a moment dispute these statements, but I cannot altogether admit the author's deductions. In as few words as possible I will endeavour to define the views I hold with regard to animal life, and the very important relations which exist between the material body and the physical forces, and between these and the phenomena of life. Of course in these comments I can do so only in the most cursory manner. If we go to the Bible, as we may well do for information on this point, we find it stated that (1) "the life of the flesh is in the blood." (2) "The life of all flesh is the blood thereof," plain statements which demand the most careful attention in any enquiry as to the nature of animal life, and which should be capable to some extent of proof. I had confidence in the assertion, and the results of my investigations assure me that they are literally true.

Many years since I began to study the nature of the blood with the object of ascertaining the mode in which it could be utilised in the maintenance of the energy of the phenomena of life. Physiology had already determined that its power in this direction resided in the oxygen which it contained; ergo, if life is a subtle and non-physical form of energy, it must exist in the oxygen, or the latter could not maintain it in the animal; and, as such a proposition was impossible, the only other reasonable conclusion was that the oxygen aroused vital energy through its physical properties. I next found that oxygen is a highly magnetic substance, and, when it is conveyed into the blood in any quantity, has the power of proportionately increasing the blood's magnetic charge. I therefore concluded, upon this and other grounds, that "life" is essentially a physical form of energy, *i.e.*, that life is a peculiar description of motion, the character of the motion being regulated by the nature of the forms of matter which compose the organifm. To prevent any misconception of the nature of my theory I will endeavour to explain it as briefly as possible. My chief points are as follows :—(1) I recognise, as the only logical conclusion, that all formed matter was created by a power external to itself, and consequently that it had its origin in the Deity. (2) That the same power which created the matter is still upholding it in all its forms. (3) That every form of matter evolves phenomena which are characteristic of that form, and the conditions to which it is subjected. (4) That the material body of a living animal is no exception to these laws, but that all the phenomena of life which it manifests are the immediate result of the work done by the different forms of matter. I hope I have now sufficiently expressed my theory to make it evident that I regard matter as the agent, and the agent only, by which impressed force is directed; whilst the various forms of physical force (of which vital phenomena are one) are regarded as the direct result of the impressions which the different forms of matter, under various conditions, convey to the ethereal medium which pervades all matter and space. Indeed the theory appears to prove that these physical impressions of animal life are registered in ethereal matter, forming the basis of memory, and also of the inward and imperishable man. Of course this theory obliges us to admit the truly mechanical nature of all the phenomena of life, and I know that there are some persons who regard this as a very low estimate of what is the greatest manifestation of the Creator's power. In my humble judgment, however, it greatly enlarges our conception of His power, just as our ideas of the ability of a mechanic are increased by the skill which he has displayed in his work. Again, if this theory be closely examined it will be found that all disorder and disease may be traced to the effect of some impression conveyed to the sensorium, either through the senses, which are truly mechanical, or by the introduction of unsuitable matter into the system.

I will only add my conviction that the Victoria Institute would confer an enormous benefit upon suffering humanity if it would take measures to probe to the uttermost the connection which exists between life and the physical forces, and in such case Mr. Slater's paper would meet with its full reward.

THE FOLLOWING COMMUNICATIONS WERE RECEIVED.

(1) Professor LIONEL S. BEALE, M.D., F.R.S., writes :—

February 18*th*, 1893.

While I agree with the general views of the author of the paper, I think the facts compel us to go much farther and draw an absolute line of demarcation between all living and all non-living. So far, no properties discovered in any non-living matter justify the opinion of the origin from it of the living. And there is good reason for concluding that every form of non-living matter might have existed for infinite ages and under any conceivable physical conditions, without the most minute speck of the simplest living being evolved.

That which universally distinguishes every form of living matter from matter in every other state is a *property*, *power*, or *agency* by which the elements of matter are arranged, directed and prepared to combine, according to a prearranged plan and for a definite purpose. This power cannot be compared with any known powers or properties. Under its influence the rearrangement of the elements of matter is effected. The matter so acted upon is always colourless and exhibits no structure when examined by the highest magnifying powers; and the changes in question only occur while the matter lives. The power may therefore fairly be called *vital power* and the living matter *Bioplasm*. Now of the chemical composition of this Bioplasm and of its constituent substances we know nothing, and it is doubtful whether we shall be able to ascertain anything concerning its exact nature, seeing that we cannot chemically examine Bioplasm without destroying it. It ceases to be alive and the substances obtained are merely the products which *result after its death*. "Protoplasm" has been applied to matter in many different states and the word has never been defined. Matter alive and dead, structureless and exhibiting structure, matter hard and soft, coloured and colourless, opaque and transparent, cooked and uncooked, has been called Protoplasm. Living matter cannot therefore be properly indicated by a word which is also applied to dead matter.

There is no gradual transition from *non-living* to *living*, but the two states are absolutely distinct. The living world is not an outcome—has not been evolved from the non-living world. The relation between life, power, and matter is not quantitative, for a particle of matter so small that it could not be seen by the highest magnifying powers at our disposal may be the carrier of vital power capable of impressing with peculiar properties and conferring peculiar structure upon hundredweights of matter which by degrees may come within the sphere of its influence; while, as regards time, this influence may be handed down through ages. I claim therefore for all *Life* a special position independent of, and not in any way related to, any physical forces. Life power must be placed in a category by itself, having nothing in common with any material forces, powers or properties, and holding in the cosmos a remarkable and peculiar place. If governed, it must be governed by laws having nothing in common with those which govern non-living.

(2) From the Rev. R. Collins, M.A.

We often perhaps get into difficulties by not distinguishing between abstract and objective ideas. "Energy" and "force" are distinctly abstract ideas, having no existence outside the mind of the reasoner. "Life" is equally an abstract idea.

The lecturer says, "We can measure any of the physical forces by their manifestations; but we cannot measure life by its manifestations." What do we mean, when we say we can measure light and heat? What do we mean by "more or less light"? and "more or less heat"? "More or less light" means, that there are more or less ethereal pulsations on a given point in a given time. We should say the same of what is called "radiant heat." Heat and light are not intrinsically capable of being either more or less subjective (not objective) realities. The same is true of life, regarded merely as to its nature ideally; and that is what appears to be intended by the author. What do we mean by "more or less" life? We cannot really measure either light or heat; we can only measure their energies, which we can only do by measuring the work done by them. Now in the same sense, surely, we can measure life. We can in fact only discern the presence of what we call life—which some call "vital energy" —by work done. And we can measure the work that is done by the will and energy of man, as truly as we can measure the work done by the energies of light and heat.

The mere exhibition of life for a longer or shorter time in an organic structure does not appear to indicate anything in the quality of life itself, but only something in the quality of the organic structure independent of the life-energy which has been manifested in connection with it.

What are called "physical forces" or "energies," are probably results of ethereal action. Why should not the energies, the working of which we call "life," be so also? May not life be the energy of something, different from that which is at the basis of the "physical forces," but yet something analogous?

So far as we can see, there is probably a more real analogy, than is often thought, between the generation of light, when it has "not previously existed," and the generation of life. If we strike a match in a "cavern" or elsewhere, we are not originating light; we arouse, mechanically, what are called "potential energies" (due to some qualities ethereal or material, which we cannot understand) in the phosphorus of the match and the oxygen of the air, the coalescence of the atoms of which, in some way, stirs the ether around into light-waves. We take potential light with us into the cavern, and we find potential light there. There must be two potentials which coalescing shall result in light. So in regard to life, we must go beyond the *ovum* to the *ovum vivum*: and that we never find, unless two potentials have already coalesced. If we say we can start, or originate, light, we can equally say, that we can start, or originate life, where the two requisite elements can be brought together. If we say, that the life-energy can only be generated by previous life, we can also say, that light can only be generated when two things that have the proper potentialities for light can be brought together. As for "spontaneous generation," whether of light or life, there can be no such thing, as is evidenced in the "physical forces" alone.

When we push back our thoughts to try to grasp the origin of these mysterious energies—all probably results of ethereal action of some kind—we are lost. All we can see at present is, that the mind and will of man are certainly capable of initiating energy; and when we think of the energies of the universe, we can but come to the conviction of an all-comprehensive and originating intelligence, of infinite wisdom and capacity, the Creator.

(3) Surgeon-Colonel S. SMITH, R.E, writes* :—

In commenting upon the subject matter of this important paper, let me premise my remarks by declaring that I am, at the very outset, at variance with the author of this paper in his view of the special nature of vital force; and in his attempt to show that it differs from force in the accepted sense of the term; and I shall venture to state my belief that vital force, or force so called in connection with organic matter, is neither more nor less than force *per se*.

If I ask myself what force or energy really is: and inquire into its origin, I am inevitably brought to the ultimate conclusion that force is in itself the expression of the will of the Creator, existing in all His works, inorganic and organic alike, and manifesting itself in an endless variety of ways.

Let us now consider the nature of vital force, and endeavour to discover the difference, if any exists, between it and force *per se*: or, as we may call it, primary force: and in order to do this we must compare the manifest effects of active vital force with those of force in action.

Force, within and without the body, exists under two conditions (*a*) a latent, (*b*) an active force.

In the organic world it lies latent in the seed as germ life.

In the inorganic world it lies latent as explosives, coiled springs, elastic substance, etc., etc.

Under altered conditions, by the energy of other accessory forces, *e.g.*, heat, moisture, endomosis, etc., the latent life force of the seed becomes active, its manifest effects being those of assimilation and growth; slow in some forms of vegetable life; wonderfully rapid in others, as in the fungi.

In the inorganic world under similar conditions as to accessory forces, the latent force becomes active: the resultant activity being more rapidly manifest as to its effects, the dynamite explodes, the released spring instantly uncoils, the elastic substance suddenly resumes its original length and form.

Here, owing to different conditions, the analogy ceases to hold absolutely good; for in the seed there is a constant accession of force by pabulum, strengthening and increasing the vital force,

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* This able communication has been somewhat abbreviated owing to its great length; but it might have formed in itself a separate paper for a meeting of the Institute.—ED.

and enabling it to overcome for a certain time all the opposing forces which, in the very order of things, must at last neutralise it.

In the case of the explosive, coiled spring, and elastic substance the force is constant, as opposed to the incremental vital force of the seed; but in both examples the ultimate result is the same, neutralisation of primary force by opposing force, or forces, producing stasis in the inorganic, and stasis or death so called in the organic world.

In the higher forms of development of the organic world, in respect of which the human body may be taken as the most perfect example, force is active *ab initio:* evidencing its activity by the movements of the spermatozoa producing activity involving change in the Graafian vesicle; and later on evolving the spinal cord and brain, the formation of the heart, and establishment of its continued action in connection with the circulation of the blood; and later still, evidencing its existence by the various functions of the body, many of which are of a purely mechanical nature, *e.g.*, mastication, deglutition, defæcation, micturition, respiration, and muscular movements of the tongue, eyes, limbs, neck, and trunk.

These forces find their analogues, and are identical with, force observed in connection with various machines, of which the locomotive affords an example.

In man this life force, conferred originally upon him by the Creator, has been given in greater or less quantity to each of his children; thus we have from birth weak infants and strong infants. So again vital force is incremental, and can therefore never be constant.

As in the case of infants, so also in respect of engines; we have toy engines capable of exhibiting a small degree of force, and greater engines of higher power.

In respect of this incremental condition of life force, it might be said that analogy again fails to represent the identity of force in the human body and locomotive. Is this so? Give no food to the infant, the life force fails; opposing forces neutralise it, and stasis (death) follows. Cease to supply the locomotive with fire and water, and you open the valves in vain, stasis follows from neutralisation of opposing forces. God gives primary force to the child, man supplies it to the locomotive.

So that if life force fails for want of pabulum (food force), does it not follow that the force which is supplied by the food is identical primarily with that of life force, else why the result?

As to the functions of the organs of the senses, are they not evolved by force from without? *e.g.*, of the eye from the impact of light, and the effect of its transmission through the organ to the brain.

Of the ear, from the impact upon its drum of vibrations conveyed by the atmosphere and their transmission to the brain through membrane, ossicles, etc., and so on with the other organs.

With the special recognition of these forces as seeing, hearing, smelling, touch, and taste, through the medium of the brain by the inner or spiritual man we have not to deal. Our theme is the identity of force; our field the conflict of force.

We do not say for a moment that primary force, or at least a portion of it, is not convertible; or, to put it more clearly, capable of acting in more than one direction: or that it may not be modified, and apparently but not really changed as such, by the conditions under which it is placed.

Let us now glance briefly at force in connection with the brain and spinal cord; and compare it with that observed in connection with a battery and accumulator.

In both cases force originates from pre-existing force active in the brain and spinal cord, latent in the battery by the agency of the pre-existing active force; the brain and spinal cord at the will of the Creator were formed. By man, the battery was constructed, and its force lies latent. So also does life force lie latent in the seed. Force in connection with the brain and spinal cord exists *ab initio*, and is increased and maintained by decomposition of organic matter within the body, the latent force of which organic matter it assimilates.

The brain and spinal cord is a living battery and accumulator, whose nerve trunks are conductors.

Force in connection with a battery becomes evident when it is rendered active by decomposition of inorganic matter, and interchange of elements liberating latent force.

In both cases, after a certain time, stasis results in respect of the brain and spinal cord, from want of food force, or it may be shock or injury; and in that of the battery, from want of undecomposed inorganic matter.

Heat, as an evidence of force, is evolved by a battery in action.

So also in respect of the spinal cord and brain the same result follows, *e.g.*, in blushing and flushing reflex conditions arising out of some temporary alteration of the normal quantity of vital force conveyed by the vasomotor nerves.

Light is produced as a display of electrical force, under the usual conditions of interrupted current, etc. So also is light, or that condition of force which gives rise to it, produced when force is suddenly and abruptly applied to the organ of vision, *e.g.*, by a blow; or, when the eyes are closed, by pressing the fingers upon the eyelids so as to cause pressure upon the eyeballs, assuming, with regard to the blow, the appearance of a flash of light, or a myriad of bright sparks; and from pressure by the finger that of a ring of light; such efforts, as in the case of the battery being obviously due to interruption of a current of force.

Shock results also from interruption of an electrical force current.

So also as to the brain and spinal cord similar consequences follow, *e.g.*, a blow over the ulnar nerve gives rise to shock from sudden stoppage of vital force current.

Small shocks producing pin and needle sensations are experienced by the use of the battery and coil, etc. The same sensations are the sequence of partial pressure upon a nerve trunk.

Complete hindrance to electrical force current and vital force flow entail the same results: cessation of all manifest effects of the former; and abolition of functions of parts supplied by the latter.

In connection with a battery, we see under certain conditions—mechanical effects of electrical force—or so-called conversion of the former into the latter, these effects being, however, neither more nor less than qualities of primary force rendered evident by the conditions under which it is placed. In like manner we find the mechanical effects of vital force in connection with the brain and spinal cord rendered evident by the conditions with which it is associated, and under which it is placed; giving rise to mechanical motion in the body wherever needed, *e.g.*, sucking, mastication, deglutition, evacuation, heart and artery movements, respiratory, limb and general movements of the body through the agency of the muscular system.

The ball and socket joint of the scapula and humerus with its associated muscles affords an example of adaptation and construction, such as permits of a display of every form of mechanical motion, which the most complex machines are capable of performing.

Is it not clear then that vital force associated with the brain and spinal cord effects all these mechanical movements of the body, just as the electric or steam force acts upon the movable parts of the machinery upon which they are brought to bear? In each case a movable body, or parts of a body—applied force—and movement as a result.

Does it not further appear that a current of primary force holds within itself as properties or constituents of it—as in the case of a ray of white light—in a state of parallelism—heat, light, electricity, actinic, and probably other forces—as yet unknown to us, which do become manifest when its parallelism is disturbed or destroyed.

We have now to consider an important statement by the author of this paper, viz., that vital force, unlike physical force, cannot be measured; and he asks for a measure of life force, and standard of comparison.

Now, if we seek for this measure of life force and standard of comparison, we must search for it among the opposing forces of life, of which it may be truly said "their name is legion," *e.g.*, starvation, blood-letting, poisons, etc., etc. From all these we may, with most advantage, select that of poison, the power of which, in opposition to that of life force, is now so well-known, as to enable us by its means most readily, and with nearly absolute certainty, to estimate the quantity of life force present in some organic bodies.

As to the degree of vital force existent in different individuals, in animals, and other organic forms of life, it is clearly and undoubtedly evident that to no two bodies has the Creator accorded exactly the same measure of vital force. Daily the old aphorism of the famous Greek physician presents itself to our minds in all its completeness and truth, "We differ from ourselves at some times in our lives, no less than we differ from everybody else at all others." If this be so, as exemplified in each individual, in infancy, youth, and old age—owing to antecedent or hereditary causes producing difference of quality of structures—inherited and acquired; from opposing forces of disease—inherited and otherwise; from mode of life, *et alia inter alias*, it follows that no absolute standard of vital or life force *per se* exists; but we can measure it relatively by those forces to which we have already alluded.

For, notwithstanding the difficulties which beset and attend such an investigation, we start with the knowledge that a given quantity of poison force contained in its alkaloid will—if administered or injected into the body—neutralise, *i.e.*, bring about, stasis of its vital force; or in other words, cause the death of such an organic body; and further, that the force employed to produce such a result must equal the vital force existent in that body or stasis would not follow. So that we may say in respect of this, that as nine-tenths of a drop of anhydrous prussic acid will cause the death of an average man, it necessarily follows that the vital force of the man must be represented by the value of the neutralising force of the nine-tenths' drop of the prussic acid.

This comparison of opposing force with life force may be extended so as to include the reptilian, insectivorous, and other poisons.

Possibly a more correct standard of the value of vital force will be found in electricity; to which, under certain conditions, as a means of extinguishing life in the criminal, the attention of the civilised world has been of late directed; and the intensity and quantity of electricity necessary to accomplish this, has been sought for, so as to ascertain the exact measure of electricity necessary to neutralise it.

By a less certain method of average as to duration of life force in individuals, does the actuary attempt to find its value.

With reference to the question of effectual resistance of vital force to opposing forces such as we have dealt with, which are cited by the author, and of which we are cognisant, their very existence only proves the truth of the old adage that "there is no rule without an exception."

To attempt to show in the present state of our knowledge the why and wherefore of these exceptions would be futile.

Why, for instance, parsley kills parrots—goats can browse upon hemlock, enjoy it and suffer not.

Why—as cited—the tsetse fly kills some animals and is harmless in respect of others.

Why eggs and mutton produce symptoms in some persons analogous to poison, etc., etc.

In regard to all these and similar exceptions, we can only assume that as life exists in a greater measure in some bodies than in others, the resistance is correspondingly greater; and that where this is not the case, that some difference of structure exists; or that some glandular product is formed; or that some principle exists, possibly, and most probably in the blood itself, constituting a force which neutralises that opposed to life force, and thus leaves it untouched.

These comments touch not upon the power of the will in connection with force associated with organic matter; but seek to show that force so associated, however divergent, however apparently changed, however different in effect, is still primary force *per se;* the expression and manifestation of the will of the Creator, arising at His command, continuing during His pleasure, pervading all His works, evidencing its existence alike in the lowest and highest forms of life.

(4) From the Rev. H. J. Clarke, M.A. :—

In endeavouring to show that life has no place among the so-called physical forces, Mr. Slater directs attention at the outset to what appears to me to be a conclusive argument. In light, heat, electricity, chemical change, and mechanical action, a convertible energy, measurable by its manifestations, and capable of representation by definite quantitative values, circulates among these classes of phenomena, discovering itself now in one, now in another. Life then, if it were some development of this, should admit of being measured by its manifestations. But such is not the case, and the difference between the two in this respect is not doubtful, but patent and striking; therefore we are entitled to regard life as an essentially distinct agency. But what conception are we to form of the *modus operandi* in the manifestations of the physical energy? Mr. Slater reminds us that there are persons who hold them to be manifestations of "certain modes of motion." I presume, however, his opinion is that he might grant this assumption without thereby conceding that they are thus accounted for. On the other hand, he would perhaps allow, at any rate his argument does not compel him to deny, that all the changes which constitute the phenomena of purely physical life, admit of being conceived as modes of motion. For its starting point in every case may be scientifically represented as a specific arrangement of molecules, in association with a tendency to select from its environment, under favourable conditions, suitable materials, to attach them to itself, to fashion, in conformity with a type to which it owes its origin, the structure which thus arises, to preserve it, in the process of waste and renewal, for as long a time as possible from the disintegrating operation of hostile tendencies, to adjust within certain limits its internal economy to alterations in its environment, thus maintaining, while it lasts, a moving equilibrium. Accordingly, if physical life, whether vegetable or animal, presupposes movements among molecules and atoms, and is scientifically distinguishable from its absence by the characteristics which are to be ascribed to such movements as are specifically its own, we are at liberty to affirm, not indeed that we have hit upon a phrase which accounts for life, but rather, that within the range of physical investigation we have arrived at no deeper discovery respecting it than that its phenomena imply modes of motion peculiar to itself, and, in the stamp they have received from the Intellect which designed them, sharply distinguishable from all other modifications which take place within the frame of nature in the way of molecular arrangement.

The proved impossibility of converting into life any inferior manifestation of energy, and the now established truth that every germ presupposes a parent life, are doubtless very instructive, if thought be directed to some far distant past when physical life could nowhere have been possible in any of the forms that are known to us. But in seeking to discover when it began to be, what do we aim at, if we ignore the question, whence comes the energy which has produced the universe, and has been ceaselessly at work throughout it from the beginning? Do we desire to trace cosmic energy to its source? Then must we not assume the all-pervading operation of an originating Intellect and Will.

(5) From Mr. D. Biddle:—

This interesting paper brings forcibly to one's mind Professor Allman's presidential address to the British Association, in 1879, on *Protoplasm*. He very truly said, "wherever there is life, from its lowest to its highest manifestations, there is protoplasm; wherever there is protoplasm there too is life. The chemical composition of protoplasm is very complex, and has not been exactly determined (but an advance has been made in this respect, during the thirteen years which have elapsed, as Mr. Slater clearly shows). It may, however, be stated that protoplasm is essentially a combination of albuminoid bodies, and that its principal elements are, therefore, oxygen, carbon, hydrogen, and nitrogen. In its typical state it presents the condition of a semi-fluid-atenacious, glairy liquid, with a consistence somewhat like that of the white of an unboiled egg. While we watch it beneath the microscope, movements are set up in it; waves traverse its surface, or it may be seen to flow away in streams, and this not only where gravity would carry them, but in a direction diametrically opposed to gravitation; now we see it spreading itself out on all sides into a thin liquid stratum; and again drawing itself together within the narrow limits which had at first confined it, and all this without any obvious impulse from without, which would send the ripples over its surface, or set the stream flowing from its margin. No one who contemplates this spontaneously moving matter can deny that it is alive. Liquid as it is, it is a living liquid; organless and structureless as it is, it manifests the essential phenomena of life." Such was the president's lucid description of protoplasm. But, as I remarked shortly after his address was delivered, there is not one phenomenon mentioned which has not its counterpart in the merely physical world. Protoplasm is simply peculiar in combining the whole. 1. The chief elements of protoplasm, enumerated by the professor, are equally contained in the sesqui-carbonate of ammonia. 2. Its consistence may be stimulated by various inorganic solutions, not to mention collodion. 3. And as to the movements of protoplasm, in what do these differ from those of the sea upon the shore, except in the matter of rhythm? There we have apparent expansion and contraction, and an upheaval of the substance, which only science has taught us to be due to something outside itself. And if this be beside the mark, what are we to say to the evaporation of water by the stimulus of heat, and the condensation of vapour by cold? What are we to say to the diffusion of gases and of liquids, and to their endosmosis and exosmosis through dead membranes? What, moreover, are we to say to the process of solution, by which a small portion of the chemical compound mentioned above, placed at the bottom of a tube a foot in length, can, by the simple addition of water, be raised "in a direction diametrically opposed to gravity," so as to occupy all parts of the vessel? Is not vital action after all quite distinct from, and much above, the phenomena enumerated by Professor Allman as belonging to protoplasm, and are not these after all only the physical phenomena of what Professor Huxley justly calls "the physical basis of life"?

(6) The late Dr. JOHN RAE, F.R.S., in a letter to the Secretary, not intended for publication in full, says:—

February 20th, 1893.

"There are certain things that are placed beyond the keenest and most educated human intelligence to understand and gain an insight into, yet I believe that new creations are taking place every day."

(7) From Professor BERNARD, Dublin University.

February 17th, 1893.

MY DEAR SIR,—Mr. Slater's comparison of the vital forces with the forces of heat, light, electricity, etc., is very interesting. The facts that life is not susceptible of mathematical measurement or of conversion into other forms of energy, as far as we know, are significant. But the kernel of Mr. Slater's paper is, I take it, the third point insisted on by him, viz., that *Biogenesis*—life from what has life already—seems to be the law of nature; and that for *abiogenesis*, or the production of living organisms from inanimate matter, we have not a particle of evidence. The only reason that has been alleged for supposing it to have taken place at some remote epoch in the past, seems to be that otherwise we come upon a breach of the Law of Continuity, which is our guide in the scientific investigation of nature. But why we should suppose the law of continuity to be thus absolutely binding is not easy to see. The formulæ for the conduction of heat, *e.g.*, distinctly show *discontinuity*, and in other branches of science there are not wanting indications of past crises in the history of the earth and the life upon it utterly unlike anything that has happened since. And therefore it does not seem unscientific to postulate a crisis of this kind at the epoch when life was originated. All the evidence, as Mr. Slater and other experts tell us, points to the vital forces being *unique*, not comparable to or interchangeable with other forces of energy. But while this is true, I should not care to build any theological superstructure upon such a basis. An argument from ignorance is at any moment liable to be overturned by the discovery of fresh facts. The origin of thought, rather than the origin of life, is the point at which we come upon an impassable barrier, not merely a barrier that has never yet been crossed.

ORDINARY MEETING.*

DAVID HOWARD, ESQ., D.L., F.C.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following paper, entitled The "Worship and Traditions of the Aborigines of the Islands of the Pacific Ocean," by Rev. M. Eells, D.D., University of the Pacific, Union City, Mason County, Washington Territory, U.S.A., was then read by Rev. J. W. McCleod in the absence of the author.

THE WORSHIP AND TRADITIONS OF THE ABORIGINES OF THE ISLANDS OF THE PACIFIC OCEAN. By Rev. M. EELLS, D.D., Missionary of the American Missionary Association, University, Mason County, Washington Territory, U.S.A.

THIS paper does not pretend to be exhaustive. It is in the same line as one which I wrote for the Victoria Institute a few years ago and which is published in vol. xix of its *Transactions*. Having become interested in the subject, I have, as I have had opportunity, made myself acquainted with the researches of others, especially in regard to the Islands of the Pacific Ocean: as next to the natives of America, the people of these islands are furthest, and most difficult of access from the cradle of the human race in Asia, as given in the Bible; and some of these islands are even more widely separated from Asia, than is even America.

Still the books on the North Pacific coast of the United States, which refer to these Islands are much less abundant than are those which refer to the natives of America; and far less numerous than they are in England, as in regard to most of these islands politically and commercially we have less relation than England has. Hence this paper must only

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* Monday, 18th March, 1895.

be considered as a contribution to the study of the subject, and I trust that it may at least suggest such trains of thought in others as will make it of value.

I shall begin on the same principle as I did in the paper of mine referred to, and that is that fewer changes have taken place in regard to the religion of the natives than with reference to the manners and customs which relate to their food, clothing, ornaments, architecture, implements, or even social, governmental and educational customs, as they are much more willing to change these latter customs on coming in contact with whites, than they are their religious ideas and customs. Hence, if there are any customs, which (as Foster's *Prehistoric Races of America* expresses it) become "infallible guides in tracing national affinities," they are those which relate to religion.

True the outside appearance of their religion is as different from that of civilized people as it well can be; but having stripped it of this outside shell, it is the inside kernel, the foundation principles which I wish to consider.

I shall also follow the same divisions that I did in my former paper; man's belief in regard to the beings of the Spirit World, more powerful than himself; man as a spiritual being; the relations between man and those beings of the other world; and man's future state.

My field is, however, different, very different, and hence the argument becomes much stronger, as some of those islands are situated thousands of miles from each other, Asia or other inhabited lands.

It must be remembered also, that the ancient inhabitants of some of these islands, although comparatively not very distant from parts of Asia, are among the lowest and most degraded people in the world, as the Dyaks of Borneo, celebrated as ferocious cannibals; the Papuas of New Guinea, who are seldom over five feet high, and who have often been treated almost as wild beasts; and some in Australia, who as some say have little to distinguish them from the brute, except their form, their power of speech, and their ideas of a good and evil spirit. (Fisher's *Book of the World*, vol. 2, pp. 682, 684, 686.)

I.—The Beings of the Spirit World.

(*a*) *The Supreme Being.*—A belief in a Supreme Being is very wide spread. The inhabitants of Sumatra believe in a good Deity;* the Dyaks of Borneo generally seem to acknowledge the existence of a Supreme Being, (though subordinate deities are supposed to watch over special departments of this world); while the original inhabitants of Java seem to be not much removed from those of Borneo in belief; and the Macassars of Celebes worship a certain divinity called Karaeng Lovi, who has power over their fortune and health.† The Tenimber Islanders recognize some Supreme existence whom they call Duadilah.‡

The wizards of Australia profess to be in communication both with their ancestral spirits and with the Great Supreme Being, the founder of their race, whose sacred ceremonies of initiation they conduct, and of whose laws they are the depositaries. All the institutions of the tribe were in the first instance established by him, whom they speak of, and reverence as the All-Father of the tribe. This Being is known under many different names in various tribes. These names, being connected with the initiation ceremonies, are often too sacred to be spoken by the people, except during the celebration of the mysteries, from which the uninitiated are excluded. The Woiworung tribe of the Yarra river district called him Bunjil; the Wiradjeri tribe of the Lower Murrumbidgee call him Baiame; and the Murring of the mountains and the coast call him Darramulun. But these names are not for common use. Except during the secret ceremonies of initiation, all these tribes usually speak of him in words which mean in each language "Our Father;" and the Kurnai of Gippsland, know him only by the name *Mun-ganngaura* and speak it, when necessary with reverential awe. Even Australian blacks, when referring to the Supreme Being sometimes do it by gesture, in order to avoid speaking his name.§

True Sir John Lubbock has held that the Australians do not believe in a Supreme Deity, or in the immortality of the soul, that they have no idea of creation, nor use prayers, or religious forms, ceremonies or worship,|| but this cannot now be accepted, for later discoveries by those who have lived long among them state the opposite.

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* Malte Brun's *Geog.*, vol. ii, p. 213.
† *Encyclopædia Britt.*, articles on "Borneo," "Java," and "Celebes."
‡ *Naturalist's Wanderings in Timor Laut.*
§ A. F. Howitt, F.L.S., F.G.S., in *Smithsonian Report*, 1883, p. 823.
|| *Smithsonian Report*, 1869, p. 356.

Dr. J. Fraser, in a paper read before this Society in January, 1888, on the Aborigines of Australia, says that the songs at their dances were given them by Baiamai, the Great Creator, that the sacred wand was also given to them by him, and that the ground on which Bora, their sacred ceremonies, are performed is Baiamai's ground, who sees all and knows all (*Trans.*, vol. xxii, p. 155).

In the *Journal of Tyerman and Bennet* (vol. ii, p. 266) likewise, the author says that near Sydney the natives had a crude tradition of a good spirit, though they disregarded him.

As to New Zealand, authorities differ; the *Encyclopædia Britannica* (art. "New Zealand"), saying that the Maoris had no idea of a Supreme Being, but believed that all things were produced by generation from darkness and nothingness; while Malte Brun (*Geography*, vol. ii, p. 38), says that the inhabitants of that island believe in a Supreme Deity; and Cook in his voyages (vol. i, p. 103) agrees with the latter.

The Fijians give Ndengei as the name of the God most generally known among them, who seems to be an abstract idea of eternal existence, with no emotion or sensation, but that of hunger, although he was the Creator of men.*

The Tongas give Tuifa Bolotoo as the name of their one God, the Supreme Being of the place.†

The inhabitants of the Samoan Islands, too, believe in a good spirit, though they seem to prefer to propitiate the evil spirit, rather than to adore the good one.

Rev. W. Ellis in his *Polynesian Researches* (chap. xiii, p. 249) gives the name of the Supreme Being of the Tahitians as Taaroa, the Tanaroa of the Hawaians, and the Tangaroa of the Western Islands, and he says that he is generally spoken of as the first and principal god, uncreated and existing from the beginning, or from the time he emerged from Po or the world of darkness. The Leeward Islands generally make him eternal. Malte Brun (*Geography*, vol. ii, p. 406) adds that they believe in a sort of Trinity, Tani-te-medooa, the Father; Aro mattow toua ti te meidi, God in the Son; and Taroa mannau te hooa, the Bird or Spirit. He adds that the Marquesans have the same religious ceremonies as the Tahitians.

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* *Fiji and Fijians*, J. Calvert, chap. 7.

† *Coral Islands*, H. S. Cooper, vol. 2, p. 153.

The Sandwich Islanders likewise had an ancient tradition of a superintending power.*

(*b*) *Good Spirits.*—Generally these are the practical deities of the heathen, as they trust in them as a protecting individual or household deity more than in the Supreme Being. This is true of the Dyaks of Borneo; for while they acknowledge a Supreme Being, subordinate deities are supposed to watch over the various departments of this world.†

The original inhabitants of Java had a similar belief, and the number of their patron spirits was innumerable. Their forests, mountains, and caves were peopled by numerous invisible beings of their own creation.‡

The ancient inhabitants of Celebes also worshipped local deities,§ likewise the Tenimber Islanders of Timor Laut have their little gods,|| the Fijians, too, have many inferior gods, but no idols; they have, however, stones in which they believe spirits to dwell at times;¶ and the Tongas believed not only in gods which existed from all eternity, but also in inferior deities.**

In Tahiti every family had its protecting deity which resided in heaven,†† and they had gods of peace, war, the sea, idiots, and the like, ten in number as gods of the first order, while the lower orders were employed as heralds or messengers between the gods and man.‡‡

The New Zealanders agreed with them in this belief of a deity for every family according to Cook and Malte Brun; the people of the Caroline and Friendly Islands believed in a multitude of celestial spirits;§§ those of Micronesia had a belief in gods, but it was overshadowed by the deification of their ancestors,|||| and the Sandwich Islanders had a multiplicity of gods and household deities.¶¶

(*c*) *Evil Spirits.*—As in America so in these islands, the

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* Jarves' *Sandwich Islands*, p. 19.

† *Encyclopædia Britt.*, art., "Borneo."

‡ *Encyclopædia Britt.* art., "Java," and Malte Brun's *Geog.*, vol. ii, p. 322.

§ *Naturalist's Wanderings in Timor Laut.*

|| *Fiji and Fijians*, J. Calvert, chap. 7.

¶ Malte Brun's *Geog.*, vol. ii, p. 342.

** *Coral Islands*, p. 153.

†† Malte Brun, vol. ii, p. 406.

‡‡ Ellis, *Polynesian Researches*, chap. 13.

§§ Malte Brun's *Geog.*, pp. 349, 402.

|||| *Encyclopædia Britt.*, art., "Micronesia."

¶¶ Jarves' *Sandwich Islands*, *p.* 25.

belief in these is not as universal as it is in the Supreme Being, and in other good spirits, still a large number of the people hold to such a belief. In Sumatra the people believed in an evil deity;* and in Borneo the Dyaks had a strong belief in the existence of evil spirits, their medical system having been connected with divination; while the people of Java had a faith similar to that of these Dyaks. In New Guinea the vague notions which the people had of a universal spirit were practically represented by several malevolent powers.†

In New Holland, while the people had crude notions of a good and an evil spirit, they disregarded the former, and paid all their homage of fear (which hath torment) to the latter.‡

According to Sir J. Lubbock, the Australians dimly imagine a being, spiteful, malevolent, but weak, and dangerous only in the dark. Indeed their religion consists of a belief in the existence of ghosts or spirits, or at any rate of evil beings who are not men; a belief which, he says, can hardly be said to influence them in the daytime, but which makes them very unwilling to quit their camp-fire by night, or to sleep near a grave.§ W. B. Wildy adds that the Northern Australians who are very low, wearing almost no clothes, and eating roots, grubs, worms, lizards and snakes, are afraid of an evil spirit, which they call Browl; and that under the trees up which they bury their dead, they will smooth the grass, in order to detect any visitation of Browl, and that before they retire at night, they will take a light, and hunt about, calling "Browl, Browl," as if to bring him from his hiding place.‖

The Fijians likewise believe in demons, and the people of the Samoan Islands seem to prefer to propitiate the evil spirit, rather than to adore the good one.¶

No people in the world seem to have been more superstitious than the South Sea Islanders, or more entirely under the influence of dread from imaginary demons or supernatural beings. They have not only their greater, but their minor demons, and sorcery and witchcraft were extensively practised.** Wherever sorcery and witchcraft are practised

* Malte Brun's, *Geog.*, vol. ii, p. 313.
† *Encyclopædia Britt.*, articles, "Borneo," "Java," and "New Guinea."
‡ *Journal of Tyerman and Bennet*, vol. ii, p. 266.
§ *Smithsonian Report*, 1869, pp. 356, 361.
‖ *Ten Years in the Pacific*, Walpole, vol. ii, p. 365.
¶ *Polynesian Researches*, chap. 19. ** *Ibid.*

(and they are almost as universal as sickness, among the heathen, as they believe that sickness is both caused and cured in this way) there is a belief in demons.

The most fearful deity at the Sandwich Islands was Pele, who dwelt in the great volcano.*

II.—Man as a Spiritual Being.

(*a*) *Immortality.*—This idea, though perhaps not universal is very wide-spread. The Maoris of New Zealand believed that the spirit survives the body, and retires to some place under the earth.† Among the Tongas the nobles were allowed to possess souls, but not the common people; for them there was no future.‡ The Tahitians believed that the soul is immortal, and that according to its degree of virtue and piety would be its honour and happiness in the next world.§ Near their dead they placed food, fruits and flowers daily, and they supposed that their food was spiritual, which they could smell, as well as having a material past.‖

Some of the Fijians, says Mr. Williams, speak of a man as having two spirits; his shadow is called the dark spirit, which they say goes to Hades; the other is his likeness reflected in the water or a looking glass, and is supposed to stay near the place where the man dies.¶ In fact all that is said in the last part of this paper about a future state gives additional evidence of their belief in the immortality of the soul.

(*b*) *Man as a sinner.*—In a paper read before this Institute (already referred to) Dr. John Fraser describes a custom among the Australians called the Bora, which individuals pass through, and after this is done, he comes forth another man, having washed away the badge of darkness and evil, and having assumed the livery of the children of light. They are thus purified and devoted to the service of good, and freed from the power of evil. The novice enters the outer circle painted red, but at its close he washes himself in a pool, and thereby is cleansed, after which he paints himself white.

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* Jarves' *Sandwich Islands*, p. 27.
† *Encyclopædia Britt.*, art., "New Zealand."
‡ *Coral Islands*, vol. ii, p. 153.
§ *Polynesian Researches*, p. 308.
‖ *Smithsonian Report*, 1819, p. 355.
¶ Malte Brun's *Geog.*, vol. ii, p. 406.

When the Tahitians embalmed a person they dug a hole in the ground, where a priest deposited with prayer the dead man's sins, asking that they do not attach to the survivors, and saying to the corpse, "with you let the guilt now remain." Every disease too was supposed to be sent because of crime, or else because of the offering of an enemy.*

Nearly all that will be said about priests, temples, and sacrifices in this paper bears directly on this subject, as most sacrifices were offered in their temples by their priests because of their sins.

III.—The Relation between Man and the Superior Beings of the other World.

(a) *What these spirits have done and are doing for man.*

(1) *Creation.*—Dr. John Fraser in describing the religious ceremonies of initiation among the Australians just referred to, speaks of certain songs in connection therewith, which they say were given them by Baiamai, their great Creator. This statement must be taken as true, notwithstanding the fact that Sir John Lubbock says of the inhabitants of Australia that they have no idea of creation.

Among the inhabitants of the Coral Islands the belief was held that Taaroa was the Creator God.† The people of New Zealand believed in the creation of man, and that woman was formed from the rib of the man.‡ According to the Fijians, Ndengei was the creator of man.§ The tradition among the Tongas has a strong Mosaic element in it, also a Cain and Abel, the blacks being descended from Cain, and the whites from Abel. The Samoan legends agree in the main with those of the Fijians.‖ Moreover the Rev. T. Powell read a paper on the Samoan tradition of Creation and the Deluge before this Institute¶ in which he gives a description, occupying seven pages, of the creation of the world, rocks, man, animals, the heavens, and the inferior gods by

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* *Polynesian Researches*, pp. 301, 306.
† *Coral Islands*, vol. ii, p. 287.
‡ Malte Brun's *Geog.*, vol. ii, p. 381.
§ *Fiji and Fijians*, chap. 7.
‖ *Coral Islands*, vol. ii, p. 153.
¶ *Trans.*, vol. xx, p. 145.

Tagaloa faatutu punun, *i.e.*, Tagaloa the creator, or more literally the people producing Tagaloa.*

According to Rev. W. Ellis, the Taaroa of the Tahitians is spoken of by some as the creator of the heavens and earth, though others speak of the existence of land as anterior to that of the gods.† While there are several traditions of creation, quite different, all agree that Taaroa, or someone created by him, made man and woman. After he had made the world, he made man out of red earth. Then when man was asleep, he took out one of his ivi or bones, and made woman whom he gave to man as his wife. Mr. Ellis, however, placed no reliance on this story (although they say that they had it long before the whites came among them) except ivi, pronounced eve, which is a native word and means bone, widow, and victim slain in war. Taaroa also made the earth, sun, moon, stars, heaven, and hell. Like most ancient nations they ascribe the origin of all things to a state of chaos or darkness, and even the first existence of their deities refers to this source. Their deities of the highest order are said to be born of night. The tradition generally received in the Windward Islands ascribed the origin of the world and all in it to Taaroa, who was born of chaos.‡

At the Sandwich Islands a tradition was prevalent that the first inhabitants were descended from the gods or were created on the islands. Their traditions refer to a period of perpetual night or chaos before the world existed. Nothing that now is, was then created except the gods. Creation was a transfer from darkness to light. Hawaii is said to have come from a large egg produced by an immense bird upon the water, which bursting, formed the island. They also say that man was originally made from the dust of the earth by Kane, and Kanaloa, two of their principal deities.§

(2) *Providence.*—According to Dr. J. Fraser, Baiamai of the Australians sees all and knows all, if not directly yet through Turramulan, a subordinate deity who is a mediator for all operations of Baiamai to man, and from man to Baiamai.

According to the Rev. J. Powell, Tagaloa the creator of the

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* *Trans. Vict. Inst.*, vol. xx, p. 147.
† *Polynesian Researches*, chap. 13.
‡ *Ibid.*, p. 96, 98, 99, 249, and chap. 13.
§ Jarves, *Sandwich Islands*, p. 17–19.

Samoans, produced Tagaloa the visitor of the peoples, Tagaloa the prohibitor of the peoples, and Tagaloa the messenger, who went forth to attend to the duties signified by these names.* Among the Tahitians every disease was supposed to be sent by the gods, because of some crime against their tabu or else because of the offering of an enemy.†

The people of the Sandwich Islands have an ancient tradition of a superintending power above. Maui, a superhuman being or god, is said to have laid his hand upon the sun and arrested its course to give his wife time to finish work, which she was anxious to complete before dark.‡

As among the Indians of America, so among the natives of these islands, all that I have said about the guardian spirits who are worshipped more than the Supreme Deity, and all that I shall say about the Deluge, sacrifices, and prayer, refers to the same great fact that the Supreme Spirits exercise a providential care over mankind.

(3) *The Deluge.*—It is somewhat strange how traditions of this event exist in all parts of the world.

Near Sydney in Australia there was a tradition of a deluge, which overtopped the Blue Mountains, and two men only escaped the devastation in a large ship.§

In the Fiji Islands there was likewise a tradition of a flood, which some say was partial, and others say was universal. It was occasioned by the killing by two boys of a favourite bird belonging to the Supreme Deity, who tried first for three months to conquer them with his army, but was unable to do so, as they were assisted by their friends, whereupon he sent a flood. They cared not for it, as they were fortified on a high mountain, but the flood came to them, when they cried to a god who taught them how to build a canoe or two canoes, or a float, according to different stories, and eight persons were saved. All the highest land was covered. They settled down on Mbengga. The highest point on the island is Nginggj-tangithi Koro, which conveys the idea of a little bird sitting there, and lamenting over a drowned island.||

* *Trans. Vict. Inst.*, vol. xx, p. 150.
† *Polynesian Researches*, p. 301.
‡ Jarves, *Sandwich Islands*, pp. 17, 19.
§ *Journal of Tyerman and Bennet*, vol. ii, p. 266.
|| *Fiji and Fijians*, chap. 7.

Others say that just as all the people were being drowned two large double canoes appeared, in one of which was the god of carpenters, and in the other his head workman, who picked up eight persons, who were landed at the island Mbengga, and in consequence of this, the chiefs of this island always take the precedence among all the other chiefs of the Fiji Islands.*

The Rev. T. Powell writes at some length of this event among the Samoans.†

One tradition among the Tahitians says that a long time ago, God being angry, dragged the earth through the water, and their island was "broken off."‡

Mr. Ellis adds that traditions of the Deluge have been found to exist among the natives of the South Sea Islands from the earliest periods of their history. The principal facts are the same among the inhabitants of the different groups, although they differ in several minor particulars. These state that in ancient times Taaroa, the principal god, and creator of the world, being angry with men on account of disobedience to his will, overturned the world into the sea, when the earth sank into the waters, excepting a few projecting points, which remained above the surface, and now constitute the present cluster of islands.

The memorial preserved by the inhabitants of Eimeo, states that after the inundation of the land, when the water had subsided, a man landed from a canoe near Tiataepua in their island and erected an altar in honour of his god.

Another tradition says that Tahiti was destroyed by the sea, no man, nor hog, nor fowl, nor dog remaining except two persons, the husband and wife. The wife took up her young chicken and dog, and the husband his young pig and kitten, all the animals formerly known to the people, and went to the highest mountain, where they stayed ten nights, when the sea subsided, after which the stones and trees began to fall from the heavens, whereupon they dug a hole in the ground or a kind of cave which protected them.

At Raiatea the people say a fisherman went to a fishing place which was sacred. He lowered his hooks which became entangled in the hair of the god of the waters, who became angry, and threatened a flood. At this the man

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* Smith's *Bible Dictionary*, art., "Deluge."
† *Trans. Vict. Inst.*, vol. xx, p. 153.
‡ *Edinburgh Review*, art., "Deluge."

repented, whereupon he was forgiven, warned of the flood to come, told to take his wife and child and go to a small island east of Raiatea Toamarama. He did so, and some say he also took a friend, a dog, a pig, a pair of fowls, the only domesticated animals known on the island. They were saved and all else were destroyed, after which they returned to the main land. They refer to coral, shells, and the like, near the tops of the highest mountains as proof of it. They give no account of rain, or that the windows of heaven were opened, although they were frequently asked about this.*

At the Sandwich Islands some say that rain fell until all the land was covered except the top of Mauna Kea: some of the people then placed themselves in a vessel, the length, breadth, and height of which were equal. It was filled with men, animals, and food, and at last rested on Mauna Kea.†

(*b*) *What man ought to do to these Superior Spirits.*

(1) *Thanksgiving.*—As a recipient of favours he ought to be grateful. The people of the Friendly Islands had two great festivals, one to ask the protection of Footla-faihu over their newly planted fruits, and the other at the close of harvest, which was a feast of gratitude.

Among the Tahitians the first fish taken were conveyed to the altar. The first fruits of orchards and gardens were also offered. Their rites and worship were in many respects singular, and in none more so than in the ripening of the year, which was regarded as a kind of annual acknowledgment to the gods.‡ The Sandwich Islanders also offered their first fruits to their gods.§

(2) *Prayer.*—Man as a weak being ought to ask assistance of the more powerful beings.—The people of Celebes had devotions, though no temples.‖ As just stated in regard to the Friendly Islands, one of their great festivals was to ask the protection of their deity over their newly planted fruits.

The priests of the Tahitians addressed a prayer to their principal deities. They were sometimes short but often very long containing many repetitions, as if they thought

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* *Polynesian Researches*, chap. 15.

† Hopkins' *Hawaiian Islands*, chap. 5. Jarves' *Sandwich Islands*.

‡ *Polynesian Researches*, pp. 269, 270.

§ Jarves' *Sandwich Islands*, p. 19.

‖ Malte Brun's *Geog.*, vol. ii, p. 342.

that they should be heard for their much speaking. The petitioner did not address the god standing or prostrate, but knelt on one knee, sat cross-legged, or in a crouching position. When embalming a dead body, they dug a hole in the ground, and a priest deposited with prayer the dead man's sins there, asking that they do not attach to the survivor. A prayer was offered up before they ate their food, when they tilled the ground, planted the garden, built their houses, launched their canoes, cast their nets, and commenced or concluded a journey.*

(3) *Sacrifices, Priests, and Temples.*—Man as a sinful being needs to atone for sins.—The people of Sumatra have priests.† The Dyaks of Borneo sacrificed animals, fruits, and sometimes human beings to appease or invoke their gods,‡ and the customs of the people of Java were very similar. The inhabitants of Celebes had sacrifices, but no temples.§ There were temples in the north and west of New Guinea,‖ and the people of New Zealand had priests.¶

Among the Fijians nearly every village had its temples, and votive offerings decorated the interior. There were priestesses, human sacrifices were common, and they offered many peace offerings.** Among the Tahitians priests were numerous and powerful and human sacrifices of slaves were offered.†† They made offerings to their ti-is or spirits, their temples were national, local and domestic, and one is described as a solid pyramidal structure, in front of which images were kept, and the altars fixed. The priests of the national temples were a distinct class, and the office of the priesthood was hereditary in all its departments. In the family the father was priest, in the village or district the family of the priest was sacred, and the office was held by one who was a chief. Their offerings included every kind of valuable property, the fowls of the air, the fishes of the sea, the beasts of the field, and the fruits of the earth,

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* *Polynesian Researches*, pp. 261, 263, 269, 306.
† Malte Brun's *Geog.*, vol. ii, p. 313.
‡ *Encyclopædia Britt.*, art., "Borneo."
§ Malte Brun's *Geog.*, vol. ii, p. 342.
‖ *Encyclopædia Britt.*, art., "New Guinea."
¶ *Cook's Voyages*, vol. p. 103.
** *Fiji and Fijians*, chap. 7.
†† Malte Brun's *Geog.*, vol. ii, p. 406.

together with the choicest manufactures. The sacrifice was frequently called Taraehara, signifying entangling from guilt. But animals, fruits and the like were not the only articles presented to their idols, for the most important part of their sacrifices was the frequent immolation of human victims. These were offered in seasons of war, at great national festivals, during the illness of rulers, and when their temples were erected. They imagined that the efficacy of their prayers would be in exact proportion to the value of the offerings with which they were accompanied. Their seasons of worship were both stated and occasional, and religious rites were connected with almost every event of their lives.*

The people of the Marquesas Islands had the same ceremonies as the Tahitians, but those of the Carolines were said to have neither temples, idols, or religious worship,† and in Micronesia temples are rare.‡

At the Sandwich Islands, temples were very common, were usually built on hills or near the sea in conspicuous places, were made of loose stones, and were works of great labour. One was two hundred and twenty-four by one hundred feet, a sacrificial altar was placed near the entrance of the court; their priests were many, and there was a high priest; priesthood was hereditary and human sacrifices were common.§ Eighty persons are said to have been sacrificed at one time.‖ There is a cord now at the missionary rooms at Chicago, with which one high priest strangled twenty-three victims.¶

(4) *Other Forms of Worship and Customs.*—Dr. J. Fraser in speaking of the initiation of a young man into the religious rites of the Australians, says that it closes with *washing and purification*, and a dance around and through a fire.

W. B. Wildy says that the Larrakeyahs and Moolnahs do not practise *circumcision*, but all the other tribes of Australia practise it, and that the custom is purely traditional.**

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* *Polynesian Researches*, pp. 261–268.
† Malte Brun's *Geog.*, vol. ii, pp. 399–409.
‡ *Encyclopædia Britt.*, art., "Micronesia."
§ Jarves' *Sandwich Islands*, p. 29.
‖ Bird's *Six Months at the Sandwich Islands*, p. 100.
¶ Bartlett's *Sketches*, p. 41.
** *Australasia and the Oceanic Region*, p. 116.

The same rite was formerly performed on Fiji youths.* At the Sandwich Islands it was also common, and was attended with religious ceremonies, and performed by a priest, an uncircumcised person being considered mean and despicable.†

The same people had professional *dancers* in honour of the gods, and had several other customs and traditions which correspond to those of the Hebrews, as a story resembling that of Joseph, another like unto Jonah, and again one similar to that of Joshua commanding the sun to stand still, already referred to.

Every person who touched a dead body was considered *unclean*, until purified by religious ceremonies.‡

At Puhonna and Honaunau were the Hawaiian *cities of refuge*. These two sanctuaries were absolutely inviolable. The gates stood open perpetually, and though the fugitive was liable to be pursued to the threshold, he had no sooner passed it than he was safe from the avenger, be he chief or king. The murderer, manslayer, tabu-breaker fled there and thanked the idol for saving them. After a time they returned to their homes, and none dared injure those to whom the gods had granted protection.§ In time of war the pursuer stopped at the gate, but in time of peace at the flag.‖

They had also a very strong system of tabu, which made days, places, persons, and things sacred, and death was the penalty for violating it, which reminds one of the word *corban* in the Bible.¶

IV.—A Future State.

In Sumatra accounts differ, some saying that the people believed in it, while Marsden says they had no such idea.** The people of New Holland in Australia had faint ideas of a future state, believing that at death they shall either roam through the regions of the air as cockatoos, or return to the

* *Coral Islands*, vol. i, chap. 9.
† Jarves' *Sandwich Islands*, p. 19.
‡ Jarves' *Sandwich Islands*, pp. 19, 40.
§ Bird's *Six Months in the Sandwich Islands*, p. 100.
‖ Cheevers' *Sandwich Islands*, p. 46.
¶ Anderson's *Sandwich Islands*, p. 5.
** Malte Brun's *Geog.*, vol. ii, p. 313.

clouds from whence they came.* The New Zealanders believed that after death the heart would be taken to the clouds according to Malte Brun (vol. ii, p. 381), but the *Encyclopædia Britannica* (art., "New Zealand") says that their idea was that the spirit survived the body, and retired to some place under the earth, and that it occasionally revisits the earth.

The Fijians believed in a future state, but it had no retribution in it. It was a place of rest.† Sir John Lubbock says that these people believed that as they died, so would be their condition after death. Moreover the road to mbulu or heaven was long and difficult; many souls perished by the way, and no diseased or infirm person could possibly overcome all its dangers. Hence as soon as a man felt the approach of old age, he notified his children that it was time for him to die. A family consultation was held, a day appointed, and a grave dug. An instance is given by a Mr. Hunt, who was invited by a young man to his mother's funeral. On going to it he was surprised to see no corpse, and on asking where it was, was shown the woman, who was walking along as gay and lively as any one present. Having arrived at the grave she took an affectionate farewell of her children and friends, and then cheerfully submitted to be strangled.‡

Bolatoo was the heaven of the Tongas, which they thought lay somewhere in the north-west. It was a spiritual paradise. Some of the people, according to their tradition, once drifted there in a cance, but did not at first know it. They found, however, that they could not get anything any more than if it were a shadow; so the gods advised them to return, which they did, but soon died, owing to the air which they had breathed.§

The ancient traditions of the Samoans placed their heavens in the west, the direction from whence they came, and whither, if they behave themselves, they should return.‖

The ideas of the Tahitians were vague and indefinite. They generally spoke of the place to which departed spirits go as Po, or the state of night, the abode of gods, and deified

* Malte Brun's *Geog.*, p. 359.
† *Fiji and Fijians*, chap. 7.
‡ *Smithsonian Report*, 1869, p. 360.
§ *Coral Islands*, vol. ii, p. 153.
‖ *Ten Years in the Pacific*, vol. ii, p. 365.

spirits. On leaving the body, it was by degrees eaten by the gods, and if it underwent this process of being eaten and going through the gods three times, it became imperishable, deified, and might visit the world and inspire others. They had a kind of heaven which they called Miru. It was described as a beautiful place, quite an elysium, where the air was remarkably salubrious, plants and shrubs abundant, highly odoriferous and in perpetual bloom. Still their ideas of the amount of future happiness to be enjoyed did not depend altogether on their moral conduct in this world. Mention is also made of a hell.*

Sir John Lubbock adds that they believed that the spirits existed separately hereafter, some going to a much happier place than others. This, however, did not depend on their conduct in this life, but on their rank, their chiefs going to the happier place, and the rest of the people to the less desirable one.† Malte Brun, however, says that they believed that according to the degree of virtue and piety in this world, would be the honour and happiness of the soul in the next world.‡

In the Sandwich Islands there was a general opinion that a future state existed, and with it, a vague expectation of rewards and punishments. Some supposed that departed spirits went to Po, a place of night, where they were annihilated, or eaten by the god. Others considered the region of Akea and Milu their final resting place. These were former kings of Hawaii, who went below, and founded the kingdom of Hades.§

Conclusion.—I must close this paper with much the same conclusions as I did my former one, only there is more reason for accepting them. The beliefs here found in these islands agree almost entirely with those of the natives of America, Asia, Africa, and Europe: with those of barbarous, savage, semi-civilized, and civilized people; with those of the idolater, Mohammedan, and Christian. Not but that they have many, very many ignorant beliefs and superstitious practices connected with them, but still the great fact remains that when these superstitious ideas are stripped

* *Polynesian Researches*, pp. 303–305.
† *Smithsonian Report*, 1869, p. 360.
‡ Malte Brun's *Geog.*, vol. ii, p. 406.
§ Jarves' *Sandwich Islands*, p. 25.

of this outside kernel, underneath them all these beliefs are found to a greater or less extent, which agree with those of the rest of the world.

That a belief in a deluge exists all over the world, because man wanted to have such belief, often as a punishment for sin; that he believes himself a sinner, prays for forgiveness, offers sacrifices of the most precious kind, even human life, having the highest class of people as priests, and the most valuable buildings for this purpose; and that some believe in a hell, because man wanted to believe himself a sinner, and wanted to be punished in the endless future, all this is not in accordance with reason. The facts both among heathen and civilized people are the other way, and man only accepts this because his conscience tells him it is true, after he has learned it from some one. For if it is innate, why do not all heathen have this belief? if innate it would not have been lost by some peoples as soon as it has been; indeed, it would not have been lost at all.

If it is not innate among the heathen, those of America or the islands of the ocean, there is no more evidence to believe it to be innate among the civilized people of America or Europe, as their ancestors were once as heathenish and savage as many of those whom we have now been considering. Nay, as civilization traces back the history of these ideas to their beginning, it acknowledges that the evidence plainly shows, that they came from those who had a clear perception of the True God. Hence I see no way but to also acknowledge that these same ideas came to the heathen of the Pacific Ocean from the same source. And if they formerly had intercourse with those who received them from God in prehistoric times, it cannot be proven, as far as I can see, that they did not descend from some of those people; it cannot be proven that there were different centres of creation. Hence it is a science based on facts outside of the Bible, though it agrees with that book, that God did make "of one blood all nations to dwell on the face of the earth," and that these ideas are vital or they would not have lived through all the thousands of miles where they have so strangely travelled, and through all the thousands of years during which they have existed.

Discussion.

The Chairman.—I am sure we have to thank not only the author of the paper, but the Rev. J. W. McCleod for rendering it so admirably at such short notice.

The paper is a very interesting one. These wide-spread traditions are of immense value. A good deal of nonsense, I venture to say, is talked about some of these wild tribes, because the assumption is that they have remained in the original condition of the human race, and that all civilization, religion, and morality are to be traced up from that state to the present one. But suppose that there has been a large amount of degeneration, and that that accounts for a good deal of degradation, even in that case this survival of old traditions is of immense value. How constantly we hear that such and such people have no knowledge of God, of spirit, or of future life and so on. Did it ever strike those who make these assertions how much of his real convictions and beliefs you can get out of a peasant in England? Directly a countryman finds you are getting interested in his ideas, he dries up and will, perhaps, refuse to answer you at all. I have rather a taste for getting hold of local traditions and stories about ghosts; but it is the most difficult thing in the world. If there is the faintest suggestion that you are making fun of him, it is fatal, and even if you are taking an unsympathetic interest, it is quite enough to stop the whole flow of information; and therefore, it is natural enough that visitors to these people should not understand them, and never giving them their sympathy, would be utterly unable to find out their religious beliefs. It is only the missionaries who have lived among them and won their confidence who get anything certain.

The Australians, when I was a boy, were said to have no religious beliefs; but Dr. Fraser's papers and others show us that they have ideas on religion which are very interesting to study, and it is curious to find how exceedingly wide-spread amongst all these Australian and Polynesian regions is the universal belief in the elements of religion. Certainly to my mind they are very little a degenerate religion, rather than an original one. They bear traces of degeneracy and not of evolution, to use a modern word, and throughout you find the same traces; but I think we may boldly say that it is most unsafe to state that any tribe, however degraded, has no knowledge of a divine Being. It is a fact that there are a good many survivors of fetish worship. Much has been written on that subject, and missionaries and those who have had to do with people who worship fetiches state that the whole conception of fetich worship, as generally understood, may exist elsewhere, but does not exist as particular fetich worship. The idea of worship of the fetich, without deity behind, is utterly unknown to those who worship the fetich, and I say it is only those who have carefully studied the people and sympathised with them, who get at their ideas. Of course too much communication with civilization may spoil tradition. I believe there is nothing more destructive to tradition than the Education Act, for instance, and in the same way the Christian native is partly ashamed of his traditions and partly inclined to make them out, either better or worse than they were, and it is very valuable to have on record the earliest possible information that can be obtained from those people.

I hope others will give us the benefit of their views.

Rev. T. J. Gaster.—Perhaps I may be allowed to make a few remarks on the Paper.

I think that probably it is well worth thinking how vast a portion of the human race, at the present time, is avowedly atheistic. The whole of the Buddhists are atheists. Atheism is at the very bottom of Buddhism, and Buddhists are believed by some to outnumber all the Christians at the present time.

In writing to the Ephesians, who you remember were not behind the rest of the world in the number of the deities and gods and goddesses they worshipped, St. Paul in his Epistle to them, before they became Christians, says in Chapter II, verse 12, . . . "having no hope and without God in the world" (αθεοι εν τω κουμω), or literally, "Atheists in the world." Having been in India and having talked with many Indians in the North-west Provinces in Bengal and in the Punjaub, I always found on questioning them closely upon their ideas that the personage they chose to call God was not in their mind a person in the least corresponding with the God in the Bible. In every case it is a local deity.

If it be said that you find millions of people in India who speak of the one God with almost as much reverence and fulness as

Moses himself, I reply they are Mohammedans, and they owe what they know of Allah to the Old Testament scriptures. But I contend that there is no evidence in ancient or modern times that any people have believed (unless they have had access to our scriptures) in the one God—in such a God as is revealed to us in the scriptures of the Old and New Testaments. You may find this evidence on the Assyrian tablets. You remember on the Creation tablets the gods are distinctly spoken of there as not being in existence when the Heavens and the Earth were first in existence.

It would take too long for me to bring forward further evidence of this now; but it is a matter which is not properly thought over in England. It is simply a fact that the heathen and those who have never had the revelation which we enjoy, are *αεο ι εν τω κουμω*.

I was so glad to hear that remark made by the Chairman, I think, that it was such a false notion that the human race had begun in a state of degradation, and that we had been working up, better and better, from that time to the present. What the Word of God states is that God put man upon the earth and made him perfect, and that it has been a gradual downward path that they have travelled upon, who have never had the revelation from God to keep them in the right way, and the practical conclusion for us is this—that so long as we have, as I trust I have, absolute and undoubted faith in the Old and New Testament scriptures and in them only, as from God alone, the moment we get away from that, we ourselves begin, in proportion to the distance which we remove from it, to become more and more degraded in our own minds.

Captain Heath.—Perhaps I may say a few words on this matter. I think the discrepancy between Sir John Lubbock's statements and those of the missionaries as to the religious beliefs of the Australian nations may be accounted for by the fact that the tribes that are almost innumerable cover a very small area, and their ideas are different on many points. The natives—and I have been in most parts of the continent—who have seen very little of the white people, I should say had no idea of what we understand as deity at all. They had a great dread of the dark. They had an idea of spirit life, and imagined that all white people, when they came among them first, were the spirits of the dead who jumped up white men. Their religion consists in a dread of the dark and a belief in the spirits of evil. I suppose the writer of the paper, when he speaks of the Papuas, that is a black race in New Guinea, had not the opportunity of hearing Sir Wm. Macgregor's paper read the other day before a public institute, or he would probably have a little better opinion of those natives than that expressed in his paper.

There is one thing about all these natives—if you ask a native about any subject and he gets the slightest idea of the kind of answer you want, he will give you that answer, and unless you put a question to him in an indirect way, so as not to convey to him the slightest idea of what is in your mind, you will not get an independent statement from him at all, and I think many of those statements that are got from the natives are obtained in that way. Though degraded they are very sharp in some ways, and pick up language easily, and the children are sharp and easily educated.

In regard to the deluge I believe people nowadays do not think that the deluge was universal—all over the world at the same time. There may be those who think that; but I think the majority of people do not think it necessary from the Bible statement of the deluge to believe more than that those living in the world at the time must have been swept away, while there were other parts of the world where there were no inhabitants. If you look at the south-east corner of the Pacific you will find an island which is a mountain peak and has I think about 1,500 inhabitants. It is very high land—I do not remember how high now, but it is of considerable elevation. On that island terraces are cut out from the mountain and on those terraces there is a series of statues of kings weighing about eight tons each. One of these was brought home in H.M.S. "Comus" and weighed eight tons. Work of this kind could not have been done on a little island with only 1,500 inhabitants, and they would not have a series of kings. They say they are not gods or idols, but statues of kings, and therefore I have no doubt that this island was part of a continent that existed in that part of the world many years ago. We have exactly the same in the Atlantic, about which Plato handed down the legend of the island, which he said was submerged many years before. To me this island in the south-east corner of the Pacific is evidence that a large tract of land has been submerged there. The various reports of the deluge that have been given do not necessarily belong to the deluge that Noah was saved from. There have been these submergences, no doubt, all over the world, and we cannot lay down exactly to which inundation, or change in the surface of the earth, they refer. We do not know how white people have been brought amongst these people in the Pacific and Australia. In the middle of Australia a white tribe has spread which evidently sprung from a mixture of race.

There is another thing in this paper, to which I might refer, about a legend in connection with Cain and Abel. "The tradition among the Tongas has a strong Biblical element in it, also a Cain and Abel, the blacks being descended from Cain and the whites from Abel." Before seeing white men how could this tradition ever have existed? It has evidently been borrowed from the white people; but at Tonga they could not know anything about white people till they had seen them. Of course the natives of the Society Islands, New Zealand, and the Sandwich Islands are all distinct races by themselves. They may be mixed with races of the north; but they have their own traditions which are very distinct, no doubt. I think the traditions amongst these natives are to be received with much caution, and they cannot all be received as being distinct traditions. I was in Fiji, one of the most savage spots on the face of the earth. The religion of that island I should say was the sacrifice of human beings for the purpose of food. If they wanted food the king always had a professional butcher who went about at night, and if he found a man out of his hut at night he would knock him on the head and bring him in for food. I mean, to talk of religion amongst people of that kind seems very unsatisfactory.

Professor ORCHARD.—I am sure we are much obliged to the author for having shown us the "inside kernel," as he aptly calls it, of the religions of these Pacific island aborigines. The idea of God is, surely, not altogether necessarily synonymous with the idea of the God of the Christians. One man may think of God as a great spirit. The idea of another man about Him may be that He is a Power working for righteousness. The idea of another may be that He is the ultimate absolute reality behind all phenomena. Surely one cannot say that none of those meu had any idea of God. Their God might not indeed be the true God of the Bible. The idea of the future would seem also to be innate.

All human conduct and action is framed on the belief of a future, whether immediate or far distant is not the point, but on the belief of a future, and there is no reason why that belief should be supposed to come to an end at the moment of death. The idea of a creator would appear to be not perhaps innate, but a primal formation of intelligence.

The vote of thanks was then put to the Meeting and carried.

The CHAIRMAN.—I think, if I might venture to say so on behalf of the author, he would very clearly acknowledge that these heathen were *αθεοι εν τω κουμω* in the strict and plain sense of the word; but I think he would say that as well of the Athenians, and therefore the question is whether the idea of God is or is not spreading amongst the heathen which I think is the special point he had in his mind.

The Meeting then terminated.

THE FOLLOWING COMMUNICATIONS ON DR. EELLS' PAPER WERE RECEIVED.

1. From Mr. M. V. PORTMAN, Officer in Charge of the Andamanese.

The Honorary Secretary has been kind enough to send me a copy of Dr. Eells' paper on "The Worship and Traditions of the Aborigines of the Islands of the Pacific Ocean," and to invite me to give my views on the same.

I notice in the first paragraph of the paper the words, "the cradle of the human race in Asia." What scientific facts have we to prove this?

I have lately had an opportunity of seeing Dr. Dubois in Calcutta, and studying his remarks on the *Pithecanthropos erectus.* While not agreeing that this is a man-ape, I do think that his discovery proves the existence of the human race in these inter-tropic parts during the Tertiary period. The particular subject found appears to have a skull of the Neanderthal type, and may have been an idiot or maniac.

My study of the Andamanese, who are the last pure remnant of the Tertiary man, and the nearest allied to the *Pithecanthropos*, leads me to suppose that he was some man, driven from his tribe, who perished alone and uncared for. The case of a corpse being so neglected as to become fossilised in such a manner would only occur where the deceased had died among strangers, or had been driven forth as a dangerous lunatic, which last his skull would lead us to suppose he was.

In ancient kitchen-middens in the Andamans I have found the lowest strata of such an age as to be fossilised (and this in the absence of streams of water, or of any marked silicious deposit), but these fossils have never been imbedded in the late Tertiary strata of which these islands are composed, and I have never seen any fossil skulls, etc. This matter is still, however, under investigation.

At any rate the *Pithecanthropos* gives us another reason to believe in the exceeding age of the human race, and makes it more difficult to dogmatise as to its place of origin.

My own views regarding the Pacific Islands are, that many of them are not part of a submerged continent, but are isolated creations by volcanic action.

I think that the inter-tropic region of Asia and Australia, including much of Polynesia, and extending to Tasmania, was, in the late Tertiary period, inhabited by a Negrito race, the traces of which are now only found in the Tasmanians (lately extinct), the Andamanese, the Semangs, the Aetas, and as Monsieur Dieulafoy has shown, in a hybrid state in a few other places.

The hills of the north prevented this race extending in that direction, and it was gradually exterminated by the Mongoloid and Polynesian races which have succeeded it. The Papuans and Solomon Islanders, among others, appear to me to be hybrid Negrito-Polynesian people, and I find isolated cases of Negrito customs and manufactures in many islands in the neighbourhood of New Guinea.

Other remarks in this paper to which, after a close study of savages on the spot, for many years, I take exception, are as follows:—

1. "It must be remembered also, that the ancient inhabitants of some of these islands, although comparatively not very distant from parts of Asia, are among the lowest and most degraded people in the world, as the Dyaks of Borneo, celebrated as

ferocious cannibals; the Papuas of New Guinea, who are seldom over five feet high, and who have often been treated almost as wild beasts; and some in Australia, who as some say have little to distinguish them from the brute, except their form, their power of speech, and their ideas of a good and evil spirit."

This is far too vague, and the author generalises about races which have little affinity, as if they were all one.

I have often heard the cry of "the lowest and most degraded people in the world." From my observations of the human race I should say this remark applied most particularly to the lower or criminal classes of many European countries, for they have had opportunities of knowing better which they have wilfully neglected, they have many vices of which the savages are ignorant, and have scarcely any of the virtues common to savages.

When will the public learn that absence of dress in a climate, where it is not required; neglect to cultivate in lands where Nature without assistance gives all the food required; and an absence of hypocrisy, do not constitute a savage; and when will they learn that it is a criminal waste of money to supply missions, etc., to the so-called savages who do not require them, when both money and missions are urgently required by real savages who are living round their doors?

Of the Australian blacks I know nothing, and they have always been rather a puzzle to me, as they seem, contrary to other races, to have degraded from a higher state; but why are the Papuans looked down upon, morally and intellectually, merely because, owing to their being "seldom over five feet high," it is possible to do so physically. Also, by whom have these Papuans been treated as wild beasts?

From what I have read of them I gather it is by the sailors of merchant ships trading in the Pacific. Now I have been for two and a half years in a merchant sailing vessel, and if there is an unintellectual and animal brute beast, it is the average European merchant sailor. This is shown by the fact that such lines as the "P. and O." do not employ them.

When we have stopped the infamous "blackbirding" in the Pacific Islands it will be time enough for us to talk of savages being lower than ourselves.

Savages (so-called) have many very excellent qualities, and fewer vices than the (so-called) civilized races; and personally, here in the Andamans, I prefer the society of my Andamanese to that of most of my European colleagues. (But then I may be eccentric.)

The Dyaks, by the way, like other kindred peoples in their neighbourhood, are descended from the Nagas and similar tribes of the North-Eastern frontier of India, and originally came from that direction.

The races mentioned in this paper differ much, and such general comparisons are too vague, at least for myself, who believe in specialists, and the study by one person of one people only.

As regards the religious beliefs, I must refer you to Mr. Man's papers before the Anthropological Institute, the facts in which are fairly correct as applying to one group of tribes in the Andamans, though I do not agree with many of his conclusions. He wrote many years ago when our knowledge of the Andamanese was less than it is now.

Though I am preparing a work on the Andamanese I am not ready to publish yet.

2. "True Sir John Lubbock has held that the Australians do not believe in a Supreme Deity, or in the immortality of the soul, that they have no idea of creation, nor use prayers, or religious forms, ceremonies or worship, but this cannot now be accepted, for later discoveries by those who have lived long among them state the opposite."

I have also lately had occasion in the *Academy* to call attention to Sir J. Lubbock's incorrect and out-of-date "science."

The Andamanese, briefly, believe in a god called Puluga, Bilaku, Ulugé, etc., according to the dialect, but have no worship, temples, prayers, sacrifice, etc. They propitiate both God, and the evil spirits in whom they believe, by refraining from certain actions which they think are forbidden, or displeasing. The spirits of the deceased are feared, also the evil spirits of the forest and the sea, who cause diseases. They resemble in this the New Holland people, and the Northern Australians (W. B. Wildy), as quoted.

As regards "Man as a Spiritual Being," "Immortality," they believe much as is quoted regarding the Maoris.

The Deluge.—They all have peculiar traditions regarding this, which I am investigating. It appears to me that the traditions of the Deluge amongst all races, when stripped of their legends and superstitions, are stories of cataclysms which have actually occurred at different times and in different places. The sudden subsidence of volcanic islands will account for some. Storm waves, such as the one which swept over Eastern Bengal in the cyclone of 1876, and destroyed 215,000 people, will account for others. I was over this spot with Sir Richard Temple three days after the catastrophe, and had it occurred to a savage race, isolated from others, it appeared to me that it would have formed a very good ground for a deluge legend.

Some such cataclysm happened here, and cut the Andamans, which were formed as the estuaries of the great Burmese rivers in the Tertiary period, off from the mainland.

The Andamanese preserve traditions of this. In short, given, as we must give, some hundreds of thousands of years for the existence of the human race, it would be odd if the different races had not got from Nature's teachings alone, Deluge traditions; and the magnitude of the catastrophes, and their importance in altering and resettling races, caused these traditions to outlast others.

I think most people accept "hell" because they have learnt of it from some one in their childhood, and the impressions of childhood, when the human mind is most liable to receive and retain impressions without reasoning on them, warps the mind, or conscience, in after life. Hell, as Europeans know it, is an invention of the priesthood, and our knowledge of aboriginal races corroborates this in similar forms.

I must apologise for the above disjointed remarks, and plead press of work as my excuse for not doing better.

2. From JOHN FRASER, Esq., LL.D., Sydney.

The belief in a Creator, a Creation, and a Deluge, belongs to all nations and all times—from the Indian Vedas and the Babylonian cylinders, down to the most recent utterances of the Australian black men; and Dr. Eells has done us a service in collecting here so many testimonies to the existence of that belief. Whatever some anthropologists may have said to the contrary, I can testify that our Australian blackfellows speak of a Creator and a Deluge. But as the Creator's work is finished, He is now quiescent, and, being entirely benevolent, He is not feared or propitiated by them, although they pronounce His name with reverence. It is the active spirits of evil that are dreaded, and must be kept off and controlled by the arts of the "wise men" (*karajies*) of the tribe.

In the greater part of New South Wales, the Creator is known by the name Baiamai, and in Victoria as Punjil. The spelling of the name is in both cases faulty, and hides the meaning. The one should be Ba-yé-mai and the other, Banjil, both being formed from the same root word *ba*, "to make, to cause." In the New Hebrides and in Melanesia generally *ba*, *ma*, *fa*, is the causative prefix to verbs; the brown Polynesians amplify it into *fa-ka*, *fa'a*. From the Australian root *ba*, the Sydney dialect forms *ba-yé*, "One who makes," and the *mai* (a dialect form is *me*) is merely a formative syllable. Bayé-mai or Bayé-mé is thus literally "the Maker, the Creator." Similarly in the Victorian chief dialect *banjilliko* is a verb meaning "to make, to bring into shape." The *ko*, there is an infinitive suffix, *j-illi* is the formative and the root is *ban*, "to make"—the same as *ba* in our dialect.

The vice-gerent of Bayemai is Dharamulan, who presides at the sacred ceremonies of the tribes and communicates his will. *Dhara* seems to me to be an old-world root word meaning "to protect," and the *mulan* is probably the Australian numeral *bula*, "two," for the native traditions often speak of him as being accompanied by another and a much smaller man. Dharamulan may thus be a dual deity. It may be interesting here to note that the Polynesian great god Tangaloa is also the Creator; that when Creation was over, he rested and is now quiescent; that any intervention in the affairs of men on earth is made by the Sā-Tangaloa, his children; they dwell in the various heavens beneath him, which are like the *lokas* of the Buddhist cosmogony.

I can certify also that our Australians believe in retribution on account of sin, which, of course, in their mind is any violation of their sacred laws. A black youth long ago was asked to break such a law, but replied that he was afraid; for "the Krooben would see it and punish him some day for it." In the next world, according to their belief, those men who have not gone through the Bora ceremonies, and had the two upper front teeth knocked out, will have a very hard time of it.

All these are facts; and I offer them here in support of the argument in this paper by Dr. Eells.

ORDINARY MEETING.

PROFESSOR EDWARD HULL, LL.D., F.R.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following paper was read :—

THE CLIMATE OF EGYPT IN GEOLOGICAL, PREHISTORIC, AND ANCIENT HISTORIC TIMES. By Dr. GRANT BEY.*

(Read May 18th, 1896.)

A. ON THE CLIMATE OF EGYPT IN GEOLOGICAL TIME.

IN treating of the climate of Egypt in Geological Time, very naturally you will expect me to take you back along the thread or scroll of geological history to that period when the nebulous mass† of this globe (thrown off during the formation of the Solar System) took on somewhat of a definite shape and had already laid the foundation of its present crust.

It would seem that the Primitive Waters of ancient mythology and tradition, during the contraction of this shapeless nebulous mass, formed a universal sea of water with a universal sea of steamy vaporous atmosphere above it, which entirely obscured the sun, although it was much larger and nearer then than now. At this epoch, darkness

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* Being the revised substance of MS. notes, read at the Pan-Amer. Med. Cong., Washington, 6 Sept. 1893.

† The fact that some of the principal constituents of this earth are non-existent in the Sun, should not militate against the nebular formation of the Solar System, seeing that *Nebulæ* are not homogeneous but heterogeneous in character, and have even many different *vortices* of varying composition within them.

covered the face of the deep, and the climate must have been very hot and very damp; but there was nothing as yet to make it malarious, for no vegetation could have existed at this period.

As the cooling process went on, the misty steam that filled the atmosphere would, in time, take on more of the nature of clouds suspended in the air, thus permitting the direct rays of the sun to penetrate here and there, so as to light up the Primitive Waters that now enveloped the central mass of this globe.

During the formation of these waters the excessive heat had caused to be dissolved in them many of the primitive elements of our earth, which, as the water cooled, were slowly deposited in crystalline form and made a solid bottom for this primitive and still comparatively hot sea. In the upper stratum of this deposit, Sir J. W. Dawson has discovered the fossil remains of a species of foraminifera showing that the climate had so far changed as to allow of the existence of, at least, a low type of vegetable and animal life.* The origin of such life does not come within the scope of this paper, as we have only to deal with things as we find them, and draw our inferences as to the kind of climate that would allow of their existence, modification, or extinction.

As shrinkage went on owing to the continuance of the cooling process, the rocky bed of the sea would become crumpled up every here and there from the external pressure causing the shell of the earth to fall in. Thus projections of crystalline rocks would appear above the surface of the water and form the first dry land as islands or even continents in this vast sea.

No doubt, at different places on the inner side of the crust of the earth, we should also find, at this early epoch, that pressure from within caused by igneous action forcing up the crystalline shell or even bursting through it, had already produced elevations, geysers, burning mountains and granite formations.

These rocks, now exposed, were being continually washed by a hot shallow sea, while they were acted on at the same time by drenching rains, thus causing their slow disintegration, the débris of which settled at the bottom of the sea and

* The author appears to refer to the *Eozoon Canadense*, the organic ature of which is not universally admitted, and is, in fact, strongly contested by Professor Möbius, Professor Ferd. Roemer, and others.—Ed.

formed the geological stratum known in our day as the Nubian Sandstone.

After a period of geological time the Egyptian part of the crust of the earth was still more upheaved, exposing a larger surface above water, and laying bare a great deal of the Nubian Sandstone that had been deposited at the bottom of the sea.

The climate was still damp and very hot all through the rest of the succeeding formations, and extending to nearly the end of the Second Geological Period. Egypt lost in area instead of gaining; for the more than tropical rains continued to disintegrate the rocks, and washed the greater part of the Nubian Sandstone into a sea, which was becoming more and more animated by organisms that were rising in the scale of existence, and which was depositing layer upon layer at its bottom an illustrated history of its inhabitants and its work.

At this time the eastern part of the island, that represented Egypt, became submerged, and on it, at the bottom of a still warm sea, a cretaceous deposit took place enclosing in its substance the remains of animals of a much higher type of organisation than we have yet met with. Some of these animals were amphibious, so that they could come out of the water and bask in the sun on the sandy shore of the sea. They were all representatives of the fauna of a warm climate.

The Tertiary Period was ushered in by a general though unequal submergence of all that is known as the Egypt of the present day, except the region about Assouan, which continued to appear as a rocky island in the Tertiary Sea, just as it had done in the early Primary and late Secondary Seas.

During the deposit of the lowest stratum called Eocene (Nummulitic) of the Tertiary Geological formation, the geographical position of Egypt was still occupied by a comparatively warm sea, as shown by the fossils that are now found in what must have been its bed.[1] In due time the crust of the earth was pushed up out of the water by volcanic action and became dry land.[2] After a space of geological time, alluvium was formed on the now exposed Eocene stratum—vast forests grew, that must have been well watered in the ordinary way, by the rains of heaven.[3] Naturally there would be a watershed somewhere, and therefore a river. This condition of things must have lasted many thousands of years, when another volcanic disturbance, or natural shrinkage took place, and a portion of this part of the globe became again the sea bottom; the alluvium was all washed away leaving only sand, and fallen decaying trees, water-logged in a silicified sea, which was rendered all the more silicious by the presence in it of geysers. As the sea cooled down, the trees became silicified, and lay like rocks embedded in the sand at the bottom of the sea; while in the immediate vicinity of the geysers themselves, the loose sand became solidified into a heterogeneous mass, containing many of the silicified trees in the lowest part of its structure.[4] Some of the trees are palms, showing that Egypt continued to have a tropical climate similar to that of the Soudan in our time. This new stratum formed what is called the Miocene, and when it in turn was upheaved and became dry land, all its loose sand was gradually blown away, leaving the Eocene towering up at places to the height of 600 feet, as the Mokattam range at Cairo, while the petrified trees were exposed, lying on the surface of the Eocene. Of course, where the sand itself was glued together by silica, it remained as a sandstone hill, such as "Gebel Ahmar" near Cairo, where traces of two geysers may still be seen, with petrified wood embedded in its lower stratum; thus showing, as if it were written on the pages of a book, the exact position in geological history to which these petrified trees belong, and the climatic conditions of that period when these natural forests existed.[5] The areas of marine Miocene however in Egypt are rare, indicating that this region had already assumed in a great measure a continental character.

According to Sir J. Wm. Dawson at the close of the Eocene Period the Gulf of Akabah, which had been, up till then, in communication with the Mediterranean, was closed, but the Gulf of Suez continued to be a Strait; and the Mediterranean, which washed the base of the Mokattam range, extended even to the east of Gebel Attaka on the Red Sea. This remained so through the Miocene Period, so that there was free communication between the Red Sea and Mediterranean and the disconnection could scarcely have taken place till the first continental period of the Pliocene, when the Blue Nile lost itself in a lagoon of the isthmus on the Red Sea side, and contributed considerably to the enlargement of that isthmus.

This was the first separation of the waters of the Red Sea and Mediterranean in geological history.

The climate was then a little warmer than now as may be gathered from the shells and animal remains of the

Pliocene formation—the Pliocene age was probably still more continental than the Miocene Period.

After this came the great Pleistocene submergence (about 20,000 years ago) when the Red Sea and Mediterranean again intermixed freely for a short geological period, while the present valley of the Nile (without any Nile) was a long fiord of the sea stretching as far inland as the rocky barrier at Assouan, and being gradually deepened by the erosive action of the sea.* The raised beaches near Cairo belong to this period.[6] The scattering of boulders from the eastern crystalline mountains over the Libyan Desert seems to imply the action of floating ice in some part of the Pleistocene Period.[7] The softer parts of the Miocene sandstone must also have been wasted away at this time.

This submergence was succeeded not long after by a re-elevation partially restoring the conditions of the first continental period, and finally connecting Asia and Africa by a permanent isthmus.

A divergence is now manifested between the fauna of the Mediterranean and Red Sea; the fauna of the Mediterranean taking the type of the Atlantic, and that of the Red Sea the type of the Indian Ocean,[8] showing a complete change between the climates of these two regions.

The oldest part of the isthmus is the Miocene bed at Shaloof, about 13 miles from Suez, and only 6 to 9 feet above the level of the Red Sea. This bed is covered in part by the old Blue Nile deposit of the Pliocene, or as some geologists contend of the later Pleistocene, both these having been continental periods with an abundant rainfall. The highest parts of the isthmus are at El Gisr to the north, and Serapeum to the south of Lake Timsah. These elevated portions of the isthmus are composed of the Old Nile deposits.

Thus the ancient Blue Nile built up a considerable portion of the isthmus at a time when the climate was warmer than at present; for this limestone stratum extending from El Gisr to Shaloof, and stretching to a considerable distance east and west, contains freshwater shells that are now confined to the Upper Nile, and that have somewhat of a modern character as compared with what we might expect in a Pliocene bed.

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* The author has somewhat inverted the order of things in the above statement. There could not have been a Nile valley before a Nile river! The Pleistocene Period began with a great elevation of the land and sea bed following the Pliocene submergence.—Ed.

In the later Pleistocene it would appear that the Blue Nile debouched into the lagoon of the isthmus, which at that time of continental elevation was much more extensive than now.

It is to this period that we must ascribe the Sahara Sea, and the large inland sea of Geikie, which included the Black Sea, and Caspian, and a large tract of country to the west of the Ural Mountains.[9] As long as these existed the rainfall in Egypt and in Arabia must have been excessive, and this accounts for the manner in which the surfaces of the anorthosite gneiss (diorite) and schist show such an amount of wasting and disintegration. Professor Hull has also found evidences of a chain of ancient freshwater lakes in the Sinaitic peninsula that must date from this period, and that disappeared when these inland seas dried up and the rainfall ceased.

At the close of the Pleistocene elevation, or in other words in the early modern geological epoch, we find the Red Sea shells at the Bitter Lakes quite like the recent shells.[10]

The ridge at Shaloof must have been at this time under water as we may judge by the shells now to be seen in its upper layer. Its elevation, therefore, is quite modern geologically speaking, and the elevating process continues, though slowly as measured by the geological clock.

At a date more immediately preceding the Prehistoric Period[11] the land of Egypt was higher than at present; but owing to the earth's shrinkage the whole country sank considerably, thereby causing two fractures that are evident, one along the Mokattam range from Cairo to Suez, and the other along the present Valley of the Nile whereby a depression of upwards of 150 feet on the Libyan side took place.

Even at the present day, were the Nile to dry up, the sea would again reach this ancient limit near Memphis along the empty bed of the river.

NOTES.

[1] One of these fossils was presented by Dr. Grant Bey to the late Professor Sir Richard Owen, who described it fully in the *Quarterly Journal of the Geological Society* for February, 1875. It proved to be the fossil skull of an Eocene Sirenian mammal, of the same type as the Dugong which still exists in the Red Sea.

[2] There is abundant evidence of volcanic action in various parts of Egypt, at Abu-Zabel near Cairo, at the Cataracts, and along the Red Sea coast plutonic rocks are met with.

[3] These forests contain exogenous and endogenous trees. Several species

of the exogenous ones have been classified, and a species of endogenous tree has also been discovered, which was described by the late Sir Richard Owen in a letter (September 27th, 1875) to Dr. Grant Bey as being "*undoubtedly palm*," but it has not yet been further classified.

[4] The sand was formed ultimately from the crystalline rocks of the interior, and proximately from the waste of the Nubian sandstone, and the sandy upper Eocene beds. The thickness of the Miocene sandstone stratum would be about 100 feet (Dawson).

[5] The igneous rocks at Aboo-Zabel about 11 miles north of Cairo belong to this period of the geysers, or perhaps even a little later (Dawson).

[6] At Het-el-Qorab hill a little to the south of the Great Pyramid, and at an elevation of 40 feet above the plain, there is an old sea beach of the Pleistocene period.

[7] Sir J. William Dawson inclines however to the water rather than the ice agency. In fact there is no trace in the geological history of Egypt of there ever having been the cool summers necessary for the formation and continuance of a glacial period.

[8] At the present day the shell fish of the Red Sea are quite distinct from those of the Mediterranean.

[9] It must have been during the existence of this sea that it was possible for the mammoth to live in Siberia, as such a large inland body of water must have much modified the climate around it.

[10] In Strabo's time (24 B.C.) the Red Sea extended but to the north end of the Bitter Lakes, and that only by means of a canal originally dug by Darius Hystaspis (520 B.C.) from the south end of the Bitter Lake to the Red Sea, about 10 miles in length.

[11] Prehistoric as far as Egypt is concerned.

B. Climate of Egypt in Prehistoric Time.

The Prehistoric Period of Egypt was preceded by the formation of the present Nile and the fluviatile deposits that have made the country rich and inhabitable. This took place only about 8,000 or 9,000 years ago.[1]

The Nile, however, did not find its way to the Mediterranean without encountering formidable obstacles in the shape of crystalline rocks, granite and sandstone dykes, and calcareous beds, which one by one were either swept before it at once, or else the pent-up water formed large lake districts, and overflowed the obstacles as cataracts. Most of these have become gradually rubbed down,[2] and form now only rapids. Some of them, however, were broken through, suddenly causing a regular deluge in the lower country; and several of these floods must have taken place in historic times, for when Solon visited Egypt, about 600 B.C. and asked the Egyptian priests if they had in their history any mention of the universal flood, such as is recorded in Greek history,[3] they replied that they had records of *several* floods, no doubt referring to the sudden giving way of cataract barricades. The first obstacle to yield to the ever conquering water in the Prehistoric Period, was the sandstone dyke at Silsilis, about 50 miles to the north of Assouan. At this time the ancient Ethiopia, commencing at Assouan, was in a great measure under water, as the cataracts at Assouan and Semneh (near Wady Halfa) had not yet been worn down, nor had they given way. The same, no doubt, may be said of many of the other cataracts that simply made the Nile Valley a series of lakes, while at the same time there was a large inland sea where the Sahara is now. These vast sheets of water, under a tropical sun must have made the neighbouring countries quite rainy, and this amply accounts for the abundant evidences we have that the Nile had a larger volume of water then than it has now, and was fed by local rains, and streams that rushed into it like so many Niagaras. (Petrie's *Ten Years Digging in Egypt.*)[4]

Professor Sayce tells us (*Ancient Empires in the East*) that the wadies and cliffs of the Nile valley are waterworn and covered with boulders and pebbles which bear witness to the former existence of mountain torrents and a considerable rainfall; and the discovery of palæolithic implements near the little petrified forests and in other places, makes it clear that the geographical and climatic changes the country has undergone have taken place since it was first inhabited by man.

NOTES.

[1] The depth of the Nile deposit across the Delta in the latitude of Zagazig was ascertained by means of a series of borings in 1883 to be between 30 and 40 feet; and as authorities are agreed that the rate of deposit is between 4½ and 5 inches in a century we thus find that the convulsion of Nature referred to in Part A, must have taken place about the time here stated.

[2] In the whole of the Nile valley, from Edfu northward, the geological formation is calcareous (Eocene) which the Nile has scooped out to the depth of 200 feet.

[3] The flood of Deucalion and Pyrrha.

[4] On the subject of the "Origin of the Nile Valley," see paper by Professor E. Hull in *Trans. Vict. Inst.*, vol. xxiv, p. 307. The period of great rainfall referred to by Dr. Grant Bey is known as the Pluvial period, which occurred at the close of the Pleistocene.—ED.

C. The Climate of Egypt in Ancient Historic Time.

As we advance to the historic period which has been characterised by the deposition of much fluviatile sediment especially in the Delta, and probably by a slight depression of the Mediterranean coast, accompanied by a slight elevation from the latitude of El Gisr, southward,[1] we find that the primitive prehistoric immigrant tribes that had come from a northern region, and had settled as independent colonies all along the valley of the Nile, were, in time subjugated by another and stronger race,[2] coming from the East, or land of Poun-t.[3] It is only now that we find anything like a concentrated government, and the establishment of a monarchy. The first historic dynasty began about 4800 B.C., and Manetho gives the name of the first king as *Mena*, the word itself meaning "the establisher."

The name may have been given to him in recognition of the power and ability he displayed by bringing all these different colonies under the rule of a central government. The exploits of Mena, as recorded by Manetho, throw considerable light on the physical conditions and climate of Egypt at this early date.

The cataract at Silsilis had either broken through, or had become gradually worn away, thus liberating the large body of water which had been impounded above it, and so diminishing the rainfall in the vicinity. Before this water was liberated, a large amount of alluvium was deposited for probably 1,000–1,400 years, and it may be mentioned as an interesting fact, that these large tracts of land then left high and dry, now only await the magic touch of irrigation to become highly productive. The cataract (granitic) at Assouan was still high (100 feet higher than now) and a branch of the river swept round by the still existing ancient quarries and re-entered the main channel a little to the north of Assouan, making Assouan an island. The cataract at Semneh was also intact, making Ethiopia an extensive lake district. Many of the other cataracts however had given way, and were now only rapids. Notwithstanding the emptying of many of these inland lakes and consequent destruction of vegetation, the rainfall must still have been considerable in those regions that are now rainless. Mena with his followers seems to have entered the valley of the Nile by way of Arabia, and the Red Sea. His first seat of government was at This or Abydos, situated between Assiout and Luxor. At that time, even as now, Abydos was on the border of an extensive fertile plain that required no great skill for its irrigation. Mena no doubt visited Silsilis and could see at a glance how much was to be gained even by a partial restoration of the cataract there; but for some reason or other he did not attempt it although he had no mean engineers in those days, who had already built the Temple of the Sphinx, and hewed the Sphinx itself in the native rock at Gizeh (Maspero). No, Mena's exploits were carried out in the northern Egypt of that day. In the region between Heliopolis and the Temple of the Sphinx, he saw a battle going on amongst the watery elements—the sea and the river—striving for the mastery. The river was throwing its mud in the teeth of the sea, and wherever there was a sand island there the mud was thrown up, and rank vegetation with dense forests soon appeared. The sea, little by little, had to retire leaving swampy morasses behind it, where the crocodile and hippopotamus were at home; but making the whole of this region malarious and unhealthy to man. Mena, who was his own minister of health, set himself to remedy this state of matters. He caused a great dyke to be raised, about 30 miles to the south of where Cairo now is, and directed the channel of the river into the centre of the valley, as it was then flowing by the foot of the Libyan range on the west side of the valley.

This he followed up by raising other dykes as he required, so as to get the control of the river, and drain off the marshes. This was evidently the beginning of reclaiming the Delta from being a morass, which would no doubt change the climate considerably and make it much less malarious. On part of this reclaimed land Memphis was built, which continued to be a city of some considerable importance down to mediæval times. While Mena was directing his irrigation schemes he was attacked by a hippopotamus or crocodile and killed, after a reign of sixty-two years. The presence of the hippopotamus or crocodile would indicate a warm climate, but not necessarily much different from what we have now, for Dr. Abd-el-Lateef writing at the beginning of the 13th century of our era has recounted that hippopotami were very common in the Damietta branch of the Nile at that time, and even so late as Mohammed Aly's time (1811-48), a hippopotamus was killed near Mansoura in the Delta.[4]

No doubt the good example set by King Mena was followed by his successors, so that the river was guided in its course, and land was reclaimed whenever possible. By the time of the IInd dynasty (4634 B.C.) Bubastis, near Zagazig, was founded and inhabited. The vast proportion of the present Delta, however, was still a gulf of the sea, with the muddy Nile running into it, and gradually forming the Delta. By the VIth dynasty (3500 B.C.) some of the sand islands, in the gulf had become inhabitable through the pioneers reclaiming the morass around them. On one of these islands Tanis or Zoan was founded, a city which played an important part in the history of Egypt in later dynasties. When we reach the XIIth dynasty, the sixth king of that dynasty (Amenemhat III) took great interest in reclaiming the swamps and in the proper watering of the land already reclaimed. He is celebrated for having conferred great benefits on his country by the construction of dykes and reservoirs for controlling the water supply. He caused a Nilometer to be chiselled on the rocks at Semneh, a few miles south of Wady Halfa, and in connection with it a series of hieroglyphic inscriptions, recording the rise of the Nile during his reign; from which we learn that the waters of the inundation rose on one occasion 27 feet, and at other times on an average 11½ feet above the greatest rise of the Nile at the present day. At that time, therefore, the cataract at Semneh had not yet broken down, and Ethiopia must, therefore, have been a well-watered country. The rock inscriptions also show that the Nile below Semneh rose some 10 feet above the highest Nile of our day, proving that the cataract at Assouan was only being slowly rubbed down; the island of Philae being of course then under water.

It was in connection with the XIIth dynasty (2500 B.C.) that Dr. Flinders Petrie found in Upper Egypt traces of an Ionian colony of workmen that had been employed by one of the Usertesens. This economical measure would seem perfectly excusable, even for such an exclusive people as the Pharaohs, for at this early epoch in Egypt's history the native population must have been sparse. But by the middle of the second century of the Christian era, when Ptolemy the Astronomer lived, the population of Egypt had so increased that it exceeded the population of our day by two millions. This points not only to an admirable climate but also to an intelligent population for those ancient times.

Were it not that the present inhabitants are so deeply sunk in ignorance, and live in the midst of insanitary surroundings that they have produced themselves, and that they need a paternal government to raise them out of, we should have had such a continuous surplus of population that the whole of Africa might, by this time, have been filled with thriving Egyptian colonies and federations. The decrease in population cannot be attributed to the climate which will compare well with the climate of the most favoured parts of the world; nor to the sterility of the race, for it is remarkably prolific, nor to intemperance, for the people are sober and peaceful.

Ignorance and filth, its twin sister, make sad havoc amongst the population, so that all the weak die early, and only the fittest survive, who in turn easily succumb, when, in more advanced years, disease attacks them. It seems altogether inexcusable, that Egypt, blest as she is with such an excellent climate, and with a prolific and sober population, should be crippled in her supply of agricultural labourers, owing to an excessive but remediable death-rate. Public instruction and public health are two very necessary and very important portfolios to hold; but public instruction has to take the first step, as ignorance must be dispelled, in part at least, before health measures can be satisfactorily carried out.

At a very early date there were direct commercial relations between Egypt and India, as well as indirect through Mesopotamia, so that Egypt was often exposed, then, as now, to the importation of Indian and Mesopotamian communicable diseases. Thus, notwithstanding the extraordinary attention given to sanitary science by the ancient Egyptians, we find, from history, that every now and then, plagues among men and beasts devastated the country, showing that, although these diseases were not indigenous to the soil, there is every reason to believe that the personal sanitary condition of the people left much to be desired; and we must not forget that the Egyptian campaigns introduced into Egypt a very large slave population, which to say the least, had not been educated in sanitary science. No doubt there was much squalor and filth in the old days, but surely not so much as now. At any rate we know for certain that the ancient Egyptians revered the Nile as a god, so that it was kept scrupulously free from anything that would pollute it. How different now-a-days when the Nile is looked upon as a common sewer, and is used as such.

The climate of Upper Egypt would still (under the XIIth dynasty) be somewhat rainy, although by this time, the

Sahara inland sea would be very much contracted from what it used to be. The great dam at Silsilis had broken through its barrier in prehistoric time, and apparently not any attempts had been made to restore it, unless perhaps on paper, as has been done in more modern times. Amenemhat III has rendered himself immortal by having created an inland freshwater sea in a natural depression in the Libyan Desert, not far from the Nile and quite near to Memphis. Suffice it to say here that water was conveyed to it from the Nile by means of a canal (the Bahr Yousef of our day), and when the basin was filled, it was said to be 450 miles in circumference, and at parts 350 feet deep. It was called by the Greeks Lake Moeris, but in hieroglyphic language it was called Ta She—the lake country.[5] It continued to act as a reservoir for the Nile surplus water, and to irrigate the country around till the Roman period, when the dykes were neglected, the sluices fell out of repair, and the water thus ran to waste; so that in the time of Pliny, 70 A.D., it was already dry, with the exception of what still remains under the name of Birket-el-Qoroon, or Lake of Horns, so named from the form of the lake being like the shape of a pair of horns. Very naturally this depression in the desert, after having been constantly filled with the muddy Nile water, and partially emptied for irrigation purposes, year after year for a period of nearly 2,400 years, is, now that it is dry, one of the richest provinces of Egypt. Its present name "Faïoum" is simply the Coptic name "Phiom" or "the Sea," carrying us back to the time when, instead of the 231,283 acres of rich arable and cultivated land of to-day, this was a veritable sea. This large body of water must have modified considerably the climatic conditions in its neighbourhood; for we must not forget that where we have freshwater to deal with in a warm climate, we have always an abundance of trees and vegetation that materially and sensibly affect the temperature and rainfall.[6] The Faïoum now is a malarious district, but more especially in the vicinity of Lake Qoroon which is brackish, and the rainfall is almost *nil* throughout the whole of this region.[7]

Amenemhat III died about 2266 B.C., and was succeeded by a number of kings of little account as far as this paper is concerned, till about 2200 B.C., the fourth Pharaoh of the XIIIth dynasty made a record on the Nilometer at Semneh, showing that the cataract there was still holding out; yet under the sixth Pharaoh of this dynasty, monuments were erected on the island of Argo, considerably to the south of Semneh, but below the level of the formerly dammed back waters of the cataract. Sometime therefore between these two reigns—a period of only sixty-six years—the Semneh cataract must have rather suddenly given way, and caused a destructive flood all along the course of the Nile to the sea, and famine would have been the natural result of such a sudden catastrophe.[8]

Ethiopia was now left high and dry, and became more or less a barren waste, even as it is to-day. It is with great labour that the natives now raise the water from the Nile to irrigate their little patches of ground simply to grow sufficient to keep them alive, and I fear that famine is not uncommon among them. Here then another rainless district has been produced, and so it remains. We may now say that the whole stretch of country from Assiout to Berber, which had an abundant rainfall in ancient times, is now almost without rain. No doubt, this would be reversed if the cataracts were restored, a new Lake Moeris created at the border of the ancient one, the Sahara[9] refilled with sea-water, and the Eurasian Sea of Geikie restored, for under these circumstances the rainfall would again be excessive. As far as the restoration of the cataracts and Lake Moeris is concerned, this has been studied by the Egyptian Government for several years past, and the study is still being pushed forward by American,[10] French,[11] and English[12] engineers.

When we go up the Nile as far as Berber, $17\frac{1}{2}°$ N. latitude, we enter the region of tropical rains, that, following the course of the sun, and falling in torrents on the Abyssinian mountains, and in the equatorial regions, create the White and Blue Nile, which uniting at Khartoum form the river that makes Egypt a habitable country. These rains are periodical, and produce the annual rise of the Nile to which we in Egypt are so accustomed, that we often forget that a few feet above, or a few feet below the average annual rise, means famine and disease. The usual difference between *high* and *low* Nile may be stated as $25\frac{1}{2}$ feet at Assouan,*

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* If the river rises at Assouan 29 ft. above the usual low water mark it means peril to the whole of Egypt; but if the rise is only 20 ft. above the minimum, then whole tracts of the valley will never be submerged. A poor flood, however, is more serious than the devastation caused by the most violent excess. (Moncrieff.)

19 feet at Cairo, and only 4 feet at Damietta and Rosetta; but in ancient times with a greater rainfall and a fuller river these figures would have to be considerably higher. We have seen that reclaiming the Delta was a very gradual process, and even at the present time the Government is draining the swamps and lakes to make the land available for cultivation; and reclamation must proceed as long as the Nile continues to bring down such large deposits of alluvium from Abyssinia and Central Africa. Formerly, the Delta swamps formed an inaccessible hiding-place for culprits, refugee kings and their followers; and they were also the home of the plague, pestilence, and other serious forms of disease recorded in history; or at least favoured their propagation when imported. The rainfall in the Delta for 30 miles inland is now as much as 10 to 12 inches annually, influenced in some measure, no doubt, by the large salt marshes and lakes lying across the 160 miles of Mediterranean front: viz., Mareotis, near Alexandria, covering 250,000 acres; Edko 100,000 acres; Burlos 300,000 acres; Aboukir 50,000 acres; Menzaleh 500,000 acres, and Sirbonis near the Palestine frontier, 100,000 acres.

Most of these lakes did not exist in comparatively ancient times, for the districts now covered by them were richly cultivated, and supported a numerous population. Lake Menzaleh was formerly a district celebrated for its fertility, but in 535 A.D., the sea broke in and submerged the eastern portion, and by 540 A.D. the whole of this region was totally under water, so that all the towns on the low levels were destroyed by submergence, and only those that were built on the high grounds escaped; but even they became so malarious and unhealthy that after a time they were abandoned. Besides, the country around that was not submerged became swampy, unhealthy, and ruined for agricultural purposes just as it is to-day, so that the population in this region has ever since remained scanty.

The present Lake Mareotis was originally a small sweet water lake, surrounded by a famous vine-growing district, celebrated in ancient times for its fertility and salubrity; but in 1801 A.D., the sea was intentionally let in for military purposes, and thus the whole district was entirely destroyed and converted into a malarious environment of Alexandria, which otherwise would be a much healthier city than it has been ever since this regrettable event.

About the beginning of the Christian era, Lake Sirbonis was 125 miles in circumference, and more anciently was much larger. It is said to have even engulfed a whole wing of the army of Ochus king of Persia (340 B.C.). It is now an insignificant lake having little or no perceptible effect on the climate in its neighbourhood.

Lake Aboukir has recently been drained and its bed is now being cultivated. This will do away with the malarious swamps in its vicinity, and render this part of the country once more healthy.

I cannot close this paper without saying something about the influence of the condition of the Isthmus of Suez on the climate of Lower Egypt.

In even late geological times we have seen that Africa was an island, so that the Isthmus of Suez is of recent formation. While "the tongue" of the Red Sea still came as far north as El Gisr it increased the rainfall in Lower Egypt and modified the climate in its vicinity. When it dried up, naturally the rainfall depending on it, ceased.

This is proved by the fact that since the refilling of the Bitter Lakes, and opening of the Suez Maritime Canal in 1869, we are having a greater rainfall in Lower Egypt. No doubt this is also influenced by a more extensive irrigation and planting of trees which the Government is wisely encouraging. This however brings me to speak of the climate of Modern Egypt, which I have discussed elsewhere.[13]

NOTES.

[1] All areas of great deposition tend to be areas of subsidence, hence the highland of El Gisr has in modern geological time been the axis on which the isthmus has oscillated; the south side rising, the north side sinking.

[2] These two races had not amalgamated at the beginning of the IVth Dynasty (4034 B.C.) as in the tombs of this period, Professor Dr. Flinders Petrie noticed that the bodies of those he judged were the subservient race, were desiccated in a doubled up form, like the ancient Inca Indians, lying with their heads to the north, and their faces to the east—while those he judged were the ruling race were buried full length. The skeletons of these two primitive divergent human types are now being studied at the museum of the Royal College of Surgeons, London, and before long we may hope to have more light thrown on the subject.

[3] Poun, according to Brugsch, means "East," but, according to others, it means "Red." The name was applied in later times to the southern part of Arabia, and the Somali country, and no doubt, as the ancient Egyptian tradition was that their forefathers came in this way to settle in Egypt, Arabia was always referred to in the hieroglyphic text, as the Ta-Nuter (the Holy Land). For there is no doubt now that Mena and his followers brought with them a purer worship of the Sun than they

found among the primitive dark-skinned colonies, who, besides the Sun, that all revered, had each a distinctive *totem* of their own. At a later period in man's history another race followed in the footsteps of Mena—passed through Arabia and crossed the Red Sea, and after lingering in Egypt for some time ultimately concentrated their government on the northern coast of Syria, and at Carthage. They were called Pounians—Phounians—or as we have it now, Phœnicians.

4 Within my own memory there was a rendezvous of crocodiles at Gebel-Abu-Fayda, about 200 miles to the south of Cairo. I saw a whole family of them in 1867. They have since then been exterminated by travellers. As crocodiles and hippopotami live in the same climate the disappearance of these animals from Lower Egypt has not occurred from any change of climate, but from the presence of hostile man. The same may be said with regard to the lion which used to be hunted by the Pharaohs in the vicinity of the pyramids of Gizeh, and by the Emperor Hadrian near Alexandria. This animal has now retired to the Soudan and equatorial regions (J.A.S.G.).

5 The Greeks, who never acquired any intelligent knowledge of the ancient Egyptian language, would often hear the natives call this lake "meri," which simply means "the lake," and they evidently concluded that it was the name of the Pharaoh who had created it, hence the erroneous appellation—Lake Moeris—has been handed down through Greek historians.

6 The ancient Egyptians were much more fond of *arboriculture* than the modern Egyptians. The sculptures tell us that Rameses III (XXth Dynasty, 1200 B.C.) "planted over the whole land of Egypt, trees and shrubs, to give the inhabitants rest under their cool shade."

7 Lake Qorūn is now about 35 miles long and 7 miles broad, and is on an average 28 feet deep. It rises and falls with the Nile, although it is always many feet below the Mediterranean.

8 A very interesting hieroglyphic inscription, discovered by Mr. Wilbour on one of the rocks near Assouan, records a famine of seven years under an early Pharaoh. Another seven years famine is recorded as having commenced 1064 A.D.

9 M. de Lesseps projected a scheme for letting the Mediterranean into the Sahara depression, by cutting a wide canal to the south of Tunis, commencing in the Gulf of Gabes.

10 Mr. Cope Whitehouse, an American engineer, has for years been very enthusiastic over a new Moeris "nest" or depression (Wady Raïan), he thinks he has discovered in the Faïoum district, which would act admirably as a reservoir for the surplus water at high Nile, and be a source of water supply at low Nile.

11 M. de la Motte, a French physician, has been for years advocating the restoration of the Silsilis cataract.

12 The English engineers of the Egyptian Government have proposed to construct a dam at the first cataract, but, let us hope to the south of the Island of Philae, so as to save that island and other monuments of antiquity from submergence. Should their plan be adopted, may Providence preserve us from a second Noachian flood, in case the "Daraweesh" get possession of the Assouan and Silsilis reservoirs even for a few hours. In Ancient Babylonia the water of the Euphrates was economised by means of a series of "barrages" that were almost harmless even though they should fall into the hands of an enemy.

Since the above was written, a commission of engineers composed of

M. Boulé (French), Sig. Torracelli (Italian), and Sir Benjamin Baker (English) came to Egypt to favour the Egyptian Government with their opinion concerning the different reservoirs that had been proposed to be constructed. They were unanimous against the Wady Ryan. The Italian and English engineers were in favour of the project that would swamp Philae, while the Frenchman was entirely against having any large reservoir whatever, but recommended the Egyptian Government to construct a series of "barrages" up and down the Nile valley (April, 1894). We live in a utilitarian age, and much as we may regret the destruction of the Pyramids for the construction of magnificent mosques and puny hotels, the work of destruction will continue, unless antiquarianism can prove itself to be of more commercial value than utilitarianism in any given case.

[The embankments for reservoirs are now in course of construction at Philae and Assiout, August, 1900.—Ed.]

[13] Paper on "The climate and health resorts of Modern Egypt," read at the Climatological Congress of the World's Fair Congresses, Chicago, 1893.

GEOLOGICAL ARRANGEMENT OF THE CRUST OF THE EARTH.

(To illustrate Dr. Grant Bey's paper on the Climate of Ancient Egypt.)

Rocks.	Systems.	Groups.		Periods.	Order of life shown by fossils.
Range of Volcanic Rocks.	Quaternary.	In progress. Recent.		Cainozoic (recent life).	Man, plants and animals, of existing species, a few genera recently extinct.
	Tertiary.	Pleistocene (most recent). Pliocene (more recent). Miocene (less recent). Eocene (dawn of recent).			Placental mammals, plants and animals of existing orders; a large proportion of extinct genera and species.
Range of Trappean Rocks.	Secondary.	Cretaceous	Chalk. Greensand.	Mesozoic (middle life).	Marsupial mammals, birds, reptiles, fishes, shell-fish, crustacea, zoophytes, palms, coniferæ, ferns, lycopods, sea-weeds.
		Not represented in Egypt as this part of the globe was continental during this long period. Oolitic	Oolite (egg-stone); Lias (layers)		Marsupial mammals, reptiles, fishes, shell-fish, crustacea, zoophytes, palms, cycads, coniferæ, ferns, lycopods, sea-weeds.
		Triassic (three groups).	Saliferous marls, muschelkalk. Upper New Red Sandstone.		
Range of Granitic Rocks.	Primary.	Permian.	Lower New Red Sandstone.	Palæozoic (ancient life).	Reptiles, fishes, shell-fish, crustacea, zoophytes, coniferæ, ferns, lycopods, sea-weeds.
		Carboniferous.	Coal measures.		
		Old Red sandstone.	Red Sandstone, Conglomerate.		Fishes, shell-fish, crustacea, zoophytes, ferns, lycopods, sea-weeds.
		Silurian	Limestones, Slates.		Shell-fish, crustacea, zoophytes, sea-weeds.
		Cambrian.	Sandstone.		
		Laurentian.	Gneiss. Quartzites.	Eozoic (dawn of life).	Crustacea and zoophytes. Traces of foraminiferal organisms (?)

Range of Invertebrata and Amphigens (growing from all sides).

Range of Vertebrata and Acrogens (top growers).

Range of Gymnogens (growing from naked seeds).

Range of Endogens (growing within).

Range of exogens (growing without).

ORDINARY MEETING.*

Professor Edward Hull, LL.D., F.R.S., in the Chair.

The Minutes of the last Meeting were read and confirmed, and the following paper was read:—

REMARKS ON THE PAST, PRESENT, AND FUTURE OF THE AUSTRALIAN FLORA. By the Rev. W. Woolls, Ph.D., F.L.S.

THE primeval history of Australian Botany is necessarily associated with the adventurous navigators, who, animated by the spirit of Vasco di Gama, traversed the Indian Ocean and reached the North-western shores of New Holland whereof Van Diemen's Land—subsequently called Tasmania, was then regarded as an integral portion. Such a mistake may seem strange to the present generation, but it held its ground until the year 1798, when Bass and Flinders discovered that Van Diemen's Land was separated from the mainland by at least a hundred miles of sea. Portuguese and Dutch navigators had already become acquainted with New Holland in their voyages to the East Indies, but as these voyages were undertaken in the interests of commerce and at a period when systematic botany was only in its infancy, they added but little to our knowledge of the Australian Flora. It was not until the days of Dampier, who in 1699 visited the Western Coast of Australia for the second time, that any specimens of Australian plants were collected and taken to Europe. To Dampier belongs the honour of having been

* January 21st, 1895.

the first to communicate any knowledge of such plants to the scientific world. His herbarium is still preserved at Oxford and contains forty specimens, eighteen of which are figured in his *Voyage* (vol. III., ed. 1709), though few of them with the exception of *Colutea Novæ Hollandiæ* (now *Clianthus Dampieri*), can be identified. The distinguished navigator COOK, was the next to render service to the cause of Australian botany, for although the original intention of his first expedition (1770) was to promote geographical and astronomical research, Mr. (afterwards Sir Joseph) BANKS had sufficient influence with the Government of the day to connect the voyage with the pursuit of natural history. For this purpose he determined to share the glory of the expedition and to furnish at his own expense the means of prosecuting his favourite study. He provided, therefore, the apparatus conducive to that object, and engaged Dr. Solander (a Swede by birth and a distinguished pupil of Linnæus) to accompany him, as well as two artists—one to delineate views and figures, and the other to paint subjects of natural history—with a secretary and four servants. "No pains," says Baron Cuvier, "were spared by the naturalist to enrich his collection or to gratify his curiosity. BANKS displayed an astonishing activity; fatigue did not depress him, nor did danger deter him. He was always in advance, and invariably referred to in time of difficulty." BANKS and SOLANDER collected specimens at Botany Bay, Endeavour River, and other parts of the Australian coast, and added 1,000 species to the few already known. On this subject, Sir Joseph's biographer remarks, "It was long hoped that BANKS and SOLANDER would give an account of their labours and of the immense collections made during the expedition. SOLANDER, having devoted ten years to his part of the undertaking, died in 1782." In addition to their common journal, their notes and all the designs made under their direction still exist in the Banksian Library, now in the British Museum. A series of engravings, which it was intended to increase to 2,000, had been commenced; but from some cause or other not very well explained, nothing was published under the auspices of the authors. Their labours, however, were not lost to the scientific world (botanists being permitted to consult the specimens which had been collected), and in the course of a few years they received due recognition from the greatest botanist of the age, ROBERT BROWN. Menzies, in Vancouver's expedition of 1791, and Labillardière in that of D'Entrecasteaux in 1792, also contributed materially to the knowledge of the Australian Flora, as did Mr. JOHN WHITE, Surgeon-General, who arrived in the colony of New South Wales in 1788 with the "First Fleet," and resided there for seven years. He sent to Europe specimens which were described by Sir John Smith, and figured in the appendix to White's *Voyage to New South Wales*. It was in the beginning of the present century, however, that the expedition of FLINDERS (1801–1803) gave additional and permanent interest to the study of Australian botany, and introduced to European notice some of its most remarkable features. ROBERT BROWN, sometimes designated "The Prince of Botanists," and sometimes "The Father of Australian Botany," accompanied FLINDERS as naturalist and rendered imperishable service to the cause of science by his observations. He had been induced by BANKS to give up his commission as ensign and surgeon for the pursuit of botany, and the foresight of Sir J. Banks was fully realised in the singular ability of his illustrious *protégé*. After having visited the southern coasts of the continent, and examined the flora from Port Jackson to the Blue Mountains, he returned to Europe *spoliis Orientis onustus*, bringing with him some 4,000 species of plants, either wholly new to science or only imperfectly known, but destined to employ him for several years in determining their relative position in the system of classification which experience had taught him to adopt. In his celebrated *Prodromus Novæ Hollandiæ* (1810), he may be said to have laid the foundation of Australian botany on a sure basis, and to have initiated that mode of arranging orders and genera which, with some modification, all subsequent botanists have been content to follow. This great work was composed in the midst of Banks's collections, and so highly did Sir J. Banks value his services, that by his will (1820) he bequeathed to him an annuity of £200, together with the use and enjoyment during his life of his library, herbarium, manuscripts, drawings, &c. He also bequeathed to F. BAUER (the eminent artist and companion of Brown who had been in Banks's employment for thirty years) an annuity of £300 on condition of his continuing to delineate the flowers at Kew. Bauer's illustrations of Australian flowers have always been valued for their elegance and accuracy, and being made under the direction of Brown exhibited the organic peculiarities on which the great botanist based his system. Few men indeed have gained a more honourable reputation in the paths of science than ROBERT BROWN, and his name will ever be associated with the Flora of Australia in the appropriate terms by which he designated many of its genera. Contemporaneously with this distinguished man, GEORGE CALEY was sent out to New South Wales by Sir Joseph Banks, and resided in the colony from 1800 to 1810. During that period he collected 400 species of plants, and advanced farther into the interior than any previous explorer, having penetrated as far as Caley's Repulse (near the present Numantia) some years before the Blue Mountains were crossed by WENTWORTH, BLAXLAND, and LAWSON. His correspondence with Banks is preserved in the *Brabourne Papers*. It is recorded of him that "his primary duties in New South Wales were the collecting of plants for his patron and seeds for the garden at Kew; but so greatly did he extend his field of action that the most splendid portion of the Museum of the Linnean Society consists of quadrupeds, birds, and reptiles, collected by his indefatigable energy." Brown named the genus *Caleya* after him "as a skilled and accurate botanist."

The surveys of Admiral KING in the intertropical and western coasts of Australia between 1818 and 1822 did much to promote the advancement of botanical knowledge. Moreover, and at the especial request of Sir Joseph Banks, ALLAN CUNNINGHAM accompanied the expeditions and made valuable collections of plants, especially on the North-west shores of Australia. His remarks on these plants appended to King's voyages reveal a multitude of new forms hitherto unknown to science. The interior of the colony having been opened up by the passage over the Blue Mountains in 1813, Cunningham was able to penetrate farther into the interior than any of his predecessors, and whilst OXLEY was tracing the Lachlan and Macquarie Rivers, he traversed 1,200 miles and collected 450 species of plants. But Cunningham was more than an accomplished botanist, and as an enterprising explorer must ever rank amongst those who have exerted themselves to extend the geographical knowledge of the continent. His discoveries in the northern parts of the colony, now part of Queensland, tended to facilitate communication with what was then called "the back country" and to prepare the way for profitable settlement. He was not, however, fortunate in his relations with the Colonial Government of the day, Governor MACQUARIE having failed to render him that assistance which was necessary for the furtherance of his pursuits and the development of Australia's resources. Nor was he more fortunate in the valuable specimens forwarded to England, many of which were not utilised until the publication of the *Flora Australiensis.* Mr. BENTHAM in alluding to the matter remarks, "the rich herbarium collected at the public expense by the late A. Cunningham in his various expeditions were stowed away, many of them for a quarter to half a century, unarranged in their original parcels, without any thought of providing the staff and funds necessary to render them of use to scientific botanists." When at length these collections were examined, they were found to be of the greatest importance in the preparation of the *Flora*, and Mr. Bentham acknowledged that, in their variety and extent, they were second only to those of Robert Brown. Cunningham's health had been impaired by his zeal in collecting, especially in tropical climates where the thermometer ranged from 105° to 115° in the shade, and although by visiting New Zealand and parts of the Australian continent in search of new plants he seemed for awhile to regain somewhat of his former energy, his health gradually declined, and when I saw him about a year before his death he appeared to have become prematurely old. He died in Sydney in 1839 at the age of 48, nearly twenty years before his great predecessor R. Brown who had attained the advanced age of 86. With the death of Cunningham, the first period of botanical discovery in Australia may be said to have closed, and for many years, notwithstanding the voyages of navigators and the expeditions of explorers, little was done to place on any connected record the valuable information which they had acquired respecting Australian plants, or to arrange them in any systematic form. Such plants were described in appendices to voyages and travels not accessible to the general public, or noticed only in papers read before learned societies, so that the greatest uncertainty prevailed as to the number and distribution of species. Thus Brown's great work of 1810 (with his subsequent additions) remained the only reliable standard of Australian botany.

The arrival of FERDINAND VON MUELLER in Australia formed a new era in the history of its flora, and the present advancement of systematic botany in the Australian colonies must be attributed principally to his exertions and to those of the numerous amateurs and collectors whom he inspired by his writings and labours. Dr. von Mueller, now Baron F. VON MUELLER, commenced his career on Australian territory in 1852, and first in South Australia, and subsequently in Victoria traversed not only all the settled districts of those colonies, but also instituted many geographic explorations in the Australian Alps, which at that time were but little known. He likewise accompanied A. C. GREGORY during his expedition in tropical Australia, and at a later period visited Western Australia and reported on its Forest Vegetation. My eminent friend, whose career I have watched for many years, may therefore, like Cunningham, be regarded as an explorer, though from the time of his landing in Australia his main work has been the elaboration of its flora. With this view he not only made large collections of specimens personally, but by means of agents, either paid or unpaid, in the various Australian colonies, he amassed an herbarium unequalled in any part of the world for the number and variety of its species. Having such material at his disposal, he conceived the plan of publishing in a connected form a description of all known Australian plants. Such a work was certainly much needed. No such work had been attempted since the days of Brown, and although according to his computation, the number of Australian plants was supposed to be about 7,000, many of them were but little known, or only partially described in the works of various authors. Whilst the Baron was contemplating the preparation of such a publication, Mr. BENTHAM, the great botanist of the age, had also conceived a similar idea, and was actually corresponding with the late W. S. MACLEAY, F.R.S., on the subject. When the difficulties of publishing the Flora in the colony were duly weighed—especially those arising from want of access to typical specimens, the notes and drawings of early botanists, and the opinions of European scientists—it was agreed, principally through the efforts of Mr. Macleay, that the work should be published in England, and that Baron von Mueller should assist in the preparation of the same. This great undertaking was commenced in 1863, and the seventh volume was finished in 1878, so that the *Flora Australiensis* contains a full description of all Australian plants which were known to the authors at the time of publication. Since the completion of the *Flora Australiensis* new species have been described by the Baron in his *Fragmenta Phytographiæ Australis* (of which eleven volumes have been published), and in other works printed in Victoria. The Baron in his *Census*, 1889, Part I., Vasculares, has also prepared a list of Australian plants comprising the most recent discoveries; 7,814 species being admitted from the Flora, and 1,025 being added by the author. Irrespective of introduced plants which now amount to nearly 200, the number of species is probably 9,000, and these according to the Baron's Census, to which I am so much indebted, are distributed in the following manner:—

Western Australia	3560	Victoria	1894
Southern Australia....	1892	New South Wales	3251
Tasmania	1029	Queensland	3758
Northern Australia....	1956		

These numbers include the species common to the different colonies, whilst of Australian plants common to other regions, the following species are recorded:—

In Europe	160	In America	315
Asia	1032	Polynesia....	558
Africa	515	New Zealand	291

The distribution of the species as enumerated by the Baron is highly suggestive. In Western Australia where purely Australian plants appear in their greatest profusion, the numbers are proportionately great, and they represent not only species but whole genera which are not represented in other parts of Australia. It is difficult to explain the cause of this phenomenon on the ground of soil or climate, but it is probably due to changes which occurred at some remote period when Australia instead of being one vast continent consisted of several islands, or at all events, portions of it were separated by water. As regards the flora of Australia in general, Mr. Bentham was of opinion that the great mass of purely Australian species must have originated, or been differentiated, in Australia and never spread far out of it, and that whilst the plants of Queensland and Northern Australia have an Asiatic character those of Victoria and Tasmania, especially in the Alpine regions, were connected through New Zealand with those of the Southern end of South America.

The order Tremandreæ, of which only seventeen species are known (Mueller), and most of these Western plants are exclusively Australian. Goodenovieæ, with 220 species (Mueller), is represented out of Australia by a solitary genus (Scævola), and though allied in some respects to other orders, it is characterised by its singular indusium. The Epacrideæ (Mueller), of which 275 species are described, is almost entirely Australian, and takes the place of Heathworts, from which it is distinguished principally by the shape and openings of the anthers. In the order Dilleniaceæ, only two species of Hibbertia are known out of Australia, whilst Pachynema is limited to the N. and W. of the continent. The curious order Stylideæ is, with one exception, entirely Australian and represented by 97 species (Mueller), the structure of the inflorescence being more analogous to that of orchids than anything else in the vegetable kingdom. The Proteaceæ are a large order in Australia (597 sp. Mueller) most of the genera not extending beyond it; and the peculiar character of the species, differing as they do widely from each other in appearance, soon attracted the notice of the early settlers, and under the inappropriate names of "Native Tulip," "Wooden Pear," "Honeysuckle," "Beefwood," "Silky Oak," &c., became known to the colonists for the singularity of their flowers and fruit, or for some property which distinguished the wood. The extent and distribution of the order were but partially known before the publication of the *Flora,* for many of the Northern genera were not described in the days of Brown and Cunningham, nor was it supposed that the species generally were of any great utility.

In the extensive order of Leguminosæ, comprising some 1,100 species (Mueller), the genus Acacia, of which nearly 300 passed in review before Mr. Bentham, has recently received good illustration in the figures published by Baron von Mueller. The genus, though well marked is a difficult one to arrange in sections, and therefore the labours of the Baron in this direction will be appreciated by botanists as affording characters for classification.

Of the Myrtaceæ, no genus has given more trouble to botanists than that of Eucalyptus, and it may truly be said that previous to the publication of the *Flora,* the system of classification was not only unsatisfactory, but that even the names of the commonest species were uncertain. The labours of Bentham and Mueller have done much to correct the errors of former botanists, and to suggest methods for the better grouping of species; but to the latter belongs exclusively the merit of furnishing illustrations and descriptions of the most remarkable species, and of making known the uses of their wood, resin, bark, volatile oil, &c. In the early part of the century only twelve species were recorded by botanists, but now probably 150 have been found in different parts of Australia, and of these 100 may be recognized in the figures of the Baron's *Eucalyptographia.*

Of Myoporinæ the same author records seventy-six species, chiefly Australian, and two genera exclusively so (*Pholidia* and *Eremophila*). Here again the Baron has contributed to a correct knowledge of Australian botany by his elegant figures, seventy-four in number, including several species of *Eremophila* which are worthy of a place in any conservatory.

Though not principally Australian, the species of Salsolaceæ are highly important as furnishing forage plants to sheep and cattle in dry seasons. Many of these the Baron has also figured with a view of aiding pastoralists and graziers in the identification of species, and of ascertaining how far the prevalence of certain plants of the order may enhance the value of runs. In the early days of the colony Bauer's drawings were very useful in making known some of the beauties of the Flora, but these have been far surpassed in number and extent by the figures published by the Baron, including not only Eucalypts, Acacias, Myoporinous and Salsolaceous plants, but also many species of the Flora generally which have economic or useful properties. The extension of botanical knowledge has led to the discovery of many plants remarkable not merely for ornamental purposes, but for commercial and medicinal value.

The various kinds of Australian timber are now much better known in Europe than before the publication of the Flora, for they can be identified by their scientific names. Formerly some of the best woods were transmitted to England with nothing attached to them but popular names, which, though understood in the districts from which they were sent, were unintelligible to European purchasers.

The two great orders Leguminosæ and Myrtaceæ furnish specimens of wood not to be surpassed in strength and durability. *Castanospermum australe* (A. Cunn.) is remarkable for the large quantity of dark-coloured heartwood that it produces, and *Barklya Lyringifolia* (Mueller) for its very tough grain; whilst the genus *Acacia* affords numerous species which can be utilised for the beauty and hardness of their wood, the tanning properties of their bark and the copiousness of their gums.

Amongst the Myrtaceæ the vast genus *Eucalyptus* is distinguished for the various kinds of wood which can be applied to practical purposes, such as house-building, fencing, railway sleepers, naves, felloes and spokes of wheels, staves of casks, piles, handles, cabinet work, &c. Some of the species yield valuable bark and resin, while others are becoming favourite trees for plantations in different parts of the world on account of their absorbing properties and the influence which they exercise on the atmosphere. In the same order also certain species of *Melaleuca, Angophora, Tristania, Syncarpia* and *Eugenia* are valued for their woods; but none are more highly esteemed than those of the Meliaceæ or Cedar family, of which the Red Cedar (*Cedrela Australis*, Mueller) is most admired and the most generally used by cabinet-makers. *Dysoxylon* and *Flindersia* of the same family are utilised for similar purposes. *Ceratopetalum apetalum* (Don) of the Saxifrageæ, *Trochocarpa laurina* (Brown), and *Monotoca elliptica* (Brown) of the Epacrideæ, and many other species allied to them are employed by artisans. On the whole, now that the woods of Australia are becoming better known, it is found that the unfavourable reports furnished by the early colonists were formed from a very limited knowledge of the Australian forests. The progress which has been made in this respect is very evident from a comparison of the woods collected by the late Sir WILLIAM MACARTHUR for the Universal Exhibition of 1867, with the lists recently furnished (1888) by Mr. F. M. Bailey, F.L.S. In the former, the Eucalypts and many others appear chiefly with popular names, whilst in the latter they are arranged according to their respective orders, genera, and species as given in the Flora or in the Census of Baron von Mueller.

Many species of Eucalyptus contain medicinal properties. Gum kino has long been known to the scientific world, and volatile oil distilled from gum leaves was used by the early colonists. The aboriginal inhabitants were aware of the therapeutic virtues of Eucalypt leaves and the efficacy of the liquid kino exuding from Angophora, but it remained for more recent times to discover the wonderful properties of *E. globulus* (Labill.), and to secure for *Folia Eucalypti, Oleum Eucalypti*, and *Eucalyptol*, a place in the Pharmacopœia. Many species of Acacia have astringent properties, and a decoction of their bark is used in cases of diarrhœa and dysentery, and also to make embrocations for the cure of cutaneous disorders. *Alstonia constricta* (Mueller) is used as a febrifuge by persons in the interior, and the so called "Sassafras Tree," *Atherosperma moschatum* (Labill.), and *Doryphora Sassafras* (Endl.) are employed medicinally as a tonic. The bark of *Cedrela australis* (Mueller) has been regarded as a substitute for Cinchona, and *Chionanthus picrophloia* (Mueller) is used in fevers. *Duboisine sulphas*, said to be procured from the leaves of *D. myoporoides* (Brown), has been introduced into the Pharmacopæia as a remedy for ophthalmia. The intoxicating properties of this species were known to the blacks, but Dr. BANCROFT, an eminent physician of Brisbane, was the first to set forth in an elaborate paper, read before the Philosophical Society in 1872, the remarkable properties of *D. Hopwoodii* (Mueller), or "Pituri" of the blacks, which is much more powerful in its effects on the human system. *Erythræa australis* (Brown), and *Sebœa ovata* (Brown), have some of the properties of gentian, and *Mentha satureoides* (Brown) is considered as tonic. *Euphorbia pilulifera* (Linn.) has been found useful in certain stages of asthma, and *Myriogyne minuta* (Less) as a popular remedy for ophthalmia. *Petalostigma quadriloculare* (Mueller) has a bitter principle resembling that of quinine, and *Melaleuca genistifolia* (Sm.) yields an oil similar to cajeput. In the early days of the colony the leaves of *Leptospermum* were used as an anti-scorbutic, and those of *Smilax glycyphylla* (Sm.), the Sarsaparilla of the colonists, as "sweet tea." It is to be regretted that much of the knowledge possessed by the blacks respecting the medicinal and other properties of indigenous plants has perished with them in the colony of New South Wales, but Mr. E. Palmer, M.P. of Queensland, has collected some interesting information on this subject from the blacks of Northern Queensland (see his Paper read before the Royal Society of New South Wales, August, 1883). Baron von Mueller, amidst his multifarious engagements, has devoted some attention to the same subject (see Documents relating to the Intercolonial Exhibition, 1867), and Dr. Bancroft has done much in reference to *Duboisia Hopwoodii* (Mueller), and *Xanthoxylum veneficum* (Bailey).

The singularity and beauty of Australian plants soon attracted the notice of the early voyagers and settlers, and the seeds of many species found their way to European conservatories. Dampier's specimens were forgotten for a while, but Bauer's drawings (made under the auspices of Sir Joseph Banks) and those in the appendix to White's *Voyage to New South Wales*, encouraged a taste for Australian species, whilst the seeds and plants collected by Banks and Solander during Cook's voyage, were soon cultivated at Kew and elsewhere in Europe. In looking over a list of Australian plants as known in the last century, that is, twelve years after the foundation of the colony of New South Wales, it will be seen that the knowledge of the Flora was very limited. Taking the four orders Leguminosæ, Myrtaceæ, Proteaceæ, and Epacrideæ as illustrative of the fact, it will be found that of the first 39, of the second 44, of the third 30, and of the fourth 8 species only were then known in Europe. Many of these were collected and forwarded under circumstances of difficulty, for owing to the want of provisions in the early days of the colony, the dangers arising from penetrating into an unknown country, and the deficiency of proper material for drying and preserving specimens, little idea can be formed of the labours encountered by the earliest naturalists in Australia. Moreover, the voyage to Europe in those days occupied many months, numbers of plants perishing in transmission, while seeds damaged by salt water or long keeping were of course useless for the purposes of cultivation.

It may be interesting, as showing the limited knowledge of Australian plants at the period indicated, to refer particularly to the species described in the work of WILLDENOW published between the years 1797 and 1810. Willdenow was the great systematic botanist of his day, the follower of the renowned Linnæus, and the editor of his *Species Plantarum.* His work, therefore, is one of authority, and it may safely be quoted as showing how small an amount of knowledge in reference to Australian plants was possessed by continental botanists before the publication of Brown's *Prodromus.* The species are arranged, as follows, according to the Linnean system.

Pimelea linifolia (Sm.)
Protea pulchella (Schrad.)
Banksia serrata (Linn.)
„ *grandis* (Willd.)
„ *integrifolia* (Linn.)
„ *pyriformis* (Gaertn.)
„ *dentata* (Linn.)
„ *spinulosa* (Sm.)
„ *ericifolia* (Linn.)
„ *gibbosa* (Sm.)
Embothrium speciosissimum (Sm.)
„ *buxifolium* (Sm.)
„ *sericeum* (Sm.)
„ *silaifolium* (Sm.)

Opercularia umbellata (Gaertn.)
Sprengelia incarnata (Sm.)
Epacris grandiflora (Willd.)
Styphelia tubiflora (Sm.)
„ *ericoides* (Sm.)
„ *strigosa* (Sm.)
„ *scoparia* (Sm.)
„ *daphnoides* (Sm.)
„ *lanceolata* (Sm.)
„ *elliptica* (Sm.)
Goodenia ovata (Sm.)
„ *albida* (Sm.)
„ *lævigata* (Curt.)
„ *bellidifolia* (Sm.)

Goodenia paniculata (Sm.)
„ *stricta* (Sm.)
„ *ramosissima* (Sm.)
„ *heterophylla* (Sm.)
„ *hederacea* (Sm.)
Billardiera scandens (Sm.)
Drosera peltata (Sm.)
Tetratheca juncea (Sm.)
Correa alba (Andr.)
Dodonæa triquetra (Wendl.)
Bæckia densifolia (Sm.)
Pultenæa stipularis (Sm.)
„ *paleacea* (Willd.)
„ *linophylla* (Schrad.)
„ *juncea* (Willd.)
„ *villosa* (Willd.)
„ *daphnoides* (Wendl.)
Ceratopetalum gummiferum (Sm.)
Leptospermum Thea (Wendl.)
„ *flavescens* (Sm.)
„ *attenuatum* (Sm.)
„ *lanigerum* (Sm.)
„ *pubescens* (Ait.)
„ *parvifolium* (Sm.)
„ *arachnoideum* (Sm.)
„ *juniperinum* (Sm.)
„ *baccatum* (Sm.)
„ *ambiguum* (Sm.)
Fabricia myrtifolia (Gaert.)
„ *lævigata* (Gaert.)
Metrosideros hispida (Sm.)
„ *floribunda* (Sm.)
„ *costata* (Sm.)
„ *globulifera* (Sm.)
„ *linearis* (Sm.)
„ *lanceolata* (Sm.)
„ *saligna* (Sm.)
„ *viminalis* (Sm.)
„ *capitata* (Sm.)
Eugenia elliptica (Sm.)
Myrtus tenuifolia (Sm.)
„ *trinervia* (Sm.)
Eucalyptus robusta (Sm.)
„ *pilularis* (Sm.)
„ *tereticornis* (Sm.)
„ *resinifera* (Sm.)
„ *capitellata* (Sm.)
„ *saligna* (Sm.)
„ *botryoides* (Sm.)
„ *hæmastoma* (Sm.)
„ *piperita* (Sm.)
„ *obliqua* (l'Her.)
„ *corymbosa* (Sm.)
„ *paniculata* (Sm.)
Mesembryanthemum æquilaterale (Haw.)
Dillenia scandens (Willd.)
Pelargonium australe (Willd.)
Platylobium formosum (Sm.)
„ *parviflorum* (Sm.
Bossiæa heterophylla (Vent.)
Glycina clandestina (Wendl.)
„ *rubicunda* (Curt.)
„ *coccinea* (Curt.)
Indigofera australis (Willd.)
Melaleuca viridiflora (Gaertn.)
„ *laurina* (Sm.)
„ *squarrosa* (Sm.)
„ *styphelioides* (Sm.)
„ *ericifolia* (Sm.)
„ *nodosa* (Sm.)
„ *armillaris* (Sm.)
„ *genistifolia* (Sm.)
„ *linariifolia* (Sm.)
„ *thymifolia* (Sm.)
„ *hypericifolia* (Sm.)
Aster tomentosus (Schrad.)
Thelymitra ixioides (Sm.)
Diuris maculata (Sm.)
Stylidium graminifolium (Swartz.)
„ *lineare* (Swartz.)
Casuarina distyla (Ventr.)
„ *torulosa* (Uit.)
Zamia spiralis (Salisb.)
Acacia verticillata (Willd.)
„ *juniperina* (Willd.)
„ *suaveolens* (Willd.)
„ *floribunda* (Willd.)
„ *linifolia* (Willd.)
„ *abietina* Willd.)
„ *stricta* (Willd.)
„ *longifolia* (Willd.)
„ *glaucescens* (Willd.)
„ *falcata* (Willd.)
„ *myrtifolia* (Willd.)
„ *hispidula* (Willd.)
„ *discolor* (Willd.)
„ *lophantha* (Willd.)
„ *decurrens* (Willd.)
Ficus australis (Willd.)
Lycopodium densum (Labill.)
„ *uliginosum* (Labill.)
„ *ciliatum* (Willd.)
Tmesipteris tannensis (Bornh.)
Gleichenia circinata (Swartz.)
Schizæa fistulosa (Labill.)
„ *bifida* (Swartz.)
Acrostichum alcicorne (Swartz.)

Grammitis Billardieri (Willd.)
„ *heterophylla* (Labill.)
Polypodium diversifolium (Willd.)
„ *quercifolium* (Linn.)
„ *rugulosum* (Labill.)
Lomaria nuda (Willd.)
Asplenium decurrens (Willd.)
„ *flabellifolium* (Cav.)
Pteris vespertilionis (Labill.)
„ *esculenta* (Forst.)
Blechnum cartilagineum (Swartz.)
„ *lævigatum* (Cav.)
Blechnum procerum (Labill.)
Woodwardia caudata (Cav.)
Lindsæa lanceolata (Labill.)
„ *microphylla* (Swartz.)
„ *lunata* (Willd.)
Adiantum hispidulum (Swartz.)
„ *assimile* (Swartz.)
Davallia pyxidata (Cav.)
Dicksonia antarctica (Labill.)
Hymenophyllum flabellatum (Labill.)
„ *australe* (Willd.)

When Willdenow's list of Australian plants is compared with the descriptions given in the seven volumes of the *Flora Australiensis* and the eleven volumes of *Fragmenta* by Baron von Mueller, as well as with the *Census* of Australian plants by the same author, some idea may be formed of the wonderful progress which has been made in Australian botany since the beginning of the century. From 1800 to 1810, CALEY continued the great work of collecting specimens and of developing the rarities of a new Flora; but it remained for ALLAN CUNNINGHAM to traverse parts of Australia unknown to his predecessors and to transmit to Europe seeds and plants not previously discovered. He was a man of taste and energy, and from his arrival in 1816 to his death in 1839, he exerted himself to promote the great object of his mission, first as "Botanical Collector to the Royal Garden at Kew," and subsequently as Colonial Botanist and Director of the Botanical Garden in Sydney. In these capacities he did much to develop the resources of Australia, and as settlements were being established in Western and Southern Australia, as well as at Port Phillip (now Victoria), the extent and variety of the Australian Flora became more and more manifest through the labours of professional or amateur botanists, and a new industry, viz., that of collecting seeds for exportation to different parts of the world, was established in the colony. Thus, in various ways, continual additions were made to the knowledge of Australian plants; and as their floral beauties increased under the fostering care of cultivation, they have obtained a favourable place in the greenhouses and hot houses of Europe.

It is only of late, as already noticed, that the extent of the Flora has been fully known, for until the publication of Baron von Mueller's *Census*, the number of species and their respective distribution were matters of uncertainty. Now the numbers, so far as species have yet been discovered, are carefully estimated, and each plant is referred by systematic arrangement to its proper genus with the date of its discovery and its distribution in the Australian colonies.

All plants have their places in the economy of nature and serve the purposes for which they were designed by a beneficent Creator, but, in the eyes of men, some species are more ornamental than others, better adapted for cultivation, and whilst "arrayed in robes of lovely hue" indicate "a Father's care" even to those who do not study the mysteries of organism or the symmetry of proportion. The order Leguminosæ with 1065, the Myrtaceæ with 663, the Proteaceæ with 597, the Compositæ with 380, the Epacridæ with 275, and the Orchideæ with 271 species, afford numerous instances of this kind. Amongst the Leguminosæ, Australia is rich in plants herbaceous, shrubby, or arborescent. *Clianthus Dampieri*, the various species of *Swainsona*, *Crotalaria*, *Kennedya*, *Oxylobium*, *Indigofera*, *Cassia*, and *Bauhinia*, are now reckoned amongst garden plants, whilst the genus *Acacia*, affording in itself examples of minute elegance or robust stature, is adapted alike for the shubbery or the plantation. Of the larger species of Leguminosæ, *Castanospermum australe*, *Barklya syringifolia*, *Pithecolobium pruinosum*, and *Albizzia canescens* are beautiful trees and capable of enduring a considerable amount of variation in temperature. The Myrtaceæ also are of all sizes from the minute *Bæckia* to the gigantic *Eucalypt*. Western Australia abounds in elegant species of Fringe Myrtles (*Darwinia*, *Verticordia*, *Calythrix*, *&c.*), small shrubs remarkable for their calyx adhering to the ovary and breaking into fringes or extended into bristles. These are much admired in cultivation. There may also be mentioned as peculiar to the West, species of *Regelia* and *Beaufortia*, whilst those of *Callistemon*, *Melaleuca*, and *Leptospermum* may be found in varying proportions in Eastern and Western Australia, enlivening the bush with their white, purple, or crimson flowers. The large genus Eucalyptus has in the Southern and Western Colonies some species distinguished from others by their showy crimson flowers, *E. ficifolia* (Mueller), and *E. calophylla* (Brown) may be reckoned amongst the marvellous beauties of the genus, whilst as Baron Mueller observes, *E. phœnicea* (Mueller) and *E. miniata* (Cunn.) vie with them in ornamental splendour. The species generally are not very umbrageous, but *E. robusta* (Sm.) and a few others are exceptional in this respect, and *E. globulus* (Labill.), the far famed "Blue Gum" of Tasmania, is remarkable for the rapidity of its growth. Few trees in Eastern Australia afford a more grateful shade than the gnarled and spreading *Angophora*, the larger species of which may be termed "Rain-trees" on account of the drops of water which at certain seasons fall from their leaves. Several species of *Eugenia* (a genus also not extending to Western Australia) are likely to be cultivated for the beauty of their foliage and flowers, as well as for the flavour of their fruits. The Proteaceæ furnish some of the most singular species in the Vegetable Kingdom. The "Wooden Pear" (*Xylomelum pyriforme*, Knight), the "Native Tulip" (*Telopea speciosissima*, Brown), esteemed as the most splendid of Australian flowers, and the peculiarity of *Dryandra* and *Banksia* were looked upon as great novelties in the early days of New South Wales, and figures of them were soon published in Europe. In later days, *Grevillea*, *Hakea*, and *Stenocarpus* have each of them found a place in shrubberies, and few gardens are destitute of the most noted species; whilst *Buckinghamia celsissima* (Mueller), and *Darlingia spectatissima* (Mueller)—some of the recent discoveries in Northern Queensland—are finding favour in southern cultivation so far as the climate permits. The great order of the Composites, of which many species are inconspicuous herbs or mere weeds, does not offer proportionally many plants for cultivation, but a few of the "everlasting" kind (such as *Helipterum Manglesii* (Mueller), *H. roseum* (Benth.) *Helichrysum elatum*, (Cunn.), and *H. bracteatum* (Willd.), and some of the Asters, including the "Musk-tree," *A. argophyllus* (Labill.), and *A. dentatus* (Andr.), may be regarded as exceptional. *Brachycome*, *Calotis*, and *Minuria* comprise some very pretty species which might be utilised for borders, and *Cassinia aurea* (Brown), *C. spectabilis* (Brown), and *Humea elegans* (Sm.), are much larger plants and not unknown in European collections. The Epacrids, which in Australia take the place of Heaths, have attracted attention for the last century, and under cultivation many species have improved in appearance or have become double. The following may be especially noticed:—

Epacris longiflora (Cav.)
,, *impressa* (Labill.)
,, *purpurascens* (R. Br.)
,, *microphylla* (R. Br.)
Styphelia adscendens (R. Br.)
,, *tubiflora* (Sm.)
Styphelia triflora (Andr.)
Andersonia sprengelioides (R. Br.)
Sprengelia incarnata (Sm.)
Lysinema, *Leucopogon*, and *Astroloma* in several species.

The larger or more shrubby species of *Richea* and *Dracophyllum* are mostly Alpine plants, and have a monocotyledonous aspect, some rising to the height of thirty or forty feet. *D. Fitzgeraldi* (Mueller), of Lord Howe's Island, is perhaps the most remarkable of the order, attaining a height of ninety feet, and having leaves a foot or more in length. Paxton speaks of the smaller Epacrids as "very elegant greenhouse plants," and Sir W. Macarthur used to say that, if anyone desired to see them in perfection, he must visit the European conservatories. Australian orchids, though not to be compared with those of the East and West Indies or the warmer parts of America in point of numbers, variety, or brilliancy, yet present on the whole many features of structural beauty and organic peculiarity whereby they commend themselves to the artist and the botanist. It is true that many of the species are minute plants, terrestrial in habit, and appearing only for a few short weeks in spring, but even these, when viewed microscopically, give the scientist the means of studying the various modes of fertilisation, the agencies whereby nature secures the perpetuation of species, and the links which seem to connect one form with another. The late much lamented Mr. R. D. FITZGERALD, F.L.S., in his splendid work on *Australian Orchids*, figured nearly two-thirds of all known species some terrestrial, and some epiphytal; and although the majority may not interest the casual observer the following must be regarded as worthy of consideration for their size or beauty :—

Sarcochilus Fitzgeraldi (F. v M.)	*Galeola foliata* (F. v M.)
Dendrobium canaliculatum (R. Br.)	*Calanthe veratrifolia* (R. Br.)
,, *rigidum* (R. Br.)	*Spathoglottis Paulinæ* (F. v M.)
,, *falconirostre* (Fitz.)	*Sarcochilus divitiflorus* (F. v M.)
,, *cucumerinum* (Lindl.)	*Cœlandria Smilliæ* (Fitz.)
,, *phalænopsis* (Fitz.)	*Dipodium punctatum* (R. Br.)
,, *Moorei* (F. v M.)	*Caladenia lobata* (Fitz.)
,, *superbiens* (Reich.)	*Prasophyllum elatum* (R. Br.)
,, *undulatum* (R. Br.)	*Thelymitra ixioides* (R. Br.)
,, *speciosum* (Sm.)	,, *grandiflora* (Fitz.)
,, *Kingianum* (Bidw.)	,, *antennifera* (Hook.)

Many of the smaller species figured by Mr. Fitzgerald are peculiar to Australia, but as here and there species occur which are not limited to that continent, they form, as it were, a connection between the botany of Australia and other regions, which, at some remote period, were not separated from it by the intervening ocean. All the species, however, as yet figured, illustrate amply an interesting portion of the flora, and will long continue as memorials of the author's artistic skill.

The Goodeniaceæ, Malvaceæ, and Liliaceæ, have numerous representatives in most parts of Australia. The elegant *Leschenaultia splendens* (Hook.), with its characteristic stigma, the pretty and strongly scented *Boronia serrulata* (Sm.), and *B. megastigma* (Nees), the gigantic *Doryanthes excelsa* (Corr.), and the pure *Crinum*, the showy species of *Hibiscus* and *Gossypium*—all of these display the glory of their respective orders. So also the rivers of the North are enlivened by the variously coloured petals of *Nymphæa gigantea* (Hook.), and the delicate tints of *Nelumbium speciosum* (Willd.); whilst the lofty conifers *Araucaria Cunninghami* (Ait.), and *A. Bidwillii* (Hook.), and the palm-like tree ferns (*Alsophila australis*, Brown), and *A. excelsa* (Brown), impart a semi-tropical character to the regions in which they abound. Of the true palms, *Ptychosperma Cunninghami* (Wendl.), and *Livistona australis* (Mueller) are rapidly disappearing in the settled districts; but in unfrequented places in Northern Queensland, and also at Lord Howe's Island, several species of *Ptychosperma* and *Kentia* still flourish in all their graceful beauty.

Great changes are going on in the Vegetable Kingdom throughout the world, and though many of those changes are not perceptible to the present generation, a reference to past history will inform us that regions once covered with forests have become desolate wildernesses, and unfruitful soil has been made subservient to the purposes of cultivation, and that species of plants which once flourished in some particular country have long ceased to do so. What occurred in geological periods, when, by the uplifting or depression of the earth's crust, the flora of many countries became differentiated or made way for other forms, is going on gradually still; and it is certain that, in the course of generations to come, as the flora of Australia was very different in ages past from what it now is, so a new order of plants may arise and take the place of the great orders which at the present period flourish on the continent. A reference to the vegetable fossils which have been found in the auriferous drifts of New South Wales and Victoria makes this supposition highly probable.

Without contemplating, however, those stupendous changes which must have occurred since many genera, now called exotic, connected the Tertiary Flora of Australia with that of northern and tropical America and Oceanica (Ettinghausen), the experience of the past century affords some indication of changes which may yet be realised. Since the British landed on the shores of Australia in 1788, the work of destruction has been going on amongst indigenous plants. That destruction was, no doubt, in operation when as yet the white man had not set his foot on the land, for the destroying tempest, the ravages of insect pests, the periodical fires in the bush and the alternation of flood and drought, had exercised their influence on the vegetation independently of the slow and imperceptible changes arising from climatic and geologic considerations. With the advent, however, of the white man in Australia a new era commenced in its Flora and henceforth the process of cultivation, the introduction of foreign plants, either accidentally or designedly, and in some instances the wanton destruction of certain species, have all combined to impart a novel character to the Flora of the settled districts, and of initiating a modified system of vegetable growth whereby the old has sometimes made way for the new, or the new and the old have become strangely associated together.

When the first settlers landed at Port Jackson the native forest appeared in its primeval grandeur, and numerous species of shrubs and flowers greeted their wondering gaze with novel forms of vegetation. This state of things did not long continue. Large trees, many probably the growth of centuries, fell before the workman's axe for the purposes of building, fencing, and burning; whilst the smaller plants were soon cleared away as useless impediments in the way of cultivation. In many countries there are wild fruits and vegetables which can be utilised by the settler. This was not the case with that part of Australia where Sydney now stands, and therefore one of the earliest objects of the colonists was to clear the ground for the cultivation of such plants as were considered suitable for food. In doing this a great destruction of native plants ensued, and now after the lapse of a century it is impossible to find some of the plants which Brown and the early botanists described as occurring in the neighbourhood of Sydney, whilst streets of houses or cultivated spots occupy the area where the towering Eucalypt, the curious Protead, the lovely Epacrid, or the host of delicate orchids, once reigned in undisturbed profusion. The introduction also of foreign plants has had a wonderful influence in destroying the native vegetation; and as the population spread further from the coast, the same result occurred in a greater or less degree, so that in all the settled districts the Flora began to assume a mixed character. Nor has this arisen solely from the introduction of esculent plants adapted to the soil and climate. Many species have found their way over the ocean and established themselves in an accidental manner, or as following the steps of civilised man.

Wherever the land has been turned up the so-called couch grass (*Cynodon dactylon* Pers.) has taken the place of other grasses, and from Port Jackson to the Blue Mountains it has become very useful as fodder, though in gardens it is regarded as a great nuisance. So also Brown's *Paspalum littorale* (referred to *P. distichum*, Linn.), which in the early days was limited to the sea coast, now flourishes on the cultivated flats of our Eastern Rivers; whilst *Cyperus rotundus* (Linn.), which in the days of Caley (1810) was known only in the Government garden at Parramatta, has become an intolerable nuisance to many gardens in N.S. Wales. It is astonishing to notice how various species of *Rumex* and *Amarantus* have encroached on cultivated fields, and how in some instances the native plants have been smothered by such Composites as *Wedelia hispida* (Ktl.), *Aster dumosus* (Willd.), or different species of *Centaurea*, *Carduus Marionus* (Linn.), *Cryptostemma calendulaceum* (R. Br.), and two species of *Hypochæris*. In alluding to this subject the late Rev. J. E. Tenison-Woods, F.L.S. (a learned man of varied scientific attainments), remarks: "The features of Australian Vegetation are also being altered by introduced plants. *Rubus rubiginosus*, or the Sweet Brier, has taken kindly to the arid western tableland, and covers the ground for miles with a dense thicket, which it is difficult to eradicate. It is worse than either the thistle or burr (*Xanthium*). The sweet brier is an equally troublesome pest in Tasmania. On the east side of the range, *Verbena Bonariensis* and *Asclepias curassavica*—both garden plants from America—are troublesome weeds. We have also an unexplained spread of an indigenous tropical plant (*Sida rhombifolia*), which infests good soil to an alarming extent. Every year also we have to chronicle the spread of some common European weed which very easily overcomes the native vegetation." In some places *Lantana Camara* (Linn.), and in others several species of *Opuntia* are detrimental to cultivation, whilst in gardens the ordinary species of *Euphorbia*, *Stellaria*, *Cerastium*, *Malva*, and *Sisymbrium*, spring up in great abundance. Contemporaneously, with the introduction of foreign plants, the gradual extinction of native species has been accelerated by the increase of sheep and cattle which feed on the more delicate plants, the wanton destruction of floral beauties for flower shows and decorative purposes, and the wholesale slaughter of Eucalypts by ring-barking. Some years ago the Cabbage Palm and the Tree Fern flourished in the vicinity of Sydney, and many orchids which once sprang up where the city and its suburbs have usurped the soil, have ceased to do so. Change, therefore, is stamped on the Flora of Australia, and though the change is more perceptible in the oldest of the colonies than in those recently established, it is evident that as the white man has extended his operations, so in proportion native shrubs have become less frequent. And this is quite independent of the fact that from some cause or other whole forests of Eucalypts have perished. Whether this has arisen from insects, opossums, flood and drought, or from fungi, has not been clearly ascertained, but such destruction must materially affect the Flora, even supposing that when the causes of destruction have been removed, the larger species spring up again. But perhaps in process of time as the "Select Plants" recommended by Baron von Mueller for industrial purposes spread over the country, it may be found that some species are likely to prove more serviceable than the stunted kinds of Eucalypt which now prevail in certain parts of the country, and forests of new and valuable trees may take the place of those which under other conditions have long been cumberers of the ground. And this leads to another matter of infinite importance to the development of the coming Flora, viz., the extensive planting of forests under the direction of the respective Colonial Governments. This subject has been ably explained in the Baron's *Forest Resources of Western Australia*, and if only a small portion of the trees which he has suggested for cultivation in that part of Australia now become acclimatised, it is evident that they will produce a great revolution in the Flora, not merely affecting the general appearance of the country, but "as the rainfall of a country depends in a great measure upon the abundance of its trees" (*Sinai and Palestine*. by the Rev. F. W. Holland), an increased moisture would lead to the introduction of many smaller plants which need shade and rain for their growth. Ancient Phœnicia, "the land of palms," furnished it is said, an example of the advantages arising from the existence of forests. Lying under the shadow of Lebanon, it abounded in streams, streamlets, and rivers; the last then navigable for some distance from the sea, by reason of the *greater flow of water caused by the primeval forests* which in those days clothed the neighbouring mountains. The plantation of forests will no doubt exercise an influence in many ways, and especially in reference to the Flora; but probably the process of irrigation, which in another half century will be carried on in the arid and sterile regions of the West, is destined to produce still greater changes. Irrigation was much practised by the ancient nations, and the ruins of former works still exist in parts of the East to testify to its utility. What was done in Egypt, Persia, and India, may therefore be done in Australia, and the means of subsistence for the population may be indefinitely increased. It is calculated that the extent of irrigated land in the Valley of the Po may be about 1,600,000 acres, and the increase of rental thus caused £830,000. Such irrigation, not to speak of the immense advantages in a commercial and financial point of view, must have had great influence on the vegetation of Southern Europe, and it is not too much to expect that a periodical watering of the land and the formation of extensive lakes in the dry parts of Australia would cause many an elegant shrub or useful herbaceous plant to flourish where now only harsh and unpalatable species occur.

Whilst dwelling on the Flora of the future it is only reasonable to expect that the uses of many plants only partially known will be more appreciated than they are at present, and that many articles of vegetable origin, which are now imported at considerable expense, will be found to exist in Australia. This may be especially true of medicinal plants. The country abounds in such species, and numerous kinds, which hereafter may find a place in the *Pharmacopœia*, are but imperfectly known by the settlers. The Medical Botany of Australia affords a fine field for the inquiries of the specialist, and so a similar region of investigation remains for those whose tastes may lead them to the study of Cryptogamic Botany. What HARVEY has done for Australian Algæ is a noble contribution to the knowledge of Marine Beauties, and it is to be hoped, that in the botany of the future, thousands of minute species in the lower kingdoms of Nature may find a local habitation and a name in the Flora of Australia.

Other subjects in connection with the progress of botany

—such as the nomenclature of the Flora, the distinction between species and variety, the simplification and division of genera, and the rearrangement of natural orders—remain yet to be considered. Any one who reads the preface to Lindley's work on the Vegetable Kingdom will see how anxious the Professor was to improve the nomenclature of botany and to suppress as far as practicable names of unusual dimensions and difficult to pronounce. Though something has already been done in this direction, it is still desirable to effect further improvements, for such long words as *Ceratopetalum apetalum*, *Aphanopetalum resinosum*, *Amorphophallus variabilis*, *Amorphospermum antilogum*, and *Tabernæmontana orientalis*, show that notwithstanding the changes effected by Bentham and Mueller, the nomenclature of the Australian Flora needs reform. Words formed from Latin or Greek, expressive of some feature peculiar to a species, are certainly the most suitable for general use, and are understood by the educated in all countries, but then such words should be limited to a few syllables, and, if possible, be euphonious. But long names, especially as specific, are frequently complained of, and none more so than those in honour of some great man. Much as many of the Baron's names may be admired for their elegance and expressiveness, one can scarcely defend *Kentia Belmoreana*, *K. Canterburyana*, *K. Wendlandiana*, *K. Forsteriana*, or *Eucalyptus Planchoniana*, and *E. Foelscheana*, on the ground of brevity or expressiveness. But the illustrious author of the *Prodromus* was not altogether free from a similar charge, though only to a limited extent, for in order to immortalise the names of those whom he delighted to honour we have the genera *Bellendenia*, *Franklandia*, *Levenhookia*, and *Leschenaultia*, names certainly derived from distinguished authors and botanists, but not calculated to improve the nomenclature of science. There may be exceptional cases, in which men from the pre-eminent position they have held, seem entitled to every distinction, but as a general rule the naming of genera after some noble or learned person teaches nothing by which a genus is characterised, nor can it be done on all occasions without making invidious distinctions. It must be left, therefore, for botanists of the future to decide whether it is better to make the Flora an instrument of personal glorification, or to impress on genera such names as may guide the student in his endeavour to trace out the differences of natural objects. The multiplication of hard words, whether of classic or of personal origin, is the source of frequent complaint against botany, and needs reform; but in correcting one error care must be taken not to fall into another, for the adoption of popular names, such as some persons suggest, would be of little service beyond an English-speaking community, nor would they escape the charge of leading to confusion in a country in which different districts call the same thing by different names.

The distinction between species and varieties is a matter of greater difficulty for the botanist of the future. In days past, perhaps, botanists were too fond of increasing the number of species, considering that every character in species was fixed, and that every deviation from some original type was to be regarded as distinct. Experience has proved that certain species are subject to a vast amount of variation; that surrounding circumstances (such as soil, climate, and elevation above the sea-level) tend to perpetuate such differences; and that cultivation in some instances produces abnormal forms not simply in size and colour, but in marked features. Such being the case, it happens that what some botanists regard as species others describe as mere varieties; and hence in comparing the *Flora Australiensis* with Baron von Mueller's *Census of Australian Plants*, it may sometimes be found that there are differences of opinion as to the specific value of certain plants, and that characters once deemed essential are not regarded as uniformly permanent. Since the publication of Lyell on the *Antiquity of Man,* and Darwin on the *Origin of Species*, naturalists have modified their views on the subject of species, and have differed considerably on the characters which constitute such, and therefore it is not surprising that great men like the late Mr. Bentham and Baron von Mueller should differ in their estimate of species. One cause of difference is the fact that the former had to form his conclusions almost entirely from dried specimens, whilst the latter in many instances had the opportunity of observing plants in their native state, and of noticing peculiarities in individuals. Without referring to such protean genera as *Eucalyptus* or *Acacia*—in which there seem to be connecting links between some of the so-called species—several genera among the Leguminosæ present great difficulties to the systematic botanist, and future scientists must yet decide how far apparent differences affect specific value. The same remark applies to the Orchideæ, an order comprising many minute species, some of which approach very near to each other. Great light has been thrown on this subject by the published figures of Mr. R. D. Fitzgerald, F.L.S.; and as the various kinds are cultivated with a view of ascertaining their liability to divergence, some aid may be given to the discovery of a method whereby the distinction between species and varieties will be better understood. It would appear that the alterations in species during many generations are not such as some enthusiastic followers of Darwin have supposed, for from fossil cereals and other plants discovered in the Swiss Lake dwellings, there is evidence to prove that many of the species are the same in character as those which exist in Europe now. In Australia, the knowledge of such matters is very limited, and a century has not yet elapsed since Brown published the first systematic account of Australian plants, but it may happen in the course of palæontological discovery that the fossilised remains of plants in particular strata will reveal the antiquity of the Australian Flora, and show how far species may have become differentiated in the process of ages. On a subject so abstruse, it may be useful to quote the opinion of one so eminent as Sir J. D. Hooker. He contends that "species are neither visionary, nor even arbitrary creations of the naturalist, but realities, though they may not remain true for ever. The majority of them," he remarks, "are so far constant within the range of our experience, and their forms and characters so faithfully handed down through thousands of generations, that they admit of being treated as if they were permanent and immutable. But the range of our experience is so limited that it will not account for a single fact in the present geographical distribution or origin of any one species of plant, nor for the amount of variation it has undergone, nor will it indicate the time when it first appeared, nor the form it had when created" (*Introductory essay on the Flora of Australia*). Since the publication of Sir J. D. Hooker's valuable essay, great progress has been made in scientific inquiries, and it is not improbable that a careful examination of species under cultivation and the study of embryonic peculiarities in individuals may suggest *that* which is fixed and permanent in plants, and *that* which is simply accidental or contingent. Amongst European botanists this question of species and variety has long been a perplexing one, and it is striking to notice that botanists of eminence cannot agree together as to the number of species in particular genera.

In the botany of the future in Australia similar difficulties may arise, indeed some have already arisen, but in a new field of inquiry traditionary views and long established errors have not the same influence as in old countries, nor are botanists called to ascertain how far cultivation in ages past may have led to abnormal development. The future Flora of Australia therefore may not be so fraught with perplexities of this kind as that of Europe, and those which now create a difference of opinion amongst Australian botanists may yield to the progress of science and give new illustrations of the wisdom which characterises the great Creator's works.

There are also, with regard to genera, difficulties which need reform, not merely in lessening the number but in grouping the species of the larger ones. Though the term genus is simply a common substantive name given to a number of species which resemble each other, yet difference of opinion may prevail as to the propriety of extending the number of genera or of placing a species under a particular genus. Baron von Mueller with a view of simplifying the study of botany, and of assisting the memory by limiting the number of names, prefers the formation of large genera with appropriate subdivisions. Thus, for instance, in the great order of Epacrids, he has amalgamated under *Styphelia* several of Brown's genera, and in a similar manner he has incorporated *Pleurandra* with *Hibbertia*. So likewise, in the order Salsolaceæ, he has reduced several of the old genera to *Bassia*, and in the Amarantaceæ *Trichinium* to *Ptilotus*. If in the future a further amalgamation could be effected, the study of Australian botany would be facilitated by the suppression of many long names (some genera including but one or two species), and the retention only of those which express the essential character of plants nearly allied. In former times it was the fashion to make too many genera, and Baron von Mueller's admirable *Census* is a proof of what may be done to lessen the number. Regarding his noble efforts as an instalment of reform, the imagination looks forward to a period when the Vegetable Kingdom, so far as genera and species are concerned, may be considerably simplified, and people may cease to think that botany is a science of bewildering terms and hard names rather than the contemplation of characters impressed on the beauties of Nature by the infinite skill of the Creator. It is said that a rose would smell as sweet by any other name, and so it would; but then there is something incongruous in fixing some name of little meaning on any of Nature's gems, or of subjecting them arbitrarily to a generic association unsuitable to them.

And then again there is a difficulty to be overcome in the formation of sub-genera, or the grouping of species in the larger genera. From the days of Brown to those of Bentham and von Mueller this has been felt especially in *Eucalyptus* and in a less degree of *Acacia*. Before the conception of the cortical or anthereal systems, species were thrown together without any suitable arrangement; but in the *Flora Australiensis* and the Baron's *Census*, the latter system has rendered the grouping of species of Eucalyptus possible. Still, however, there are objections to both systems, for whilst the one is useful in the field and the other in the cabinet, they are both liable to exceptional anomalies, and there is inconsistency in placing in close proximity to each other species which differ materially. Here then is a problem yet to be solved. Whilst therefore thanking those great men for what they have done to remove past errors, and render the identification of many species an easy task, thus affording the means of grouping trees in some respects similar, men of observation can regard the present arrangement of the genus as provisional only, and an instalment towards better things to come. With regard to the genus *Acacia*, in the describing of which Mr. Bentham experienced so much trouble, Baron von Mueller has furnished a series of figures whereby the character of many species will be clearly seen, and when his work is completed the grouping of the species will be comparatively easy. As in *Eucalyptus*, the flowers of very different trees or shrubs are very similar, and Mr. Bentham when dealing with dried specimens, remarked that he found "species with the most discrepant pods sometimes almost identical in foliage, and on the other hand pods apparently identical sometimes belonging to species widely different in foliage and even in flower." In *Acacia* therefore the grouping of the species must be regarded as only provisionally settled until the pods of all the species have been collected and carefully examined, and a system devised founded on the shape and nature of the fruit.

The arrangement of the natural orders is the last difficulty which I propose to consider—a difficulty rendered highly perplexing by the fact that our most eminent botanists have entertained different opinions on the subject. Passing over some of the minor differences, it may be sufficient to notice that the main divergence in the two great works—the *Flora* of Bentham and the *Census* of Mueller—is due to the position of the Monochlamydeæ amongst the natural orders, for whilst the former places them separately (Vols. V. and VI. partly), the latter distributes them amongst the petalliferous orders. His reasons for this departure are given in the preface of his *Census*, in which he expresses his conviction "that so long as the Monochlamydeæ remain isolated and associated with the Gymnospermeæ, we must necessarily have an imperfect natural system." And then he adds, as showing the inconsistency of the arrangement in the *Flora*, "Even amongst the Thalamifloræ and Calycifloræ represented in Australia, we have already not less than fifty-eight genera which are entirely apetalous, or contain species in which the corolla remains undeveloped."

The Monochlamydeæ, as given in the *Flora* are twenty-one, viz.:—

1. Phytolaccaeæ.
2. Chenopodiaceæ.
3. Amarantaceæ.
4. Paronychiaceæ.
5. Polygonaceæ.
6. Nyctagineæ.
7. Myristiceæ.
8. Monimiaceæ.
9. Laurineæ.
10. Proteaceæ.
11. Thymeleæ.
12. Eleagnaceæ.
13. Nepenthaceæ.
14. Euphorbiaceæ.
15. Urticeæ.
16. Casuarineæ.
17. Piperaceæ.
18. Aristolochiaceæ.
19. Cupuliferæ.
20. Santalaceæ.
21. Balanophoreæ.

In order to meet the views of the Field Naturalist's Club in Victoria, Baron von Mueller has published a *System of Victorian Plants*, according to the dichotomous method of Lamarck, but this system was not chosen by the Baron at his free will, nor is such an arrangement likely to prove useful in the ultimate mode of settling the natural orders of Australia. In the botany of the future, the alliances of Nature will be preferred to the ingenious contrivances of art, and therefore it may justly be presumed that no system which is beset with the danger of leading astray through the misunderstanding of any solitary characteristic, will obtain adoption in the general Flora of the future. The Baron's work must have given him a vast amount of labour, as it was "to be rendered alike available for elementary schools and for high educational institutions; it was to serve the amateur gatherer of plants in the field as well as the professional investigator in the exercise of stern duties, and yet such a work was to be inexpensive, concise, and reliable!" There can be no doubt that the intentions of the author have been highly appreciated—his two volumes having in a great measure answered the purposes for which they were designed—but after all it must be admitted (as the learned author is fully aware) that in a small genus or order the dichotomous splitting-up of characteristics is but of little help (as one may just as easily look over short diagnoses) whilst in a large genus or order the system is frequently misleading. If headings are made in a large genus or order and then the salient points are brought out clearly in a brief diagnosis, a complex of characteristics (which we lose sight of in the dichotomous method) is obtained whereby not merely the name of the species is ascertained but a clue given to the better understanding of its properties. Since the gradual disuse of the Linnean system the arrangement of the natural orders has been viewed differently by authors of eminence, but all seem to be now agreed in following natural alliances as nearly as possible and of placing in close proximity those groups which are connected with each other. The illustrious Robert Brown, when laying the foundation of Australian botany, was one of the first to recognize the advantages of the Natural System; but the *Prodromus Novæ Hollandiæ* records only a limited portion of the vegetation known in 1810. The labour therefore of extending that work, of elaborating new orders and describing genera and species according to the additional light thrown upon them, devolved on the great systematic botanists, Bentham and Mueller, and it must in justice be added that they have proved themselves worthy successors of the Father of Australian Botany.

At the present time about 9,000 species, exclusive of the lower Cryptogams, have been subjected to scientific investigation. How many more are yet to be discovered, and what influence they may have in the modifying or reconstruction of the Flora are mere matters of speculation. New species are being found occasionally as travellers penetrate into remote parts, but now that Australia has been traversed from one end to the other, it is scarcely probable that many new types of vegetation will be discovered on which additional orders or genera may be established. It is to be hoped, however, that as each succeeding species falls into its proper place in the systematic arrangement, the nomenclature of plants will be simplified, the specific distinctions better understood, the genera lessened in number, judicious subdivisions devised, and that to crown all, the aspirations of BROWN, BENTHAM, and VON MUELLER will be consummated in a perfect disposition of the orders. In New South Wales there are many reasons why such things may be hoped for, because in that, the oldest of the Australian colonies, the Linnean Society of the colony has already done so much for the furtherance of botanical science, and yet promises to do more. The Society may feel a just pride in referring to the labours of such men as the late Rev. J. E. TENISON-WOODS, Professor STEPHENS, Mr. C. S. WILKINSON, F.G.S., and Sir WILLIAM MACLEAY, who by their writings, as recorded in the Transactions of the Society, have contributed so much to the study of natural history, whilst it must be mentioned that the munificent benefactions and endowments of the last naturalist have not merely eventuated in the establishment of the "Linnean Society of Sydney" on a firm basis, but are designed to perpetuate for future generations the means of pursuing those researches with which the name of MACLEAY must ever be associated.

On the motion of the CHAIRMAN a cordial vote of thanks was accorded to the author for his very able and interesting paper.

DISCUSSION.

The CHAIRMAN.—Is it your pleasure to return thanks, I cannot say to the author of this paper, but to his representative, and particularly to Surgeon-General Gordon for his kindness in reading it, the pleasure of listening to which has, I am sure, been enhanced by the running paraphrase which he has thrown in from his own individual experience? We should be very happy to hear any observations upon the subject of the paper from two gentlemen here who will probably offer a few remarks, and from any others who may be pleased to do so. The two gentlemen I refer to are Sir Frederick Young and Mr. Petherwick.

Sir FREDERICK YOUNG.—Sir, ladies and gentlemen, I came here, perhaps with some others in the room, not with a view of taking any part in the discussion, but to learn a great deal from the valuable paper which Surgeon-General Gordon has been good enough to read to us on this very interesting subject. I propose, therefore, in my one or two remarks that I will venture to make to confine myself to allusions to the great importance of the cultivation of botany for the sake of the material advantages which it gives to the inhabitants of course, no doubt, not only of particular parts of the earth in which botany is studied, but to all mankind. The fact of the knowledge which is derived from the scientific pursuit of the study of botany in discovering the value of various moods is alluded to here in reference to the various kinds of Australian timber, which are much better known in Europe now than before the publication of the *Flora*, for they can be identified by their scientific names. That is a most important thing, and we know what great developments are taking place at the present day from the greater knowledge of the qualities of the different timbers that abound in Australia. Then, again, there is an interesting remark which the author of this paper makes with regard to all plants which have their place in the economy of nature, and serve the purposes for which they were designed by the beneficent Creator. Again, I observe that Surgeon-General Gordon rather invited some remarks with regard to the importance of irrigation. Now it is well known to all those who are acquainted with Australia, that great development has taken place with regard to artesian wells in the Colony of Queensland, from which the most important results have already been obtained. I have not before me the figures, but I am perfectly well aware, as every one connected with Australia must be aware, of the enormous benefits that have been derived during the last few years from the sinking of artesian wells in the country. A parallel instance is to be found in another part of our great Colonial Empire with which I am more personally acquainted, and that is South Africa. When I was in Bechuanaland five years ago I had some personal communication with Sir Sydney Chever, the Admiralty Administrator of that day. Part of that country is called "a waterless desert," but it is known, and always has been, that there are underground waters to a great extent there, and that they only require to be properly tapped in order to make that part which is called "a waterless desert" into a fruitful field, to the immense advantage of the future generations of population with which I have no doubt that land will one day teem. (Applause.)

Mr. PETHERWICK.—I should like just to say a few words as to the work that has been done by an individual like the author, working quietly and unassumingly for fifty years in Paramatta. His work has been good, although his name is not published attached to any very great work like that of Hooker or von Mueller or Bentham, still he has in his way accumulated information which has been made use of in the larger works of the country. Dr. Woolls went to Australia more than sixty years ago, I think. He had written little works and was a student of botany, and went out there to what was a comparatively new field of exploration at that time, when, as he says in his paper, nothing or very little had been published except Brown's *Prodromus.* That, of course, compared with the later works, was very small indeed. Dr. Woolls settled down at Paramatta, and there he has been at work for fifty years, and although he has not published any very great authoritative work, his influence has been exerted in a quiet way, and there are hundreds of amateur botanists in Australia who owe their incentive to his good influence.

Professor ORCHARD.—We have all been very much interested in what the author has stated on pp. 115 and 116 as to the botanical knowledge possessed by the aborigines, and the great extent to which they seem to have made use of the indigenous plants of Australia. That is a circumstance which points to the conclusion, tolerably evident indeed on other grounds, that the primeval doctors went to the vegetable, rather than to the animal, world for their drugs and medicines. What Dr. Woolls states on p. 127 with regard to the importance of the correction of the nomenclature of botany applies, I think, not only to the botany of Australia, but to that of other places as well. There can be no doubt that the importance of nomenclature to the inductive sciences is very much greater than we are apt to imagine, and the names ought to be aids to the scientific memory. That is the principal purpose, I apprehend, of any scientific nomenclature—not, as Dr. Woolls truly says, to make invidious distinctions between one worker and another by bringing into use personal names. The names should be distinctly contributions to the more easy acquisition and better retention of scientific knowledge.

Mr. SLATER.—Mr. President, concerning the great subject of artesian wells, I have received some original communications from my youngest son, who was engaged for eight years in Queensland in practically working out the matter. He has seen deserts changed into gardens by means of the water thus found. He has met with districts where, after the expenditure of much labour and money, the water brought to the surface has been brackish, so as to be destructive instead of beneficial. Whether this same mischief will extend to the districts in South Africa where water is so much needed I cannot say. As regards injurious influences affecting vegetation, it may be interesting to remember that Sir J. D. Hooker points out, as predominant above all others, the goat. From his travels in various parts of the world, and comparing the present state of the countries through which he has passed with what has been historically reported of them, he feels himself warranted in saying that the damage done by war is insignificant in comparison with the ravages committed by goats. It is much to be regretted that they multiplied so in South Africa. The ancient nations of the East were not very far wrong in regarding the goat as a type of evil. In some parts of Africa the effects they have had in destroying forests are so striking that a detachment of the Cape Mounted Rifles on the march actually cheered when they saw a tree. The way in which the creatures do the mischief is exceedingly simple: they browse off all the young seedlings; and as the giants of the forest do not live for ever, when they fall and perish there is nothing to take their place. The rainfall then, instead of coming gradually on to the soil, falls on it in terrible deluges, interrupted by long periods of drought, and by its heavy floods washes away the soil, and carries it down into the beds of the rivers, and blocks them up, and compels the waters to spread out of their channels, and thus turn the surrounding districts into swamps. In either way the mischief done is untold. But I am no botanist, and can therefore, unfortunately, not throw any light on the main subject of Dr. Woolls's paper.

The PRESIDENT.—Ladies and gentlemen, I just wish before we close, as time is now far spent, to offer one or two observations only, with your permission. There can be no question about the extreme value and interest of this paper, and I think we may consider that our Society is fortunate in the fact that Dr. Woolls was spared long enough to complete this paper before passing to another and a better world. I think one of the chief interesting points in this paper is the reference to the distribution of the plants of

Australia. You will see from the paper that they have representatives from all the continents of the globe; and some of these migrated plants we can easily account for. We can account for the large number of Asiatic species which have travelled down the Malayan Archipelago, and for a number of the species of New Zealand and Polynesia, but when we come to Africa, with 515 species common to Africa and Australia, and to 315 species common to Australia and America (I presume South America), the problem is evidently very much more difficult to solve. But geology comes to our assistance here, because not only the plant fauna, but the recent Tertiary fauna, of South America is represented in Australia, and gives indication of a not very ancient —indeed, a most recent—connection between South America and Australia. Then with regard to the community of African species, it is also known on geological grounds—on the comparison of the former fauna of the two countries—that Southern Africa was connected with Northern India by a tract of land which is now under the Indian Ocean; and therefore we can understand how the plants migrated along this line into India, and then southwards through the archipelago of islands down into Australia. All these questions are of extreme interest as showing how very different is the distribution of land and sea, continent and ocean, at the present time, in regard to their outline, from what it was at a not very distant period of the world's history. In this manner we can account, I think, for the remarkable fact which is here stated, that Australia in its flora represents all the continents of the globe.

Surgeon-General GORDON.—There is one thing I should like to remark upon, and that is the interest with which I have listened to, and the great information I have derived from, some of the remarks that have been made, more especially on the subject of irrigation. It is within our own knowledge that, with regard to the effect of vegetation and water mutually upon each other, only a few years ago when the great Suez Canal was begun there was scarcely an atom of vegetation along it, whereas now there is a strip of vegetation springing up all along its banks. Of course the matter that was mentioned with regard to the risk that there is, and that the circumstance had actually occurred, of brackish water having been got up from the lower reservoirs instead of fresh water, simply confirms what I had previously heard, and it also gives a suggestion to those who are engaged in extending the system of irrigation to other countries.

The PRESIDENT.—It is well-known that some rocks give fresh water and others salt water. That is a thing which depends very much on the manner in which they are formed. These artesian wells pierce down into the strata which are very often of marine origin, contain sometimes salt in their pores and crevices—the salt water of the primeval ocean in which they were formed—and it is only by actual experiment that it can be determined whether the water which comes from them will be salt or fresh.

The SECRETARY, having read a few letters expressive of sympathy on the death of Dr. Woolls, said:—Having been personally acquainted with Dr. Woolls for many years, I may be permitted perhaps to add a few words to what has been said. Dr. Woolls was seventeen years old when his father died, and he went out there in the year 1831. He first was taken notice of by Bishop Broughton, the first Bishop of Sydney, who died shortly after I myself arrived in the colony. Dr. Woolls at first devoted himself to literature, and then he was appointed assistant master in Paramatta School. After that he went out to an old friend, a Mr. Cope, in Sydney, and was appointed assistant master in his school. Finally he took up the study of botany and settled down at Paramatta—that was about the year 1836—and from that time he has devoted himself entirely to the study of the botany of Australia. Sir Frederick Woolner has assured me that there was not another man in the whole of Australia who was such a capable botanist as he. (Loud applause.) I regret to say that it was only just after finishing the paper that the author was attacked with paralysis.

The Meeting then broke up.

Comments by Baron Sir F. VON MUELLER, Ph.D., M.D., LL.D., F.R.S.:—

The Council of the Victoria Institute having through its indefatigable and accomplished Hon. Secretary done me the honour of submitting to me for remarks the proof print of a treatise on the "Australian Flora," by the Rev. Dr. Woolls, I wish in the first instance to pay a tribute to the Manes of my lamented friend, whose last essay is now before us, it having become almost posthumous when it was finished. A correspondence with Dr. Woolls, which extended almost over forty years, in which epistolary intercourse we exchanged probably not less than 1,500 letters, or perhaps more, gave opportunities to numerous Phytologic discussions, he having mainly through myself been drawn into his botanic path, and during this long period, which came to a sudden end through an accident, sustained by him as an octogenarian, he contributed most zealously and thoughtfully to my collections. It is therefore with a deep interest that I now read what proves the last of his extensive literary efforts; and I fulfil with mournful feelings the wish of the Victoria Institute to offer some brief notes on his memoir.

As regards investigations on Dampier's plants, to which the author early alludes, it may here be stated that already R. Brown chose one of the plants gathered by that renowned traveller, for a dedication, and that after Cunningham's elucidations on Dampier's own ground, some further notes on the memorable xylograms given by Dampier, were promulgated by the Royal Botanic Society of Edinburgh, in its seventh volume, when I referred also to Plukenet's and Dryander's records; further that Professor Lawson, when at Oxford, added from inspection of the original material to the published elucidations on this subject

Sir Joseph Hooker, in treating for the preface to the Flora of Tasmania the development of our knowledge of Australian plants historically, refers also to Dampier's merits as a botanic observer pointedly.

Following up Dr. Woolls' notations, it is at this moment of particular interest to learn from Sir Joseph Hooker of the intention to get under his surveillance published in London very soon the original diaries of Sir Joseph Banks (his sponsors) as written during Cook's first voyage, and this is sure to throw additional light on the Australian vegetation; as for instance, the incidents connected with the earliest discovery of a Musa in our part of the globe. As affecting the recorded discoveries of Banks' and Solander it may be proper here to recollect that the elder Gaertner from 1788–1791 brought first under notice several of the plants of that expedition, chiefly from carpologic specimens. We should also not lose sight of the fact that Robert Brown's researches were not confined to continental Australia, as this great phytologic investigator had the happy chance to visit also Tasmania previously; thus indeed it was that the first alpine plants (from what is now called Mount Wellington) became known.

Why R. Brown stopped short at the volume of his celebrated *Prodromus*, in which the Ferns, Monocotyledonæ, Apetalæ, and part of the Monopetalæ are contained, is better known in Britain than here; but it is a fact which influences the bearing of that so prominent man to the systematic elaboration of the Australia Flora.

Dr. Woolls emphatically expresses what we early explorers had to endure, while often contending with hostile autochthones, not rarely famishing from want of food, and what is far more terrible, the want of water, especially in desert heat, finding our way by the sextant and compass, during lengthened time sleeping under the canopy of heaven. Few outside of Australia can estimate Allan Cunningham's position as a traveller, though his land-tracks remained not the most extensive among the lines of other land-travellers, especially when the extent of Gregory's expedition away from any settlements for nearly one year and a half is considered; but such chances as R. Brown and Allan Cunningham could seize on for coast-observations, through grand maritime expeditions, stand unique in the history of sciences. More of Cunningham's than of R. Brown's plants found their first public place in the famous suite of volumes of De Candolle; and what Professor Lindley and Sir William Hooker, and still more Robert Brown, have done for the volumes of Sir Thomas Mitchell's and Captain Sturt's great land expeditions is well recognised at home and abroad.

As Bentham has given at the commencement and at the end of the *Flora Australiensis* a *résumé* of what during the second half of the century had been accomplished for Australian phytologic exploration, and as these records regarding still later times have been supplemented by Mr. F. M. Bailey in an inaugural address at the Royal Society of Queensland, wherein his own important working is also detailed, and passingly in some publications of my own, it seems unnecessary adding to what Dr. Woolls so ably expressed in this direction. It may, however, be but right to point out at this stage of the present review, that my own personal researches fall also into the first half of the century, because the writer instituted numerous observations at and near St. Vincent's Gulf already in 1847, went twice to Murray River in 1848, and rode overland from thence in the same year to the boundary of the colony of Victoria, what was at that period almost unsettled country, mainly with the object of determining the range of Tasmanian forms of plants westward.

From merely such data it is easily understood how one of the largest of the herbaria anywhere in existence arose in Melbourne, especially as were incorporated into it by spontaneous free gift, the writer's own private collections, commenced in 1839, and as he acquired also early home collections rich in plants typic for species even back into the last century. For authentic testimony as to localities of growth, display of variability, the Australian division of our Herbarium is the richest in the world, and would under ordinary foresight serve for fundatory information through centuries. But local herbaria have been started in most of the

Australian colonies, though chiefly limited to the plants of each dominion. Endless studies, worrying perplexities, great expenses and invaluable loss of time have been saved in all these southern colonies by the vast extent of namings of specimens for the public and private collections, representing an amount of endless patient toil and application of knowledge, a boon the lasting influence of which does not impress itself readily on all the workers, who thus had cleared their paths and had guiding marks in all directions; and yet the facility and safeguard cheerfully and disinterestedly offered have hardly ever yet in a single instance throughout these colonies been recognized by a word of public appreciation of those whose researches—while working with the aid of safely-named collections—became so very much easier, or when later botanists were thereby started on their career.

Substantial gratitude would never have been expected nor accepted, but a thankful thought about the originator of the great Melbourne Herbarium is hoped for even in far futurity. Since the death of my revered friend has appeared in Professor Leveillé's *Le Monde des Plantes*, at Le Mans, a computation of the plants known up to 1892; this therefore brings the numbers and the notes connected therewith three years further than those of the second *Census of Australian Plants* from which Dr. Woolls quoted.

Where still uncertainties remained to be cleared up after local researches, the doubts were removed mainly by Bentham in the course of his issue of the *Flora Australiensis*.

Subjoined are the final results:

Statistics of Australian indigenous plants, so far as known up to the end of 1892:—

Total number of Orders of Vasculares	156
,, ,, Genera ,, ...	1424
,, ,, Species ,, ...	9021
Of these species occur in extratropic West Australia	3660
,, ,, extratropic South Australia	1969
,, ,, Tasmania	1051
,, ,, Victoria	1949
,, ,, New South Wales ..	3356
,, ,, Queensland	3873
,, ,, North Australia	2037
Admitted in the *Flora Australiensis* indigenous species (after some reductions).	7814
Additions recorded in these preliminary statistics..	1207

Proportion of distribution through the respective colonial territories :—

	Per cent.
In West Australia..	40·6
,, South Australia	21·8
,, Tasmania	11·6
,, Victoria..	21·6
,, New South Wales	37·2
,, Queensland	42·9
,, North Australia	22·5

Of the total number, 7,588 species are endemic in Continental Australia and Tasmania; therefore 1,433 or 15·8 per cent. extend also to other countries. Of these 166 are found in Europe, 1,057 in Asia, 531 in Africa, 323 in America, 638 in Polynesia, 350 in New Zealand.

Species added since the publication of the first *Census of Plants*, 375, since the issue of the second *Census*, 182, irrespective of some systematic changes or reductions.

Geographic entries added since the issue of the second Census, 555.

The total of the vascular indigenous species of all Australia will in all probability finally prove to be less than 10,000.

The deepest impression which such calculations will probably make on readers, may be caused by the amazing endemism, and should that startling emotion be merely ephemeral? The generation of the sturdy and enterprising founders of these colonies has almost passed away. Their descendants should love the flowers of their native country, should prevent defacing or demolition of even the last vestiges of the pristine vegetation, should in a patriotic spirit reserve from alienation commensurate areas wherever the sylvan or floral traits display the most marked features, and should thus seek to deserve from future beholders some feelings of admiration for providing with the loftiest of forethoughts the purest of pleasures.

Concerning the sanitary effects of the Eucalypts, dwelt on by the departed essayist, a very extensive article from my pen was furnished to the *Sydney Medical Gazette*. The successive international Exhibitions since 1855 have brought forward gradually a large mass of information on the utilitarian aspect of the Australian vegetation, and in his position as a Commissioner, even as far back as forty years ago, it fell also to the share of the writer to advance these interests by original efforts. From various sources in all our colonies, through the successive reports, accumulated technical knowledge, which could only to a limited extent be given in such a manual as the *Select Plants for Industrial Culture and Naturalisation*, of which the ninth edition (of those in the English language) will early pass through the press. Mr. J. H. Maiden, the curator of the Technological Museum of Sydney, has in an admirable volume, *The useful Native Plants of Australia*, 1889, not only collected together the scattered information extant, but has furthermore enriched the work with a multitude of original results, chiefly from his own chemical laboratory.

The active principle of the bark of Petalostigma, to which Dr. Woolls refers as similar to quinine, bears, however, no chemical resemblance to that alkaloid. Respecting his startling enunciations on the phytographic names of plants, he stands probably alone, though new vernaculars might be put forward. I might have been tempted to exercise some censorship on his communication to the Victoria Institute, had the lamented author (in a wish, as he wrote to me at the time, to pass an eulogium) not refrained from placing the manuscript before me, so that it will be best not to correct the minor inaccuracies which occur, more especially so as his essay will have been before a meeting of the Institute prior to this lengthened corollary, now supplied as desired, can reach London; and as I cannot be aware what the comments may have been at your gathering, but which on the whole must have been laudatory, even if this was not his "swan-song."

In so large a subject as that on which he treats, it is impossible to follow up his remarks very exhaustively, it may nevertheless here be stated that for Mr. Malcolm Fraser's latest West Australian year-book a general vegetation sketch of the extratropic portion of that vast territory has been provided, and this may serve as an addition of what I had written myself on various occasions since the two contributions in *Hooker's Kew Miscellany* of 1853 appeared.

Some homage is also due to Sir William Denison, who as Governor-General of Australia at his time conceived the idea of, and gave the first impulse to, the elaboration of our Colonial Floras. Indeed, in letters to myself during the earlier years of the second half of the century His Excellency detailed his views not only on the preparations of Floras but also of Faunas, and now after forty years' more research and preliminary publications the time is fast approaching when for special higher education and utilitarian application complete standard works on Australian zoology are needed; also the subject of providing "Colonial Floras" under the powerful influence of Sir Joseph Hooker, was also early promoted by your venerable and enlightened Vice-President, Sir Henry Barkly, whilst governing the colony of Victoria.

All the Australian colonies have now their local Floras, that for New South Wales by Moore and Betche, some collections for it accumulating already in Sydney through Leichhardt, soon after Cunningham had passed away, whose herbarium, however, remained not in Australia. Mr. Bailey ably furnished a synopsis for Queensland, Professor Tate an excellent manual for South Australia, bringing geology and phytology also more particularly into contact. Although West Australia with as yet a small population stood not in need of a work on its plants for local requirements, but much material was brought together already by Drummond and Preiss. Sir Joseph Hooker's work on Tasmania is world-famed, and gave also a further insight into the alpine vegetation, the elucidation of the Flora of the Australian Alps falling to the share of the writer, with a slight exception, through Dr. Lhotzky's travels.

The solid treatment of the vegetable forms of life by the genius of Bentham in the Universal Flora of the fifth continent, founded on European experiences, should tend to prevent for all future in Australia a danger from which many other regions of the globe did not always escape—the want of a rational recognition of specified limits, and the consequent undue multiplication of generic and specific definitions which has embarrassed so many of workers elsewhere. An intricate, perplexing, and burdensome synonymy could be thus, we trust, for ever avoided.

As Dr. Woolls says, for record of new forms really specific of vascular plants our Flora seems now nearly exhausted, though some South Asiatic and Polynesian plants may yet be traced across to us. The Evasculares give, however, still scope for the discovery of actual novelties and multifarious detail observations. Vast exertions are, however, still needed by local observers, particularly in the far interior regions of our continent, to fix more exactly the geographic range of numerous species of both phanerogams and cryptogams.

The venerable and erudite author had evidently in view, when engaged in this, the last of his writings, that a clearer perception should be arrived at as regards the relation of the science of plants to general requirements of life; he himself having been unceasing to diffuse information. I feel touched with the praise which he, carried too far away by the ardour of his friendship, lavished on me, and the recollections of my scientific intercourse with such a good man will remain among the most elevating thoughts of my own life. It is particularly gratifying that his long literary labours should end before the Victoria Institute, which in its religious tendencies leads always up to the highest contemplations of human destiny under divine ruling for eternity.

P.S.—Mr. Aird, of Sydney, has kindly made some corrections in the proof, consequent on the death of the learned author of the paper.—Ed.

SUB-OCEANIC VALLEY OF THE RIVER CONGO.

PLATE I.

Harrison & Sons, Lith.
S. Martins Lane, W.C.

Isobathic Contours from soundings on the Admiralty Chart No. 604.

ORDINARY MEETING.*

THE REV. CANON GIRDLESTONE, M.A., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed, and the following elections took place :—

MEMBER :—S. P. Klein, Esq., M.A., F.R.A.S., F.L.S.

ASSOCIATES :—E. J. Gardiner, Esq., Kent ; J. Walter Brown, Esq., Wilts.

The following paper was read by the Author :—

THE SUB-OCEANIC RIVER VALLEYS OF THE WEST AFRICAN CONTINENT AND OF THE MEDITERRANEAN BASIN. By Professor EDWARD HULL, LL.D., F.R.S., F.G.S. (With Map.)

HAVING on former occasions laid before the Victoria Institute the evidence for recognising that the rivers which enter the Atlantic from the British Isles and Western Europe have their channels carried down to a depth of several thousand feet under the water of the ocean,† I have now the honour of extending these descriptions to the coast of West Africa, as far as the valley of the Congo. In the discussion which took place after the reading of my paper on "The Sub-oceanic terraces and River Valleys of Western Europe," Professor Etheridge, F.R.S., expressed a hope that I would continue my investigations beyond the Straits of Gibraltar to the south-western extremity of Africa‡; and, feeling certain in my own mind that these straits could not form a physical limit to the submarine features characterising ~~the coast~~ of Europe, I determined to follow my ~~friend's advice, with the results I am now~~ about to lay before the Institute. I may observe, however, that as the possibility of carrying out these investigations

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* February 19th, 1900.

† *Trans. Vict. Inst.*, vol. xxx, p. 305, and vol. xxxi, p. 259.

‡ *Ibid.*, p. 290.

depends altogether on the number and extent of the soundings on the Admiralty Charts, we can only restore the submarine features where these soundings occur in sufficient number, and are extended to considerable depths.

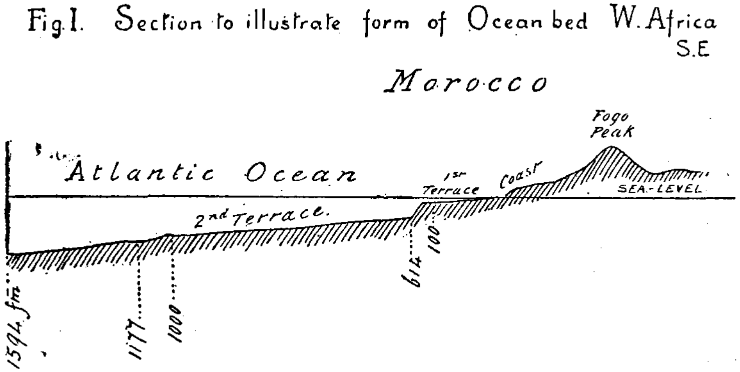
My subject naturally divides itself under two heads: first, the western coast of Africa; and, secondly, the Mediterranean basin.

PART I.

SUBMERGED PHYSICAL FEATURES OFF THE WESTERN COAST OF AFRICA.

1. *The Continental Platform.*—The gently sloping terrace extending out from the coast of Western Europe known as "The Continental Platform" loses much of its importance, or sometimes altogether disappears, to the south of the Straits and passes into a more or less gradual slope, from the 100-fathom contour to that of 1,200 fathoms. This slope, in all probability, consists of a succession of minor terraces breaking off in cliffs; but it would be difficult to determine this with certainty unless with the aid of maps on a large scale containing very numerous soundings. We were somewhat prepared for this remarkable change in the character of the submarine litoral of the two continents by the contraction of the Continental Shelf on approaching the vicinity of Cape St. Vincent, where it has contracted to a breadth varying from 10 to 20 miles. Directly opposite the Straits of Gibraltar and again along the coast of Morocco, between 31° 10′ N. and the Canary Islands, there occurs a broad terrace extending for about 50–60 miles in breadth between

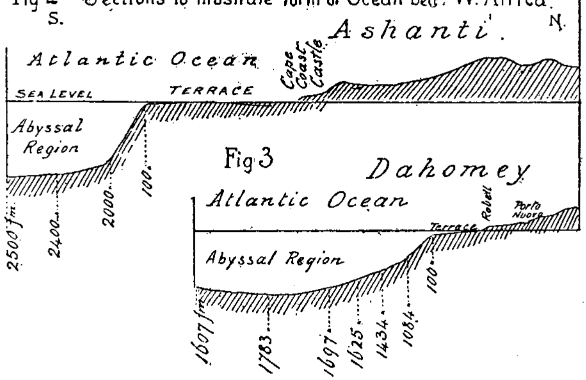
Fig. I. Section to illustrate form of Ocean bed W. Africa



the 500 and the 1000-fathom contours, which may be taken to represent the Continental Platform at a lower level (*see* Fig. 1), and indicates a prolonged pause in the process of elevation or depression of the crust at this stage.

Along some parts of the coast, however, the descent into deep water is very rapid, sometimes precipitous. Such is the case along the Ivory Coast and the Bight of Benin, where the descent from the 100 to the 1,200-fathom contour is precipitous. Off Cape Coast Castle the base of the escarpment descends to over 2,000 fathoms (Figs. 2 and 3).

Fig 2 Sections to illustrate form of Ocean bed. W. Africa.



From Cape Lopez southwards along the French Coast and as far as Cape Lombo in Loanda, the soundings on the charts are few, except in the vicinity of the Congo, but they indicate a wide expansion of the Continental Platform from the coast to the 100-fathom contour—in striking contrast with the precipitous coast described to the north of this tract.

2. *Base-level of Erosion, or Old Coast Line.*—Assuming the base of escarpment, or declivity, which descends from the margin of the Continental Platform, to be the original land margin at the time that the sub-oceanic rivers were eroding their valleys and pouring their waters into the ocean of that period, we are always able to define its depth with great accuracy when we know the level at which the rivers open out on the sloping plane of the abyssal region, and we have seen this level to be at (approximately) 1,200 fathoms (7,200 feet) below the surface off the coast of Western Europe. But where rivers are absent, as along a large

extent of Western Africa, and where the descent into the abyssal region down to, say, 2,000 fathoms and upwards is rapid, or almost continuous, as off the coast of Ashanti (Fig. 2), it is difficult or impossible to define the level of the old coast during the period of maximum elevation, because we are confronted with the question;—Was the bed of the ocean actually raised to the extent here indicated by the base of the escarpment, which is so much deeper than that shown in other places, or did deep water extend to the very edge of the land? We cannot answer this question. It is fortunate for our purpose that the *embouchure* of the Congo valley at a depth of 1,200 fathoms is very clearly defined; but along many parts of the African coast there is apparently no very marked change of gradient from below the 100-fathom contour till we reach depths of 2,000 fathoms and upwards, as is the case off Cape Coast Castle. It is possible to assume that in such cases the vertical movements both of elevation and depression have been greater than those which characterise the submarine lands of Western Europe; and on reflection this appears probable, as it is not to be supposed that throughout a coast-line of 3,000 to 4,000 miles the amount of vertical oscillation would be exactly the same throughout. Variations to some extent are more than probable.*

3. *The Submerged Valley of the Congo.*—In dealing with this subject I feel that an apology is needed, because this is almost the only river on the west coast of Africa of which the continuation of the channel under the ocean has been described by previous authors. I might well have brought my own investigations regarding the sub-oceanic river valleys of the eastern side of the Atlantic to a close on reaching the Straits of Gibraltar, but when describing the submerged channel of the Tagus, and showing to what a great depth it could be traced, it became evident that the Straits could not be regarded in any sense as a physical limit to the region of elevation and depression, but that it must have extended far southwards along the coast of Africa itself. From the actual investigations I shall now lay before you, supported as they are to a great extent by those of other writers, I hope

* It is to be recollected that the submerged river valleys and the base of the great declivity off the coast of the British Isles corresponds rather to the 1,000-fathom contour, while off the coast of Western Europe they are represented by the 1,200-fathom contour.

to show beyond question that these great terrestrial oscillations of level which have characterised the coast of the British Isles and of Western Europe are continuous, and undiminished in extent, far beyond the equator itself—and that the lands bordering the eastern Atlantic, through its whole extent, have been subject to the same vertical movements which, as we have seen, characterise those of the region to the north of the Straits of Gibraltar.

Reference to Previous Authors.—In 1887, Mr. Edward Stallibrass, F.R.G.S., read a paper before the Society of Telegraphic Engineers on "Deep Sea Soundings in connection with Submarine Telegraphy," * in which he describes the sub-oceanic channel of the Congo, and traces it from its upper limit, where the river itself enters the Atlantic, down to the 1,000-fathom contour, giving the length of the channel at 100 miles. The map which accompanies his paper showing the course of the submerged Congo agrees very closely with my own, but is on a smaller scale than that of the Admiralty Chart, and fails to give the full length of the submerged channel, which actually extends some 20 miles farther out to sea than is shown by this author.

In the remarkable paper contributed by Mr. Warren Upham, of the United States Geological Survey, on the "Causes of the Ice Age," in which he indicates his opinion, founded largely on the existence of the submerged valley of the Congo, that the great "epeirogenic movements" which characterised the close of the Tertiary period embraced the western side both of Europe and Africa, he states that, from soundings carried out by Mr. J. Y. Buchanan for telegraphic purposes, he found the channel of the Congo to extend 80 miles under the ocean, and to a depth of more than 6,000 feet, and he proceeds to give further details regarding the breadth and depth of the channel.† Here, then, we have two independent authorities for the existence of this great sub-oceanic river valley. Both, however, fail to give the entire length of the valley, and, therefore, to give an adequate idea of the extent and depth of this magnificent submerged cañon; it will, therefore, not be considered a wholly gratuitous undertaking if I attempt a description of it drawn from my own examination of the soundings on the Admiralty Charts.

The Congo.—The Congo is one of the largest rivers of the

* *Journ. Soc. Teleg. Engineers*, vol. xvi, p. 479.

† Warren Upham, *Journ. Vict. Inst.*, vol. xxix, p. 218. Mr. Upham quotes the *Scot. Geog. Journ.* vol. iii, p. 217 (1887).

African continent, and enters the Atlantic Ocean in lat. 6° S. Its depth opposite Banana Creek only reaches to 9 fathoms (54 feet), but at a distance of 5 miles to the westward under the ocean, the soundings suddenly plunge down to depths of 228 and 242 fathoms (1,368 and 1,452 feet) representing the head of the sub-oceanic river valley; at this point its breadth is about 2 miles, with well-defined, steep or precipitous sides. At a distance of 50 miles from its head, the breadth of the cañon has increased to 10 miles, and its depth to 813 fathoms (4,878 feet) from the surface, or 713 fathoms (4,278) from the edge of the Continental Platform—here represented by the 100-fathom contour. From this point the descent of the floor is gradual for the next 57 miles, when it reaches its maximum depth of 1,200 fathoms (7,200 feet) below the surface, and opens out on the general floor of the abyssal ocean, bounded by banks of moderate depth and steepness. The total length of the cañon from its head below Banana Creek to its *embouchure* is about 122 miles. Throughout this distance, owing to the remarkably uniform slope of the floor of the ocean from the 100-fathom contour downwards, there do not appear to have been any great falls or cascades such as occur in the submerged channels of some of the European streams. (See Plate.)

In order to realise the length of this sub-oceanic valley we have to compare it mentally with distances with which we are familiar, and I have taken a few of these at random; speaking in all cases approximately. For example, the sub-oceanic valley is twice the distance from Kingstown to Holyhead in crossing the Irish Channel; it is more than twice the distance from London to Brighton; it is longer than the distance from London to Bristol or Birmingham, and it would take a train three hours to traverse, travelling at the rate of 40 miles an hour—which is the average speed of "through" trains for long distances. These comparisons may, perhaps, enable the reader to realise the magnitude of this great submerged river valley. Then we have to recognise that the breadth of this gorge, near its centre, is seven miles, and it is bounded in some parts by nearly vertical cliffs more than 4,000 feet in height. As far as I am aware there is no physical feature in Europe to compare with it.

One would like to further dwell on the characteristics of this magnificent submerged valley; but I am restrained by the consideration that I might be charged with unduly giving way to fancy for my facts.

4. *The Grand Bassam.*—Another West African submarine channel is that of the Grand Bassam (lat. 5° N.) described by Mr. Stallibrass. The Continental Platform is here from 40 to 50 miles broad, with a gentle slope to the margin of the 100-fathom contour; and across this shelf the old river channel is traceable, with a well-defined margin to the 400-fathom contour and beyond. This channel is called on the Admiralty Chart "The Bottomless Pit," and was sounded by the officers on board the S.S. "Buccaneer" in 1886. The submerged channel is probably that of the River Akha, which now enters the sea about 15 miles to the east of the point where the channel begins. I am unable, owing to the paucity of soundings, to add any further information regarding this sub-oceanic channel to that given by Mr. Stallibrass in the paper already quoted.

5. *The Niger or Quarra.*—It might have been expected that concurrently with the well-developed sub-oceanic channel of the Congo there would be one continuous with that of the great African river, the Niger. This may be so; but unfortunately we are unable to ascertain the fact, because the soundings on the Admiralty Chart fail us just where we might expect the channel to be found. Along the Bight of Benin on both sides of the mouth of the Niger, the soundings are sufficiently numerous to enable us to trace approximately the isobathic contours, showing that the land descends from the 100-fathom to below the 1,000-fathom contour with a very steep, almost precipitous, gradient; but between long. 6° 30′ and 7° 5′ the soundings are shown only twice, viz., those of 228 and 270 fathoms, neither of which had touched bottom, and, therefore, give no certainty regarding the actual depth. Until this gap in the soundings is filled up the form and extent of the submerged channel of the Niger, supposing such to exist, must remain unknown.

6. *The Orange River.*—This is the third of the great rivers opening out on the ocean from West Africa, and it would have been interesting to know whether or not it has a sub-oceanic channel indicating vertical oscillations of the floor extending to the very south of the continent; but I have only the same statement to make regarding the soundings off the mouth of the Orange River that I have made above regarding those of the Niger. They absolutely fail us just where they are most wanted for the purpose of determining the existence of a submarine channel continuous with that of the Orange River itself.

PART II.

THE MEDITERRANEAN BASIN—SUBMERGED RIVER VALLEYS.

That the Mediterranean Basin, at least in its western portion, must have partaken in the great vertical oscillations which have affected the regions bordering Western Europe and the continent of Africa requires no proof. The general elevation of the ocean-bed and adjoining lands to the extent of 7,000 or 8,000 feet through a distance of over three thousand miles must have influenced the regions embracing the Mediterranean and bordering countries. But while this is the case, it is not to be expected that the physical features of the submerged lands should be as clearly developed within the confined area of the Mediterranean Sea as along the shore of a great ocean extending for thousands of miles in two directions, and exposed to the action of prevalent westerly winds originating powerful wave action on the opposing coast. To such action we owe the cliffs bordering the British and Continental coast along the Atlantic, the formation of the Continental Shelf, and the stupendous line of cliffs by which it is bounded.* These features, however, are not so clearly defined within the Mediterranean area, if at all in some parts; but the submarine coast is found to descend into deep water by a broken slope, continuous with the bordering lands down to a depth of 1,000–1,200 fathoms, when it gives place to the abyssal region, which descends to depths of over 1,500 fathoms. As a consequence of this, and as we might *a priori* expect, the submerged river valleys are also less clearly defined than those off the coast of France, Spain, Portugal, and, we may add, of West Africa.

The submerged channels which I have succeeded in tracing on the Admiralty Charts are those of the Ebro and Rhône, as also that of Admiral Spratt between "Adventure Bank" and Cape Bon; but I will take this opportunity of bringing before the members of the Institute the remarkable discoveries of similar channels made by Professor Arturo Issel off the northern coast of the gulf of Genoa, which

* It may seem strange that the same causes, namely, vertical movement of the crust and wave action along the border of the ocean, should have produced two such dissimilar features as the Continental Platform and the Great Declivity, but it can be shown that this is so; the difference in the features being due mainly to the relative duration, or length of time between the two components above referred to.

are of special interest as tending to confirm the conclusions arrived at by myself in this and preceding communications.

1. *The Submerged Channel of the Ebro.*—The number of soundings off Cape Tortosa is not as numerous as might be wished for the purpose of determining the course of the submarine channel of this river; still, the inward bend of the contours from that of 40 fathoms down to that of 1,000 fathoms, immediately opposite the mouth of the river, cannot be mistaken as indications of the course of the channel.* Along the Gulf of Valencia the representative of the Continental Shelf is unusually broad and well defined, breaking off at the 100-fathom contour at a distance (opposite Valencia) of 60 miles from the coast, and with a very steep descent for a depth of 500 fathoms.

2. *Channel of the Rhône.*—The submarine channel of the Rhône is perhaps even more definitely indicated than that of the Ebro by the inward bend of the isobaths, extending from 100 to 1,200 fathoms. The channel commences directly south of the city of Marseilles at a distance of about 30 miles to the east of the point where the river itself now enters the sea; but it is in a direct line with the course of the main stream below Arles; and between the two points the submerged channel may be supposed to pass along the Continental Shelf; though not apparent owing to silting up, as is usual at the *embouchures* of large rivers. The shelf itself is here of considerable breadth—varying from 50 to 25 miles in the Gulf of Lyons, and limited by the 100-fathom contour.

3. *Submerged River Valleys of the Gulf of Genoa.*—The remarkable series of submerged river valleys continuous with the rivers which descend from the Apennines into the Gulf of Genoa (the Ligurian Sea) have been determined by Professor Arturo Issel, of the University of Genoa, and are of peculiar interest both from their number and also from the light they throw upon the geological age of these submarine channels. These river-channels were described as far back as 1887 by Professor Issel, and subsequently in two other publications; but have not received, at least in this country, the attention they have deserved. I,

* The sounding "928" without touching bottom, and in close proximity to one of 137, which has done so, indicates a very steep slope for the western margin of the channel (see Chart No. 2158A).

therefore, feel great satisfaction in being the channel for bringing them before an English-speaking audience.*

The soundings upon which the determination of the submerged valleys depend were carried out by Capt. I. B. Magnaghi in the ship "Washington," of the Royal Italian Navy, and were laid down on a chart which enabled Professor Issel to trace the isobathic contours by which the submarine features of the ground have been portrayed. It was found that the sinuosities became especially well defined along the contour of 200 mètres (about 110 fathoms) which marks the edge of the Continental Platform at a distance of about 7 miles from the coast; they are called "*Sinuosites profondes*" and are always directed towards the coast.

The contour line of 500 mètres passes 25 miles to the south-west of Spezia; that of 1,000 mètres is irregular and runs at variable distances of 8 to 14 miles from the coast; all, however, are "notched" by sinuosities of the submarine valleys.† But the point of special interest is the fact that all these submarine channels are actually, or inferentially, continuous with those descending into the sea along the coast of Liguria and having their sources in the Maritime Alps. The following are named by Professor Issel, viz.:—the Basagno, Polcevera, Giuliano, Aquila, Merula, Arma, and the Roida; these streams keep their channels under the sea in the same directions as upon the land, and can be distinctly followed to a depth of 900 mètres, or nearly 500 fathoms. These observations lead the author to the conclusion that there has been an elevation of the whole region of Liguria to the extent of 900 mètres (about 3,000 feet), at a recent period (*à une époque récente*)—in other words Post-Tertiary —a conclusion in harmony with that arrived at by myself and other observers on other grounds. But I must here state the grounds of this conclusion as given by Professor Issel himself.

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* Professor Issel's observations on the submerged valleys of Liguria were first published in the *Comptes Rendus des Sciences*, Nos. 24th and 31st January, 1887; then in his work, *Il Terremoto del* 1887 *in Liguria* (Genova), and again in his work, *Liguria Geologica e Preistorica* (2 vols., Genova, 1892).

† I have myself endeavoured to trace these contours on the Admiralty Chart (No. 2158A), but the scale is too small to admit of a detailed representation of the small river valleys described by Professor Issel, and leads me to conclude that, with maps of sufficiently large scale and numerous soundings, many streams entering the Mediterranean might show their underground channels.

Geological Conditions.—The valleys which descend from the Alps are eroded through strata of successive geological ages in an ascending series as we approach the coast; thus the valleys of the Basagno, Polcevera, the Merula, and Arma are eroded through Eocene strata, but the Roida valley is eroded through both Eocene, Miocene, and Pliocene formations. And as this valley (as well as the others) is prolonged under the waters of the Mediterranean, it follows that the valley is of a newer geological epoch than the Pliocene, through which it is eroded; in other words, it is of Post-Pliocene age. This exactly brings us to the epoch to which I had ventured to refer the elevation of Western Europe and the formation of the sub-oceanic river valleys, and it is eminently satisfactory to have such confirmatory evidence. Such an elevation of the Alpine region as that determined by Professor Issel, namely, some 3,000 feet as a minimum, during the Post-Pliocene or Glacial period, would go a long way to account for the great accumulation of snow, and the extension of the glaciers beyond their present limits, which we know to have taken place at that epoch. But the elevation has been doubtless even greater, as inferred from the depth to which the sub-oceanic valleys have been traced, along the western European coast, as well as in those of the Ebro and Rhône above described. The soundings made by the officers of the "Washington" may not have extended far enough out to sea to permit Professor Issel to trace the river valleys further than the 900-mètre contour, but the valleys themselves probably descend to greater depths, involving conditions of greater elevation, and subsequent depression.

General Conclusions—Long duration of the Post-Pliocene Period.—From the above statements it will be apparent that the phenomena of terrestrial elevation, resulting in the formation of submarine valleys, and of subsequent depression, resulting in their submergence, which have been demonstrated in the case of Western Europe and the British Isles, are fully borne out by the soundings off the coast of Africa and within the Mediterranean. They are all in harmony, and point to an elevation of the lands bordering the Atlantic to the extent of about 7,000 to 8,000 feet, and subsequent depression during a period geologically "Recent" or "Post-Tertiary." Professor Issel's determination of the age of these great movements, based on geological grounds, coincides with my own, drawn from other sources. And in order to give time for the natural (or physical) operations involved, namely, the erosion of wide and deep valleys, the sculpturing of extensive lines of coast rising several thousands of feet above their base, and the levelling down of a continental platform sometimes one hundred miles broad, from which the existing continents and islands spring—all these operations necessarily involve a lapse of time of long extended duration;—much longer than that which many of us were disposed to grant to the period succeeding the Pliocene.* Such a prolonged period, however, gives time for the great extension of glacial conditions which necessarily accompanied the elevation of the land, together with the subsequent submergence which characterised the Inter-Glacial epoch—during which portions of the British Isles were submerged to the extent of 1,200 feet, and the ultimate emergence which resulted in bringing about (approximately) the existing distribution of land and sea. Movement is still going on, but apparently on a less stupendous scale than in Post-Tertiary times. But to this subject I may probably return on a future occasion.

The CHAIRMAN (Rev. Canon GIRDLESTONE, M.A.).—I am sure all will be glad to pass a vote of thanks to the able author of this paper. (Cheers.) I will now ask the Honorary Secretary to read some correspondence which has been received.

Captain F. PETRIE, F.G.S.—The first letter is from Professor T. Rupert Jones, F.R.S. He says :—

This is a well considered and highly cymmendable continuation of Professor E. Hull's former conclusions as to the extent and character of the submarine extensions of the rivers, from the western coast of Europe, across the continental plateau and ancient coast line into the abyssal region. The work is now carefully continued along the west coast of Africa and within the Mediterranean area, partly by the application of the soundings given in the Admiralty charts; partly by the hydrographic map,

* Professor J. W. Spencer, in a recent letter to the author, has suggested this view of a prolonged period in Post-Tertiary times.

constructed by Mr. Stallibrass, Telegraphic Engineer, especially for the mouths of the Grand Bassam, the Niger, and the Congo rivers; and further with the special help of Professor A. Issel's researches on the submerged valleys of Liguria in the Bay of Genoa. These Alpine valleys having eroded Tertiary strata of the late Pliocene stage, the elevation of their water-shed must have been of Post-Pliocene date, and intimately associated with the great Ice age; and this is in accordance with already accepted theories. The subsequent erosions making terraces, cliffs, and cañons, must represent enormous lapses of time; and these protracted periods were followed, by the great submergence, probably quite slowly accomplished, accompanied with the gradual formation of ancient cliffs, and terraces, and the present existing coasts. These last also exhibit evidences of subsequent vertical oscillation, sometimes on a grand scale.

Cavaliere JERVIS, F.G.S., Turin, writes:—

We are led to infer from Professor Hull's investigations that the duration of the Post-Pliocene period, required in order to produce upheaval on the grandest scale over such a considerable area, must have ushered in the Glacial period in quite as gentle a manner as that in which contemporaneous geological movements take place. Both the number and relative state of preservation of submarine river valleys, and the oceanic platforms would likewise confirm the similar character of the subsequent depression, by which the glacial zone was gradually reduced to its present limit. Further, such marked features of the submarine valleys of existing rivers, conclusively show that their still emerged courses must have been already sculptured much as at present. Thus, the physical features of mountains and valleys at the present day (where not passing through still newer strata), are but the continuation—the finishing touch, as it were—of what already existed in later geological times, no intermediate break having occurred. Roman structures, built eighteen centuries ago, are common in towns situated in Alpine valleys, surrounded on either side by mountains many thousand feet high, in striking contrast to which the rivers now flow at a level of from 30 to 40 feet lower down, nor did the ancients build at the level of the river.

Thus, coming down to our own times, I am of opinion that more ample data are required in order to establish generalizations regarding the participation of the Apennines in the latest submergence which took place, unless they were subjected to a subsequent emersion, basing my argument upon the great geological differences between them and the Alps with the two N.W.-S.E. chains of mountains to their south. Professor Sacco alludes to Pliocene clay rising to the height of 500 metres (1,640 feet), at Pianfei (Cuneo). Strata of the same age, abounding with marine mollusca, largely of species still living in the Mediterranean, are among the commonest along the lower skirts of the Apennines, from one extremity to the other, often overlaid to considerable elevations by Pleistocene clays, sands, etc. Balducci found Pliocene strata in Sicily at the height of nearly 1,000 metres (3,200 feet). On the southern slope of the Western Alps, Pliocene strata are by no means common, and these towards their base, an apparent indication that subsidence occurred differently in the Apennines to what it did in the Alps.*

If this view be correct it may be inquired whether certain fractures may not have resulted from the greater subsidence of the Alps in which the Apennines participated to a far lesser extent. At their base, approximately parallel to their axis we find intrusive rocks of various periods, such as granite at Cavour and Traversella (*Turin*); syenite at Quittengo, and granite at Biella, Pella, and Baveno (*Novara*), basalt (*Vicenza*); trachyte in the Euganean hills (Padua). It is a question which remains to be investigated.

[The Rev. Professor BLAKE, F.G.S., took part in the discussion, and expressed the view that the sides of the submarine channels consisted of mud brought down by the rivers and deposited on either hand of the current.]

Mr. HENRY BENEST.—It has afforded me much pleasure to be present this afternoon, as the subject of Professor Hull's paper is one in which I take more than a passing interest. Last year I was favoured by the Secretary of the Geographical Society with an invitation to an afternoon lecture by Professor Hull, and found that his views coincided in some respects with those that I entertain myself, and, in fact, I had a paper before the Geographical Society at that time, which subsequently appeared in the Journal; from observations of the sea bottom, which have come within my

* There are none. It was the period of "the great elevation."—E. H.

own experience while fishing up and repairing broken telegraph cables. Cable repairing, requiring as it does close and careful survey, necessitates sounding at distances of perhaps half a mile apart, whereas in ordinary deep sea surveys for cable laying purposes sounding at distances of 10 to 12 miles apart have been considered sufficient. This close examination of the bottom by sounding enables us afterwards to draw contour lines that map out the configuration of the ground upon which the cable lies, and this has been our practice for the past 20 years. Sometimes we find it to be variable and uneven. This survey forms a very interesting study in itself, apart from the exigencies of cable operations, and one is loth to confine it to the area of the work in hand. I have wondered that the owners of steam pleasure yachts have not emulated the example of the Prince of Monaco, Mr. Coats, and a few others, and have taken up this subject as a pleasant and interesting field of research, the outfit required being light, simple, and comparatively inexpensive. The soundings taken over the Bottomless Pit by the Silvertown Company's telegraphic steamer *Bree* in 1886, and to which Professor Hull refers, were under the supervision of Mr. J. Y. Buchanan. The latest corrections show the width of this gully at a mile and a half from the shore to be less than one mile, with a depth of 170 fathoms. At about 7 miles from shore, the width is 2 miles, with a depth of 327 fathoms. At about 9 miles off, it widens to nearly 5 miles with a depth of 452 fathoms. The slopes of the sides averaged in some parts 2,000 feet per mile. During cable repairs in other localities more or less similar features to these have been met with, notably in vicinity of Cape St. Vincent and of the supposed sub river outlet of River Parvinas, North Peru; but I think the most remarkable instance that I know of, and one outside cable work, is the depression called on the Admiralty charts, "the Swatch of no ground" off the mouth of the Ganges. This gully formation is from 6 to 12 miles wide, with a maximum depth of close on 600 fathoms, with 75 and 80 fathoms to each side. From the fact of these submarine gullies existing, I am inclined to the belief that in some instances they are evidence, not only of possible ancient river courses, but of probable present outlets for freshwater escapes beneath sea level.

Commander HEATH, R.N.—The formation of the deltas of rivers is pretty well known to us, and they are formed at all rivers by the silt there running down; but one effect of the constant running down is that the silt is deposited almost immediately, and in no case, that I am aware of, can you find outside the bar of the river, outside the deepest of the rivers, any trace of the river channel beyond the sea. You get at once into the normal depths of the sea bottom. As to the question of no deposit being found at the mouths of ancient rivers in abyssal depths, may not it be accounted for by the want of the alluvial soil which is in existence now and which is now brought down in large quantities? But was there at this time, any quantity of alluvial soil which if brought down would form those deposits and terraces at the mouth of a river?

The CHAIRMAN.—As time is advancing, I will ask Professor Hull to reply to the points that have been brought forward.

Professor HULL, F.R.S.—I am very pleased that Mr. Benest, who is familiar with this subject, is present this evening. What he said about the Ganges is very interesting, and it strikes me, if we had the necessary soundings made, some very important results would arise as regards the former extension of the great Indian Peninsula—that we should find it was vastly greater than now if those river valleys could be restored to their original positions. I am also glad to have heard Captain Heath's observations. As regards the spreading of the sediment at the mouth of the river we have exactly what Professor Blake referred to; the old river channel of the Congo no doubt extended far up into the land and is now filled with silt, and that sediment runs out to this point in the ocean,* and has filled up the original valley.

Professor ORCHARD.—Might I ask whether you refer all these submerged tracts to one source? Do you suppose that they all occurred in or about the same epoch in geological history?

Professor HULL, F.R.S.—Yes. I would remind you that these sub-oceanic channels are not peculiar to the eastern side of the Atlantic, but that they have been recognised on the western side as well. Professor Spencer and others,—have recognised them along the coast of America. So that the whole region of the Atlantic underwent some great physical change.

The Meeting was then adjourned.

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* Indicated by the 228 and 242 fathom soundings.—See Map.

COMMUNICATION RECEIVED.

Professor J. LOGAN LOBLEY, F.G.S., writes:—

All geologists ought to be grateful to Professor Hull for continuing his investigations of the ocean floor along the eastern side of the Atlantic. The results of these investigations are geographically highly interesting, but geologically they are more than interesting, they are exceedingly valuable.

Apart from the submarine ravines revealed, the continuation of the continental platform from Iceland in the north, to the south of the equator, is a most important fact, from which only one conclusion can be drawn—that there has been a general subsidence of the western parts of Europe and Africa from a former higher level. The suggestion that this great terrace, at the summit of a steep ascent of thousands of feet, and, with the exception of far separated indentations, continuous for thousands of miles, has been formed by the deposition of material at each side of the mouths of existing rivers that have brought it from the interior lands, is altogether untenable, for it will not for a moment bear examination.

If this be so, the formation of the depressions crossing the terrace has obviously been by subaerial water erosion, and the position of these depressions with respect to present river valleys undoubtedly points to the former continuation seawards of these valleys and their excavating rivers.

The great depth of the submarine ravines, however, if the whole has been due to subaerial erosion, requires such a great elevation of enormous areas of land in late geological times, that some hesitate to accept this conclusion. But other evidences of great changes of level in Post Tertiary times, the consideration that 5,000 feet is but the $\frac{1}{8000}$ part of the diameter of the globe, and that such an elevation affords the most simple explanation of the cause of the Glacial epoch, ought to lessen the disinclination to accept conclusions which have been drawn by Professor Spencer, Mr. Warren Upham, and Professor Hull, from the phenomena of the Atlantic floor both in its western and its eastern margins.

One apparent inconsistency is the greatness of the submarine ravine attributed to the lesser River Adour and the smallness of that attributed to the greater River Gironde. This, it seems to me, admits of a complete explanation, as I endeavoured to show to the Institute in a recent paper; for, with elevated and consequent glacial conditions as well as during the subsequent subsidence, there would be converging on the ocean shore opposite to where is now the bight of the Bay of Biscay, vastly greater erosive power than at any place further north.

Evidences of the upheaval of the whole of the Iberian peninsula, and not merely of its western side, are not wanting. Professor Hull gives some facts as to the sea bottom of the Mediterranean opposite the mouth of the River Ebro. It seems to me, however, that the Ebro Channel, before the subsidence and the formation of the present delta, took a southerly direction. There is a very decided indentation of the continental platform, having a northerly direction from nearly opposite Valencia, and extending northwards between the Columbrates Isles and the coast at Castellon. It points directly to the Ebro at Tortosa before the delta is reached by that river. The present mouth of the Ebro at the Cabo de Tortosa I regard as having a quite different direction and being consequent on the formation of the delta of which the Cabo de Tortosa is the most eastern point. Opposite to the delta of the Ebro the sea bottom descends from 200 metres depth to 1,000 metres in a distance of 10 kilometres, but this is at a distance of from 90 to 100 kilometres from the old coast line on the landward side of the delta.

An explanation of the glacial conditions that undoubtedly prevailed over vast areas of the northern hemisphere during Pleistocene times, must be regarded as a most important geological result, and believing that continental elevation will afford this explanation, and that the investigations of Professor Spencer and Professor Hull furnish cogent evidence of such elevation, I think they deserve the hearty thanks of all geologists.

ORDINARY MEETING.*

PROFESSOR E. HULL, F.R.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed. The following paper was then read :—

THE HUMAN COLOUR SENSE, AND ITS ACCORDANCE WITH THAT OF SOUND, AS BEARING ON THE "ANALOGY OF SOUND AND COLOUR." By Dr. JOHN D. MACDONALD, I.H.R.N., F.R.S.

IN dealing with the sense of colour it is usual for writers to affirm that "colour is in fact an internal (subjective) sensation," and has no external and objective existence, but surely this can only be true in part. Now that we are able to obtain colour as well as outline light and shade in photography, objective conditions must be present in all. The word subjective is only applicable where colour vibrations are induced in the nerve terminals independently of any corresponding objective vibrations impinging on the retina. We are still confronted by the "*ultimate fact*" that a certain wave length will induce in us the sensation of *Red* and not *Blue*, and *vice versâ*, while the intermediate wave length will induce *Yellow* and nothing else. We may use the word subjective in this connection, but it gives us no further insight into the true cause of a specific colour sense.

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* Monday, 1st February, 1897.

Nor does the following gratuitous supposition do anything more than send the inquirer farther, which is the usual effect of all attempts to clear up ultimate facts. *A Trichromic Colour Sense* seems to have sprung out of the doctrine of three primary or fundamental colours, though a tripartite constitution of light is untenable on scientific grounds. As set forth by Professor Church, "Young's theory of colour perception amounts essentially to this, that in each minute elementary part of the retina of the eye there is at least one set of three different nerve fibrils (whether 'cones' or 'rods'), each of the three fibrils of a set being especially adapted for the production of its specific colour sensation, yet in a less degree of the two others. Thus, the receptive structure of the retina as a whole may be said to consist of an immense number of nerve fibrils of three orders, what we may call red fibrils being particularly acted upon by such long light waves as those in the red, but being also stimulated in a minor degree by the shorter waves in the green, and still less by those in the blue. The green fibrils will respond most actively to green waves and in some measure also to red and to blue waves; while the blue fibrils will be most excited by blue waves, though not uninfluenced by green and even by red waves. It follows that when all three kinds of nerve fibrils are equally and simultaneously affected, the complex sensation of white is alone produced." In the above statement as far as Young was concerned Violet should be substituted for Blue. In his selection he obviously laid stress on the question of refrangibility, which is least in Red, most in Violet, and intermediate in Green; but if the octave Red (760) were visible, Blue (570) would undoubtedly be in the mean of refrangibility, and this would be in keeping with the musical analogy, the 5th G, holding an intermediate position between the 1st C (380) and its 8th or octave C (760). But to return to the argument. If the nerve terminals are accredited to be the recipients of the three so-called primary colours, though in different degrees, one having the predominance to aid the trichromatic theory, it would be just as reasonable to suppose that each of those nerve terminals were equally susceptible of the impact, not even of all the three primary colour waves, but also those of the intervening hues. This would do away with the necessity for the co-operation of two or more nerve elements in the perception of every ordinary mixture of colours, a complex physiological condition which would infallibly give rise to minute interruption in any simple wash of colour, in which nothing of the kind is perceptible to the normal eye, no matter what the hue or tint may be.

Helmholtz's independent theory is practically the same as that of Young, but he has simply carried inventive histology one step further, and thus given additional force to the foregoing argument and the legitimate deduction drawn from it. As to the support which certain forms of colour blindness are supposed to yield to this theory, the matter will not bear close investigation, and certain other considerations may be adduced to meet any apparent difficulty in the case. We are thus brought back to the simple but sound exposition of the physiology of the colour sense given by Newton himself, and have gained nothing by setting it aside. He held that all the nerve filaments of the retina were equally sensitive to the different prismatic hues whose specific vibrations were thus in effect conveyed to the centre of perception. Dr. Rutherford, F.R.S., in his excellent address delivered before the British Association in Edinburgh, 1892, contends very naturally that "we should refer our different colour sensations to differences in the nerve vibrations transmitted from the optic terminals rather than to specifically different activities of cells in the vision centre."

In reference to the pseudo-anatomical refinement of the Young-Helmholtz theory, Dr. Rutherford or any other anatomist must fail to see a tripartite constitution in the retina which such a view would necessitate. "There are indeed," he remarks, "two anatomical elements, namely, the rods and the cones so called, that would require special notice. The rods are very much more numerous than the cones, and though both are found in the general field of the retina, the cones alone occur in the yellow centre where the visual sensitiveness is most perfect. Here then we perceive that the colour sense is not impaired by the absence of the rods." But to return to a subject already referred to, though the cones are necessarily very small they would appear to be a sufficient distance apart, with numerous intervening rods in surrounding zones to render it improbable, if all the colour sense be attributed to them, that a continuous wash of any colour could be perceived without minute speckling or a finely broken ground, but as we know that no such obstruction occurs normally, we can scarcely withhold colour perception from the rods. Further, as Professor Rutherford remarks, "the image of a coloured star, small enough to fall on only one cone, can be seen of a fixed and definite colour that does not alter when the position of the eye is changed and the image shifted from one to another on the yellow spot." That fact alone seems to him sufficient to show the necessity for supposing that each cone is capable of stimulation by all visible undulations of light, and transmitting such nerve vibrations as are capable of inducing all the colour sensations. Moreover, when the image of a coloured star is made to fall on parts of the retina peripheral to the yellow spot, its colour does not disappear and reappear when the eye is moved as would inevitably be the case if the rods were not terminals concerned as well as the cones in colour sense. It is indeed obvious that if the colour of the star were made to pass through all the hues of the iris, the facts would be practically the same. There is, therefore, no standing room here for the Young-Helmholtz theory, while the Newtonian view is in touch with every part of the argument.

Though we are not at all prepared to say that the number seven does not reign in the vibrations of taste and smell in keeping with the properties of their appropriate stimuli,* no one has ever thought it necessary to invent special nerve terminals for the perception of the leading notes of the musical scale, or for particular tastes and odours, which are far more diverse and indescribable than colours and sounds.

Further, as to the perception of white and grey in the absence of all objective colour, it is hard to accept the gratuitous and complex doctrine that it requires the balanced stimulation of all three coloured terminals for red, green, and violet, to effect this. Of course the principle would be the same if red, yellow, and blue, or any other colours were selected as primitives. It is rather curious to notice how scientists differ in their choice of such colours, while each suggestion is supposed to be satisfactorily set forth by its propounder. Thus 1.—Newton and Brewster adopted *red*, *yellow*, and *blue*; 2. Young and Helmholtz, *red*, *green*, and *violet*; 3. Maxwell, *red*, *green*, and *blue*; 4. Hering, *red*, *yellow*, *green*, and *blue*; 5. Rosenstiehl, *orange*, *yellow*, *green*, and *blue*; and 6. Roechlin takes *yellow* and *blue*, while a *third principle* is supposed to be present, but always

* Messrs. Piesse and Lubin distinguish their perfumes by musical notes, and the former gentleman informed the writer that he is quite satisfied that all the senses are allied, by analogy.

associated with yellow or blue to form the reds and the violets (probably a kind of red?). From this also it will be seen that every colour in the scale has been made to take its part as a primitive by special authority, thus:—

1.	Red	is taken by	Newton and Brewster.
2.	Orange	,,	Rosenstiehl.
3.	Yellow	,,	Newton and Brewster.
	Yellow Green	,,	Rosenstiehl.
4.	Green	,,	Young and Helmholtz.
5.	Blue	,,	Newton and Brewster.
6.	Indigo	,,	Often confounded with blue and violet.
7.	Violet	,,	Young and Helmholtz.

Physically speaking, there would appear to be ground enough for any unbiased person to form the conclusion that no one colour in the rainbow can be more primitive than another, or a bit more than any one sound can be, taken in the abstract. Independently of relative refrangibility, and taking the analogy of sound into consideration, the relative position of the colours in the scale would naturally determine their relative importance. This will be apparent in the following tables, corresponding ratios in the vibrations producing definite pitch in sound and definite hue in light.

TABLE I.

THE SYMMETRICAL SCALE OF COLOUR.

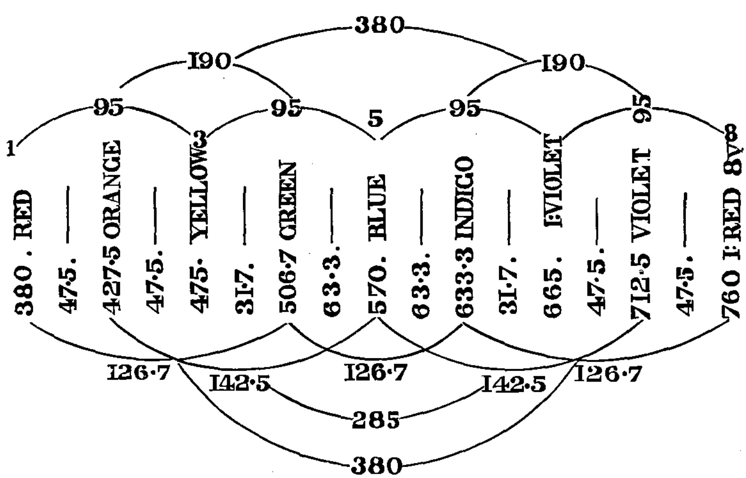
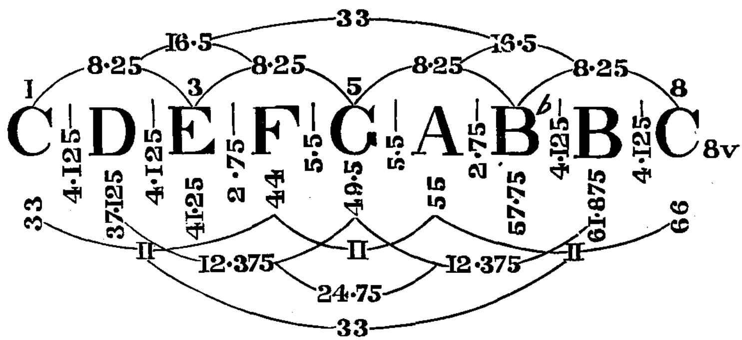


TABLE II.—THE SYMMETRICAL SCALE OF SOUND.
(*The Contra Octave.*)



N.B.—The note numbers here express the frequency per second, but in both tables the intervening and arc numbers are *increments*, which demonstrate the symmetry more palpably than if the frequency numbers alone were supplied.

On comparing the two foregoing tables it will be seen that the 1st, 3rd, and 5th C, E, and G in the musical gamut correspond with red, yellow, and blue in the scale of colour, and that the colour (blue) and the note G hold the central position in their respective scales. Moreover, it is all-important to notice that the "*intervening increments*" are disposed in the most perfect symmetry on either side of the centre in both cases.

It is rather a good thing that the musician and the painter have not so much to deal with thunder and lightning or acoustic and optical experiment as with the well-tempered musical and colorific scales. Two important laws or tenets have been brought to bear in the construction of the foregoing tables, namely, 1st, *that the undulatory theory is applicable to both light and sound*, and 2ndly, *that the musical ratios appertain also to colour*, though comparatively low numbers in one case have to be compared with billions in the other.

Angström's tables of the wave lengths and frequencies of the undulations of colour, which are now taken as the standard, were consulted and applied in Table I with no difficulty whatever. Herschel's calculations gave some little hope of success, but they were found to be a little too narrow. Thus, the chief difficulty in founding the analogy of sound and colour on a truly scientific basis would appear to be swept away; so that we have now only to apply the laws of musical harmony to painting, with no reservation whatever, only observing that juxtaposition is to colour what synchronous co-operation is to sound. The visual faculty deals with space and the auditory with time; but this simple physiological fact can scarcely be taken into account by those experimentalists who mix rays of colour in the hope of obtaining a harmonious combination, and further, if they don't succeed good names may go to swell the list of the opponents of the "*analogy of sound and colour.*" Moreover, they don't appear to be aware that they are only dealing with "*overhues,*" as physical mixture would seem to be impossible, except in the case of pigments. Thus great stress is laid on the fact that green cannot be produced by the mixture of yellow and blue light, but the cause of this is not far to seek. In the first place the mean of the two sets of vibrations would be a blue green (F♯) and not pure spectral green (F♮), and 2ndly, the sum of the two would be theoretically the octave of the same green, and consequently overreach the limit of colour vision. In the prism itself the formation of green is always coincident with the overlapping of the yellow and blue bands, though it is assumed that the fact admits of some other explanation.

In all the experimental mixtures of coloured light hitherto carried out, no reference has been made to the analogy of "*overhues*" in colour to "*overtones*" in sound, and the result has been the reception of green and violet as primitives so called to the exclusion of yellow and blue, and so lend support to the "*Young-Helmholtz theory.*"

Whatever progress had been made in the study of music up to the days of Pythagoras it is clear that he made good use of the monochord, and handed it down to us as the only test of musical perfection, so that the validity of the deductions drawn from any other means must still be submitted to the same test, which is satisfactorily applied in Table II. We talk familiarly of the scale of colour as being composed of red, orange, yellow, green, blue, indigo and violet, but as in the iris there are numerous grades of hue in all the colours, and the human colour sense is not always to be depended upon, without the application of the musical ratios it would be quite impossible to furnish so perfect a scale of colour as that given in Table I.

As might be expected whenever the analogy of sound and colour is ignored, all reference to tones and semitones of colour must be indefinite and uncertain. Thus red spoken of might have a mixture of orange in it, and yellow the same, or it may be too much on the green side, while blue, indigo, and violet with their intermediate *semitones* or *semihues* are often so indefinitely alluded to as to preclude that precision which is a *sine quâ non* in the statement of experimental results. The annexed table is intended to supply a reliable scale and nomenclature of the semitones of colour in relation to the chromatic scale of music.

TABLE III.

Chromatic scale of colour.	—	Chromatic scale of sound.	
	Billions.	Vibrations per second.	
1 Red	380	1 C	33
— Orange Red	403·75	— C♯	35·0625
2 Orange	427·50	2 D	37·1250
— Orange Yellow ...	451·25	— D♯	39·1875
3 Yellow	475·00	3 E	41·2500
4 Green	506·70	4 F	44·0000
— Blue Green	522·50	— F♯	45·3750
5 Blue	570·00	5 G	49·5000
— Indigo Blue	617·50	— G♯	53·6250
6 Indigo	633·30	6 A	55·0000
— Indigo Violet	665·00	— A♯	57·7500
7 Violet	712·50	7 B	61·8750
8 Red 8ve.	760·00	8 C 8ve.	66·0000

N.B.—The numbers to the left of each column indicate the Diatonic Scale of sound and colour respectively.

Unless some intrinsic defect can be shown to exist in the frequencies of the notes and colours given in the foregoing table as well as the inapplicability of the undulatory theory to the case, it would be difficult for any opponent to evade the truth of the analogy of sound and colour. On the other hand if these matters are admitted to be intrinsically correct, notwithstanding the temporary opposition which is sure to present itself, the well-founded laws of musical harmony will be applied to painting, the art will be converted into a science, and the principles of the analogy will be taught at the Royal Academy in time to come.

Discussion.

At the reqnest of the Chairman, the author added some verbal explanations of his diagrams, and a hearty vote of thanks was accorded to him.

Mr. D. Howard, D.L., etc.—I do not know whether the learned author of this paper has considered the relation of this theory (which I confess is extremely interesting, and one which commends itself very much to my mind) to the question of colour-blindness, which is one of the oddest phenomena that we have experience of. Of course, the limitation of one's ear to sound is pretty familiar to many people. I do not know whether you have noticed how many people are stone-deaf to a bat. I am, for instance, but I think, on the other hand, I can hear a 50-foot organ-pipe better than most people. A colour-blind person may be utterly unable to see *these* two colours, and may be able to see *these* two colours [*pointing on the diagram*]. What condition of the nerves one can imagine to explain that is certainly difficult to make out. Even with the idea of three nerves in each of the cones, or filaments, whichever it may be, according to one's imagination, it is very difficult to see how you get two out of four colours missing, and the other two perfect. It so happens that I have known a good deal about colour-blindness since I was a small boy. A school-fellow of mine, now my brother-in-law, was absolutely colour-blind in red and green; therefore my boyish mind was taken up a good deal with it. A colour-blind woman is one of the rarest things possible, but here you have, undoubtedly, relations of vibrations with colour, though the cause is difficult to discover.

Mr. Hulme, F.R.C.S.—Has Dr. Macdonald, in his experience, found out what is the deficiency in colour in colour-blindness?

Dr. Macdonald.—A normal deficiency occurs in the retina, beyond a certain cone, that limit being confined to blue and yellow. Outside a certain cone there are certain properties in the retina itself which vary in perceptive power.

Mr. Hulme.—It has fallen to my experience, as a surgeon to the Marine Society, to examine boys, and I have never found (out of the three colours on a table, red, violet, and green) a boy refuse violet, and very rarely red. It is invariably the green.

So in matching colours I will say, "What are those three colours?" (red, violet, and green). Perhaps ninety-nine out of one hundred will distinguish them, and the hundredth will go up and see the red and violet, and will go up to the green and not know what to make of it. Then I will give him my skeins of silk, and say, "Match those," and probably he will put the red on the green.

Dr. MACDONALD.—I remember in the case of my brother, when, as boys, we used to make paper soldiers and paint them, he would paint a soldier's coat with emerald green with the same satisfaction that he would vermilion.

Mr. HULME.—What is the percentage of colour-blind boys or men?

Dr. MACDONALD.—It is seriously stated, but it is remarkable, that ladies are more highly gifted than men in this respect. There is a matter of great importance connected with this, and that is the subject of signals. As to violet, if you extend it to blue, the blue is more constantly present than green—consequently, if signals were red and blue instead of red and green, there would be much less likelihood of confounding them.

[Dr. MACDONALD here further explained his diagrams.]

Mr. WALTER H. THELWALL, M.Inst.C.E.—I think it may be as well to mention, though no doubt it is known to many, that these vibrations are, of course, only theoretical. The actual vibrations of the sounds we hear are not *these* vibrations, because all music is planned on what is called a tempered scale, and it is these sounds we hear in listening to music. The notes of the diatonic scale, C, D, E, F, are almost always used by mathematicians in dealing with matters of music, and they form, to a great extent, the basis of the theoretical laws of harmony; but those intermediate notes, D sharp and F sharp, and so on, have no existence at all. They are neither tempered sounds, nor are they the sounds required by theoretical harmony. I do not know whether this has relation to the question of sound and colour, but that really is the case, and the ratio of one musical note does not continue below—it is always a twelfth, or 1·05946. I am not quite certain of the figure, and I do not know whether that fact has a bearing at all upon it; but if this table is going out as a table of sound used in music, I think it well that the correction should be made, particularly as the author speaks of the improper tuning of the organ. That is just one of the points that theoretical, mathematical, and practical musicians cannot agree upon. If we were to go by what mathematicians tell us we should have, in organs, about fifty notes to every octave, which would be practically impossible, and which no musician requires, and the fact whether music would be possible under such conditions is an open question, but the tempered scale throughout music is, as I have said.

One point in regard to discord. Musicians have got a way of talking of concord and discord, the idea, apparently, being that discord is something unpleasant to the ear; but that is not so at all. The most disagreeable sound you can have in music is a perfect fifth by itself, and that is what all technical musicians call a concord; but I think when there is a discordant sound the ear requires some particular note to follow, or one of a particular series of notes.

Dr. MACDONALD.—No doubt the question of temperament you have taken up is very important and one of some difficulty, so as to admit of modulation. A scale such as I have given here is limited to C, and you cannot apply it in any other key with the vibrations this way [*explaining on the diagram*], but you may take an equal temperament, or some principle which enables you to give a semi-tone at equal distances apart. It is rather difficult in some instances, for you would require an infinite number of key-boards, or pipes, or notes, as the case may be.

Mr. THELWALL.—I only thought it important to distinguish between the theoretical scale and the sounds that we hear.

The Rev. A. K. CHERRILL, M.A.—I should like to ask one or two questions about this table. If you divide two scales proportionally they would be proportional when you divide them; but I do not quite understand how you select this so-called scale. I suppose the musician selects the notes by ear. You cannot draw a fine line and say, "This is red and this is orange."

Dr. MACDONALD.—Yes; you take the musical ratio and you do it at once.

The Rev. A. K. CHERRILL.—Exactly; if you take the musical ratio. But if you take the musical ratio of course that corresponds. I do not quite see where the point comes in there. I do not see where the visual point, with regard to the light, comes in.

Dr. MACDONALD.—In regard to the monochord, whatever scale is adopted that will be found to be the test of the monochord. The division of the string is found in this diagram, and the number is determined exactly by the string of the monochord—for instance if the whole string sounds C, you get off $\frac{1}{9}$th, and $\frac{8}{9}$ths go on D, and you divide their parts according to the ratio given in this first series, $\frac{8}{9}$, $\frac{4}{5}$, $\frac{2}{3}$, and so on, and divided into three parts you get three G's, one part G, and two parts G, and the whole three sounded together give you the note of the string itself. The same law applies to these colours. If you have a certain number of pigments *here* you would have double the number of vibrations [*explaining the diagram.*]

Professor Orchard.—One of the most important parts of the paper is at the commencement, viz., that colour is, in fact, not merely subjective but also objective.

The phenomenon of colour-blindness, to which allusion has been so interestingly made, and also those other phenomena, colour sensations, when the eyes are closed to external objects, abundantly prove that there is a subjective aspect of colour, and we should, indeed, on other grounds, be led to that conclusion. It is very important, to my mind, to remember the two sides of the shield—that it is not merely objective on this colour (though it is objective), but that it is also subjective; but it is only when those two are on this colour that you call it unison and we get the sensation of colour.

It is rather surprising that Dr. Rutherford, on page 3 of the paper, should have reasoned in the fashion he did in regard to the cones and rods: "The cones alone occur in the yellow centre, where the visual sensitiveness is most perfect. Here, then, we perceive that the colour sense is not impaired by the absence of the rods." That is, indeed, a very curious conclusion to adduce from that premiss. I think it is clearly shown that the rods also play their part in connection with colour sensations.

We have to thank Dr. Macdonald for a most concise presentation of a most fascinating subject, and as one reads the concluding sentence one may endorse the hope and expectation that the art may become a science and be taught at the Royal Academy in the future.

Dr. Biddle.—One does not like appearing as a critic of such an admirable paper as this, but I feel that exception ought to be taken to one or two passages at the beginning of it. The author objects to our affirming that "colour is in fact an internal (subjective) sensation," and says that "the word subjective is only applicable where colour vibrations are induced in the nerve terminals independently of any corresponding objective vibrations impinging on the retina." But in conceding that colour sensations can arise without the presence of an external object to produce them, he, in fact, confirms the view of those whom he opposes. The colour is not in the object, but in the subject, being simply excited by the object, or, more correctly, by the peculiar vibrations of the light which the object reflects to the eye of the observer, and the impression of which is conveyed through the optic tract, a specially organised instrumentality, to the sentient power, in which alone the sensation arises.

The fact that colour can be obtained on a photograph simply indicates that the peculiar conditions in any object, which give rise to colour sensations, can be transferred to the chemicals on the sensitive plate; and it is only by bearing this in mind that progress in colour-photography will be made.

In the Appendix to Vol. xlii (1885) of reprints from *The Educational Times*, on page 127, is a part of my paper, *Ratio Rationis*, which may be considered worth repeating in the present connection:—"The most intimate faculty of the human mind (next to that of bare *feeling*) consists in the detection (however imperfect and undefined) of similarities and dissimilarities in the various objects of which it takes cognisance. This in its simplest form is a matter of impression or perception, which defies further analysis. For, though we can perceive the difference between the impressions produced, for instance, by two colours such as red and blue, we cannot adequately describe the difference, much less the impressions themselves; and for aught we know, our impression of red may be totally unlike that produced on another person, and this without any colour-blindness, either on our part or his. It matters little, provided we can distinguish red from other colours, as well as our fellows. But it is more than probable that the impression produced by red is compound. If, therefore, it is difficult to describe the compound impression, how impossible must it be to describe the simpler impressions which compose it! It is the same with all elementary impressions: we cannot describe them to other persons. But we can distinguish between them and we can select and classify objects which produce various combinations of them."

ORDINARY MEETING.*

DAVID HOWARD, ESQ., D.L., F.C.S., IN THE CHAIR.

The Minutes of last Meeting were read and the following Elections took place :—

MEMBER :—C. R. N. Mackie, Esq., Devonshire.

ASSOCIATES :—G. A. Gutch, Esq., C.E., London; Mrs. S. C. Kemble, Wilts.

The following paper was then read by the author :—

CREATION OR EVOLUTION. By WALTER KIDD, Esq., M.D., F.Z.S.

SEVENTEEN years have passed since a leading review† gave the place of honour to an able and severe attack upon "The Gospel of Evolution" by Dr. Charles Elam. The attitude of the evolutionists of 1880 was more calculated to alarm their opponents, then represented by the majority of educated people, than is the case at the present time; and notwithstanding the truly vast amount of investigation which has proceeded from the evolutionary school of biologists, accompanied by harangues in sufficiently menacing tones, the noise of battle grows fainter and might be mistaken for the distant hum of a united camp. Indeed a notable illustration of the better feeling which prevails took place the year before last, which may well be likened to that honourable incident in the great battle of Saratoga, when, as the body of the gallant General Fraser, in obedience to his dying request, was being carried to its

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* 15th March, 1897.

† *Contemporary Review*, May, 1880.

burial within the former British lines, the conquerors turned their hostile fire into the minute-guns of respect for a noble foe. It was so, when not only his allies in great numbers, but such opponents as Lord Salisbury, Lord Kelvin, Mr. Balfour, gathered to do honour to the memory of Professor Huxley, that doughtiest champion of evolution, who had actually died with his severe criticism of Mr. Balfour in hand.

The occasion of the article by Dr. Elam was a striking one. Professor Huxley had recently proclaimed at the Royal Institution, on the occasion of the "coming of age" of *The Origin of Species*, that evolution was "no longer an hypothesis but an historical fact." The vast inheritance of the heir of all the ages of thought seemed to be resting at last on sufficiently secure title deeds. It is true that evolution at that time did not generally and publicly claim more than the origin of all terrestrial life from a few primordial forms: the doctrines foreshadowed by Democritus, Empedocles, and Lucretius were the possession of the few. More recently this theory "rightly conceived," under the improving care of its trustees, has felt called upon to annex the universe.

If the theory of evolution has become more ambitious and has widened its claim over the territory of thought, how comes it that of late, except for an occasional dropping fire from the citadel of faith from Sir Richard Owen, Mr. Gladstone, Sir William Dawson, Dr. Wace, Lord Salisbury or Mr. Balfour, directed against some one or other of the divisions of the investing host, good-natured indifference, on the whole, marks the prevailing attitude of orthodox men of science and men of faith towards this remarkable theory?

Further, though it is not denied that the majority of biologists accept this theory *in some form or other*, is there anything more to be said after seventeen years than what Dr. Elam so well said for that theory, older by some three thousand five hundred years than its rival?

It may be here acknowledged that the theories of creation and evolution, logically pursued, are directly opposed. The former stands or falls with the theory of design, the latter relies solely upon natural causation, dispensing with supernatural intelligence and action.

The term creation implies two conceptions, original creation of the universe, and so-called "special creation" in successive stages, of plants and animals, up to its culmination in the creation of man. There are doubtless certain evolutionists who look upon evolution as a form of *mediate creation*, but these are not the leaders of thought with whom the believer in creation has to reckon.

The first question may be to a great extent answered by an illustration. The delta of the Mississippi is a vast area comprising 12,300 square miles, and the river itself great enough to deposit sediment annually to the extent of 812,500,000,000 pounds. But great as is the delta and great as is the potential value of its silt, it is nothing in regard to force when compared to the river, as it flowed within its banks. Though this vast amount of detritus leaves fertilizing alluvium on the neighbouring land to be utilized in other days by other men, the river has wandered into a thousand dwarfed channels, and in the Gulf of Mexico has lost itself for ever. Such a change as that of a river into its delta may well describe the present or closely approaching position of the theory of evolution, and indicates its weakness as an attacking force. Some explanation may here be given of the introduction into such questions as those of evolution and creation of terms which suggest strife. In the popular view, in its earlier days, Darwinism was nothing if not combative, however little its great founder was responsible for this. It was not unnatural, probably necessary, in the state of public opinion which then existed, that Huxley should employ the imagery of war in his brilliant essays against superstition, Hebrew tradition and other "strangled snakes." But this was very much what gave pith and point to evolutionary literature. Now, however, seeing that the theory of evolution is still an unproved theory, and that the citadel of faith is more full than ever of warriors, whose attacks are directed rather against the common foe under the aspect of heathenism than of evolutionary agnosticism, a dangerous slowing of the current of the evolutionary river has set in, and no better description of the state of things can be given than that of a German writer, "a confused and indefinite movement of the mind of the age"—in fact the delta-stage.

For answer to the first question more is required than illustration and assertion, but the facts which supply this will be best derived from the answer which will be offered to the second question. Seeing then that the majority of biologists accept the evolution hypothesis in some form or other, is there more now to be said in favour of the creation hypothesis than there was in 1880? Progress there has been, of a remarkable kind, but that "last infirmity of noble mind" has led many out of their depth, and far from the shore of fact, so that time has been on the side of the older theory. The fact that the consensus of current biological teaching is in favour of evolution hardly needs much proof. If Mr. Herbert Spencer can make the compendious claims which he did lately in *Lord Salisbury on Evolution*, Mr. Wallace reminds us, from time to time, of the *Method of Organic Evolution*, proof of the fact not seeming necessary; Professor Haeckel could make it a strong point in the praises of Lang's *Comparative Anatomy*, in his prefatory remarks, that "he has always endeavoured to give the phylogenetic significance of ontogenetic facts"; if Professor Huxley could say in the *Encyclopædia Britannica* that "on the evidence of palæontology the evolution of many existing forms of animal life from their predecessors is no longer an hypothesis but an historical fact"; if Romanes could say of this theory that "it is held to be virtually a completed induction"; if Professor Karl Pearson, in an attack upon Lord Salisbury's Address, recognising "the danger of the reaction which is spreading among us," could say that "the danger to science . . . . was in truth small," this indicating evolutionary teaching of course, the elegant description of the opposing line of thought being "the old bigotry"; if Professor Marsh could say a few years ago that "to doubt evolution is to doubt science, and science is only another name for truth"; and if the "story of Creation" can be told by Mr. Clodd with nearly equal authority, though hardly the majesty of Genesis, from the opposite point of view; and if the scientific and quasi-scientific press is full of references to it and assumptions that never raise a question of its truth—if these things be so, it behoves the man of faith to give good reasons from the side of science which justify him in still believing those noble words, "In the beginning God created the heaven and the earth."

Before proceeding to the special consideration of this theory and its imperial claims, it may be remarked that the ranks of evolutionists are anything but united, and the divergences of view become ever more marked. To take a few notable specimens: Darwin's views on the origin of species by natural selection through heredity, great as was the revolution they produced, were not concerned with that "great progression of nature from the inorganic to the organic, the formless to the formed, the simple to the complex" which Huxley and Haeckel have assisted in adding to the original theory. Mr. Wallace, who has been justly honoured as the joint-discoverer of the theory of natural selection, has strongly opposed the origin of the higher faculties of man by natural selection, and has been looked upon as a deserter from the ranks, claims for it an exclusive prerogative in the field of organic revolution. Romanes, the loyal and highly cultivated follower of Darwin, maintained the joint action of natural selection and sexual selection in this process. On the subject of the inheritance of acquired characters, Professor Weissmann, as ardent an evolutionist as any, is engaged in hot conflict with Mr. Herbert Spencer, who himself took the field in this fruitful subject before 1859, and who now claims "all existence" as the province of evolution, with rigid logic spurning the notion that only "things that breed" come under its action. The Christian evolutionism of the late Professor Drummond, and the social evolution of Mr. Benjamin Kidd, which some of our transcendental and severe scientists, but not Mr. Wallace, would be for placing on the *Index Expurgatorius* of science, need only to be mentioned to show that the younger followers of this school of biology see plainly that synthetic philosophy will not satisfy the moral and religious sense of this generation.

The broad lines of evidence, which are supposed to favour the theory of organic evolution, are well-known and have been brought forward with valuable clearness by Mr. Herbert Spencer, to the evident advantage of both sides. The lines of evidence, indirect or direct, for inorganic evolution, exist only in the inner consciousness of Mr. Herbert Spencer, Professor Karl Pearson,* and Professor Haeckel. Romanes indeed said "it is now a matter of demonstrated fact that throughout the range of *inorganic* nature the principles of evolution have obtained,"† giving the geological history of the earth as an instance. Such absolutely vague statements as to what constitutes evolution do not help the theory much; nor did such flashes as those of Tyndall at Belfast, and Huxley,‡ being more in the nature of delicate touches in the hand of an artist, when finishing off a picture, than of sober argument.

The five lines of evidence for the theory are:—(I) The facts of classification; (II) Geographical distribution; (III) Palæontology; (IV) Rudimentary characters; (V) Embryology.

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* *Fortnightly Review*, November, 1895, pp. 678, 679.

† *Darwin and after Darwin*, part I, p. 17.

‡ *Critiques and Addresses*, pp. 238, 239.

These formidable witnesses must first be heard, and then certain flagrant discrepancies in the tale which they are supposed to tell of terrestrial life must again be brought forward, after which teleology, the old and incorruptible witness for the opposite side, will be examined once more.

Classification.—The now familiar tree of life, constructed by evolutionists upon the ruins of many older and artificial systems of classification, gives an excellent educational view of natural history. It will serve its purpose admirably while the pendulum of current science swings to the evolutionist side. But the theory of creation is not among the class of extinct beliefs, nor is that Book obsolete in which this theory is enshrined, and in which it is announced as a fact, if one society alone sends forth every year four million copies, or portions of it, and it be translated into 320 languages and dialects; under which circumstances the arborescent view of classification may still obtain when the delta shall have been well passed. The knowledge of a Darwin or a Romanes would hardly suffice to test the statements made by the latter in his remarkable chapter on classification. But if all be allowed which is claimed,* the "argument from ignorance," which Romanes offers as the last ditch to the defenders of special creation, proves a fortress of remarkable strength. When the marvellous order which exists, as the plants and animals of this globe are marshalled in review by an expert in biology, it is positively trifling with the matter to allow that this order, of immense duration in point of time, could arise by a process of natural selection, which would be nothing if chance did not enter largely into it, and to refuse to see this same order emanating from a Divine Power, whose operations depend upon intelligence and will. Romanes truly says, that if the defenders of the creation theory explain by the hidden reasons which the Creator may have had, those zoological and botanical affinities which exist, they are bound to show some independent evidence for their theory. Nothing can be more fair; and this the facts of teleology—absolutely independent—will supply. Classification may be left out of account as being equally in favour of the two theories—opposed to neither.

Geographical distribution.—In this department facts are multitudinous, much valuable silt having been brought by the tributaries of the evolutionary river. The most impor-

* *Darwin and after Darwin*, part I.

tant work of all has been done by that master in biology, co-discoverer of natural selection, seceder from the ranks of orthodox Darwinism, opponent of the origin of man's higher faculties through natural selection, Dr. Wallace. In this division of the subject it may be noted that the theory of creation seldom receives fair handling from its opponents. There is a prevalent misapprehension as to what Genesis does and does not say. Details, times, and methods are ascribed to that Infinite Mind which planned the cosmos, not only by the mistaken opponents, but also by many mistaken defenders of the theory. In those early records written (*pace* Wellhausen!) in the sixteenth century before our era, the marvel is to observe how the "current science" of Egypt and Babylon has been studiously avoided, how as much cosmogony as the early readers could apprehend, or the later need, was given in two short chapters, and how place was left in the two first verses, before the ordering of this earth for man commenced, as announced in the third verse, for all those geological epochs which science has so lately discovered. The "British Cuvier," as Huxley called Owen, summarised in his great axiom the true view of creation, with specific centres—"*The continuous operation of the ordained becoming of living things*"—from Laurentian times to the age of man. When this aspect of creation is allowed fair play, most of the difficulties as to geographical distribution of plants and animals disappear. Various curious questions may be asked by evolutionists (and ingenious answers supplied by their own theory) as to such facts as geographical restriction and natural affinity being correlated, as to the same plan obtaining in extinct as well as in living species of plants and animals, as to remoteness of affinity and range of dispersal, or as to the reason for difference in type on opposite sides of a mountain-chain. All such general facts, those of emigration of forms of life from neighbouring continents to oceanic islands, and such as the large percentage of *peculiar* faunæ and floræ in oceanic islands of known high antiquity, the law that "every species has come into existence coincident in time and space with a pre-existing allied species," find their explanation not less naturally under the above view of creation than under any theory of descent with modifications. One continental island may be considered as an example. The Australian mammalian fauna is limited to a few low types, marsupials, bats, rodents, and the oviparous monotremata; and looked at dispassionately, this adaptation of fauna to a peculiar soil and climate speaks fully as plainly in favour of design, as of an independent centre of evolution. In passing a reference may be made to the monotremata. These "animated fossils," so-called, are of great use to the evolutionist builder of the family tree of man. They figure among certain important links in the chain from the invertebrata to man, and, being oviparous mammals, are of peculiar value to the diagrammatic method, ranking in point of importance with lemurs, insectivora, and the honoured amphioxus. They did not need to be invented, as did certain of Professor Haeckel's links formerly, for two genera of them do actually exist. Here is a remarkable little group, ancestors of man, not known anywhere except on a great continental island, which probably *from its origin* was disconnected from the rest of the land, and not known palæontologically, except for one species of echidna in Australia itself, in late Tertiary times; and yet this group is to rank as an important link in the ancestry of man! The results of human experiments illustrate by contrast the wisdom which has regulated the fauna and flora of New Zealand and Australia. A few instances may be mentioned, quoted partly from a paper by the Rev. Theodore Wood.* Thirty-six years ago a few rabbits were introduced into Australia, by way of experiment, with that disastrous result which is now an old story in Australia. It is said that after this experiment, in one season, 1880, twenty millions of skins of rabbits were exported; that on one estate eighteen poisoners were kept daily and constantly at work; that £400,000 was paid in New South Wales alone as "head-money," and all in vain. In New Zealand the sparrow was imported from Europe with similarly grievous results. In the case of plants, the water-cress was introduced into New Zealand by certain persons with sufficiently innocent intentions, but with the result of producing in ten years Brobdingnagian weeds, with stems as thick as a man's wrist, and leaves as large as a water-lily, blocking up the streams and ditches. A Scotchman of patriotic mind plants a single thistle in Australia; in a few years the weed has grown so alarmingly that his neighbours rise up and call him—well—not blessed. And as with the sweet-briar, a harmless enough plant in its English and *appropriate* home, but one which in Australia soon becomes such a pest that farmers are dragging it from

* *On the Australian Mammals*, Victoria Institute, April 13, 1896.

their land with cart ropes and teams of horses. One may at least be thankful that no similar *entrepreneur* has attempted to improve the fauna of Australasia by the importation of a batch of wild felidæ of various kinds! The regulation of the fauna and flora of this region of the world by divine wisdom has not produced, through vast geological epochs, the chaotic results which a generation of human bungling has easily brought to pass.

In the case of geographical distribution, as in that of classification, if the same justice be extended to the theory of creation which the opposing theory would claim for itself, this line of evidence supports the former as much as the latter.

Palæontology.—This department forms the probable battle-ground of the future, and an ample field indeed is supplied by the succession of life-forms from Cambrian or Pre-Cambrian to Quaternary times. It is obvious from the nature of the case that, if the doctrine of evolution be true, the teachings of palæontology, with the growth of ascertained facts, must verify it accurately. In this subject the evolutionist is in a very comfortable position. If the facts of palæontology favour him, well and good; and with such a vast *succession* of life-forms for his study, it is inconceivable that many lines will not favour him. If the facts are against him, he has but to point to that imperfection of the record which is a name to conjure with, and which is admitted by all. If finally no light is forthcoming from the fossiliferous beds on a certain line of argument, again the imperfection of the record is adduced. Evidently here the evolutionist "stands to win" for some time to come. All writers insist so elaborately on the necessarily broken record of palæontology that it needs no proof, but the latest utterance from English geology, by Professor Marr, may be alluded to. He said at Liverpool in his presidential address, "As it is, we have barely crossed the threshold of discovery, and the 'imperfection of the geological record' gives geology one of its greatest charms."* Several lines of descent are supposed to be proved as favouring the theory, and, as mentioned already, Professor Huxley spoke of the evolution of certain forms from their predecessors as an historical fact, instancing the equine type in particular, the ungulate types in general, the carnivora, birds, and reptiles, and the crocodilia. By this time the equine type has become

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* British Association of Science, 1896. Presidential Address in Geological Section, p. 2.

a little *passé*. In the day in which Dr. Elam wrote it was an old story, and there has been really enough said *for* it, but there are some very awkward imputations cast upon its character as a credible witness for evolution by Sir William Dawson, whose eminence as an authority will not be questioned. Some words of his on this point are so striking that they may be quoted in full. "The worthlessness of such derivation is well shown in a case which has often been paraded as an illustration of evolution—the supposed genealogy of the horse. In America a series of horse-like animals has been selected, beginning with the Eohippus of the Eocene—an animal the size of a fox, and with four toes in front and three behind, and these have been marshalled as the ancestors of the fossil horses of America; for there are no native horses in America in the modern period, the result of the long series of improvements having apparently been extinction. Yet all this is purely arbitrary, and dependent merely on a succession of genera more and more closely resembling the modern horse, being procurable from successive Tertiary deposits often widely separate in time and place. In Europe, on the other hand, the ancestry of the horse has been traced back to Palæotherium—an entirely different form—by just as likely indications, the truth being that as the group to which the horse belongs culminated in the early Tertiary times, the animal has too many imaginary ancestors. Both genealogies can scarcely be true, and there is no actual proof of either. The existing American horses, which are of European parentage, are, according to the theory, descendants of Palæotherium, not of Eohippus; but if we had not known this on historical evidence, there would have been nothing to prevent us from tracing them to the latter animal. This simple consideration alone is sufficient to show that such genealogies are not of the nature of scientific evidence."*

Four formidable objections brought against the theory of evolution from palæontological facts in regard to animals, and three in regard to plants,† are mentioned by Romanes. All the former‡ are met with arguments drawn from "the imperfection of the record," what could be called "the argument from ignorance if used by an opponent, and of the

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* *Modern Ideas of Evolution*, p. 119.
† *Darwin and after Darwin*, part I, Appendix, p. 435.
‡ *Origin of Species*, 6th edition, p. 267.

latter one is met in the same manner. Such acknowledgment of the vast extent of the present and possible evidence which remains to be unravelled, renders it becoming for the advocates of either theory to be chary of dogmatic statements. Darwin* himself expressed this forcibly: "From these considerations, from our ignorance of the geology of other countries beyond the confines of Europe and the United States, and from the revolution in our palæontological knowledge effected by the discoveries of the last dozen years, it seems to me about as rash to dogmatize on the succession of organic forms throughout the world, as it would be for a naturalist to land for five minutes on a barren point in Australia, and then discuss the number and range of its productions." As we have had such uncompromising statements of late on this line of evidence from one side, it is appropriate that one by Sir William Dawson, which must carry much weight, should conclude this portion of the subject. He says:† "It cannot be disguised that though it is possible to pick out some series of animal forms, like the horses already referred to, which simulate a genetic order, the general testimony of palæontology is on the whole adverse to the ordinary theories of evolution, whether applied to the vegetable or to the animal kingdom"; and, "we may also conclude that the settlement in very early times of so many great principles of construction, and the majestic march of life along determinate paths throughout the vast lapse of geological ages, and along with so many great physical changes, cannot be fortuitous, but must represent a great creative plan conceived in the beginning and carried out with unchanging consistency."‡

Rudimentary characters would be more properly called "vestigial" in all cases. Whatever these characters indicate they are not rudimentary or elementary, but all of them "speak of something that is gone." In an altogether new sense we are now taught that "our birth is but a sleep and a forgetting," and this class of characters is pointed to in proof. Professor Drummond's slightly scornful description of the human body—"museum of obsolete anatomies"—belongs to this class of teaching. Professor Huxley admitted this class of facts to be double-edged, inasmuch as it is

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* *Darwin and after Darwin*, part I, p. 438.

† *Modern Ideas of Evolution*, p. 146.

‡ *Ibid.*, p. 127.

impossible to prove that they are not of use to their present possessors. In truth according to the theory of special creation, it is only in keeping with its basis to allow that the original type of man, for instance, was a more perfect machine, if possible, than we find to be the case after several thousand years of degeneration. Reference will be made later to the subject of degeneration, which is an important factor in the history of terrestrial life, insisted upon much by evolutionists themselves. Certain vestigial characters in man which are brought forward are irrelevant, others incorrectly stated, but it is not out of keeping with the theory of creation that others, such as the muscles which move the skin of the forehead and neck, those which extend from one part of the pinna to the other, and those which are attached to the side of the head and move the pinna, which are found in a certain number of human subjects, other muscles which are occasionally found connecting the sacrum and coccyx, should be simply departures from a more perfect type and cases in which degeneration through disuse has taken place; in fact that they are "vestigial" in a sense different from that which is usually employed. The vermiform appendix of the cæcum, called by Mr. Bland Sutton an "abdominal tonsil," is as difficult to explain on the theory of design as the tonsil itself, though there is a possible significance in the commanding position which each occupies and the incidence of microbic attacks upon each, by reason of the mass of lymphoid tissue with which they abound. Its comparative anatomy is singular. It is confined to man and the anthropoid apes, and is found only in one other animal, the curious Australian marsupial, the wombat, and it appears to represent the long cæcum of herbivorous animals in whom it is functionally active. In the wombat Professor Struthers* doubts if the tube which exists along the end of the ileum, opening by the side of the ileum into the colon, is a true appendix of the cæcum. But to say the least of it, it is remarkable to find a so-called "vestige" of this kind only in man, the anthropoid apes, and a closely similar structure in a low marsupial animal. Seeing that man is not supposed to be the direct descendant of the higher apes now existing, such an ancestry as is required for this little appendix stretches back into the hoary antiquity of Miocene times,

* *On varieties of the appendix vermiformis, cæcum, and ileocæcal valve in Man.* John Struthers, M.D., p. 34.

and in so doing casts grave reflections upon the efficiency of natural selection. It is not here a question of a trifling degenerate muscle, or a fold of mucous membrane, which is either useless or slightly useful to the possessor, but of a structure which is frequently the seat of serious and fatal inflammation by reason of its position. It is said to be functionless: but a worse indictment is brought against it for the danger which it constitutes to its possessor. It is the subject of language almost abusive in character, and as some think of surgical abuse, being considered by certain authorities so perilous to the young as to warrant its excision. All the reflections cast upon the vermiform appendix cannot fail to interest the opponent of evolution. Here at last was something tangible and valuable that natural selection, in the course of many thousand years, might have brought about, viz., elimination from the human body of a structure so dangerous to it in its struggle for existence.

The strong inward deflection of the foot of the human infant is taken as a vestigial character, inherited from simian ancestors; an entirely unnecessary view of it, when the many months during which the fœtal foot is in this position are taken into account.

The *membrana nictitans* of all vertebrate animals is of more or less functional value, especially no doubt in birds and fishes, but the *plica semilunaris* in the human subject is of manifest value, by its action as a kind of ledge, over which various small foreign bodies are pushed into a safer position than if this little fold were absent from the deeply set inner corner of the eye.

Certain facts connected with the distribution of hair on the human body are supposed to point back to a simian ancestry. Of these the distribution of hair on the forearm of man and the higher apes is incorrectly described by Romanes in* *Darwin after Darwin*, and the whole subject dealt with in a partial manner, as shown in papers treating of this subject.† The lower forms of life are held to be full of vestigial structures, but, by whatever theory they are met, great difficulties remain. The aborted pelvic limbs and their arches, of python and tortrix, the only two of about a thousand species of snakes which possess them, are most obscure on any theory,

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* pp. 89, 91.

† *The Difficulties of Evolution*, Walter Kidd, M.D., Victoria Institute, May 4, 1896; *Nature*, January 7, 1897, p. 267.

and almost as remarkable as the possession by the wombat of something very like the human appendix cæci. The fœtal teeth of Balænidæ, and the generally aborted dentition of the Cetacea and Sirenia, are in keeping with their character of degenerate mammals, which have become aquatic. It is in keeping with this also that an ancient Sirenian from the Tertiary deposits of Jamaica exhibits a distinctly superior dentition to those now living, and that the extinct Zeuglodon and Squalodon manifest a similar superiority over any existing Cetacean, whose teeth are simple, numerous, and of one kind. DEGENERATION DOWNWARDS in the scale of organization may be found as valid an explanation of these characters in man and the lower animals as that of the evolutionist.

Embryology has been left to the last, because in the "evolution of the individual" we do actually come upon undoubted evolution or development. Let the evolutionist dwell to his heart's content on the facts of this class, which are clear, open to verification, and undisputed. But in proportion to the fulness and freedom of this study will be the demonstration that if this be evolution, it has no thinkable relation to the supposed origin of species or of communities by evolution. Vaguest analogy there may be, such as would suit the purpose of a biological teacher for diagrams on the blackboard, but true similarity of process or causation there is none. The supposed origin of species depends for its very existence upon certain factors which all, more or less truly, represent observed facts, and which it is the conspicuous merit of Darwin and Mr. Wallace (in some degree preceded by Mr. Herbert Spencer) to have discovered. Wonderful as was the insight gained by this discovery, or systematizing of previous discoveries, into the workings of nature, the conclusions drawn from them are exceedingly insecure. The factors referred to are of course the familiar "struggle for existence," "natural selection" or "survival of the fittest," "heredity," "variation," and one, which is often ignored, *extinction*. And of these there is only one which can with any reason be applied to the cells of the developing embryo, viz.—heredity. The process by which the embryo is developed is called "epigenesis," or "the successive differentiation of a relatively homogeneous rudiment into the parts and structures which are characteristic of the adult," and in the phenomena of ovulation, fertilization of the ovum, blending of the male and female pronuclei, karyokinesis, segmentation of the ovum, gastrulation, formation of ectoderm and endoderm, a beautifully accurate knowledge is obtained of *this* development. But the very exactitude of the knowledge of embryology is the precise reason which prevents this class of facts from lending any aid to the general doctrine of organic evolution. Huxley could say no more than "it is a probable hypothesis that what the world is to organisms in general, each organism is to the molecules of which it is composed. Multitudes of these, having diverse tendencies, are competing with one another for opportunity to exist and multiply; and the organism, as a whole, is as much the product of the molecules which are victorious as the fauna or flora of a country is the product of the victorious organic beings in it."* This is obviously no more than the *opinion* of an eminent man. Among the developing cells of an embryo neither "struggle for existence," "survival of the fittest," "variation" nor "extinction" is proved to take place, and, by the terms of the definition of epigenesis given above, even true analogy to general organic evolution is absent. In the embryo there is a definite and ascertained beginning, a fixed line of development, a certain known type to which it is tending, an *adult* or finished stage. In the production of species according to the postulate of the evolutionist where is the perfect type, or that which corresponds to the adult stage to which an embryo tends? The ambitious theorizing of evolutionist teachers has indeed extended far into nebulous regions, but they cannot with any regard for consistency claim that organic evolution ends with man, and, if not, then even the analogy of general with individual development fails in an essential point. So that without proof, and without complete analogy, this line of evidence is poor indeed. The doctrine of recapitulation invented by Fritz Müller teaches that the development of the individual is an epitome of the development of the race, that an embryo "climbs up its genealogical tree" during its embryonic history, repeating the steps of its ancestry in its own development. It is taught by Romanes, by way of accounting for the great gaps which are left in these ancestral histories, that a foreshortening of the developmental history will take place, and those steps which are not necessary, and which put too

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* *Critiques and Addresses*, p. 309.

much strain upon the resources of the developing embryo, will be got rid of by natural selection, "or whatever adjustive causes we may suppose to have been at work in the adaptation of organisms to their surroundings." This statement is quoted with the object of showing how much the evolutionist feels the difficulty of bringing into line the gaps and contradictions which he finds in the histories of embryos with this necessary doctrine of recapitulation! But one cannot but ask how *any* of the ancestral traits which are exhibited can be of use to the individual embryo? This recapitulation may be a *picture*, and a very interesting one, but a great authority lately admitted that these ancestral traits are "rudely indicated," "roughly represented"; and in the vegetable kingdom "recapitulation" has been very scantily observed. Professor Ray Lankester said of this doctrine "though it is now recognised that 'recapitulation' is vastly and bewilderingly modified by special adaptations in every case, yet the principle has served, and still serves, as a guide of great value."* In very much of the arguments from embryology in favour of evolution there is more of the teacher of current biology with epitomes and diagrams at his elbow, than of the interrogator of nature.

The five lines of indirect evidence for the theory of evolution have now been shortly examined, and it is maintained that CLASSIFICATION and GEOGRAPHICAL DISTRIBUTION are equally in favour of this theory and its rival, PALÆONTOLOGY, too imperfect as yet to give a final verdict, but considered by a great living authority to be *on the whole adverse to evolution* —RUDIMENTARY or VESTIGIAL CHARACTERS, double-edged and uncertain—EMBRYOLOGY, suicidal if pressed much in favour of evolution. Of these five, Embryology by Romanes;† Palæontology by Huxley;‡ Geographical Distribution in connection with Palæontology by Huxley;§ have all been said to be the strongest of the lines of argument, and Vestigial Characters by Huxley to have been the most potent in promoting general acceptance of the doctrine of organic evolution.||

The question must be considered how it comes that the great majority of eminent living biologists accept the theory

* *Encyclopædia Britannica*, vol. xxiv, p. 811.
† *Darwin and after Darwin*, part I, p. 155.
‡ *Nature*, June 21, 1883; November 1, 1894.
§ *Encyclopædia Britannica*, vol. viii.
|| *Ibid.*, p. 751.

of evolution in some form. In the first place, the vastness of the subject both as to time and area of distribution affords endless scope for investigation for generations to come, and scientific men are at liberty to hold this theory in any degree of exactitude, from that of "a working hypothesis" to that of a mechanical theory of the universe reaching back even to the "physical selection of more stable elements" of Professor Karl Pearson,* and forward through the whole series of plant and animal life-histories to those still future beings which presumably are to succeed man. The wide-reaching and intricate character of the problems involved, and the great extent of the facts underlying them forbid the expectation of proof or disproof of this theory for many a year to come; this accordingly adds much fascination to the theory. Further it promises to science the high reward of systematizing under natural law "all existence," faith, except as placed in the men of science themselves, being excluded. Soon after its promulgation in form by Darwin, it received the enthusiastic support of a brilliant writer and speaker as well as one of the greatest zoologists of his day, though in Huxley's advocacy there seemed ever to be a reserve such as one so candid and judicial would feel. Lord Kelvin indeed at the Royal Society said in 1894, "We may well be glad that the advocate of 'the origin of species by natural selection,' who once bore down its foes, is still among us, ready, if needs be, to save it from its friends!"†

Finally, this ancient theory modernized, came into apparent conflict with views of creation, held for ages by faith, and supported by most imperfect knowledge of biology and geology, which views were not contained in the true exegesis of the records which were appealed to; and the profound reserve of which, with accuracy in what they did teach, are alone an evidence of divinity. Now that it is seen that the Bible is not a handbook of science for Chaldæan, Greek, Roman, or modern times, but a book essentially moral in its purpose, whose science, if scanty, is true, and whose history every "find" of entombed treasures of the East endorses, and in whose favour the very stones are crying out, this conflict has lost its bitterest sting.

Certain difficulties which obstruct the path of the thorough-going evolutionist remain to be mentioned.

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* *Fortnightly Review*, Novemebr, 1895, p. 678.

† *Address at Anniversary Meeting of the Royal Society*, p. 19.

Abiogenesis or "equivocal generation" is no nearer to proof than it was when in 1873 Professor Huxley was obliged to "admit with sorrow that the question has been 'marking time,' rather than marching,"* and that it appeared to him that "Redi's great doctrine of Biogenesis" was "victorious along the whole line at the present day,"† with certain limitations which were strictly only prophetic acts of philosophical faith. It was the question of Abiogenesis which provoked from Darwin himself the remark, with an impatience rare in him, that this was "mere rubbish." The remarkable progress of synthesis of organic compounds, as with certain other lines of scientific evidence captured by evolution, by virtue of its immense positive progress on the one hand, and its significant negative results on the other, goes to swell the general verdict, "not proven." If this "hiatus valde deflendus" continue indefinitely, the origin of life will either require to be demanded as an axiom of scientific faith, or the evolutionist will need to fall back upon Lord Kelvin's suggestion of an aberrant meteorite as the origin of the life of this globe, a suggestion apparently not made seriously. It is not without a significance which bears upon this question that the most fruitful of all advances in surgery, reaching even to medicine, that of Lord Lister, depended for its possibility on the fact that, in the present order of things, Abiogenesis does *not* occur, as shown by the genius of Pasteur and Tyndall, and foreshadowed by Helmholtz.

Natural Selection.—Without reference to the difficulties under this heading no criticism of evolution should proceed. Natural selection or "survival of the fittest," a phrase of whose "unfortunate ambiguity" Huxley speaks‡ is without doubt the cardinal point in the theory of organic evolution; so much so that Mr. Wallace makes all the evolution that does exist to depend upon it. But Darwin found it inadequate, and invented *sexual selection*, for the purpose of accounting for facts of beauty, colouring and markings, and Romanes has fully supported this supplementary theory. As before referred to, Professor Karl Pearson suggests that *physical selection* of more stable elements may account for inorganic evolution, pointing out truly that this physical

* *Critiques and Addresses*, Preface, p. xii.
† *Ibid.*, p. 39.
‡ *Evolution and Ethics*, p. 32.

selection is but a part of natural selection, viewed broadly and apart from heredity. Sexual selection is taught for the purpose of supplying the obvious inadequacy of natural selection, and is admittedly applicable, when it seeks to account for beauty of form, colour and markings, only to those higher animals which have sufficient intelligence to come under its sphere. Here is a vast wealth of beauty of lower invertebrate life wholly outside sexual selection! The beauty of this class has to find another explanation, and it finds it in *accident*, the bye-products of chemical processes supplying a parallel. The fact that beauty among these life-forms is not universal is taken in proof of this theory of accident; but beauty is no more universal in monkeys (even if not nearly absent), many classes of ungulate mammals, cetacea, reptiles, *among allied classes of which* sexual selection is supposed to operate in the production of facts of beauty. One more great class of forms of life which come neither under natural selection nor sexual selection, and which Romanes declares to constitute half of the animal species of the world, is that of parasites, largely degenerate animals. The beauty of colouring and form of plants, the gaily-coloured corollæ, variegated leaves, numerous markings, and attractive fruits are accounted for by the theory of natural selection, owing to the fact that so large a proportion of these are fertilized by birds and insects, and that these attractions bring about a form of selection and survival of the fittest among plants, their gay fruit and flowers leading to the swallowing of the seeds by birds, and conveyance of pollen by insects to other plants, with obvious results. For that class of plants, which, whether hermaphrodite or not, are fertilized in this mediate manner, this explanation is good enough. But there remains a class of plants directly self-fertilized, or fertilized by the action of wind, which also are necessarily removed from the range of sexual selection and yet not destitute of beauty. This class is very much smaller than that in which cross-fertilization takes place, as Darwin shows. In illustration of it he mentions two lists each of forty-nine genera which he examined. In the first* list fertilization by insects was proved, and of these forty-nine there were about thirty-two which had asymmetrical flowers or presented remarkable peculiarities. The second list of forty-nine genera, including species which were fully or

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* *Cross and Self-Fertilization of Plants*, p. 371.

moderately fertile when insects were excluded, showed only about twenty-one out of the forty-nine whose flowers were asymmetrical or presented remarkable peculiarities.

Still another class of organisms, often of remarkable beauty and variety, the larvæ of lepidoptera, which in their markings and colouring differ strongly from those of the pupa and imago stages, and which of course are removed from sexual selection, remain unaccounted for, as to their beauty, by natural or sexual selection. This point has nothing to do with their "protective markings."

One patent objection to the claims of natural selection in the production of species is in the earlier stages of organic evolution. It is not enough to be dazzled by men of vast knowledge with cleverly described cases among higher animals, such as vertebrata, where the ideas of struggle, selection, adaptation to environment can be more or less graphically pourtrayed for us. The imaginary picture of the lengthening of the cervical vertebræ of the giraffe, again brought forward by Mr. Herbert Spencer, is at least conceivably though not demonstrably true. But when we are told to suppose that in the case of the myriads of larvæ, grubs, worms, insects, required by the voracious and world-wide insectivora, to whom a fast of four hours is fatal, in the case of the thousand herrings, smelts and other marine animals which a great cetacean or elasmobranch fish may engulph in a day, similar *wholesale* ravages upon lower forms of life going on now in numerous lower levels of life, as well as the infinite extinction in this manner, which has reached back, for example, to Devonian times—that in these cases natural selection or survival of the fittest must have operated in the production of new species—and further that it is in harmony with scientific thought that processes analogous to those in the giraffe must have taken place in the *individuals* of the foraminifera and diatomaceæ, we feel no obligation whatever to accept such dogmas. In a piece of chalk, composed of little else than minute Globigerinæ about $\frac{1}{100}$th of an inch in diameter, or a mass of cretaceous marl from Upper Eocene beds, weighing 21 oz., with a sectional area of 14 square inches, on which section are visible 109 univalve fresh-water fossils, Planorbis measuring from $\frac{1}{12}$th of an inch, to 1 inch in diameter, Paludina $\frac{1}{20}$th of an inch, to $\frac{3}{4}$ of an inch in length, we have an object-lesson of the wholesale ruthless extermination, without regard to variations, favourable or otherwise, which must have taken place in Secondary and Tertiary times. And when a vague conception is attempted of the futility of natural selection applied to individual Foraminifera, Crinoids, Sponges, and Corals, which in more recent times are flooring the Atlantic and Pacific Oceans with the "Atlantic ooze," and have built up the limestone and flint which have entered so largely into the earth's crust, we cannot but wonder how the process of progressive transformation, or survival of the fittest, or natural selection ever began.

We are thus met with a diminished number of acres of the once fair inheritance of natural selection, origin of species of protozoa unaccounted for by natural selection, as to proof, and even in imagination—facts of beauty in general unaccounted for by natural selection—those of lower invertebrata by sexual selection—those of plants self-fertilized or fertilized by wind—those of larvæ of lepidoptera unaccounted for by sexual selection—parasites by either natural or sexual selection.

There are results which would have been looked for from natural selection, but which it has *not* produced. The dog has been domesticated by man certainly from early Assyrian times and probably in those of palæolithic man, from the wild forms of Canidæ indigenous to the various countries in which they exist. This period would at the lowest calculation reach back five thousand years—Prince Kropotkin and others might allow twenty thousand, and others thirty thousand years. At any rate during a vast stretch of time artificial selection has been carried on by man among the descendants of the wolf, and the extent of this is visible all around us in the bewildering varieties of the dog in every land. The change of intelligence which has been produced is described by Huxley* with his usual felicity as that which has converted the brother of the wolf into the faithful guardian of the flock, and he hazarded the hope that the same intelligence which had produced this result might do much to change the nature of man himself—a poor substitute, by the way, for the Commandments given on the Mount to Moses, and for the New Commandment given in later days. But in the change wrought in the brother of the wolf as to intelligence or instinct by artificial selection, a most remarkable result has been produced, and by its very contrast to the small physiological change, it is the more remarkable.

* *Evolution and Ethics*, p. 36.

These thousands of years of artificial selection have failed to develop a true new physiological species, seeing that the wolf and dog still interbreed, and produce fertile offspring, their gestation is the same in duration, and osteologically they agree. Here is an instance in which selection carried out during several thousand years, having done so much in regard to mental change, might reasonably have been expected to have acted powerfully, in a vast crucial experiment of this nature, as to physiological change. The non-production of a physiological species is one of the outstanding accounts against natural selection, in regard to which one of Huxley's inconveniently clear statements is on record. "I adopt Mr. Darwin's hypothesis, therefore, subject to the production of proof that physiological species may be produced by selective breeding."* All the extended experiments in this direction have not produced a normally fertile and stable new species, the cases of hybrids between horses and asses, sheep and goats, hares and rabbits having resulted in descendants infertile or of limited fertility, or of a fertility lapsing after a few generations. De Quatrefages speaks of this infertility, or restricted and rapidly limited fertility between species, as a *law* equal in the organic world to that of attraction in the sidereal world, and says: "Suppress upon earth the law of crossing and the confusion would be immense. It is scarcely possible to say where it would stop. After a few generations the groups which we call genera, families, orders and classes would most certainly have disappeared."†

Degeneration is a factor almost invariable in individual, family and national history, and evolutionists themselves show the great effect the doctrine of Dohrn has had upon their teachings. A large number of individual animals beside parasites are degenerate animals, and according to evolutionary views one may consider all animals as degenerate *qua* this or that organ or character. Man himself is looked upon as highly degenerate, as to his external ears, his organ of hearing which once was a gill-slit, his sense of smell, his eyesight, his teeth, his non-hairy skin, his pentadactyl and plantigrade state. These are all matters of theory in line with evolutionary doctrines. But, as to facts, we know how quickly man degenerates in

* *Man's Place in Nature*, p. 150.

† De Quatrefages, *The Human Species*, p. 80.

his higher mental and moral qualities under certain conditions, and no better illustration of this can be given than the case of Alexander Selkirk, a vigorous Scotchman thirty years old, placed in the island of Juan Fernandez, and rescued by Dampier, of whom Rogers says in his narrative, "Immediately our pinnace returned from the shore and brought abundance of cray-fish with a man cloathed in goat-skins, who looked wilder than the first owners of them. . . At his first coming on board us he had so much forgot his language for want of use that we could scarce understand him; for he seemed to speak his words by halves." This "degeneration" was accomplished in four years and four months.

It was strongly contended by Professor Haycraft in his Milroy Lectures on "Darwinism and Race Progress" that civilisation and preventive medicine have together markedly diminished the vigour of those races to whom they have been applied, and he stated, "Preventive medicine is trying a unique experiment and the result is already discernible—race decay."*

"The introduction of this conception (degeneration or progressive simplification) necessarily has had a most important effect in the attempt to unravel the genealogical affinities of animals. It renders the task a more complicated one; at the same time it removes some serious difficulties, and throws a flood of light on every group of the animal kingdom."† This "degeneration" appears to be of that kind which leaves in the particular organism vestigial characters on its upward course of development, but *degeneration from a higher to a lower type* is a view of the process which needs to be reckoned with.

It is submitted that the case for evolution though vast in area and unlimited in ambition, is still unverified; and a Quarterly Reviewer speaking of the lifework of Owen was able to say, "It can now be said that the greatest English comparative anatomist of this century has, after a consideration of the hypothesis for more than the duration of a generation, continuously and finally rejected it."‡ The case for design with which creation is linked, stands reinforced by the fruitful labours of a generation of evolutionists, and the multiplied proofs of adaptation of organisms to their environ-

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* *Lancet*, 1894, p. 457.
† *Encyclopædia Britannica*, vol. xxiv, p. 811.
‡ *Quarterly Review*, April, 1895, p. 398.

ments, traced in the interest of the theory of natural causation, cannot fail to shed an added light upon the teleology of Paley. This "correspondence of life with its circumstances" is so immanent in nature as to warrant a fresh name; accordingly the "new teleology" with its subtle connotation of "better" or "truer," takes the place which has been pronounced vacant, and a *mechanical* theory is ready to attempt the grouping of all the facts of adaptation in organic nature under a natural law. Indeed, Romanes says, "Unless the theory has succeeded in doing this, it has not succeeded in doing anything, beyond making a great noise in the world. If Mr. Darwin has not discovered a new mechanical cause in the selection principle, his labour has been worse than useless."* To this last statement few even of his opponents would agree. The "new teleology," which emerges from Darwinian studies, so far transcends in accurate minuteness the former teaching, as to be itself a stronghold for those who hold the necessity of divine origination and superintendence of that Cosmos which encircles us. That cause which, on the development theory, availed even in the course of four hundred millions of years to elaborate from carbon, oxygen, hydrogen, and nitrogen, those protozoa, which, amidst incalculable disturbances, eventuated in man, can be nothing else than a supremely intelligent and powerful Being. In comparison with a "law" such as that of evolution, those with which astronomers and physicists have to deal are simplicity itself.

The whole of animal and vegetable life affords a field for the study of these adaptations, but the anatomy and physiology of man offer the best, because the most elaborate illustrations of design, and for an introduction to this investigation, "Natural Theology," with certain subtractions, and a few additions, is valuable indeed. In physiology, defined by Huxley as "the mechanical engineering of living machines" rather than in anatomy, much has been added in a hundred years to the demonstration of the perfect mechanism of the human body for its life; and organ after organ has been dignified by a discovery of its function, until it is hardly exaggeration to say that every tissue and organ is instinct with purpose, calculable and demonstrable from the side of physiology. The most recent demonstration of the interworking of the various organs of the body is that of the

* *Darwin and after Darwin*, part I, p. 402.

profound effect upon the general health produced by ablation or disease of the thyroid body.

Not more than a few simple illustrations of design in this highest of life-forms can be given here. The arrangement of the skeleton of man, tubular construction of the shafts and mechanical disposition of cancellous tissue in the ends of the long bones,—the remarkable qualities of bone as a tissue,—the positions and actions of the two hundred and sixty pairs of voluntary muscles,—the protection by position of the large arteries, veins and nerves, and of the thoracic duct—the protection by strong bone of the brain and spinal cord—the delicate water-bed on which they lie—the spaces in the interior of the brain with vascular fringes, in which heightened blood-supply can occur—the various types of joints—the sudoriparous glands, numbering between two and three millions—the specialized functions of all the organs, with a wealth of anatomical and physiological facts which it were wearisome to enumerate, constitute a weighty mass of *a priori* evidence for design and contrivance.

Three more latter-day discoveries pointing to minute teleology may be mentioned. The course by which the lymph is collected from the different tissues of the body and conveyed by branching vessels into the thoracic duct (which itself lies in about the most carefully protected situation which can be conceived), and so into the general venous current at the exactly appropriate spot, is wonderful indeed. But more recent investigations into the peripheral circulation of the lymph show contrivances still more minute. In the pleura, pericardium and peritoneum, which are open lymph-spaces, the lymph is drawn by suction into the neighbouring lymph vessels, through the constant motion in the pericardium of its contained heart, and in the pleura and peritoneum by the muscular action of the diaphragm in respiration. Similarly, as shown by Ludwig, the relaxation and elongation of the voluntary muscles and their contraction and shortening which takes place during exercise, on the one hand draw by suction into the lymph-spaces which exist in the faciæ of each muscle the plasma from the muscular tissue, and on the other drive it out of these lymph-spaces into the surrounding lymph-vessels, which are supplied with valves, at the same time drawing in an increased blood supply. And in the arteries a similar pumping of the lymph from the spaces between the intima and media takes place by reason of the alternate expansion and contraction of these arteries, and *pari passu* blood is drawn from the *vasa vasorum* for the fresh supply of their coats.*

A second illustration of minute teleology is exhibited in the demonstration by Lord Lister and others, that inspired organisms do not as a rule enter the air cells, being detained or destroyed in the respiratory passages. And Dr. St. Clair Thomson† has found that though 1,500 micro-organisms are inhaled every hour in a London atmosphere, "The interior of the great majority of normal nasal cavities is perfectly aseptic," this vast assemblage of germs being filtered by the vibrissæ in the anterior nares, and washed away by the watery mucus and cilia of the epithelium of the passages. A third illustration is in the extensive arrangements for defence against invading micro-organisms, constituted by that phagocytosis which has been found to be occurring in the white corpuscles of the blood, and the lymphoid tissue which abounds in many regions of the body, and the *immunity* against repeated attacks, and probable extermination by zymotic disease, which so largely obtains.

It goes without saying that all these few contrivances, which are eloquent of design, are claimed to have been produced by selection, and in fact as many more as may be known now, or remain to be discovered. Romanes allows one serious and formidable case of difficulty, and only one—the electric organ in the tail of the skate—from which we gather some measure of the supposed extent of selection.

The adaptations of organisms to their various environments being so wonderful as they are, have perhaps been studied in a one-sided manner too often; and here the evolutionist, with his denial of supernatural causation and his reliance upon "struggle for existence," "survival of the fittest," "natural selection," "sexual selection," "heredity," and finally "accident," which constitute his varied and efficient armament, has too often triumphed over his teleological opponent. He can show that very many of these adaptations can be conceived to occur after his method, and his theory is therefore possible, and that others do occur. More than this is not needed, for has he not hundreds of millions of years for his time, and all terrestrial life for his space! The advocate for creation and design by an Omnipotent Being *ex hypothesi* does not claim to specify in human language all the purposive details of all the life-forms in

* *Lancet*, October 12, 1895, Brunton, p. 901, 902.

† *Lancet*, January 11, 1896, p. 86.

earth, air, and water. His faith in a Person Whose mind he darkly discerns in His manifold works, is deemed unworthy of the consideration which the faith of an evolutionist in a kaleidoscopic "law" deserves. The *facts* of biology are the common possession of both, but the man who sees in them "broken lights" of One Whom he knows by "verified experience," is not less worthy than his opponent of the honoured attribute, "scientific."

But another side to this question is inextricably mixed with the point at issue, "Creation or Evolution?" A simple illustration will best introduce this line of evidence. The history of any fertilized ovum, say in mammalia, furnishes one continuous commentary upon design, plan, preparation. It is not enough to study to the uttermost the stages through which the embryo itself passes until the birth of the individual. The environments which it meets from the outset, a vascular mucous membrane, an arterial circulation capable of being massed together for the placenta, a distensible sac, space in which enlargement can take place, muscular power for its eventual extrusion, each and all of these is an essential factor in its development.

Not less necessary is it to study, in the controversy as to design in general, that marvellous preparation of the environments for all life, from man to the protozoa. In this region neither "evolution," "progressive transformation," "survival of the fittest," "natural selection," "sexual selection," "heredity," nor their discreditable ally, "accident," using this term in its broadest meaning, will even verbally account for the amazing fitness of the environments for the organisms "about to be." No longer, though employed in this preparation, are the secondary laws of physics and chemistry in question. No talk of the cooling globe, with its phenomena of upturnings, flexures, bendings of strata, metamorphosis of rocks, opening of fractures with production of volcanoes, earthquakes and the like, will touch the fringe of the subject, nor will theorizing as to nebular condensation help the case, nor will it avail to point out that the organic remains of myriads of buried invertebrata and cryptogams have in the dim past of Cambrian, Silurian, Carboniferous and Cretaceous times gone to form in measure the very home and food of their successors, and heirs. It can hardly be that by means of one mechanical law all vegetable and animal life has been evolved, their requirements being met by other blind laws, such as those of physics and chemistry, a matchless environment being thus prepared for each coming race. The broad facts of environment referred to are such simple major conditions as—

1. Adequate and not insupportable supply of solar heat.
2. An atmosphere surrounding the globe, by which heat and light are moderated and the proportion of oxygen, carbon dioxide, hydrogen, and nitrogen, suited to terrestrial life are afforded.
3. Supply of average rainfall.
4. Nutritive material in the crust of the earth for plants, however produced.
5. Inter-relation of plants and animals, as to nutrition and respiration.
6. The seasons.
7. Alternation of day and night.
8. Variety of soil and climate.
9. Varying contour of earth and sea.

Certain minor "circumstances" which obviously contribute to the higher possibilities of animal life, of man especially—

1. Specific gravity of animal bodies as compared with water which removes the *necessity* of drowning.
2. Supply of wood and metals contributing to the higher efficiency of man.
3. Preparation of soil by earthworms for increased productiveness.

If no other than these fore-ordained conditions of life for coming millions of beings can be adduced, a very temple of design stands out to view, and rebukes a mechanical theory of the universe.

Design, supremely wise, supremely powerful, is not less manifest in the preparation of the required environments for each succeeding generation of living things, from the dawn of terrestrial life to the age of man, than was human foresight and purpose in the purchase by David of the threshing-floor of Ornan, and the collection by himself and Solomon of the treasures of Lebanon and Ophir, for that army of workmen who were to fashion, and did fashion the Temple of Solomon to its perfected design.

Teleology, which thus recognises the harmony between life and its circumstances, the adaptation of environments for organisms, not less than the adaptation of organisms to their environments, will ever furnish a solid mass of indirect evidence for Design and Creation.

Discussion.

The Chairman.—We shall now welcome any remarks on the very interesting and suggestive paper which we have just heard. I think all will join in giving Dr. Kidd a most hearty vote of thanks for his paper.

The Rev. Hammond R. Bailey.—I come from the home of inductive science (Cambridge), where I was bred and reared and lived a long time, though at present it is and has been my lot for many years to be simply that despised character—a country clergyman; but the subject of Evolution has been brought before me very strongly in recent times.

First, I thank Dr. Kidd very much for his paper, and I was specially pleased to hear what he said in comparing the advance of Evolution coming to the "Delta stages."

In regard to creation there is one tremendous flaw, surely, in Darwin's book (I speak of his large edition corrected and enlarged by himself), in which, as you all remember, he traces the genealogy of man and of animals, really, to one primordial being—to one Protozoon—between the vegetable and animal kingdom—something of an Ascidian, I think it is called; and more than once he excuses this and apologises for this by adapting, or applying to it, the theory of Maupertuis. We can all understand that the Almighty in the Universe allows to be used, or uses such force as is suitable. Maupertuis, as you know, applies his theory as if it excused him in reducing creation to its lowest term. Those who have read his remarks will remember that he constantly carps at creation, as if the creation of an individual race and so on was a thing to be hardly swallowed, and that the creation of one original was easy. There is a manifest fallacy in that. The creation of one being implies Almighty power most assuredly, and if the Almighty power can create one animal, or being, it can create as many as it sees fit. You will remember, as Dr. Kidd said, his great theory is "natural selection," which he plainly learnt from what he found in artificial selection in regard to animals, the force that is acting upon it being, as he says, in so many words, the "struggle for existence." As far as my poor reason enters into it, if there was one form of life from which all others were developed, it has the world before it, and its own home, and where is the struggle? I cannot see it.

The third fallacy seems to be in the word "existence." Speculation is limited by what experience proves in these cases—experience proves this—that in the case of animals without choice they are provided (by, we believe, the Almighty) with what serves to prolong their existence and maintain their life and, with that, life is defended and maintained; after that is provided for they are satisfied and do not want more.

There is another point, as it seems to me. Science, as far as I used to know anything about it at Cambridge, proceeds upon demonstration—that is natural science—its method of evidence is demonstration, not possibility. We get no demonstration here.

The theory of Descartes, as accounting for the motion of the heavenly bodies, was founded on fact, but was the merest guess and speculation in the world, and the theory is scientific; and so the theories of evolution may be founded on facts, as they are, but it does not for a moment follow that the theory is scientific.

Dr. Kidd, in one part of his excellent paper, uses a kindly expression, viz., "venial"; but I do not think, myself, that the putting out of these theories is a venial thing. It may be very well for an investigator to have before him a kind of approximate definition by which he works; but to put those things out to men of a reasoning mind in this age of the world, I think, is not venial. They do not study these things merely to play with them and toss them about. They know very well that the matter has to do with serious and important things. Men of science in arriving at foundation truth require positive and necessary proof, as it seems to me, the same as in mathematics and other subjects.

I am sorry to have occupied your time so long, and I thank you for having listened to me.

Professor EDWARD HULL.—We have all listened with pleasure to the "country parson," and it is not the first time that a country parson has thrown a great deal of intelligent light and good sense on topics which exercise us at the present day.

Now, in regard to Dr. Kidd's paper I must say, and I think it must be the feeling of all those present, that I have listened to it with the greatest gratification. It shows it has emanated from a man, who is not only by his profession a physiologist and comparative anatomist, but from one who has also grasped the problems of that science which I pretend to know something about—that is, geology; and it is quite true that anyone dealing with this question of development, or evolution, whatever name you choose to give it, must in some degree have mastered the rudiments of geology, as well as of physiology, and comparative anatomy. Dr. Kidd, in his paper, has shown that he has done so—sufficient certainly for the purpose he had in hand.

Now, I have spoken so often on questions of this kind that I really hesitate to appear before this Society this evening, and I should much have preferred to have been an intelligent listener and to have heard others, who have taken up this question of the succession of animal and plant-life on our globe, than to hear myself speak upon it. But I thought that, perhaps, the author of the paper might think, that if I did not take part in the discussion, I did not sufficiently appreciate the value of the subject which he has put before us; that is very far from being the case.

Now with regard to the general question of design in Nature I am really ashamed to have to stand here, or in any company, and to have to plead, along with others, for the evidence there exists for Design in creation. It seems to me so to plead for itself, and to answer for itself, that it is almost impertinent for any one having ordinary reason, with which he is endowed, to have to come before an assembly, and have to point out the wonderful organization and arrangement of animals and plants of this globe, as well as those bodies which I am glad to see the author has introduced under the term of inorganic evolution, though I doubt whether it is a proper term. When we look at the world around us and know something of past history, physical and organic, to deny creative design seems to me to be like a man who shuts his eyes and denies there is a sun in the heavens. The "country parson," if he will allow me to call him so, as I have not caught his name, has very properly stated that the origin of life requires a Creator. There is in the current number of the *Contemporary Review* a most able article by the Duke of Argyll, who, I am pleased to see, although of very advanced age, still possesses that acute intellect and reasoning power combined with great range of knowledge as fresh as it was 20, 30, or 40 years ago. It is an article on this very subject in reply to one by Mr. Herbert Spencer, whose essay was dealt with by Lord Salisbury in trenchant words at the British Association at Oxford. The Duke of Argyll has made use of an argument there which seems to me to be absolutely incontrovertible. It is partly a geological and partly a zoological point. He says (or in words to this effect) every geologist must admit—that there was a period in this world's history (when in a gaseous or molten condition) at which life could not have existed. Therefore life has been implanted on this globe at a time when the outer crust came into such a condition that it was suitable for the existence of life upon its surface and not till then. Well, where did this life come from?

Dr. Kidd referred to Lord Kelvin's amazing idea (I can only call it amazing, and I do not think it was ever referred to by its author again), which he expressed at the British Association at Glasgow, that perhaps life was implanted in this world by a meteorolite coming from some celestial world in the universe, and happening to alight on this little world of ours and so introducing life for the first time in the form of some simple and minute organism. I think it cannot have been serious, or, perhaps, only an outburst of fancy coming at the end of a most interesting and able Presidential address. Then, as our reverend friend well stated, if there was necessarily a Creator to introduce life upon the globe at a particular period, why might not the same Creator have introduced various forms or types of life from time to time during the vast period that has elapsed from the commencement of the primordial period down to the present time? If you admit that He has once necessarily interfered in the history of creation, you cannot deny that He may have interfered throughout successive ages down to the present day. It may be out of order; but I may be permitted to refer to a remarkable utterance of Him whom we, as Christians, call our Divine Master when He said, "My Father worketh hitherto and I work." That is a most remarkable expression, and it seems to me to imply this—that God, the Creator, has been engaged in superintending, carrying on, by design and through evolution of some kind, the work of creation in this world, but that He had now ceased to do so; and then it was the time that the Saviour Himself should commence His divine mission amongst mankind.

Having said so much I will not detain the Meeting longer at this stage. I thank Dr. Kidd most heartily for this able and lucid explanation of the subject, and I am sure it is not only a gratification to us, but it is a great advantage, in the present state of controversy, to have such a paper to fall back upon for future reference.

Professor ORCHARD.—With your permission, Mr. Chairman, I wish to express my acquiescence in that tribute to Dr. Kidd for his paper which has been so felicitously tendered by Professor Hull. The paper, in my judgment, is, perhaps, the most valuable on this subject that has ever been brought before this Institute. The very important point, I think, is that in which Dr. Kidd insists, towards the close of the paper, on the co-adaptation of organisms to their environments and *vice versâ*.

The paper is indeed eloquent of Teleology and must shatter, in the opinion of all thoughtful people, this much vaunted theory of Evolution. At times one wonders how any one with any logical sense of reasoning could swallow such a theory.

Dr. Kidd has done good service in bringing before us several reasons which no doubt have had to do with the acceptance of the theory by many biologists, and others who are not biologists, but who follow blindly in their wake. To Dr. Kidd's reasons I think may be added two more. One is, undoubtedly, the diversion of the human heart from God, thus causing an inclination to believe in anything that is hostile to the Bible. Another, as has been so well pointed out by the gentleman who spoke first, is this—that this theory is not, apparently, discordant with certain facts. There are certain facts known which do not, of themselves, appear to contradict the theory. That is true; but the same may be said of every false physical theory that has ever been brought forward. The gentleman to whom I have alluded spoke of the vortex theory of Descartes; that did something, no doubt, to retard the theory of truth. So have other theories in the past, and we shall do well to remind ourselves of Huxley's dictum—that if an hypothesis is inconsistent with one known fact that hypothesis should go, and a far greater man than Huxley (Sir Isaac Newton) warned us to accept nothing in science but what is proven.

It is most unfortunate that in what we may call almost the twentieth century there has been a substitution of imagination for science.

I beg to express my personal thanks to Dr. Kidd for his most valuable paper.

A Rev. VISITOR.—May I say one word? I desire that the excellent paper of Dr. Kidd's should not pass without some warm testimony on my part to the remarkable research, the exhaustive examination and fearless looking into of all the various points of the Evolution theory which it displays. It has given me the greatest possible pleasure; but I may be pardoned for apparently speaking strongly when I say that we are laid under a great obligation to the writers on the side of the Evolution question. We should never have had such a splendid paper had not we these strange theories put before us.

I will only add that I beg the author kindly to accept this warm, earnest, and heartfelt testimony to the excellent clearness and lucidity of the paper that he has put before us, and I hope it will strengthen faith in the great argument of Design which has never yet really been impaired.

The discussion was continued by the Rev. J. RATE in support of the views of the author.

The CHAIRMAN.—I think before calling upon Dr. Kidd to reply, and before conveying to him that cordial vote of thanks which has been already expressed so well, I would urge the very careful reading of this paper upon anyone who wants to understand how the matter really stands. It does so clearly trace the curious change which has come over the theory of Evolution. It shows how many theories there are, and how the old theory of chance variations of species has to get over Weissmann's theory—in fact, much has changed to alter the theory of Darwin as it used to be. Then we go to inorganic evolution as compared with original development, and that has got down to development by law and not by caprice. If development by law is not a sign of design I do not know what is. One can use the phrase *evolution* to express what we see around us. "The work of the Creator" is a useful expression. We talk of the electric current, for instance, but one does not commit one's self to the current—a man talks about a hexagon, and makes the sign on the blackboard, and if he believes that is how atoms are built up he must have great belief. Some accept it in that way without committing themselves to any authentic theory, as I believe this is; but when it is used contrary to the doctrine of design, we cannot too strongly consider the arguments that Dr. Kidd has put forward.

Dr. KIDD.—I am greatly indebted to the Chairman and the speakers for their kind approbation of my paper. I have hardly any adverse criticism to deal with.

I will refer to the last point, which is the only one I need refer to, viz., that mentioned by the Chairman, the belief of Weissmann. That seems to be destructive to a great extent of the real theory of evolution, as Darwin put it forward.

In the end I hope we shall see the Delta stages reached.

I thank you for the very kind reception of my paper.

The Meeting then terminated.

THE FOLLOWING COMMUNICATIONS ON DR. KIDD'S PAPER HAVE BEEN RECEIVED.

From Rev. F. R. TENNANT :—

I feel grateful to Dr. Kidd for the timely caution which his paper gives. In a time when Evolution is "in the air," it is a courageous, if a thankless task, to point out the difficulties and shortcomings, real or apparent, of the almost universally accepted Theory. I do not feel myself able to estimate the value of all the evidence Dr. Kidd has marshalled against the all-sufficiency of natural selection, but I can the more easily realise, since reading his paper, that possibly the progress of Evolution has been rather too rapid; that science has lately been too much engrossed in enumerating what Evolution *can* explain, to notice as carefully as she might how much evolution, or rather, natural selection, *cannot* as yet explain. I think it is well for evolutionists to be reminded how much of their system has been arrived at by processes which must, to say the least, be regarded as methods of "exterpolation."

But I am sorry that Dr. Kidd has taken up the position, which he expresses in the following sentence :—"It may be here acknowledged that the theories of Creation and Evolution, logically pursued, are directly opposed." The word "creation," is there ambiguous; it might mean "creation," simply, *i.e.*, bringing into being by God, out of nothing, but His infinite capacity to will or cause; or it may mean what is now commonly called "special creation,"—immediate and direct creation of species in their present state. In whichever sense Dr. Kidd means us to take the word, I should object to the statement. If in the first, he is setting up an imaginary opposition between Evolution and Theology. If Evolution were proved, it would not in the least render creative acts unnecessary or impossible. Most evolutionists have seen that. Darwin, Huxley, Haeckel, Spencer, Tyndall, Romanes, Clifford, and others can be quoted as stating that Evolution supplies no argument against the *possibility* of creative acts. And if the theory of Evolution is often stated to rely "solely upon natural causation, dispensing with supernatural intelligence and action," I presume no evolutionist would be so rash as to assert that it precludes, and is *incompatible* with supernatural intelligence and guidance. The possibility of an original creation, which is absolutely essential to Christian theology, or of a Divine Personal Intelligence immanent in nature, is a question which natural science cannot decide one way or the other.

The whole question is as to the *mode* of creation. And this brings us to the second possible meaning of the word in the sentence I have quoted above from Dr. Kidd. It is of course plain that Evolution and "Special Creation" are contradictory to the other, though "Creation *by* Evolution" is a possible third alternative, which I regret that Dr. Kidd ignores. And, with regard to the opposition between the theories of Evolution and Special Creation, I would like to point out that the Christian Faith is not committed to the theory of Special Creation. That theory was manufactured mainly by seventeenth and eighteenth century science.* There had, of course, been commentators on Genesis in all ages, who had interpreted the Bible in terms of it; but there had been great authorities of influence, like St. Augustine, and St. Thomas Aquinas, who preferred a crude "evolutionary" interpretation. Neither was regarded as essential. Theology refuses to be held responsible for either. She can absorb the theory of Evolution, I think,

* Ray, Linnæus, Cuvier.

with less difficulty than the other, if it should prove the true one. Of course, I am assuming that the old-fashioned (but unauthoritative) view regarding the inspiration of scripture, which would make us look to Genesis for infallible natural science, and not merely for great spiritual truths taught in the imperfect scientific language of remote centuries, must be laid aside for one which is more true to the facts.

NOTES BY MAJOR W. H. TURTON, R.E., ON DR. KIDD'S PAPER ON "CREATION OR EVOLUTION."

(1) I am unable to agree with what the author says as to Creation and Evolution being opposite theories, the former alone showing design; or perhaps I do not attach the same meaning to Evolution as he does. As I understand the term it is the *process* by which all forms of organic life have been developed out of the earliest form, and a process is not a cause. Each slight variation must have been caused somehow. It cannot be due to *chance* or accident, for this is merely a convenient term for the results of certain forces of nature when we are unable to calculate them, and strictly speaking cannot cause anything. And therefore Evolution requires an Evolver, just as much as Creation requires a Creator, and the opposing theories would in my opinion be better expressed as Creation *by* Evolution, or Creation *by* separate acts. Each equally shows design, each equally requires a Designer. Only on the former hypothesis (that of Evolution) the design is seen to be on a grander and more comprehensive scale, and therefore more worthy of the Designer.

(2) Moreover, I do not agree with the theory that the geological epochs can be fitted in between the second and third verse of Genesis I. The evidence appears to me to be overwhelmingly in favour of the view that the word *day* in Genesis I. denotes an *indefinite* period of time, though the subject scarcely falls within the present paper.

Mr. Robert P. C. Corfe writes:—

The most able lecture to which we have just listened comes as a fresh, cool, invigorating breeze across the hot desert of dust and doubt of this present age.

There is, however, in connexion with all this vast subject, an aspect of the highest importance, which cannot now be ignored, and which has become so closely associated with the subject of this paper as to be now inseparable from it—namely, the incorporating of unproved theories of Evolution into the religious teaching of the country, even including the adoption of the Evolutionist's theory of the origin of man as an integral part of Christian teaching.

I should wish to express especial pleasnre at the learned lecturer's admirable reference to the gradual but effective demolition of that particular form of attack on the Bible which is known under the singularly attractive title of "The Higher Criticism," and which is attributable to the frequent discoveries being made in the East hardly more, may I add, than to the patient literary work of faithful divines and laymen in this country.

However, this demolition is at present a Nemesis of which the Higher Critics seem to be hardly yet aware.

I trust, however, and believe that a similar Nemesis, hastened by the labours of this Victoria Institute, will soon overtake all who have joined in the hue and cry against God and the Bible; but whether it comes sooner or later, we have a right to expect that they shall fight on the side of God and the Bible who have set themselves apart for teaching and guiding the religious life of their fellow-countrymen.

Dr. GLADSTONE, F.R.S., writes as follows:—

I have had no time to think over the very interesting and suggestive paper to which we have listened, but I may express my general concurrence with the views of the writer. Looking lately at the work of the Rev. A. D. White—*A History of the Warfare of Science with Theology*—I was led to think how it has come to pass that the words of the Bible were appealed to to settle what is true or what is false in recent science. It is not that the sacred writers themselves make any claim to be authorities in this matter. They do frequently introduce allusions to nature, but it is in the way of illustration, or to direct the hearer's thoughts up to God, the great Creator and Ruler of the universe. The language in which this is done is usually that of poetry; and I do not remember that in any case any didactic reference to nature is introduced by such a formula as "Thus saith the Lord." Most of the old pagan nations worshipped the sun or some other natural object, and, accordingly, they looked upon their priests or sacred books as expositors of nature. Is it possible that this same idea has been transferred, like many other pagan notions, to the Jewish and Christian writings, which make no such profession?

As to the question of creation by evolution; there is no scriptural difficulty in receiving what is now the almost universally accepted view of the origin of different species of plants and animals, including man himself. Anyone who will take the trouble to look up the forty-eight or more passages of scripture where the word *Bara* is employed, will find that, as already stated, the word is never used except with reference to the work of God; but it is not stated or even implied in any one of them that this creation was out of nothing, while it is impossible to attach such a meaning to such passages as Psalm cii, 18, Isaiah liv, 16, Ezekiel xxi, 30. The same is equally true of the thirty-eight passages in the New Testament where *κτίζω* or its derivatives occur. I am fully convinced that, in making the material world as we see it now, God has proceeded by a method of gradual development similar to that which He has employed in revelation.

ORDINARY MEETING.*

CAPTAIN HEATH, R.N., IN THE CHAIR.

The Minutes of the last Meeting were read, and the following election took place :—

ASSOCIATE :—H. Hartshorne, Esq., M.A., M.D., Japan.

The following paper was read :—

COMMON ERRORS AS TO THE RELATIONS OF SCIENCE AND FAITH. By GEORGE MACLOSKIE, D.Sc., LL.D., Professor of Biology in Princeton University, U.S.A.

IN a memoir of the great investigator, Joseph Henry, it is stated that, whilst he was of a devout spirit, he was not much troubled by physico-theological controversies. He thought it would be strange if, in an advancing world, the theologian and the investigator in their independent paths should not occasionally misunderstand each other. And he held that men should not lower their scientific flag in order to conciliate theology, or lower their Christian flag in order to satisfy scepticism. Like many other thoughtful men, he knew that, as between Christianity and science in their own essentials, there is no quarrel; and that on neither side of the controversy over them is there a monopoly of blamelessness. It is instructive to observe how largely ex-President A. D. White's able sketches of the conflict bear on tenets once accepted by all schools and professions, and how the development of science has involved a reconstruction of men's ideas of jurisprudence and philosophy and therapeutics as well as of physico-theology: and to note that the one general truth evolved by history is that a worthy clergyman even when well read in divinity and in classical literature, is not safer against error in his scientific excursions, than is a brilliant scientist when he turns anti-theologian. This is a

* March 1st, 1897.

wholesome truth which ought to commend itself to our hearts. The following notes are also directly suggested by a historical review of our problem, and appeal to those who attempt the conciliation of science and faith.

1. In view of the relative independence of the testimony for religious and scientific doctrines, all that should be expected is a *general harmony;* and to press for excessive conformity is dangerous. In fact no sound method of homologizing the Bible and natural science has been discovered; nor was it ever possible in the formative stages of science to effect their harmony. Thus it comes that all the well-meant efforts in this direction have been necessarily in great measure failures; and any efforts that we may make must be provisional, as they have to do with sacred exegesis and scientific opinion, which are growing, and therefore changing, things. Munro Gibson has enforced this principle by reminding us that men have fought for Milton's ideas as passionately as if *Paradise Lost* had been added to the Canon. The same error is gladly accepted by sceptics, who insist on the Miltonic idea of creation as the only Scriptural idea, and therefore insist on the incompatibility of Scripture with well-established science. To harmonize Scripture and science is good, if the harmony be provable beyond doubt; even a general refutation of charges of their discordance is useful. It should be remembered that there is a large unexplored hinterland between our science and the exegesis of the early chapters of Genesis; and the anti-scientific divine is always sure to join hands with the anti-religious man of science in filling this region with impassable barriers. We must, however, carefully keep our interpretations of Scripture untainted by our scientific ideals, and we must keep our science clear of theological glosses. If Hugh Miller had succeeded in engrafting his *Testimony of the Rocks* upon the narrative in the Book of Genesis, every new departure on either side would have brought a rupture. Some parts of the bright volume on *Natural Law in the Spiritual World* appear to us to err in this respect, often modifying its theology for the sake of completely harmonizing with its science. It would also be wrong, we think, for churches to readjust their deliverances as to the creative week, so as to embody Miller's or any other particular view of the creative days; although it might be proper to eliminate from them any definite interpretation which has been proved to be untenable. The general harmony of the

Mosaic cosmogony with geology is sufficiently clear; but every man who in the present state of our knowledge ventures to develop their harmony in details is sure to fail.

2. Neither reason nor Holy Scripture gives us any warranty for restraining scientific researches or speculations; and any attempt to restrain them proves our ignorance of the laws of investigation, and is a usurpation of the rights of human thought. On looking into the past, we learn that the most important discoveries were reached by men going blind-fold, and often going against the current of popular opinion. Men have used wrong methods, and arrived at valuable results; Columbus was wrong in the notion that westward was an easy route to the East Indies, but it was better to take the wrong route than to remain at home. Scientific inquirers claim the right to go wrong, to use wrong methods, if these appear the best, and not to be challenged as for a moral delinquency; they also believe that religious councils (or even scientific councils) are as unfit to regulate their procedure as they are to instruct army commanders how to handle bodies of soldiery. The investigator may be astray in his views of nature, may be biased in his mode of drawing inferences, may be ignorant of the religious tendency of his opinions. But his erroneous assumptions may be a necessary step in his progress; and we must let him follow out his own plans. Many illustrations bear on this. Sir Isaac Newton made his optical discoveries by the help of an erroneous theory as to the nature of light; and we are almost certainly in the dark or astray as to the nature of gravitation, yet much useful investigation is in progress as to its subject-matter. All scientific investigation is at first groping in darkness; even the student of mathematics must at the beginning of his course deal with *minus* quantities, and with their imaginary square-roots, and must learn to add and to multiply infinities, all which impossibilities prove to be both legitimate and useful.

3. The right to investigate and to speculate carries with it the right to publish the speculations at any stage, and however crude. It is indeed to be remembered that if any man comes to anti-moral or to atheistical conclusions, he ought to hold himself responsible for the views which he actually entertains, however he has come to accept them. But a man who accepts particular views about science (or about history or philosophy) is not to be held responsible for deductions that somebody else can justly or unjustly draw

from his opinions. It rarely happens that one man can see all the bearings of the facts or theories on which his mind is occupied; and a single investigator rarely completes a subject of his research. It is by the publication of his ideas that others are able to confirm or confute him. To prevent unverified publication would have killed much of Sir Isaac Newton's work, as it was nearly two centuries after his time that the necessary rectification arrived. His errors were in many instances suggestive of further researches which led to the true explanation of phenomena.

The constant appeal to verifications is characteristic of scientific theory. What is called the Higher Criticism in Literature is weak in this respect, at least as to its positive side of emendations and distributing fragments to hypothetical authors. Richard Bentley gave an object lesson of his method in his emendation of Milton, an imaginary editor included, which to us non-critical people would seem quite as justifiable as his revision of Horace, or as others' parcelling out Moses and explaining the peculiarities of the Bible by a naturalistic quasi-evolution. Out of several possible theories about the origin of a book, the tests for determining which is the right view are rarely available; and the scientific method is to regard hypotheses as only hypothetical until we can verify them by tangible evidence.

4. The enemies as well as the friends of religion are sometimes inclined to regard every novel scientific doctrine as necessarily atheistical. Some hail the new dogma as a weapon of destruction, others denounce it as perilous; and both parties appeal to each other for confirmation of the opinion that the new dogma and the old faith cannot coexist. Three-quarters of a century ago most of the English clergy thought that Geology was dangerous to men's religion, and even geologists like Lyell were of the same opinion. Since that time we have come to the conclusion that the geologists were right as to their science, and the humanists were wrong, and that there is nothing specially wicked in the discoveries of the former.

5. A very foolish and sinful practice is that of taking flings at the departments of science that are subjects of popular suspicion. A learned professor recently assailed Geology on the heavy charge that within the last century the geologists have changed their views two hundred times. He might have truthfully said two thousand times: but he ought to have been ashamed to make such a charge, especially in

the remembrance of the treatment meted out towards the geologists by men of his own kind. The fact of many changes redounds to the credit of science, if these changes, though limping and often stumbling, are on the whole progressive. The same objection is constantly reproduced in newspapers, showing obtuseness that will condemn a branch of science because of its manifold advances. Will men condemn Geography because the map of the world has changed so much within the last century? Or will they condemn electricity because of the changes effected in it since Franklin hoisted his kite? A living science is always undergoing change, just as the living body is in a continual flux; by many tentative efforts after light and truth, often with steps backwards, the research goes to new fields. The geologists had hard times between their own unavoidable blundering and the sharp criticism of many who did not sympathize with them and did not comprehend their mission. The blame of opposing them does not belong exclusively to the clergy; professors in universities, eminent physicians, lawyers, men of humanistic and even scientific culture, all looked askance on the young foundling that was seeking admission to the family of the sciences. We cannot understand how any intelligent Christian can now refrain from thanking God, and blessing the memory of the early geologists who fought for and won the liberty of studying in their own way the structure of the earth's crust. A living science, like a living college, and like a mighty nation, must be always changing, seeking something higher, and will regard its early struggles as the most honourable part of its history. On the other hand, a perfect science, no longer changing, is dead, useful perhaps to guide Chinese artisans in its applications, but unworthy of further research. One of the drawbacks of the ancient classics as frequently studied is that they live too much in the past, without opening new lines of research: like aristocratic families that are proud of their record, though now decadent. Even in the classics, men like William Ramsay have opened new lines of research which are reviving the fascination exercised by such studies on our ancestors; and the great attraction of the sciences is that they send their students in search of new fields.

6. We take the opportunity of challenging a common assumption as to the Scripture narrative of the Noachian deluge. It is supposed that whether universal or local it must have been simultaneous. A series of successive

devastating floods over many lands, with much, if not universal, destruction of human life, is what geologists know to have actually occurred. We do not advance this view as the correct exegesis of the record in Scripture, but submit it for verification.

7. The conflict has now shifted from Geology to Biology, and specially to the question of the origin of species, and still more directly to that of the origin of man. The various terms, *Evolution*. *Development*, *Darwinism*, are, according to the *usus loquendi* of the scientific world, synonymous at least when applied to the organic world; all of them just indicating the actual derivation in some way or other of distinct species from common ancestors. The term *Natural Selection* further suggests that the forces causing the production of new species are chiefly external, that in the struggle for existence they represent the influence of the environment. The name of *Neo-Lamarckians* is now applied to those who, believing equally with the selectionists in evolution, regard the forces as chiefly or largely internal, the organism itself when acted on by the environment responding by appropriate changes of its own structure. None of these views involves any assumption either for or against the supreme control of the Divine Being over the process of evolution, and over the environment and the movements of the organism. An evolutionist may, if he choose, say that it is all nature and nothing more; another may say that nature is only a name for God's mode of directing or effecting changes.

Candid thinkers may be led to condemn this theory. An eminent British physicist is astonished at the "coolness of assumption with which mere speculations are spoken of as if they were established truths." His criticism is thus far justified—in that many praise evolution as if it unlocked all the secrets of the organic world, and yet no well-grounded theory of its *rationale* or its limitations has been reached. Neither natural selection nor Neo-Lamarckism goes back to the real origin of variations, a point which is yet unknown; they are rather like interference in athletics, which may secure a clear field for the movements of variations otherwise initiated. So far, established evolution is only empirically true, and ought not to be applied too widely in a deductive way. Nevertheless one may be biased against it by one's mental habit as a physicist, accustomed to mathematical, or at least experimental, evidence. Such evidence is rarely accessible in Biology, as it is inaccessible in sociology and politics and theology. Yet appropriate evidence, and a great deal of it, favours some kind of evolution; evidence from many widespread and independent sources ever cumulatively growing. The theory opens new lines of research, is continually leading the way to new discoveries, often enables us to prophecy, and is reinforced by fulfilments of its predictions. Thus by the only evidence that can bear on the case the general theory seems fairly established, and ought, we think, to be provisionally accepted.

On many particular points, as the first origin of life and the origin of man, there are special difficulties. The recent lecture of Professor Hubrecht at the Sesquicentennial of Princeton University shows that the genealogy of man cannot be traced through either the apes or the lemurs, and that the nearest known ancestral form is away back in the Eocene formations, and even this one is only possibly ancestral; a result which rather increases the sense of our solitude, and shows that whether miraculously produced or more slowly evolved, there must have been something very special in this case, and that our moral nature cannot be accounted for on any theory of naturalism. But let nobody fancy from this that the evolution of man is disproved; at any time discoveries may be made which will change the whole aspect of the question. For the Christian public we think the best attitude at this time is that taken by the late President J. McCosh, in these terms: "If any one asks me if I believe man's body to have come from a brute, I answer that I know not. I believe in Revelation, I believe in science, but neither has revealed this to me; and I restrain a weak curiosity which would teach me to inquire into what cannot be known. Meanwhile, I am sure, and I assert, that man's soul is of a higher order and of a nobler type."

If any man can prove that evolution is false he will find a ready hearing in scientific circles. But the trend of testimony goes strongly in the opposite direction; and men are rendering a poor service to religion who attempt to get up an issue between it and evolution. Such attempts nearly always show misapprehension as to the meaning of evolution. Here an able writer fancies that it can change a rose into a dandelion (which no evolutionist thinks possible), and argues against evolution because it fails to explain the origin of sex—which it, however, explains so well as to turn this into an argument in its favour. A learned lawyer writes a book entitled *Creation or Evolution*, entirely unconscious of the additional alternative of "Creation *by* Evolution." Of course *creation* in this connection refers to the secondary creation of living things out of already existing matter, living or dead. The greatest error of Charles Darwin was the publication of his theory as antagonistic to the Biblical record of Creation, an error that summoned to his side the sceptics, and was a challenge to Christians. A well-known professor of divinity charges against Evolution, and against Biology in general, that it gives no place for mathematics and is therefore devoid of certainty. He does not appear to see that the same objection hits Theology; and if he knew more about Biology he would find that it contains a good deal of applied mathematics, as shown by Macalister on the *Human Skeleton*, and by Matthiessen on the *Dioptrics of the Eye*, as well as by the mechanics of levers and centre of gravitation of the body. Worthy men too often prejudice youth against Christianity by making its defence rest on their misapprehensions; and many arguments offered to shield theology from new scientific theories will, when examined, be found to be the revival of the exploded theories of Cuvier and his followers.

8. We think it wrong to denounce scientific work because of the infidelity of some of its disciples. Science is not God's way of saving men from sin, and it welcomes to its realm believers and unbelievers. The artificial selection of drafting off our brightest Christian students to the Christian ministry has a tendency to leave the proportion of Christians going to other professions in a minority. This drawback is aggravated for scientific study by a system of criticism that informs a man that on entering science he must either deny his faith or renounce his independence; and if he renounce his independence he will never amount to anything in science. Nobody, not even the scientist himself, can draw the limiting line between legitimate and illegitimate argumentation; and in grave cases the line has been drawn wrongly, to the prejudice of both religion and science. We cannot foresee what we shall ultimately come to; and to start with the resolution that we shall only see the side of science that will favour popular notions of physico-theology is to insure our incompetency and to prevent our ever getting to the front. The history of both Astronomy and Geology is the best argument in favour of

wide toleration, and the best proof that this is really not injurious to Christianity. Science cannot afford to walk in fetters, and an attempt to bind it must always have the effect of confining its prizes to the rebellious.*

9. The error of the "*evil tendency*" objection would merit a long discussion. Men brand unwelcome doctrines as having an evil tendency, when they see no direct answer to them. Our reply is that we cannot satisfactorily estimate tendencies; that persons holding different tenets are often alike distinguished for morality; that the real question as to the truth is one of testimony; if the evidence is sufficient we will receive the doctrine, and leave the tendency to take care of itself. In science, as in religion, we can only take what comes to us, without asking whether it is likely to prove beneficial or otherwise to faith. But the Christian scientist enjoys his religion in every step of his work, and its influence tends to confirm, not to weaken, his faith.

10. It is sometimes an error to condemn a book because you do not accept its conclusions. If it shows honest research, it may be valuable and deserving of honour, though the author failed in the last stage. Such was Newton's work on light, already referred to, which served for generations as a scaffold for building up the science of optics. One of its prophecies was that we should find light to pass more rapidly through water than air; the fulfilment of this prophecy in the opposite sense, by Foucault in 1850, gave the *coup de grâce* to the Newtonian theory, and established the wave-theory. Dollond committed a blessed blunder when he entered on a mathematical tournament against Euler, maintaining that a lens composed of differing materials, as glass and water, could never be cleared of its dispersive colours. He afterwards improved on his own work, when by reducing his arguments to experiment. he surprised and refuted himself, and established Euler's principle. Thus he became the fortunate inventor, and his son the manufacturer, of achromatic lenses, as the sequel of his antecedent error.

11. A mischievous error bears on the relation of Divine Providence to Physical Causation. Able men have supposed

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* Our freedom in Princeton from any religious-scientific difficulty is chiefly due to the happy combination of intellectual independence and Christian sympathy, which characterized the late President McCosh, and which he encouraged in others.

that the less science you find in things, the more Divinity belongs to them. Some have seemed to think that Providence is less providential, and miracles are less miraculous, if natural causation enters in any degree; that "all events truly miraculous" are produced "by the simple volition of God without the intervention of any subordinate cause." We do not pretend to explain miracles as embraced in scientific causation; but we find in our Bible that winds, rain, hail-stones and floods are employed in the performance of His mighty acts, and that the Bible does not trouble itself to say whether the acts are miraculous or only providential, and never gives a hint of the difference between primary and secondary miracles, which the theologian is careful to note. As to matters of Providence, the error appears on opposite sides; the naturalist is so deeply impressed by natural laws that he says, "Hands off!" to the supernatural; the Providentialist proves his faith in the divine working by disparaging scientific explanations. Many of our worthy Christians have been grieved to find one part of nature after another rescued from chaos and subjected to natural law; and to see that every step forward in science involves a mechanical, or more properly physical, explanation: so that now all inorganic nature, and in large measure the organic world, even the actual constitution of the human body, are reduced to physical causation. The old doctrine of "vital force" is now superseded; all the force in plants and animals has come into line with the doctrine of "conservation of energy," and life itself has come to be regarded as only a directive immaterial principle, just as in a more exalted sense God is not a force, but the Author and Director of all the forces of the universe. In the organic world the difficulty of applying physical explanations to all the phenomena is very great. Darwin's attempt to apply these was, we think, worthy of commendation, though his success was very partial. Complete success would not, so far as we can see, involve the dethronement of Providence. The more advanced our theory of nature as a physical system, the more firmly established is our conviction of its origin from, and continued subjection to, the will of God. The investigator who does not see God, and who derives all his stock from human experience of antecedents and consequents, is often unable even to see causation, and sometimes fails to perceive either his own existence or the objective existence of the world: all is to him a phenomenon or dream. It is hard for the investigator who does not believe in the existence of God to believe in the real existence of anything, even of his own personality.

12. It is a mistake to suppose that a miracle should ever be capable of scientific explanation. Whatever is so explainable is not miraculous; and the iconoclastic service of science has been rendered in thus exposing mediæval and modern miracle-mongering. The *a priori* improbability of the miracles of scripture as supernatural manifestations is removed by the extraordinary character of the redemption to which they were incidental. Each of them has a supernatural part grafted on to a natural basis. The basis is of course amenable to scientific exposition; and some people fancy that when they have found this, they have "naturalized" the whole miracle.

13. It is an error to suppose that we can explain how the Divine Being operates upon nature. Some people argue that such operation would necessitate the injection of a new force *ab extra.* Malebranche's *Occasional Causes*, Leibnitz's *Pre-established Harmony*, and Edwards' doctrine of *Concursus*, and the illustration of miracles by a supposed extra-wheel in a Babbage calculating machine, are attempts to explain what from its nature must be always inscrutable. We cannot bridge over the gap between the genius of an inventor and the resulting machine; or even between our own mind and the act of our hand. Yet we never suggest that mind has no control over body. If we could give a physical explanation of their relations, we should either materialize mind or spiritualize body. Thought may be regarded as the spiritual aspect of matter, but even this we are unable to prove. In a similar way, whosoever detects the divine contact with matter, as by reaching the Deity from a material starting point, will reduce Him to membership of the material universe, as surely as the sun and the star Sirius have been brought into our system. Any objection to belief in Providence, even in a particular Providence, because of our inability to comprehend its mode, would *a fortiori* render it impossible for our own mind to act on our environment. It would on such principles be as difficult for God even to know what is occurring in His world, as it is to direct it, as His knowledge may be regarded as a measure of reaction of the universe upon His own Being. Nor can our argument be evaded by a materialistic theory of mind itself; for whatever be its relation to its material investment, we must assume that the

Divine Being has at least an equally pervading relation to all nature.

14. There is a wide-spread opinion that the acceptance of the evolutionary theory of the origin of man would destroy our faith in the great doctrines of the Gospel. Without going into detailed argument we think it can be shown that the Christian Evolutionist would still hold to the miraculous creation and endowment of the spiritual and moral nature of man, and to his immortality: and in general to the essential doctrines of our religion. The case would be the counterpart of that of the arch-evolutionist George Romanes, when he turned Christian. He came into the enjoyment of a new set of very happy experiences, and yet did not find it necessary to discard a single item of his scientific ideas.

15. We deem it a mistake to assume that the conflict between science and faith is only mischievous; and we hope that people will remember that "science falsely so-called" is not in the Revised Version, and that the passage so rendered in the older version does not contemplate what we call *science.* Bad things are very often ventilated in the name of science; and the conflict is hurtful when scientific scepticism goes on the war-path, or when students of science are suspected by the community. But even here there are compensating benefits. Sharp criticism is wholesome both for Christianity and for science; it compels people to re-examine their foundations and to marshal their evidence. Christianity owes to science the overthrow of superstitions, and greatly improved conceptions of the works of God, also new confirmations of Scripture and refutations of once dominant idolatries. Both religion and science are greatly helped by the brisk controversy that attracts the public attention. No subject is ever of much interest until it becomes a matter of debate:—the debate resulting from and often adding to men's appreciation of its value. If physical and religious questions were all settled, they would lose their attractive force. The discussion is going on all along the line, and he who believes in his cause will have no fear of the result.

On the motion of the CHAIRMAN a vote of thanks was accorded to the author.

Discussion

The Chairman.—We have listened with great interest to this paper, which covers a large ground, and the subject is full of interest to all those present. Professor Macloskie has treated the subject from a very broad and liberal point of view, and we are much obliged to Dr. Kidd for reading the paper so distinctly and clearly to us.

Dr. Kidd.—I only wish to make a few remarks in explanation of the apparent inconsistency which arises on my reading the paper. I suppose it is by the fitness of things that I have been asked to read the paper, in which there appears to be a rather strong condemnation of the attempt to set up an issue between religion and evolution; so I desire to explain that I cannot go entirely with those views of Dr. Macloskie's in which he speaks of evolution alternated by creation and that evolution is only creation by evolution. I think that is to confuse things that differ. I do not think that any service will be rendered to either science or religion by evading an issue of this kind, which has been raised for a generation, or more, and which will be always raised, by the question whether this world came into existence, as we see it now, by a process of development from nebulæ, or whether by the direct agency and work of God. I desire to say that I take the view of the creation which is given in Genesis i, 1: "In the beginning God created the heaven and the earth," and that word "create" as used there is used only as applying to the agency of God and never of man. It refers to bringing into existence that which never existed before, and one must be prepared to stand or fall, I think, by the meaning of the word "create," and not by this half-hearted "creation by evolution," which is an attempt to "run with the hare and hunt with the hounds." "Of course *creation*, in this connection, refers to the secondary creation of living things out of already existing matter, living or dead." But that lower form of creation is too small altogether to be taken for man by those who believe in his special creation. However, I think the paper is a very valuable one for this Society.

Dr. Gladstone, F.R.S.—I can only say that I have not had the time or opportunity to study this paper so as to speak to my own satisfaction upon it. I never saw it until this morning when I was just leaving home, and then I looked at it and was struck with it, and thought I would manage to be here this afternoon. As to the general tone of it, I agree almost entirely with the statements here, and I agree also with that book which is referred to on the first page, viz., that of Ex-President A. D. White—his able sketches of the conflict between religion and science. I think that is one of the most valuable and important books that have come out recently.

The subject here is one that I have been thinking of, certainly, for this last sixty years, for even as a child I used to think of these things, and I have in my pocket a little paper. It is, I believe, forty years old, and it is headed "The Development of the Divine Revelation." It appeared to me, during the discussion about Darwinism and development and evolution, the discussion seemed to be too old. Theologians have been constantly believing in the development of the Divine Revelation. Why should not they believe in various forms of beings upon the earth? I welcomed that book of Darwin's *The Creation of Species*, because it explained a number of difficulties I felt then, and it seemed to me to tell you so thoroughly the nature of God's way of dealing with the universe; but I must not speak of personal feeling in that matter.

There are many matters which are very well worth considering as bearing on the whole history of this controversy. I am inclined to think that a great argument might be advanced in regard to it which I have not yet met with, viz., that in very early pagan times the old religions of the old world were, to a large extent, natural religions. Natural forces were looked upon as deities, and the prophets were the expounders of nature, and strange were the explanations they gave. They were to a large extent hypothetical, but I know the tendency is to give them a literal meaning; but it is curious, I think, why it should be considered necessary that the Sacred Writings should give the true revelation as to Nature. The writers of the Bible never professed to do that, that I can see. They, of course, frequently refer to Nature, and with the exception, perhaps, of that passage in Genesis i, which of course is matter of an exceptional character, they do not lay down anything except just speaking of the objects round about them in such a way as an intelligent person would employ. Look at the descriptions of Nature in the Psalms! They are in poetic language, and very beautiful they are. They are not intended to teach us what the subjects are, but to lift our minds up to God as the Creator, the Governor, and Director of all. So with the teaching of the Great Master Himself. He took lessons from all the different objects round about Him. He used these lessons frequently, in a somewhat poetical sense, *e.g.*, "Consider the lilies of the field, how they grow; they toil not, neither do they spin: and yet I say unto you, that even Solomon in all his glory was not arrayed like one of these." That is poetical or metaphorical. Our Lord spoke of those objects that were round about Him, and used them as great lessons, and I think the descriptions of Nature throughout the Bible are only employed in that way to direct us to higher and greater things.

In regard to the question discussed just now as to creation, I believe thoroughly with the writer of this paper in creation by evolution, and I do so because I think we ought to use all those words, as nearly as we can, in the scriptural sense of the term, and therefore I use the term *creation* in the sense in which I think it is used in scripture. This word is always applied to the work of God, and never to the work of man—I believe that is invariable—but in the dozen or twenty cases in which it occurs in the Old Testament it is never once used, I believe, for "creation out of nothing." In Genesis i we have it, "God created the heavens and the earth"; but of course the question then arises as to what He created them from—whether from nothing, or from things that already existed.

When we come to other parts of the Bible, we find the Psalmist speaks of the animals and plants then existing, and the earth, as having been created by God. Of course they were created in the ordinary way—not made out of nothing, but by evolution. I think I am right in saying you will find that half, or more than half, of the cases in which the word *creation* occurs, it is clearly a creation from something which preceded it, and in the other instances there is nothing to indicate it one way or the other. It appears to me that the idea of God creating by a gradual progressive method is a far greater and far more noble and far truer conception of His work than that plan which is believed in by those who do not hold that view.

I hope you will excuse my mentioning in this very simple and rough way some of my thoughts on the subject.

The Rev. Dr. PORTE.—Perhaps I might be permitted to say, in regard to the statement that has been made in this room that God is supposed to have created man out of nothing, or anything out of nothing, that as far as I know Genesis there is no such statement made, and as far as I know most ordinary students of the Bible never hold any such theory. We hold that God formed this world as it now is by a process of stages, as we believe, from what is described as something "without form and void." There is not a word about its being formed out of nothing. We know, I hope, what that something "without form and void" means. Creation does not profess to go beyond this, that God took that which existed then, and perhaps every process or stage lasted millions of years. I suppose many of us believe (who are not otherwise believers in evolution) in a certain sort of evolution spoken of in the Bible, an evolution from a lower to a higher thing. We believe in animals of which we are told remains are amongst us to-day, those strange, marvellous creatures that for many generations lived on the earth and have passed away; but I think that many of the leading scientists acknowledge that there is not the slightest link between successive generations of various birds, beasts, and fishes. We speak of the successive stages of the world, and when it comes to man himself we are told that God formed man out of the red earth, that He took the earth and built up man, and, as was said just now, God formed him a perfect creature.

Mr. THRUPP.—The inevitable conclusion to be drawn from the arguments of the two last speakers is that God did not create material. To my mind that is an utter fallacy. The great mischief, I think, in all discussions of this question of evolution is that it is assumed that evolution is proved. The great difficulty of studying the subject thoroughly prevents a very large number from going into it, and therefore they more readily accept as proved that which great men have laid before us. But now, to refer to the paper itself, we see what a great assumption it is to take evolution as proved and as a thing we have to reconcile with religion. At p. 222 you find these words: "Neither natural selection nor Neo-Lamarckism goes back to the real origin of variations, a point which is yet unknown." In other words, that the very first step of evolution is not proved—not known. If people would only think thoroughly upon it and really study it, there are such constant admissions, even from those who contend for it, as to make them pause before they accept it as a thing proved. Take Wallace, who was the co-originator, in this century, with Darwin of the theory of evolution. In his work (*Darwinism* I think it is called) he distinctly stated that there were three exceptions in the development of the world—the origin of life, the origin of mind, and the origin of spirit, and he uses this remarkable phrase: that as to these three "they must have originated from the spirit world."

Wallace has stated that he is an evolutionist, and people seem to think that he has accepted all the various statements put forward by evolutionists; but when a man, standing so much in the forefront as he, makes these distinct exceptions, how can we say that evolution is proved? The fair argument, therefore, is, if these three grand steps or stages in the development of the world are due, not to materialism, not to naturalism, not to any development, but are the actual work of the Great Supreme Spirit outside the world altogether, it is but reasonable to assume that in all other matters there is the same ruling Spirit bringing about and causing all things; and if we once believe that mind was created, that life was created, and that spirit was created, what difficulty is there in assuming that the very first animal, fish, and vegetable were also created? In all these matters there has been too much assumption that evolution is proved.

The Rev. Dr. PORTE.—I am afraid I have been accused of what may be considered very shaking heresy, which I have no idea of promulgating. The last two speakers have said that I had practically declared my belief in the eternity of matter. I declare no such thing. I do not believe it for a moment, and I never dreamt of such a thing.

Dr. GLADSTONE.—I do not know whether it is necessary for me to say that I believe God is the Creator of all things, and that He is now evolving, by gentle stages, from the imperfect to the perfect, and from the inferior to the superior.

The discussion, which was of unusual length and interest, was continued by the Rev. A. M. CHERRILL, Colonel ALOES, Professor LANGHORN ORCHARD, Dr. HAYWOOD SMITH, Captain PETRIE, and Professor HULL.

ORDINARY GENERAL MEETING.*

PROFESSOR EDWARD HULL, F.R.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following Elections were announced :—

MEMBERS :—Rev. H. G. D. Latham, London ; Rev. Okey Johnson Moore, U.S.A.

ASSOCIATES :—Rev. J. Hodgson, M.A., Cornwall ; Rev. C. H. Kilner, U.S.A. ; Rev. P. P. Flournoy, D.D., U.S.A. ; H. W. Rankin, Esq., U.S.A. ; Rev. A. V. Thornton, M.A., Cornwall.

The following paper, entitled "The Scope of Mind," was then read by the author, Alfred T. Schofield, Esq., M.D., M.R.C.S.E., etc.

THE SCOPE OF MIND. By ALFRED T. SCHOFIELD, Esq., M.D., M.R.C.S.E., etc., Chairman of the Council of Parents' National Educational Union.

A FULL concept of mind must be the basis of all true physiologico-psychical education, and also has a direct bearing in its issues on every stage of life; more particularly on those earlier periods when the character is formed. And this is becoming of increasing importance from the great interest that is being taken in the mental development of children. It is not too much to say that true education or true child-culture must be based on a full and broad concept of mind.

There can be no doubt that amongst psychologists the concept is changing and enlarging. The causal force at work is at present largely German, where the new is perhaps accepted as the true with a greater facility than with English scientists, who carry all their national stolidity and doggedness into their studies, and still move on stereotyped lines with proper reverence for established authority.

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* April 12th, 1897.

Investigations and inferences are more boldly pushed and more rapidly made abroad, and perhaps not unfrequently supplemented by that inner consciousness whose dicta are incapable of verification or proof. We have, however, in England notable exceptions to the rule of "follow-my-leader" whom we shall often quote, but whom at present it is needless to name.

Historically, distinguished men have from time to time striven to enlarge our concept, but with indifferent success from the want of support from the physiological side, which only of late years has made much advance, and on which all future psychology must be increasingly based. A decided impetus from an irregular but prolific source has undoubtedly been recently given in the phenomena laid bare by hypnotism, and it is somewhat significant that all modern psychologists feel constrained seriously to discuss and examine these phenomena.

At the same time deliberate efforts have not been wanting to check and ridicule all concepts of mind that exceeded the old time-honoured definitions, lest the new wine should burst the old bottles; while many physiologists so far from extending our horizon, have definitely limited all idea of mind to a function of matter. Thus, while there is generally a consent to extend our ideas, in most quarters they are limited in others either by flat denial of a *non possumus* kind, or by a physiological materialism; both, though the offspring of different schools, being probably expressions of the smallness of our thoughts compared with the largeness of our subject.

One word of explanation perhaps is needed as to why the present writer deals with subjects so abstract and abstruse. It is because, being a physician in constant contact with nerve and mental phenomena, and witnessing continually the powers of that which he desires to recognise as mind, both in the production of disease, and in a power of relieving and curing it, that the writer has been forced to study these matters. It would in his opinion be well if all physicians and surgeons investigated these powers more, which, when known, give a key to many unexplained and perplexing lapses from, and restorations to, health.

Without further preface, therefore, we will proceed to consider the relations of mind and matter. Such questions bristle with difficulties, and like unpractised navigators when exploring the stream of knowledge, we must take especial care at the outset to avoid those numerous rocks which project from either bank, on which we might early suffer shipwreck from the temptation to exceed our limitations.

For instance, are the psychical and the physical the two Cartesian clocks, abysmally apart, which, when wound up, nevertheless correspond tick for tick? Or shall we follow Professor W. James when he says,* "The simple and radical conception dawns upon the mind that mental action may be uniformly and absolutely a function of brain action, varying as the latter varies, and being to the brain action as effect to cause."

"This conception" (he continues) "is the 'working hypothesis' which underlies all the 'physiological psychology' of recent years." To adopt one theory is to be proclaimed a dualist, to adopt the other, a monist, and we would therefore avoid both, the more especially as neither contains the whole, but each contains a part of the truth.

For instance, the abysmal distance between mind and matter is shown in that while "physical phenomena are phenomena in space, psychical phenomena are phenomena in time only,"† for it is a fundamental thought to grasp that mind cannot have a "seat," as it has not any extension in space, having no relation with it that we know of. It does not cover a surface or fill a volume. It is only related to time. In this we follow, of course, the popular assumption that time and space are essentially different, neglecting certain speculations as to time being after all a spatial extension (in a fourth dimension). The extent of the connection between mind and matter is still unknown, though it has furnished material for discussion for centuries.

Some like Professor Clifford make psychical action universal in matter, others like Descartes limit it to man only, while Schopenhauer from a broader standpoint says, "The materialists endeavour to show that all mental phenomena are physical and rightly so, only they do not see that on the other hand every physical is at the same time metaphysical."

Lest, however, we should become dogmatic on these relations we are reminded that the whole material universe may be, after all, but an inference of mind, and that matter and mind may not be two but one, the former being in this view a projection of the latter, rather than the latter a function of the former.

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* *Psychology*, W. James, p. 6. † *Human Mind*, Jas. Sully.

Professor Herbert says,* "The common supposition, then, that the material universe and the conscious beings around us are directly and indubitably known, and constitute a world of 'positive' fact, in which reason can certainly pronounce without any exercise of faith . . . is an entire mistake, based upon astonishing ignorance of the essential limitations of human knowledge, of which thinkers who lived in the very dawn of philosophy were perfectly aware. The fact is we are equally obliged to transcend phenomena, and to put faith in events and powers and realities which do not appear, when we recognise the past, or the distant, or the material universe, or the minds of men, as when we infer the existence of God and of the unseen world."

That life involves mind has, of course, like all else, been vigorously disputed and equally vigorously affirmed. "Life,' says Professor Bascom,† "is not force, it is combining power. It is the product and presence of mind." No mechanical process can indeed ever adequately represent or account for the processes of life, and yet life is not in itself a force, it is the power to use force for unique ends.

The extent to which the word "mind" may be employed as the inherent cause of purposive movements in organisms is a very difficult question to solve. There can be no doubt that the means employed to produce such movements are the natural forces, but behind these the directing and starting power seems to be psychic. "From the first movement," says Dr. R. Dunn in the *Journal of Mental Science*, "when the primordial cell-germ of a human organism comes into being, the entire individual is present, fitted for human destiny. From the same moment matter, life, and mind are never for an instant separated, their union constituting the essential work of our present existence." Again, "one cannot forbear assuming in the vital process of each individual organism an *idea*, which continually supports and renews the organism."‡ Carpenter goes further still,§ "The convertibility of physical forces and correlation of these with the vital and the intricacy of that nexus between mental and bodily activity which cannot be

* *Realistic Assumptions of Modern Science Examined*, Professor Herbert, p. 455.

† *Comparative Psychology*, Professor Bascom, p. 58.

‡ *Psychology*, F. Kirchener, p. 141.

§ *Mental Physiology*.

analysed, all leads upwards towards one and the same conclusion—the source of all power is mind. And that philosophical conclusion is the apex of the pyramid which has its foundation in the primitive instincts of humanity."

It would thus appear we cannot define where psychic action begins, for however far we travel down in the scale of life, psychic action is seen. "Entirely ignorant as we are," Maudsley remarks, "we certainly cannot venture to set bounds to its power over those intricate and insensible molecular movements which are the basis of all our visible bodily functions . . . There are many more things in the reciprocal action of mind and organic elements than are yet dreamt of in our philosophy."*

Regarding the unicellular organism Professor W. H. Thompson in his Belfast address in 1894 actually says, "The amœba present active and spontaneous movements, and here one not only meets with a power of choice, but also an intelligent consciousness in selecting food."

Maudsley observes, "An organism plainly has the power (call it intelligent or call it what you will) of feeling and eschewing what is hurtful to it, as well as of feeling and ensuring what is beneficial to it."†

Perhaps one instance of this may be given. Romanes observes,‡ "No one can have watched the movements of certain Infusoria without feeling it difficult to believe that these little animals are not actuated by some amount of intelligence. There is a rotifer whose body is of a cupshape, provided with a very active tail armed with strong forceps. I have seen a small specimen of this rotifer attach itself to a much larger one with its forceps, the large rotifer at once becoming very active and springing about with its burden till it came to a piece of weed. It took firm hold of the weed with its own forceps, and began a most extraordinary series of movements to rid itself of the encumbrance. It dashed from side to side in all directions; but not less surprising was the tenacity with which the smaller rotifer retained its hold, although one might think it was being almost jerked to pieces. This lasted several minutes, till eventually the small rotifer was thrown violently away. It then returned to the conflict, but did not succeed a second

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* *Mind and Body*, Maudsley, vol. i, p. 39.
† *Ibid.*, vol. i, p. 7.
‡ *Animal Intelligence*, Romanes, p. 18.

time in establishing its hold. The entire scene was as like intelligent action on the part of both animals as could well be imagined. So that if we were to depend upon appearances alone, this one observation would be sufficient to induce one to impute conscious determination to these micro-organisms."

However strongly such an illustration as this proves the presence of psychic force, all may not be agreed as to the question of consciousness. By some it is assumed, as we have said, to accompany all psychic action.

That unconscious psychic action is to be attributed to plants seems a little startling and need not be pressed, but on the other hand we think it must be admitted in all animals.

Dr. Noah Porter says,* "The first acts of life, whether they pertain to body or soul, are unconscious," and when Herbert Spencer says,† "Reflex action is the lowest form of psychical life," he thereby tacitly admits unconscious mind action in animals.

When we proceed higher in the scale another question arises with regard to instinct and intelligence; but again we are confronted with the inscrutable problem of the connection of the two, and the origin of the former.

Consider an illustration given us by Romanes from a class by no means renowned for instinct or for intelligence. "Sticklebacks swim quietly about amidst rapacious pike which do not attempt to attack them; for if by oversight a pike even actually attempts to swallow a stickleback, the latter with its projecting dorsal spines sticks in his throat and the pike must infallibly die of hunger, and accordingly cannot transmit his painful experience to posterity."‡

Proceeding one step higher to insects, their instinct or intelligence is summed up by Professor Lindsay in the following 15 psychic phenomena§ :—

1. Co-operation for a given purpose.
2. Division of labour, working by turns, and relief parties.
3. Obedience to authority, including language of command.
4. Understanding a language (often of touch).
5. Organization of ranks and military discipline.

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* *The Human Intellect*, N. Porter, p. 100.

† *Principles of Psychology*, Herbert Spencer, vol. i, p. 428.

‡ *Animal Intelligence*, Romanes, p. 99.

§ *Mind in Animals*, Lindsay, chap. vi.

6. Knowledge of possession of power and use of it; subjection of the weak by the strong.
7. Judicial punishment of disobedience or rebellion.
8. Forethought, real or apparent.
9. Practice of agriculture, harvest and storage.
10. Respect for and interment of dead.
11. Mourning in bereavement, or its resemblance.
12. Funeral ceremonies, including processions.
13. Use of natural tools, instruments, and weapons.
14. Passions of rage and anger.
15. Imagination and its derangement by hypnotism.

Now how far are these phenomena of instinct and how far of intelligence?

We fear a solution that will meet all difficulties has yet to be discovered; meanwhile we may accept the broad statement that instinct is unconscious psychic action. "As in human ideation," says Kirchener, "we find in instinct the action, unconscious and yet purposive, whose consequence is indeed much more certain that that of human ideation."*

Leaving now these perplexing and yet unsolved problems that surround the threshold of our inquiry, let us pause for one moment to consider the present position and aim of the science known as psychology.

Its definition, given by Professor Ladd and quoted by Professor James,† is—the description and explanation of states of consciousness as such. In this explanation it assumes as true two peculiar data‡:—1. Thoughts and feelings, or whatever other names transitory states of consciousness may be known by. 2. Knowledge, by these states of consciousness of other things.

Psychology is, however (until lately), so fettered and bound by its arbitrary limitation to the discussion of states of consciousness that it is thus described (or decried) by James§: "Psychology is but a string of raw facts, a little gossip and wrangle about opinions; a little classification and generalization on the mere descriptive level, a strong prejudice that we *have* states of mind, and that our brain conditions them; but not a single law in the sense in which physics shows us laws. At present psychology is in the

* *Psychology*, Kirchener, p. 138.
† *Psychology*, W. James, p. 1.
‡ *Ibid.*, p. 2.
§ *Psychology*, W. James, p. 468.

condition of physics before Galileo and the laws of motion, or of chemistry before Lavoisier."

We have purposely paused over this word "psychology" and given these extracts in order that our temerity may not be deemed so excessive in endeavouring to overthrow its most cherished dogma, and to enlarge our conception of the word mind.

After all not only have we a house divided against itself but one in a state of chaos: a science bristling with contradictions, its greatest agreement being in the general proposition that consciousness and mind are one and the same, the sphere of the latter being entirely defined by the extent of the former, and that to speak of unconscious mental phenomena is to stultify the meaning of words, to betray confusion of thought and as a matter of fact to talk nonsense. It is this proposition and no less that we seek to overthrow, it is these bonds that we hope to burst, in the firm belief that it is mainly for want of a broader basis, and on account of this rigid adherence to this narrow, and we may say effete, shibboleth that psychology has not made a greater advance and reared a more imposing structure.

The way will be better prepared for the consideration of the connection of mind with consciousness if we briefly touch upon two points; first, the connection of mind and brain, and secondly, the various mental qualities connected with their action, and constituting our personality.

To some it is very difficult to draw the line between mind and matter in the human brain.

The intelligible connection of the two is well expressed by Dr. Browne, "The great character of current opinion appears to be that wherever there is nerve there is psychical function, actual or potential, which may rise with the range of consciousness.* Not only is there apparently inseparable connection during life between the nervous structures and mental phenomena, but the latter are clearly dependent on the former. The ordinary condition of the nervous system is like that of a moderately charged battery, that can be discharged by the completion of the circuit and re-charged by the blood. The will can complete the charged circuit. Mental causes can produce physical effects and physical causes mental

* Dr. W. A. F. Browne in *Journal of Mental Science*, vol. xii, p. 321.

effects." "We have every reason to believe," says Professor Bain, "that with all our mental processes there is an unbroken natural (physical) succession." Herbert Spencer says, "No thought, no feeling, is ever manifested save as the result of a physical force. This principle will before long be a scientific commonplace."*

Having thus marked the intimate connection and interdependence of mind and brain we must, to keep the balance of truth, equally insist on the radical distinction between the two. "The intelligence of man," says Calderwood, "as known in personal consciousness, is of a nature entirely distinct from any sensory apparatus. Mind is not a product of cerebral evolution."† Again Herbert Spencer sounds a timely note of warning, "Here indeed we arrive at the barrier which needs to be perpetually pointed out alike to those who seek materialistic explanations of mental phenomena, and to those who are alarmed lest such explanations may be found. The last class prove by their fears almost as much as the first prove by their hopes, that they believe that mind may possibly be interpreted in terms of matter whereas . . . there is not the remotest possibility of so interpreting it. For the concept we form of matter is but the symbol of some form of power absolutely and for ever unknown to us.

"Mind is also unknowable, and the simplest form under which we can think of its substance is but a symbol of something that can never be rendered into thought. Nevertheless were we compelled to choose between translating mental phenomena into physical phenomena, or of translating physical phenomena into mental phenomena, the latter alternative would seem the more acceptable."‡

It may not be out of place here, having touched upon the connection of mind and brain, to give a brief description of the latter as far as it throws light on mental activities.

For this purpose then besides the obvious divisions of the brain into greater and lesser (or cerebrum and cerebellum) and into two halves right and left, we may divide the cerebrum into three regions, consisting from above downwards of "cortex" or surface brain, "basal ganglia" or mid-brain, and

* *First Principles of Psychology*, Herbert Spencer.

† *Relations of Mind and Body*, Professor Calderwood, p. 307.

‡ *Principles of Psychology*, Herbert Spencer, 2nd edit., p. 63.

"medulla" or lower brain, each of these containing a large proportion of the active agent in brain work known as grey matter, which consists of masses of brain cells.

The medulla or lower brain connects the spinal cord below with the mid-brain above, and is "the co-ordinating centre of most associated movements."* It is in fact the organising centre for carrying on all the processes connected with the passive or vegetative life of the body as contrasted with the active or animal life. All the processes carried on here are far below the level of consciousness.

The basal ganglia of the mid-brain are principally three in number; the corpora quadrigemina, connected with sight, the corpora striata with motion, and the optic thalami with sensation.

In this mid-brain we see the organization of the functions of animal life subject to, or of an inferior order to, the highest centres and conducted without consciousness.

Lastly, we come to the cortex or surface brain, the seat of conscious mental life and the source of all voluntary actions.

The cortex is the seat of conscious sensation, though we are by no means conscious of all that takes place even in the cortex, for innumerable sensations may, and probably do, continually reach it of which we are wholly or partially unconscious; in many cases, of course, this is accounted for by non-attention. On the other hand, it would appear from recent researches that it is not possible to be conscious of any currents that do not reach the surface of the brain.

With regard to there being two hemispheres right and left, Gall, Spurzheim, Dr. A. L. Wigan, Sir H. Holland, and Brown Séquard conclude we have two brains united for common action, and that we have probably two minds acting normally in perfect harmony, but which can and do act separately in many conditions.

When a nerve cell acts (whatever this means), impulses tend to pass off from it along its various connected nerve fibres, and the force and number of these impulses depend on the violence of the cell action; if this is gentle there may be only a slight impulse passing off through the largest connecting fibre (the freest channel); if the action is violent it may overflow through the various connecting fibres in any direction.

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* Ferrier, *Functions of the Brain.*

It appears that apart from the cortex, the nerve paths in the lower parts of the brain consist of sensori-motor arcs, the nerve currents arriving at the hinder part of the brain by the posterior part of the cord, and leaving the anterior ganglia, notably the corpora striata, and descending down the front of the spinal cord, in the resulting motor impulse. To use now the words of Dr. Hill:* "On these arcs, which collectively make up the lower system, are superadded arcs the loops of which lie in the higher grey matter (of the cortex). At the same time, therefore, that an impulse flows across the spinal cord as a simple reflex action, a certain part of this impulse is also diverted to the brain along fibres which ascend in the outer part of the spinal cord; and from the brain descending fibres carry the impulse back again to the lower arc. One thing is quite certain, namely, that the routes which are the most frequently used are the most open, and therefore the most easily traversed."

All this means, speaking generally, that a nerve current arriving at the brain may take one of three courses—either being directly reflected as action by the lower brain, or travelling in a short arc by the mid-brain in unconscious action, or in a long arc by the cortex in conscious action. In connection with this it may be observed that the cranial nerves have all two deep origins, the one in the basal ganglia of the mid or unconscious brain, and the other in the cortex or upper conscious brain.

It only now remains for us very briefly to touch on the action and qualities of mind before reaching in conclusion the question with which we started: Is mind limited by consciousness? First of all then with regard to the old classical question as to whether the "mind," which we have seen is so inseparably associated with nerve cell action, is the player or the tune of the harp, the rower or the motion of the boat,—the harp and boat being both the nerve cells in question.

Professor E. Montgomery of California† concludes "We are unhesitatingly certain that our movements are not directed and controlled by the peripheral stimulation of sensory elements. In shaping our actions we are not slavishly executing the immediate promptings of our actual

* Paper on "Reflex Action," by A. Hill, Cantab., *Victoria Institute Proceedings*, 1893.

† E. Montgomery in *Mind*, vol. v, p. 23.

environment. This is so palpable a truth that no serious doubt concerning the same has ever gained or ever can gain ground." The existence of the will is proved by knowledge and experience. The consciousness of effort as well as purpose in will when running counter to prompting sensations is strong proof (in spite of explanations) of its real existence. Carpenter says,* "It is clear the will is different from the general resultant of the automatic activities of the mind; for in the first place all alcoholic stimulants excite the automatic activity of the mind while diminishing the power of the will." No doubt, however, a large part of the mind runs in grooves, which though they may be unknown and unfelt are none the less real. The lines of mental function are in many respects as definite as the lines of instinct in bees or ants.

The three great divisions of the mind generally laid down by psychologists of feeling, knowing, and willing, first came from Germany before the days of Kant.

Professor Dunn traces the evolution of the three. "At birth the nascent consciousness becomes awakened, purely sensational at first; and emerges step by step from self-consciousness to world consciousness, and through the ideational and emotional up to the intellectual."

This, however, practically traces the rise of our mind to unconscious origins; and indeed all willing, thinking, and feeling are ultimately based on unconscious springs and trains of thought and motion. Even when developed many mental qualities seem partly or wholly unconscious. Let us enumerate a few. *Intuition* may be conscious or unconscious. *Perception* is an example of conscious intuition. *General synthesis* may be conscious or unconscious, some can say why they think so and so, others cannot.

Kant says, "Innumerable are the sensations of perception of which we are not conscious, although we must undoubtedly conclude that we have some obscure ideas, as they may be called (to be found in animals as well as in man). The clear ideas indeed are but an infinitely small fraction of these same exposed to consciousness. That only a few spots in the great chart of our minds are illuminated may well fill us with amazement in contemplating this nature of ours."†

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* *Mental Physiology*, Carpenter.
† *Anthropologica*, Kant, Sec. v.

Tact, the psychic analogue of touch, is a faculty of unconscious origin.

The *will* itself may be unconscious. "The conscious and unconscious wills are essentially distinguished by this, that the idea which forms the object of will is conscious in the one case, unconscious in the other."*

"If it is desired further to distinguish the two kinds of will, for conscious will language already offers the term exactly covering the conception—free-will; while the word 'will' must be retained for the general principle, which exists in us all, unconscious will."† "We may regard it as settled that the laboratory of volition is hidden in the unconscious. That we can only get to see the finished result, and that the glances we succeed in throwing into the laboratory never reveal those unconscious depths of the soul where occur the reaction of the will on motives and its passage into definite volition."‡

The discovery of the *beautiful*, and the "creation of the beautiful by man proceed from unconscious processes whose results the feeling and the discovery of the beautiful represents in consciousness, and forms the starting point of further conscious work which however at every stage needs more or less the support of the unconscious."§

The ordinary artist does everything with conscious choice. There is a lack of "divine frenzy, the powerful breath of the unconscious, which appears to consciousness as higher and inexplicable suggestions which it is forced to apprehend as facts, without ever being able to unravel their source."‖ "The difference between talent and genius is the difference between the conscious and the unconscious."¶

Instinct is not the result of conscious reflection, not a consequence of bodily organization, not mere results of the mechanical foundation of the organization of the brain, but "the individual's own activity, springing from his inmost nature and character."**

The *ethical* element in man lies in the deepest night of the unconscious. "Consciousness may perhaps influence actions

* *Philosophy of the Unconscious*, E. von Hartman, vol. i, p. 253.
† *Ibid.*, vol. ii, p. 69.
‡ *Ibid.*, vol. i, p. 263.
§ *Ibid.*, vol. i, p. 291.
‖ *Ibid.*, vol. i, p. 278.
¶ *Heredity*, E. Ribot, p. 229.
** *Philosophy of the Unconscious*, E. von Hartman, vol. i, p. 113.

by presenting motives to react on the unconscious ethical, but whether this reaction follows, consciousness must calmly wait."* "Mystics in every country and age put faith only in their unconscious knowledge."†

Our personality itself, the "ego," seems to have its origin or source in the unconscious region.

Professor Barrett (Dublin) says:—"It is to the existence and vital faculty of this large area of our personality which is submerged below the level of consciousness, that I wish to draw attention, for psychologists are agreed that its range must be extended to include something more than is covered by our normal self-consciousness. What we call 'ourself' is a something which lies in the background of our consciousness, enabling us to combine the series of impressions made upon us, or the states of feeling within us, into a continuous personal identity."‡

We are now prepared by the brief survey of mind from various sides and in its various developments to see that it everywhere tends to burst the confining wall of consciousness that has so long interposed as an iron barrier between it and the vast psychical region without, which we desire to see included under the one word "mind." Let us then in the first place see what can be said in favour of the limitation of "mind" to consciousness, for to us the limitation is so transparently artificial that it is well to know it is still seriously and stoutly maintained. Thus "Mind is to be understood as the subject of the various internal phenomena of which we are conscious. Consciousness is to the mind what extension is to matter. We cannot conceive mind without consciousness, or a body without extension."§

Positivism defines mind as (1) the sum of consciousness at any instant in an individual; or (2) as the sum of the consciousness during the life of an individual, consciousness being not an attribute of mind, but mind itself. Again the extreme statement "All and only the phenomena that are conscious are psychical."‖ "Wherever consciousness is impossible, mental action is impossible."¶ Professor Brentano declares there are no such things as unconscious psychical acts.

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* *Philosophy of the Unconscious*, E. von Hartman, vol. i, p. 265.
† *Heredity*, E. Ribot, p. 229.
‡ Barrett, in the *Humanitarian*, 1895.
§ *Lectures on Metaphysics*, Sir W. Hamilton, ix.
‖ *Psychology*, Professor Ziehen, p. 4.
¶ *Relation of Mind and Body*, Professor Calderwood, p. 269.

Again "psychical and conscious are for us, at least at the beginning of our investigation, identical. The conception of unconscious psychical processes is for us an empty conception."* Here we find a little hedging, but what is worse, on the same page† we get an illustration of the unconscious passing of a friend when absorbed in thought coming to our consciousness after. Professor Ziehen accounts for the unconscious impression by saying that more intense ideas absorbed the thoughts, and that only as these waned did the psychical perception of the friend appear, or he says the sight of a friend "may be accompanied by a sensation which, however, is not very intense in consequence of the predominance of other ideas."

This theory is negatived by the simple fact that these unconscious impressions do not rise to consciousness as other ideas lessen, but are flashed into consciousness often at long intervals afterwards. Of course an impression was made at the time unconsciously. Again, "Though in a loose sense of the term consciousness, some mental events may be said to be outside it, in another and stricter sense of the word all that is mental is at the same time an element of consciousness. Consciousness is the widest word in our vocabulary, and embraces everything, that mind embraces."‡ This may be so as used by Mr. Mill, but if so it embraces unconsciousness and becomes a word without meaning. Crofessor Alexander (Oxford) says, "Mind and consciousness are coextensive, though not synonymous. I take mind to be convertible with consciousness." Aristotle, Mill, Hamilton, and Ward generally consider that consciousness is the cause and necessary form of mental states, and that mind cannot be conceived without it, and yet, as we shall see, more than one of these contradicts this position in his own writings.

Reid, Stewart, Jouffroy consider consciousness is a faculty of mind. "The school of Descartes and Locke, *i.e.*, the whole of the 17th and 18th centuries, expressly held that psychology has the same limit as consciousness, and ends with it. What is without consciousness is remanded to physiology, and between the two sciences the line of demarcation is absolute. Consequently all those penumbral phenomena which form the transition from clear consciousness to perfect unconsciousness

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* *Psychology*, Professor Ziehen, p. 5.

† *Ibid.*

‡ *Analysis of the Human Mind*, James Mill, p. 227.

were forgotten, and hence came superficial explanations and insufficient and incomplete views.

"The nature of things cannot be violated with impunity. Leibnitz alone in the 17th century saw the importance of this. Less was not to be expected of the inventor of the infinitesimal calculus. By his distinction between perception (conscious) and apperception (unconscious) he opened up a road in which in our time most physiologists and psychologists have somewhat tardily entered. There is no completed work on the subject. Such a work would need to show that most if not all the operations of the soul may be produced under a twofold form; that there are in us two parallel modes of activity, the one conscious, and the other unconscious."*

Turning now to those in favour of unconscious psychical action, we find that the fundamental importance for the conscious of the unconscious psychical life, the thorough dependence of the former on the latter is with Maudsley, as we shall see, a firm conviction. Amongst others he cites Hamilton, Carlyle, and L. P. F. Richter in support of it. G. H. Lewes sees consciousness everywhere even in the reflexes of the spinal cord, while Maudsley equally clearly, but to our mind with far greater reason, sees unconsciousness everywhere. He says,† "It is a truth that cannot be too distinctly borne in mind that consciousness is not coextensive with mind, that it is not mind, but an incidental accompaniment of mind." "The whole business of mental function as work might go on without consciousness just as the machinery of a clock might work without a dial. It is a necessary concomitant, not an energy at work in the manufacture, of the mental organism. The misfortune is that ordinary language assumes it to be a kind of superior energy."‡ Again, "Those who base psychology on the revelations of consciousness cannot but acknowledge that it is not essential to mental being at every moment, nor at any moment coextensive with the whole of it; but that mental powers exist habitually and even act occasionally in the absence of consciousness."§ A. Bain thinks that‖ "Mind must be understood to cover the entire storage of mental impressions (even) when absolutely inactive and exercising

* *Heredity*, E. Ribot, p. 221.
† *Mind and Body*, Maudsley, p. 25.
‡ Dr. Maudsley in *Mind*, vol. xii, p. 503.
§ *Ibid.*, vol. xii, p. 489.
‖ Professor A. Bain in *Mind*, New Series, vol. iii, p. 353.

no mental agency. The term consciousness refers purely to the moments of mental wakefulness or mental efficiency for definite ends."

In 1888 the Aristotelian Society held a special meeting to decide if "Mind is synonymous with Consciousness." It was decided in the negative. Professor Shadworth H. Hodgson, President of the Society, said, "It seems to me that both usage and accuracy of definition alike concur in deciding the question in the negative, for if we identify mind with consciousness, what are we to do with those states commonly called mental which are below the threshold of consciousness, and some kinds of which never rise above." With this Dr. G. Ritchie (Oxford) and many others agreed.

To proceed with our roll of witnesses.

"In the developed soul there is a perpetual alternation of consciousness and unconsciousness."* Professor Beneke proceeds, "What has once been produced in the soul continues still to exist even when it has ceased to be excited. That which was conscious merely becomes unconscious, or lives in the internal substance of the soul. This unconscious continuation of what has once existed in the soul is memory." Sir W. Hamilton practically admits unconscious psychical action in his illustration of a chain of thought of which the first and last links alone are recognised; being like a row of billiard balls, which if struck at one end only the last one moves, the vibration being only transmitted through the rest. He gives as an instance, suddenly when on Ben Lomond thinking of the Prussian System of Education. These were the first and last links, the intermediate ones of which were recalled after, seeing that previously on the mountain he had met a German, and this German was a Prussian. He says, "Some hold that these hidden links rise into consciousness momentarily, but are forgotten."† But a few pages previously he says, "The whole we are conscious of is constructed out of what we are not conscious of."‡

"It is necessary to realise," quoting Stout, "clearly that psychical dispositions, out of consciousness, form an indispensable factor in mental processes throughout conscious life."§ These psychological writers of advanced views all feel

* *Elementary Psychology*, Professor Beneke, p. 190.
† Lecture in *Metaphysics*, Sir W. Hamilton, vol. i, p. 354.
‡ *Ibid.*, p. 348.
§ *Analytical Psychology*, 1896, G. F. Stout, p. 23

it necessary to state them as tentative and novel simply because the bulk, not alone of metaphysicians but psychologists, have undoubtedly held that mind is consciousness. Some using, as we have seen, a "wide" sense, have included under the term states that may become conscious if sufficient attention is directed to them. But to talk of unconscious mind was distinctly held to be a contradiction in terms, and even the unconscious cerebration of the brain, which is now nearly universally acknowledged, was considered as late as 1876 a most objectionable doctrine.

Professor Lazarus says*: "We have first of all to remember that our psychic life is made up of conscious and unconscious elements. We think of consciousness as a brightly illuminated space surrounded with widely extended darkness, with the dim elements, though outside consciousness, co-operating with those within in a state of co-vibration."

The testimony of physiology is as follows: "The facts of physiology have at length led psychologists to see that states of consciousness form only a portion of the mental life, and have as background sub-consciousness and unconsciousness. At first it seems like a contradiction to speak of facts of unconsciousness as belonging to psychology; but when it is considered that the same changes in the nervous system may be accompanied by consciousness, or some sub-conscious change, it is evident that mind must consist of other elements than those which appear in consciousness. The study of physiology was necessary to bring out clearly the conception of unconscious feelings as facts in mental phenomena."†

Again, "The metaphysical view that mind and consciousness form an indivisible unity will not harmonize with the facts of physiology; for whole tracts may be cut out of the territory of intellectual consciousness without interfering with the integrity of consciousness, and will may be abolished while consciousness remains."‡

We will now sum up the evidence in the words of Bastian: "If we are, as so many philosophers tell us, to regard the sphere of mind as co-extensive with the sphere of consciousness, we shall find mind reduced to a mere imperfect disjointed series of agglomerations of feelings, and conscious states of

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* *Das Leben des Seele*, Professor Lazarus in *Mind*, vol. vii, p. 599.
† T. White in *Mind*, vol. vi, p. 506.
‡ *Functions of Brain*, Ferrier.

various kinds—while a multitude of initial or intermediate nerve actions would have no claim to be included under this category. For these and other reasons we feel ourselves driven to the conclusion that the common notion as to what should be included under the term mind is one which is altogether erroneous."* "If we are compelled to believe that consciousness is not co-extensive with the sphere of mind, in face of the now admitted fact concerning the frequent interpolation of unconscious nerve actions as integral parts of mental processes, only one course lies open to us. We must widen the signification of the term 'mind' itself.

"This is no question of choice, but one of absolute necessity. The meaning of the word 'mind' must be considerably enlarged so as to include . . . as mental phenomena the functional results of all nerve actions . . . whether these nerve actions are accompanied by a recognized conscious phasis or no."† "Let us enlarge our conception and definition of mind. Let us openly profess that which has already been tacitly implied by many. Instead of supposing that mind and consciousness are co-extensive, let us make mind include all unconscious nerve actions. We must inevitably come to this, and the doctrine of unconscious cerebration (Carpenter) has served to pave the way for it."‡

The case for the enlargement of the scope of mind has now been placed before our hearers, the writer having sought all through to establish the various points by voices other than his own, and it is for our readers to judge whether all through the history of mind from its earliest dawn it is not everywhere inseparably connected with unconscious psychic actions, and finally whether when speaking of the mind that is in man it is not now high time definitely to include the unconscious mental powers that we trust we have proved to exist.

It appears indeed to the writer that the conscious mind is a very small part of the whole psychic force within. A coral island in the South Pacific is a mere ring of rock in the water of insignificant size to the sailor; but to the biologist or geologist it is the highest peak of a stupendous structure that rises from the bottom of the ocean as a mountain miles high. Commencing as it does in the very smallest beginnings,

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* *Brain as an Organ of Mind*, C. Bastian, p. 146.
† *Ibid.*, p. 148.
‡ H. C. Bastian in the *Journal of Mental Science*, vol. xv, p. 522.

it remains unrecognized until it rises above the surface of the sea. We only see the top of this structure and call it an island; indeed, it is all we are conscious of except by soundings or occasional glimpses of what is beneath, on calm days or at low tides. In the same way it appears to me that of the sum of the psychic forces which we may call mental, and which constitute mind, only a very small portion are fitfully illuminated by what we call consciousness.

Some may think the point raised in this paper has merely an academic interest. It is not so. Had it not the most far-reaching practical issues throughout life this paper would never have been written. The establishment of the fact of an unconscious mind has a great bearing on the training of children; as children can be moulded unconsciously with far greater ease than through their consciousness. It gives also a great key to the cause and cure of many, if not of most, diseases. It lays bare at last the foundations of character, of conscience, of the entire Ego so long obscured by a psychology bounded by the conscious.

Discussion.

The Chairman.—Ladies and gentlemen, is it your pleasure to return your thanks to Dr. Schofield for this communication? I feel that your applause has already answered that question, and I trust that such a very interesting paper as this will give rise to an interesting discussion, as it is a subject on which, no doubt, there are various opinions; while gentlemen are making up their minds, perhaps Captain Petrie will read one or two communications that he has had.

The Hon. Secretary (Captain Francis Petrie, F.G.S.) then read the following communications:—

From T. Barkworth, Esq.:—

Having read Dr. Schofield's paper, I feel it right to say that I am in complete agreement with his main positions, and wish I could have been present to support them; but the state of my health made that impossible. A few criticisms which occurred to me I sent to the author, as the meeting was past. The old notion of metaphysicians that the Ego is one and indivisible (which is partly based upon a theological assumption of its being necessary to the possession of a "soul," and inseparable from moral responsibility) will take long to break down; but physiology is doing much for this, and experimental psychology will do more, and presently it will be seen that the integrity of the Ego is no more essential to faith than creation by fiat, or the geocentric theory of the universe.

From Professor CLELAND, M.D., D.Sc., LL.D., F.R.S. (Professor of Anatomy in Glasgow University):—

Were it not that the kind request of the President and Council is not lightly to be refused, I should hesitate, in the few sentences allowable in commenting on a paper which is not very long, to trench on so grave and intricate a subject as that which is involved in Dr. Schofield's communication.

I am probably not the only one who has not gathered from the title the object which Dr. Schofield has had in view. "The Scope of Mind" may be considered as including God and the whole universe, God being provably the source of all being. That is to say that even matter, although changeless when subjected to experiment, affords indication of an Intelligent Originator. It is not eternal, even though Milton (according to Macaulay) thought it was. Such questions, however, scarcely belong to Dr. Schofield's theme. His desire has been to point out that "of the sum of the psychic forces which we may call mental, and which constitute mind, only a very small portion are fitfully illuminated by what we call consciousness." In a great deal I cordially agree, as every scientific man will, with Dr. Schofield's contentions. We are much too liable to imagine that our whole mental constitution lies open to introspection, while in reality it is very far from doing so. Our own consciousness, so far as we can submit it to observation, is but the superficial stratum of something far deeper. But I do not consider that there is anything which can properly be called mind apart from consciousness. To apply the term mind to aught which is devoid of consciousness is to alter the meaning of the word.

So far as I can see, there are two faults of analysis leading to the confused notion of unconscious spirit—first, insufficient attention to the distinction between consciousness and self-consciousness, and, secondly, failure to distinguish between a conscious factor, however existent, and our own consciousness.

It is owing to the first of these faults, the failure to distinguish between consciousness and self-consciousness, that many actions are described as automatic which we perform habitually without, as we express it, thinking about them. Thus we are not conscious of the rapid and easy operation of our minds in the movement of our limbs in walking, and in the movements of the various organs of speech in the formation of the different sounds which go to make up words. We often, indeed, take no note of numbers of the words themselves as we speed them, each in proper place, to express an idea which touches us so slightly that it is forgotten the moment after. Yet we were once painfully conscious of the small details which have long since become so easy as to escape the introspective glance. Moreover, the same sequence of events is observed in actions to which persons become habituated at periods long after infancy and childhood are gone; for example, many movements of the hands in manufacturing and in music. When Dugald Stewart accounted for these things by pointing out that attention was necessary for memory, and time necessary for attention, he was surely nearer the truth than are the modern scientists who call them automatic. Had he lived a little later, he might have spoken of the attention required for noting a conscious act as self-consciousness.

But there are things in the history of mind to which my second criticism applies, viz., that we must distinguish between a conscious factor and our own consciousness. Thus, we talk of voluntary movements, and yet it is the fact that in performing in accordance with the dictates of our wills the simplest of these we are utterly unconscious of the existence of the different muscles brought into play. If we depended on our knowledge of muscles, nerves, and brain to bring them into operation in carrying out our conscious decrees, the longest lifetime would not suffice to raise the most distinguished anatomist or physiologist up from his bed. Yet it is not to be believed that these movements are accomplished by other than conscious power.

Let me give another example of the evidence of what Dr. Schofield, following others, considers as psychic force without consciousness, but which I am constrained to refer to a conscious Power beyond the sphere of our own consciousness. We come —our minds come—whence? We note, as development proceeds, the close connection between mind and brain. We follow the development of the brain from its first beginnings in the embryo, and we trace back the embryo to the fusion, within the yelk, of spermatozoon and germinal vesicle. Now, mental phenomena are as much hereditary as are physical phenomena. Through what paths shall we trace them to their source? "Authorities" will ask you to accept of the physical facts as proof that mind is but a phase of matter. But to do so is simply to change the meaning of the word matter by including under the term something which is not included in the phenomena by which matter is defined in the laboratories. Dr. Schofield, supported by the authorities whom he quotes, asks you to believe in unconscious mind. By doing so you will change the meaning of the word mind, and the question arises—what do you gain?

The Rev. RICHARD COLLINS, M.A., writes:—

I thank you very much for sending me a copy of Dr. Schofield's paper on "The Scope of Mind." The conclusions of the paper seem to me to be very valuable. But I note the expression "unconscious mind." The word "mind," which carries with it always the idea of the nature of mind only, seems here to be taken as embracing what is evidently the whole acting absolute Ego, or self, apart from all that is material. What do we mean by "mind"? I do not think we shall ever be able to define "mind" any further than by saying that it is the *conscious* action of the *self* in the direction of reason, choice, purpose, will. Mind is not a *thing*; it expresses the operation of some *thing*. That thing is the individual self, or that entity which is the real centre of life and mind in the individual. It is the self, surely, that works both consciously and unconsciously; but I would hesitate to speak of the self as an "unconscious *mind*." The mind and will have power, no doubt, beyond their ordinary routine of working, as, for instance, when we will to control our breathing, or other involuntary functions, by an unusual act of the will; and we may not be able fully to set limits to such power. It is the self acting on its mental side, and this is a strong point in Dr. Schofield's paper. But the self cannot be defined in terms of anything which is merely mental. I am only able to think, therefore, when Dr. Schofield speaks of "unconscious mind" action, of the *self* acting unconsciously. The self acts in directions other than the merely mental. It receives, for instance, through the material body certain material and ethereal impressions, and interprets them, not as mere impressions, but as tones and colours of exquisite beauty; this is not by a mental act, but rather by an instinctive and receptive character of its own, which seems to differentiate it from all merely mental, as well as from all physical, phenomena. The self also, undoubtedly, rules all the involuntary physical functions of the body, not mentally, but by some innate power too deep, perhaps, for us at present to fathom; although even these are influenced evidently to some extent, perhaps to a greater extent than we have often thought, by the mental action of the self on the body—as, for instance, in the physical results of fear, anxiety, grief, hope, anger, moroseness, joy, etc. Our self, or spirit, therefore, must be some *thing* apart from our bodily frame; and it acts in other directions than, strictly speaking, the mental. Now what the self is may be as difficult of apprehension as what an "unconscious mind" is; but we all hold, no doubt, that it is not, as philosophical sceptics like Straus and others have put it, the material body, but some other objective existence, which has built about itself by its own unconscious force the material body, as its fit and necessary instrument for dealing with its environments. The "unconscious mind," then, of this paper appears to me to be really the *self*; and all I contend for is that the "mind" ought not to be used as synonymous with the "self," or "soul," or "spirit," or by whatever other term we choose to represent that which is the real objective seat of life and thought. What is regarded in this paper as an enlargement of the scope of mind seems rather to be a deeper insight into the psychic, or what I should prefer to call the spiritual, nature of man, his spiritual powers embracing not merely what is, properly speaking, mental, but also all those energies which are needed for the life, action, and welfare of the body. That thought, or the mental functions of the self, may have an immense power over the welfare of the body through the spirit, whose power of thought is one side, though only one side, of its functions, is probably a matter of study of the utmost importance, as Dr. Schofield clearly shows, and such studies may be calculated to open up wide vistas of fresh thought on the subject of the powers of spirit over matter; but I do not see that this forces us to give the whole of the life-functions of the self a mental complexion.

Professor Lionel S. Beale, F.R.S., writes:—

Although unable to offer an opinion upon many of the important views alluded to in the interesting communication of Dr. Schofield on "The Scope of Mind," I hope I may be allowed to draw attention to some influences which suggest themselves to the mind from a somewhat more restricted standpoint.

The physico-chemical doctrines of life and mind so long in favour have recently given place to a very different doctrine, the advocates of which seek to extend the application of the words mental and psychical to all or nearly all living organisms, apparently forgetting, as it seems to me, that this will necessitate the admission on their part of different orders of psychical actions which characterise the different classes of living forms. Surely the psychical phenomena of man's brain cannot be regarded as of the same kind or order as those of an amœba. To me it seems preferable to include all actions peculiar to living things, to living matter, in one category—*vital.* All mental actions are vital, but to call all vital actions mental would surely be incorrect and without meaning. The matter concerned in mind is actually living, and like all living matter in nature, actually structureless. But all structure has been formed from previously existing structureless living matter. This absolute distinction between *matter that lives and matter that is formed*—matter that has lived, but is no longer endowed with vital powers—has, I venture to think, been established by observation; and whether we examine the lowest and simplest organisms, or the highest cerebral cells or bioplasts of man's brain, we are led to the same general conclusion. Not only so, but when we trace backwards the formation of man's highest and most wonderful structures to their earliest state, to the living matter or bioplasm particles from which they were formed, we find similar structureless matter having no indications of structure, no chemical or anatomical characters which would enable us to say, "This, under certain favourable conditions, will become a man," no characters by which any evidence is afforded of its wonderful endowments—the existence of which endowments, however, is established by observing the changes which are brought about and the structures which are formed as development steadily proceeds. In relation with all structures of all living beings from the earliest period of existence are particles of living matter or bioplasts, which are necessary to life. Those, in relation with man's brain structure, possess those vital endowments without which no mental act is possible.

If this be so, the nerves, the marvellously complex arrangements of fibres slowly produced by living matter, are in all cerebral actions directly influenced by the vital movements and other changes of the millions of bioplasts in relation with them in the cerebral convolutions; and mental actions, like the mere movements of an amœba, are purely vital actions; but vital actions of different orders are dependent, as I think we must admit, upon different vital endowments communicated to matter from matter with similar endowments, we know not precisely how or when—endowments certainly not due to any properties of the atoms or combinations of the atoms of which they are composed, or to any powers of which science is cognisant, or of which, as yet, we have the slightest conception, powers undiscovered, and so far undiscoverable, powers beyond comprehension, but the existence of which we must admit, if we do not deny the facts we have established by actual observation.

Only last week I received, from one of the most eminent Professors of Minute Anatomy in Germany, a recognition of the results of some minute anatomical researches published in my lectures at the Royal College of Physicians thirty-six years ago.* The views I was then led to form have been confirmed and further strengthened by subsequent observations. Unfortunately over a period of many years we have been drifting towards purely physical doctrines of life, but a more careful review of facts long known and the results of recent investigations have led many to revise the general view they had been led to entertain and to admit that many facts in connection with living nature in all departments justify the conclusion that vitality is a special endowment which is transferable without loss or without modification from living to lifeless matter. All mental actions are purely *vital actions occurring in living matter.*

April 12*th*, 1897.

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* "On the Structure and Growth of the Simple Tissues of the Human Body," a course of lectures delivered at the Royal College of Physicians, April–May, 1861 (*out of print*). London: John Churchill. Translated into German by Professor Victor Carus Engelmann, Leipzig.

Dr. ROBERT JONES, F.R.C.S.—I am afraid I shall be regarded somewhat as a kill-joy if I do not agree with the remarks as to the value of this paper. I am afraid, in this day, we are more or less mixed up with the verbal aspect of psychology, and to my mind the paper that has been read has not so much contributed to the value of physiology as I should have anticipated. I was not in time to hear the paper read, but I read it before I came here, and, so far as I can see, I expected a little more from "The Scope of Mind." I expected the application, perhaps, of the moral sentiment which is sometimes called "the seventh sense." I expected, from a medical reader, to have some application of the moral sense to a certain area of the brain perhaps. The late Dr. Jackson's views seem to tally more with the psychological sense of the present day than many of those that have been published in different papers and books on the subject.

The relation of mind to body must always remain a matter of interest. How far it may be a matter of interest I am not prepared to say, and I would suggest that, in future, the advantage we are to derive from psychological research will not be so much by the use of words. Mind has been held to include the conscious being. We may look on mind in a physical aspect. This has been recognised lately, so far as psychological research has gone, in the University of Cambridge.

I am sorry to say that I do not see the value of the paper in the education of children and the treatment of diseases. The climax is reached in the last few lines of the paper, where the author says the point raised in the paper "lays bare at last the foundations of character, of conscience, of the entire Ego so long obscured by a psychology bounded by the conscious." The paper has not explained character, conscience, or the entire Ego. It has been a paper built up, to my mind, by what has been taken from those who have written on the subject—a kind of summary, with a request that mind should include not only conscious, but also unconscious, actions.

I am sorry that I do not agree with the value of the paper to psychology.

Professor ORCHARD.—The able author of this paper will not, I am sure, think it is from any want of appreciation of its value, but I cannot see my way to concur in his very ingenious and interesting conclusions.

On page 236, he gives us a special warning to "take especial care, at the outset, to avoid those numerous rocks which project from either bank on which we might early suffer shipwreck from the temptation to exceed our limitations." I am very much afraid that the author, with all this piloting, has not entirely succeeded in steering clear of a certain rock he mentions in the third paragraph on page 235, as "physiological materialism." The trend of the paper is, to my mind, a little in this direction. I do not say it is intentional on the part of the author, but that is the impression it rather gives me.

On page 240, line 17 from the top, the author quotes a line from Kirchener—"We find in instinct the action, unconscious and yet purposive." That is a remarkably worded line! Does he mean by that that the action is unconscious in the animal, but purposive in him who is doing the action, or what does he mean? No doubt, if you row in a boat-race, you may say the action of the oar is unconscious, as far as regards the oar, and purposive as regards the rower. I do not know whether that is what the author of the passage means, or whether it is simply a line of pure and unadulterated nonsense.

I must differ from the author of the paper with regard to the statement (possibly it is a *lapsus linguæ*) at the top of page 246—"The will itself may be unconscious." An unconscious will is, to me, an unmeaning phrase, nor can I agree with the author in his theory that "children can be moulded unconsciously" (at the end of the last page) "with far greater ease than through their consciousness." Possibly this expression "unconsciousness" may be used in this paper in a somewhat different sense to what it is generally understood to be. Of consciousness there are three kinds, dormant or latent consciousness, which we know as sub-consciousness; ordinary consciousness, or wariness of anything, and attention, or concentrated consciousness. It a little appears as though, in this paper, *consciousness* is sometimes confused with *attention*, and *unconsciousness* certainly with *sub-consciousness*. I would suggest to the learned author, if he will allow me, to abandon the term "unconscious mind" and to substitute for it "sub-consciousness."

The author has given us much from other minds; but he has not given us his own definition of mind. This does not conduce to clearness of thought. I do not know whether he intends to adopt, as his own definition, the definition of Bastian, on page 252, line 20 from the top, that mind includes "all unconscious nerve actions." If mind includes all unconscious nerve actions, why should not it also include all unconscious moral actions and all unconscious mental actions? It would be, I think, very difficult to draw the line. It is really to confuse psychology and physiology to speak of conscious actions and unconscious actions, or conscious movements, rather, as belonging to mind. The notion that mind consists, wholly or partially, of a series of modifications is essentially materialistic. Conscious impressions may, of course, fade away and afterwards be revived. In such a case they are supposed to exist in sub-consciousness, or dormant consciousness. Undoubtedly, we are very familiar with that kind of phenomena. They may be revived by recollection, may these pictures that have faded, or by association of ideas; but I cannot revive the colours of a picture which has not, first, been painted, and so nothing can exist in sub-consciousness which has not first existed in consciousness. To confound thought with brain, and brain with nerves, is as unphilosophical as to confound the engine driver with his locomotive and the steam boiler with the wheels on which it runs. If you make mind co-existent with life you obliterate the soul of fundamental distinction, and alter, not advantageously, established definitions. In this age, especially, it seems important to emphasise difference and distinction as well as resemblance. There is too great a danger of attending only to the resemblance of things and ignoring their differences. That all power belongs to mind, or, as I would rather say, spirit, is a concretion in which I thoroughly concur with the author. Matter is itself unconscious; but it is another thing to say that there is such a thing as unconscious mind. Undoubtedly there may be certain spiritual actions of an unconscious character, but that is not mental action. Undoubtedly, there presides over all nature great intelligence which we know as God. This action is conscious and purposive. "He doeth all things according to the counsel of His own will." There is no unconsciousness about it; but, essentially, consciousness directed to an end.

While I am unable to agree with the learned author of this paper in what I cannot but regard as fallacious conclusions, I am, at the same time, exceedingly sensible of the great ability and originality for which we are indebted to him, and for the value and benefit which we cannot fail to derive from this most interesting paper.

Mr. ANDERSON, C.B., LL.D.—I should say that I very sincerely thank Dr. Schofield for this valuable paper. I confess I came here, as the last speaker did, hoping to hear his own definition of mind. On the other hand, I must say that I concur fully in what the author says—that you can train children better while they are unconscious than when they are conscious. It is a fact, as I have seen myself, in that far-off British colony, the Mauritius, where we have to deal with a great number of children—especially uncivilised children coming from the depths of the centre of India—that it has been much easier to train these young minds when they do things unconsciously than when they do things consciously. I think I would not, in physiology, abandon the term "unconscious mind" and I think we can hold to it, that mind is conscious or unconscious. I was present at a strange incident that happened the other day in Paris. I was attending an operation on a boy of nine years old, under chloroform, and, at a certain moment, the boy became pale and his lips turned blue and he ceased to breathe. A fellow student of mine came near me and said, "Where is the soul now? Can you answer me, Anderson?" I was non-plussed, I confess, but I said "Certainly, it must be somewhere." But by some power which, of course, the surgeon exerted, the little fellow came to. In the presence of that example I said to myself, "Under the power of chloroform the mind becomes, certainly, unconscious." The brain had no power to act, but there was reflex action, because we saw the beating of the heart and the breathing of the lungs.

This is a very absorbing subject, and the more we study it the sooner the light will lead us through this mystery called mind.

I thank Dr. Schofield very much indeed for his paper. I am only sorry that I had not time to read it before I came to this hall.

The CHAIRMAN.—Before Dr. Schofield replies I should just like to ask him one question. We had from him a very interesting account of the action of an amœba, and, although its actions were exceedingly like the results of mind, I would like to ask Dr. Schofield whether he feels disposed to extend the range of what we call mind to the action of that amœba, or to similar actions amongst very lowly organic forms?

I will now ask him to reply to the criticisms on his paper.

Dr. SCHOFIELD.—It has been my unfortunate lot hitherto, Mr. Chairman, ladies and gentlemen, to read papers that have been so generally agreed with, being on somewhat stereotyped lines, that there has been no active discussion or opposition. I am extremely fortunate, at last, to have thrown down a bone of contention, to some extent, and to hear views diverse from one's own, which is always encouraging. I would ask you to distinguish between the many imperfections of the paper and the extreme theses that I am trying to prove, and not let the one suffer for the other.

The second writer's remarks on my paper simply beg the whole question, and he limits mind to pure consciousness. I have been asked for a definition of mind. I consider it is the sum of psychic action on us. Unconscious mind, he says, is ourself, or ego. There is no such assertion in my paper. I say it is an important part of it. He absolutely speaks of spiritual powers that are not mental. A man who can distinguish and talk of spiritual powers that are not mental, I cannot follow. I consider that which is mental to be that which is not material; but certainly that which is spiritual is of the nature of mind. I am not here to distinguish between mind and soul, and so on, but I am taking mind as contrasted with matter.

Now, with regard to Mr. Jones, who, I regret to see, has departed, he complained that the paper was very limited. Nothing has tried me more, in writing this paper, than having to so exceedingly limit the scope of it, because one could have given such a much more interesting paper (and, perhaps, I may have the opportunity on a future occasion) to this audience; but I felt I must lay the foundation stone first. The misuse of words misleads science. If we talk of mind, which is conscious, where is mind when you are under the influence of chloroform, unless you admit unconscious mind? That is artificially unconscious; but I am speaking of a constant unconsciousness which is going on in all of us at this moment. Mr. Jones also made the extraordinary statement that mind here includes unconscious actions. Now I have shown, over and over again, that all unconsciousness is expressly excluded. He says that he does not understand children being taught unconsciously. Let me say the sooner it is understood the better. As a matter of fact, we do train children very largely, without knowing it, through their unconscious minds.

The unconscious mind can be trained and educated, as the conscious mind, by the force of environment unconsciously acting on the vital powers, and may so imbibe principles without knowing it. Take the instance of making a child clean. You surround it with materials of cleanliness and you will impart to its unconscious faculties cleanliness, and make it cleanly. You do not excite opposition, and it is educated without opposition, and this can be arranged definitely so as to educate it in definite directions; but that is a large matter that I need not enter upon.

My great and esteemed friend, who spoke in such flattering terms of my paper, Professor Orchard, does not seem to like the term "unconscious mind" as applied to "purposive." When bees form the hexagonal cells of the honeycomb they act unconsciously, and yet purposively, in a most astonishing manner. Surely instinct is purposive. I do not know that the point is open to much dispute. As to children being moulded unconsciously, perhaps Professor Orchard will take these remarks as applying to that subject also. Occupied, as I am, in the Educational Union, one finds the enormous use of educating children through their unconscious mind—the great point being that there is no opposition excited.

Now, as to sub-consciousness and unconsciousness. When I read a similar paper here, some time ago, Professor Orchard suggested that the term might be limited to sub-consciousness. There are many important psychic actions on which our conduct is based and which influence it, and which are connected with it in every way through life, that you may call sub-conscious; but *sub-conscious* really means, if you come to look at the word, *unconscious.* It is not that it has been conscious and become latent but it is that it is latent now and may never become conscious. If it is not conscious it is unconscious. I object to *sub-conscious* as being rather confusing. *Partly conscious,* perhaps, would be better than *sub-conscious.* At any rate, I must fight for the whole thing as the unconscious psychic faculties in man.

I agree with Professor Orchard, most fully, in repudiating the material basis as mind, and whatever quotations I made that might give such an impression I am not responsible for.

The valuable illustration given by Mr. Anderson I am thankful for.

With regard to the evidence of mind amongst the lower animals, I think I am not likely definitely to answer Professor Hull's question. In my opinion there is mind in all purposive psychic action, and, if that amœba not only apparently but really comes within that category, I do not see why we should limit our term, or arbitrarily deny the term, to one when we apply it to another for similar actions.

The CHAIRMAN.—It has no ganglia.

Dr. SCHOFIELD.—No.

The Meeting then terminated.

ORDINARY MEETING.*

PROFESSOR EDWARD HULL, LL.D., F.R.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed, and the following elections took place :—

ASSOCIATES :—S. Beswick, Esq., U.S.A.; A. S. Haile, Esq., London; C. Sharpe, Esq., late H.B.M. Consul, Costa Rica, Sussex; Rev. R. J. Campbell, Sussex.

The following paper was then read :—

"*NATIONALITY.*" — *LIKENESSES AND DIFFERENCES WHICH POINT TO MANY RACES MAKING UP WHAT ARE CALLED* NATIONALITIES. By Professor T. MCKENNY HUGHES, F.R.S.

Introduction; Race and Nation; Nationality.

Formation of Races and Nations; America; Mediterranean; Cattle; Volga; Baltic.

Examples of persistent racial characters—

Ancient Greece.

East Anglia, Yorkshire and Lowlands of Scotland, Highlands, Ireland.

Wales; Language; Physical Characters; English and Flemings, Baltic and Norse immigrants; Saxon invasions; Romans; Pre-Roman tribes; Silures and Demetæ; Glamorgan, Carmarthen, and Cardigan; Ordovices and Cangi (?), Gwyr Ardudwy and Gwyddelod; Marriage by capture; Cochion Caio, Libyans, Red Arabs, Amorites, Votiaks. Common origin in North Asia.

Nationality; Conclusion.

Introduction.

THE proper study of mankind is man: but of that vast subject we can only attempt to follow one small branch this evening. The particular line of enquiry which I propose for your consideration is, however, one for which we have the material around us everywhere—one which requires the co-operation of many, and one, therefore, which is suitable for discussion by a society like this.

I have often amused myself when travelling abroad or walking about some great town at home by trying to make out from the faces of the passers-by the answer to some

* May 1st, 1899.

simple question, as, for instance, Were they a happy people? Sometimes we may notice among the hundreds hurrying by to business a careworn look often but little relieved by hope. In another place we are struck by the same anxious, disappointed look upon the faces of those who make a regular business of their pleasure. In another place we observe a general alertness and self-possession, the outcome of productive work within the compass and possibilities of the individual.

Sometimes I ask the question, Of what nationality are they? using the word nationality in its common sense, so that the question means only to what race, whether more or less pure or mixed, can we refer any individual or family or larger group by reference only to external and obvious characters.

That is the question I venture to propose for discussion to-night, and the people to whom I wish to apply it are selected for convenience, either because I am more familiar with them myself, or because they are of more general interest, or more accessible to observation. Of course we must turn aside now and then to consider the value of the evidence on which we rely or to enquire what support historical records give to the conclusions at which we have arrived.

Nationality.

It will be convenient to draw attention at once to the distinction between a Nation and a Race. A nation is a group of people or peoples held together by a common government, but not limited by blood, country, language, or religion, and generally exclusive of peoples merely held in subjection; a race is a people having a common origin; a nation is a political unit, a race a physical unit. But, curiously enough, when we use the word nationality we generally have in our minds racial characters. In that sense I use it in the title of this paper. A nation is an agglomeration of various elements held together by diplomacy or conquest. A race, too, may be built up in various ways but by processes which may be called natural.

Origin of Races and Nations.

The great migrations of whole tribes or peoples are continental phenomena. When the people become too numerous there follows, directly or indirectly, pestilence or famine or the sword. Pestilence is essentially the scourge of tropical regions, and overcrowding does not so often lead to migrations; but in these speculations we must take account also of wholesale infanticide and other crimes. In the cold inhospitable regions of the north, where man requires more food-fuel than in the balmy south, hunger drives men to migrate, and migration to the battlefield. All this is complicated by facilities of route and by the resistance offered by the invaded people.

Periods of bad weather and dearth, or periods of prosperity and the difficulties arising from a rapid growth of population, set up great movements in the interior of the continents that tend to the mixing and making of races. The nations press on one another, as the Huns on the Goths and the Goths on the Romans. Whether we have as the result an invading army or a migrating horde of men, women, and children, we get a mixing or a supplanting of previous races, and very often a dominant ruling race remaining long distinct from the conquered people.

But the sea, while it facilitates the mixing of the people of the seaboard, is a bar to all migratory movements on a large scale. As the races of the interior press on the people of the coast these travel along the shore to regions already well known to them where kindred folk are settled, and where they are readily absorbed into the existing population. Where there is a difference of blood, language, and religion, two peoples may long live side by side with little intercourse and practically no fusion. But we can generally detect among the people the traces of any such influx of a different type; and even when history is silent on the subject, we feel some assurance that there has been such an inroad if we find among the people of any country either a few villages or families or individuals occurring sporadically who persistently exhibit the characteristics of some other race.

Physical Characters.

The physical characters of a people change but slowly, and in considering them we are dealing with that which man has in common with all the world of life and that which is governed by the same laws as those which regulate the variation of form, colour, &c., among the lower animals. It is, for instance, a well-known fact that some characters are more unstable than others: that there are some races which have greater prepotency of transmission than others; that is to say, when two different breeds are crossed there is a greater tendency to reproduce the characteristics of the one than of the other: that, as a rule, the more ancient and long-established breeds have greater prepotency of transmission than the newer: that under certain conditions there is a reversion of type; that is to say, characteristics of some ancestral form reappear in the remote offspring: that when two divergent types are crossed there is apt to be a reappearance of an ancestral type differing from *either* of the parents. All such points should be taken into account in any enquiry into the characters of a people made up of various races—sometimes closely akin, sometimes widely divergent, which have been time after time crowded together and isolated from the rest of the world.

What we have to deal with to-night are groups of people who have been geographically isolated so long that in accordance with their environment they have arrived at some common characters which have become more or less stable.

We can trace some of these back through long ages and various vicissitudes; others appear to have been stereotyped, as it were, long before they take their place in history. But let us see whether we can anywhere watch the formation of a race and the circumstances which mould its characters.

America.

Any one might think that we could find in America the examples we seek; and although the conditions are too complex and artificial to give us any very satisfactory results, yet there is much to be learned from the facts observed there. America began with a large population of negroes and a small number of white people encroaching on the territory of mixed races of unknown origin. But the limits of these three distinct groups have always been somewhat sharply defined, and there has not been any great amount of interbreeding between them.

In more recent times an enormous white population has poured into America, and this has not absorbed but has pushed away and nearly exterminated the native tribes, and has not coalesced with the negro. Where large bodies of Celtic-speaking people from the British Isles, or Germans or French have gone out together, or settled in the same district, they have to a certain extent remained distinct, retaining their own language, habits, and physical characters, but, as a rule, the immigrants have been merged in the mixed population of the great centres of industry or been broken up as they advanced west with the waves of agricultural settlement. And there is an American type being evolved. While the bones remain large and strongly knit, there is a tendency to lose flesh. Protuberant features, such as are associated with sensuous character, are reduced, and a more intellectual though often somewhat stern and concentrated expression is apt to be developed. It is a matter of speculation how much is due to the dryness of the climate, and what to a life in which so much depends upon individual prowess in meeting the unexpected and grappling with new combinations.

It has sometimes been remarked that the characteristic American type approaches in some respects to that of the North American Indian, and, if we believe in the development of physical characters in accordance with environment, this is what we might expect. The modern American is only showing the early stages of that modification in a certain direction, which was carried further in the case of his precursors, though the original stock may have been very different in the two cases.

Another curious fact is observed in America. The people who go over from Britain and the countries round the Baltic thrive best in the cool temperate regions. The negroes have more children, and more of these survive in the tropical parts of America, while the intermediate warm temperate climates best suit the people of Southern Europe. If there were no railways or steamboats or even roads, as was the case in old times, not only in America but in Europe, the different races would not get mixed up as they now are, and there would soon be a belt of white people in the northern part of America—a belt of people like those who live round the Mediterranean in the central part, and a negro belt in the south.

Europe.

Now let us turn to the old world, where the history of the development of races goes back further and is more obscure. In the interior of continents modification has taken place so often by immigration and invasion that we have small opportunity of forming an opinion as to what the result of any mixture of blood would have been if it had been left long isolated and cut off from any new additions. We see, however, many instances where varieties of language, government, &c., which are artificially kept up have tended to perpetuate differences which, but for these, would probably have disappeared. We see also how natural barriers, such as high mountain ranges, almost entirely cut off all intercourse between adjoining valleys. But we see also how no differences of race, government, or religion interfere with the perpetual circulation of the inhabitants round and round the shores of any inland sea. Merchants and pirates, warlike leaders, or peaceful people driven from their homes, all contribute to the ever moving, circulating population of the seaboard, till in the course of the ages a mixed race has been formed having some of the blood and characteristics of all the various nations that have lived around its shore.

Mediterranean.

Around the Mediterranean, for instance, we have a mixture of Moorish, Spanish, French, Italian, and Greek, with remnants of many an ancient seafaring people from the Black Sea and the Levant. The maritime population has much in common wherever we see it. They have a swarthy complexion, dark hair, and a quick, restless eye. They are excitable, deceitful, treacherous. In the "tideless, dolorous midland sea" the struggle has been chiefly that of man against man, and, where force could not prevail, craft might; therefore they are inveterate liars. Severity inspired fear; therefore they are cruel. They lived in an atmosphere of distrust. Suspecting and suspected, their object was to outwit their opponent, and the means employed did not so much matter; therefore they are treacherous. These are the people with whom travellers are brought into contact at Marseilles, at Smyrna, or Batoum. These are the people who give a bad name to the Neapolitans, and Greeks, and Levantines.

When the recruits who had been drawn from all over the country were being disbanded in Athens after the war with the Turks in 1897, it was very interesting to notice their racial characteristics and the difference between them and the sailors in the Piræus; for the seafaring folk who swarm round the side of your ship among the Greek Islands or at the Piræus are very different from the Greeks of the interior, and probably were always different, even before the great influx of Slavs into Greece.

The Florentines and Romans, without any reference to the chequered history of Naples, would be loth to acknowledge the Lazzaroni as their kinsfolk. If there were for any reason a considerable migration from the Mediterranean basin and a settlement on some foreign shore, the colony would consist of this seafaring population who have all the ships and all the knowledge of how and where to guide them. They would not show such a variety of type as to suggest that they were drawn originally from every race of Southern Europe and Northern Africa. One thing would be quite clear with regard to them, and that is that they had not come from Northern Europe.

Volga.

If now we cross to the Volga and travel northwards we cut across one great line of migration from Asia into Europe, and about Tsaritsyn we still see the Tartar element pressing on from the East. They bring with them camels and an entirely different breed of cattle from that seen either in Northern or Southern Europe, although a few seem to have found their way into the Mediterranean area from very early times.

Cattle.

It is very interesting to notice the breeds of cattle that accompany the different races of men. Along the Mediterranean and in Southern Europe generally you find two conspicuous types: the cattle with the lyre-shaped horns, such as you see commonly about Rome, and those with the spiral horns projecting almost horizontally from the side of the head, such as are common in Umbria and Emilia. Both are ancient breeds pictured on the monuments of Egypt. There are modifications of the cattle with the lyre-shaped horns seen in the enormous oxen of Hungary.

There is a breed found in Sicily, and also represented on the monuments of Egypt, with much straighter, upturned lyre-shaped horns. This seems to be due to a cross with the breed that is seen in a purer form with the camels and the Asiatic people whom we find at Tsaritsyn on the Volga. There the cattle are all whole-coloured red like our Devon breed, and have what we may call the antelope type of horn; that is, straight or somewhat spiral upturned horns starting very close together from the top of the skull.

When we get to Northern Russia and the Baltic area the brown or black-and-white sheeted breed, like poor Dutch cattle, with small forward-curved horns, are what you see everywhere, with a few imported individuals of other classes occurring here and there among them. These are all breeds which owe their characters to domestication, which have always accompanied man, and which may be taken as evidence in tracing his wanderings and principal trade routes. In America also much may be learned from a study of the cattle which have been brought over from Europe and of the characters which seem to result from their return to feral conditions.

To return to the Volga. If we now travel on from Tsaritsyn further north, passing by Samara and Kasan, we find the true Russians beginning to prevail.

These are square-featured men, with brown hair changing to very light yellow at its ends. They form the mass of the people all the way to Esthonia and Finland, where the purest example of this race is represented. With them appear the northern breed of cattle, which is never lost sight of again as we travel along the Baltic westward to the British Isles. There is a saying, "Scratch a Russian and you find a Tartar." As far as I went that was seldom true. The substratum of the population over the greater part of the northern and western provinces of Russia was, as far as I could learn, Finnish or mixed Finnish and Scandinavian. I may remark in passing that if you did find a Tartar when you scratched a Russian you would find a very good kind of fellow. Some of the Tartar tribes furnish the most trustworthy domestic servants to St. Petersburg and Moscow.

Baltic.

We now find ourselves on the shores of the northern midland sea, and, as we saw a dark race being developed around the Mediterranean, so round the Baltic we find a fair people resulting from the mixture of Finns and Scandinavians and North Germans.

Here the type is entirely different from that of the Mediterranean. The characters evolved out of this northern mixture of races are—a very powerful frame, a fair complexion with red or yellow or sandy hair, and blue or grey eyes. In the stormy and often ice-bound Baltic the struggle was chiefly against the forces of nature, which the hardy Norseman had often to face alone, and this bred a stern resolution and a calm resignation to the inevitable. In the face of such dangers mutual aid was freely given, and the value of being able to rely on one another developed a more kindly fellowship. These folk are honest, manly, and soberly self-reliant.

If sometimes they laid themselves open to the charge of being severe and coarse, they had the more noble qualities of courage, trustworthiness, and the spirit of comradeship. We can follow them further than we could the Mediterranean race; for they have been pushing their way along the shore to more genial climes, and we can trace their descendants even to our own country, upon whose shores small bodies have been landing and settling from time immemorial. There was no tremendous incursion by a whole nation: for the sea, which facilitated the circulation and mixture of races round the coast, imposed limits to wholesale migration. Only the people of the seaboard had any ships, and only a small body of men could be conveyed across at any one time. The invasions must have been going on so long that the first comers had settled down comfortably and been anything but glad to see the arrival of another body of needy and perhaps unfriendly visitors from their old home. We are apt to think of these invasions as belonging only to the time of disorganisation and discord which followed the withdrawal of the Roman legionaries from Britain; but the number of distinct tribes which Cæsar found here, and the early descriptions, show pretty clearly that there had been settlements of this Baltic race upon our coasts long before the Romans came.

The proportion of the various elements is not everywhere the same. The grey Scandinavian, the florid German, the yellow Finlander, and the red Votiak have contributed their quota, and the descendants of this mixed race revert—some to one, some to the other, type. Where geographical conditions have facilitated the immigration of any one type we see it conspicuously predominant: as in the case of the Norwegian along the north and east of Britain, of the Finnish on the Eastern Baltic, of the German along the Southern Baltic and the South of England. We see the Norwegian on the coast of Moray, notably at Burghead; we see the German in the lowlands of Scotland and in Yorkshire; we see other Scandinavians in the Lake District. The Finn is less marked now, but there is a suggestion of his occurrence in East Anglia, and some recognise the name in the Fin or Feon of Gaelic song.

The overcrowded or oppressed or hunger-smitten population of the interior often pressed upon the coast and gave a distinctive character to different migrations, but generally it must have been largely composed of the mixed people of the seaboard.

Sometimes, as we should infer from observation, and as we know from history, a larger number of one or other continental locality came over together, but they were a mixed race when they started and generally got more mixed after they arrived.

As the result of observation we may take it as proved that no dark race has its origin in northern climates, and no fair race has developed its characteristics in tropical regions. There are of course many difficulties and what may appear to be exceptions to any such wide generalizations; as, for instance, the occurrence of dark nomads on the shores of arctic seas, whom of course we must infer were pushed north from warmer climes; or in the existence of fair pygmies in Africa which we should try to explain by supposing that they are the dwarfed representatives of a fair northern race long ago driven to degeneration, which is as true as progressive evolution; or that the effect of their living always in the dark shade of tropical forests has been the same as living farther north under less torrid suns. Another very interesting example I may mention in this connection. I once, when travelling with Sir Charles Lyell in the Western Pyrenees, had the good fortune to see at Lourde a pilgrimage of Basques from the very heart of the Basque country, and I noticed that the majority were a square-faced people, of medium or certainly not short stature, tanned it might be, but not of dark complexion, eyes, or hair; people who from their physiognomy I should have said had their origin somewhere in the Baltic regions. I was elsewhere shown dark people who I was told were Basques and who spoke Basque, but these were obviously Spanish or Southern French who had been somehow absorbed into the Basques. If we look for the ancient race akin to the Finns who peopled Europe in very early times and try to find whether we have not a remnant of these represented in the Basques, we should exclude the marginal mixed race which must inevitably have resulted from thousands of years of contact. In Africa or India we can at once pick out the Europeans and the descendants of Europeans after many generations of residence. So little change of a permanent kind is seen that we have no data for any approach to a numerical estimate of the time which would be required to bring about the conversion of a white race to a black, and yet the stable varieties of the human race are so numerous that it is almost impossible to entertain the idea of independent origin from many different centres.

With the knowledge of such facts as these we look at the people of each place we visit and soon notice some features and colours more prevalent in one area than another. We form in our mind's eye a kind of compound photograph of such characters, and this become for us the type to which we refer in all comparisons. This is a different and, for certain purposes, a more trustworthy test of race than exact measurements. Size, weight, muscle, and bone change rapidly according to food, climate, and other conditions, but physiognomy and colour are more persistent.

Greece.

To apply these results to cases which can be easily brought under observation I will first refer to the ancient ruling race of Greece, the kings and heroes described by Homer, and the royal or deified personages represented in the archaic statues of the Acropolis at Athens.

We may be sure that these were portraits* to this extent: that the artist combined in one ideal person the characters which were most admired by those to whose taste he was appealing, and that, when he represented members of a dynasty or of a family, he was careful to give those distinctive features which marked their lineage, of which they themselves were proud, and which others recognised as characteristic of them. Homer's heroes—Achilles, Ulysses, Menelaus, Meleager—had auburn hair, and were described in terms which could only mean that they had light complexions. So also we must believe that Agamede, Demeter, and Ariadne were fair. And in later times this golden hair, being rare in the south, was represented as the type of royal lineage and the ideal of youthful beauty. On the Attic Stage it was always attributed to Apollo and to princely youths. Electra identified the hair of her brother Orestes upon the tomb because only the royal family had that auburn hair. Had any loyal domestic placed a lock of

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* See *Camb. Review*, April 28, 1898.

his own hair there it would have been dark. The hair was as distinctive of her brother and of her as the high instep which they remarked in the footprint.

If now we turn to the archaic statues of Athens we find these historical descriptions confirmed by contemporary portraits. From the custom of tinting the statuary and sometimes introducing gems or other material to represent the eyes we can recall not only their physiognomy but even the colour of their hair, eyes, and complexion.

We see a type common to all running through them. They were bright, intelligent people, with a pretty, piquante expression; a delicate face, oval or tapering slightly to the chin; a broad intellectual forehead, not smoothly rounded, but gently and symmetrically undulating; a straight or slightly curved mouth, breaking into a smile in which the downward curvature of the middle of the lips was increased and the dimples played on the upturned points of the bow. The traces of colour recall blue or grey eyes set well apart and looking you straight in the face; golden or auburn or reddish-brown hair worn low on the forehead or neatly braided back.

These characters run more or less through all the statuary of what is called the archaic age of Greek art. The figures have the stiff posture which exaggerates the height and squareness of the shoulders, and taper from them to the feet, while the arms generally hang straight down by the sides. This is the conventional Egyptian treatment; but in most of them the features show no relation to the Egyptian race. In some early Greek sculpture we observe in the firm mouth and prominent, though, as seen in section, pointed rather than full lower lip, features with which we are familiar on the monuments of Assyria or Egypt; but in the series of archaic statues exhibited in the museum on the Acropolis of Athens, for instance, which we may take as a good example of the type of which we are speaking, we do not see Egyptian features.

The later sculpture of Greece has based its ideal of beauty on a more luxurious type; a more strictly oval face; a smooth forehead and a generally voluptuous mouth, in which, however, there is often more soul than passion. As far as can be inferred these were dark people. The archaic statues were alive, and the higher art of later times put this life in motion; but, even where this was not the object, the new race look as if they were used to, and needed, easier attitudes. In their mouths Cupid's bow is drawn downwards at the sides and a smile is seldom pictured. They are handsome rather than pretty. The productions of this later Greek art were based on real persons of whom we may still see representatives, but it was idealized into what has become the standard of beauty for all time.

If we were to search through the surrounding regions of the earth to see whether we could anywhere find these several characters to-day we should perhaps look for the later more luxurious type in Southern Asia. Among the fairer races of India, for instance, we might find many a one who in form and figure, and even complexion, would pass muster in a gallery of Greek art. Around the Mediterranean this rich beauty is sometimes seen appearing here and there by reversion of type among the mixed people derived from Moors and Spaniards, from Greeks and Italians, and many another race. But nowhere among them is there anything like the archaic Greek.

Although we see in some ancient statues what looks like a blending of the earlier and the newer types, there is not that gradual modification of the archaic characters into the portraits or ideals of the following ages, spoken of as the highest period of Greek art, which we might expect if this were a question of skill in manipulation or the development of creative genius. It rather points to the absorption of the remnants of an ancient race into one less strong perhaps but numerically far superior.

If, then, all the sculptors and poets of ancient Greece represented their rulers as fair, blue-eyed people, and if there is a reasonable presumption that this portraiture represented the characteristics of a dynasty, where is now the race to which that dynasty originally belonged? Not in Asia nor anywhere round the Mediterranean. It is now a northern type. We find its nearest representative along the shore of the Baltic and on the coast of Britain among the people that have been developed from the hardy races that spread from Germany to Britain and still seem to absorb all that come within the influence of their greater prepotency of transmission.

When and in what direction did the migrations which have produced this result take place? Have we in this a record of the time when, ten or twenty centuries B.C. movements in central Europe sent conquering hosts in all directions over the surrounding regions.

Some of these extended on the one hand over Greece and other parts of South-Eastern Europe, where the dominant race long remained distinct in the ruling families, as we see in the noble families of Esthonia, the representatives of the Teutonic knights who conquered the country in the twelfth century, while their followers have been merged in the native race.

Some of these pressed on the people of the Baltic in the Bronze or Iron Age, and formed a large proportion of the seafaring folk who then began to settle on the coasts of Britain. The eastern influence seen in early British art tells us that there was then communication with the continent, and all the results of archæology and the records of history teach us that immigration after immigration took place, each people pushing the earlier comers further west or north or absorbing or being absorbed by them, till we have not much that is trustworthy save the internal evidence from the most stable racial characters of each region to guide us in search for the origins of our nation.

However we may explain such points, nothing can get over the fact that the characters portrayed in Greek archaic art belonged to a type not to be found in the Mediterranean, but common in North-Western Europe.

British Isles.

Now let us return to our own country and apply these observations and inferences to the living men and women around us. We have no means of examining the physiognomy and colour of the palæolithic race or races so largely represented in our islands by their imperishable stone instruments. Nor can we apply the test of which we are speaking to-night to the Neolithic or Bronze folk. But when we reach Roman times our line of research is suggested by history. Cæsar records as the result of his own observations and of the information he received that there were several different tribes in Britain; that these differed in race and appearance; that some of them resembled certain continental nations with whom he was already familiar. Here we have in brief the story of long ages of immigration from different areas. We commonly hear that the people of Wales or the Highlands are the descendants of the Ancient Britons pushed by each new conquering nation into the mountain fastnesses of the west and north. But we must go back a very long way before we can entertain the supposition of there having been any one race occupying Britain. Certainly when the Romans conquered the natives they were made up of many tribes differing from one another in all the characteristics that indicate community of origin. Moreover, the Romans were not in the habit of exterminating the native populations of the countries conquered by them. The native tribes were far more likely to have driven out their neighbours when themselves pressed by new arrivals on the coast.

The Saxons, Danes, Jutes, Angles, and Franks came in small parties, and formed a still more and more mixed population as time went on. In their case there was much oftener extermination, sometimes even extirpation. Differences of language, religion, and laws increased the difficulties in the way of amalgamation, and accentuated the results of the isolation of small groups of people, each, it may be, very mixed in its origin, but representing a somewhat different mixture from that prevailing in an adjoining district.

I do not propose now to offer any general description of the population of England, or to criticise the many attempts which have been made to locate the various groups of immigrants or to recognise traces of them in the existing population. There are, however, a few examples which have been more particularly forced upon my notice to which I will refer.

East Anglia.

In the Fenland there are two distinct types of people among the rural inhabitants: One, a dark man who would not be looked upon as a stranger if he were to turn up on market-day in any inland town in Carmarthenshire. He may be one of the original pre-Roman Britons derived from the Mediterranean mixture, or a Breton who came in with the Normans, but he is not one of the Baltic race.

Another Fenland type is a sandy red man whose double might be found in any seaport in Wales and more or less commonly all round the coast of England, Scotland, or Ireland. He cannot however, be for a moment mistaken for a Man of Snowdon or a Cardy or a Silurian, nor for a Cumberland man, and he is not quite like either a Lowland Scotchman, or a Yorkshireman. He belongs to the Baltic type, and his ancestors may have come over with any of the earlier invasions of even pre-Roman times, or they may have followed the Norman conqueror. For we must remember that the followers of William were not likely to have been all dark, although on the Bayeux tapestry the English are coloured red and the Normans black for distinction. William himself is represented in the picture in St. Etienne in Caen as a red man, and his son received the descriptive title Rufus.

As a single example of reversion to an East Baltic type I may refer to a labourer in Cambridge who tends the lawn in front of the University Library. He assures me that he and his people are natives of Cambridge. I pointed him out to my friend Col. Alfthan, chief of the staff of the Finnish Army, a man before whose eye tens of thousands of mixed Scandinavians and Finns are continually passing, and asked of what nationality he would take him to be. Without hesitation he replied, "If it were not for his clothes I should take him to be a North Russian."

In the villages round Cambridge there is a great mixture, but bright, fair complexion, blue eyes, and flaxen hair is often predominant, this last character being more conspicuous in children; so that we do not carry away the same impression from a visit to the village school as we do from a gathering of adults.

In the north of England we see a marked difference between the florid sandy-red Yorkshiremen and the tall grey Cumbrians, among whom we may here and there find traces of the Strathclyde Welsh.

Wales.

I will now turn to Wales, and follow up the same line of enquiry with reference to the various people to be found there.* I will examine them in greater detail; first, because I am more familiar with them than any others, and secondly, because I think I can thus offer you more that is new to you.

Language.

The language spoken by a people is no trustworthy indication of their racial affinities, as we may see in our own country without referring to the innumerable examples to be observed throughout Europe. Most of the people once spoke Celtic in Cornwall, Ireland, and Scotland where their descendants now speak English; and, although Welsh, the strongest and most beautiful of our Celtic languages, not-

* See *Y Geninen*. Cyf. xi, Rhif 4, tud. 231. Hydref 1893.

withstanding the obvious hindrance which it offers to commercial advancement, still holds its own close to, and even in the centres of, the greatest commercial and intellectual activities of the world, yet English is surely and steadily creeping in, and must eventually drive it out.

In our present enquiry the language spoken by a people goes for very little except so far as it appears in place-names. New-comers asked the names of prominent features and adopted them at once for convenience of reference without any knowledge of their significance. The practice of changing old names in order to conceal the associations connected with them, or to glorify by a new name some easily achieved modification of old work, was reserved for modern scientific nomenclature and Parisian political sentiment. Ancient place-names can generally be trusted.

Although the men of Gwynedd,* the northern district, can detect one of the Hwntws† of the Deheubarth, or southern parts, by his speech, yet there is not in Wales any such difference as exists between the dialects of different counties in England. And yet all the evidence that can be collected on the subject, the nature of which is indicated in the few examples which I am laying before you to-night, leads to the inference that the people of Wales belongs to many very different races.

It becomes, therefore, a matter of interest to enquire whether any marked characteristics of physical feature can be now observed in different well-defined areas, and whether any connection can be made out between these and the early races mentioned in history or suggested by place-names.

We have, of course, all round the coast a belt of more recently mixed races. There was the English occupation along the line of the mediæval castles: there were the Flemings settled in Lloegr fach tu hwnt i Gymru (Little England beyond Wales). That is a district in the south of Pembrokeshire where Flemings and English were planted by Henry I and the Earl of Pembroke.

Of the mercenary soldiers who followed the feudal lords along the Marches and held the castles round the coast it

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* Gwynedd, a not very clearly defined district including nearly the whole of North Wales. A similar name is applied in Brittany to the country of the Veneti: the Diocese of Vannes is now called Eskopti Gwénèd or Escobty Guénèd.

† Hwntws, from hwnt=outside, foreign. *cf.* forestieri.

would be difficult to find clear evidence now. The fair, fat, stolid, unaggressive, but unyielding people who settled in the south-west corner of Wales are there still, but have left very little mark on the features and character of their neighbours, while they have themselves been only slightly modified by contact with a different race.

The two districts are separated by a river, on one side of which the physical characters and language of the people are English, on the other Welsh.

There were still earlier the Norse and Baltic rovers landing here and there all round the coast and perhaps holding some of the earthworks still conspicuous on the promontories round the coast of Wales as elsewhere; small entrenched positions which a few men could easily defend.

There were the pre-Norman English usually spoken of as Saxons along their eastern frontier, and before them the Romans advancing from Deva on the north, and from Isca Silurum on the south, and sometimes penetrating far along the principal valleys and trade routes. All this pressure must have caused a great shifting of the relations between the tribes who occupied that little mountain land and have resulted in great mixture of blood along the borders.

The Norsemen and Baltic race have certainly left traces round the coast in the strong square-shouldered, sandy-haired, grey-eyed men who are so common in our seaports, and have perhaps had much to do with the formation of the hardy sailors whose courage and seamanship are kept alive and quickened by the rough seas and rocky coast on which they pass their lives from their youth up. They belong to the race that was developed in the Baltic and along the adjoining coasts, and which forms the backbone of our navy and mercantile marine.

I do not know whether we shall ever be able to recognise, among the men who live along the borders or anywhere in Wales, traces of the Romans or of the various foreign nationalities the Romans sent as soldiers into Britain. It is difficult to know what to look for in most cases: Italians, Asturians, or Huns, or what not. Sometimes, but rarely, inscriptions and history help with a note on this point.

But I think we do see in the racial peculiarities of some of the geographically defined districts of Wales sufficiently marked characters to suggest a community of origin and some long-continued isolation from the people of other more or less disconnected areas.

For instance, in the valleys and mountains of South Wales and from them largely gathered into "the Works," *i.e.*, the great centres of coal and iron manufacture, we all know a short, dark, active race, with straight features, small mouths, wavy or slightly curly dark hair, and large brown eyes.

North and west of these there is a race of large, dark, but florid complexioned men, with high cheek bones, large mouths and teeth, and small dark bright eyes, straight nose, and straight hair growing down over the forehead. We recognise in "The Cardy" a distinct type of feature and of character. It is among them that we have always found the greatest intellectual activity. They have been the first to encourage higher education, and have the reputation of being the shrewdest men of business. They belong to a type which most Welshmen think they recognise at once.

It is said that in ancient times there were two tribes in the south of Wales, occupying at first, of course, a wider area than that into which they were driven by invaders from Roman, Old English, and feudal England, but holding their own in the mountainous districts of the interior through all historic time. These were the Demetæ on the west and on the east the powerful Silures, who had to bear the brunt of every advance from the south-east. Each of these had probably in succession been driven west from the south and east of Britain, but when and by whom we shall probably never know, and how they were originally made up there is at present no evidence to show.

Those who were pushed furthest west were probably the first comers.

There is another type to be found chiefly in North Pembrokeshire and South Cardiganshire and extending far into Carmarthenshire. These folk have prominent features, soft light brown, but not flaxen, wavy hair, grey-blue eyes, good stature and carriage. These would be claimed by some as the true Celts; but as everyone seems to define that term for himself, I have avoided the use of it except for a linguistic group, which includes all these various races whose diversity of origin I am insisting upon.

Judging by their physical characters only I should be inclined to refer these grey, fair people to a cross between some native dark race and a seacoast people probably of Scandinavian origin.

Another race we all know in Wales: the short, swarthy, wiry men of Snowdonia, with piercing dark eyes, curly dark hair, small clear-cut, often slightly aquiline, nose. These people are never florid, never fat. On old maps you will find their country marked *Heriri Montes;* we call them "*Gwyr Eryri.*" If we enquire what tribes in ancient times lived in that part of Wales we find that here we are in the heart of the mountain fastnesses of the Ordovices, that powerful race against whom in the north, as against the Silures in the south, the waves of Roman and of Saxon invasion again and again broke in vain. The Ordovices had been forced back from the banks of the Dee and the Clwyd as the Silures had been driven from the Severn and the Wye; but they were never exterminated, and in all probability we have, in the competition between the Cor Eryri and the champion choir of South Wales, a renewal of the struggles between the Ordovices and Silures carried on through long ages before the Romans ever set foot upon our shores.

There was another race along the north-west coast of Wales, as we know from history, archæology, place-names and tradition, but of this I cannot say that I can detect any traces at the present time among the people. They have been either extirpated or absorbed in the various new-comers along the coast, of whom I have made mention. The geography of ancient history is very obscure, and on this point I will do no more than refer to the ancient maps on which, as the outcome of impression after reading ancient history, a tribe has been located, to which by some the name Cangi has been assigned, but I cannot say much more for it than that it seems to be a word unappropriated elsewhere on good evidence and remaining to be applied when a name was wanted.

Tradition helps us to assure ourselves that there was some tribe there independent of the Ordovices. I remember many years ago telling Sir Lewis Morris one story of this region which he said he had never heard before and which he has since enshrined in song.

The men of Ardudwy, in the days when marriage by capture prevailed, made a raid into the country of the tribe which lived to the north and carried off each man a maiden. Wedding ceremonies recalling the old custom of marriage by capture were kept up in Wales till quite recently. I have myself seen them in Cardiganshire. The return march was necessarily slower, and they were overtaken at the foot of the crags, perhaps as they were making for Drws Ardudwy or the pass into the mountains along the line of Sarn Helen between the Manods and Migneint.

There was not a moment to be lost. The maidens were placed between the crags and the lake, and the men of Ardudwy drew themselves up in front and fought and fell to the last man. The maidens, no unwilling captives, seeing their lovers fall, threw themselves into the lake, hence called to this day Llyn y morwynion (The Maidens' Lake), while their lovers repose beside it under the tumuli known as Beddau gwyr Ardudwy (the graves of the men of Ardudwy). The word Ardudwy is not unlike Ordowic.

I will not, however, criticise the story further, but only pick out from it the tradition that another tribe lived in touch with the Ordovices on the north; and next appeal to Archæology. As I was once wandering along the coast of Anglesea I saw a line of stones evenly laid in the cliff and covered by a heavy surface soil, and that by blown sand. I recognised the floor of one of the old Cyttiau'r Gwyddelod (the cots of the Gwyddel) like those which I had in other localities near helped to explore with General Pitt-Rivers, and which have been described by Mr. Stanley of Penrhos. The sea was cutting back the cliff and exposing the whole section. Below on the beach was the handmill, just dropped from its place on the floor of the house above. But here was a measure of its antiquity. The floor was covered deep by the surface soil; the soil was overblown by sand, which could only have been carried there before the sea had removed the long slope up which it travelled; and there was the high cliff, a measure of the work the sea had had to do. Besides this there was the previously discovered evidence of stone implements in similar cyttiau on the mainland or in Anglesea.

So here we had tradition applying the name of Gwyddelod to the people who lived north of the Ordovices in the age when polished stone implements were used in Wales, and a confirmation of their great antiquity in the physical geography of the district.

All round the frontiers of the Ordovices the hilltops bristle with camps; the mound-graves of their buried warriors are not uncommon. The less perishable weapons and relics of their work turn up here and there all over the country, and above all there are the people, "an ancient race tenacious of its idiosyncrasies, and distinguishable by physical features as well as character." All these various facts as far as they go are fairly safe guides to the student of the story of the development of the people, and he may look with suspicion on the results of pedantic history which do not harmonise with the results thus obtained.

I have aimed at no complete sketch, but have tried to suggest some lines of enquiry along which we may reasonably hope to pick up some useful evidence as to early inhabitants of our island and the origin of the English race.

Around Scotland we find the Baltic and Norse and German types far more strongly developed, as that country lay much nearer the opposite shores from which they started.

In the Highlands we have dark races, but I cannot say whether they can be distinguished from one another as I have endeavoured to do in the case of the Welsh.

In Ireland there are also some dark people, especially in the south-west, but geographical features have not to the same extent helped to isolate varieties, and the waves of conquest were not determined by the same well-marked shore lines. Dublin was, and in the features of its inhabitants is seen to be still a Scandinavian city, while Norman names are common among the farmers of south central Ireland.

We will now try to trace to its source another race whose origin is still more obscure. For shortness I will speak of it as the red race, to distinguish it from the other two which I have been describing as fair and dark respectively.

If you were to start from Belfast, travel through Lowland Scotland or the North of England, on through North Germany or on either side of the Baltic, through Esthonia down the Volga—at any rate as far as Kasan and Samara,—you would meet with no people as dark as the little swarthy man of Eryri (Snowdon).

But if you were to start in the South of Ireland and travel through Central Wales, Glamorgan, Devon, Brittany, France, and along the Mediterranean to the countries bordering the Levant, you will find no people as fair as the Lowland Scot or Yorkshireman.

We get the impression that the characteristic colour of the Baltic race is fair and the characteristic colour of the Mediterranean race is dark, and we feel that our inferences are based on sufficiently wide observations to justify the generalization that all fair races are of northern and all dark races of southern origin.

Now among the various groups of dark people that we have been describing as occupying the mountains of Wales and Scotland there appear here and there sporadically, or endemically as we may say in individuals or families or hamlets, people with bright red hair, blue-grey eyes, a fair easily-freckled complexion, and generally a tendency to stoutness. Theirs is not the sandy red, brown, and yellow hair of the Baltic race which I have already described as occupying nearly all the coast of the British Isles, but bright unshaded red. This bright red hair is sometimes seen among the sandy red people of the Baltic race also, but it is more conspicuous by the contrast when it occurs among the dark races. So common was this type in one village in Carmarthenshire that the people were spoken of as Cochion Caio (the red folk of Caio), from the name of the village. This seems to be a reversion to a very ancient ancestral form. It is seen also among the people of Central Wales south of Snowdonia.

If we try to trace these red folk along the Baltic we find beyond its eastern end the Votiaks, a race perhaps from northern Asia, who are said to be the most red-headed people in the world.* These may account for the reddest red strain among the people whom we refer to the mixed Baltic or fair race.

But the red race appears also sporadically among the dark people of Wales. Now, there is nothing in the climate of Wales to turn fair people into dark; that must have been done in some southern clime. We must therefore bring the dark races along the southern route from southern or Mediterranean regions. If, then, we find this reversion to an ancient red race occurring sporadically among them, shall we infer that the red folk were here first and were absorbed by the dark races, or that the red folk came after the dark and were merged in the numerically, or otherwise stronger, dark people, or that the dark people arrived with this red strain in their blood, which by reversion still appears in their offspring? Without going far into the question I favour this last view, but it involves an enquiry into the probability of finding any red race in the southern or Mediterranean area: perhaps along the line of migration of the builders of megalithic monuments we may expect to find traces of them.

In North Africa, among the Libyans, there are such red people; among the Arabs east of the Red Sea there is a tribe of them; following the evidence back into far

* Latham, R. G. *The Native Races of the Russian Empire.* Lond. Baillière, 1854, p. 53.

antiquity the Amorites are said to have been of the same type*; and to what is the fashion of staining the beard bright red, which I saw in the region between the Black Sea and the Caspian, due if not to the tradition of that being the aristocratic colour, as auburn hair was adopted out of homage to Queen Elizabeth and in the present century flaxen hair was produced artificially out of homage to Fashion?

May we speculate upon these red people having all had a common origin in Northern Asia, from which they travelled west to the Baltic, and south-west to the Mediterranean, and by their great prepotency of transmission reached the British Isles in two distinct streams: one in the blood of the Baltic people and the other in the blood of the dark Mediterranean race?

In all these enquiries I have confined myself to observation of the softer parts—of the hair and eyes and skin, and not of the bony structure, except so far as it affects stature and obvious features. There is much to support the view that the skin and flesh are less changeable than the bone. On Egyptian monuments Negroes and other races are depicted so that it is easy to recognise them by the character of nose and lip, and skin and flesh.

Animals grown on richer soil than that which is their usual habitat often become larger, but in almost every other character remain the same. The red deer dug up in the peat mosses and rich alluvial plains of the south are much larger in the bone than any now seen in the Scotch forests; and the type of the Kerry cow cannot be maintained on the rich pastures of England. A clearer example for our purpose is furnished by the manner in which the horns were got rid of in the black cattle of Southern Scotland. I heard Lord Selkirk give an account of how it was brought about. A little more money was given for the polled Angus or Galloway, until by selection the horn core, which is a development of the bone, was got rid of, and the horn, which is a development of the skin, hung loose beside the animal's head, there being no bone to support it. At last both were got rid of altogether in about 50 years. We see in this case that the bone changed more readily than the softer parts. Craniology has, of course, its own proper place; but this method of distinguishing race by observation of the colour, the hair, the skin and flesh, rests on the more stable elements.

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* Sayce.

Happy comment on the saying "Beauty is only skin deep, but ugliness goes to the bone," for thus beauty lasts the longer.

Nationality.

Nationality is a stage in the formation of a unit of grouped human lives which have, in accordance with their environment, developed characters of greater or less persistency.

It is said that in the Austrian Parliament, when a motion involving different legislation for different parts of the Empire was being urged on the ground of their distinct racial characteristics, a member opened his speech on the other side with the remark that the question before them really was whether Darwinism was true or not. He went on to say that if the truth of that theory were admitted they should legislate for a better state of things, and trust that the progressive development of the people would adapt their habits of thought to the conditions under which they had to live.

Nationality is quite independent of racial unity. Loyalty and impulsive patriotism may be developed in a nation made up of the most heterogeneous races, and characters fostered by local circumstances may develop into strong idiosyncracies.

In consequence of this confusion between *national* and *racial* we have of late years often heard the demand for independent administration of local affairs urged on the ground of difference of racial character where what was really meant was that difference in habits of thought, which is produced by external circumstances and isolation, had brought about such a difference in the way of looking at things that the whole population of a district had begun to believe that they could not live exactly in the same way as their neighbours, and referring to temperament what was due to habit have considered it wise to perpetuate their isolation.

Nations are formed of groups brought together by various circumstances, among which racial affinities play only a small subordinate part.

The British nation is made up of the jetsam and flotsam thrown up by the waves of migration that have for ages been breaking on our shores. At one time we have great pieces from the wreck of Empires which the storms of war have broken up and stranded on the beach; at other times the smaller fragments which the gentle ripple of the every-day rising and falling tide of commerce has gathered in our bays and estuaries. The foolish cry of agitators, "Give us something different, for we are of more tender kind than our neighbours," gains no support from such enquiries as we have been carrying on to-night. There is no single race in England, in Wales, in Scotland, and least of all in Ireland; and the reasons given for separate legislation are worth no more than those given by the O'Gradys, who would not be beholden to Noah for a place in the Ark but had a boat of their own. Let those who cannot sail in the good old British barque go to the bottom!

There are different races in the British Isles, but they are not conterminous with any seaboard or any mountain ranges or counties or groups of counties. The combination is now more chemical than mechanical, and the mixture is so intimate that to separate out the different stocks is now impossible. But it is a mixture of which we may well be proud, and which we should not try to break up into its components, but by all means in our power endeavour to weld into something ever stronger and truer.

The CHAIRMAN (Professor E. HULL, LL.D., F.R.S.).—I am sure all present desire to accord Professor McKenny Hughes their best thanks for this admirable paper (cheers). Having a pressing engagement I will ask Captain Heath to take the chair.

The chair was then taken by Captain HEATH, R.N.

The HONORARY SECRETARY (Captain FRANCIS PETRIE, F.G.S.).—May I mention that one of our members from America, the Bishop of Minnesota, is present. This is his first visit to the Institute, and I am sure all present will desire to hear his views upon this subject.

The BISHOP OF MINNESOTA.—Mr. Chairman, ladies and gentlemen, it is a very great pleasure for me to be present at this meeting, for although I have been one of your members for many years and have taken very great delight in reading all the papers that are published by the Institute, this is the first time I have had the pleasure of being present.

I do not know that I can add anything to the paper, which has interested me profoundly; but perhaps it may interest some of the members of the Institute if I mention a few facts in reference to the North American Indians with whom I have been somewhat closely connected for the last forty years, as Bishop of the Diocese of Minnesota. These Indians are to be found in all parts of the United States. All the Indians, from the Atlantic to the western part of Minnesota beyond Lake Superior, with one exception, belong to one great family (*Algonquins*), and it was for them that Elliot published his Bible. It has always been a great pleasure to me that the Indians amongst whom we have had missions which have been marvellously blessed are the same Indians for whom Elliot laboured. The Rev. Dr. Hale, a clergyman of Boston, sent me a little while ago two chapters of Elliot's Bible, without indicating the source from which he took them. I sent them to our chief missionary and he sent back the translation showing that these Indians speak the same language. There is, however, a slight difference. His language is a marvel. There are more than twenty times the inflections in the verb than are to be found in the Greek. If an Indian said to you "I love," and stopped, you could tell, by the inflection of the verb, whether he loved an animate or inanimate thing, and whether he loved the thing or the quality of the thing.

He has some remarkable customs that would point back to a higher state of civilization and a greater knowledge of God. He has not the slightest doubt of the existence of a Great Spirit. In one respect his theology is a very good theology, viz.—that the Great Spirit never harmed anybody, and that when one is harmed it is because one has fallen into the hands of the devil. Everything that he cannot understand he attributes to a spiritual influence. When he first saw the telegraph he said a spirit ran on the wire and carried the message. He has a passionate love for his people—he would lay down his life without the trembling of a nerve for those he loves. He is always truthful. I have never known, during the forty years that I have been amongst them, an Indian to tell me a lie. I heard an officer of the United States Army say in a public address, "I have lived with the worst and most warlike Indians in this country for twenty-one years. Half the time I have been hunting them; and the other half they have been hunting me, and I never knew an Indian to tell a lie, unless under the influence of drink. I have now charge of

500 Indians, and one of the things I would punish most severely would be intoxication. If an Indian is accused of having been drunk I send for him and ask him if he was drunk, and if he says 'No' I never ask him another question; but very likely if he drank at all he would say, 'I do not know if I was drunk, but ask that Indian and he will tell you.'"

His hospitality is extended to his worst enemy, who if he came to his house would be treated well, while the old hatred would come back if he met him elsewhere.

Then he always offered his first-fruits—the first-fruits of the hunt. Ask an Indian what he means by the act and he says, "We give these for the Great Spirit." So there are certain customs that appertain to their family religion, and in that they are so like those to be found in the Old Testament, that I recollect one of my first converts, who afterwards became a clergyman—when he read the Litany in which he asked God to forgive the sins of our fathers, tears came into his eyes—he believed so strongly that he belonged to that race.

I have listened to this lecture with great delight, but I came to listen and not to make a speech.

Mr. D. Howard, V.P.C.S.—I must say it is exceedingly interesting to hear such an admirable sketch of unmixed races in contrast to the extremely mixed races of Europe.

The idea of nationality is very curious. The late Professor Freeman expressed opinions about the French nation which were not exactly what one would venture to express in France; but certainly it was strictly to the point, that there was no French nation. We find remarkable instances of the survival of type. The most striking thing is the survival of the smaller isolated groups of some races and the extraordinary mixture in others. One of the most extraordinary things in regard to race is that we speak of the Norman as of Scandinavian origin; and yet we find the Norman race, as far as appearance and language go, is distinct from the Danes, who are nearly related to them as far as their fathers are concerned. Here you have one race kept pure and another race which evidently did not bring their wives with them, but intermarried with Latin-speaking mothers and made the Norman race; whereas the Danes probably, when they came from their homes, brought their wives with them, and you get the true Danish type in many villages on the coast of Scotland, and in some places on the coast of England of a more Danish type than on the Danish coast itself. The reversion to type is very extraordinary. That is rather a complex question. It is a most interesting subject to which the paper is a very valuable contribution.

Mr. Martin Rouse.—Might I say that it seems to me that there are, amongst United States Americans of European descent, many men of a Red Indian type. It may be only a casual observation; but it seems to me that our American brothers are approaching Red Indians in having less hair on their faces than the English. The Indians are remarkable all over the Continent for having very little hair on their faces. As a rule they have scarcely any; and I think it is a fact that the Americans of the United States have also very little hair on their faces compared with their kinsmen in this country. They are also taller with higher cheek-bones, and aquiline noses.

The Bishop of Minnesota.—As to our North American Indians, it might be interesting to know that all the Northern Indians are men of great stature and are marvellously well built. It is also true that all Indians found in the extreme south are men of comparatively short stature; and the same thing holds with regard to Alaska, for these Indians are also of small stature.

As to hair—if any men in the world have marvellous heads of hair it is the North American Indians. I attribute it to the fact that the head is always uncovered. They pride themselves upon their heads of hair.

I may also add a very gratifying fact in connection with the Indian tribes in the United States. According to the last census there had been an increase of 300 persons, and in that year the Indians had sold to the United States Government a million dollars' worth of produce.

[The Bishop here left the meeting, having to meet an engagement.]*

The Author.—I was much pleased to hear the remarks of the Bishop of Minnesota, because one of the conclusions at which I had arrived from the characters which I had the opportunity of

* The Bishop says in a letter, "Our friend is quite right in his idea that the characteristics of the North American Indian show a noble ancestry. His bravery, hospitality, love of kindred, truthfulness, not less than the structure of his language, show this. All this is emphasized by his religious customs and his traditions."

observing or forming an opinion about from the observations of others, as well as from more general considerations, was that the North American Indians did not represent a stage in the upward progress of a race from savagery, but that they belonged to a very high type of humanity which had somehow been cut off from the opportunities and appliances of civilization, and had had a hard struggle for existence against the forces of nature.

Mr. Howard has referred to some very good examples of the formation of a race, mixed in its origin, but attaining to characters in common from the blending of the original elements, and isolation from any further strong admixture. Mr. Rouse has emphasized my remarks on the modern American type, which seems to approach that of the North American Indian; but in all these tentative suggestions and speculative ideas we must bear in mind that, owing to the enormous influx of Scandinavians and Germans, America is in the main only carrying on and reproducing the same mixture as that from which in past ages the English race sprang. The point of my paper was that, tracing back the history of the British race as far as we can, we learn that it has been formed by the successive introduction of many different elements, and that the result of this mixture is seen in existing characteristics of appearance and disposition which have become more or less stereotyped; but that the elements, when they can be discriminated, or the blend, when it can be defined, may be regarded as marking a race, as distinguished from a nation which is only held together by the artificial bonds of government; and that the indications of racial characters obtained by observation of the colour, physiognomy, etc., of the people we meet in the world, offer valuable and interesting matter for study.

With regard to the suggestion that there may be a physiological explanation of the origin of the red hair, I suppose we must accept that as in a sense true not only for the red hair, but also for the dark colour of the skin, it is the province of the physiologist to investigate those subtle changes in the pigments to which the colours of the hair and skin are due, but I hardly think that we can refer the sporadic occurrence of red people among dark, or dark among fair, to any direct and exceptional influence of a physiological kind brought to bear upon the individuals affected. These appearances require for their explanation the consideration of the laws which govern prepotency of transmission, reversion of type and so on.

Mr. HOWARD.—I meant that they were superior.

The AUTHOR.—That may be, but I do not see how we can prove which were originally superior. Sometimes you can find reason for inferring that a race was red. The Ammorites were red, were they not?

Then with regard to the ruling races of classic story being either dark or fair. Professor Westlake, one of our most distinguished scholars, I see is present, and I daresay he would answer that.

Professor WESTLAKE.—I should be inclined to think they were fair.

The AUTHOR.—I have only tried to trace the fair races to the Baltic, the red races to Asia, and the dark races to the mixed people of the Mediterranean coast.

The Meeting was then adjourned.

COMMUNICATIONS RECEIVED IN REGARD TO THE FOREGOING PAPER.

Canon ISAAC TAYLOR, D.D., writes :—

I am much obliged by your sending the proof of Professor Hughes's paper, the discussion on which can hardly fail to be of interest.

If health permitted I would gladly come up to take part in it.

I agree with him so far as he goes, but belonging to the school of Broca, I believe that language and colour are less persistent racial characters than the *orbital* and cranial indices or the section of the hair, which is circular in races coming from the east and flat in those from the south.

Colonel C. R. CONDER, R.E., D.C.L., writes :—

Agreeing cordially with the general results of this paper, I venture to make a few remarks, due to personal knowledge of various nationalities and study of their histories. It is almost impossible to find, even as early as 3000 B.C., either a pure race or a pure language. The Babylonians intermarried with Mongol Akkadians, and borrowed words of their language. In the fifth century B.C. it is proved that Persians and Babylonians intermarried. The Egyptians early intermarried with both Semitic and Mongol tribes, and with Nubians also. Their language shows these influences. The Latins in Italy were mingled, in the same way, with non-Aryan Etruscans, who appear to have been Mongols.

I do not understand how it is possible to speak of a "Mediterranean race." In Asia Minor the population, from an early age, was a mixture of Greeks, Phrygian Aryans from Europe (from whom Armenians are mainly descended), Medes and Persians (including the Lycians), and Turks, preceded by Mongol Akkadians and Hittites.* In Palestine the populations were mainly Semitic. In North Africa we have Berber races, closely connected with the ancient Egyptians, and an infusion of Celtic Aryans (White Libyans) with the later Aryan Vandals, as well as the Semitic Phœnicians and Arabs. In Italy the Neapolitan type (with which I am familiar) appears to be a mixture of Latin Aryans with Greeks and Arabs (possibly also Phœnicians), and the language contains Arab and Greek words to the present day. The Portuguese type also owes much to the Moors—a mixture of Arabs and Berbers. The fine Tuscan type still represents the mixture of Latins with Etruscans; and the *folletti* or fairies of Etruria still retain the names, not of Latin, but of Etruscan deities.

In all cases that I have been able to trace, the physical resemblances are due, not to the effect of climate, but to intermarriage, and this I believe is true in America also. The effect of temperature on colour is on the other hand sufficiently evident.

The distinction between the purer Slav and the Tartar Russian is very evident in a Russian crowd. The Finns speak a Mongo language, but one full of Aryan loan words, and they seem to be a mixed Slavo-Mongol race. The Basque dialects are grammatically nearest to the Finnic language, and the vocabulary is mainly of this class, but is also full of Latin words. The Basque type in the same way appears to have been Aryanised.

That the early Greeks were a people with auburn hair and blue or green eyes, seems to me proved, not only by the early statues

* There was also a Semitic population in Cilicia speaking a language like the Assyrian about 1500 B.C., and the coin of Baal Tars at Tarsus indicates Phœnicians in this same region at a later period. The Carians appear to have been Aryan in the fourth century B.C., but some Carian and Lydian words were apparently Mongolic.

mentioned, but by the Egyptian pictures of Greeks and Ionians, with blue eyes and light hair, as early as 1300 B.C. The home of the race seems to have been on the Volga, and the red-haired Alans, from the north of the Caucasus, appear to have presented the same type. Linguistically the Greek and Latin languages are nearest akin to the Celtic.

It is often said that language and race have little or no connection; yet to the present day, broadly speaking, the various stocks (as far as they are distinguishable) speak the same language that they used when history opens. It seems that the prevailing tongue is that of the majority of any population, and that culture words are furnished by whatever element in that population is most cultured.

The Danes appear to have been specially fond of islands, and the type of islanders often differs greatly, on our coasts, from that of their neighbours on the main land. The Danish type may be observed in the islands on the west coast of Ireland—as I have personally observed—and the Portland islanders are mainly Danes, as contrasted with the Dorset Saxons. I have been equally struck with the difference between the latter (who resemble the Dutch), and the red-haired, brown-eyed type prevalent in Devonshire and Cornwall. Having travelled over the greater part of Ireland, I was surprised to find how mixed was the population, even in the far west—Saxons, Dutch, Walloons, and other Teutons, being distinguishable, with the two Celtic types: one black-haired, pale, and with blue eyes, especially in Mayo, where they often speak Irish only: the other, red-haired with blue eyes. In Kerry there is an admixture of Spanish blood, dating from the sixteenth century A.D., and, in the north, of Teutonic from the Scottish Lowlands.

One of the most marked features of the Scandinavian, as contrasted with the Lettish and Teutonic types, appears to be the long flat skull, which was found among Normans (as in the case of Robert Bruce), and among the prehistoric inhabitants of the Channel Islands, as I ascertained in Guernsey in 1890.

I venture to think that the prevalence of "marriage by capture" has been somewhat exaggerated. I have studied customs among Arabs which would usually be ascribed to such an origin, but have found that the repulse of the bridegroom was generally ascribed to certain ideas of modesty on the part of the women.

There is not, I think, any reliable evidence that the Amorites were red-haired. There has been some confusion as to the monumental evidence in this case, but it is well known that they spoke a Semitic language, and they are represented as very like the Assyrians, in both type and complexion, on some bas-reliefs.

The ordinary Semitic type is dark-haired, dark-eyed, and olive-skinned; but it is not uncommon among the Semitic peasantry of Palestine to find auburn hair with brown eyes, as among the Samaritans also, and the Spanish Jews. Blue eyes are very rare, and regarded as unlucky. They may, I believe, generally be traced to intermarriage with Europeans in Syria. There is no sound reason for supposing that the ancient inhabitants were blue-eyed. The Metâwileh and Druzes have often blue eyes, but they are of Persian origin, and this peculiarity may be traced to the Eastern Aryans, as also among the Kurds.

Generally speaking, it appears to me that the division of races by language is the safest that can be adopted, under the complicated conditions due to early and frequent intermarriage of the various stocks. In this sense the Europeans (Scandinavian, Celtic, Teutonic, Latin, and Slav) are properly called Aryans, while the existence of an earlier Finnic population is indicated, not only by the prehistoric remains, but by the existence of the Basque and Etruscan languages. In Russia, however, the Ugric, Finnic, and Tartar tribes retain their Mongol dialects—though extensively Aryanised, while the Huns and Magyars in Hungary survive from the great inroads under Attila, and by the later Turks and Mongols.

THE AUTHOR'S FINAL REPLY.

Canon Isaac Taylor is of opinion that language and colour are less persistent racial characters than the form of the bones or of the hair, but I am sure that he fully recognises the value of the indications derived from the colour of the hair and skin, and of what I lay great stress upon in this paper, the form of the softer parts such as the lips, nose, and flesh generally.

Colonel Conder has very clearly stated my contention that it is impossible to find a pure race or a pure language. I was referring chiefly to the inhabitants of the British Isles. He carries back the enquiry and arrives at the same conclusion in regard to all the historic races of antiquity.

In "Mediterranean race" and "Baltic race," I was only using a short expression by which to refer to the people, whose existence Colonel Conder seems to recognise, namely, the ever-shifting seafaring population of the shores of those seas, which has resulted in a mixed race, sometimes derived more from one, sometimes more from another source, but having now many traits in common along the whole seaboard; and indeed having more in common with one another than with any single people from whom they were derived.

ORDINARY MEETING.*

CAPTAIN G. P. HEATH, R.N., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed, and the following paper was read by Dr. Walter Kidd in the absence of the Author :—

MARKS OF MIND IN NATURE. By Rev. Professor J. DUNS, D.D., F.R.S.E. (Hon. Cor. Member of the Victoria Institute).

WHEN, at the request of your Honorary Secretary, I agreed to write a paper under the title "Marks of Mind in Nature," the history of the scientific and literary contributions in kindred lines of thought was not forgotten. I remembered the days of old and the efforts of devout and thoughtful men to utilise the science of their day, in giving prominence to the evidences of "Creative Mind in Nature." We are indebted to the institution of the *Boyle Lectureship*, towards the close of the seventeenth century, for this movement. Bishop Burnet spoke of Boyle as "a man who never mentioned the name of God without a pause and a visible stop in his discourse." Among the early lecturers were Rev. John Ray and Rev. W. Derham, who were both Fellows of the Royal Society. Ray's contributions to science were many and of great value. His book on *The Wisdom of God manifested in the Works of Creation*, was published in 1691. Derham was Rector of Upminster, Essex. His *Physico-Theology, or a Demonstration of the Being and Attributes of God from His Works of Creation*, was the substance of

* March 20th, 1899.

sixteen sermons delivered as Boyle Lectures, and published in 1711 and 1712. These books were early, if not the earliest, British contributions to the literature of natural theology. They were the forerunners of, and the introduction to, the *Bridgwater Treatises* (1825) *on the power, wisdom, and goodness of God as manifested in Creation.* Among the authors of the Treatises were Dr. Chalmers, Dr. Buckland, Dr. Whewell, and Sir Charles Bell. Outside of the Bridgwater group the names of Paley and Bishop Butler may be mentioned. To them and others we are indebted for works teeming with facts illustrative of creative self-manifestation. But notwithstanding the amount and value of these contributions, much remains to be done in the departments suggested by the names now mentioned, and there is abundant room for many workers. Points of view have changed. The natural sciences have brought to light facts and phenomena unthought of twenty years ago. Materials for review and criticism have greatly increased, and the question is asked, has the recognition of marks of mind in nature kept pace with the discoveries of science? Looking back to the times of Boyle, and Ray, and Derham, the opposition to the doctrine of creation found its chief strength and expression among those who were equally opposed to the Christian doctrine of redemption. Is it so still? A straightforward answer to this question is delayed at present. But that the attitude of an influential group of men of science to the doctrines of the existence of God and of a future life* has recently become more hostile than at any other period, few, if any, thoughtful men will deny. In Britain, no doubt, the group is comparatively small, but what it wants in numbers is counterbalanced by ability in the various branches of natural philosophy and natural science. The mere fact of the existence of such a company has a hurtful influence. It shakes the ground on which those stand whose religious knowledge is much greater than their religious convictions. Assuming that the conditions of thought now referred to exist, how are they to be met? Not, certainly, by that mere and bare dogmatical antimaterialism which shirks argument and denounces claims made in behalf of freedom of research and of speech. Not thus, but by a full and dispassionate

* This modification (suggested by the President) was accepted by Dr. Duns in letter dated March 23rd, 1899.

statement of the opposite truth, by heartily according to others the liberty of thought and expression which we claim for ourselves, by affirming without reserve that we will welcome truth, come how it may and whence it may, and that the only limits of freedom we will recognise are those which the truth itself determines. This attitude to free inquiry is sacred in every department of science; in biology, especially, the least indication of forgetting it is to be resisted, because in it we have to deal with many legitimate, though speculative, questions, and to handle many facts whose significance may vary—often does vary—as the relations in which they stand, and as the mental qualities of those who appeal to them. In these, indeed, the student finds what gives to enquiry its strongest attractions. Every fact has its own meaning—a meaning which time cannot destroy and which mental bias cannot vitiate. To reveal this, to set it in its own place as beyond challenge, as an established truth, in a word as science, becomes a substantial contribution to the sum of our abiding knowledge. Slowly but surely this has been going on whenever and wherever the true students of nature have worked with right motive and in legitimate lines—avoiding generalisations whose data are partly speculative and partly real, and rejecting the reasoning which claims for notions touching changeful phenomena the value of established principles, or, even, the weight and dignity of natural law.

"What dazzles for the moment spends its spirit."

It is alleged that *all* the tendencies of recent Biology are toward materialism, indeed, that the well-marked trend of all highest thought is in that direction; that philosophy is slowly but surely undermining religion; that the pursuit of truth for truth's sake is disappearing from among men; and that the natural sciences are valued by the prevailing industrialism of the age, only so far as they can be helpful to money-making. These, however, are less than half truths, but even as such they claim attention, were it for no other motive than to encourage that great constituency whose vigorous and enlightened common sense keeps them clear of the wild assertions of "the new biology," the verbal mists of "the higher criticism," and of "godless materialism."

The object I have in view throughout this paper is to give prominence to biological facts and phenomena, which seem to me to warrant not only the postulation, but the absolute proof, of mind-marks in nature. Of purpose the teleological method is avoided, because both in Darwinism and in much recent physicism it is held that there are qualities in matter itself equal to do all that is implied in the well known *Doctrine of Final Causes.*

The scientific study of nature may be entered on and pursued from several different points of view and under the influence of different motives. Some, ignoring the question of origin, or having the conviction that it lies outside of the scope of science, content themselves with trying to add to man's knowledge of nature by simply recording the phenomena and the facts which fall under their observation. They are satisfied with, and find their reward in, the increase of scientific information. Seldom, however, are their labours more worthy of the name of science, than the labours associated with making a bare list of the names of the kings of a country are worthy to be called its history. Others, tracing phenomena to the action of a self-originated and self-guided something which they name natural law, hold it to be their duty to proclaim, that science can make no true progress till its students cease to burden themselves with the belief that thought underlies things, and that there is or ever can be a "knowable supernatural." They find in matter material energy—an inworking quality which, independently of non-material guidance, has realized all the, so-called, living forms which ever were, and which now are, on the earth or in the sea. But there is a third group of natural science students which consists of men who are not afraid to deal with the question of origin. It has been settled for them, and they are not only satisfied with this explanation, but throughout the studies of their life they find innumerable facts utterly unintelligible apart from it. What a noble band have worked from this point of view of origin,—Linnæus, Cuvier, Owen, and Agassiz; Kepler, Newton, Brewster, Clerk Maxwell, and Lord Kelvin! Their followers, even at a great distance, work under the impression that the facts and phenomena of natural and physical sciences are but as the steps of a ladder planted on earth but reaching into the presence of Him Who has made all, Who is in all, and over all, "for without Him was not anything made that was made." Thus in the wide fields of Nature—in the Animal and the Plant Kingdoms—every fact touching form, and structure, and habit, and environments is literally laden with meaning. We see not things only, but we meet everywhere illustrations of thought and forethought; in a word we meet with "Mind manifested in Nature."

To neutralize the influence of this third group of students on public thought—on the common sense constituency to which ultimately all science has to appeal—a change of front has been taken by the second group referred to. With them the question is not "are marks of MIND manifested in NATURE?" It is the revival of a question put long, long ago—"Is not LIFE a quality of MATTER?" The answer on their part is affirmative, and earnest efforts are put forth to make it good. Now, while it would be vain to imagine that aught save very scant justice can be done to the subject suggested in the title of this paper and within its limits, there are topics touching which some critical remarks may not be out of place. It will prevent repetition if, from our chief point of view, we associate our remarks with the terms Nature, Organisation, Classification and Vitalism.

1. The widest meaning attached to the word Nature is—the whole external world without regard to origin or continuance. In theology it includes the whole external world as the outcome of creative acts, and as under unceasing supernatural upholding and guidance. Thoughtful men, however, cannot but be aware of the influence at present of symptoms of a return to the views of nature held by the ancient physicists—views which imply belief in the eternity of matter and the chance realization of organisms, plant and animal. The relevancy of this reference to the tendencies of some present science studies may be questioned, but, as we shall see, not its logic, when we weigh the argument touching vitalism. But what strikes one here is the effect on men of the phenomena which suggest that mind is manifested in nature. The character and power of this acknowledgment depends on, or is anticipated by, the intellectual condition and, to some extent, the physical environments of those who make it. Take, for example, the history of religious thought apart altogether from Revelation. There are proofs of order in nature, but order implies intelligence, and intelligence personality. A wide and intensely interesting subject opens before us here. Early in the history of the world the discovery of aspects in nature which were suggestive of mind, and of personality, led to those immense systems of religion which not only had their day but which were characterised by features whose traces

are felt even in our own time. The earliest and purest of them was Monotheism—God over nature and nature from God. Radically different from this was Pantheism—God in nature and all nature God. And Polytheism—single powers of nature as personified in individual men. These systems are not dead but they are passing away. What is to occupy their ground? Is science saying "there is no God"? or is it willing to admit that its findings warrant the upward look and the desire to join with the noblest of its students in the words—"Lord, Thou art God, which hast made heaven, and earth, and sea and all that in them is'"? Till now the best and the greatest scientific workers have rejoiced in this revelation. They see in all their studies evidences of mind in nature which they cannot ignore, and the words quoted strengthen the conviction that they are there by creative gift and as the expression of creative thought: "Ask now the beasts and they will teach thee; and the fowls of the air and they shall tell thee; and the fishes of the sea shall declare unto thee."

2. Organisation. Take a lump of formless, unmarked, plastic clay firmly into the hand and then examine it. What are those fine, curiously arranged lines on its surface? They are marks of the striæ on the human hand and they thus at once suggest personality—brain, heart, and thought power. Now place *amœba* under a good lens. It looks, at first sight, as if it were only a lifeless gelatinous speck, but it begins to move, by pushing out part of its body. Prepare it for the microscope, and it will be found to be an aggregation of cells, each one of which suggests well marked parts—cell membrane, cell protoplasm, nuclear membrane, nuclear protoplasm, and nuclear coils (chromatin). If the striæ marks on the clay led us to believe that it had been in a human hand, what cause have we to doubt the proofs of creative touch on *amœba*—a touch which determined the permanence of its specific marks throughout the ages? The workman's touch could give the striæ marks but could not give life. God alone could do that, and the simplest of living forms is the proof that He did it. From this point of view, we get a glimpse of the beginning of organisation.

Matter may either be looked at as in the mass, or as specialised. The latter is living, the former is dead; the latter has structural parts or organs; the former is destitute of these; the latter grows by the assimilation of food in digestive organs; the former is enlarged by mere aggregations of particles. It may please eager, "new biologists" to point with a smile to mineral composition and ask, "Have you not here an agent of increase if not identical at least very like what you call living growth"? Intelligent common sense may be safely left to ask in return, "How do you account for the existence of the agent of increase as the explanation of growth in organised bodies, and of bulk in unorganised bodies?" It is easy to say, "We trace both to the natural properties of things." "The organic and the inorganic are the outcome of the inherent properties—the laws of their being, in short. Organisation then implies the action of law. But does not law, both in it and in its continuance imply personality? Mechanism the fruit of unguided natural properties is absurd. This sort of science sheds no light on "being" whether we call it living or dead, organic or inorganic. There is another question which the mechanical "natural properties of things—theorists" cannot away with, namely, *whence* the properties which give organisms? Such theorising is not science, because science is truth, it is the truth of things. It refuses no student the liberty of research, but it dreads guess-work. Thus it is literally *mind-full.* "Science," says Dr. L. A. Dorner, "may go astray and so do harm. But if it could not do this neither could it be of any real service; it would not be free, and would consequently be unable to be truly productive, while it would fail to make a deep impression, or awaken any confidence since it would merely work, as it were, to order." True, that is truth seeking, workers rejoice in liberty of research, but keep clear of speculative licence. They have no sympathy with workers who find organisation to be the mere outcome of qualities characteristic of all matter—men in many cases we might say:—

"Thirsting for Truth, but wretchedly in Error."

3. Classification. When in Dresden at the opening of the Franco-German War, and chancing to pass across the magnificent bridge which unites the two parts of the city—Altstadt and Neustadt—I noticed a large building, evidently run up in haste, near the bank of the Elbe. Thither waggons heavily laden with war materials of different sorts—swords, bayonets, rifles, horse-trappings, and the like—found their way. These as they arrived were passed into the building without selection and regard for order. But from another part of the same structure, and at the other side, waggons

were passing away as heavily laden. Now, however, everything was suggestive of order. The articles had been in the hands of men employed on purpose to select, classify, and mark off, for despatch to the Rhine. Evidences of intelligence were clear in bringing like to like—swords were by themselves, rifles by themselves, and so with other forms. All were thus more readily available than they would have been had no distribution according to kind taken place. Now science has rendered a service analogous to this in connection with the phenomena and facts of Nature. Astronomy has done it for the heavens, by arranging the star worlds in groups for the purpose of study. Geology has done it for the earth's crust by arranging groups of strata in the order and sequence of superposition, giving us the geological record. Zoology does it for the animal kingdom and Botany does it for the vegetable kingdom. Classification is thus virtually the expression of the order which everywhere exists in Nature. What to the uneducated eye seems only an agglomeration of diversities becomes in the hands of the trained observer (say a zoologist) a series of groups, each group consisting of animals whose form and structure warrant their association, notwithstanding the fact that there are features in each group which are common to all. Huxley shrewdly characterised the method of study indicated here as the application of "trained common sense." And in the *Introduction to the Classification of Animals* (1869), he says: "Every animal has something in common with all its fellows; much with many of them; more with a few; and, usually, so much with several, that it differs little from them." There are then "gradations of likeness in animal structures." Systemists do not determine them. They only interpret them, and their interpretation is the testimony of experts to the presence of order, throughout all the differences manifest in animal groups. Were we to say "every species" instead of "every animal," this prevalence of order would even be more evident and suggestive. The very existence of species implies a history of orderly life steps, every one of which was as sharply defined, though immature, as their aggregate in the mature form. Without claiming for these assertions the value of logical inference, they at least entitle us to postulate (1) that every species holds something which is common to it with every other species. There is a common substance in which and through which what has ever been known as life acts. This brings together the simplest amœboid—a mere structureless, gelatinous, but vitalized speck—and the highest form of animal life, man. The so-called life in both, works in both, using what seems to be identical substance for the continuance of species, and the differentiation of individuals under species. (2) Every species holds what distinguishes it from every other species. To affirm that the highest animal holds something in which the lowest can have no part is self-evident, but it is not equally so to say that the lowest has what it cannot share with the highest. The element which, in the humblest *Foramenifer*, determines pattern, separates it not only from forms high in the zoological scale, but also from the comparatively low forms which are next to it in the scale. (3) One side of specific rank includes what an animal holds of matter disposed in it as in no other, a second what it holds of life under the same limitation, and a third what of psychical element thus regarded also. If the biologist confine himself to facts and to the thought underlying them, of which they are the expression, he will likely see the significance of these positions. In the noble words of a great systemist—"Classification is the rendering of creative thoughts into human language."

4. Vitalism. When Tyndall energetically expressed his indignation against the use of terms which seemed to cast doubts into the very heart of his most favourite theories, he might, perhaps, have found rest in the thoughts of Faust:—

> * * "I seek assistance.
> And thus the bitter task forego
> Of saying the things I do not know,—
> That I may detect the inmost force
> Which binds the world, and guides its course;
> Its germs, productive powers, explore,
> And rummage in empty words no more."

As to Vitalism, it is beyond doubt that there has been, and there continues to be, much "rummaging in empty words." This has chiefly been with the view of hiding proofs of mind in nature. The cries have been—"let us cast the term vital force from our vocabulary; let us reduce, if we can, the visible phenomena of life to mechanical attractions and repulsions"; are not affinity, unity, extension, duration, and consciousness properties of molecules; are not the atoms waiting for the accidental change which, in one or another of them, gives life and its constant accompaniment consciousness; and do not the properties of the particles of matter abide till the mature forms mysteriously undergo the change we call death? The school of theorists referred to here seems to have found an adjective which fits into their aspirations, and is believed to make sure that life shall be held to be only a quality of matter. Thus we have "the physical theory of life," "the physical basis of life," "the physical doctrine of life," "the physical origin of life," "the physical view of life," "the physical nature of life," &c. Is not this "multiplying words without knowledge"? Some acquaintance with the literature in which these phrases occur creates the impression that the term Vitalism has been found a sort of compromise in recent biological discussions, as if it was a recognition of life apart altogether from questions of origin or originator. Looking at this from the historical point of view, one is struck with the changes of aim on the part of recent enquirers. It is not so much touching the nature and increase of elementary substances, their laws of combination, their characteristic affinities, their divisibility and the like, as it is to shed light on, and account for, the alleged chance behaviour of molecules as the explanation of the origin of life. Biology is made to stand aside and stereo-chemistry takes its place.

Since shortly after the beginning of this century, when Dalton's remarkable discovery astonished the world, the "Atomic theory" has had much attention devoted to it by such physicists as Faraday, Clerk Maxwell, Pasteur, and Lord Kelvin. As the decades glided past from Dalton to Kelvin, interest in the theory went on increasing. It came to be regarded as now a kind of finger-post bearing the inscription "this way to the source of life—the spot where the non-living passes into the living." But before the *terminus ad quem* is reached, lively conversation by the way leads to a good deal of discussion touching that of which they are in search. "What are to be dealt with," some say, "are Atoms," others "Molecules," others "Germs," and yet others "the material ultimate living element,"—the mother of the multitudinous life forms which have not yet been found; they have only been defined! Each seeker seems to have discovered what he was in search of; but that no two of them find the same life-starting point comes out in bold relief when notes are compared, and an effort is made to unite the seekers after truth by hastening to table a term which might satisfy all. The term referred to is "*enantio-*

morph"! It is to be feared that instead of its being a rallying point, there is that in it "which scattereth." Has not one authority boldly said, "the chance synthesis of the simplest active compound from inorganic materials is absolutely inconceivable"? And has not another as boldly replied, "On the contrary if the theory expounded be correct, the inorganic origin of optically active compounds is not only conceivable, but it has a degree of probability which, however small, might be calculated when we know what is the minimum number of molecules in a physically just sensible solution and what is the majority of enantiomorphs of one kind which will give you a just measurable amount of rotatory polarisation"? And has not a third said,—"Now assuming, what there is every reason otherwise to think quite probable, that life started from some few centres, the chances are not that it was equally divided between right and left-handed forms, but that one or other of these forms preponderated"? Then, a voice comes from the Chair of the British Association—"Several years ago I pondered on the constitution of matter. I endeavoured to prove the tormenting mystery of the Atom. What *is* the atom? Is a simple atom in space solid, liquid, or gaseous? Each of these states involves ideas which can only pertain to vast collections of atoms. . . . An isolated atom is an unknown entity difficult to conceive. The properties of matter are due to molecules in a state of motion, therefore matter as we know involves essentially a mode of motion; and the atom itself—intangible, invisible, inconceivable—is its material basis and may indeed be styled the only true matter." Now all such utterances show that those who make them hanker after the old notion of the eternity of matter. They talk of the mystery of being and not being, and of life as "one of the natural properties of things," and yet refuse to listen to the request, "whence these properties of things" which to them are scientifically so real and true? How widely different the attitude of Sir John Herschel when considering the substances to which we refer! "These discoveries," he said at a meeting of the Royal Society, "effectually destroy the idea of an external self-existent matter, by giving to each of its atoms at once the essential characteristics of *a manufactured article and a subordinate agent*. . . . When we see a great number of things precisely alike, we do not believe the similarity to have originated except from a common principle independent of them."

The foregoing quotations are fitted to suggest that the widely different inferences drawn from the same, or corresponding, data are likely to be accounted for by the differences of the point of view, if not the method, of their authors. That their starting points could not be the same seems clear. Was the object of one class of writers to find in the facts and phenomena of nature support for preconceived opinions, and the object of another class to understand the phenomena irrespective altogether of current notions regarding them? Then there are schools of scientific thought—often very ill-informed groups whose chief delight is to charge all who differ from them, as being narrow-minded, the victims of prejudice, and all manner of bias; altogether forgetful that it is not only possible, in this description of others, they may be speaking of themselves; but it also shows that bigotry in the departments of science may be more bitter even than what it is believed to be in "religious coteries." Does not something very like ignorance lie at the root of these expressions of feeling? The mere specialist sees no value in any aspect of thought which cannot find a place in, or connected with, his own hobby. Great attainments do not necessarily imply wide intelligence, and they may carry with them strong and often narrow-minded prejudices. Enlightenment touching the objects disliked may be much needed. Enlargement of acquaintance with intellectual environments often works wonders, not in science only, not in philosophy only, and not in religion only, but in the relations of each of these to the other two. The beneficial reflex influence of interactions among these cannot be questioned. To bring this about many will think that there must be a common starting point. To insist on this would be to miss the end in view. The balls thrown earnestly by different hands would meet, and then the rebound! Looking at this from our present point of view, let the common starting point be "God is," and however small this may seem it is in a line at present, as we shall see, of great significance. Indeed without this, argument would be impossible or, at least, hopelessly useless. With this, mind-marks in nature would have the highest meaning.

There are many able and intelligent men who do not think well of science mainly because they are ignorant of the phenomena with which it deals, and they treat its findings very much in the same way as men ignorant of the Bible treat its contents, whenever they meet its demands to be heard in their special department. If we may judge of their feelings by the attitude they assume to those who study both parts of the One Revelation, our estimate of them will not be very high, but neither will our dread of them be overwhelming. We wish, however, that they would read the *BOOK* before they condemn its contents, and make some effort to understand the reasons, which those who do read it give for their belief, both Biblical and scientific. These are easily stated: adaptations to ends are innumerable, and it is concluded that just as analogous fitness and purpose in man's works are ever credited to the workman's mind, so, when met with in nature, they warrant the inference of presiding mind. Any such adaptations in nature point to a person as their author, as surely as any piece of human mechanical art does, whether we look at the material of which it consists, or to the relations of its several parts, or to the end in view in making it. No doubt it is alleged by some "we acknowledge that in all this there is what we call personal skill,"—but is not this skill as much a physical quality as the material parts are! The assumption is absurd. Physical features, physical qualities, physical energies, can be scientifically dealt with by physical tests; but does not the power to test them lie outside of them? The individual man finds by introspection that his work of art is the outcome of applied mind, and when he sees other men producing corresponding works does not his knowledge of himself warrant the inference that they also have mind like his own?

Some may say this is the old Paley point of view, but things are changed. A higher force, or higher forces, now reign. This reference is made to the old starting point—"Design implies a Designer"—with the view of indicating the source whence the main objection to it came, and of stating the fact that what was held to be its weakness is really its chief strength. Say, we put it thus:—God is, matter is, matter is from God. This length even Kant went, having, he said, a conviction "of the reality of the phenomenal." But a consistent logic goes farther—in the collections of matter there are proofs of wisdom, therefore God is wise. But even when Kant refuses to go thus far he tries to undervalue the importance of his own *terminus ad quem*, by concluding, that though the evidence of order and power in nature and organisms warrants the inference of creative personality, such an argument may produce conviction, yet it is not scientific, because it transfers the conception of cause by man from himself to things. It leads to the acknowledgment of an extra-world Author, but not of an Almighty and All-Wise Creator; or, as it might be put—a most mighty and omniscient Being with the nature of man. Now it is at this point of our demonstration of "Mind in Nature" that students of natural theology are charged with anthropomorphism—the worship of an almighty man! The monstrous assertion as thus expressed is unworthy of criticism; our anthropomorphism is suggestive of something better and higher as we remember the words, "And God said, Let us make man in our image, after our likeness; so God created man in his own image, in the image of God created he man; male and female created he them. And God blessed them." It is, as thus created, we can not only understand His works but hear His words. The children, *in virtue of their origin*, can know what their Father says, and can appreciate what their Father has been doing from the first act of creative self-manifestation. And as the joints of time fit in historical sequence into one another, are we not led into the presence of another glorious Personality? "Doth not Wisdom cry: 'Jehovah possessed me in the beginning of His way,' before His works of old." "I was set up from everlasting, from the beginning, or ever the earth was; then I was by Him; rejoicing in the habitable parts of His earth." "My Father worketh hitherto and I work." It is here we meet with *Christus Creator et Christus Redemptor*. To this one Personality we trace the proofs in all Nature of thought and forethought—in a word of PRESIDING MIND.

The CHAIRMAN.—We are very much obliged to Dr. Kidd for reading this interesting paper by Professor Duns, and we shall be glad to hear any remarks that any gentlemen present may wish to make on the paper.

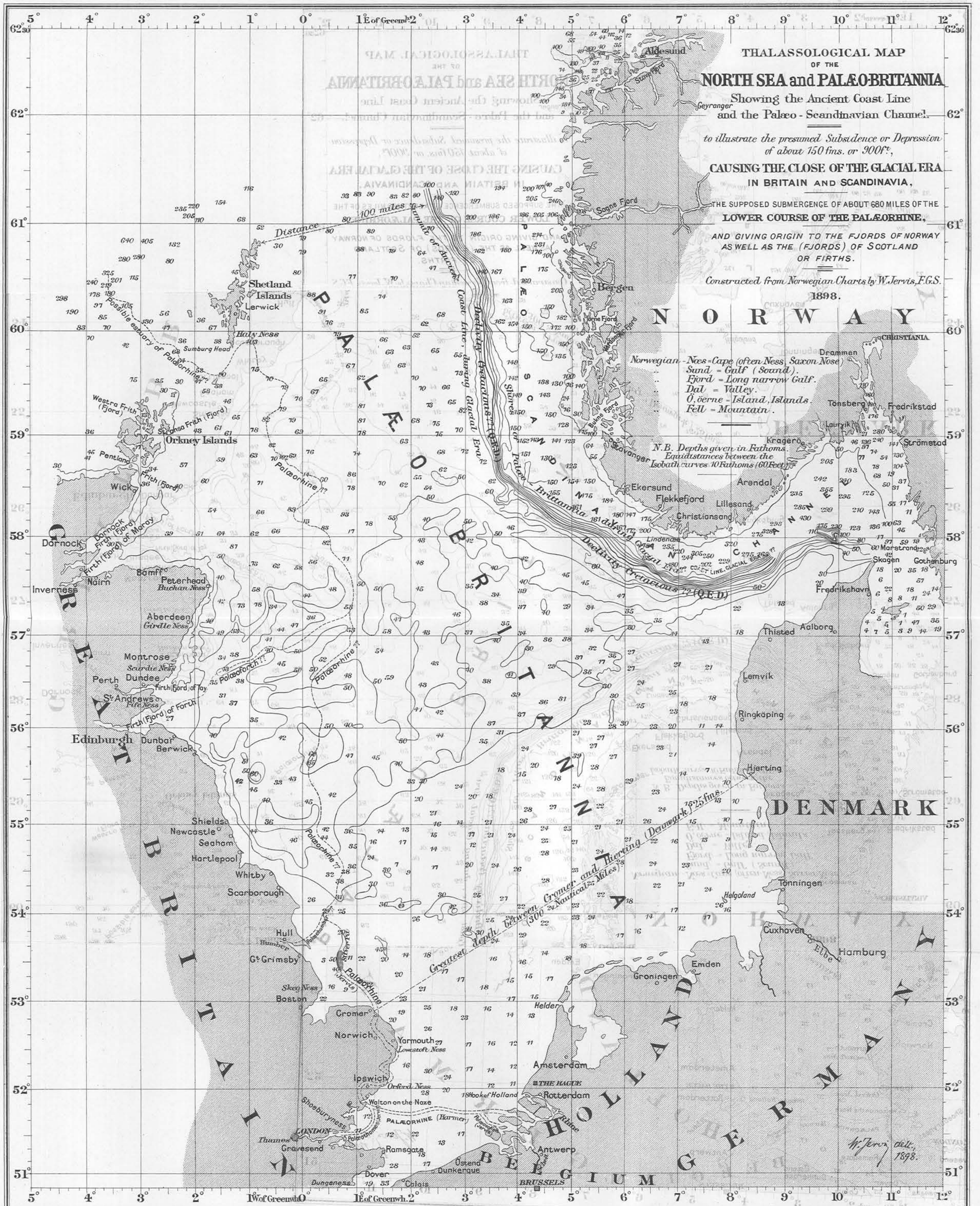
The Rev. BERESFORD POTTER.—I notice it is a very common thing, of late years, to throw discredit on the old argument which is referred to in this paper, viz., the Paley argument of design; and I have seen it stated by a good many writers that owing to the Darwinian theory of evolution the Paley argument of design falls to the ground. I must say I have never been able to see that myself. I should like some gentleman, who has thought more on the subject than I have, to make it clear. It seems to me that the argument of design is quite as strong under the theory of evolution as without it. But I know it is a very common thing, and I was only reading a book yesterday by Fiske in which he throws discredit on the Paley argument.

It seems to me that one sees in evolution, if evolution be true, quite as much the marks of intelligence in the universe, as you do in the old theory of creation.

Mr. E. Schinzel.—In the first place I wish to convey my thanks to the lecturer for the interesting paper he has been reading out to us, and I am induced to make some remarks now, on account of what has just been said. I am sure it is only Sir Charles Lyell who has suggested that there might be plan and design in the evolution theory, but all other evolutionists have protested against it, and have distinctly declared that there is no design. I will read some observations of Darwin. In his autobiography he says, "The old argument from design in nature fails now that the law of natural selection has been discovered. There seems to be no more design in the variability of organic beings than in the course which the wind blows."

Natural selection, I consider, is a naked hypothesis, unsupported by facts. Hypotheses have been made before, and have often led to glorious results. Sir Isaac Newton's solar system is a grand and glorious hypothesis, as explaining satisfactorily all the apparent movements of the heavenly bodies. A hypothesis made at random, and thrown out for anyone either to believe in it or not, is a worthless plaything for the fancy of sanguine visionaries. To deserve general adoption it is necessary that the hypothesis should supply us with a key to explain all phenomena; each and every fact must have a full recognition in the theory which is submitted to our approval. But has Darwin ever attempted to explain the evolution of a single organism by the process of natural selection? Huxley at least hit upon the supposed evolution of the horse. There are some links, but these links do not touch, and they only prove an evolution in the mind of the Creator.

Professor Orchard and Mr. Martin Rouse took part in the discussion, and the meeting terminated with a vote of thanks to the author and Dr. Kidd for reading the paper.



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ORDINARY MEETING.*

DAVID HOWARD, ESQ., D.L., IN THE CHAIR.

The following was elected a Member :—Professor H. M. Ami, F.R.S., Canada.

The following paper was read by Professor J. Logan Lobley, F.G.S., in the absence of the author.

THALASSOGRAPHICAL AND THALASSOLOGICAL NOTES ON THE NORTH SEA. By CAV. W. P. JERVIS, F.G.S., A.V.I.,† Conservator of the Royal Italian Industrial Museum, Turin. Being a few observations suggested by Professor Hull's papers read before the Victoria Institute. (With Map.)

> "Ce que nos connaissons est peu ; ce que nous ignorons est infini."

SUCH were the sublime expressions of that truly great scientific man, Laplace, and after having sat for thirty-five years at the School of Practical Mineralogy and Geology, I proclaimed that I had not met with a single fact which in the slightest degree clashed with inspired writ, in fact, wherever there are apparent contradictions these will disappear as our knowledge advances. True science consists in the collection of a store of facts, in classifying, weighing, and making use of them. It is observations which are the foundation stones upon which the structure of science is to be raised. Old Seneca truly taught: *Stude, non ut plus aliquid scias, sed ut melius.* Though perhaps bold, such is the course which I desire to follow in the present paper.

Professor Hull ably sketches in the paper he read before the Victoria Institute "On the Submerged Terraces and

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* April 2nd, 1900.

† *Vide* my work on the *Topographical Distribution of Minerals and Mineral Springs throughout Italy.* Loescher. Turin.

River Valleys bordering the British Isles," the most important pelagic features presented between Rockall to the north and the south coast of Ireland, as well as along the St. George's and British Channels, to their junction with the former line.

With his permission I will endeavour to follow up the subject under his inspiring leadership, by pourtraying some of the grand features of the North Sea, that is, limiting myself to the region east of Great Britain, by no means intending to invade his ground, but rather to show how he has opened my eyes to understand facts well known to me, but which I hitherto considered to be merely curious and absolutely unimportant.

My first initiation into these facts was when in London in 1886, my attention was riveted by Mr. Jordan's model in the Educational Department of the South Kensington Museum, and in which he so admirably delineates the British Platform. Professor Hull's first paper dwelt upon the phenomena of the Glacial Epoch, and I shall keep that broader subject in view, hoping that these studies may conduce to further results in abler hands that mine, anticipating much from the discussion which may follow the reading of the present paper.

The Glacial Epoch may, indeed, have been confined to the period which dawned at the close of the Pliocene, as far as regards Scandinavia, Scotland, Greenland, etc., or it may not have been so. That is foreign to my present point. Certain it is that Dr. Heim,* as also other eminent Swiss geologists, accept two distinct periods during which glacial action took place in the Western Alps of Switzerland; the first in Pliocene times, the later in Pleistocene times, with an interregnum of milder climate. I have seen abundance of boulders of Alpine Archaic serpentine and other ancient rocks in the Collina di Torino, which forms the last link of the Apennines, a fact first pointed out by Gastaldi, these boulders being embedded in fossiliferous Miocene strata.

The structure and description of the portion of our globe which is at present covered by the sea is of such importance and interest, in order the better to understand the nature and even the genesis of a great proportion of that which constitutes dry land, that we must hail all investigations in this direction as tending to fill up many a hiatus in natural science. The scientific corps of the *Challenger* and *Blake*

* *Die Geologie der Umgebung von Zürich,* 1894.

expeditions have already achieved wonderful results, and Professor Hull has drawn the most important deductions of like nature. But we are still shivering on the shores of an unexplored ocean. In order to confer due honour to this vast subject I venture to ask the members of the Victoria Institute to consider whether we might not very properly introduce the two new terms THALASSOLOGY and THALASSOGRAPHY, instead of Geology and Geography of the sea. which would certainly be misnomers. In describing regions of the sea which were emerged at the period of which we are speaking, perhaps the prefix PALEO would confer clearness, not otherwise so easy to obtain, and obviate much circumlocution.

§ I.—NORWEGIAN COAST.

Evidence of important submergence of Norway, once entirely covered with ice.—Let us land at Christiania, and starting thence make a coasting tour of Norway, for many hundreds of miles, passing through the Skager Rack into the North Sea, and reaching a parallel of latitude corresponding to that of the extremity of the Shetland Isles, by which voyage we shall fall in with Professor Hull's "Gulf Stream."

Thus early it is well to point out that it is a characteristic feature of the Norwegian fjords to have numerous ramifications on a large scale, so that it is difficult to meet with an isolated fjord, and each branch bears its own special name; since they are often so large it is a difficult matter to know which of them to select in naming the region. For the present purpose it would be both monotonous and useless to stop to examine more than a few of the principal ones.*

Christiania fjord. Lat. 59°—59° 50′ N.—On embarking from the head of this fjord, at the quay of the beautiful capital of Norway, the water is shallow, only 7 to 10 fathoms

* During the mission confided to me by the Ministry of Public Instruction at Rome, to the Paris Universal Exhibition of 1878, on behalf of the Royal Italian Industrial Museum at Turin, Mr. W. Christophersen, the Royal Commissioner for Norway, and Mr. N. Christensen, Secretary of the Commission, presented a copy of the magnificent topographical and geological surveys of Norway, and the charts of the coasts and fishing grounds published by the Government. Without the aid of such invaluable documents I could not have pretended to make the accompanying studies, much less to claim confidence in my data, as I do; I here take the opportunity of publicly returning the most hearty thanks to those so kindred minds, whose warm friendship and noble character I shall never forget.

deep; further down the soundings reach 47 fathoms, then 87, and afterwards 118 fathoms, even below the junction of the Drammen fjord from the west, which has a similar depth. Near Tonsberg the depth is 230 fathoms, which is the same as that at the point where the Christiania fjord enters Bohns Bay, at 55 miles below the capital. Beyond this, however, the central channel of the submerged fjord is closely bounded on either side by depths of 50 to 60 fathoms, notwithstanding the evidence that the sea current has considerably filled up the original central channel, preventing the progress of the detritus to any great distance.

Langesund fjord. Lat. 59° N.—Some remarkable facts can be observed near the entrance of the great Frier fjord, which originates in grand mountains 6,000 feet high, that is, where it discharges itself into Bohns Bay, and after having assumed the name of Langesund fjord, in honour of the town it passes. Though the depth of the fjord below Brevik is only 130 fathoms, for upwards of 10 miles out to sea we can clearly trace the central channel of the magnificent submerged fjord, many miles in width, with soundings giving 205 fathoms, while on either side they do not reach that amount by 100 fathoms. The line of 100 fathom soundings approaches to within two miles of the mainland.

Proceeding westward for 100 miles, from Langesund to Ekersund, the bathometrical curve of 100 fathoms follows the present line of coast of Norway with considerable regularity at a distance of 10 miles.

From Ekersund nearly to the 61st parallel of latitude—120 miles—the 100 fathoms isobath runs within a distance of from one or two to 11 miles from land.

Lister fjord. With its tributaries the *Fedde fjord* and the *Flekke fjord*, near the town of Flekkefjord. Lat. 58° 15′.—At the mouth of the Lister fjord a deep submarine channel is traceable for 5 miles to sea, indicating the original course of the fjord, so that the 100 fathom soundings approach to within a short distance of the coast on either side, and run up the present fjord for another 5 miles, where they hug the precipitous rocks. The submerged fjord commences at once with a depth of 120 fathoms, gradually increasing to 295 fathoms. The sea bottom invariably consists of slik.

Stavanger fjord. Lat. 59° N., Long. 5° 40′ E.—Near Stavanger there is a family party of secondary fjords, partly caused by the submergence of the land having given origin to numberless islets and rocks, many of them sunken, and of the most dangerous kind, both in the land course of the fjords themselves and off the coast on all hands. All these fjords concentrate in the Bukne fjord, strictly speaking a wide land-locked gulf.

Forty miles before reaching the coast Vinda fjord branch is already 368 fathoms deep, and (disregarding the constant local changes of name), at 20 miles it attains 382 fathoms, reduced to 200 fathoms in passing the last island guarding the entrance into the sea, a circumstance easily explicable by the fact that the slackened current was no longer strong enough to carry off the immense amount of detritus borne down from the mountains any further, on account of the counter current from the sea. Yet, as the 100 fathoms isobath is in immediate proximity to the islands there is a clear width of 5 miles of the submerged fjord, and which preserves a mean depth of 190 fathoms. For 30 miles to sea the whole sea bottom on all sides is slik, with a pretty uniform depth of 140 to 159 fathoms.

Bömmel, Hardanger and His fjords. Lat. 59° 30′—60° N.—The extreme length of these fjords is 62 miles. At 50 miles inland the Hardanger fjord shows soundings of 315 fathoms, but for the last 20 miles of its course the depth is only from 160 to 200 fathoms, evidently the result of the extensive deposits of detritus, for the sea bottom for upwards of 20 miles from the coast line never exceeds a still lesser depth of 140 fathoms, and consists invariably of sand and slik.

The imposing Skjæggedalsfos—unparalleled in Europe—and the Vöringfos, are two charming waterfalls belonging to the Hardanger fjord.

Group of Sælbjörns fjord, Kors fjord, Björne fjord, Fuse fjord, etc. Lat. 60° N.—Total length 65 miles. Depth at 28 miles inland 230 fathoms, at 18 miles from the sea 310 fathoms, while at 10 miles further down it already attains 338 fathoms. Only 9 miles from the coast of the island of Sotrö the soundings at sea show 182 fathoms in the submerged prolongation of the Kors fjord with sand and slik, a depth merely local, and without any parallel in all the bathometrical measurements hence in a direct line to the shores of Britain.

Bergen group of fjords, viz., *Jelte fjord, By fjorden, Öster fjord, Sör fjorden.* Lat. 60° 20′—60° 45′ N.—These complex fjords penetrate 45 miles inland, but do not appear to have any important direct outlet for the last 15 miles northwards, or for the same distance to the south, where they communicate with the Kors fjord. The shipping entrance to Bergen is even further south, by the Sœlbjörns fjord. At 30 miles from the sea the Öster fjord is found to be 340 fathoms deep, but much lower down it must have been considerably silted up, for the depth is greatly reduced. On the other hand the Sör fjord branch, which is only 198 fathoms deep at 30 miles from the sea, rapidly increases to 275 fathoms depth near its junction with the Öster fjord. At 11 miles inland the Radö fjord is 229 fathoms deep, which is exactly what it measures at its termination on the coast.

It would appear most probable that these fjords originally discharged themselves into the sea south of Feje, Lat. 60° 45′ N.

Sogne fjord. Lat. 61° N.—If we steam up this imposing feature of Norwegian scenery, which, together with those which change names as we proceed, is 127 miles long, and for many miles 2½ miles broad, we readily realize that the whole mercantile and war fleets of the world could manœuvre in it without risk of collision. After proceeding up it for a certain distance the grandest landscapes succeed each other, and mountain masses rapidly descend from heights of 4,000 to 5,000 feet to the water's edge, so that at numerous places the largest vessels could load directly from the shore. For the first 25 miles up this fjord the depth of the water is between 630 and 660 fathoms, except at one place, near the village of Brekka, where a lateral fjord joins it from the south at right angles, and the detritus brought down by which cannot find easy means to proceed onwards. Here the soundings are only 450 fathoms. Thence to the coast, a further distance of 28 miles, the depth of the great exit is reduced to 128 fathoms, and even in places to 93; but the gorge to the north, through the Aspö fjord, is still over 200 fathoms, a depth marked for 50 miles of its course.

For 6 miles out to sea the soundings to the north of the central channel of the submarine fjord are 100 fathoms less than in this latter. Bottom invariably sand or slik.

Bru fjord, Stav fjord, Beksten fjord. Lat. 61° 30′ N.—Depth: 27 miles before reaching the sea 178 fathoms; at 20 miles 205 fathoms; entrance channel 180 fathoms.

Group of fjords south of Aalesund, viz., *Sule fjord, Stor fjorden, Sunelvs fjord, Gejranger fjord,* etc. Lat. 62° 6′—62° 30′ N.—

From Gejranger to the sea is 60 miles, and near this village is situated the magnificent group of waterfalls known as the Seven Sisters; but besides this waterfalls are abundant, and even measure from 2,000 to 3,000 feet in height. With a more particular account of the perfect example of a submerged fjord exhibited by the Sule fjord it is time to close these unpalatable lists of soundings along the Norwegian coast, and we would fain have the opportunity of speaking of the fine inhabitants. Five miles to the west of the busy little fishing town of Aalesund is the submarine valley known to every fisher lad in the place under the name of the Bredsund dybet. It commences immediately below the mouth of the Sule fjord, without change of form, and extends westward for 25 miles to sea, and within a like distance of 25 miles in every direction, and it is one-third deeper than any other spot, except where other fjords debouch into the Atlantic. In general terms it may be described as bound laterally by a sea bottom of 50 fathoms depth, covered with sand, the depth very gradually diminishing in receding laterally from the dybet.

The greatest depth of the Bredsund dybet is 160 fathoms, at the lower extremity. To the right, or north, the 50 fathom soundings correspond precisely to the upper margin of the declivity, which presents a marked slope. On the left hand side the margin is indicated by soundings beginning with 30 fathoms and ending with 60. Extreme breadth 2 miles, remarkably regular, although the course is slightly tortuous. Mid-way a sunken islet dominates its course, rising to within 50 fathoms of the surface of the water. The mid-channel beginning at a mile and a half from the shore with 220 fathoms, soon attains 150, and finally 160 fathoms; but evidently the currents have demolished all the upper portion of the islet, for the surface gently slopes on all sides, and the detritus has reduced the depth of the channel in its proximity by one-third. For a long distance the thalassological Thalweg is a mile wide and the regular steep slopes of the submerged valley may be about 1 : 5. For the first 18 miles the bed consists of fine sand, which nowhere rises so high as the 50 fathom soundings, where the sand is invariably coarser,—it likewise covers the lower 7 miles of the dybet. This truly remarkable physical feature has no outlet into the Atlantic, but terminates in an amphitheatre of horse-shoe form, 2 miles long, beyond which the sea resumes its ordinary 50 fathoms depth. Such obstruction of the submerged valley is plainly established, since the bed of the sea for at least another 25 miles further out consists of sand and shingle, which the various currents have deposited and equally distributed in their lateral course, and so have absolutely obliterated the merest further traces of the Bredsund dybet.

No human being ever attempted to count the islets and rocks, a multitude of which are sunken, all along the west coast of Norway—not even the swarm of rocks off the coast of Nordmark, where the powerful currents rush in opposite directions, and change with the winds, the ebb and flow of the tides, and the phases of the moon—all such ideas would soon be abandoned. But, with the exception of the Lofoden islands, it is particularly to be noticed that *none of the channels running in the direction parallel to the coast, whatever be their width, are deep.* The whole of these facts point to the subsidence of mountains of all heights, and mountain slopes preserving traces of their original form. This last, during geological eras, having been characteristically irregular in outline, would easily lead us to understand the occurrence of miniature islands, while the sunken rocks would be the remains of the harder crystalline rocks at their base. The Maelström is a well-known classical example of the force of conflicting currents at given phases of the oceanic tides.

§ II. Palæoscandinavian Channel.

A second line of 100 fathom soundings skirts the Danish province of Jutland. Proceeding due south from Christiansand it lies at the distance of 30 miles from the Norwegian coast. This isobath runs for 120 miles westward, always preserving, as near as possible, the same distance from the shores of Norway—as though these lines were arcs of concentric circles—as far as a point S.W. of Ekersund. From thence it trends to the N.W. as far as Lat. 60° 45′ N., where it lies at a distance of 50 miles from the Norwegian mainland. A short distance further on, Lat. 61° N., it is only 100 miles distant, due east, from Saxavord Hill, the extremity of Unst, in the Shetland Islands.

This line is, in fact, the eastern boundary of the British platform, or what might be more elegantly termed Palæobritannia.

Opposite the shores of Jutland the plateau lies within 30 fathoms of the surface of the water, gradually becoming lower, until we reach Lat. 58° N., Long. 5° E. Between the two lines of 100 fathom isobaths thus described there is a conspicuous channel of very marked depth, which might be termed, for the sake of clearness, the Palæoscandinavian channel, at first 20 miles wide in its southern portion, and 40 miles across in its northern, but in its entire length into the Atlantic approximately parallel to the coast of Norway.

It will be advisable to commence the study of the configuration of the bed of this channel still farther to the east, apparently where it originated.

Cattegat.—Doubtless the great danger this passage presents to shipping is owing to the fact that the depth of the sea between Marstrand, in Sweden, and the northernmost point of Jutland, in Denmark, as well as for 60 miles, at least, farther upwards, nowhere reaches 60 fathoms, and is in general only half that amount.

Skagerak (*Skager Rack*).—A transverse section of this sea between the entrance to the Christiania fjord and Jutland already shows 165 fathoms in mid-channel; that between Kragerö and Jutland 355 fathoms; that between Arendal and Jutland—which is precisely in prolongation of the axis of the Norwegian mountain chain—430 fathoms, its maximum depth. Between Christiansand and Jutland it is 328 fathoms; also from Christiansand due south, towards the western coast of Denmark, the depth is 330 fathoms; off Farsund the depth is reduced to 235 fathoms. Broadly speaking the deepest part of this Palæoscandinavian channel is one-third of the distance from the Norwegian mountainous coast towards the flatter shores of Denmark.

North Sea.—Between Lat. 58° N., Long. 5° E., and Lat. 61° N., the former coast line of the British plateau, or Palæobritannia, is pretty uniformly marked by a definite incline, with soundings of 70 fathoms at its summit and 150 fathoms at its base. Off the Danish coast the inclined plane bounding the channel is very gentle, becoming gradually steeper as we proceed westward. But whatever be the inclination, *the base still continues to mark with considerable regularity* 150 *fathoms.* To the west of Norway the mid-channel rarely exceeds a normal depth of 160 fathoms; a few soundings at the northern extremity mark 200 fathoms, and in some local instances even 231 fathoms. Between the parallels of 60° 30′ and 61° 30′ the soundings across the channel vary but slightly from 200 fathoms within a central part 10 miles wide.

Since we have found a depth of 430 fathoms in the Skager Rack, off Avendal; 368 fathoms in the Vinda fjord; 348 fathoms at a great distance from the coast; 348 fathoms in the Oster fjord, while the depth of water in the Sogne fjord is no less than 660 fathoms, it seems reasonable to conclude that the bottom of the Palæoscandinavian Channel must have been filled up with a thickness of from 230 to 450 fathoms of newer tertiary deposits.

§ III. PALÆOBRITANNIA.

From any point along the coasts of Denmark, and thence to Belgium, the ancient mariners could steer in a direct course across the North Sea, so as to land at any locality on the east coast of England, between Dover and Newcastle, without leaving the British platform, and find that the soundings were exclusively less than 50 fathoms—frequently far less—as between Tonning and Yarmouth in no instance exceeding 27 fathoms; the bed of the sea being everywhere sandy.

It may be interesting to state, in passing, that at least 70 localities are specified by name in the map of Eastern Palæobritannia, or, more strictly speaking, in the charts of the North Sea. Such names are given to parts of the bed of the sea where the depths are considerably different from those of the adjacent portions. Navigators are compelled to give heed to them, and fishermen know by experience that fish have their haunts regulated by them.

But what is this to the marvellous thalassography of Norwegian mariners? There every small rock peeping above the level of the water has its particular name, and often the very sunken rocks. The charts of the coast-line are crowded with such information. In the vicinity of Aalesund and the Bredsund dybet, of which we have given a sketch, there are far more than 70 names given for positions in the Atlantic within the radius of a few miles.

It is to be hoped that future charts will register all such data, which will serve in the most marked manner to give precision to our knowledge of two-thirds of our globe, which remain yet as little explored as is the centre of Africa to geographers. To talk of the phenomena, the fauna, the flora, etc., of the *North Sea* or *Atlantic*, is about as vague as to speak of the same scientific data of *Europe*, or *America*, and it is high time to take the splendid researches of the *Challenger* as the model upon which we must carefully pursue our future investigations.

I confess candidly to have glanced with considerable complacency on Mr. Harmer's paper on the Geology of the Eastern Counties. But on taking up this paper again, with our mind enlightened by Prof. Hull's observations relating to submergence of the British Isles, we have been brought to agree with Mr. Harmer in his deductions, hoping even to be able to show that they are capable of being very greatly extended without poetry or risk of erring.

The following are briefly some of his remarks on several purely local beds of the Pliocene of Norfolk and Suffolk, in descending order, and employing his terminology.

Cromer beds.—Contain teeth and bones of elephants, hippopotami, and other forms characteristic of *southern climate*; but likewise bones of the musk ox and glutton, animals of *northern facies*, these latter probably indicating more nearly the temperature then prevailing in Norfolk.*

Weyborne Crag.—Contains *arctic forms* of marine mollusca.

Chillesford Clay.—Mineralogically characterised by great abundance of *minute particles of mica*, as also are similar beds in Holland, having been brought down by the Rhine and Meuse, and derived, according to Mr. Harmer, from Devonian and Carboniferous rocks.† For our own part we think this to be erroneous, for we should attribute the mica in such characteristic abundance as due to the destruction of granite and allied rocks, gneiss, mica-schist, etc., of the crystalline lower palæozoic, archaic and intrusive region of the Swiss and Austrian Alps.

Norwich Crag.—Contains *mica* and Rhenish pebbles.

Red Crag.

All the Pliocene beds of Norfolk, says Mr. Harmer, contain *pebbles of white quartz*, similar to those of the Rhenish and Mosean drifts of Holland.‡

It is by the help of these incontestably southern mineral substances that Mr. Harmer has traced the map of the course of the Palæorhine, as far as it still lies above the ordnance datum.

Basing his arguments on the similarity of the fauna of the

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* *Quart. Journ. Geol. Soc.*, vol. lii, p. 774.
† *Ibid.*, p. 770. ‡ *Ibid.*, p. 770.

newer Pliocene strata of Holland, as revealed by well-boring, and those of the Eastern Counties, as well as on their mineral constitution, Mr. Harmer concludes that Great Britain still formed part of the Continent of Europe, and traces the course of the "Rhine" by such data, or, as we distinguish it, the Palæorhine, in a tortuous course, from Walton-on-the-Naze (Suffolk), for a distance of 70 miles, uninterruptedly, to Mundesley, near Cromer (Norfolk). Were the river still to run in its original bed we might speak of Ipswich-on-Rhine, Lowestoft-on-Rhine, Norfolk-on-Rhine.

The North Sea currents, acting during thousands of years, have so distributed the fine sediment brought down by the Rhine, Schelt, and Thames, forming numerous shoals, that the course of the Palæorhine for a distance of 103 miles, which is the crow flight between the Hook of Holland and Walton-on-the-Naze, has been entirely obliterated.

In this part of its course the Palæorhine received two important affluents on the left, the Schelt and the Thames, which may have been of a width similar to what it now has near Greenwich, until it blended its waters with those of the parent stream from the Alps.

Mr. Harmer leaves the Palæorhine at Mundesley, supposing for reasons we cannot follow that it had reached its estuary. But is such a deduction logical?

The Silver Pit.—Fifteen miles out to sea off the coast near Grimsby, lies the Silver Pit, well known to fishermen. This remarkable physical feature is a distinctly marked, tortuous, submerged river valley, 23 miles long by 2 miles broad, running towards the north. For the first 15 miles the depth of the mid-channel rapidly increases from 40 to 45 and 50 fathoms consecutively, bounded by lateral declivities 40 fathoms in height, in other words by respectable elevations of 240 feet. Farther on the depth gradually diminishes to 35 fathoms and finally is only 23 fathoms, beyond which we cannot now follow the valley, which has been quite filled in with sediment.

Cromer (Mundesley) is 33 miles distant to the S.E. from the head of the Silver Pit, which we consider to have undoubtedly formed part of the course of the Palæorhine. There is nothing to surprise us if all evidence of the line the river followed should have been obliterated (as between Holland and Walton), except in this one isolated place, seeing that it ran principally through Tertiary strata with low banks. Possibly the Silver Pit, on the other hand, marks its passage through chalk rocks. What with the strong littoral currents, and the detritus caused by the very considerable encroachment of the sea on the east coast of Lincolnshire and Norfolk, the wonder is that any trace of the original valley should have come down to our times.

If this theory is accepted we have been enabled to trace the course of the Palæorhine for 60 miles farther than Mr. Harmer. But that is not all.

One hundred fathoms sounding, North Sea, Lat. 58° 45′ N., Long. 0° 22′ W.—Precisely 300 miles north from the Silver Pit the first deep sounding is marked as 102 fathoms. *No other spot in the North Sea in its vicinity, and none in Eastern Palæobritannia at lower latitudes, approaches in the remotest degree to such a depth.*

Channel between the Orkney and Shetland Islands.—Off Sumburgh Head, which constitutes the southern extremity of Mainland Island, Shetland, Lat. 59° 55′ N., Long. 1° W., there is again a depth of 103 fathoms in the channel communicating between the Atlantic and the North Sea. Similar soundings occur in the Atlantic, proceeding thence in a N.W. direction, until 48 miles to the W. of Shetland, Lat. 60° 44′ N., Long. 3° 7′ W., a depth of 249 fathoms is attained. Five miles farther on 640 fathoms marked on the chart was probably taken at some spot on Professor Hull's Great Declivity.

Corollary.—Mesozoic strata, with well-marked elevations, stretch uninterruptedly from the British Channel to Yorkshire. Farther north the Palæozoic hills are followed by Archaic rocks, rising into noble mountains in the lake district of the North of England and in Scotland. If we are correct in tracing the Palæorhine as far as the Silver Pit there is no way whatever out of the dilemma, unless we admit frankly that it must have followed a northerly course, probably passing by the two points referred to, and finding its way somehow into the Atlantic after reaching the western shores of Palæobritannia, of which (between the Hook of Holland and Shetland alone) it must have fertilized upwards of 600 miles, thus doubling its present length.

The principal tributaries to the left would have been successively: the Palæoschelt, the Palæothames, Palæohumber, Palæoforth, Palæotay, etc. By such an extension of its Thalweg it must have been comparable in size in days of yore to the Oronoco, or by its geographical position to the Mackenzie river or Yenisei.

Palæobritannia was flooded by the waves, and as regards the eastern portion would appear to have been submerged about 900 feet (150 fathoms), if not 4,000 feet (660 fathoms) since the Pliocene times, when the glacial peaks of Norway could have been visible for a distance of hundreds of miles along the shores, and when the bears of Russia infested all the forests, their principal obstacle having been to ford the majestic stream which often bore on its way towards the arctic circle the swollen, half-putrid carcases of drowned elephants, dead hippopotami, and all kinds of ancient denizens of warmer climes.

The sea had not yet burst a passage at the Straits of Dover, but chalk downs probably extended between the sites of Dover and Calais. On the other hand there is great probability that the chalk rocks of Denmark formed bold cliffs along the coast line. In all which precedes we are far from approaching the immense submergence so clearly established with reference to the Atlantic.

To follow up the image. Great Britain's isolation has proved to be her most precious boon: she is a microcosm. Forty fathoms of water are a greater protection than as many citadels. Her bravest sons instinctively toil in the now submerged regions, undaunted by winds and waves. While every race of men has the same sacred right to independence in their respective countries, an All-wise Providence gave the sea for the free neutral use of mankind, to serve as the great bond of union for friendly intercourse between the most varied members of the one human family; and who could better exercise such a privilege than the inhabitants of the sea-girt British Isles?

The Chairman.—We have in this paper the following-up of a very important subject, which has occupied us on more than one occasion, on what is to be learnt from deep-sea soundings, and it is very interesting to have traced some of the information we have received. Of course it becomes immensely difficult to trace the ancient channels under such waters as one finds in the south of the North Sea and the coast of Holland, filled with dilute sand and gravel, and the wonder is that any channels have remained at all.

But it is a very interesting subject and deserves careful attention, and I hope some of those present will favour us with their views.

Professor E. HULL.—I think our thanks are due to the author of this paper, Cavaliere Jervis. He is a Fellow of the Geological Society, and has for a long time been Curator of the Royal Museum at Turin. When at Turin, last autumn, I had the pleasure of calling on him, and I was much gratified by that visit. Our thanks are also due to Professor Logan Lobley for reading the paper.

Now, as has been observed, the subject which Mr. Jervis has opened is a very wide one and opens out many questions of interest.

I am glad to say that Mr. Harmer, whose elaborate investigations in this region are testified to by his paper read before the Geological Society, is able to attend to-day, and no doubt he will meet the points that the author has raised with reference to these channels.

I do not see any necessary discrepancies between the results arrived at by Mr. Harmer and those arrived at by the author as regards the Palæorhine. I think both are compatible with each other.

Now the principal points the author has brought before us in the first part of his paper are the soundings of the fjords, and he has brought to our notice a very remarkable circumstance, viz., that these fjords, which run up for so many miles into the heart of the Scandinavian mountains, almost always (perhaps I might say always) deepen their channels as they go up into the mountains from their mouths where they open out into the North Sea. That is a very remarkable fact, and the soundings testify to that without question. We have several illustrations of it mentioned by the author—in the great Langesund fjord, for instance, and the Hardanger fjord, where the depth varies from 315 fathoms to 160 fathoms, or a difference of 155 fathoms; and the Sogne fjord, where for the first 25 miles the depth is from 630 to 660 fathoms, until it is reduced to 128 fathoms, or a difference of 532 fathoms.

Now what is the origin of these fjords? Unquestionably they are old river valleys; and river valleys of immense geological antiquity. They come down, probably, from the period preceding the Old Red Sandstone, or Devonian, as their representatives in Scotland certainly do, and they have remained in the condition of river valleys during the uprise of the whole of the Scandinavian promontory and all that part of Europe, which is the oldest land in Europe except part of Moravia. It is the oldest land in the north of Europe; and all the time, while part of the British Islands and other parts of Europe were submerged under the sea, receiving enormous deposits of great thickness, this old Scandinavian land remained above the waters, and the rivers were employed in ever deepening their channels. We all know that when a river flows down it continually deepens its channel from its source to its outlet; but, as I have observed, and the author points out, that is not the case with these fjords. They are, of course, submerged river valleys. That is unquestionable; and the question arises, Why is it that they do not, as in the case of ordinary rivers, continue to deepen their channels all the way? The author attributes the shallowing of the channel towards the mouth to the silting up of that part of the channel. For my part, I cannot accept that explanation as at all sufficient. In fact, the beds of these submerged rivers are "rock basins." Their floors are of solid rock, not silt, towards their outlet. Of course they are covered, to a certain extent, with silt and mud carried down and deposited on their floors; but their solid part is probably not far below the silting beds, and, in the case of the islands, comes up to the surface. In fact, the valleys are old rock basins. [*The author here illustrated his meaning by a drawing on the board.*] The late Sir Andrew Ramsay expounded the formation of rock basins by showing that they are basins scooped out or eroded by glacial action. In Norway, as we all know, we find the most remarkable examples of glacial erosion. All along these fjords the rocks, where not covered with detritus or old sea beaches, are glaciated in a most remarkable manner. You can understand how that during the Glacial period enormous masses of ice, coming down from the sides of the mountains and entering these old river valleys, loaded with stones and rocks, would continually, as long as the ice lasted, be engaged in eroding the floor of the valley deeper and deeper, until, at last, a rock basin was formed; because the farther the ice receded from the mountain source the less powerful would be the erosion, and, consequently, the greater amount of the erosion would be near the base of the mountains and the higher part of the valleys. In Scotland we have precisely similar instances of rock basins—for instance, Loch Lomond, which is

100 fathoms deep very far up under Ben Lomond, but at its outlet it is near the level of the sea floor in the same way as Loch Etive, which comes out near Oban; in fact, nearly all these lochs (once river valleys) in the North of Scotland are, as Professor James Geikie has so well shown,* rock basins, which enter at the sea very little below the level of the surface and are not very deep, while some miles up higher they are considerably deeper. I think it would be a very interesting subject to take up (which perhaps I shall be able to do) to show the comparisons or analogies between the rock basins of the West of Scotland and the fjords of Norway.

I am very much inclined to believe that the author has proved his point about the Silver Pit off the coast of Lincolnshire being the ancient river bed of the Palæorhine, and that it has been silted up is only what one would expect. As the Chairman remarked, it is a wonder, considering that the sea was at a former time filled with glacial ice carrying great masses of material which it spread over the floor, that we have any of these old river valleys remaining in such a condition that they can be determined by the soundings of the Admiralty Charts.

As others are going to speak, I will not detain you longer except to express the great pleasure I have derived from listening to the author's paper.

Mr. HARMER, F.G.S.—The author has been good enough to write to acquaint me with the fact that this paper was coming on, and I am glad to be here. The subject is most interesting, and I am very glad to be able to agree with many of the conclusions that the author has reached. There is no doubt, I think, that from the time the Rhine began to run northwards it must have forced itself out to the North Sea between Scotland and Scandinavia. I agree with Professor Hull that it is not strange that we cannot trace the whole of this old channel. The wonder is that there is any trace of it left.

With regard to the point he raises, with which my name has been connected, I am afraid I cannot follow the conclusion he reaches, and if it will not take too much time I will sketch out my views shortly. [*The speaker here illustrated his theory on the black-board.*] Changes of level took place in the North Sea area during both the Pliocene and Pleistocene periods, but the stages in the

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* Geikie, *The Great Ice Age.*

geological history referred to in my paper belong to the former, and those dealt with by the Cavaliere Jervis, I believe, to the latter epoch. The so-called forest-bed of Cromer, and the Chillesford Clay, can, therefore, have no connection with the elevation of the North Sea basin, which occurred in glacial and post-glacial times, when England was joined to the Continent, and the sea retreated sufficiently far to the north for the "Silver Pits" depression to form part of the Rhine valley.

The Chillesford beds, with their marine shells, and the mammaliferous deposits of the Cromer coast, do not represent, in my opinion, any former existence of the Rhine itself in East Anglia, so much as some of the estuarine channels by which, during the Pliocene epoch, it found its way to the sea; the latter then reaching, probably, as far south as the north coast of Norfolk.

I agree with the author that the mica, the presence of which is so constant a feature of the Chillesford Clay, may possibly have been derived from the Alps, as well as from the highly micaceous Devonian schists of the Ardennes. Of course it is always exceedingly unsatisfactory to criticise an author's paper in his absence, and I am very sorry that he is not present. It is possible that I may have misunderstood him to some extent, and I should have been too glad that he should have had an opportunity of replying to my remarks.

[A long discussion here took place, in which the Rev. Dr. WALKER, Mr. MARTIN ROUSE, Mr. HARMER, and Professor HULL took part. Dr. WALKER pointed out some analogies between the features of the coast of Norway and those of Iceland.]

Rev. G. F. WHIDBORNE, F.G.S.—I have kept very carefully away from such slippery things as glaciers, and therefore I will only just ask a question.

It seems to me, if I understand rightly, that what this paper points to is the time of the elevation of the whole west coast of Norway, England, and France, and, apparently, the point of disagreement between the author and Professor Hull is that the author thinks these fjords were filled up with detritus washed down by the Rhine, and Professor Hull says, "No—the reason of the central depression is a scooping out by ice action."

Then Mr. Harmer says this elevation could not have been at the time of the Cromer beds because they point to a time of depression and not of elevation. I really wanted to ask whether I am right in what I have gathered from the paper because I thought it might clear one's mind. May the whole question of the great elevation that has gone on in the Rhine's action have something to do with the great elevation that must have occurred in the raising of the Alps, or any subsidiary elevation connected with it?*

Professor LOGAN LOBLEY.—I would say a word in reply to the point as to some of the fjords being deeper at the sea end and others not. It does not at all follow, because some of the fjords are deeper at the sea end, that Professor Hull's explanation of the other fjords that are deeper in the interior is at fault. We have river valleys deepening out towards the sea now, and other river valleys that do not. So there may be one explanation that will afford grounds for one class of river valley, and another that will suit the other class. Therefore the one does not contradict the other at all.

The rocks that have been spoken of are clearly not moraines, but much older. If they were of moraine matter they would have been swept away long since by the great storms and currents of the coast.

As to the age of elevation, we are dealing with a period of enormous duration, and it would be a period when the levels would be similar to what they are now, and other stages when the levels were quite different. The period of elevation, I take it, was subsequent to the Pliocene period, when the deposits on the east coast of England were laid down.

I think this paper is very interesting, and very noteworthy as following in Professor Hull's steps, and is one of great importance, not only to geographical and thalassographical studies, to use the new word, but also to geological studies; for it gives us fresh grounds for coming to a conclusion with respect to phenomena which have undoubtedly existed on this earth and which have been a great puzzle to many deep thinkers.

Mr. M. L. ROUSE.—I thought the contention of Professor Hull was that all these valleys were formed by glacial action. That is

* The answer to Mr. Whidborne's question seems to be: 1st, that the period of the great elevation and of glacial erosion was subsequent to that of the Cromer beds, and 2nd, that the valley of the Palæorhine participated in the general upheaval of the whole region.—ED.

the general opinion, that the fjords were so hollowed out by glacial action, is it not?

Professor HULL.—They were formed in the first place by river erosion; but they have been deepened in certain parts by glacial erosion.

Mr. ROUSE.—Then we might suppose, regarding the Christiania fjord and such of them as are not shallow at the mouth, that they were not subject to glacial erosion.

Professor HULL.—Not at present.

Mr. ROUSE.—At present there is no erosion at the head of the Christiania fjord?

Professor HULL.—No.

The HON. SECRETARY (Captain Francis Petrie, F.G.S.).—I have received a communication from Professor Rupert Jones, written in his usual very graphic style, and he agrees, in the main, with the whole of the contention which is included in Mr. Jervis's paper.

The CHAIRMAN.—I am sure we must ask the Hon. Secretary to convey to the author of the paper our great appreciation of it, and he will learn of the interesting discussion that it has given rise to. We also thank Professor Logan Lobley very much for reading it.

The Meeting then terminated.

ORDINARY MEETING.*

HELD IN THE THEATRE OF KING'S COLLEGE.

THE PRESIDENT, SIR G. G. STOKES, LL.D., F.R.S., IN THE CHAIR.

THE NATURE OF LIFE. By Professor LIONEL S. BEALE, F.R.S.

PART I.

MR. PRESIDENT, LADIES and GENTLEMEN:—Before I pass to that very difficult problem, a part of which I hope to bring before you this evening, perhaps you will allow me to explain, in a few words, why we are assembled here this afternoon rather than meeting in our usual room.

It is because the Council thought that perhaps the room where we usually have our meetings would not be quite large enough to accommodate all who are here without inconvenience, so we applied to the authorities of King's College and they very kindly placed the large theatre at our disposal.

There must, naturally, be some sympathy between King's College and the Victoria Institute. Both Institutions have been founded upon somewhat similar principles—both are situated in a central part of London. Their portals are always open to everyone who desires to study and who

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* February 20th, 1899.

takes an interest in scientific subjects. Both Institutions carry on their important work in hope, and the only wages they look for are "the wages of going on and not to die," and both discharge important functions, of benefit to the world. To me of course it is a great pleasure that our meeting should happen to be here, for this is the theatre in which I have been lecturing now for many, many years (applause), and I can only say that it gives me pleasure to return, for once, to my old home.

Let me, for a moment, recall a trifling incident, of some considerable interest to all, which happened a great many years ago, when there were 300 or 400 boys in the school in the regions below this theatre, and I can remember perfectly well, when I was one of them, there was once a great disturbance in the college. Many great people came in, and the yard was full of carriages. There were numbers of soldiers and a band was playing, and guns were firing. Presently Prince Albert arrived and was conducted to the terrace fronting the river. Some little urchins, full of curiosity, managed to make their way through the crowd to a small wooden table placed on the terrace, and there was a gentleman sitting with a little round disc before him. Round the disc were capital letters, A, B, C, D, and so on. It was moved round, one way or the other, by the finger. The operator looked anxious and, every now and then, towards the Shot Tower on the other side of the Thames. Various efforts were made. We did not, of course, know exactly what was intended; but we knew it was something very important, or the Prince would not be there. Close by, stood Professor Daniel and Professor Faraday, and a great many celebrated scientific men of that old time. Messages seemed to pass to and from the tower along the wires. This was the beginning of the electric telegraph, and the very instrument that Wheatstone used that day, is now in the museum upstairs. That day is of great historical interest, and a number of experiments were then made, and new investigations were undertaken by many scientific men, leading, at last, to telegraphy gaining the perfection which it has since attained, enabling us to communicate with our friends all round the world.

1. The problem that I wish to bring before you this evening is, perhaps, still further from solution than was the question of telegraphy at the time I mention. I do not suppose that fifty years have advanced our knowledge of the

problem of life, to the extent that the problem of telegraphy has been advanced in that time. Vitality has moved slowly compared with physics and chemistry.

The nature of life has been under discussion by the wisest and best men for, perhaps, 2,000 years, and still we do not know exactly the general views we ought to hold, concerning the nature of those wonderful changes which go on in every living organism in every part of the living world. However, it must be borne in mind that during the last fifty years new investigations have been made and new instruments have been obtained, so that we are able now to peer more deeply into the inmost recesses of living things than was possible on the part of our predecessors. We now look from an entirely different point of view; and, however much we may differ in opinion and doctrine from one another (and we *do* differ indeed on the very first principles) we can proceed further and deeper than was at that time possible. We really see a great many things, which it was quite impossible to see only a few years ago. The improved magnifying powers of the microscope and new means of investigation, enable us to determine the actual particles which *live* and move and upon which "life" depends —particles that act vitally—*particles which alone can die.* Living particles are the only particles in the world that can die. This is not the first time that I have appealed to the members and associates of the Victoria Institute for consideration of the nature of life, and, as many are probably aware, I am on the side of *vitality*—vitality absolutely distinct and apart from all other powers, properties and forces in nature. I consider that vital power should be placed in a category by itself, quite distinct from that in which other forces or properties are included. Of course this notion is opposed, but unfortunately the various reasons I have advanced in favour of my conclusion have not been criticised as I should desire. Some will be now able to criticise my views, and if it would in any way further real knowledge, I should be quite happy to meet members of the Institute at any convenient time; and instead of expounding my views, I would ask to have my notions freely criticised, and be allowed to answer them if I could, and if I could not reply and explain more clearly, I would confess that I could not. (Applause.) In this way I think we should soon come to some valuable conclusions. At any rate that seems to me what anyone who is really interested in the matter, however much he may cling to his own views, would desire. I must not say that no one has found fault with me, but the objections that have been raised have not touched the main issue. I have replied, but the position seems to remain much as it was.

2. Now it seems to me the first conclusion we must come to is that the *living world is very small and limited, and the non-living world enormous and infinite.* When we think of the very small amount of matter of our own earth, I am sure that everyone must feel that I am quite justified in making this remark—*that the living world is a distinct world, and is limited, and not one with the worlds composed of matter only.*

We all know, of course, that the great part of the matter of which our world, and the whole of other worlds is made, consists of matter of many kinds of which not one kind can live. The greater part of all world-material is not of the nature to constitute a necessary part of living organisms.

The living and the non-living are, and in my opinion have ever been, *distinct.* So that when I am speaking of life, I am only speaking of the life that is known to us here, not that which *may be.* I speak of the living things which we see, and know something about. I do not intend this evening to attack, in the least degree, the question of the origin of life. I wish to consider life as it is—the living things we see and can examine, and parts of which we can place under the microscope, and see very much that we could not have expected. We can also enter into various investigations concerning them, and ascertain something of their nature.

Further I hold that all life is absolutely distinct from all non-life; and that there is no bridge, as has been asserted over and over again, between the non-living and the living. There is a gulf between life and non-life which is unfathomable, and has never been bridged, and I cannot believe that it ever will be bridged. (Cheers.)

3. All living things come as far as we know (for as I said I am not going just now to enter into the question of the origin of life), from pre-existing living things. As far as I know not a single proof has been advanced that justifies us in considering that the non-living can be converted into the living, except by the influence of existing life. This always seems to be the case. A minute quantity of matter already living may transfer without loss (and that is a most wonderful thing) its power to an enormous quantity of matter; but the matter must become part of that which is actually living at

the time. So that, as it seems to me, whatever view may be taken of spontaneous generation, which was in vogue some years ago, facts are completely opposed to it. (Applause.) There is not a fact that justifies the inference that under any circumstances, the living can come from the non-living, and the more carefully we investigate the cases supposed to favour the doctrine referred to, the more certain we feel that mistakes have been made. So that I think it may be most positively laid down that everything that has ever lived certainly came from something which lived before.

4. All living matter, of whatever nature, forms substances which differ entirely from the living matter itself. All living matter is structureless—it has no form, and the active life-power cannot be separated from the matter and examined. When any attempt is made to do so, what happens is death; and when we come to examine what remains, please remember that we are not examining the living thing, *but the products which resulted from death*, and this holds good all through nature as far as is known. Some chemists make out wonderful things; but when they conclude that the components they obtain were actually present in the living matter, they go a great deal too far and too fast, for they succeed only in destroying the life. You must destroy the life before you can chemically examine the substance of a living thing, or in any way analyse it.

5. Let us try to ascertain how life—vital power—differs from all other forces known in the natural world. Whether life began on this globe twenty millions, fifty millions, or a thousand millions of years ago, seems to me to be a matter of no real interest. We cannot conceive changes which are spread over an enormous distance of time like that. So that if elementary and other substances were originally formed, nobody can know how or when, or whether life originated in them, or in some other way cannot be reasonably considered until, at any rate, we find out what life is here.

Neither do I think it profitable to discuss whether life, as present on the surface of the globe now, resulted from life being brought here on a fragment of another world. It seems to me we cannot profitably discuss such a conjecture. Whether the organic forms would live in passing through the ether and then through our atmosphere, I do not know, and the idea cannot be submitted to experiment. They must have been very strong living things indeed, if they reached this earth alive. And then I should think that when the supposed fragment impinged on our globe the impact would be so great that every mortal thing would be killed and its remains smashed to atoms.

6. The matter of our life-world is taken up over and over again. I mean this—that of the constituents of living organisms of to-day, many are at any rate substances formed by living things—that had formed parts of living organisms many times before; and, I suppose, there is no doubt that a great many of the substances that exist in our living bodies now will, some years hence, be among the components of other living beings.

The quantity of matter in the world of course can never change, but the matter on the surface is always changing. Things are coming into the living world, living for a while and dying, and other organisms take up the products of their decay. In the course of time the matter of the dead takes other forms which may be of advantage to lower forms of life which grow and multiply exceedingly. This process, I imagine, has been ever going on since life appeared on the earth. In all living things the material changes in the living matter seem to be governed by vitality, and life exists, in any given particle of Bioplasm or living matter, as we know, for only a short time. In all the food that we eat, or the food that is taken into an organism, *there are certain constituents which are very soon taken up by living matter and which, themselves, become part of the only living stuff, the Bioplasm.* Some Bioplasm is always dying in different parts of every living organism, and the products resulting from death may be, and generally are, especially in early life, taken up by other living particles of Bioplasm; a portion of these die, and the products resulting are taken up by other living particles. This is the way in which the process of *nutrition* goes on—the particles of bread or meat which we take into our stomachs, after being altered by digestion, are at length so changed that they become fitted for the "food" of, say, muscle and nerve Bioplasm before they can become converted into these structures, or, as the case may be, into other constituents of our tissues or organs. It is at this time certainly reasonable to conclude that these processes of Bioplasm living and dying, go on over and over again in all living. Thus are the particles of food, milk for instance, or other substance at last, so to say "appropriated," by the Bioplasm of the tissues of our bodies, before any "tissue" or lasting structure can result.

7. All vital power is invariably associated with matter. There is no question of "vital force" resident in matter generally. Any such notion is absolutely untenable. Every living particle, however minute it may be, is unquestionably matter; but, as it seems to me, *the matter of this living particle is controlled, governed, caused to act in a certain way, by the life or vital power, vitality, briefly associated with it.* That one living particle may be detached from others is certain, for a few living particles can be easily killed, while their immediate neighbours may live, and grow, and form.

What becomes of the life is another matter. It seems to me when a living particle dies, better to say, that it ceases, for there is no evidence whatever that life power, vitality, is transformed into anything else. *No one has brought forward any proof to favour the view that when living matter dies the life power becomes converted into any other form or mode of force.* I conclude that if it were possible to get a quantity of matter actually living, and to place it under circumstances which ensured its sudden death, it would weigh exactly the same the moment after death as it did the moment before death when it was living. The dead matter would of course soon change. Evaporation would go on and this loss would necessarily cause a difference in weight; but I imagine in the same matter, alive or dead, there would be no difference in weight. Neither in any experiment, as far as I know, has it been shown that when living matter dies any force or energy or any other form or physical agency or factor is set free and can be identified—from the highest to the very lowest living creature—from a particle of living matter however "crude" or imperfect, or in a condition "about to become living,"—anything that can be seen, weighed, measured or touched, thrown on a screen, or separated from the matter with which it was in life, associated, or in any way isolated. *Vital power* is, no doubt, well expressed by a distinguished philosopher of our day as "*a factor which no physical research whatever*, can *disclose* or *identify*, or get the remotest glimpse of." This is the very vital power, the existence of which I claim to have proved and the absence of which from any form of living matter now existing or capable of being caused to exist is impossible. I challenge proof—I hold this view as more than an opinion—as a fact of nature. I challenge the author, or some of his friends, to publicly condemn me, to criticise me as they like, for I venture to think I can defend my view. Let anyone, if he can, show us another way out of the vital difficulty, and say, to what the peculiarity of all life is to be attributed. That there is no difference, or that there is only a difference of degree and not a difference of kind, between the living matter and the same matter dead, and every form of non-living matter, is an opinion, which I do not believe any reasonable being will now defend. The living thing is in one state and the dead thing is in an *absolutely different* state. There can be no analogy whatever between the living condition and the non-living condition. In other words *the distinction between living matter of any kind, however minute—whatever may be the quantity—and the same matter, dead, is absolute.* No gradual change can be proved when a living particle dies. The actual matter involved passes from one state to another, suddenly—not gradually. and the difference between the two states, I think, must be, admitted to be truly expressed by the word *absolute.* The identical matter of the *living particle that dies never lives again.* The matter of which it was composed of course may be, and almost universally is, taken up by other forms of living matter belonging to living things; but the same material particles which during life held certain definite relations to one another in the living state, cannot possibly exhibit those same relations again. The death of a particle, like its life, is once only. The products which result from its death are another matter altogether. The life is lost for ever and can never be restored; and although we are told of many cases of prolonged dormant vitality, and so on—such cases prove nothing. A thing dormant is not dead. Some of the lower creatures may be dried and moistened again, and come to life, apparently, but who has proved that all the matter of which those bodies were composed was dead? Can any living matter be dried? Can any living matter exist which does not contain water? No properly desiccated living thing survives, or can be revived. Everything living of which we have actual knowledge and experience must absolutely die.

8. Now all living matter has certain definite powers and may therefore be referred to under one particular name, and it does seem to me that the most convenient word to indicate living matter, by which to distinguish it from matter in any other state, is bioplasm. It is a Greek word, and for thirty or forty years there has been a tendency to find fault with Greek; but it is difficult for many of us to understand this, as we can hardly read a page of chemistry or botany without

Greek—or even physics, without finding Greek words; and, if we study medicine—why the father of medicine was a Greek, and there is hardly a disease we can name without talking Greek. It is indeed mysterious why people oppose the introduction of Greek into our schools. If a boy is to be taught science his difficulty is much increased if he has not been taught a little Greek. I know this by experience, for I have been teaching all my life, and students of pathology or medicine get on but slowly if they are quite ignorant of Greek. A little Greek is a great help, for we are saved the trouble of looking out many words in dictionaries, and the memory retains the word with ease—almost by instinct if the student understands its meaning and knows its root. How many a gardener recollects the enormous number of names of plants is wonderful, as he depends solely on memory.

9. During the last forty or fifty years, microscopical investigation has vastly improved, for we are able now to use very high magnifying powers. We make careful drawings of what we see, and we can distinguish, in many instances, the difference between *living matter* and *matter which is formed* from the living matter. The difference is made very clear by tinting the living matter just after death, as indicated in many of my published drawings.

I will not attempt to go into a description of even one of these enlarged drawings; but I beg you just to notice the red circular or oval spots in each, indicating living matter; many of these are the so-called nuclei of the tissue, and called by some cells, by others corpuscles, the adjacent bodies or cells in some cases also consist in part of living matter. These tissues are all coloured artificially by staining with an alkaline solution of carmine immediately after the tissue or organ is taken from the body of a recently dead animal. You see then in all of these diagrams the living particles I have spoken of as *Bioplasm* coloured red. The matter round this, which forms the *tissue*—the matter, for example, which constitutes fibrous tissue, gristle, tendon, cartilage, and so on, is situated between or around the living particles of living matter. If you take a small very thin section of ordinary cartilage, this is the appearance you get. The diagram shows a very important point, that the material upon which the character of the tissue depends is *really produced by these little particles of living matter*. If you take a thin section of the cartilage of a kitten which contains the living matter and is not itself living, you observe a certain proportion between the two—between the *Bioplasm* or *living matter* and the *tissue* or *formed matter*. In a kitten somewhat older you will find the cartilage tissue has considerably increased, and the little particles of living matter are separated farther from one another by the increase of the tissue ; and at a later period of life, the same thing is shown in an advanced degree, and so on till the adult stage is reached. We learn these important points not only from cartilage, but from muscular, fibrous, and other tissues of our bodies. From the brain and ganglia, nerves, vessels, epithelium, we obtain like evidence. In every living organism as it advances from early age to maturity, the same lesson is taught, to any one who will observe the facts and think them over.

10. Further, it must be borne in mind that living matter alone has this power of producing the formed material or tissue. All the properties which distinguish the several tissues are due to the influence of "vitality"—the living power of the Bioplasm acting upon the matter in solution brought to the Bioplasts—passing into the very substance of the living, and receiving from it, vital power. I cannot see how we can accept any explanation other than that I have brought under your notice. Indeed, having thought well over the question after prolonged investigation on organisms widely differing, I can come to no other conclusion, and do not believe the facts are open to any other interpretation without doing violence to fact and reason.

It comes to this—that every part of every living organism was once in a state of perfectly clear, transparent, structureless material which contained a very large percentage of pure water. Take a small portion of bioplasm from any department of living nature, and while it is growing and active, you will probably find as much as 90 to 95 per cent. of water, and in some cases even more. The powers of this clear, transparent, and structureless material are something quite extraordinary. The wonderful structure and properties of all the tissues that exist throughout the living world come from Bioplasm, and every kind of Bioplasm comes from Bioplasm particles that existed before it. All our Bioplasm particles are descendants of the original germ particles which existed at the very beginning of each individual organism—from the lowest, to man the very highest. However complicated the mature organism may be, the same remarks apply, and, I believe, must be accepted as true.

11. Years ago. our courses of physiology, attended by medical students, included such matters as those I have brought before you, bearing as you must perceive, in an important degree, upon the nature of man, his growth and action; but some years ago physiology was caused by teachers to assume more and more a physical aspect, and physics and chemistry have at last almost replaced every physiological idea. The living body becomes a physical laboratory. In fact one may almost say that physiology is gradually being caused to take the position of a mere department of physics and chemistry. The chemist and physicist examined the constituents of dead organisms, and so the lifeless compounds obtained, were promoted to life, as if they had been there when the body was alive. Physiological investigation becomes the investigation of the substances resulting from the death of the Bioplasm and the lifeless tissue of a dead thing, by physics and chemistry. Perhaps some of my friends may think it a little hard to put it in that way. We have, however, raised a new biology on the ashes of a dead physiology, and it is to be hoped that a vital philosophy will soon follow.

12. Everybody knows that Biology is from that little expressive word βιος, life. Bios means life; and I doubt whether the meaning of the word will ever be changed. We may alter the meaning of *physiology* and indeed the meaning has been altered more than once as physical investigation advanced. Bios is an old word. We find bios in biology and bioplasm, which I trust will take the place of the vague "protoplasm" which may be living or dead or roasted, but *Bioplasm* is *living only*. As soon as the life, the bios, has ceased, what *was* living only remains—no longer *Bioplasm.* Although we do not know exactly what βιος (life) is, at any rate it is perfectly distinct and different from any force or power or property that we know of in nature. *No machinery, or mechanism, or apparatus has ever been shown* in the living matter which I have spoken of as bioplasm.

13. Now I had hoped to have been able to say something about the heart and one or two other matters, but my excellent friend, Captain Petrie, our Hon. Secretary, hinted to me, as I was coming up, that I need not finish my remarks to-day, so that if you are not utterly tired of vitality, I shall be very happy to say more on some other convenient occasion; and, as I hope will be the case, if any friends wish to ask any questions and will kindly promote discussion

on the subject I have brought forward, it will be a pleasure to me to enter into it; and, as I have previously remarked many times, if it be shown I am wrong, I would give up my views. But I do not mean to do so unless it be proved that my views are erroneous. I am ready to be beaten; I am getting old and do not mind. But above all things it is most important the question of vitality should be settled, and soon —if it can be settled.

Allow me now to break off for to-day, and I trust enter upon discussion, and I feel sure the members of the Institute will be glad to hear any observations members and visitors will be kind enough to offer on this widely interesting subject. (Applause.)

Dr. SHETTLE.—I am much obliged to Dr. Beale for giving us this able address on his views of life, and also for his kind promise to further investigate the matter.

I quite concur with Dr. Beale as to the origin of life—in fact, life is something that has been handed down from the very first to now; but I cannot accord with his view that life is not physical. I think it is just as much physical as any other creation of the Almighty's.

Now I would just state the points on which I think the discussion might be opened with profit.

(1) My point is that matter, in whatever form it was created, was the direct outcome of the Creator's Divine power—so that I do not take animal life away from the power of God. I entirely concur in that.

(2) Animal life in man is the highest development of that Divine power.

(3) The earth and the celestial bodies in general all show that the first motion (of life) existed in the form of axial rotation in which the central and centrifugal forms of force were essentially marked. Dr. Beale has commented in his book on the central and centrifugal forces as having the power of life as distinct from other things.

(4) The shape of the human blood corpuscles, which are the agents by which animal life is carried on, shows that they have been formed and have acquired their magnetic

characters whilst subject to axial rotation. This fact is further proved by their forming rouleaux, like unto piles of money, when they have been brought to rest, *i.e.*—polar attraction. If I understood Dr. Beale rightly, he said there was no evidence at all of any physical force being given out at the time of the cessation of life. These corpuscles, which contain the life of the living animal, collect together and form piles like coils of wire, and when we go into the physics of the question we see that the form has been acquired by rotation, and their physical properties maintain the life of the living animal by their motion through the tissues.

(5) The stress which the blood corpuscles exercise upon the nerves originates the nerve current, under which all work done in the various processes of life is effected. No doubt, according to the condition of the blood, with regard to oxygen, so are the powers of life. Thought even is governed by the oxygenated condition of the blood, and as soon as it loses that condition it loses the power of sustaining life. I do not at all detract from the view that life is handed down, but simply that it is maintained by these physical processes.

(6) My sixth point is that as the stress which the blood corpuscles exercise has a direct relation to their material conditions, purity of blood is one of the great factors for ensuring a healthy body and a well-balanced mind. There is no getting out of that, I think—in fact, these are all facts that you can prove or disprove. I believe them to be all positive facts, and I think the importance of this question of animal life cannot be exceeded by any other question which occupies men's minds.

(7) A due recognition of the relations which exist between animal life and its material basis is of enormous consequence to the well-being of the human race, and it is because of its consequence to animal life that I think this is a matter that should be gone into even by the State itself, seeing what is going on in the world—the vitiated appetites of the present generation, and seeing how morbid appetites are being fostered and kept up. We should then see what has taken place in the material body—what changes are effected in it, how impure it has become, and how impossible it is that the brain, and

> everything else, can carry on its work under such conditions. This point interests me very much, for I have been associated, as far as my professional career has permitted, with animal life as a physiologist. It is not a personal matter with me; but I am looking at it from a broad point of view as to what is best for the human race. If anything is to be done it ought to be done so as to steadily improve the condition of the human race. We know what the indulgence in intemperance, and other appetites, will foster and bring about. This is why this subject should be studied from a broad point of view, and there, no doubt, our excellent lecturer has shown his wisdom. When we come to look at these diagrams we see the work he has done, microscopical and otherwise, but this is a point that really ought to extend from the broadest possible basis.

I apologise for making these remarks, but I feel strongly on the subject. (Applause.)

The PRESIDENT.—If any other members of the Institute wish to speak I hope they will rise and do so.

Professor ORCHARD.—I am sure we all feel indebted to Prof. Lionel Beale for this important contribution to the discussion of a subject of which I myself had no knowledge whatever.

We all, I think, agree with him that he has proved that vitality is something *sui genesis* associated with matter, but not in any way material.

I must dissent from the expression used by Dr. Shettle as to the material basis of life. It does not strike me as a very happy expression. Life is not built up of matter. There is no doubt of the material use of life. Life does make use of matter. That is very different to the notion that it is in any way the product of matter. Truly there are many contentions which seem to show that life is altogether different from anything else. One is surely this, as pointed out by Prof. Lionel Beale—that you cannot transmute physical force into life, nor transmute life into physical force.

As to the arrangement of the blood corpuscles, when an animal dies, that is surely explicable in some other manner. We must be careful, I think, not to confound accompaniment with cause, nor mistake conditions for effects. Transmutability is a characteristic of vitality. It is *sui genesis*. Another characteristic is, surely, directive government, as one may call it. Vitality co-ordinates in a way that mere force never does. Force is not governing or directive. Another condition is what I think I may call the unique property of vitalism. That was alluded to the other day by Professor Japp in his address before the British Association in speaking of bodies known as Enanatiomorphs. He shows that vitalism nearly always produces or selects one kind of these Enanatiomorphs without the other kind, and that no other force or power in nature can do this. There is, therefore, in vitalism an uniformity—a directive government—and there is intransmutability to anything else. The suggestion, I believe, was let fall before the Victoria Institute some time ago by our honoured President that life was the result of the action of spirit. We know that matter cannot produce force any more than it can produce life. It is spirit from which force proceeds—it is spirit from which life proceeds. This is in harmony with the declaration in the Word of God where the spirit and life are associated together in such expressions as "the spirit giveth life."

Mr. TUCKWELL.—I am afraid that I have nothing of importance to contribute to the discussion, but I should much like that we should have a little more of it. One would like if possible to have some light on such a question as this—What is the relation between individual bioplasm and living organisms? A question of profound difficulty and, I am quite sure, one of very great importance indeed. The gentleman who first spoke seemed—I do not know whether I misunderstood him—to suggest that life, *i.e.*, I presume, bioplasm has originated in material substances aided by motion, or something of that kind.

Dr. SHETTLE.—Pardon me for interrupting you—but my remark was that bioplasm was a created thing—created, I should say, by the spirit and power of God, and in no other way, and is maintained by His power now, just as much in the vegetable as in the animal.

Mr. TUCKWELL.—I am glad to have any misapprehension removed. I rather understood Dr. Shettle to refer to motion as having something to do with it, or being a manifest cause of the production of bioplasm. There must be a degree of heat that is destructive to bioplasm.

Professor LIONEL BEALE.—Oh, yes; certainly—a very mild degree.

Mr. TUCKWELL.—Then in that case it would be impossible in the ordinary physical course of things that bioplasm could have originated from the material substances of which this world is composed, seeing, if you go back a certain number of millions of years you find that everything was in an incandescent condition. The subject is one of great importance from various points of view, and in regard to health, taking the condition into which human beings are apt to drop by unguarded and immoral conduct.

The degeneration of life, or the bios, is another of those points which I should like to have discussed. I do not know that Dr. Beale in his books has shown us that bioplasm is capable of rising in the scale of being. I have not read all his works. I remember how he shows that much disease arises from the degeneration of bioplasm. If that could be avoided it would show a great advance in medical science, and would be helpful to us as moral and religious teachers who have to mingle with people who are thoughtless and careless of their own and their children's habits, and it would be helpful to us in the exposition of the Scriptures. (Applause.)

A MEMBER.—Might I ask the President a question on a subject which I think is interesting?

I remember years ago, when the telephone was introduced, that a number of persons stood holding one anothers' hands, and a current of electricity was passed through them from one telephone to another. It was alleged that the sound had been changed into electricity, and that it changed back again into sound. What happened on its passing through the human bodies? Did it change into a form of fluidity, or did it remain electricity?

The PRESIDENT.—I have not much hesitation in answering that it simply passed through the bodies as an electric current.

The MEMBER.—Could that inquiry be pressed a step further? Of what nature is nerve force, that electricity so acts upon it as to cause, for instance, a rabbit's nose to move after the rabbit is dead? How are we to distinguish true nerve force and the electric current that produces this?

The PRESIDENT.—I may say that I do not profess to know anything about the vital action, or the action of electricity on animals; but in the particular case of the telephone and producing a shock by means of passing a current through the body, I do not think there is anything to indicate that that had anything to do with vitality at all. The body acts as a wet sponge would to convey the current.

The action of electricity on the nerves is a different thing altogether. I must leave that to physiologists.

A VISITOR.—May I be permitted, as a visitor, to make a remark? I think we are getting rather off the track of the discussion.

I understood Dr. Beale to say that all visible bodies we see are really forms of matter. Bioplasm is shut up in a particular cell, and we do not see bioplasm. The question that has arisen this evening has been chiefly on the action of formed matter. I suppose, with Professor Beale, we shall never find out exactly what bioplasm is; but there is one point that I should like to have his experience on, viz. whether, in his microscopic investigations there is any possibility of differentiating the different sorts of bioplasm, and what are the different forms that bioplasm takes to itself when forming cartilage and gristle. It seems there must be in bioplasm certain differentiating points which seem to me to be almost beyond the possibility of our investigation, unless Dr. Beale can tell us that he has been able to differentiate, either by action or investigation, the position in which different bioplasms stand.

Professor LIONEL BEALE.—All the different forms of bioplasm in the body which form the different organs and tissues come from a single embyronic one capable of increase of size, and with infinite power of division. The bioplasm of each organism has individual characteristics as regards power of forming, although no physical, material or chemical properties can be shown to account for it. The "differentiating" depends, I believe, on *Vital Power*, and not on material properties, but I object to learned words like "differentiation," in which the simple statement of a fact is made to masquerade as something to account for it—as an explanation. No one has defined exactly what he means by the verb to "differentiate," or whether we ought to look for a "differentiator."

The VISITOR.—It is a wonderful thing that the goose, the sheep, and the hare all feed on grass, and one produces hair, another wool, and another feathers.

Dr. SHETTLE.—And there is also a directive influence of the germ in each creature, and that germ exists as an entity.

Professor LIONEL BEALE, in reply, said—My position is a more humble, but a much more decided one, than is generally supposed. I only aim at discussing the subject by degrees, beginning from the so-called simplest lowest forms of life. For instance, I have said nothing about the amœba. The living matter of a young amœba is perfectly clear, transparent and structureless, and it possesses powers of movement not yet explained, perhaps inexplicable, but possessed by all *living matter*. I should like to discuss with my friends the movements of bioplasm or living matter, which movements are natural in every kind of living matter, and not in any kind of non-living matter. I would venture to speak of them as *vital movements*. The movement is totally different from any other kind of movement known.

We find that from the very beginning of the developmental process—say in the chick, particles of clear, colourless, structureless stuff, call it what you will, which divide and sub-divide, producing innumerable particles, and before long indications of vessels containing blood and a *pulsating organ* driving the blood through the vessels—and remember, the red corpuscles which give to the blood its colour—every one comes from pre-existing particles of Bioplasm. The *red corpuscles* of blood have no vital power of their own at all, for those of many animals readily crystallize—for instance, the red blood corpuscles of guinea pig's blood crystallize on a glass slide a few moments after it has been taken from the vessels of the animal, and I have seen a single blood corpuscle form sometimes one, sometimes *many tetrahedral crystals*—and very beautiful they are.

I cannot go into the great question of the origin of life, nor do I care to do so until we hear of some hypothesis more in accordance with reason, than anyone of those advanced during the past two thousand years. We now know of the colourless stuff out of which everything that lives or that has lived, has come, and I venture to say, every living organism that is about to come will have similar origin. Let us restrict ourselves, for a time, to the consideration of the actual matter in which all living here undoubtedly begins.

One gentleman referred to Professor Japp, whose observations are extremely interesting, and I am sure will lead to very important further observations. Three years ago a very distinguished chemist said he wanted a little more vitality. I quite agree with him. We not only want a little more, but very much more vitality than has been allowed by what is called the tendency of scientific thought; and I for one mean to demand it, and on purely scientific grounds, and in accordance with reason.

I was going to say something about the heart and its action; but I have already trespassed upon your time and thought, and must postpone what I would say to another opportunity. I think we ought to restrain ourselves for a time to a very restricted portion of the infinite, and stick to the question of *the living matter* universal in all living, from the first moment of life to death. This clear and structureless matter having much water—from which all future structure is derived, and all structure "evolved" by "evolutional power," if you please.

I believe that every word that I am speaking depends on changes in the Bioplasm of certain of my brain "cells" and the bioplasts concerned in vocalisation. All the wonderful changes determining the phenomena begin in, and must start from, the minute particles of living matter, which are in all the tissues, parts, and organs concerned, and I hope these bioplasts will be for a short time longer in a healthy state, and retain yet a little of their necessarily waning activity.

Two or three gentlemen alluded to the medical or medico-hygienic part of the question, and if I may be allowed to say a few more words, I should like to remark briefly on the universal presence of an enormous proportion of water in all Bioplasm or living matter. The relation between the quantity of food taken and the quantity of water required to dissolve its products seems to be seldom adequately considered. Many of us take far too little water, and many a poor child suffers torture in hot weather from being allowed too little. We have lately become more and more prejudiced against water. There are so many of those dreaded bacterial creatures found in it, that people have been led to associate horrors with these, and though the majority are harmless, many persons seem to think that bacteria of some kind are the usual and most potent cause of disease and death. For myself I have no objection even to filtered Thames water, and am not much afraid of its bacterial millions. A distinguished chemist once remarked that although they had been hunting for typhoid germs in the Thames for years, perhaps not a dozen had ever been found.

With regard to healthy human Bioplasm there is a great deal more to be considered of the greatest importance with reference to keeping alive the millions and millions of Bioplasts in our bodies, not only for a time, in health, but in a continuing healthy state, so that we may not only be healthy and vigorous in youth, but be able to look forward to a healthy old age. To live long in health is a great pleasure, and according to the experience of many, quite as great as in boyhood. I can easily imagine it to be a greater pleasure than many a small boy actually enjoyed, especially in his early boyhood, who meets with compensation by being healthier and far happier as he gets older, and may even look forward to the enjoyment of some years of mental and bodily health in old age.

The PRESIDENT having conveyed the thanks of the meeting to Professor Lionel Beale, the proceedings terminated.

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