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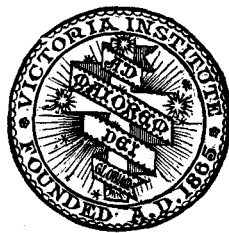
JOURNAL OF THE TRANSACTIONS
OF
THE VICTORIA INSTITUTE.

VOL. XXXIV.

JOURNAL OF
THE TRANSACTIONS
OF
The Victoria Institute,
OR,
Philosophical Society of Great Britain.

EDITED BY THE SECRETARY.

VOL. XXXIV.



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

PREFACE.

IN the preparation of this Volume of the *Journal of Transactions*, I have to express my acknowledgments to the Authors of the papers for the pains they have taken to render the published matter as free from inaccuracies as possible. I would also esteem it a favour if Members and Associates would not only send communications on subjects they think interesting and suitable for bringing before the Institute, but also suggest titles of such subjects and the names of persons they consider qualified to deal with them.

EDWARD HULL,

Secretary and Editor.

August 2nd, 1902.

ANNUAL GENERAL MEETING

HELD AT THE HOUSE OF THE SOCIETY OF ARTS,
MONDAY, MAY 26, 1902.

The President,

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

IN THE CHAIR.

The Secretary, Professor EDWARD HULL, M.A., LL.D., F.R.S., read the following Report of the Council :—

1. In presenting the THIRTY-SIXTH ANNUAL REPORT, the Council has the pleasure of stating that the position of the Institute is satisfactory, both as regards membership and funds. Notwithstanding the period of financial stress through which this country has passed during the year 1901—when increased taxation and reduced income have pressed heavily on the classes which are the chief supporters of the Institute—we are able to show an increase in both directions. The stated credit balance of £18 3s. 7d. for the previous year (1900) was obtained by placing the sum of £196 9s. arising from the sale of £200 Consols of the Reserve Fund to the “Receipts.” But if this sum, which in reality reduces our resources, had been omitted there would have been a deficit of £178 10s. 10d. For the past year, when there has been no sale of Reserve Stock, the deficit only amounts to £10 11s. 3d.; so that the Institute is really in a better financial position than on the last day of 1900. It should also be mentioned that we commenced the present year without debt of any kind.

2. As regards Membership, there has been an increase in the number of Annual Associates to the extent of 31,

as compared with the previous year, while the numbers under the head of Life Members, Annual Members, and Life Associates remain nearly the same. There is a slight diminution under the head of Hon. Corresponding Members, only a few of whom pay the half-guinea which entitles them to receive the Annual Volume of Transactions. The following is an approximate statement of the constituency of the Institute at the end of May, 1902:—

Life Members	..	..	..	42	in number.
Annual „	..	..	..	195	„
Life Associates	..	..	..	64	„
Annual „	..	..	..	511	„
Hon. Corresponding Members	..			177	„
				<hr/>	
			Total	..	989

The Council last year expressed the hope that during the coming year an effort would be made to bring the adherents up to the number of one thousand; it will be observed that this hope has been nearly realised, and it ought to be fulfilled before the next report is issued.

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

President.

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

Vice-Presidents.

The Right Honourable The Lord High Chancellor, F.R.S.

Sir T. Fowell Buxton, Bart., K.C.M.G.

Sir Joseph Fayrer, Bart., K.C.S.I., M.D., F.R.S.

Professor Lionel S. Beale, F.R.C.P., F.R.S.

W. H. Hudleston, Esq., F.R.S., *Past President of Geological Society.*

Alexander McArthur, Esq., D.L., J.P.

The Ven. Robinson Thornton, D.D., F.R.Hist.S., *Archdeacon of Middlesex.*

Honorary Correspondents.

The Right Hon. Lord Kelvin, Past P.R.S.

Professor A. Agassiz, D.C.L., F.R.S.

Professor Etheridge, F.R.S.

Professor E. Naville (*Geneva*).

Professor Maspero (*Paris*).

Professor B. Virchow, F.R.S.

Professor Fritz Hommel, Ph.D.

Professor A. H. Sayce, D.D., LL.D.

Professor Sir B. S. Ball, LL.D., F.R.S.

Honorary Auditors.

J. Allen, Esq.

General G. S. Hallows.

Honorary Treasurer.

Edward Stanley M. Perowne, Esq.

Secretary and Editor of the Journal.

Professor Edward Hull, M.A., LL.D., F.R.S.

Council.

(In Order of Election.)

His Honour Judge Waddy, K.C.
 Rev. Principal James H. Rigg, D.D.
 D. Howard, Esq., D.L., F.C.S., F.I.C., *f.c.*
(Trustee).
 Rev. Dr. F. W. Tremlett, D.D., D.C.L., Ph.D.
 Rev. Prab. H. Wace, D.D. *(Trustee).*
 Rev. Chancellor J. J. Lias, M.A.
 Gen. G. S. Hallowes, *f.c.* *(H.S.).*
 Rev. F. A. Walker, D.D., F.L.S., F.R.G.S.
 Capt. E. W. Creak, C.B., R.N., F.R.S.
 Thomas Chaplin, Esq., M.D.
 Rev. Canon R. B. Girdlestone, M.A.

Theo. G. Pinches, Esq., LL.D., M.R.A.S.
 Ven. Archdeacon W. M. Sinclair, M.A., D.D.
 Gerard Smith, Esq., M.R.C.S.
 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.
 Walter Kidd, Esq., M.D., F.Z.S.
 Edward Stanley M. Perowne, Esq.
 Martin Luther Rouse, Esq., B.L.
 Rev. J. Ashington Bullen, M.A., F.G.S.
 Rev. John Tuckwell, M.R.A.S.

4. Deaths.

The Council regret to have to record the death of the following supporters of the Institute:—

C. A. Barclay, Esq., Colonel Alten Beamish, R.E., Right Rev. Bishop Bousfield, D.D., Dr. Allan Campbell, J. Fortescue, Esq., Right Rev. Bishop Gell, D.D., Rev. Edwin Harwood, D.D., H. Cadman Jones, Esq. (Member of Council), Rev. L. W. Kip, D.D., Captain H. P. Lowe, Rev. J. A. Peters, D.D., R. C. Shettle, Esq., M.D., Sir Sidney Shippard, K.C.M.G., the Right Hon. Sir Richard Temple, Bart., G.C.S.I., H. Thornton Tanner, Esq., Rev. J. H. Wythe, M.D., D.D., the Right Rev. Bishop Whipple, D.D.

It will be difficult to replace men of such eminence in Church and State as some of the above. It will be recollected that Sir Richard Temple delivered the address at the annual meeting of the Institute, the subject being, "The Unity of Truth," in which he endeavoured to vindicate the accuracy of various passages in Holy Scripture which are often the subject of doubt or controversy, ending with the words, "I recollect when 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 study, the more we enquire, the more we know, the better shall we understand the words of Scripture as the one thing on which we are to base all our happiness on earth, and all our hopes in the life beyond the grave."

4. Finance.

The income of the Institute for the past year was £1,001 16s. 4d., and the expenditure £1,012 7s. 7d., leaving an adverse balance of £10 11s. 3d.

5. *The Gunning Fund.*

The mode of disposing of the interest of the "Gunning Fund," was finally determined upon at a Meeting of the Council, by a resolution dated December 9, 1901, in accordance with the wishes expressed by the generous donor. The amount of interest accruing, which up to the end of last year went towards the augmentation of the funds of the Institute, is now being reserved for the triennial prize.*

Special.—The Council desires to urge the great importance of all subscriptions being remitted during the first half of the year (Bye-law III, 3 and 4). Adherence to this rule will facilitate the work of the Institute, and help towards removing any cause of anxiety to the Council. Forms for paying the subscriptions through a banker are used by a large number of Members and Associates, and may be had at the office.

6. MEETINGS.

The meetings of the Institute have been generally well attended, and the subjects dealt with have been of a varied character, as will be seen by the following classification:—

1. HISTORY.

1. "Iceland: its History and Inhabitants." By Herr Jon Stefansson.
2. "Procopius's African Monument of Joshua's Conquest of Canaan." Narrative of a Visit to the Site. By MARTIN L. ROUSE, Esq.

2. ZOOLOGY.

1. "Locusts and Grasshoppers, with special reference to Biblical Species." By the Rev. F. A. WALKER, D.D.

3. GEOLOGY.

1. "The Preparation of the Earth for Man's Abode." By Professor J. LOGAN LOBLEY, F.G.S.
2. "Artesian Water in the State of Queensland, Australia." By R. LOGAN JACK, LL.D., F.G.S.
3. "The Physical History of the Norwegian Fjords." By Professor EDWARD HULL, LL.D., F.R.S.
4. "The Physical History of the New Zealand Fjords." By J. MALCOLM MACLAREN, Esq., F.G.S.

* The information regarding the fund founded by His Excellency the late Robert Halliday Gunning, will be found in Vol. XXXIII, p. 6. The triennial prize will be competed for after the close of the year 1904.

4. BIBLICAL.

1. "On Some Diseases mentioned in the Bible." By Dr. THOMAS CHAPLIN.

5. BIOLOGICAL.

1. "Adaptation and Selection in Nature and Their Bearing on the Evidence of Design." By Dr. WALTER KIDD, F.Z.S.
2. "Water Essential to all Life." By Professor LIONEL BEALE, F.R.S.

6. SCIENCE AND RELIGION.

1. "Modifications in the Idea of God produced by Modern Thought and Scientific Discovery." By Rev. CHANCELLOR LIAS, M.A.
- The "ANNUAL ADDRESS," by Major-Gen. Sir C. W. WILSON, R.E., K.C.M.G., F.R.S., on "The Water Supply of Jerusalem."

7. *The Journal of Transactions.*

The thirty-third volume of the *Journal of Transactions*, containing as it did a series of papers of more than ordinary number and interest, appears to have given much gratification to the Members and Associates. Assurances of such appreciation have been frequently received, of which the following from two esteemed supporters may be considered as examples. The first is from Herr F. W. Lönnbeck, Stockholm, dated May 7, 1902. When sending an order for Vols. 24 to 30 inclusive, in all seven Volumes of the *Transactions*, he adds:—

"The papers contained in this valuable publication I often find very helpful in my work of fighting the critics and sceptics by supplying fresh and reliable evidence on points under debate. Even now I am engaged in public controversy with two Swedish scholars about the great Ice Age. One of them had maintained on a public occasion, when lecturing upon the subject of the earlier traces of man in Europe, that man had existed ages before the Glacial Epoch, 'certainly hundreds of thousands, probably millions of years ago—and in Sweden at least 12,000 years ago.' Replying to this mad talk I have also cited your own views as to the post-Glacial appearance of man in Europe, and Mr. Warren Upham's remarks on the length of the post-Glacial time."*

The second is from Sgr. Chev. W. Jervis, F.G.S., Luserna San Giovanni, 26 April, 1902, late Director of the Royal Museum at Turin, in which he says:—

"It is only this month, during the continual rainy days in the Alps, where I am come for a short time, that I have had a moment's time to read Vol. XXXIII of the *Transactions of the Victoria Institute*. I am deeply impressed by the very high class of the papers read there, from many of which I have learned a great deal, and with the statements expressed, in the greater part of which I fully concur, or consider to be

* "Time Divisions of the Ice Age," by Warren Upham, M.A., *Trans. Vict. Inst.*, Vol. XXXIII, p. 409.

most plausible, so far as my knowledge, which is so limited, can judge of Thus I feel what a privilege it is for me to belong to an Institute in which science and belief in Divine inspiration are not considered to be divorced, much less antagonistic and contradictory.

“What a field lies before the members, in the more accurate study of ethnology, physical geography, geology, as elucidating the former coast lines and orographical conditions; the Tertiary constitution and conformation of the bed of the then existing seas (which study I ventured to propose to style *Thalassography*); ancient history of the most ancient races, as it were but now unearthed, after lying buried for a score or two of centuries! The choice of the subjects, taken in general, appears to me to be extremely wise, and moreover to be such as to interest me in most cases; since the very varied studies converge to one grand centre. Few Transactions of general academics give such little trouble to the single student in picking and choosing such memoirs as may be useful to him individually. They are all rich materials for thought.”

8. Conclusion.

In conclusion the Council desires to express its thankfulness for the success thus far of the Institute. The importance of the work it endeavours to carry on has been recognized by the loyal support from its Members in all lands. There are few civilized countries in which our *Transactions* are not to be found, not only in Europe, but in India, Australia, Africa, N. America and Canada, while at home it has the support of men eminent in every walk of life, and the Council would welcome fresh Members, and offers of subjects for reading and discussion.

Signed on behalf of the Council,

G. G. STOKES,
President.

ANNUAL BALANCE SHEET, from 1st January to 31st December, 1901.

RECEIPTS.				EXPENDITURE.								
				£	s.	d.						
				£	s.	d.	£	s.	d.			
Balance from 1900				18	3	7	Printing			313	2	6
Subscriptions :—1 Life Member		21	0	0			Postage			43	5	0
1 Member, 1897		2	2	0			Binding			49	8	3
2 Members, 1898		4	4	0			Reporting			25	4	0
3 " 1899		6	6	0			Stationery			22	15	1
7 " 1900		14	14	0			Expenses of Meetings			15	5	9
146 " 1901		306	12	0			Clerk—Salary			113	1	4
5 " 1902		10	10	0			" Insurance			2	12	3
1 Entrance Fee		1	1	0			Rent			180	0	0
6 Life Associates		61	19	0			Housekeeper			1	2	3
1 Associate, 1893		1	1	0			Coal and Light			7	16	3
1 " 1894		1	1	0			Library			13	7	10
2 Associates, 1895		2	2	0			Secretary			210	0	0
3 " 1896		3	3	0			Insurance			0	12	0
5 " 1897		5	5	0			Bank Charges			0	14	8
8 " 1898		8	8	0			Sundries			3	12	6
13 " 1899		13	13	0			U.S. Subscriptions collected 1902			4	4	0
30 " 1900		31	10	0			Balance			6	3	11
338 " 1901		354	18	0			Purchase of £500 Indian Peninsular 3% Stock			491	7	0
13 " 1902		13	13	0								
1 " 1903		1	1	0								
Dividend on £1,165 18s. 9d. 2½ p.c. Consols					864	3						
Donations					30	6						
Sale of Books, &c.					60	4						
Bond (Dr. Gunning)					501	18						
Interest on same					22	7						
					<u>£1,503</u>	<u>14</u>	<u>7</u>			<u>£1,503</u>	<u>14</u>	<u>7</u>

N.B.—The Gunning Fund is no part of the Assets of the Institute, but is held in trust by it to be administered according to the intention of the Founder.

We have examined the Balance Sheet with the Books and Vouchers, and find a Credit Balance in hand of £6 3s. 11d.

JOHN ALLEN, }
G. S. HALLOWES, } Auditors.

Rev. Canon GIRDLESTONE, M.A.—Mr. President, ladies and gentlemen: I am permitted to move the following resolution: "That the Report of the Council now read be received and adopted and circulated amongst the Members and Associates, and that Edward Stanley M. Perowne, Esq., be appointed Honorary Treasurer."

I am sure that those of us who have looked over the Report, and have heard it read, must be satisfied that the Victoria Institute is doing its work faithfully. We have now got to the great age of 36 years! When I was a boy, I thought 36 years was a tremendous age; but I confess that I now look on 36 as youthful, and I hope the day will come when this Society of 36 years will have fulfilled a long series of years and a happy useful existence, as it has done hitherto.

On looking back over the Society's meetings, I dare say you are struck with the great variety of the subjects. That is because Nature is so various and thought is so various, and one of the delightful things in connection with this Institute is, that we not only listen to Papers, but we discuss them fairly as far as time permits. Of course, the subjects are so big and many-sided, that it would be impossible to get to the bottom of any one of them; but when you read the printed discussions, I think you will see that the subjects are dealt with fairly, if not fully.

Nature is a very big book, and we have only turned over a few pages at present. I was thinking the other day of the frontier line lying between the known and the unknown. The more we push that frontier line back, the more we realise the known, and yet as we do so, we cannot help realising that the unknown extends further before us than ever. We cannot fathom it, whether we look up into the sky, or down to the depths of the earth, or contemplate the minutiae of Nature by the microscope. We find the wondrous steps of God all through Nature, and we feel, indeed, that the Book of Nature is the Book of God, and the more we study it the more, I think, we feel that we need not be perplexed if we cannot get behind it, and cannot understand how Nature came to be. The first chapter of the Bible seems to give us a hint how Nature came to be; but it is hard to get behind the laws of fixity and variation, and speculation sometimes runs rather rampant in the endeavour to read God in Nature. It may be that speculation will some day help us further than it has, and I think we cannot get on without speculation. There has always been

speculation, and it has always proved to be useful in the long run. But still, behind Nature is God, and it is better, I think, to realise Nature as the revealer of God than to spend too much time in speculating as to the mode in which Nature came into being.

I have great pleasure in moving the resolution I have read.

Major-General HALLOWES.—I beg to second the resolution that has been moved by Canon Girdlestone.

[The resolution was then put to the Meeting by the President and carried unanimously.]

Dr. WALTER KIDD, M.D.—I beg to propose the following resolution: "That the thanks of the Members and Associates be presented to the Council, Hon. Officers, and Auditors for their efficient conduct of the business of the Victoria Institute during the year."

Major-General Sir CHAS. WILSON.—I beg to second that.

[The resolution was then put and carried unanimously.]

Mr. DAVID HOWARD, D.L.—On behalf of the Council and Officers of the Victoria Institute, I beg to thank you for the vote you have just passed.

I can assure you it is not a light matter to take part in the work of the Victoria Institute. There is so much that is new, so much that is interesting, and so much that ought to be thought about that it is often a little difficult to know exactly what line to take for consideration. It is impossible to do all we might do, or we would willingly do it under the terms of our constitution, and yet what we do is done with all our hearts. What we do is to endeavour to spread a wise and sober habit of thought in all the many questions that come up before us, and, after all, it is the habit of thought that is perhaps the most important point. It is very possible to arrive wrongly at a right conclusion. It is very possible to hold what is perfectly true on a perfectly unsound basis.

I have known people who on points of elementary science had that delightful assurance which comes early in life, and which we unfortunately lose in later life, when we know a little more; and when I have asked them the grounds of their certainty, they have given answers that were right, but their bases were wrong. What we want is soundness of method, and the more one studies, the more the measure of soundness of method seems to me to be the proportion that rules the two great factors in progress—viz.,

patience and humility. The danger, in regard to all progress, is of being in too great a hurry, and therefore patience is a thing we should cultivate. "Genius is of long patience," as a French philosopher said, and it is perfectly true, when we come to consider the infinite perplexities and difficulties of many of the questions that we endeavour to solve and the marvellous abyss of ignorance in which we are; because, after all, when we have gained the faintest conception of what the force of gravitation is (I mean the real basis of it), and are familiar with its most elementary points, we know nothing. I think, therefore, we may learn patience in giving time to find out what little we know, and humility when we are face to face with the infinite mysteries of Nature, inasmuch as we have learnt the infinite littleness of man.

I cannot help feeling, in reference to the recent awful calamities in the West Indies, that great as our attainments and our knowledge may be of Nature its forces are infinitely greater. [Applause.]

*THE WATER SUPPLY OF JERUSALEM.**

By Major-Gen. Sir C. W. WILSON, R.E., K.C.M.G., F.R.S.

ABOUT forty years ago there was a scarcity of water at Jerusalem in consequence of a deficiency in the rainfall of Southern Palestine. The sufferings of the poorer classes, especially amongst the Jews, aroused the sympathy of many charitably disposed persons in this country, and there was a general feeling that some steps should be taken to improve the water supply and sanitary condition of the city. Proposals for their improvement were put forward by Dr. Whitty and Sir John McNeill; but it was soon realized that no scheme could be carried out until an accurate survey of the city and its environs had been made. This was carried out in 1864-65, by the Ordnance Survey Department, at the cost of Lady, then Miss, Burdett-Coutts, and, on its completion, the same generous lady offered to provide the requisite funds for the improvement of the water supply. The offer was rejected for various reasons, amongst which may be mentioned the desire of the Governor to obtain possession of the money and carry out the work himself. In the end, the Governor's suggestion that he might be permitted to raise money locally and repair one of the ancient aqueducts was approved. Money was raised, and the Governor was soon able to report that, as in the days of Solomon, Jerusalem was supplied with spring water. The water ran for about two months; then some evil-disposed person broke the conduit; and, as it was nobody's business to repair it, matters reverted to their previous condition.

In after years the city spread northward and westward beyond its walls, and the water supply question occasionally received slight attention. Twice or thrice the old aqueduct was repaired with the usual result; but it was not until 1888 that a serious effort was again made to improve the water supply. This effort was due to Sir Edmund Lechmere,

* Being the Address delivered at the Annual Meeting of the Victoria Institute, 26th May, 1902.

whose name is so well known in connection with the Ophthalmic Hospital of the Knights of St. John, at Jerusalem. Sir Edmund, whilst on a visit to the Holy City, had his attention drawn to the great scarcity of water, and, when at Constantinople, he submitted a memorandum to the Grand Vizier on the subject. He at the same time asked the Imperial Ottoman Government to grant him a concession for bringing water into the city, and explained that he was actuated by philanthropic motives and not by any desire for gain. The Grand Vizier and the Minister of the Interior promised a firman for the execution of the work; and H.M. the Sultan, at an audience which he granted to Sir Edmund, expressed his great interest in the undertaking, and said as much as he could without committing himself to a definite promise. On his return to England, Sir Edmund formed a committee for taking over and working the concession: financial support was promised, and a definite project framed which would have supplied water free to the poor by standposts in various parts of the city, and have given every resident a reasonable daily supply. Sir Edmund paid more than one visit to Constantinople and Jerusalem in connection with the enterprise, but failed to obtain a firman. After his death, an application for the concession was made by his son, Mr. Anthony Lechmere, and Lady Lechmere, who had also been kindly received by the Sultan, made a personal appeal to H.I.M. through the British Embassy. The replies were courteous but non-committal. In 1898, after continuous effort to obtain a concession without making any solid progress, the Committee was dissolved. The chief reason for the failure was the old one—the desire of the local authorities to obtain possession of the money and spend it themselves.

Shortly afterwards the Municipality of Jerusalem was authorized to form a company, on which no foreigner was to be a director, to supply the city with water. An appeal for financial assistance was made to some of the members of Sir Edmund Lechmere's Committee; but no satisfactory guarantee could be obtained that the money would be profitably expended, or that the poor of all creeds would receive a gratuitous supply. Before this correspondence was closed, a serious deficiency in the rainfall during the season 1900-01 was followed by a water-famine, and great suffering amongst the poor. The municipal authorities were obliged to take immediate steps to obtain water, and made

arrangements with the railway company to bring up a supply from Bittir and "Philip's Fountain," and with camel and donkey-owners to carry in water from other springs. The railway company brought the water in tanks to the station on the Plain of Rephaim, and then ran it down through pipes to the low-lying pool, Birket es-Sultân, in the Valley of Hinnom. Thence it was carried up to the city by the water-carriers. About 1,122,000 gallons were delivered at a cost of about £425.

At the same time the municipality arranged with a local engineer to bring water to the city, from Solomon's Pools, in iron pipes. The arrangement ended in a fiasco which has cost more than £6,000 without permanently improving the supply. The ancient low level aqueduct, ascribed to Solomon, which delivered a strong head of fresh cold water, from the pools, in the Harâm esh-Sherîf, or Temple Area, might have been well restored and utilized, as it had been on previous occasions, at a cost of about £600. But, instead of adopting this obvious plan, as a temporary measure, a contract was made with a German firm for the supply of about 12,700 yards of 4-inch iron pipes at a cost more than £300 higher than the estimate of a Birmingham firm. And when the pipes arrived they were laid on the surface of the ground, up hill and down dale, from Bethlehem to Jerusalem. The result has been loss of level and pressure. Feeble streams of water are delivered in the Harâm esh-Sherîf where it is only available for Moslems, and at the Birket es-Sultân whence it has to be carried up a steep hill to the city. To obtain even this small result, the floor of a remarkable rock-hewn tunnel of the ancient aqueduct was lowered and a long narrow reservoir formed in which water is allowed to accumulate during the night so as to keep up a steady stream on the following day. The water running by day through iron pipes exposed to the direct rays of the sun arrives in such a heated state as to be unfit for drinking. No attempt has been made to supply water to any quarter of the city, and the sum expended may be regarded as practically thrown away.

It is well known that the water supply of ancient Jerusalem was ample, and that, at the time of the Turkish occupation of the city, there were still public fountains in the lower parts of the city. The details of the old system of supply are not fully known, but the existing remains of pools, conduits, etc., are sufficient to show that, in

engineering skill and extent, the works connected with it were comparable to those of ancient Rome. An examination of the conditions which governed, and still govern, the water supply, and of the various works constructed during the most flourishing periods in the history of the city, must necessarily precede any attempt to prepare a scheme which will satisfy modern requirements.

Jerusalem stands at the end of a well-defined spur, which lies between the Valley of Hinnom and that of the Kidron and stretches southward, for about $1\frac{3}{4}$ miles, from the ridge that parts the waters of the Dead Sea from those of the Mediterranean. The Kidron, after running eastward for $1\frac{1}{2}$ miles, changes its direction to the south, and separates the Mount of Olives from the lower ground on which the city stands. The Valley of Hinnom, after following a southerly course for $1\frac{1}{4}$ miles, turns eastward, and meets the Valley of the Kidron below the south-east corner of the city. The enclosed space may be described as a small limestone plateau, about 1,000 acres in extent, which falls gradually to the south-east, and terminates in abrupt slopes. The two valleys, at first little more than shallow depressions in the ground, become, as they approach the city limits, rocky ravines, and their point of junction is 672 feet below the ground in which they rise.

The surface of the plateau is broken by two minor ravines which rise in it to the north of the city walls. One, the Tyropœon, runs southward through the city to join the Kidron at Siloam, and divides the lower portion of the plateau into two spurs of unequal size. The western is high and broad-backed, but its continuity is broken by a short ravine, the "Palace Ravine," which falls abruptly eastward from the vicinity of the Jaffa Gate, and joins the Tyropœon about 700 yards above Siloam. The eastern and lower spur, upon which the Temple formerly stood, is for the most part a narrow ridge of rock. The second, of the small ravines, "St. Anne's Ravine," rises in the eastern half of the plateau and, running beneath the north-east corner of the Harâm esh-Sherif, falls into the Kidron a short distance to the north of the Golden Gate. Those portions of the ravines which lie within the city walls, are now filled with *débris* from 80 to 125 feet deep, and the rocky nature of their slopes is concealed.

The surface of the plateau is composed of thin beds of a hard reddish and grey stone (Upper Hippurite limestone,

locally known as *misse*) which have a south-easterly dip. These strata overlie a thick bed of soft, easily worked stone (Lower Hippurite limestone, locally known as *meleke*), beneath which are beds of pink and white indurated chalk. This formation greatly facilitated the construction of underground cisterns, conduits, and drains, since the soft *meleke* could be quarried away, and the harder *misse* left as a natural roof to protect the water from evaporation and pollution.

The only true spring, at the present day, is the "Fountain of the Virgin" in the Kidron Valley, at the base of the eastern spur. The people principally depend upon wells, upon the rainfall collected in cisterns and tanks, upon flood water impounded in reservoirs and allowed to flow down to the city by gravitation, and upon water brought from a distance by aqueducts. The position of Jerusalem is convenient for the construction of works connected with these artificial sources of water supply.

Rainfall.—This varies greatly. The average for the rainy seasons of the forty years 1860–1900 is 25·7 inches, the minimum 12·5 inches, and the maximum 35·6 inches.

There is no reason to suppose that the laws which governed the growth of Jerusalem differed from those that prevailed at other places. The first settlement would naturally be on the eastern spur in close proximity to the spring; and many of the best authorities believe that the town had not spread beyond the limits of that spur before its capture by David. Possibly the pre-Israelite occupants constructed conduits to carry off the surplus water of the spring to irrigate gardens in the Kidron Valley, and made the rock-hewn shaft, which was discovered by Sir Charles Warren, to reach the water in times of war and siege.

The improvement of the water supply must have kept pace with the growth of the city and the increased requirements of the people. For instance, the rapid extension of the city during the prosperous reigns of David and Solomon, and the institution of the Temple services, must have necessitated the construction of waterworks on a large scale. So also the revival of the services by Hezekiah and his preparations to resist the Assyrian army were accompanied by additions to the works connected with the supply of water. After the fall of the Monarchy, the only pre-Christian building periods of importance were those connected with the names of Nehemiah and Herod the

Great. In Christian times there were the building of *Ælia Capitolina* by Hadrian and of "New Jerusalem" by Constantine, and the readaptation or reconstruction of the city by Arabs, Crusaders, and Turks. Upon each of these occasions the supply of water must have been a matter for serious consideration; pools, conduits, and cisterns would be restored and possibly new works constructed. Our present knowledge of the works connected with the ancient water supply is very far from being complete, and the identifications proposed in the following notes can only be regarded as provisional.

Springs.—The "Fountain of the Virgin" (the Gihon, and possibly also the Enrogel of the Bible) is the source of a small perennial stream which is increased in volume at uncertain intervals by a sudden rush of water from the spring. During a wet winter the stream floods two or three times a day; in summer only once in two or three days. The spring is dependent upon the annual rainfall, and the water is to a certain extent polluted by its passage through the accumulated refuse of centuries. The water was originally sweet, and digestive properties were attributed to it by the Rabbis. It is now brackish and impure, but is still used, without apparent ill effect, for drinking purposes by the poor of Jerusalem and the villagers of Siloam. The spring cannot thus be utilized in any scheme for a supply of pure water.*

In early days the water from the spring ran down the valley of the Kidron, and perhaps irrigated gardens; then, possibly during the reign of Solomon, it was impounded in a pool in the same valley, which is called "Solomon's Pool" by Josephus (*B.J.*, v. 4, § 2), and has not yet been recovered. Then, apparently for the convenience of dwellers in the lower parts of the city, and to give increased facilities for the irrigation of the king's gardens, a conduit, partly rock-hewn, was constructed to carry the water to a pool in the Tyropœon valley in the position now occupied by the pool of Siloam (see *Q.S. of P.E.F.*, 1886, p. 197; 1891, p. 13; 1902, p. 29). This conduit is perhaps referred to in the words of Isaiah (viii, 6), "The waters of Shiloah that go softly"; and as "the brook that ran through the midst of

* The Editor some years ago endeavoured to explain the cause of the intermittent action of this spring on the syphon principle. He is unable to recall the name of the publication in which the paper appeared.

the land." Lastly, probably during the reign of Hezekiah, the winding rock-hewn tunnel, which still connects the spring with the pool of Siloam, was made, and the water was collected in the two pools of Siloam (*see Hastings' Dict. of the Bible*, art. "Siloam").

It is possible that other springs may have existed in the Tyropœon and St. Anne's ravines, but they are not mentioned in the Bible or Josephus, and cannot have been of any importance.

The only *Well* of importance, Bir Eyûb, or "Job's well," which has claims to be considered Enrogel, is situated below the junction of the Kidron and Hinnom valleys. It is 125 feet deep and is rarely dry. After four or five days' continuous rain it becomes filled with flood-water and a stream runs for a short distance down the valley. There are also in several parts of the city retort-shaped excavations at the bottom of deep shafts for the collection of such water as filters through the beds of limestone. The well that supplies the baths, Hammam esh-Shefa, is merely a shaft in the rubbish which gives access to a small basin in which water running down the Tyropœon valley collects. It is not certain whether the well known "well of spirits" in the Harâm esh-Sherif is a well or not.

Cisterns for the collection and storage of water, coated with hard durable cement, are found in all quarters of the city and its environs. The oldest are those with natural rock roofs which have been excavated in the *meleke* bed. They are of all sizes, from the small rectangular tank with its single draw-hole to the great storage reservoirs in the Temple area which have their roofs supported by pillars of rock. The finest of these, called "The Great Sea," holds 3,000,000 gallons, and is supposed to be the cistern which Simon covered with plates of brass (Sir. i, 3). Next in date are the rock-hewn tanks with vaulted roofs of masonry: a few of these may date from the second century B.C. Cisterns partly rock-hewn and partly of masonry, and those built in the *débris* of the old city are of later date.

Cisterns are mentioned by Jeremiah (ii, 13), and, under the monarchy, every house appears to have been supplied with one (2 Kings xviii, 31; *cf.* Prov. v, 15; Isaiah xxxvi, 16), for the collection of rain water, which was conveyed from the roof and courtyard by pipes and surface gutters. The water was drawn from the cistern by means of a wheel (Eccles. xii, 6). Water collected, as described above, naturally

carries into the cistern much solid matter, which falls to the bottom and necessitates annual cleansing. It was into an uncleansed cistern in the court of the guard that Jeremiah was lowered (xxxviii, 6). Much of the sickness amongst the poorer classes in summer and autumn is due to the neglected state of the cisterns and want of care in sweeping roofs and pavements before collecting the rainfall.

Pools.—The valleys which enclose and intersect the Jerusalem plateau offer peculiar facilities for the impounding of flood water in pools, or reservoirs, and in each of them there are either the remains of such pools or evidence of their previous existence. The pools are all of great size, and partly rock-hewn; and the dams at their lower ends, where not of rock, are constructed of solid masonry of great thickness.

Near the head of the Kidron Valley are the remains of a large pool well situated for the collection of flood water; but the conduit through which the water ran down to the city has not yet been found. At the lower end of the valley was "Solomon's pool," mentioned above, which is perhaps that referred to by Nehemiah (iii, 16) as "the pool that was made."

In St. Anne's Valley there are the twin pools near the Church of St. Anne which are believed by some authorities to be the Pool of Bethesda, and, lower down the valley, the Birket Israil, also identified with Bethesda, which in recent years has been filled up with rubbish and refuse. The dam of the Birket Israil apparently formed part of the *second wall*, and so of the defences of the city.

There is documentary evidence, brought to notice by M. Clermont-Ganneau, of the existence of a pool near the head of the Tyropœon Valley. In a charter dated 1177 it is termed the "lake" of Legerius, and, in some old Arab title deeds, the ground in the vicinity is called Hâret el-Birkeh, the "Quarter of the Pool." There is now no trace of the pool, but it was apparently high enough to supply the ancient rock-hewn conduit on the eastern spur (*see below*), and it may be the "Upper Pool" referred to in Isaiah vii, 3; xxxvi, 2. At the lower end of the valley are the Upper and Lower Pools of Siloam, which were supplied with water from the Fountain of the Virgin by means of the rock-hewn tunnel supposed to have been constructed by Hezekiah. The upper pool, of which the true dimensions were determined by the excavations of Dr. Bliss for the Palestine

Exploration Fund, is probably the Pool of Siloam of the Bible. It is now a small open tank built in the rubbish that fills the old pool. The lower pool, which has not been completely explored, is apparently the reservoir between the two walls mentioned in Isaiah xxii, 11. As in the case of the Birket Israil, its dam formed part of the defences of the city. It is now used as an open cess-pit for the reception of the drainage of the city. There is some reason to believe that, higher up the valley, between the *first* and *second walls*, there was a fourth pool.

In the short "Palace Ravine" is Hezekiah's Pool, apparently the "Pool Amygdalon" of Josephus (*B.J.*, v, 11, § 4), which receives its water by gravitation from the Birket Mamilla near the head of the Valley of Hinnom. The latter reservoir appears to be the "Serpent's Pool" of Josephus (*B.J.*, v, 3, § 2), and is supposed by some authorities to be the "Upper Pool" mentioned by Isaiah. Much lower down the Valley of Hinnom is the Birket es-Sultân, constructed or restored by German knights in 1170, and repaired by Sultan Suleiman in the sixteenth century.

There were thus ample means for storing water in and near Jerusalem, but, as the town grew, the supply from the rainfall was insufficient and water had to be brought from distant springs by conduits or aqueducts.

Conduits.—The two principal conduits have been distinguished as the high- and low-level aqueducts. The *low-level aqueduct* conveyed water from three pools in Wâdy Urtâs, about seven miles south-west of Jerusalem, to the Temple enclosure on the eastern spur—Mount Moriah. The reservoirs are now known as "Solomon's Pools," and tradition, not without reason, ascribes the construction of one or more of them, and of the conduit which carried their waters to Jerusalem, to Solomon. The pools act as storage reservoirs for the waters of 'Ain es-Sâlih—a fine spring better known as "the Sealed Fountain," and of flood water after winter rains. The conduit starts from the Lower Pool, and almost at once receives a stream from 'Ain 'Atân which rises in a *kariz*, or tunnel, in the vicinity. The aqueduct has a length of about thirteen miles, and passes through the hill on which Bethlehem stands by a tunnel. A second tunnel nearer Jerusalem has been turned into a tank in connection with the new waterworks (*see* p. 13). The conduit crossed the Valley of Hinnom above the Birket es-Sultân, which it probably filled, and, after winding round

the western spur of the plateau, passed over the causeway and Wilson's Arch to the Temple enclosure. It is this conduit, which only supplied the lower quarters of the city and the eastern spur, that has from time to time been repaired. At a later date the supply of the low-level aqueduct was increased by the construction of a reservoir in the Wâdy 'Arrûb, near the road to Hebron, for the collection of spring and flood-water. This pool was connected with the Wâdy Urtâs system by a conduit 28 miles long, which is possibly that attributed by Josephus (*Ant.*, xviii, 3, § 2; *B.J.*, ii, 9, § 4) to Pilate. It is, however, doubtful whether Pilate did more than restore an existing conduit.

The starting point of the high-level aqueduct is *Bir ed-Darije* at the head of a remarkable *kariz*, or tunnel, about four miles long, in Wâdy Biâr. This tunnel, reached from the surface by numerous shafts, tapped several small springs, and, in winter, collected much flood-water. After leaving the tunnel the conduit carried the water to a pool in which the solid matter settled, and then, passing through a tunnel 1,700 feet long, crossed the Urtâs Valley above the Upper Pool. Here, where its level is 150 feet above that of the low-level aqueduct, the conduit received the waters of the "Sealed Fountain," and delivered them at Jerusalem, at a level 20 feet above that of the Jaffa Gate. The high-level aqueduct was thus able to supply the western spur, south of the Jaffa Gate, and all that quarter in which the Church of the Holy Sepulchre now stands; it probably also fed the Birket Mamilla.

An interesting feature of this aqueduct is the inverted syphon of perforated limestone blocks, forming a stone tube 15 inches in diameter, by which it crosses the valley near Rachel's tomb. On several of the blocks Latin inscriptions of the time of Severus (A.D. 195), in nearly every case the names of centurions, have recently been found; and this has led some authorities to ascribe the construction of the aqueduct to that period. The objections to this view are:— That the constant supply of running water implied by Josephus' description (*B.J.*, v, 4, § 4) of the fountains and streams in the gardens of Herod's palace could only have been furnished by a high-level aqueduct from perennial springs; that similar stone syphons at Patara, Laodicea, and other places in Asia Minor are of much earlier date than Severus, and possibly of Greek origin; and that at the close of the second century A.D. the level would have been

maintained by building an aqueduct across the valley, and not by a laboriously constructed syphon. A more probable view seems to be that the high-level aqueduct was the work of Herod and that it was restored in the reign of Severus. Both high- and low-level aqueducts must have been seriously damaged during the Jewish revolt in Hadrian's reign; and the low-level aqueduct alone may have been restored on the foundation of *Ælia*. The great tunnel in *Wâdy Biâr* was perhaps constructed at an earlier date to feed the low-level aqueduct, and afterwards utilized by Herod.

It has been conjectured that the low-level aqueduct was popularly called "Tannin" from its serpentine course, and that the "Dragon's Fountain" of Nehemiah ii, 13, was a fountain which it supplied in the Valley of Hinnom. Similarly the "Serpent's Pool" of Josephus (*Birket Mamilla*) may have received its name from the fact that it was filled by the high-level aqueduct.

Within and near the city several portions of conduits have been found. The oldest are:—(i) The rock-hewn conduit on the eastern hill, which delivered water to the Temple enclosure, and is broken by the ditch that separated *Bezetha* from the *Castle Antonica*, and by the *peribolos* wall of the Temple precincts. This was perhaps fed by the "lake" of *Legerius*, and may have been "the conduit of the upper pool" (2 Kings xviii, 17; Isaiah vii, 3; xxxvi, 2). After the construction of the *Antonia*, it could only have served the two pools in the ditch of that fortress. (ii) A conduit at a low level in the *Tyropœon* valley, beneath *Robinson's Arch*, which was destroyed when the western wall of the Temple enclosure was built. (iii) The tunnel already mentioned as conveying the water of the fountain of the *Virgin* to *Siloam*. (iv) The remains of a conduit at a very high level have been found on the western spur, but no clue has yet been obtained to the source of its supply. *Bireh* has been suggested, but the remains of a conduit of such length could hardly have escaped notice.

The method adopted for distributing water in the ancient city is unknown; but it seems probable that there were public fountains and small pipes to the palaces and larger houses. The beautiful fountains built by the Arabs are well known to those who have visited Jerusalem.

The steps that should be taken to ensure a water supply which would in some measure meet modern requirements can be only briefly noticed. The question, a simple one

when Lady Burdett-Coutts made her generous offer, has been complicated by the extension of the city over the plateau north of the walls, and over parts of the valley of Hinnom. This has been accompanied by a very great increase in the value of the land, and in the numbers to be supplied; and by the fouling of ground that was formerly clean and suitable for the construction of reservoirs.

The only proper system is to construct reservoirs which can supply the plateau with water by gravitation, and to feed them by pumping up water from lower levels. A supply, amply sufficient for present requirements, could be obtained by repairing the Pools of Solomon; by constructing reservoirs for impounding flood-water in Wâdy Biâr; by tunneling, three miles, from the springs in Wâdy 'Arrûb to Wâdy Biâr; and by pumping up water from the spring at Urtâs to the low-level aqueduct. The water could be carried along the line of the ancient aqueduct to a pumping station at the Birket es-Sultân, whence it would be pumped up to the reservoirs. Other springs could be brought into the system when necessary.

It need hardly be said that the proper repair of some of the old works such as Solomon's Pools, the Wâdy Biâr reservoir and conduit, and the low-level aqueduct; and the establishment of public fountains in the lower parts of the city would give a certain amount of relief. But it would be more economical in the end to construct permanent water-works for the supply of the rapidly growing city. Pumping operations have been greatly simplified by the construction of the railway. An order compelling the builder of every new house or public building to provide a cistern of proper size might also be suggested.

The provision of proper drainage, for which the position of the city offers certain facilities, is quite as necessary as that of a sufficient supply of water. No serious attempt has yet been made to grapple with this very important matter. The existing drains are bad; the main sewer has its outlet in the lower Pool of Siloam, and the rubbish upon which the city stands is nearly everywhere saturated with the sewerage of centuries. Even in the new quarters outside the walls the arrangements are little better except in those houses which have properly constructed cess-pits that are periodically cleaned and deodorized. The ancient system appears to have centred in a main drain which ran down the Tyropœon Valley to a series of subterranean rock-hewn tanks and

drains discovered by Sir C. Warren near Bîr Eyûb. The solid matter settled down in the tanks, whilst the fluid ran off; and the tanks could be reached by several flights of rock-hewn steps when it was necessary to empty them. The restoration and extension of this system would seem to be the best way of meeting existing difficulties, and of improving the sanitary state of the city.

DISCUSSION.

The SECRETARY.—Mr. President, ladies and gentlemen: It is my privilege to be allowed to move a hearty vote of thanks to Sir Charles Wilson, for his kindness in delivering this interesting and most instructive address this evening.

Some time ago it occurred to the Council that they might, perhaps, induce Sir Charles, notwithstanding the constant calls upon his time, to give one of our ordinary papers on a subject in connection with Jerusalem, particularly the water supply, in which we are all interested; but, afterwards, we thought on reconsideration that the subject would warrant our asking him to give the annual address, as he has done this evening.

I am sure you will agree with me that the Council came to a wise decision [applause], and that we are greatly indebted to him for the address he has given. Jerusalem is a city of the world to which all eyes are turned, both of Jew and Gentile, and those who have been residents for any time in Jerusalem know how deficient it is in two of the great requirements of a city—viz., water supply and proper sanitary drainage. To myself it has always been a wonder how it is that the inhabitants have not been, from time to time, swept away by typhoid, cholera, or some other disease arising from the want of drainage. If things had been allowed to take the course they ought to have done when Lady Burdett-Coutts so handsomely offered to pay for the restoration of the water supply to Jerusalem from Solomon's Pools—if her wish had been carried out, which was to call in the advice of Sir Charles Wilson himself, who has not mentioned that point (but I believe I am right in saying this)—to put the money into his hands and to have been as adviser and engineer for the carrying out

of this great and desirable system of water supply, restoring it to what it was at the time of Solomon, things would have been very different in the city of Jerusalem from that day down to the present. But we have had this evening a sufficient illustration of the character of Turkish rule in Jerusalem, and, I may say, in almost every part of the world where it is predominant. If British rule had been adopted there, things would have been different in this city, and I venture to say we should have had a proper water supply and an efficient system of drainage. Let us hope that the day may come. We know that the inhabitants would welcome the British suzerainty and authority there to carry out works, instead of the works that are carried out now under the Sultan's authority.

I will now call on you to pass a hearty vote of thanks to Sir Charles Wilson for his address, illustrated as it has been by a very interesting series of photographic pictures.

Dr. PINCHES.—I have much pleasure in seconding the vote of thanks that has been proposed by Professor Hull to Sir Charles Wilson for his interesting address.

[The vote of thanks was then put to the Meeting and carried by acclamation.]

Rev. F. A. WALKER, D.D.—Mr. President, ladies and gentlemen: I have been entrusted with the very pleasing duty of proposing a hearty vote of thanks to our President, Sir George Stokes. We are all aware how often he comes among us from Cambridge, probably constantly leaving his other pressing duties to do so. It needs no words of mine to denote how we value the privilege of having him for our President as one of the leaders in physical and experimental science. Long may he continue with us to help us, and to lead us all more towards the light.

Rev. JOHN TUCKWELL.—I have great pleasure in seconding the resolution which has just been proposed, for no more fitting President of such an Institute could be found. It is a source of strength to us in the work we do in connection with it, to have one so eminently scientific and of such acknowledged eminence as Sir George Stokes presiding over us, and at the same time occupying a position which enables us justly to say, according to the principles of our Institute, that there is no contradiction between the voice of science and the voice of divine inspiration concerning truth of every sort and kind.

I have great pleasure, therefore, in seconding the vote of thanks, and as the President cannot well do so himself, I will now put it to the Meeting.

[The vote of thanks was then carried unanimously.]

The PRESIDENT.—I am very grateful to you, ladies and gentlemen, for the kind way in which you have received this proposal.

I am advanced in years, and I have duties in Cambridge, so that I fear it is only now and then that I have been amongst you. Still I have occasionally and on somewhat recent occasions come up, when most of you have not been aware of it, to take part in important meetings of the Council when I have felt it my duty to be present.

I have endeavoured throughout my office to lead everybody to examine any subject quite fairly and without prejudice, for we may all be sure that truth from one quarter will not contradict truth from another. Let us openly and honestly follow out Truth. (Applause.)

The Meeting then terminated.

ORDINARY GENERAL 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 by the author:—

ON THE SPRINGS OF CHARACTER. By ALFRED T. SCHOFIELD, Esq., M.D., M.R.C.S.E.

IN offering a few remarks upon the springs of character, it will be well to clear the ground first by a brief consideration of character itself. The first question is, What is character? Character etymologically is the mark of the brick-maker on the Babylonian brick, by which it is recognised as his own. In the same way character may be defined as *the shape that the mind becomes by use*, just as a glove or shoe—perhaps at first exactly like thousands of others—becomes individually specialized by the shape of my hand or foot by wear. This gives a fairly good idea of character in one of its aspects. It may be defined as the *εἰκων* of the *εἶψα*, or likeness of the self—the psychic likeness, exactly as the body is the physical likeness. The physical impress of my being is in what meets the eye in the body generally—the psychical impress of my being consisting of my mental attributes, and the amount that is seen of the character I possess.

Character has its home in the unconscious region of the mind and it is only by an effort of introspection, more or less difficult, that we can even partially discern our own characters.

In saying this I must just make one observation on mind in general. I regard mind as never being wholly in consciousness, or within the range of what may be called our

* March 19th, 1900.

own mental vision. It is a natural error, into which many have fallen, to limit the term *mind* to what is seen of mind. But sight is not our only method of investigation, either in the physical or in the psychical. The fact that our thoughts are largely governed by what we see may be instanced when we call the top of a high coral mountain, say in the South Pacific, an island of a certain size; we say it is so many miles long and broad because that is all of it that is visible above the water, but in fact at low tides and on very calm days we can see that it stretches away underneath the water to a much greater extent, and we know well by other agencies than sight that our island is really the top of a vast mountain made up of minute organisms rising from the depths of the ocean. So only a limited part of the mind is ever in full consciousness, more may be seen by careful introspection, but there still remains a vast area beyond consciousness that is recognised by other methods.

Again a thermometer only recognises the extent of temperature within its range or scale, just as only those waves of ether or air are called light or sound that are within the range of our vision or hearing. But we know well in all these cases we are merely recognising the middle regions of phenomena that really extend both below and above the range of the thermometer scale, or of our sight or hearing. So with our minds,—what we generally call the mind is that psychic action that is within the range of our mental sight or consciousness, and we only say we are thinking when we know we are thinking.

Such a mode of speech is safe and convenient, but it is limited and not strictly accurate. If we dogmatise on it and say that consciousness alone is mind, we are led into the serious error of denying that we have any psychic powers that are beyond the range of our own consciousness. In astronomy some most remarkable advances have been made by inference. Planets have been discovered from the deviations caused in the motions and orbits of planets already known, from which their existence was correctly inferred. In like manner we can, with the utmost certainty, infer and prove the existence of extensive psychic processes beyond the range of our own consciousness. No one who does not recognise unconscious mind, or unconscious psychic powers in individuals, can really form a clear idea of what character is, or where it is to be found.

We are here to-day, however, to speak, not of character,

which may be defined as the sum of our mental and moral attributes; but of the springs of character—something deeper still! If the whole of character lies hidden in the unconscious mind, so *a fortiori*, do the springs on which it depends. In using the word *spring*, one must distinctly understand that it has three, or more meanings. It is a season of the year, it is a source, and it is a power. A spring is the source of a river or the power in a watch. In speaking of the “springs of character” we use the word in both of these two meanings, and we say that the main springs of character are three in all—the sources being two-fold, constitute two of the springs, and the power is the third; the three being Heredity, Habit and Will—heredity and habit having been very aptly and alliteratively termed Nature and Nurture.

Let us then look very briefly, first of all, at these three and then consider them a little more in detail.

With regard to the first spring, Nature or Heredity, we have in an infant the product of at least six human beings—four grandparents and two parents being generally more or less clearly seen in the product (the child). If we consider this for a moment we see at once what extraordinarily different characters we can get from the same hereditary stock. Many have been much puzzled as to why the same system of treatment that answers so well with one child is purely hurtful to another. It is because these parents have never really grasped in the first place the all-pervading power of heredity, nor seen in the second, as a cook would, the enormous variety of dishes that can be produced from the same ingredients according to the proportions that are used. Thus if we get a boy with a dash of the maternal grandmother and the rest mainly paternal grandfather and father, we get a very different character from one with a good deal of the maternal grandfather and only a little of the paternal ancestry. In this we have the key to the extraordinary diversity of characters seen in one family descended from the same stock.

When we pass on to the second spring—Nurture, or the formation of Habit—we come to a power which has the property of infusing new principles into the character; new principles so strong that they may have the power of overcoming those qualities that were derived from heredity. Herbert Spencer has observed, with immense force, with regard to this, that “a man is more like the company he keeps than that from which he is descended.”

Now in considering habit as a source of character we must be clear about one point. New acts, or the motives that cause new acts, do not form a fresh part of character until they become unconscious. As long as an action is performed each time by effort or from a conscious impulse, it forms no part of the character; because when the impulse comes into consciousness, the mind has to consider what it will do, seeing the action is not yet natural to the individual. The moment it becomes natural or, in other words, sufficiently habitual, that new action, or that new principle, begins to form an actual part of the character. This is an important fact—that acts must sink, in their motives, into unconsciousness, and be performed without conscious effort before they express a part of the character of the individual. This I will enlarge upon a little later. Let me give an instance—I may tell the truth in a court of law, or I may tell the truth under certain circumstances, with undeviating regularity, and yet I may not be a truthful person habitually. A liar may on certain occasions speak the truth when there is sufficient impulse or consciousness present to prevent his telling his habitual lies. It is only when I tell the truth unconsciously and naturally that you can call me a truthful person. Again, I may exercise great care in the pronunciation of French and speak it with the utmost nicety, but that does not make me a careful person or careful in doing other things—such for instance as riding a bicycle. But if I am a careful person naturally I shall show care all round—it comes unconsciously into play whenever occasion arises.

The third spring is the Will, and to this merit and direct responsibility attach. Direct responsibility does not attach to what I do unconsciously. Direct responsibility does not attach to unconscious principles that I have inherited from my parents. Merit, demerit, and direct responsibility attach to the energising of these into actions by the will. This is the direct work of the *ego*. We must remember with regard to will, that a strong will simply means a strong character; but not necessarily a good character, any more than a weak character implies bad morals.

Now let us look a little closer, in what time we have at our disposal, at these three intricate springs of character.

First—Heredity. In heredity we must remember that we no longer believe that we inherit fixed qualities nearly so much as that heredity shows itself in tendency or potenti-

alities: tendencies which, by education and culture, can be converted into flowers or weeds, into virtues or into vices. This is the case nearly all round. It is true even in our physical nature. It is very rare indeed for a man to inherit a disease, but it is exceedingly common for him to inherit a *tendency* to disease; and this saves us from fatalism, because we are certain that in time we may prevent the tendency, but we cannot prevent a fact that is already established. Therefore, I repeat, instead of looking on children as ready formed compendiums of virtues and vices, we rather look on them as teeming with endless potentialities, filled as they are, with tendencies that have been derived from their ancestry. Let me give an illustration of this.

Battered and defaced though the Divine image may be in the human mind it is still clearly to be traced, and especially in infancy. All infants are distinguished by inheriting two remarkable tendencies, or principles. The one is love, and the other is justice. All children love, and all children, in infancy, have a most marked sense of justice or right, which often causes them great distress when they find the limits overstepped by those whom they are taught to believe are wiser than themselves. Now love and right are, simply, love and light, and love and light are essentials in the character of God. God has impressed these two qualities on every infant mind. But, observe, that love may be changed into a positive vice when it becomes love of self, or pure egoism. Justice itself may be changed into positive evil if it is developed into nothing but standing up for one's own rights. On the other hand, the two may be made to blossom and bloom into two most beautiful virtues—the love of others and standing up for the rights of others: in short, we have tendencies which may become altruistic or egoistic virtues or vices. This is effected by the training of these potentialities, which is largely carried on in early life by the unconscious influences by which the child is surrounded. Environments and suggestions are, undoubtedly, two strong forces by which a child's early life should be trained—by which its infant mind is evolved—suggestions of good and not of evil: for suggestions have an enormous weight when those suggestions come from one having such a powerful influence over a girl or child as its own mother. It is hardly too much to say that a mother is nearly as all-powerful over a child's mind as that of a hypnotizer over the hypnotized: the re-

lation, I need hardly say, being very different. Of course, the results of such training may not be seen till long after; for we may notice here that the springs and roots of character lie deep in the unconscious mind—the flowers and fruit blossom—and bear in consciousness.

Now with regard to the second great spring of Habit, may I just turn your attention, for one moment, to the physical side of the question? Professor Hill at Cambridge and others have shown that sensations and impulses that at first rise into consciousness and require effort and will to produce action, if sufficiently frequent and the resulting action be the same, eventually do not rise into consciousness at all, but are “short circuited,” and performed without effort, or the active intervention of the will; in other words, actions at first consciously performed become unconscious as they become habits, as, for instance, walking and the act of reading. To put my left (or right) foot first into my stocking soon becomes an unconscious habit, and I do it as a matter of course. As long as an action proceeding from a new principle is performed consciously, or is performed with a certain amount of effort, we have no reason as we have seen to believe that the principle forms part of character—in fact, it is clear that it does not, because on other occasions we do not act in the same or similar way. But when an action becomes habitual the principle at the root of that action begins to form part of character, and is a spring of conduct that can be relied and calculated upon; in other words, I may possess a virtue, or a virtue may possess me, and there is all the difference between the two. If I teach a dirty boy to wash his hands before meals I do not make cleanliness a part of his character; but if he habitually washes his hands and is made to be clean in other ways by a watchful parent or teacher, for a length of time, he eventually becomes a clean boy, and cleanliness becomes engraved on his character, so as to form a fresh spring of action throughout his life that can be relied upon. This is shown in the principle, “Train up a child in the way he should go and when he is old he *will* not depart from it”—(because it is made part of his character). At the same time let us guard against the error of supposing that nothing can be a part of character that is performed consciously. I may be a most truthful person naturally, and yet tell the truth deliberately.

It is well to note therefore in this instance, and in many others, because a positive statement is made on one side,

the corresponding negative on the other side must not be taken for granted. It is too often assumed in regard to statements that an assertion implies a direct denial of its opposite. It is not always so.

We have now, perhaps, sufficiently insisted that when an action ceases to require conscious effort for its performance and then becomes unconscious, by repetition, it begins to establish a fresh principle in the character; and we may now pass on to look at the way in which habits are formed.

The Greeks were very fond of the word wisdom; 'Ο Σωφρων, or the wise or prudent man, was really the product of perfectly organised habit, and could be relied on to act wisely in every path in life as the result of a formed character.

What are the means by which habit is formed? There are two—environment, or what is *around* the man—the habit of the same atmosphere; and ideals, or what is *before* the man. An illustration of the power that breathing the same atmosphere has in producing fresh springs of character may be found in considering the professions.

Supposing a man sends one of his sons to be a sailor, another to be a soldier, another to be a doctor, another to be a lawyer, another to be a merchant, and, perhaps, another does nothing at all. At forty years of age a very marked difference will be seen between these men. The sailor has not only a characteristic body and gait, but a sailor's mind—he is a sailor all through his character. In short, there would be more fresh springs seen in his character than in that of any other class, because he begins earlier, and the atmosphere he breathes on board ship is more intense and specialised than in any other profession. A sailor, therefore, is stamped through and through in character, in thoughts, mind, consciousness and unconsciousness with all those traits that are the hallmark of his profession.

A regular soldier again differs from a volunteer in that the latter is a civilian at heart, though a soldier when he is being paraded and on duty. In himself he is a clerk, or accountant or student who at particular times puts on his uniform and does his drill. But that does not affect his character materially. Now a soldier, who enlists for a certain time in the army, becomes changed in his character by the fixed environment he is forced to breathe. He is a soldier when off duty as much as on parade. This shows the power of habit in producing fresh springs of character. I cannot

enlarge on or labour this subject further, but it is sufficient for us to see how, in varying degrees, professional influences alter the man himself.

Let me say a word about the surroundings of character. One character acts upon another to an immense extent. A remarkable sentence, that I have never since forgotten, dropped on my ears on attending a little village church some years ago. Just as I was falling asleep in an old worm-eaten pew, and the clergyman was reading an old sermon, by the light of a tallow candle, he said, "Never forget, that the mind casts a shadow just like the body."

It is thus we influence others unconsciously for good or for evil. In fact, character is just like that mysterious substance in the body known as a ferment. We have, all our lives (after six months old), a ferment in the mouth which has the power of changing the starch in our food, which is indigestible, into sugar, which is digestible. This ferment changes, by virtue of its presence simply, the one into the other. In the same way our characters are potent as ferments, and it is well when they can change the starch in others into sugar. There are characters that are health-giving; there are characters that are nothing less than moral ozone, who do good to everyone who breathes their influence; and there are characters that are not less poisonous and infectious than sewer gas. With regard to unconscious influence Maeterlinck says, "In silent company with another, the character is often deeply formed; and a truth, which cannot be even taught in words, may be learned in silence."

Secondly, with regard to ideals, or what is before the mind as forming fresh springs of character. Introspection, as a former of character, is no good. We never benefit any characters by taking a piece off here and putting a piece on there. To continually explore the character by forced introspection is as injurious as having an arc light burning all night in one's bed room. It is intended that we should have darkness at night, in order that the brain should rest, and if we turn night into day literally, or figuratively by prying into the unconscious recesses of the mind, we produce troubles. Close introspection, therefore, will not benefit our characters. The pursuit of a noble ideal turns the eye outward, and not inward.

These ideals vary from the highest to the lowest. I believe there exist some who absolutely say, "Evil, be thou

my good!" and set before themselves ideals that are absolutely bad. That is the lowest class. Then there are morbid ideals—people who aim at what is not necessarily bad, but which certainly ought not to form an ideal. In my profession, for instance, we often meet with those who "enjoy bad health"!—whose ideal is really to be invalids, and who have nothing before them but sickness, and enjoy it as long as they can keep it. Then we have the man whose ideal is pleasure. If he can only fill his life with a round of pleasure, he has satisfied his highest ideal.

Then there are those whose ideal is negative. Their great idea is never to do anyone any harm, and if they succeed in passing through life without doing others injury, they fulfil their highest expectation.

Then there are those who go a step higher, whose ideal is to excel others in quantity, in acquisition, to store up, to be the richest, and to acquire millions. Others desire to excel in quality, to be the first and best, and not necessarily the largest or richest.

Higher still are those whose ideal is domestic, and who seek to fulfil their highest aspirations, as a good father, a good mother, daughter, or son. Then there are those who are actuated by philanthropy, and those whose aim is highest of all, and who feel that no ideal is satisfactory until it reaches God Himself. The higher and loftier the ideal, the nobler and more spiritual the character.

The third point is the will, and that is a spring of character in the sense of being the force that produces conduct from character; and yet the will itself is moulded by the character which it energises. Of course, we understand a strong will may be used for good or evil. We cannot will a new quality in our own character, or in that of anyone else. We cannot even *will* to play the violin, or retain our balance on a bicycle or a pair of skates by an effort of the will alone. But we can will the practice that will produce it. We can will the means that will ensure it; and so we can get our results, not by directly willing the thing to be acquired, but by willing those means by which it may be obtained. The will, of course, can be enormously strengthened, particularly in childhood. A child can be accustomed, and should be accustomed to fixed purposes, which it should not be allowed to change lightly, and thus it should acquire a habit of keeping to what was originally willed. Many are too strong-willed, and some are weak-

willed, and so education proceeds wisely to modify the one or stimulate the other. Will comes mostly into play as a factor in the formation of character, when we have left our parents, and when our home education is well nigh finished. Previously to that time, our characters are mostly formed by them, and after that they are mostly formed by us by means of our own will.

I will say one word, in conclusion, about growth of character. Character grows. I do not say it gets fresh springs, but it grows, as the body grows, by food and exercise. The food of the character is ideas, and the exercise of the character is the circumstances of life. Now food, as we know, to nourish the body, must be of somewhat the same material as the body is composed of. A substance similar to the material of which the body is formed is called homologous, and is a food. If it is different in composition, it is called heterologous, and is a poison. This casts a flood of light on what has puzzled many people, viz., why the same idea is absolutely food to some minds and poison to others. It is because with some it is related to their own character, and with others it is not. This is a matter that would furnish most interesting material for study.

Character, which is thus fed by ideas, is exercised practically, as we have said, by the circumstances of life. Strong persons and strong characters can stand severe exercise. The more severe the exercise and discipline through which they pass, the better and quicker does the character grow to perfection.

The value of character, I need not say, is immense. It is our acts that always really tell our worth.

"Still, as of old,
Man by himself is priced;
For thirty pieces Judas sold
Himself—not Christ!"

Before closing may I add that parents should accustom themselves, figuratively speaking, to look at their children through the Röntgen screen. You do not see by means of these rays whether a woman has got on a particular dress, or cloak, but you see what the heart is doing. And so children, by the maternal eye, should be looked through and through and not merely seen outwardly.

Again, for child training parents should be provided with

tools. Allow me to point out in a few words twelve tools with which each mother should be equipped:—

1. First of all parents can form *habits*, of moral value, as none other can, in a child's character.
2. Parents can control a child's *environments* by suggestions of good and not of evil.
3. Parents can, by example, fill a child's mind with inspiring *ideals*.
4. Parents can feed a child's mind with *ideas*, the character of which ideas they can largely control.
5. Parents can *exercise* a child's moral powers by the circumstances of life, not too hard, lest it be discouraged; not too soft, lest it have no moral backbone.
6. Parents can by watchfulness and tenderness *balance* one characteristic against others, so as to produce an even and not a one-sided character.
7. Parents can strengthen the *will* power and make it act with energy and decision.
8. Parents can educate the *moral sense* and keep it strong so that it may last good through life.
9. Parents can increase the sense of *responsibility* to themselves, to others, and to God.
10. Parents can teach, directly, moral principles and the *sequence of cause and effect*.
11. Parents can inspire *faith* in God and in Christ and a right spirit of humility.
12. Lastly—Parents can at least *obey* the two divine precepts, "Train up a child in the way he should go, and when he is old he will not depart from it." "Offend not, despise not, hinder not one of these little ones."

DISCUSSION.

The CHAIRMAN expressed the interest and pleasure with which he, and he believed all present, had listened to the paper, which was both wise and suggestive; and remarked, in illustration of the subject, upon the effects of habit in moulding the physical and moral character of our soldiers and sailors, who often entered the service of their country under most unfavourable surroundings

and conditions of life, but ultimately, in consequence of their training, became bodies of men to whom the honour and defence of their country and of the empire could be safely entrusted.

The Rev. F. A. WALKER, D.D.—Time will only allow me to allude very briefly to a few of those points that I have noted in the course of the instructive and edifying address we have had the privilege of listening to.

The point that impressed itself on me particularly was the very striking way in which the lecturer remarked on habit and its power which coincides with the text-book we used to read at Oxford.

I notice that Dr. Schofield's deductions from habit agree almost entirely with Aristotle's Ethics, and I suppose no book, with the sole exception of Holy Scripture, has exercised such an influence on the mind of scholars as Bishop Butler's "*Analogy*."

There was one passage about habit that also struck me, and that was that the constant repetition of acts tended to produce a habit so strong that it became, in time, overpowering in its influence; and then those habits—all unconscious, as Aristotle tells us—reproduce acts; nor can anything, he says, that was accustomed to be done in one particular way be done otherwise. We may remember the text in Job—"Man is born unto trouble as the sparks fly upward." That seems to contain the same illustration as Aristotle on habit.

Professor ORCHARD, B.Sc.—While thanking the author for his paper I may say that his remarks upon ideals struck me as particularly valuable, and also what he said about tendencies. I cannot but regret that an address which certainly affords considerable scope for discussion, as the Chairman has pointed out, should not have been put before us in a printed form. It is exceedingly inconvenient, especially in matters philosophical, to criticise, unless you have the very *ipsissima verba* before you. It is hardly fair, indeed, to the author of the address to do so.

I have noted some expressions which Dr. Schofield used to which I am sorry to say I can by no means assent. "Character is the sum of our mental and moral attributes." No doubt we may agree to that; and its "springs and roots . . . lie deep in the unconscious mind." "The springs are," says Dr. Schofield, "heredity, habit, and will." First of all, I must entirely differ from the author that any such thing exists as "unconscious mind." The great

mark which distinguishes mind from matter is consciousness. Perhaps the learned author has found some other distinction between mind and matter, and will favour us with what he takes it to be. But all philosophers, from the time of Aristotle, have held consciousness to be the distinguishing peculiarity of mind as distinguished from matter. In the different operations of the mind, everything is a form of consciousness. You cannot have a sensation without being conscious of it, or any kind of feeling, desire, emotion, or sentiment, without being conscious of it. You cannot know a thing without being conscious. To speak of unconscious knowledge is nonsense. You cannot will a thing without being conscious that you are willing it.

It is frankly admitted by Agnostics, that between unconsciousness and consciousness there is an impassable barrier. Apparently the learned author thinks not. Unconscious mind! What produces, if you please, unconscious mind? The springs of unconscious mind are, however, said to be "heredity, habit, and will." Heredity has been, I think, broadly defined as referring to tendencies only. Have you any mind as long as you have tendencies only?

Habit:—In habit, surely Will is much concerned. It requires considerable perseverance, as a rule, to form habit. Surely that is not an unconscious thing. Even if you take the most mechanical habit, as it might be called, of putting one foot before another, we have never done that in life yet without being conscious.

So with taking your breakfast. I never had my breakfast without being conscious of it. What it appears to me is being done is to confound together consciousness and attention. That we do a number of things without particularly attending to them is true. There are many operations of the mind, which we perform without any special thought, but at the time we perform them we are conscious of performing them; we may not give them much attention, but we are conscious that we are doing them.

The third spring is Will itself. Will is distinguished from Habit, though I cannot see how there can be habit without will; but let that pass. Will, surely, is no part of unconscious mind. If Dr. Schofield says it is, it would be very interesting to know the relation of pain to the unconscious mind.

It appears to me that there is great danger in this doctrine. It has a tendency to take away Will; to take away the great

distinction that separates matter from mind; to open the door to the false theory of materialistic evolution in asserting, as is done by Spencer, that all things have come about by mechanical force acting upon mere matter.

What Dr. Schofield said about tendencies is to my mind of very great value. Any system of education is bound to take account of tendencies; to cultivate, or repress or check them; and we should be always keeping before us when we can the Röntgen screen, to which the Doctor so beautifully alluded, and a high Christian ideal.

Mr. MARTIN ROUSE, B.L.—I understood Dr. Schofield, when he used the term “unconscious mind,” not to mean that mind was like matter, or was like forces inter-acting mechanically, like a set of wheels started in a factory by an engine, and doing a great deal of work in spinning bobbins and so forth without their own will; not exactly that, but that we were not aware of the operations of this unconscious part of our brain, and that in being aware of the operations of what he would call “the conscious part,” we knew that we willed to do a certain thing, and we did it. (Hear! hear!) Further, that when he said that will was one of the springs of character, and that character found its home in the unconscious mind, he did not mean to say that will was an unconscious thing, but that will, together with heredity and habit, built up a character which then worked unconsciously; that a man told the truth without effort or determination to tell the truth, but simply because it was perfectly natural to him. In the same way, an Englishman who has lived in France or Germany for some little time will quite unconsciously speak French or German, instead of first speaking English in his mind and then turning it into French or German. The phrase comes to the mind without effort—without saying, “I want to express that idea in German,” but it is used as naturally as the English phrase would be. I know this through having spent a year and a half in Switzerland as a boy; the latter part of the time I dreamt in French and, as a habit, I prayed in French. It did not seem to be a strained effort, or unnatural, but it came quite naturally. In the same way we have been told by Professor Orchard that we are always conscious, that he has been conscious all his life, and that we are so in putting one foot before another, which we are taught as school boys. But, I maintain, that is not the case. He used his will, at the beginning, at the

bidding of the drill sergeant, until it became a matter of habit to put the left foot before the right in starting to walk.

No doubt many present have experienced that in reading aloud the mind has wandered off to some subject urgently important, and we have gone on reading and not known what we were reading. That is certainly an unconscious habit. We were not conscious of that operation of the mind. I have always held (though I have not studied mental philosophy) that we cannot think of two things absolutely at the same time. Therefore, the mind is certainly acting mechanically in reading aloud, if we are at the same moment thinking of some other subject.

Rev. Dr. PORTE.—It appears to me that both the lecturer and Professor Orchard are right—one philosophically and the other practically. We all have experience, in daily life, of what the lecturer said on unconscious acts of mind, so to speak, though that may not be the philosophical expression. I had an experience of it a few Sundays ago. On reading the service, which I trust I do not read carelessly without entering into it, I was startled to think that I had omitted two pages of the service, and when I went into the vestry I said to my curate, “Is it true that I omitted two pages of the service to-day?” He said, “No; not a word.” I replied, “All I can say is that from such a collect to such a collect was a perfect blank to me.” He said it was quite right. That is not the only time that such a thing has happened to me. Have not some of you repeated with your lips a collect or prayer, and yet have been unconscious that you have done so? That is a simple and practical proof I think of what Dr. Schofield referred to a few minutes ago.

The CHAIRMAN.—I am afraid time is against the discussion being extended, so I will ask Dr. Schofield to reply briefly, and before doing so I am sure we desire to return a hearty vote of thanks to him for his address.

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

Dr. SCHOFIELD.—My remarks at this stage will not only be brief on account of time, but because there is little to reply to expect from my very good friend, Professor Orchard. I have gone over the ground with him carefully on previous occasions, and such a discussion if resumed this evening would be purely academic. I must admit that he has made a very good point; but I think, throwing myself on the audience, my meaning was sufficiently

clear. I believe I did say *spring*; but it has, as I said, the meaning of source or of power. When I said, "Springs are the root of character," that could not mean *will*—it is *power*. I was only using the word *spring* then as *source*, and I maintain still that the source and root of character are in the same unconscious mind; but I quite go with Professor Orchard in saying that will is a conscious exercise as a rule. But if Professor Orchard lays down, *ex cathedrá*, that consciousness is mind and mind is consciousness, and connects the one with the other, he must take account of its various degrees. There is that condition called *attention* and degrees less and less extreme until it oversteps the threshold of consciousness and falls into regions we know not of. A genius cannot tell you where he gets his inspiration from, and to limit mind to consciousness is equivalent to limiting the body to what is seen by the eye. A man who limits mind to consciousness has to maintain that all that comes from mind is of material origin. I see Professor Orchard shakes his head. He says we are conscious of every sensation.

Allow me to say that we are conscious of what we are conscious of; but there are an enormous number of perceptions which do not rise into consciousness. If I were to tickle the sole of Professor Orchard's foot he would feel it; but when he was reading a book he would not notice the same amount of tickling if he were sufficiently absorbed in his book.

I will not multiply these instances. We are hopelessly irreconcilable on this question, but we are very good friends on every other.

THE HON. SECRETARY (Captain FRANCIS PETRIE, F.G.S.).—Before I announce the next meeting there was one remark of importance that was made a few moments ago, in regard to the absence of a printed paper. That we could not avoid. We must either have taken, as we have, this valuable address, without its being printed beforehand, or have done without it altogether. That I am sure we could not have done.

The Meeting then terminated.

ORDINARY MEETING.*

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

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

ASSOCIATE :—Rev. W. C. Penn, M.A., Noble College, Masulipatam.

The following paper was read by the author :—

MODIFICATIONS IN THE IDEA OF GOD, PRODUCED BY MODERN THOUGHT AND SCIENTIFIC DISCOVERY. By Rev. Chancellor LIAS, M.A.

IT is more than a quarter of a century ago since I first was honoured by a request to read a paper before this Institute, and in about a week it will be a quarter of a century since I read it. I am thankful to be honoured once more with such a request. The current of thought changes swiftly in our time, and it is pleasing to be able to note a great change for the better since I first addressed this assembly. *Then* we constantly heard of the opposition between religion and science. *Now* it cannot fairly be said that there is any opposition at all between religion and science. Such misunderstandings as still remain are rather of the nature of the ground swell which witnesses to a storm that is past, than evidences that the storm is still raging. *Then* the tendency was to a blank materialism, such as was openly expressed by Tyndall in his celebrated Belfast address. In these days a great many men of science—perhaps I might say the majority of men of science—are beginning to realize that for causes we must go behind the material universe and its laws and processes—that there are

* Monday, January 6th, 1902.

forces and laws at work in phenomena, of which science is at present unable to take account. Whether it will ever be able to take account of them is a question. For my own part, I am convinced that though recent scientific research has done a vast deal to explain to us *how* things are, it has not approached even infinitesimally nearer to the discovery of the reasons *why* they are. It has formulated the laws of many forces. But it can tell us no more of the nature or origin of force itself than it could tell us centuries ago. A vast number of scientific men are now ready to confess the difference between observations of the laws of nature and determination of the causes which have produced those laws.

Some years ago I read a paper before the Institute on the agnosticism which was at that time prevalent. There were two points which, in that paper, I set myself to prove. The first was, that God is not an abstract metaphysical idea, but a living Being—the very opposite of an abstraction—the source of all existence, and the cause of all causation. The second object I had in view was to establish the truth that even if the idea of God was ultimately unthinkable, the same fact might be predicated of everything else; and that as the fact that everything in nature ultimately runs up into a mystery does not prevent us from thinking about and from knowing a great deal about each individual fact in nature, so in like manner it does not prevent us either from thinking, or even knowing, a great deal about God.

Later still I wrote a paper in which I pointed out how an examination of the facts of the universe led us to the conclusion that mere mechanical or material facts were the lowest in the order of things, that above them towered, in an ascending scale, mental, moral, and finally spiritual facts, and that, so far as I could see, the ultimate fact of all was Love. I deduced the conclusion that material forces, which include all those with which science undertakes to deal, were dominated by mental, moral, and spiritual forces; and that the ultimate cause of all, eternal love, made it reasonable to postulate a Being to whom prayer for “everything”* may not improperly be addressed, One whose main object—perhaps I might say whose *only* object—is the welfare of the sentient beings to whom He has imparted a share in His existence.

* Phil. iv, 6.

On being asked to read a third paper on this subject, it seemed to me that I could not do better than endeavour to estimate the bearing at once of modern scientific research and of modern religious thought on our earlier conceptions of God. But I would ask my hearers to bear in mind that while, in compiling my former papers, I had excellent libraries close at hand, I am now far from them, and that the exigencies of a somewhat large, scattered, and populous rural parish, as well as other circumstances only too well known to those who study Church problems at the present time, prevent me from going to consult them. Illness, too, of a disabling kind came on while I was preparing these observations. I must therefore, in my present paper, substitute the light of nature for study and research. Perhaps this, however, may not be in every way a defect. It has occurred to me not infrequently of late that the stress and strain, the hurry and bustle in which we live, are unfavourable to reflection, and that now, more than ever, "much study is a weariness of the flesh." If one attempts to read all that is written on the latest theory which has attracted attention, one attempts the impossible. One also finds that what is written post haste to catch the public ear does not always repay the trouble of perusal, and that if the literary activity of the hour could only find time for a few "brilliant flashes of silence," the world would be none the poorer for it.

My paper on the "Unknown and Unknowable of Modern Thought" has recently been criticized by my friend Professor Caldecott in his learned and most interesting book on *The Philosophy of Religion*. He quotes me as saying that "abstract principles are fatal to the progress of thought." I cannot find the passage. Perhaps I have overlooked it. But what I *have* said is that, in my belief, "abstract ideas have no real existence" *; that they are "simply convenient formulæ of classification" †; that "philosophy has failed to form satisfactory abstract conceptions of God" ‡; and that "the Bible offers us no metaphysical abstractions in its doctrine concerning God, but practical facts." § I will honestly confess, however, that my reverence for abstract ideas does not grow with my growth. Just as, in my former paper, I insisted on a definition of the words "infinite," "absolute," "unconditioned," and

* *Journal*, 1883-4, p. 110.

† p. 105.

† *Ibid.*

§ p. 109.

showed not only that the same writer used them in contradictory senses, but that different writers seem to have used them as meaning pretty much what they pleased, so now I must ask those who talk about abstract ideas to explain what they mean by them. "Abstract" means "that which takes or is taken away." Now what idea can you form of anything if you have first stripped it of everything which has any correspondence with the world of fact? An idea of anything which has been carefully deprived of all correspondence with the reality is either an idea contrary to the fact or it is no idea at all. The concrete must come in somewhere, in order to discriminate one thinkable thing from another. Otherwise we have entered a world where "naught is everything, and everything is naught." It is all very well to talk, as metaphysicians do, very freely, of the "*Ding an sich*." But what is the "*Ding an sich*"? How can we conceive of anything, unless through its relation to or contrast with other existing things or facts? There is nothing whatever of which existence can be predicated which is not intimately connected with all kinds of other things in the universal Cosmos. How, then, can you conceive of it accurately if you persist in tearing it from its necessary environment? I am inclined, therefore, to think that abstract ideas, not when regarded as convenient formulæ of generalization, in which capacity they are not merely useful, but absolutely necessary, but when regarded as metaphysical terms dissociated from the results of observation, and supposed from that very dissociation to become sound foundations on which to build conclusions, have been very "fatal" indeed to the progress of thought. I am inclined more and more to regard experience as the true foundation of all knowledge, except that of the Divine Being—an exception to which I shall presently return—and to regard the progress of our knowledge as due, not to abstract speculation, but solely to additions to our stores of experience and to our successive generalizations from them. That man has a capacity for drawing conclusions from experience, and that these conclusions form the ideas on which he acts there can be no doubt. But it is a capacity for receiving impressions from facts, not a capacity for forming ideas apart from facts.* The more I

* This does not amount to a declaration that our characters and habits of thought are simply the result of circumstances. Character may be

think over the matter, the less I can believe that ideas can exist in our minds antecedent to experience. Tennyson's view that experience alone can enable us even to grasp the primary fact of our own identity, and that thus, by experience alone, can we "round to a separate mind from which dear memory can begin,"* seems to me a satisfactory explanation of the fact that even consciousness of one's own existence, the primary condition of all active life and profitable thought, can only exist after our experience has reached a certain stage in its development. Nor shall I be alarmed if this assertion should be shown by some objector to involve a contradiction. Mr. Herbert Spencer has shown that all ultimate ideas land us in contradictions; but we accept obvious facts nevertheless. I will therefore venture to assert that, like the idea of self, the idea of God, as formed by man, is, primarily at least, the product of experience.

The capacity for drawing conclusions from facts is, no doubt, innate in us. And there is, doubtless, in the case of ideas of God, another ultimate source than mere experience—that is, if the Christian idea be true. For that idea involves a revelation. And this revelation does not simply consist in imparting information to the mind about God; it consists in the impartation to the soul or spirit of man, of the very nature of the Divine Being Himself.† But in the first instance we form our conceptions of God from observation. Observation itself may, no doubt, be quickened by the teaching of those from whom our first ideas are derived. But even that very teaching itself is a form of experience. And our experience confirms, modifies, corrects those ideas, when imparted.

The very variety of the conceptions formed by mankind of the Divine Being tend to support this view. The fundamental principle, in every case, is that of a Being above and beyond ourselves, and above and beyond what we see around us. But that principle assumes various forms among various races. Yet only the most degraded or

the result of inheritance, or of the Will of the Creator, in the same way in which a machine is contrived by the inventor or formed by the maker to fulfil a certain purpose. This original draught, so to speak, of the machine will condition its action when brought into contact with facts. But there can be no action on its part until it does come in contact with

* *In Memoriam.*

† 2 Pet. i, 4.

the most disputatious of mankind have ever failed to arrive at this conclusion. Its lowest form is fetichism. A step above this is the worship of ancestors. Yet a higher form of it is the deification of the various powers of nature, which was the religion of Greece and Rome. A still higher form is the original Hindoo religion, which, while it deified the powers of nature, regarded the primal deity as inter-fused with and underlying them all. Yet another form is Buddhism, which seems to have arisen as a protest against Hindoo pantheism, and to have regarded God, with the Gnostic Basilides, as outside all existence—the Absolute of modern philosophy—that is to say, something, or someone, entirely unconnected with the limitation involved in being. This, however, cannot be described as a higher form than pantheism. For it not only dissociates God from the universe, but it persuades man to seek the same end, encouraging him to aim at detachment from everything around him—a creed which, as competent observers tell us, results in idleness, stagnation, and degradation. Observation and reflection, then, are the ordinary sources of the idea of God.

The Hebrew idea of God appears to have been altogether on a higher plane than that of any of the systems I have mentioned. Here, perhaps, I may be permitted to explain why I find myself unable to make use of the recent researches in Hebrew history, which, we are informed on high authority, may be regarded as having established certain conclusions. The reason is because, in endeavouring to use them, I can only find that as far as the course of Hebrew religious development is concerned they have unsettled everything and settled nothing. The only certain results which are said to be established are these:—First, that what have been supposed to be the earlier Israelite books are not the earliest, but contain materials originally published between the ninth century B.C. and the fourth; next, that the Book of Deuteronomy was written between the reigns of Ahaz and Josiah; and next, that the prophets did not follow, but precede, the Law, which the Hebrew Scriptures, as handed down to us, ascribe to Moses. I will not attempt to dispute these conclusions. I only say that they do not help me at all in my endeavour to follow out the development of the idea of God in the minds of the Hebrew people. Moses—let it be granted—has vanished at the touch of scientific criticism. But as yet nothing has taken his place. We do not know in the

least whether the original Hebrew religion was Egyptian or Semitic in its genius. That some of its traditions come from Babylonian sources seems clear. But it seems equally clear that the Israelite religion was not originally of the Babylonian type, presented to us by modern investigation. It has indeed been suggested that, from Moses to the later kings, the Israelite people were engaged in the task of evolving a religion from fetichism, through polytheism, into an ethic monotheism. But even if this were the accepted conclusion, we are still without evidence as to the steps of the process. It is not yet settled at what period fetichism was abandoned for polytheism, and when and how polytheism refined itself into the religion which the Hebrew records tell us prevailed from Moses to Malachi. And even if it did tell us all this, it would be met by Professor Caldecott, who, working on other lines of scientific research, tells us that "after generations during which belief in the supernatural has been regarded as derivative from animism, nature worship, and the like, the direction is reversed and these are being regarded as derivative from it."*

I must therefore, until criticism has produced some more certain positive results, be content with what the Hebrew Scriptures themselves tell us. It can hardly be wholly unscientific to accept the statement of a nation in regard to its beliefs, contained in documents handed down with an unusually jealous and scrupulous care. And as long as the course of Hebrew religious history, as ascertained by criticism, remains so undefined, no other course is open to me.

We are told that the original Hebrew idea of God was expressed by the words El and Elohim, and it has generally been admitted that the root idea in that word was Power, or, to use a word preferred in recent scientific researches, *Force*. It would seem, then, that the early object of worship among the Hebrews was the Being which produced, controlled, and kept in being the phenomena they saw around them. Whether this was a revelation or not we cannot tell; Hebrew history gives us no information on the point. The fact that a monotheistic king is introduced to us in the history of Abraham as the priest of the Most High God (El 'Eljon †) rather points to the opposite view. Monotheistic

* *Philosophy of Religion*, p. 86.

† Gen. xiv. There is no etymological connection between El and 'Eljon. The latter signifies *height*; it seems to imply the existence of deities inferior to the Highest One. If I speak of Melchizedek as a

views may not unreasonably be supposed to have preceded polytheistic, and many high authorities have believed this to have been the case. Of the moral qualities of this Being, conceived of as illimitable Might, we have, again, no information. The account the history gives us of Abraham's mental struggles on this point represent him as having no definitely formed convictions as to the moral character of the God whom he worshipped. Whether he regarded Him as the Force which governed men's actions as well as the Force behind material nature we do not know. Neither do we know—save in the reference to the serpent in Gen. iii—to what cause moral aberrations were ascribed, and we cannot say whether the idea of an adversary or tempter was present to the mind of Abraham, or whether it reached the author of Genesis through a different channel.

The original conception—for if we follow the Hebrew narratives, and not the theories of modern critics, it was the original conception—of God among the Semitic races was thus an extremely rudimentary conception. But rudimentary though it was, it pointed in the right direction. It soared far above the fetichism, animism, deification of the powers of nature, pantheism, abstraction, of which I have spoken. There was present in these elementary conceptions of deity the idea of a Personal Being, a living Force or Energy, that is to say a Being possessed of mind and will, and capable of moral relations with His creatures, which exerted itself for the guidance and protection at least of those who sought its favour. It is this germ which, through the various stages which the Hebrew Scriptures have not failed to point out, has developed into the Christian idea of God.

Side by side with this elementary conception of God among the monotheistic Semites stands another conception in close relation to it. This is embodied in the word *Shaddai*, a word frequently found at crucial points of the early history of Israel. The word *Shaddai* is supposed, like *Elohim*,* to be a *pluralis excellentiæ* derived from the Hebrew root *shad*, signifying *destruction*. This conception of God, though in one

monotheist, it is because it seems probable that he conceived of a difference in kind, as well as in degree, between the Most High and inferior beings.

*Some have endeavoured to prove that *Elohim* should be translated "gods." But this view would throw the entire religious teaching of the Hebrew Scriptures into confusion.

sense kindred to the former, brings in the aspect of terror side by side with that of origination or protection. God is here conceived of as a God of wrath, capable of avenging Himself against His enemies, as well as of guiding and protecting His votaries. It is a conception which every one who is familiar with the Old Testament writings sees to have been embodied in what, until lately, have unanimously been accepted as the later Hebrew delineations of the character of God. The word disappears in the later literature, but the ideas it represented are preserved. The use of the word Shaddai in the Hebrew Scriptures is very characteristic and significant. It is confined almost entirely to the Pentateuch, the Book of Ruth and the Book of Job. It occurs only three or four times in the Prophets, and only once, I believe, in the Psalms. In the Pentateuch and the Book of Ruth it is placed in the mouths of the patriarchs on solemn occasions,* in the mouth of Balaam, and in the mouth of Naomi when she returns from her sojourn in the land of Moab. By far the greater number of cases in which the word occurs are found in the Book of Job. In Balaam's utterances the title Shaddai is the parallel to the title El 'Eljon, the Deity whose priest Melchizedek is represented as being. I shall not take up your time by discussing the question of the authorship of the Book of Job. But I think it cannot be regarded as unfair if I venture to represent it as the most cosmopolitan of the books of the Old Testament—the one which, of all others, displays the most familiarity with Semitic monotheistic thought outside the Jewish race. Thus, then, our authorities with remarkable unanimity represent the early Semites, and, we may add, the monotheistic Semites of a later date outside the borders of Israel, as believing in one God, a God of vengeance as well as a God of might, one who would punish His enemies as well as reward those who were faithful to Him—in fact, precisely the conception of God which is embodied in the Second Commandment. The moral aspects of this Being were as yet undeveloped. He appears before us as Power, not as Righteousness—power to avenge as well as to reward, but without any definite ethical characteristics attached to His use of the power which is in His hands.

We come next to a remarkable step in the development of

* It is noteworthy that the word is found in *both* the narratives into which modern criticism has divided the first four "Books of Moses."

the idea of God. Modern criticism does not permit us any longer to assume the historical or chronological accuracy of the Hebrew narratives. But until it has substituted a clear and incontrovertible account of the growth of Hebrew religious ideas for the statements of the Hebrew authorities themselves it cannot forbid us to make use of their contents. They represent to us an Israelite, brought up in the Egyptian court, and enjoying the best possible opportunities of becoming familiarized with contemporary Egyptian civilization and thought. Driven from the land of his birth by palace intrigues, he takes refuge in the Sinaitic peninsula and becomes a shepherd. We may be sure that this highly educated and cultured man—a man who, as the narratives also do not fail to point out, possessed high and conspicuous ability—must have pondered long and earnestly upon religious and political problems. One day he beholds a marvel in the desert. The Deity, we are told, appears to him by a sign, and reveals Himself as the Eternal—the Ever-existing. I am aware that the view that Jehovah, or more properly Jahveh, is simply the third person singular of the imperfect* tense of the Hebrew verb signifying “to be” has been and is contested. But when critics differ one may be allowed to introduce other considerations beside mere criticism. One may, for instance, be justified in contending that the founder of a famous religion and a famous polity may not improbably have been a great man, and that, from whatever source his ideas were derived, he may reasonably be supposed to have imprinted some grand religious ideas indelibly upon the heart and conscience of the race from which he arose and to which he was sent. What more important idea could he have imparted to the people which have been destined to exercise so vast an influence upon the other peoples of the earth than this: that the Being they had worshipped as Might—Might to produce and save, and Might to destroy—was the Eternal Existence Itself, and therefore the Fount of all Being, in other words, as He was afterwards represented, the living God—living for ever in Himself and the Source of life in others? † We are

* *I.e.*, the tense which represents *unfinished* action or condition, past, present, or future. The notion, however, that this tense is really the *present* tense, though not, I believe, in favour with Hebrew scholars at the present moment, seems not unworthy of consideration.

† He is being, *i.e.*, He continues to be; He has never had beginning nor end.

not now permitted to cite the so-called "Five Books of Moses" as embodying Mosaic teaching. But the so-called "Book of the Covenant"* is generally allowed to be almost if not quite, Mosaic in its date. And it distinctly tells us that God, as represented by Moses, was a Being who presented Himself in a moral aspect, and did not require obedience only, but righteousness from His votaries. If we may accept the first chapter of Genesis as the work of the founder of Judaism, the idea of creation was inseparably united with the conception of this Eternal Being. And it appears to me, I must confess, that the grand originality of this and the following chapters fits in better with the idea of their being the work of the founder of a religion than the afterthought of an unknown writer or editor some ten centuries after him.† The elementary conception of God as Righteousness as well as Power was gradually filled in by the prophets. The severer attributes involved in the title Shaddai were incorporated into the national ideas of Jahveh and Elohim by their writings, and they did not fail to point to disasters in Israelite history as a consequence of their neglect of Him and His laws. It must be confessed that, on the whole, the idea of God contained in the Hebrew Scriptures, though sterner than that which is presented in the New Testament, is nevertheless a truly high and noble one, involving qualities of exquisite gentleness and tenderness side by side with its unbending righteousness and its rigid inflexibility towards those who fail to fulfil its requirements.

Upon such a foundation as this the Christian idea of God was based. We proceed to ask what special modifications of previous conceptions were introduced by the Christian revelation. We may first remark that it aims not at the negation but at the fulfilment, or rather the filling in, of the conceptions entertained by the Jews. God is still the Force which brought the universe into being; He is still the Eternal, the Unchangeable, the Ever-existing; He is still the

* Exod. xx-xxiii.

† I do not wish to deny that this unique religious teacher may have made use of traditions handed down from remote ages among his people. But he would naturally cast them into the form which seemed best adapted to his purpose. The idea that portions of inconsistent narratives were unintelligently pieced together seems to me hardly reconcilable with the high position of Mosaism among the religions of the earth for thousands of years.

Living God, the source of all life; He still appears to us as unbendingly just, as well as indescribably tender. But only the teaching and the life of Jesus Christ can explain to us the apparent contradiction involved in such a conception, and resolve the mystery how a righteous Being can place forgiveness of sin in the forefront of His dealings with sinful man.

I do not propose to enter into the theological questions involved in the solution of this mystery. Suffice it to say that of late they have entered into a new phase, and that this phase is largely conditioned by a belief in the Divine immanence, a fact which is strongly insisted upon by our Lord as reported by the Evangelist St. John, and which assumes an importance for a long time unsuspected in the writings of St. Paul, St. Peter, and St. James. This doctrine reposes upon a declaration on the part of our Blessed Lord which may be looked upon as the starting-point of His revelation—*Πνεῦμα ὁ θεός*, God is Spirit, or rather *Breath*.* This declaration, it appears to me, has been much misapprehended, and the misapprehension has rested on a confusion of thought as to the meaning of the word spirit. Spirit has usually been represented as that which is opposed to matter. It may be observed that though philosophy presupposes such an opposition, neither Christianity or Judaism even so much as hint at it. In Greek and Hebrew, and perhaps in Latin, spirit means *that which is breathed*, but when applied to God it also involves the idea of Him who breathes it. Thus to the mind of the early Christian God appeared as the subtle, impalpable, penetrating Essence which lies beneath all that is; not identified, as the pantheist would have it, with Its own creations, not “fusing all the skirts of self” in the Divine Being, but inspiring and controlling Its own creations, and impelling them towards the fulfilment of Its own ultimate purpose. This indwelling Deity is obviously the God brought before us by the Evangelist St. John. The idea is scarcely absent from a single page of his Gospel or his Epistle.† It is the province of theology to show how the

* This idea, it may be observed, is Hebrew in its origin. The Ruach Elohim is placed in the forefront in the work of creation (Gen. i, 1). And in the account of the creation of man (Gen. ii, 7), though a different word is used, the same idea is preserved.

† It is the starting-point of both. The *λόγος ἦν* (was existing, the same idea as is contained in the word Jehovah) *πρὸς τὸν θεόν*. In Him life is, (*ἐν αὐτῷ ζωὴ ἐστίν*). The *λόγος* is described as “leading forth” (*ἐξηγούμενος*) the Father or Source of life. That is to say, He is the *manifestation* of

Divine indwelling is connected in the Christian scheme with the person, the work, the sacrifice of Jesus Christ. Into such questions it is not, therefore, my purpose to enter. I confine myself to the fact, which no careful reader of the sacred records will dispute, that beneath and around all the facts of the Christian scheme lies the great fact that God is Breath, and that the subtle pervading influence emanating from Him is the ultimate source of our salvation from the evil influences which surround us.

The Greek philosophic divines discerned this truth, albeit not too clearly. As has just been said, they were misled by importing the ideas of Greek philosophy into the Christian scheme. The leading principle of that philosophy was the antagonism of spirit or mind to matter. Another misapprehension of theirs was the confusion of mind with spirit. In Greek philosophy these two things are identical. In Judaism and Christianity they are altogether distinct. The one is a direct emanation from on high, altogether moral and elevating in its character; the other is the organ of the soul which draws conclusions from premisses, and by analogies and logical processes endeavours to arrive at the truth. Thus Origen, in his *De Principiis*, misses the true drift of Scripture teaching by endeavouring to show that Spirit is independent of body. He describes it as "*simplex intellectualis natura*" (it is a sad pity that we have here the less definite Latin in the place of the original Greek). He says that the Holy Spirit is "intellectual existence" (*subsistentia*), and speaks of the Divine nature as "*natura illa simplex et tota mens*."* Yet in his *Commentary on St. John* he takes a more scriptural view of the facts, and speaks of God as being Spirit because He breathes into us the breath of a Divine life, higher than we have by nature.† His instructor, Clement of Alexandria, has a noble passage which looks the same way. "The bare volition of God," he says, "was the creation of the universe. His mere willing was followed by the springing into being of that which He willed."‡ In another passage he refuses to regard God as a

the Divine Being, or the Divine Being in the act of self-manifestation "From His pleroma" (our word "fulness" hardly conveys any idea to the mind) "we all have received." In other words each of us has a share of the infinitude of the Divine perfections.

* *De Principiis*, I, i, 3-6.

† *Commentary on St. John*, iv, 24.

‡ *Ehortation to the Heathen*, ch. iv.

theological abstraction. He denies that He is either "the One, or the Good, or Mind, or Being in itself, or Father, or God, or Creator, or Lord." None of these terms by itself will describe His perfections. The world-ruler is, in fact, the sum of them all.* Elsewhere he speaks of God as the Source of all existence.† And he points out that the conceptions of God entertained by the Greek philosophers were unsatisfactory.‡

I do not propose to take up your time with a history of the idea of God in the early Greek Fathers. It must, I think, be confessed to have oscillated between the teaching of Scripture and that of the philosophers. I have found here no more evidence of the systematization of vague impressions on points of Christian doctrine than on other theological questions, the Person of the Son alone excepted. Very often God is looked upon as a transcendent Being, outside things created. But there is a magnificent passage in Athanasius§ which speaks of God as the Force behind all created things, and recalls the equally majestic language of St. Paul, where he speaks of the Son as the image of the invisible God, the Creator of all things, whose all-pervading influence holds them all together.|| In other words, God was looked upon as both transcendent and immanent; as dwelling in the visible universe and yet extending beyond it. Thus two tendencies of thought which have been regarded as incompatible were wisely and reverently combined.

It has been a misfortune for Western thought that it has been so largely dependant on the Vulgate—a very inadequate vehicle, as most of us are aware, for the expression of Greek or Hebrew ideas. Another drawback has been the inheritance by Western theologians of the Roman idea of God as a Potentate—a just and beneficent Potentate, no doubt, but still a Potentate, and little more. In the earliest Latin Fathers the Greek idea of immanence struggled with that of a just and wise Ruler who dwelt outside phenomena and governed them according to the counsel of His will. These two opposite tendencies are very strongly marked in the writings of Augustine. Unfortunately for us in the West, the Latin tendencies of that epoch-making Father ultimately prevailed among races brought under the influence of Latin

* *Strom.*, v, 12.

† *Ibid.*, vii, 1.

‡ *Ibid.*, vi.

§ *Contra Gentes*, 41-44. The whole passage is most striking.

|| *Col.* i, 17.

thought over the more Scriptural aspects of his teaching, and it has not been until lately, when the renewed study of the Greek Testament and of the Greek Fathers has revived the idea of the Divine immanence in man, which had been largely lost sight of, that this idea of God as a Sovereign has been combined with other Scriptural attributes. I need do no more than call your attention to the remarkable work of Professor Allen, of Harvard University, on the *Continuity of Religious Thought*, in which he points out how the supposed antagonism between religion and science would have been reduced to a *minimum*, had not the idea, partly accepted by Greek theology, of the indwelling of God in man, and the consequent restoration and ultimate perfection of the latter, been suffered almost to disappear from the popular mind. The Latins lost sight of these ideas through their ignorance of the language in which the Greek Testament was written. The Greeks lost them at last on account of the growing corruption of their Church, and of the consequent tendency to substitute interminable refinements of speculation, endless discussions, passionate conflicts of opinion, for the gradual growth and development of the Christian idea, as revealed in Holy Scripture.* There is hope now that by means of free inquiry and full discussion, coupled with a fairer and more critical study of our authorities, the ancient antagonisms between religion and science may altogether disappear, and the Book of Nature and the Books of Scripture be looked upon, as they ought to be looked upon, as the two complementary sides of the revelation of Himself by God.

That hope is not by any means damped when we turn to the history and results of modern scientific discovery. It is, on the contrary, very much heightened by a reference to them. Scientific men, it has appeared to me, took up at first a needlessly aggressive attitude towards revelation. It is true that the teachers of religion had for the most part committed themselves to theories which brought the Divine interferences in the order of nature into far too great prominence, and had represented that order rather as a series of jerks than as a continuous development. As scientific research progressed, fact after fact was rescued from the region of the miraculous and reduced under the dominion of

* Since these words were written, Bishop Westcott's *Lessons from Work* has come into my hands. Very similar thoughts to those in the text will be found in pp. 8-11.

ordinary natural law. But though this might have been an excellent reason for calling on religious teachers to modify their language, it did not justify scientific discoverers in proclaiming a blank materialism. If order and law had been proved to reign in the material world to an extent which men in past ages had never suspected, it did not follow that order and law were to be enthroned in the place of Him from whom they proceed. Yet a very considerable number of men of science, some fifty years ago, ignored a first cause altogether, and confined themselves entirely to the observation of secondary causes, while some very positively and defiantly declared that in matter all the causes of phenomena might be found. Divines, on the contrary, in their hostility to this sweeping conclusion, endeavoured to discredit scientific theories altogether, and the antagonism between religion and science thus became acute. But by degrees both parties began to reconsider their position. Divines lost their suspicion of scientific research, and scientists (I fear I cannot avoid the word) began to see that there must be some force behind matter.* Many of those who at first were loud in their defence of materialism subsided into silence on this point, and while admitting that their adversaries had a better case than they at first supposed, preferred to suspend their judgment on questions so tremendous as the origin of all things. Others, again, after many painful and agonizing struggles, found themselves at last able to accept the Christian faith.† They did this with the less difficulty, because it became clear that, in the simple and true sense of the word, evolution was not in the least incompatible with Christianity. By evolution I do not of course mean the doctrines of Mr. Darwin. It is not my intention to discuss the Darwinian theory of evolution. I believe that it is now disputed on many grounds. The hold it obtained for a time was due to the craving of human nature for certainty, and the tendency, in a restless, busy, and impatient age, such as this is, to imagine that certainty is to be obtained by being content *jurare in verba magistri*. It also rested largely on the

* "In our endeavours to understand the wonders of nature, we have ever brought before us the fact that there are innumerable mysteries which can never be accounted for by the operations with which science makes us familiar, but which demand the intervention of some Higher Power than anything that man's intellect can comprehend." Sir R. S. Ball, *Trans. Vict. Inst.* vol. xxxiii, p. 19.—Ed.

† The case of Dr. Romanes will occur to every one.

respect which was due to Mr. Darwin's amazing knowledge, untiring industry, and insatiable thirst for truth.

The tendency towards premature acceptance of results is to be found in various departments of thought to a greater extent, I fancy, than has ever been the case before. It was so in the case of Mr. Darwin. He was not only, as has just been said, a man of character, of principle, of remarkable acuteness, and of the most extraordinary industry, but he had been unjustly attacked. Consequently the theories of Evolution by natural selection, the struggle for existence, and the survival of the fittest, were enthusiastically hailed as the final results of science by a host of scientific investigators. I cannot pretend to speak as an expert in this matter. But my experience tells me that in the early stages of scientific investigation the opinion of an impartial outsider is not to be despised. I will not say that I am an impartial outsider. But I may at least be allowed to express my conviction that the evolutionists of the last century were in too great a hurry to announce the settlement of a great question. The most careful and industrious investigator might have hesitated to proclaim any results of his generalizations from the mighty host of facts which stared him in the face. He might have been pretty sure, one might think, that he had omitted one or two factors—possibly a good many more—which were of infinite importance in solving the problem of the universe. I never, when I try to study the demonstrations of scientific hypotheses, can resist the impression that there is too frequently a tendency to jump to conclusions unwarranted by the premisses, and that to establish conclusions from those premisses is a far more difficult task than many of those who have attempted it imagine. It will be a long time yet before we know all the causes which contribute to the evolution of species. Impatience is the parent of error. We must be content to wait, it may be for ages, before we have collected, marshalled, and generalized correctly from, all the vast store of materials before us.

Meanwhile evolution, in the sense of a power working from within, as distinguished from interferences from without, is confessed on all hands. We cannot deny that it is by forces working within, not by interferences from without, that the material universe, as well as plant, animal, human life, is produced. Evolution is plainly a law of the universe at the present moment. There is, therefore, no

reason why it should not have been a law of the universe from the beginning. So the Hebrew Scriptures seem to tell us. The Breath of God brooded over the surface of the waters, and the result of His action was the production of form in the formless and life in the lifeless. Where the mistake comes in is in the notion, found alike on each side of the question, that the fact of evolution is incompatible with the working of a Divine mind. It is nothing of the sort. The creative energy can unfold from within as well as interfere from without. It can graft new forms on old ones by a new impulse from within as easily as we can graft a rose bush or an apple tree. And the influence of the Divine mind is as necessary to the true theory of evolution as it was to the old notion of perpetual interferences. No other cause than that influence can, I think, be assigned for the production of new species, especially when the laws which regulate life seem to be directed towards the preservation of existing distinctions and towards the prevention, under ordinary circumstances, of the development of one species into another. Thus the comparatively modern idea of the benevolent despot, governing by successive exertions of an arbitrary will, is replaced by the old Hebrew doctrine of a Divine force, governed by self-imposed laws, and working for the good of sentient beings. The only modifications which are required are those which are introduced first by the revelation of God in Christ, which taught us to look upon God, not only as Power, Mind, Will, or even Life, but as primarily and above all Love, thus enthroning, as surely should be the case, the moral aspect of His Being above all others, and next by the discoveries of science in later years, which have shown, from the facts of the Divine working that greater limitations have been placed on the exercise of the Divine will by the principles of order and law, than had been conceived possible before this wide extension of our knowledge.*

In truth, then, scientific research has simply brought the old idea of immanence, hinted at in the Hebrew Scriptures,† fitfully discerned by Greek and almost entirely obscured in Latin Christianity, once more into prominence. The despot theory—and in mediæval and even to a certain extent in modern theology the despot was not always benevolent—

* I may be permitted once more to refer to *Lessons from Work*, pp. 30-32.

† *E.g.*, Psalm cxxxix, 15; Isaiah xxvi, 12.

gives place to that of a mighty energy operating by its laws of evolution, steadily, tirelessly, unintermittently, onward and upward. From the formless void to the universal cosmos, from the ascidian to man, from the psychical body to the spiritual body, from the psychical man to the spiritual man, from the Fall to the day when even the Head of humanity Himself shall yield up His Empire "to Him that did put all things under Him that God may be all in all," there has been a triumphal forward march of the Divine order from one conquest to another, from one achievement to another, up to the restoration of all things, when there shall "be no more anything accursed; when the throne of God and of the Lamb shall be in the heavenly city where He dwells, and where His servants do Him service; where there shall be night no more" because the Eternal Light is ever shining; and where His servants "shall reign for ever and ever in the light which He is giving."

Here, perhaps, I might well stop. But as it is by no means probable that I shall again address the Institute upon this great and fundamental topic, I may ask permission to offer some cautions which my meditations on this matter have suggested to me. In the first place I would remark that, as Mr. Balfour has told us in his *Foundations of Belief*, theological propositions require a new "setting," if they are to meet with a ready reception in the present age. And in no point is this fresh setting more urgently required than in our conceptions of the Divine Being Himself. The old "potentate" theory need not, it is true, be abandoned. But it needs to be qualified according to the "analogy of the faith."* It needs to be subordinated to ideas yet more primitive and fundamental. That offences against the great Ruler of the universe are matters of grave import, and that they need adequate punishment and call for adequate atonement, need not be disputed. But above and beyond these propositions, we must also look upon God as the great Force working through and in nature and man, for the evolution of a great moral purpose, the perfection of rational beings. In the second place I would suggest that it has been a serious mistake on the part of some thinkers to imagine that the idea of God is a simple one. As God is at the root of everything that is, as He touches us at every

* Rom. xii, 6.

point of our complex being, material, mental, moral, one would imagine that the idea of Him must be one of infinite complexity. My friend Professor Caldecott, in his kindly notice of my paper read before the Institute in February, 1883, and of my addendum to it in my little book on the Nicene Creed, remarks that I "let down a very wide net for the 'strengthening,' and—we may suppose—the filling in, of the conception intuitively given at the outset." * Holding the views I do, it would be strange indeed did I not do so. I would let down "a very wide net," an infinitely wide net, for the strengthening and filling in of our rudimentary conceptions of a Being "of infinite power, wisdom, and Goodness." † We have already had a warning from Clement of Alexandria against one-sided conceptions of the Divine nature. In fact, as I remarked in my former paper, ‡ I believe the best way of treating the question of the Being of God to be the scientific one. In other words, I contend that our theories of the Divine Being, as of other truths, should be founded on the principle of inductions from observed facts; and that thus, by successive approximations, we should arrive, not at a complete knowledge of the Divine nature, but at as close a correspondence with the truth as should be necessary as a guide to action. I do not altogether deny that among the factors which contribute to our knowledge on the subject intuitive impressions are to be reckoned. But I confess that, on reconsidering the subject, I should be inclined to restrict the area of our intuitions. I would not extend them to the intellectual; I would confine them to the moral region. In the intellectual direction I should be inclined to deny the existence of intuitive conceptions of God and confine myself to maintaining that each of us has a capacity for receiving impressions of the Divine nature from external sources. But the workings of conscience I should ascribe to the direct influence of the Divine power upon the heart of man, though restrained in its operation by the imperfection of the moral organs through which it works. Such an influence I believe to have been at work from the very first. But far more is this the case since the revelation of God in Christ. If, by virtue of our faith and of the atonement wrought out for us by our

* *The Philosophy of Belief*, p. 342.

† Art. I of the Church of England.

‡ Also in my little book on the Nicene Creed.

Lord Jesus Christ, God dwells in us, and we in Him, surely there must be a revelation of Himself to the heart in which He thus dwells—a revelation proportionate to the degree in which our wills have become identified with His. This is what He Himself tells us: “If a man wills to do His will, he shall know about my teaching, whether it be of God, or whether I speak of Myself.”* I do not say that the intellectual side of the question is to be neglected altogether. *All* error, moral or intellectual, tends to lead us astray. We need that each factor in our complex organization should contribute its proper share to the process of investigation. But inasmuch as the highest relations of God to His creatures are moral and spiritual, not merely intellectual or material, it is to the correspondence of the moral and spiritual part of our being to His that we must turn for the highest revelations of His nature.

The truth is that we have been too much accustomed to separate speculation from revelation, instead of basing the former upon the latter. And we have been inclined to suppose that the being of God was rather a purely intellectual than a practical question. We have attached too much importance to abstract ideas, whereas it is impossible to conceive of God apart from the universe, He has brought into being—an universe which soars above the region of the material to an extent which is not “dreamed of” in most of our “philosophy.” Even the Greek conceptions of the best age of Greek theology seem based rather on the ideas of Plato than on those of the Old and New Testaments, *Accedamus ad fontes*. We must go back to the days of the old conceptions of God as a living force manifested in the world which He has brought into being, and as an eternal, self-existent Ruler of that world for the highest good of beings who live, think, and feel. We must conceive of the acting and working Elohim, the Moral Avenger Shaddai, the unchangeable and imperishable Jahveh or Jehovah. And we are bidden to think of Him as dwelling in as well as extending beyond phenomena. Modern science has confirmed this view, which is the Bible view from the beginning. It has shown us, more clearly than we ever saw before, the evolution of the Divine purpose through the Indwelling Power. It has proved more clearly than ever before that that evolution of purpose,

* St. John vii, 17.

that manifestation of power, proceeds in accordance with the direction of an Infinite Mind. If we are to give up the million-fold evidence of design in consequence of certain *a priori* objections of philosophers, we must be prepared to abandon the laws of evidence altogether.* It has taught us, once more, to recognize the onward and upward sweep of that purpose as a continuous flow of the Divine energy, not as a series of interruptions or interferences from without. If modern science has failed in its theories of God, it has been because it has too severely confined itself to the material universe. If metaphysics has also failed to give us workable ideas of God, it has been because it has too closely confined itself to the intellectual side of the question. We need a wider range of thought if we are to attain to satisfactory conceptions of the Primal Force beneath phenomena. We must grasp the idea of the loving will of a Personal Being, capable of entering into moral relations with His creatures, and directing all the forces He has called into existence towards the realization of a moral purpose. We must study the working of the religious idea among all peoples, and recognize in it an influence which has been implanted by the Creator for beneficent ends, and which, in spite of the manifold perversions to which it has been liable, has not, on the whole, failed to attain those ends. Above all, we must not fail to discern in the Incarnation of Jesus Christ the last step in the Divine evolution of humanity, grafting upon, or bringing out of, the "old Adam" a new and more perfect type of human life, and through the Eternal Spirit energizing for ever among the sons of men to produce in them the conformity to the image of God, which the Eternal Son displayed among us, and has now exalted to the right hand of God. When, therefore, I say, "I believe in God," I may venture to expand my creed as follows:—"I believe in a great and living Intelligence and Energy, eternal, all-wise, all-holy, all-embracing, in Whose never-ceasing action the material is subordinated to the mental, the mental to the moral, the moral to the spiritual, Who in bringing the material universe into being has done so for the welfare of sentient beings, and

* In my book on the Nicene Creed I have pointed out that Kant has given up the argument from design on such *a priori* grounds, and I have commented with some severity on what appears to me somewhat like a slovenly treatment of so great a question on the part of the renowned philosopher.

Who seeks to produce in each of them the highest development of which their nature is capable. I believe that the fullest knowledge of His being is to be attained, not by logical demonstration, but by observation of, and reflection on, His works in the realms of matter, of mind, of soul, and of spirit," and by the close communion with Him which comes from faith in His Word, and obedience to His Commandments. "And thus," as Bishop Pearson would say, "I believe in God, the Father, the World-Ruler, the Maker of heaven and earth, and of all things visible and invisible."

DISCUSSION.

The CHAIRMAN.—I am sure we have heard with the deepest interest this most valuable paper, and I shall now welcome remarks that any who are present may desire to make upon it.

Rev. Canon GIRDLESTONE, M.A.—I think this is a most stimulating and suggestive paper, and we are all, I am sure, under a great obligation to Mr. Lias for having prepared it and read it to us.

There are only a few points that I desire to call attention to, if I may do so, in the way of criticism.

There are two sources of the idea of God given by the author, viz., observation and reflection. I think perhaps it is an oversight that conscience is left out. It seems to me that with the mass of mankind reason and conscience always go hand in hand as concerning the things of God.

Then farther on I find what can hardly be an oversight, viz., that in the patriarchal age the thought of God was one of "illimitable Might." He says, "Of the moral qualities of this Being, conceived of as illimitable Might, we have, again, no information." That is wholly opposed to my own conception of what the thought of God was in the patriarchal age. I will only give one sentence of Abraham's—one of the grandest and one that sticks to us all—"Shall not the Judge of all the earth do right?" It is a magnificent sentence, and it does not stand alone. The whole idea is included in the idea of the fall, the idea of Cain and Abel and onward, and it seems to be moral teaching concerning character and, consequently, concerning God.

Then, again, there is a reference to the term Shaddai for God. I do not think it has anything to do with the Hebrew root, Shad, in the sense of destruction, but with another Hebrew root, and has to do with the cherished idea of the Jews which is consistent with God being all-sufficient rather than an Almighty Being, and in all the passages in Genesis that I can find it has to do with God's promise of seed—the numerous seed of Abraham and his son and grandson. The impression conveyed by the usage of the word is that it refers to the richness and bounty of God.*

There is another passage that I would call attention to. It is a difficult subject, but very important. It has to do with the suggested declaration in the New Testament that God is *Breath*. Long before our Lord's time the Hebrew scriptures had abounded in the use of the word *Ruach*, and it is impossible to conceive that the passages referred to *breath* in the ordinary sense of the word. The truth is that divine things are largely known by analogy, and there are two analogies which we naturally look to—one is the wind, which suggests an unseen force, and the other is breath, which suggests life and deep feeling. Life, Feeling and Force are the three words which analogy gives us concerning the thought of God. This matter was threshed out in the Old Testament and we find it much earlier than is suggested here, and although the word *Matter* is never used in the Bible in its philosophical sense, the word *Flesh* is used in the Old and New Testaments in contradistinction to *Spirit*.

I well remember a sermon, as some of you no doubt do, preached by the celebrated Baptist, Robert Hall, on the spirituality of God, for which he took one of these Old Testament texts as his guide, the one in which the Egyptian horses are referred to as *Flesh* and not *Spirit* (see Isaiah xxxi, 3), and really, when I think on that passage, the word *Flesh* answers almost to the philosophical idea of *Matter*, though it is not used for strict philosophical purposes.

I am thankful that Mr. Lias has raised the question concerning the meaning of the words "God is a Spirit," or, as some persons prefer it, "God is Spirit," *i.e.*, by nature spiritual. But before I can discuss the Divine Spirit, I must have an idea of the

* See my discussion on it in *Old Testament Synonyms*, 2nd ed., p. 32.

human spirit. How can I tell what the nature of God is unless I have an idea of my own nature? If you have a low opinion of the nature of man you will have a low idea of God.

If we could get to know more of—I will not say psychology, but—pneumatology, we could discover what we mean by spirituality, and a great deal of good would be done not only in connection with this subject, but also with regard to various other discussions. But I think you will find that *spiritual* in the Bible always includes *moral*, and also the thought that there is a Being higher than ourselves that works within us. So that it is far more than a matter of feeling or sentiment, but rather a question of force and righteous attraction, and that force cannot be dissociated from the idea of personality. Thus you have in the Old Testament and the New Testament the thought of personality, plus thought, plus feeling. While you have the two analogies of the wind and breath, you feel that they are not more than illustrations and you must look beyond the illustration for the grand truth, and when we get that truth with regard to man, I think it is possible to build up our thoughts with regard to the Divine Being also (see *Old Testament Synonyms, s.v. Spirit*).

REV. JOHN TUCKWELL, M.R.A.S.—Like the last speaker I do not wish any remarks that I make should be regarded as wholly depreciatory of the paper, but it seems to me that perhaps there is a little too much conceded to the idea of evolution in the paper in connection with Christianity. Evolution, as applied to nature, may be regarded as a useful theory up to a point, but I think it must be admitted that a great deal more information is required on the subject before we can finally accept it. If we go back, as far as we know, to the origin of things—take, for instance, the nebular hypothesis from which all creation is supposed to have started. Supposing you grant that there was a mass of nebulous matter somewhere in space, that nebulous matter somehow got started with motion of a particular kind, and according to the law of the correlation of forces, the amount of force that starts the whole process must be equivalent to all subsequent results. Then comes the question, Whence did that force originate which started the whole nebulous mass in such a way as to produce the results of sidereal motion? Did that force originate in the nebulous mass itself? I think it must be admitted that no such hypothesis is proved, but that the force must have originated from something

outside and beyond the nebulous force itself. So I think you will find that in Christianity there has been an external force which has been at work from the beginning. In Scripture where did the whole idea of the creation of the world originate? If you read that first chapter of Genesis what cause was behind, according to scientific thought, the millions of years before the creation of man? Man could not have discovered those facts.

Then the lecturer tells us that evolution is going on now. I have failed to ascertain that there is any proof of that fact. It seems to me that there is not any evolution going on now. There does not seem to be a springing into being of any new species. It would seem therefore as though the Almighty Spirit originally impregnated matter, so to speak, with vitality and that that has ceased and that there is no evolution going on now, as previously. Again, applying that to Christ, from whence came the knowledge or idea, of the Trinity—the Almighty God becoming incarnate and living a life of humility, dying on the cross, rising again from death, ascending into glory, interceding for man and sending forth His Spirit for the regeneration and salvation of man? Where did that idea come from? Did that come from a process of evolution out of the human understanding? If we regard Christ as incarnate it is impossible to apply evolution. He came from the Father. He came into the cosmos and He says, “I leave the cosmós and go unto the Father.” It seems to me, therefore, that we cannot apply the evolution theory to our Christianity and try to work it out on those lines.

I am obliged to take a little exception to the idea of Divine immanence which the writer of the paper laid so much stress on. No doubt the universe is the dress, so to speak, of the Almighty; but you cannot apply that idea to our humanity entirely. Will any dare to say that if God tells you there are certain persons who are living in the world without God, that the likeness of His Divine image is to be applied to those persons so living without God? Is God working in those that are living without Him? If so we must make the Almighty the author of much that is repulsive to His Divine nature.

While there is so much that is excellent in the paper, we must be on our guard against letting our ideas proceed on lines that are not in accordance with Scripture, and it is necessary in that view to carefully filter them.

Rev. Prebendary WACE, D.D.—At this late hour I should not be justified in troubling the meeting with many observations; I only wish to thank Mr. Lias very much for his paper.

I think the gentleman who spoke last need not be afraid to let the ideas expressed in the paper pass into his mind, provided, as he says, that he will “filter” them. I think their substantial truth will be apparent to almost everyone. But the principal thing that I would venture to say anything upon, in supporting the paper, is the great stress that Chancellor Lias has placed on the idea of God being formed from induction and not from *a priori* reasoning. We have a great advantage on this subject in the present day. We have two great sources of our knowledge of God, viz., the word of God and the operations of Nature; and, if I may be allowed to say so, the only danger that has arisen is from the attempt of one of those sources to act without the other. As Chancellor Lias says, the assistance that has been given by science in forming our ideas of God is, practically, incalculable. I will mention one point; and that is the demonstration given of the unity of God. There was nothing unnatural in the Greek conception of a number of different deities; but when science has demonstrated that all the forces in nature are working in absolute unity you have scientifically established that fundamental part of the Christian creed. But you have to take into account the fact of revelation as a necessary part of the whole subject. It is perfectly absurd, on purely scientific grounds, for anyone to talk of the idea of God without taking scripture and our Lord’s life into consideration. They are most momentous. You have got to explain them, and when you bring those two things together, the phenomena of Scripture and the phenomena of the Universe, you get the first step towards an approximation to the idea of God.

There is one phrase in Chancellor Lias’s paper that I would take exception to, and that is the one in which he speaks of “that approximation to the idea of God” is a hope that is held out to human nature through infinite ages. The idea of the being of God is so vast that our minds now fall short of it in the result; but the blessed hope is held out to us that we may progress more and more to something like an approximation to an idea of His infinite perfections.

Rev. Chancellor LIAS.—As I understand Dr. Wace I think I am thoroughly in agreement with him.

Professor LANGHORNE ORCHARD, B.Sc.—Chancellor Lias has given us a thoughtful and suggestive paper, as any paper from him invariably is. I cannot, however, feel myself to be in agreement with him in regard to some of the statements he has made in the paper. For instance, he ventures to assert “that, like the idea of self, the idea of God, as formed by man, is, primarily at least, the product of experience.”

That strikes one as being, perhaps, a little contradictory of what he has said in a previous page, where the idea of God is said to be an exception to this—“I am inclined more and more to regard experience as the true foundation of all knowledge, except that of the Divine Being.” Mr. Lias strikes me, therefore, as being slightly contradictory here. But can we really suppose that our idea of God is obtained from experience? You must have a notion of a thing to precede its experience; and as to the idea of God, it is not easy to see how the idea of the infinite can be given by experience. Experience does not supply the idea of the infinite at all. Take the notion of space, time, or duration. The notion of infinite space or duration is only intelligible as a notion of an infinite attribute; but the notion of an infinite attribute requires the notion of an Infinite Being to whom the attribute belongs. It appears to me, therefore, that you cannot trace the original notion of self and of God to experience. But undoubtedly our knowledge of self and our knowledge of God are very much increased by experience; but that is not the original notion, but rather a *development* of it.*

I am inclined to agree with what fell from Canon Girdlestone with regard to Abraham. The patriarch must surely have had a definitely formed conviction as to the moral character of the God he worshipped when he so trusted Him that he forsook his country and home and knew not whither he went, and was even prepared to sacrifice his own son! Would that be possible, unless he had the most complete faith and confidence in God and His goodness?

* Is there not some confusion of phrase, or words, in speaking of the “idea of God,” or “knowledge of God”? Do we really not mean (as Dr. Wace points out) ideas or knowledge of His attributes and perfections?—Ed.

The learned author gives rather an extraordinary definition of evolution, and he says, "Meanwhile evolution, in the sense of a power working within, as distinguished from interferences from without, is confessed on all hands." It may be "confessed on all hands" that there is a power working within nature, working according to what we call "laws"; but that is not evolution. Any belief in a Divine working in nature is certainly not confined to evolutionists, or confined to them principally. Farther on he appears to regard evolution, as generally defined by evolutionists, as a process by which one species is transmuted into another. "Evolution is plainly a law of the universe." It is not a law of the universe, and there is no proof of it. It is an *a priori* hypothesis.

On p. 59 I find a curious argument: "The creative energy can unfold from within as well as interfere from without. It can graft new forms on old ones by a new impulse from within as easily as we can graft a rose bush or an apple tree." Undoubtedly it can. Who can doubt that God could work by the curious and grotesque method of evolution, or otherwise, if He so pleased? The question is, *does* He do so? not whether He *can* do so; and if no new species can be found to be produced from previously existing species, it is not credible to say that evolution is a law or a fact. The evidence is all the other way. You must produce your new species and not quietly assume that they *are* produced and argue from that. Variety is produced, no doubt, but not species.

It was Huxley, who is a pretty good authority for not accepting evolution, who said in a letter to Faraday, "We cannot prove that a single new species has been produced." The learned Chancellor proceeds, "No other cause than that influence can, I think, be assigned for the production of new species, especially when the laws that regulate life seem to be directed towards the prevention, under ordinary circumstances, of the development of one species into another." That was ably pointed out by Lyall's experiments* and those of Dr. Dallinger with monads, when it was found that you could not produce new species from previously existing ones.

At p. 61 of the paper the learned Chancellor expresses his belief that we have no intellectual intuitions of God. Why not?

* Lyall was a great reasoner, but not experimentalist; the reference is probably to some other authority.—Ed.

We have a notion of infinity. Can that notion be explained except by reference to an Infinite Being? And that Infinite Being is God.

Passing on to p. 63, I am sorry to see a sentence against which, as a believer in Christ, I protest with all the indignation and all the energy of which I am capable. That passage reads, "Above all, we must not fail to discern in the incarnation of Jesus Christ the last step in the evolution of humanity." I entirely deny the truth of that. I am exceedingly sorry, and it is a matter of astonishment and regret to me, that the learned Chancellor should have permitted himself to write that sentence. The incarnation of the Lord Jesus Christ, according to the Christian doctrine, was not the result of any natural law working in humanity. It was a stupendous miracle. I remember, years ago, hearing Chancellor Lias in this room speak of miracles and how I admired his able arguments in defence of their reality, and I can hardly believe that this is the same gentleman who so boldly championed Christian miracles. The incarnation of the Lord Jesus Christ was a miracle.

The CHAIRMAN.—I do not think the author's words can be said to be capable of the construction put upon them by Professor Orchard.

Rev. Chancellor LIAS.—It is Divine evolution, of course, of which I spoke (page 63).

Professor ORCHARD.—Then you admit that Divine evolution includes miracles.

Rev. Chancellor LIAS.—Yes, I believe evolution is a Divine process; I said so all the way through.

Professor ORCHARD.—And includes miracles?

Rev. Chancellor LIAS.—Yes.

Professor ORCHARD.—I was afraid the author did not mean that. I am obliged to Chancellor Lias for stating what he has just now stated.

Rev. Chancellor LIAS.—I thought that possibly it would be better to make my reply more full when the proceedings are published, and I will try to make a written reply; but I would make one or two observations. And first, as to what Canon Girdlestone said about conscience being left out in the paper. Though there is no special reference to it, I imagined it would be seen where it came in.

Then with regard to my reference to Hebrew history, I may

say I am in shackles by the fact that a very influential section of the clergy of the Church of England, including persons in high places, do not allow me to talk on the Pentateuch as history at all, and therefore I have to get it where I can find it. Then as to the expression, "Shall not the Judge of all the earth do right?" that seems to me to prove the contrary of what he contended for, for it seems to me that Abraham was in great difficulty and was not quite sure that "the Judge of all the earth" would do right.*

With regard to *Shaddai* and God as *Breath*, Canon Girdlestone and I have simply given an opinion, and therefore that does not come much into argument. When he says that *Flesh*, in the Old Testament, represents *Matter*, I am not with him there, and I do not think he has taken a very accurate view of Old Testament teaching on that point. I do not think he apprehended what I meant by evolution. I meant what Dr. Gladstone spoke of, viz., development. He says himself that he believes in evolution up to a certain point. So do I, and I do not think I go beyond that.

As to the doctrine of Divine immanence, if I read my Greek Testament aright, immanence is merely a Latin form of abiding which we read of in the Gospel and Epistles of St. John; but I can express myself more fully on that when I reply in writing to the paper.

J. H. GLADSTONE, Esq., D.Sc., F.R.S.—At this late hour it would not be desirable to detain you with many words. I may, however, be permitted to express the great pleasure I have had in listening to a paper with which I think all, whether theologians or thoughtful scientific men, will substantially agree.

An interesting point is the comparison between the historical development of natural science on the one side, and the historical development of the knowledge of God as made known to us in the Holy Scriptures on the other. It appears to me that there is a very striking parallelism between the two. We have just been shown that nature affords conclusive evidence of one supreme mind, and the unity of God is of course affirmed in the Bible; in both instances the conviction of this unity has become more and more evident as knowledge has increased.

* The author here seems to take a mistaken view of Abraham's meaning. The interrogatory form of the expression is the strongest evidence that the Patriarch was certain that God would do right.—Ed.

Again, there was an early conception that God was like a greatly magnified man, but in both departments of human thought it has become more and more evident that "His ways are not as our ways." The early conceptions of God have frequently represented Him as—shall I say?—capricious; but the gradual widening of the scope of revelation has made known to us more and more His divine purposes and plan, just as the Chaos of the ancient natural philosophers has given way to our present belief in a Cosmos and a Reign of Law.

This idea of development in both departments has long been familiar to me. I gave a series of lessons to my Bible class "On the Harmony of Successive Revelations" in 1850, nine years before the publication of Darwin's *Origin of Species*, and ten years before the notable contest between the Bishop of Oxford and Professor Huxley, at which I was present, and had a talk with Huxley as we left the hall. This controversy has almost ceased to exist, or to arouse interest. It seems now to be pretty generally acknowledged that the way in which God has revealed Himself as disclosed in Scripture is in accordance with what may be deduced from a study of nature.

The CHAIRMAN.—There are one or two very valuable comments which the Secretary has received and which will be printed with the discussion.

May I return our thanks to Chancellor Lias and add my own thanks to him for the admirable way in which he has brought forward certain points that I have been feeling after, but not very successfully, until I read his paper? I believe this doctrine of Divine immanence, or belief that God upholds all things by the "word of His power," whatever the mysterious word *logos* means, is, as Chancellor Lias says, the link between the mistaken conceptions of science and Eternal Truth, and I thank him most heartily and ask you to do so. (Applause.)

The Meeting then adjourned.

THE FOLLOWING COMMUNICATIONS WERE RECEIVED:—

From Rev. Professor CALDECOTT.—The discussion on this paper turned upon some of its main features, but there were also some other points in the paper which merit attention at this time—points belonging to another region of "science," the field of psychology.

This region is being slowly admitted to share in the honourable name of science, but only slowly. Even Mr. Lias, while making good use of psychological results, seems to have only the physical region in view, when he writes the word "science," though in reality he is thinking of much more.

First. Mr. Lias has himself either made good use of psychological science, or else has by his own interpretative faculty succeeded in setting himself in the main stream along which modern psychology is flowing on a most important point. The rank of intellect among the forces which produce our living beliefs is not rated by modern psychology anything like so high as it was in the eighteenth century and most of the nineteenth. A change has come, and the function of intellect seems now rather to be regarded as that of a servant of high character than that of master of the house. This Mr. Lias sees, and expresses by referring to abstract ideas—the contribution of intellect at its highest—as simply "convenient formulæ of generalization" and terms of similar purport. Whether this is correct or not I am not here attempting to decide; what I am concerned to do is to point out that Mr. Lias has found his way to the same general attitude as that which now prevails in Britain, America, and Germany. Whether he has heard of it from philosophical quarters or has discovered it for himself, he has accomplished the change, just as of philosophy in Germany it is written, "*Sie wendet sich von der intellektualistischen zu einer voluntaristischen Auffassung.*"

Second. Mr. Lias's position on this is at the same time congenial to the prevailing mood in theology, both general theology and Christian. The position was claimed by Luther as against many of his fellow-workers in the Reformation, who were scholastics of the Intellectualist type at heart with a change of the seat of authority from tradition to the canonical scriptures. Luther always depreciated intellect, as a source of conviction, in favour of moral and spiritual influences; and Protestant theology at least is returning to his side. Indeed, in the hands of the Ritschlians there is a danger of intellect being mistreated as having no *locus standi* in the tribunal where religious judgments are delivered. Mr. Lias does not go this length, but he agrees in regarding correspondence with *truth* as valued according to its power as "a guide to action." Here, again, I am only pointing out that Mr. Lias is with the stream.

I may indicate, however, that where defenders of a higher rank for intellect would join issue is upon the amount of credit to be allowed to it as a *creative* power. They would say that what Mr. Lias allows is insufficient. Where he deals with intellectual operation they would say that he has before him only a passive and receptive function, that he is, in short, too close to Locke and Mill and Spencer—not sufficiently Kantian or Hegelian. He has a right to be so, but perhaps he may hardly relish these congeners, and he probably prefers still the company of Mansel in his conceptualism, as he did when he wrote his previous paper some years ago.

Third. In the reference to science few will be found to disagree with Mr. Lias when he maintains that materialism is out of date. I think that it reached its high-water mark in Britain in Tyndall's famous pæan at Belfast. That blast woke the echoes over Britain, but no peal like it has been heard since that time. The fact was that Tyndall was a student and expounder of the physical sciences; in them he buried himself, and for other fields of observation and induction he had neither opportunity nor special talent. But what has gone on since Tyndall's time? Not least impressive of changes has been the widening of the term "science" to include study of human nature as well as of the external world. We do not now look for explanations of the varieties of men's personal character in the recesses of physiology, nor for explanations of national character in the geographical and climatic circumstances which one nation deals with in one way, and another nation in another. The British Association has widened its range to include the study of the sciences of mental life: first economics was admitted; then anthropology; latest education; and now psychology and ethics may almost be heard clamouring at the gate.

As an honorary member of the Institute I have pleasure in emphasizing, on these points, the fact that Mr. Lias's position in this paper is in accordance with the general trend of recent advances on the side of the mental and moral sciences, and also of theology, as I read the signs of the times.

Rev. W. F. KIMM, M.A.—The meanings of the names El, Shaddai, etc., are discussed, and it is inferred that the moral attributes of God were unknown to Abraham. But we have much more than these names to guide us; we have the *history* of the patriarch and of preceding times, and Chancellor Lias gives us sufficient reason

for accepting this history, where mention is made of "sin," "wickedness," the "evil imaginations of men's hearts," the "very grievous sin" of Sodom, and of the Divine displeasure against sin. Abraham is sure that the Lord will not slay the righteous with the wicked, or that the righteous should be as the wicked "that be far from Thee. Shall not the Judge of all the earth do right?" Abraham "commands his children and his household after him to keep the way of the Lord, to do justice and judgment."

Regarding the name Jehovah, the context in the passage quoted suggests that the name was used to teach the people that God, who was come to deliver them, was the God of their fathers who had promised deliverance (Exod. iii, 15, 16, 17), and thus their faith was linked on to the faith of their fathers.

It does not appear that the Decalogue was given as a higher standard of duty than had been known to men before, but rather that it was a call to the people to return to the faith and practice of their fathers. The Mosaic institutions would, however, serve to deepen a sense of sin in men's minds, and so would prepare them for the revelation that was to follow, as the paper has shown.

Professor J. LOGAN LOBLEY, F.G.S.—As a lover of science from my youth up, I am rejoiced to find that it has at last been recognized as a factor in the evolution of theology, and consequently as possessing a religious character. This, it seems to me, should give it a place in the curriculum of students of theology, and so I regard this paper as being in support of what I have long advocated, the making of elementary science obligatory for the pass degree at Oxford and Cambridge, both of which universities are already splendidly equipped for its teaching.

The Rev. G. F. WHIDBORNE, F.G.S.—In one other way, at least, the idea of God has been modified by scientific discovery. Every year now with its crowding discoveries is revealing new vistas of originative power. The fact of God must be either acknowledged or denied; acknowledge it, and every fresh natural law recognized, and every new scientific truth discerned, magnifies the known meaning of that fact, and intensifies the presumption of the utter immeasurability of that part of it which remains beyond our knowledge. And this process is not completed; it is still going on. Scientific discovery is imperfect; it has not yet reached its goal. That is to say, future generations will gain yet further

insight into the idea of God ; and after all they will only know in part, even as we.

And may it not be that, even as scientific discovery is imperfect, so is modern thought imperfect. May it not be that there is a limitation in its ideas of God that shall melt away in the light of fuller knowledge ? May it not be that the supposed antagonism between " a power working from within " and " interferences from without " shall prove unreal ? " Did not He that made that which is without make that which is within also ? " If by " evolution " be suggested any limiting of the ways of God, may not such limits to the limitless break down ? Modern thought is our little atmosphere ; its atmospheric effects are often most beautiful, sometimes delusive. But there is a vast ether above it, and the ways of God are there. Unexplored by human knowledge, unscanned by the eagle eye of science, those higher walks of wisdom are the paths of God alone. So what is supernatural with man is natural with God. " The Breath breatheth where It listeth, and thou hearest the voice thereof, but canst not tell whence it cometh, or whither it goeth. " *

Rev. L. G. BOMFORD.—With regard to the immanence of God, which the learned author seems to consider the great lesson which theologians have learned from modern thought and science, it may be pointed out that theologians have long been well acquainted with the words of St. Paul in Acts xvii, 28—words quoted so often by Christian evolutionists, quoted sometimes as though they were the only words known to us of the great apostle, in their apologies for their Christian faith—" for in Him we live, we move, and we exist. " Meyer in his commentary, published, I think, in 1839, says : " Paul views *God* under the point of view of His immanence as the *element* in which we live, etc. ; and *man* in such intimate connection with God, that he is constantly surrounded by the Godhead and embraced in its essential influence, but apart from the Godhead could neither live, nor move, nor exist. " Meyer, however, points out that these words of St. Paul are said " solely

* In substituting " The Breath breatheth " for " The Wind bloweth, " does not Mr. Whidborne rather spoil the beautiful imagery of Our Lord in his conversation with Nicodemus (John iii, 1), illustrating the unseen influence of the Spirit of God on the heart of man ?—Ed.

of *man*, and that indeed in so far as they stand in essential connection with God by *divine descent*," which is evident from the following words, "for we are also His offspring." The theory of the immanence of God as brought forward by modern theologians, and notably by the able writers of some of the *Lux Mundi* essays, goes, if this view of St. Paul's words be true, much farther. It seems to me in some hands, at least, to postulate the presence of God in every grain of sand, in order that there may be in every such grain the potentiality of evolution, and that an evolution which shall reach again as far as God. This theory has apparently been made to fit the extreme evolution theory. If man has been developed from sand, then man must have been in the sand, and as man is divine, sand must be divine, this seems to be the argument. The theory has well been named, if I remember right, by one of its advocates "Higher Pantheism," everything in God, as distinguished from ordinary pantheism, God in everything, and like some other theories it remains to be proved. If the miraculous element in God's manifestations was formerly too much insisted on, and was used to explain almost everything, there is a danger now that it be lost sight of. Without miracle we can have no Incarnation, in the Trinitarian sense at least, and that a miracle is not necessarily a "jerk" may, I think, be shown by the history of the Incarnation. There is at all events yet room for miracle; growth and evolution have not yet explained everything, not even everything physical, still less everything moral and spiritual.

If I may venture further to criticize, I might remark that we are apt to be somewhat too severe on the theologians of fifty years ago. Certainly thirty years ago, if not fifty, theologians with few exceptions were quite conscious that there could be no opposition between religion and *true* science. What they were afraid of was not scientific investigation, but the hasty deductions and generalizations which scientific men were making, and which were being somewhat eagerly swallowed in an undigested state by a credulous and unthinking public. It must be remembered that the attitude of Darwin and the rapid reception of his conclusions were somewhat alarming, for although Darwin concluded his *Origin of Species* with a reference to the Creator, he afterwards wrote, "I have long regretted that I truckled to public opinion and used the pentateuchal term of creation, by which I really meant 'appeared' by some wholly unknown process."

What the theologians of 1871 feared—Darwin's *Descent of Man* was published in that year—was not science but speculation, and that their fear was not groundless may be learned from Darwin's own words in his life, p. 271: "I must try not to fall into my common error of being too speculative. But a drunkard might as well say he would drink a little and not too much." As Illingworth has pointed out in *Lux Mundi*, the danger of Darwinism was that it attacked final causes. The presence of final causes or design in the universe has always been one of the strongest supports for natural religion, "it is contained in the very notion of a . . . creation by an Eternal Reason. And this was supposed to be directly negatived by the doctrine of the survival of the fittest through natural selection." If theologians have ceased to quarrel with science, it is not so much that theologians have changed their view of God, as that "scientists" have, in many cases unconsciously, abandoned Darwin and returned to the idea of design.

At the same time the last thirty years have undoubtedly seen a change in the theologian's view of God and of the working of God. The operation of God by His bare "fiat" has been seen to be only one view or only a partial view of His operation; it has been seen that "Let there be light, and there was light," may be compatible with a very gradual dawn, a very gradual increase of light; and that much which was at one time accounted for by the mere exercise of will on the part of the Creator is due also to His self-limitation; that not only the possession of free-will by man and the existence of evil, but also the very existence of the universe, and above all the Incarnation, is due to this power of self-limitation. In other words it has been more plainly seen that the Latin "omnipotens" and the English "almighty" do not accurately represent the Greek παντοκρατωρ, and this acknowledgment has led to a more easy rapprochement of modern theology and modern science.

In alluding to the necessarily complex nature of God our author gives, I think, only one of the three definitions of God found in the writings of St. John:—

"God is Spirit," the force which lies behind all manifestations of force, whether physical, moral, or spiritual, in other words the "Father";

“God is Light,” and therefore can be comprehended little by little, can be seen, can be revealed, in other words the “Word,” the “Son”;

“God is Love,” and therefore can be loved, can impart Himself, can embrace His willing creatures, in other words the “Holy Spirit.”

The first gives us design, the second gives us revelation, the third makes religion possible. Science seems willing now to grant us the first; let us hope that it may see its way presently to grant the second and the third.

THE AUTHOR'S REPLY.

I will reply as briefly as I can to my critics.

Canon Girdlestone remarks that in one part I have made no mention of conscience. He has overlooked the fact that I was there speaking of the *original* sources of the idea of God, antecedent to revelation. He will find that I have taken account of conscience in other passages. This is also my answer to Professor Orchard on this point.

Canon Girdlestone's next objection, which is also made by other speakers, does not take sufficient account of the limitations imposed upon me by the fact that recent critics who have maintained their position within the Christian Church have disputed the accuracy of the Hebrew records. I cannot, therefore, use them as undisputed witnesses to facts. My critics bring forward the reflections of the historian as authoritative. They forget that in a purely historical inquiry we should certainly not be permitted to use the *obiter dicta* of Herodotus or Thucydides, Livy or Tacitus, Macaulay or Froude, as evidence of facts which occurred long before their time, or as decisive as to the opinions of the historical personages they bring before us in their narratives. I can, under present circumstances, only use the facts which the Hebrew historians relate; I cannot insist on their explanations of them, however much I should be personally willing to do so. On the one fact alleged by Canon Girdlestone I am, I regret to say, altogether in conflict with him. I can only interpret Abraham's words, “Shall not the Judge of all the earth do right?” when coupled with the anxiety he evidently feels on the subject of his prayers, as an evidence that he was not by any means sure

that the "Judge of all the earth" would "do right."* His prolonged and fervid pleading for the doomed city seems to me to differ very considerably indeed from the calm confidence with which the Christian "makes his requests known unto God." Nor do I think that the Old Testament can be fairly and rationally explained, except on the ground on which the writers of the New Testament, and especially the author of the Epistle to the Hebrews, insist, namely, that the revelation of God has been a *progressive* revelation.

With regard to the derivation of the word Shaddai, Canon Girdlestone simply expresses a different opinion from mine. He gives no evidence for it. He will therefore forgive me if I adhere to my view, especially since, as I have pointed out, the conception of God as an Avenging Deity is introduced in the Second Commandment. But if any other view of Shaddai be preferred to my own, it can be substituted for that which I have adopted without materially affecting the argument in the paper. I may say almost the same thing in reference to Canon Girdlestone's view of *πνεῦμα*. I did not base my argument on the Hebrew scriptures, but on the declaration of our Lord in St. John's Gospel. The Hebrew word for spirit, I think, is nevertheless connected with the idea of breathing. And *σῶπξ* in Greek is more frequently contrasted with the word *πνεῦμα* than in the corresponding words in Hebrew. But *σῶπξ* never signifies *matter*, so far as I am aware, but the evil tendencies of the body degraded by the fall.

In regard to evolution, some of my critics seem to have been possessed by a preconception that whenever that word is used it must be used in the sense in which it was employed by Mr. Darwin. This seems to me to be the case especially in Professor Orchard's remarks. I had hoped that I had sufficiently explained the sense in which I employ the word in pp. 57, 58. But it appears that I have not done so. I certainly did not mean by it the "evolution of new species." In the first place I see in it a *Divine* working, not a working apart from God. And next, I apprehend that it can no longer be denied that God is working *in* phenomena, not simply outside them. That is also what I mean by immanence. But that it does not, in my mind, exclude transcendence is clear from p. 60. If any one questions the

* See notes pp. 72 and 77.

Divine immanence in man, I would simply ask him to note the way in which the word *μένω* is used in St. John's writings. I may add that on p. 63 I have introduced the word "Divine" in my paper to meet Professor Orchard's other objection.

I can only, in conclusion, express my thankfulness for the way in which the paper has been received from the scientific side, and I hope I may regard it as a proof that the controversy between theologians and men of science has been finally closed.

POSTSCRIPT.—When writing my reply, I had not the *written* criticisms before me. I thank Professor Caldecott for his kind words. I have had no opportunity of studying recent investigations in psychology. What I have said in accordance with them has been instinctive. But I am glad to have my conclusions and general method confirmed by independent evidence.

I acknowledge the justice of Mr. Bomford's criticism, that beside the doctrine that God is Spirit, I should have added that St. John also describes God as Light and Love. My explanation is that I did not wish to add to the length of my paper, and that the latter part of it, as I stated at the outset, was written under great difficulties in consequence of illness. Mr. Bomford will, however, find statements exactly in accordance with his in my *Doctrinal System of St. John*, p. 27, and in my *Nicene Creed*, pp. 85, 86. I have there stated distinctly that God is described in the Bible as Light and Love, as well as Spirit, but I have added that He is also represented as Life—the source of all life, animal, moral, spiritual.

ORDINARY GENERAL MEETING.*

THE REV. F. A. WALKER, D.D., F.L.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following elections were announced :—

LIFE MEMBER :—William Arnold Hepburn, Esq.

MEMBERS :—Edgar Erat Harrison, Esq. ; Rev. William D. Fanshawe, M.A. ; Dr. John Hall Gladstone, D.Sc., F.R.S.

LIFE ASSOCIATE :—Miss Ella Smith-Bosanquet.

ASSOCIATES :—Lieut.-Colonel A. R. W. Sedgfield, M.B. ; The Rt. Rev. Dr. Lefroy, Bishop of Lahore ; The Rev. Arthur H. Ewing, M.A., Ph.D. ; The Rev. Henry Merwyn Tyrwhitt, M.A. ; Herr Frederick Waldemar Lönnbeck, Stockholm ; Rev. G. E. White, Anatolia College ; Clifford King, Esq. ; James Malcolm Maclaren, Esq., F.G.S.

The following paper, entitled, "The Preparation of the Earth for Man's Abode," was then read by the author :—

THE PREPARATION OF THE EARTH FOR MAN'S ABODE. By J. LOGAN LOBLEY, F.G.S., F.R.G.S., Professor of Astronomy and Physiography, City of London College.

INTRODUCTION.

A HUNDRED years ago the story of the earth could not have been told. Although the constellations had been devised, the heavens mapped, and the stars numbered and named, although the character and motions of the planets were known and the times of eclipses could be determined, although the globular form of the earth and its movements both of rotation around an axis and of revolution round the sun were well established facts, and although, moreover, gravitation had been discovered and Newton's *Principia* had been written and published, yet the structure of the earth was unknown. A century ago, the character and origin of the ground on which he trod and the formation of the rocks beneath his feet, man did not know, though cosmical theories had been advanced by a few learned men while the more extended knowledge which now enables us to give an

* Monday, 9th December, 1901.

incontrovertible account of the preparation of man's abode was not possessed by anyone, however learned.

Indeed, it is not too much to say that while some other sciences were advancing by leaps and bounds, terrestrial knowledge had made no headway until Hutton's *Theory of the Earth* was published. But after that epoch-making event, notwithstanding even then much strong opposition, geology advanced by rapid strides. It enlisted the enthusiastic love and devotion of some very able men; the Geological Society was founded,* as was also a Chair of Geology at each of our two great Universities, and Dr. William Buckland, afterwards Dean of Westminster, was appointed to be the first teacher of geology in the University of Oxford, and the Rev. Adam Sedgwick to the same position at Cambridge. The State recognized the substantial character and the utility of geological science by the creation of the Geological Survey of Great Britain and Ireland, and for half a century the truths revealed by geological investigation have been acknowledged and highly valued in every civilized country on the globe.

On previous occasions I have dwelt strongly on the educating power of geological knowledge and methods in different directions, and now I will venture to invite attention to its effective teaching of the unity of nature and the constant working of the processes of nature in one direction, that of progress towards the conditions at present existing on the earth, which are, in fact, the conditions under which man can live and develop his capabilities.

The record of the rocks is one of change—change world-wide and change continuous. But if it be a record of incessant change, it is also a record of persistency of direction to which the work performed by that incessant change points. For all the changes revealed by geological investigation are but steps in the great march of cosmical events towards the production of present terrestrial conditions. And as these conditions allow not only of the life of mankind, but also of the increase and physical development of humanity and of the mental and moral growth of the human being, we must conclude that all geological changes, which include palæontological or ancient zoological changes, have been the necessary steps for man's existence on the earth. After referring to the analogies between the

* By Mr. George Bellas Greenhough, F.R.S., in 1807.

three living genera of Crustacea—*Serolis*, *Limulus*, and *Branchipus*—and the trilobites of palæozoic times, Buckland, in his *Bridgewater Treatise*, writes: "When we see the most ancient trilobites thus placed in immediate contact with our living Crustaceans, we cannot but recognize them as forming part and parcel of one great system of creation, connected through its whole extent by perfect *unity of design*, and sustained in its minutest parts by uninterrupted harmonies of organization."*

The story of the earth has been the subject of many voluminous works, so great is the accumulation of the results of the observations and researches of geologists in many lands. It will be obvious, therefore, that in a single paper nothing more can be attempted than a very general summary of the wonderful story, which can deal only broadly with the great teachings of the records of the rocks.

These records, clearly, distinctly, and even conspicuously, tell of progression throughout a vast period of time, as the result of agencies of nature working ceaselessly and unchangingly, yet with results differing in magnitude and intensity in different regions and at different epochs, but all the consequence of laws that know no change. Thus, although what is commonly called uniformitarianism in geology has been displaced by the present evolutionary geology, even as uniformitarianism displaced catastrophism or convulsionism, every geologist is and must always be a uniformitarian with respect to the ultimate causes of the building up, and of the sculpturing and conditioning of the present surface of the globe.

THREE PERIODS.

The existence of this planet may be said to have extended through three periods, the first of which is hypothetical, the second consequential, and the third historical, since its history has been written in language both clear and unimpeachable; the universal language of the records of the rocks.

The First Period saw the aggregation of the matter of the earth; its fused and intensely heated condition; its assumption of the globular form; its revolution around a great overmastering attracting body, the sun; its rotation

* "Geology and Mineralogy considered with reference to Natural Theology" (*Bridgewater Treatise*, vol. i, p. 394).

around a constant axis, and its consequent deviation from the spherical to the spheroidal figure; and, subsequently and finally, the loss of one-eightieth of its bulk by the separation by centrifugal force of its equatorial, exterior, protruding portion, with the resulting formation of the moon.

The Second Period saw the solidification of the exterior by cooling, the *consistentior status* of Lord Kelvin, by which the first permanently solid rocks of the globe were formed; the furrowing or wrinkling, and local depressing of the surface by shrinkage; the cooling of the hot and heavy vaporous atmosphere, with the consequent condensation of the water-gas (H_2O); the gradual filling of the surface hollows with the water so condensed, and the consequent formation of the primæval seas and oceans of the globe; also the commencement of the destruction of the first-formed land by the continuous and heavy rain highly charged with acids, and the transportation of the eroded material and its deposition beneath the waters of the first-formed seas. Thus would be accumulated vast thicknesses of sedimentary rocks to be afterwards melted by interior heat or transformed in character by metamorphosing agencies.

The Third Period saw the commencement of organic life following on the establishment of the necessary normal atmospheric and land conditions. With variations of temperature between 32° F. and 212° F., winds would be produced, with evaporation and precipitation of water, that would give rise to storms, rain, and rivers, and so denudation and the formation of sedimentary rocks would be continued. The earlier of these rocks would also afterwards be largely metamorphosed and any organic remains entombed in them obliterated; but they are the foundation stones of the vast pile of stratified and fossiliferous rocks of later ages.

This Third Period, therefore, witnessed the accumulation of the stratified rocks and the innumerable generations of animals which have successively inhabited the globe, with the introduction of higher and higher forms, or organisms of greater and greater complexity; and witnessed, too, the production of those great physical features of mountains, valleys, and variously indented coast lines which now diversify the land areas of the globe. And along with all this animal life and these geological results, there was the growth of plants, at first lowly cryptogamic organisms,

and afterwards lordly forest trees and the vast variety of phanerogamic vegetation which now clothes and beautifies the surface, for this period has seen all the geological and biological changes that have been in progress up to the present time.

It is to this period that modern geology has almost confined its attention. But geology has now taken a wider view of its scope and functions, and in doing so it approximates to the etymological meaning of the word geology, as the science of the earth; for it embraces all that can be taught respecting the earth as a whole, its relation to the sun, to the other planets, and to its own satellite, as well as its structure and the changes to which that structure is due. All terrestrial knowledge is, in fact, within the scope of geological inquiry.

It is, however, the Third Period, of which the earth has preserved for our instruction copious records in the great stone-book of nature, to which I must now necessarily confine myself.

From all analogy, I think it is fair to conclude that each of the two previous periods had a very long duration. Lord Kelvin is, however, of opinion that when the solidification of the exterior of the globe was consummated, the surface rapidly cooled and soon became fitted for the existence of organic life.

But whatever was the duration of the First and Second Periods, there can be no hesitation in concluding that the Third Period was one of prolonged duration.

THE RECORDS OF THE ROCKS.

Rocks which are obviously sedimentary, or composed of material worn away from other rocks—clastic rocks, as they are termed by geologists—occur much lower than the oldest Cambrians, for they form large masses amongst the pre-Cambrian or Archæan rocks.

The Cambrian rocks, however, have preserved the hard parts of animals inhabiting the seas of the period so admirably that not only the lower sub-kingdom, Hydrozoa, but the much higher classes, Crustacea, Brachiopoda, and Lamellibranchiata, are clearly shown to have been both in existence and to have been well developed and abundantly represented. Some of these ancient rocks are conglomerates, or beds of cemented shingle, each pebble of

which was rounded by the rolling action of sea-waves, exactly as is going on now at Brighton.

In the rocks that were formed after the Cambrian, namely, the Lower Silurian, we find remains of higher Mollusca than those in the Cambrian rocks, for there are fossil gasteropods, pteropods, and cephalopods, some in great abundance. The trilobites and brachiopods of the Cambrians become more numerous and more differentiated so as to give many genera of these groups. The Lower Silurian rocks include limestones, slates, and shales, telling of tranquil waters; and thick masses of volcanic rocks, both consolidated fragmentary ejectamenta, or ashes, and compact basalts, telling of violent eruptions and great lava flows, such as we have at present.

The inorganic conditions, therefore, of the Cambrian and Lower Silurian epochs cannot be said to have been greatly dissimilar to those of the present time, and consequently we must look chiefly to the organic worlds of plants and animals to find the changes that chiefly prepared the earth for man's existence and abode.

A great step in this wonderful progressive march is indicated by the fossils of the next great division of the sedimentary rocks, the Upper Silurian, for these rocks reveal the appearance on the globe of the highest sub-kingdom of animals;—the Vertebrata, since in them are the remains of fishes—true fishes certainly, but of an early type only. Their most conspicuous difference from the usual fishes of the present seas is the form and character of the tail, to the extremity of which the backbone extended, giving it a prolonged pointed form. These herocercal-tailed fishes, as they are called, have still many representatives in the sharks, sturgeons, and skates, but they are now less numerous than the homocercal or equal-lobed-tail fishes which are now so common and abundant. In Silurian rocks, too, are remains of undoubted land plants, which Sir William Dawson described as *Prototaxites*, but now called *Nematophyton*, which was probably a thallophtalform.

The Devonian epoch saw a considerable development of Vertebrata, as the fishes were numerous, and though retaining the vertebral tail, diverged from the pristine type and approximated to the modern salmon-like form. Large crustaceans very much larger than our present largest species, the giant Australian crab, abounded. One of these,

a *Pterygotus*, in the Geological Museum, Jermyn Street, measures 4 feet in length. As the beautiful Devonshire marbles conspicuously show, reef-building corals worked as industriously as now. In this period, too, there was a great development of plant life, both aquatic and terrestrial, including amongst the land plants lycopods, equisetaceæ, rhizocarps, and an abundance of true ferns, *Filices*, vascular spore-bearing plants, amongst the highest of the cryptogams. When the little likelihood of land plants being included and preserved in marine deposits is borne in mind, we cannot wonder that the far more ancient plants of Cambrian times (if such there were) have not yet been met with to give us examples of the lower steps of our terrestrial flora.

A further advance is distinctly seen when the Carboniferous rocks are examined. Comprising, as they do in some places, fully 3,000 feet thickness of limestone, what a wonderful amount of animal life is proclaimed! For this is a marine deposit, and so has been produced by the accumulation of material secreted by animal forms as solid matter to form their endo- or exo-skelctons. Innumerable examples of the beautiful structures built up of this organically converted solid matter have been perfectly preserved in the crinoidal, shelly, and coralline limestones of Derbyshire and other localities, which are well-known objects in our museums. In Carboniferous rocks, too, there is evidence of the appearance on the globe of a class of vertebrates higher than the fishes of the Devonian rocks. This, the Amphibia, is represented by the order *Labyrinthodontia*. The Amphibia, or Batrachia, best known now by our frogs and toads, are intermediate between fishes and reptiles. Insects of several orders seem also to have abounded.

But it is the wonderful preservation of the produce of plant-growth that gives to the Carboniferous rocks their greatest interest and their chief value to man. The coal seams in these rocks are but consolidated masses, or beds, of vegetable matter grown on land or, at least, on swampy areas. This enables us to ascertain the biological level to which plant forms had attained in the Palæozoic epoch. It also shows that the climate then prevailing over a large portion of the earth's surface was warm, or at least very mild; for the vegetation in temperate regions was as profuse as it is at the present day in the forests of the Amazon and other tropical river valleys. Nor were the Carboniferous

forests wanting in stately, arborescent forms, for lycopods attained a large tree-like size in *Lepidodendron*, and in *Sigillaria* grew to a girth of 16 feet and a height of 50 to 60 feet. Equisitaceæ gave the genus *Calamites* in great abundance, while the ferns were most profuse in the great number of genera and species, some of which are remarkably similar to those now growing so freely in the southern counties of England.

The Carboniferous rocks and their contents are of the greatest value to mankind and most conducive to the progress and advancement of humanity; and as to our own country, it may be said that Great Britain owes its wealth, power, and importance in a great degree to the beds of coal contained in the rocks of this period.

Of the various substances, all most useful to man, and stored up for his use in the Carboniferous rocks, the most important is coal, which for two hundred years at least has been abundantly employed for giving heat, light, and power to mankind. It occurs in very large and widely separated areas, for it is found in both the Old World and the New, and in both the Northern and the Southern Hemispheres. Yet great and extensive as are the coal-beds of to-day, they have been much more extensive in the past, for very large areas have been swept clear of the coal they once possessed by the agency of denudation.*

Although the conditions prevailing in the regions in which the known Permian rocks were deposited were unfavourable to animal life, with the result of giving to those rocks a diminished fossil fauna, yet the comparative abundance of amphibian forms is evidence of continuous progress towards present terrestrial conditions. The epoch was intermediate between Palæozoic and Mesozoic (or Secondary) times, between the age of Invertebrata and of fishes and the age of reptiles, birds, and mammals. The flora had a quite Carboniferous character, ferns being abundant and tree-ferns numerous. In addition there were some phanerogams, though confined to the gymnosperms, as remains of cycads and conifers are found in rocks of Permian age.

As in the older so in the later Palæozoic ages, volcanic

* This is especially the case in the case of Ireland, the whole of the central plain of that country having been originally covered by deposits with coal.—ED.

outbursts added igneous rocks to the sedimentary deposits, and so contributed to the picturesque beauty and varied elevation of many localities at the present time. Many of the hills of the south of Scotland, including the well-known Arthur's Seat and the Castle Rock at Edinburgh, owe their existence to the eruptions of volcanoes in Carboniferous times, as does the marvellous scenic beauty of the Cumberland Lake District to volcanic action in Lower Silurian times.

It should be added that the Palæozoic rocks as a whole form a vast store-house, as it were, of economic minerals available for man's use at the present time. Amongst the treasures which they contain, in addition to those peculiar to the coal-measures, are gold, silver, copper, mercury, lead, platinum, zinc, and antimony. These ancient rocks, too, by their general hardness and consequent greater resistance to denuding agencies, have added great beauty to the world, and so have in this way also contributed much to the happiness of mankind. The most picturesque and beautiful scenery is in regions where the Palæozoic rocks occur, forming as they do mountains and hills, deep valleys, lakes, and irregular coast-lines with lofty and precipitous cliffs.

The Secondary rocks continue the record of change and progress. Very many of the life-forms of the older rocks are absent, and thus tell us of the extinction of a great number of species and genera and of some large groups. The most noteworthy is the extinction of the entire group of trilobites, which were most abundant in Silurian times. These very well defined crustaceans ranged in time from the Lower Cambrian to the Carboniferous epoch.

Although the oldest of the three great divisions of the Secondary rocks, the Triassic, is not, as a whole, well adapted for containing organic remains, since the Triassic rocks are largely formed of sandstones, yet one series of strata, the Rhætic, has been sufficiently preservative to yield decided evidences of a striking and most important advance in animal organization; for in these beds are remains of an animal in the highest zoological class, Mammalia. The *Microlestes antiquus* was a small animal of one of the lowest orders of the class, Monotremata, yet it was unmistakably a mammal, and thus the highest class of the animal kingdom is found to have been represented in early Secondary times.

In the varied and highly fossiliferous Jurassic formations,

the rocks were formed during an epoch which has been called "the Age of Reptiles" from the dominance of the large marine and the gigantic land reptiles which then peopled the globe. The enormous and terrible Dinosauria is an extinct order of Reptilia;—our present largest reptile, the crocodile, having a femur only one-sixth the length of the femur of a deinosaur. Another most remarkable extinct order, the Pterosauria, flourished in Jurassic times. These extraordinary creatures were winged reptiles, the wings having a range of extension up to 24 feet. Although the wings were bat-like and not feathered, the pterodactyles had some of the characters of birds in conjunction with some that were reptilian. The remains of a true feathered bird, however, have been found in these rocks, showing that all the classes of Mammalia were in existence in the Jurassic epoch.

One feature of the Secondary fauna is too remarkable to be here omitted. It is the incoming, enormous development of, and then the extinction of, two well defined groups of the class Cephalopoda, the ammonites and belemnites. Along with the ammonite flourished the nautilus, of the same order of Cephalopoda, the Tetrabranchiata, yet in Palæozoic times the nautilus lived when there were no ammonites, and the nautilus still flourishes, while the ammonite ceased to exist at the close of the Secondary epoch.

With the exception of the Old Red Sandstone and the coal seams with their underclays and shales, the rocks known to us up to the Jurassic series are, from their fossils, obviously marine. But some of the beds of the lower oolites are estuarine in origin, and they contain a large assemblage of land plants, in some cases beautifully preserved, which afford an indication of the character of the terrestrial flora of Jurassic times. From these fossil plants and parts of plants it is seen that this was an epoch of gymnospermous phanerogams. The prevailing order was Cycadaceæ, about twenty genera of cycads having been described from Jurassic rocks, and the conifers were represented by the genera *Araucaria*, *Pinites*, *Thuytes*, and others.

The Cretaceous rocks furnish a most interesting connecting link with the present, since their most remarkable division, the chalk, is a rock of the same character and composition as a deposit now forming on the floor of the Atlantic Ocean. Even some of the species of the microscopic shells of which

it is made up are the same in both cases, and one, the *Globigerina bulloides*, is abundant in both the Cretaceous beds and the Atlantic ooze of the present day.

The fauna of the Cretaceous rocks is noteworthy as well for what it lacks as for what it includes. One of its *lacunæ* is the absence of mammalian remains in the European area, with the exception of a species ascribed to the genus *Plagiaulax* found at Hastings. Fishes of the highest type, the *Teleostei*, now make their appearance, and one genus, the *Beryx*, is not uncommon in the chalk of Surrey and Sussex. Of the Reptilia, the great Jurassic dinosaurs, although in some abundance still, die out with the Cretaceous epoch, and the same may be said of the pterosaurs. The Cretaceous reptiles have left some remarkable examples for our instruction. Amongst these are the gigantic three-toed *Iguanodon Mantelli* of Sussex and Kent, and the still larger *Iguanodon Bernissartensis* of Belgium, which have been made well known by our museums; and the pterodactyles of the Cambridge greensand. But it is to the rocks of the Western States of North America that we owe the greatest exposition of the reptilian forms of the Cretaceous epoch. From these rocks have been obtained many species of dinosaurs, pterosaurs, crocodiles, marine-saurians, turtles, and no less than fifty species of veritable sea-serpents, of which the enormously long *Mososaurus* is best known. These dominating monsters of the Cretaceous seas were some as much as 75 feet long.

Although birds do not live under conditions favourable for the preservation of their bones, some remarkable species have been entombed in Cretaceous rocks, chiefly in North America. One group, Odontornithes, was toothed, and in the genus *Hesperornis* the teeth were in a common alveolar groove as in the reptilian *Ichthyosaurus*. Thus some of the birds of the Cretaceous epoch had affinities with the then dying out reptilian groups of dinosaurs and pterodactyles. In America, too, in the Cretaceous rocks of Dakota and Wyoming, a large assemblage of mammalian remains have been discovered. These have been placed by Professor Marsh in sixteen genera, but all are of the lowest orders of Mammalia and allied to the Jurassic forms of the same class.

A very important advance in plant-life marks the Cretaceous epoch, for in its rocks are the remains, often beautifully preserved, of the earliest known angiosperms.

which give to us at the present day our highest forms of the vegetable kingdom, and with these the phanerogams are also represented abundantly by the gymnosperms that marked the Jurassic epoch. From Westphalia alone fifty-three species of dicotyledonous angiosperms have been obtained from Upper Cretaceous beds. These include species of, amongst other genera, *Quercus*, *Populus*, *Eucalyptus*, and *Ficus*. In the Cretaceous rocks of other parts of Germany the phanerogams are represented by the genera *Acer*, *Salix*, and such conifers as *Sequoia* and *Pandanus*, the screw pine.

Another very remarkable feature of the Cretaceous flora is its extension, and in great abundance, to the Arctic Regions, where, in North Greenland, are found remains of oak, walnut, plane, laurel, ivy, ilex, and even magnolia and eucalyptus. Again, in the Uppermost Cretaceous of North America, the Laramie formation, one hundred species of dicotyledons have been discovered, amongst which the vine (*Vitis*) is especially to be noted. The Potomac formation of Virginia and Maryland furnishes, besides, about three hundred and fifty species of conifers, cycads, and lower groups, and seventy-five species of angiosperms, including the genera *Sassafras*, *Ficus*, *Myrica*, *Bombax* and *Aralia*.

The epoch, therefore, during which the Cretaceous rocks were deposited not only witnessed the existence of the highest class of animal life, Mammalia, but also saw clothing the earth the highest division, the dicotyledons, of the highest class, the angiosperms, of the highest sub-kingdom of plants, the phanerogams, or in other words the highest group of plants known to man.

The stores of mineral treasures in the Secondary rocks, although not so vast and important as those in the Palæozoic rocks, are yet very great. These rocks contain large amounts of copper and iron ores, and gold has been obtained from the Cretaceous rocks of North America. Alum and gypsum are other substances useful to mankind which these rocks supply, and building stones, both limestones and sandstones, are very largely obtained from Secondary rocks, as well as the more ornamental marbles and alabasters, and various useful sands and clays. But their most noteworthy product is perhaps rock-salt, occurring in beds of great thickness and resulting from the drying up of lakes and shallow seas usually in Triassic times, but some in the Jurassic epoch.

In the Tertiaries, the latest of the main subdivisions of

the sedimentary rocks before that containing undoubted evidences of the advent of man, we read the records of the consummation of the preparation of an abode for man. Physical changes will of course continue, but we have no reason to suppose that new forms of life will appear.

The most striking features of the work of Tertiary times are (1) the production in the rough, if I may so say, of those great modellings and sculpturings of the land that now diversify its surface, and (2) the great development of the highest organic forms, both animal and vegetable.

The elevation of great mountain ranges, mountainous regions, and plateaux, though not of all, the cutting of river-valleys, the spreading out of great low plains, the formation of lakes, the separation of islands from the large land masses, and the production of coast lines, as we now know these geographical features, were in the main the work of the Tertiary epoch. Some, it is true, of the great surface features of the earth have a much older date, and, on the other hand, considerable modification of the features of Tertiary geography has been accomplished by the unceasingly acting agencies of nature, operating geologically all through the by no means short Quaternary epoch quite up to the present time. But it is still true that the present physical features of the land were, in the main, the work of Tertiary times.

Miocene rocks occur at an elevation of 5,000 feet in the Alps, and Pliocene strata are found as high as 14,000 feet in the Himalayas. To elevation during the Tertiary epoch is due the chief part of the height of the Andes in South America; and the Rocky Mountains in North America, in which Cretaceous strata are now 14,000 feet above the level of the sea, may also be termed Tertiary mountains, although part of the elevation has taken place in both older and newer epochs.

In the British Islands the work of geological agencies in the Tertiary epoch has left very conspicuous results. In the Isle of Wight Cretaceous and Lower Tertiary strata are now so far altered from their original horizontal position as to be absolutely vertical. The denudation of the chalk has been so great that although from its protective covering of basalt the chalk has been preserved in the North of Ireland, all the part that once was continuous to the chalk of Sussex has been swept away except that to the south-east of a line from Dorset to Flamborough Head, and in this area the greater

portion has been destroyed. When it is remembered that the chalk has a total thickness of over a thousand feet, the denuding agencies that have destroyed so much of it will be at once seen to have produced most important changes of surface in Tertiary times.

In the south-east of England, where we now are, the chalk extended over the whole of the Wealden area, connecting the North Downs of Surrey and Kent with the South Downs of Sussex. The pebbles constituting the Oldhaven Beds, 40 or 50 feet thickness, and forming still a large area in West Kent and East Surrey, are cogent evidence to everyone walking over Blackheath or Croham Hurst of the enormous destruction of chalk that took place in early Tertiary times, for these beds are of Lower Eocene age, and every pebble is a highly finished, well rounded fragment of a chalk flint.

Of the geological work and consequent geographical changes accomplished during the Tertiary epoch, Sir Archibald Geikie says: "The Tertiary periods witnessed the development of the present distribution of land and sea and the great mountain chains of the globe. Some of the most colossal disturbances of the terrestrial crust of which any record remains took place during these periods. Not only was the floor of the Cretaceous sea upraised into low lands with lagoons, estuaries, and lakes, but throughout the heart of the Old World, from the Pyrenees to Japan, the bed of the early Tertiary or nummulitic sea was upheaved into a succession of giant mountains, some portions of that sea-floor now standing at a height of at least 16,500 feet above the sea."*

The great development of the highest organic forms which, as has been said, also distinguished the Tertiary epoch is abundantly testified to by the records of the Tertiary rocks. The highest group of plants we have seen was well developed at the close of the Secondary epoch, but in the animal kingdom only the orders Marsupialia and Monotremata, of the class Mammalia, were represented, so far as we know, at that time. In the Tertiary formations, however, the fossils introduce us to higher and higher species, until in its latest strata forms are found almost identical with species of the highest existing orders.

From the Eocene beds of the Paris Basin remains have

* *Text Book of Geology*, 3rd edit., p. 963.

been obtained of a number of species of birds which include forms allied to our living pelican, flamingo, quail, and hawk. And in these beds is the first appearance of the higher orders of Mammalia, but the earlier species, although carnivores, have affinities with the marsupials, and then occurs the bones of the *Hyracotherium*, a small pig-like animal with canine teeth.

The Upper Eocene beds, now called Oligocene, both of the Paris Basin and the Isle of Wight, have given a rich assemblage of mammalian bones. Baron Cuvier in France and Professor Owen in England worked at these bones with such success that they both arrived at the same conclusions, which established their accuracy. Thus *Anoplotherium*, *Palæotherium*, *Xiphodon*, and other genera of the order Ungulata were added to the fossil fauna of France and England. The *Anchitherium* was intermediate in structure between the tapir-like species just named and the horse. It was as large as a small pony, but had three toes. With these, the earliest allied form to monkeys, the *Cænopithecus*, appears, and hornless deer and antelopes seem to have been numerous in the Eastern Hemisphere.

In Miocene times, what is now Great Britain was probably a land area and so contains no deposits of this age. But Central Europe was then under water that extended along the line of the Alps, not yet raised to their great elevation, and the Pyrenees, and during the Miocene epoch marine gradually changed to brackish water conditions in this central sea. The result has been the accumulation of enormous deposits in Southern Europe and the basin of the Mediterranean, and the entombment of a magnificent assemblage of organic remains that presents us with a very vivid picture of at least the flora, if not of the fauna, of Miocene lands.

The fauna is, however, sufficiently illustrated to show that it differed considerably from that of the Oligocene epoch. We now find the earliest elephantine animals in the great mastodons, and with these there was an enormous ant-eater, the *Macrotherium*; an early pig, the *Hyootherium*; a sabre-toothed tiger, the *Machairodus*; and a bear with affinities with the hyæna, the *Hyænarctus*. According to Gaudry, the first anthropoid ape, the *Dryopithecus*, appears; but Owen thought it was more allied to the gibbons. In America, deposits of Miocene age have given the large *Brontotherium*, which is distinct from any existing family,

but is nearest to the rhinoceros. The Miocene fauna is especially interesting from its giving to us the remains of the earliest dogs and camels. The genus *Canis*, of the Upper Miocene of Oeningen, is related to the *Hyænartus* already mentioned. The *Protolabis*, of the Miocene of North America, is regarded by some as the earliest camel, but the *Procamelus* of rather later deposits, though still Miocene, is nearer to our present camel.

The leaves of the forests of the surrounding lands have been beautifully preserved by the deposits in Miocene lakes, and they have been carefully described and illustrated by Professor Heer, of Zurich. The flora as a whole indicates a subtropical or warm climate, becoming colder towards the close of the epoch.

In the Miocene flora there are remains of representatives of families of plants that have for a long period been of great use to mankind for fruit, for flowers, and for timber. Of fruit trees both *Pomaceæ*, giving us our apples and pears, and *Amygdalaceæ*, giving our almonds and plums, appear, the former in *Pirus*, pear, and the latter in both *Amygdalus*, almond, and *Prunus*, plum. *Rosaceæ*, *Violaceæ*, *Papilionaceæ*, and *Ericaceæ* added floral beauty to the Miocene forests as they now do to our gardens. Of forest trees we find that the following genera, which were of earlier introduction, were in great abundance:—*Quercus*, *Ulmus*, *Platanus*, *Acacia*, *Acer*, *Ilex*, *Sequoia*, and *Mimosa*. The flora also included *Magnolia*, *Betula*, *Laurus*, *Myrtus*, *Ficus*.

We have at length reached the epoch immediately preceding the advent of man on the earth, the Pliocene or latest of the Tertiary periods. The approach to present conditions, both in the animal and the vegetable kingdoms, is very conspicuous. Deposits of this age are not wanting, in the east of England, showing, therefore, a depression of this area beneath the waters of the Pliocene sea, but they seem to have attained their maximum importance in Italy and Sicily where they have a thickness of 1,500 feet.

The Miocene *Deinotherium* and *Mastodon* still lived, but they were now being supplanted by the true elephant, the rhinoceros and by the hippopotamus, and a large number of other herbivora allied to antelopes, deer, etc., indicating large grass-covered areas, together with the giraffe-like *Helladotherium* and *Samotherium*, and the Sewallik Hills of India give to the Pliocene fauna the *Sivatherium* and the

Bramatherium. Now we find the true horse, *Equus*,* and along with it the *Hipparion*, now extinct, which had three toes, but only one, the middle one, touching the ground. Now, too, we have the ox, with the cat, the hare, and the mouse. The *Mesopithecus* and the *Dolichopithecus* were the apes of the period.

The flora of the Pliocene epoch was very similar to that of the present day in England, with the addition of one or two subtropical plants, and towards the end of the period the plants requiring most warmth disappeared, indicating a lowering of the temperature and an approximation to present climatal conditions. Besides the present forest trees of England, we find the buttercup, chickweed, dock, sorrel, marsh marigold, the *Osmunda regalis*, and many other plants with which we are familiar.

Although at the commencement of the Quaternary or Human epoch the climate in this and more northern regions was undoubtedly too rigorous for man, yet in more southern latitudes, to which the ice-covering conditions of the Glacial epoch did not extend, there would be no climatal hindrance to his existence. On the return of more suitable climatic conditions, man was undoubtedly living in these and adjacent areas. Judging from the large number of flint implements found in the Pleistocene gravels of England and France, man seems to have been tolerably abundant in the European regions soon after the departure of glacial conditions.

Since that time, favouring conditions for man have continued to increase, and profiting by these, man has made advances, and by these advances has aided the progress of favouring conditions. But with the preparation of the earth for the earliest man, the simple human being, we have had alone to do, and the changes that have taken place during the Quaternary epoch are not, therefore, within the scope of this essay.

CONCLUSION.

The records of the rocks which have now been presented, although briefly and quite disproportionately to the greatnes-

* The *Equus asinus*, the ass of East Africa, has left its remains in the Pleistocene cave deposits of India, though not now living there.

of the subject, will be sufficient, I hope, to clearly show that present terrestrial conditions are the result of innumerable links in a chain of events extending throughout a vast period of time, and that every one of those links was necessary for its successor; and that therefore all have been concerned in the preparation of man's abode.

Even the vastness of the time has been a most important factor in producing phenomena of every-day observation. For to it is due the great range of the character of the rocks, the extreme hardness of some and the softness of others, which give to us now our mountains and our vales.

The composition of the original rocks has been the source of all we find of value to mankind in the present crust, and the various geological changes that have taken place have given variety to the rocks now at the surface, furnishing the soils suited to the production of all that the varied wants of man require. Regions we have for mining minerals, regions for forest growths, areas for the growth of the plants that give us food and all the many valuable products of the vegetable kingdom.

These plants, too, and the animals useful to man, have been the ends of series contemporaneous with the geological changes, and therefore part of the preparation of an earth suitable for the habitation of man by the Creator.

Still further may we say that the means of communication by water, the seas and rivers of the globe, by which mankind can intermingle, spread the products of the land, learn and progress, and subdue the earth, have also been the result of the changes of the past. Nay more, beauty and variety of landscape, beauty of field and flower, and even the charm of the music of the birds, have all been the outcome of this wonderful preparation extending throughout geological time.

DISCUSSION.

The CHAIRMAN.—I think you have already anticipated what I was going to propose, viz., a cordial vote of thanks to Professor Lobley for his interesting and instructive paper, dealing with so many products of the past and present world, showing us the links between the two and the successively higher forms of organic

beings and the times at which they appeared. We shall be pleased to hear any one who would like to speak on the subject or to put any questions to the author.

The SECRETARY (Professor HULL, LL.D.).—Mr. Chairman,—At my suggestion Professor Logan Lobley kindly undertook to deal with the subject of his essay. It is one which, as it seems to me, is eminently suited for the consideration of members of the Institute, and I feel sure it will be allowed that it has been ably handled by the author.

It is one of the great triumphs of Science of the nineteenth century, and of the Victorian Era, that it has witnessed the unfolding of the Geological Record. For nearly eighteen centuries of the Christian Era, not to speak of the many previous centuries, mankind had no other guide to his knowledge of what we may designate "the pre-Adamic history of the world and its inhabitants" beyond that afforded by early chapters of the Book of Genesis. I am not here to disparage the geological record as contained in that wonderful book, which I never read, or hear read, without recognizing that it is far beyond what unassisted human reason could have imagined or produced at the time it was written. It contains in simple and stately language the main outline of the history of the world and of its inhabitants; but it was left for recent scientific investigation to fill in the details, and so complete the record. That has been the great work of the nineteenth century; and the author has unfolded it to us this evening, briefly as was necessary, but with sufficient fulness to enable us to recognize the grand procession of vital phenomena—the development of animal and plant life, of which the earth has been the theatre—from the earliest dawn to the present period.

The portion of the essay which will cause most interest is probably that in which we approach the appearance of the animals and plants now inhabiting the globe, and which ranges through the Tertiary period. There we have the process of organic evolution by which the forms more and more approximating to those now inhabiting the world appeared in company with man himself. It was a slow and gradual process, as are all the great events of Providence in the affairs of the world; in His plan for the government of the world there must always be "the fulness of time"; and in the natural world we know that it is governed according to the proverb "*Natura nil facit per saltum.*" Thus when

the time arrived those forms of animal life appeared which were destined to minister to man's physical wants as well as to his advance in civilization. Along with them came the forms of plant life specially adapted for sustenance, as well as to adorn and beautify the face of nature, and so minister to his mental enjoyment. At last man himself appeared on the scene—the last and most perfect of all God's works, equipped with powers and faculties suited to enjoy the great gifts placed within his reach, and with mental powers capable of investigating the laws which govern the universe. For him the whole world is a Garden of Eden ; for him, every habitable portion is furnished with animals and plants suited to minister to his wants. Surely, in all this we may see clear and unmistakable evidence of design and adaptation, illustrating the striking passage of the Psalmist, " The heaven, even the heaven is the Lord's, but the earth hath He given to the children of men," given as his school for training in the knowledge of God and of His works, and of His purposes of love, in preparing us for a still higher state of bliss.

The Rev. JOHN TUCKWELL, M.R.A.S.—I should like to follow what our Secretary has just stated in regard to the wonderful agreement between the first chapter of Genesis and the paper which we have listened to. Every one well remembers the first verse of that chapter, which states a very remarkable and universal fact, and that is, that it was God who created, in the beginning, the heavens and the earth. But if you look carefully into the chapter, I think it will be found that those stages are delineated in the chapter. Take the statement of the story of the earth in particular—that "the earth was without form and void." Now as the Septuagint was translated, that expression "without form" is "invisible," and the word "void" indicates an unfinished state. What could more fitly represent the chaotic condition of our globe than such a word? A globe of gas would be without form and without those objects that are now around us.

Now in the next stage you have the statement that "darkness was on the face of the deep." That is a remarkable expression.

In an address given before this Society some years ago by Lord Kelvin, he told us there was a period in this earth's history when there was a molten envelope something like twenty-five miles deep round the globe which seems to have given place to the aqueous condition of our globe through condensation of vapour.

Then we have the next thing represented, viz., that "the spirit of God moved on the face of the waters." It is very remarkable we should have these two distinct words, the "deep" and the "waters." They are evidently used deliberately to indicate two conditions.

Then Professor Logan Lobley has told us there subsequently came a period when the dry land appeared. We do not know what the first continental land may have been; but the late Professor Dawson has told us about the Laurentian formation—the Laurentian upheavals and Laurentian deposits; and then we have, following the formation of land, the formation of plant life. Professor Lobley told us about the cryptogamic and the phanerogamic coming at the first appearance of continental land, and in that chapter you have the statement made that God created green things, and two classes are mentioned—herbs and the tree, "every tree in the which is the fruit of a tree yielding seed." So that the cryptogamic and phanerogamic are mentioned in that chapter. Then we have a statement of the reptiles following the Carboniferous period—creatures which, as Professor Lobley says, were as much as seventy-five feet long.

Then next you come to the creation of the mammalia and cattle, and you have exactly that same thing in the paper in our hands, following, as you see, the period of the Cretaceous strata. Then you have finally the creation of man—the last of all the works of God. "And then God rested from all His work which He had created and made"; and it does certainly appear that there is no creative action going on at the present time, but that the Almighty is "keeping His Sabbath." Whether or not that creative power may be put forward again we do not know, at any rate until, as we are told in the inspired record, "God will create a new heaven and a new earth." It seems to me that the two records fit each other as closely as hand and glove, and it seems impossible to account for the writing of this beautiful chapter, so many thousands of years ago, unless we attribute to it an inspiration which affects the very words and language in which the chapter is written.

The Rev. Canon GIRDLESTONE, M.A.—I think it is very good sometimes to survey shortly that which we are dwelling upon, the earth and its foundation, and I think the paper brings us to three good results. First, the unity of the earth; secondly, its progres-

siveness; and thirdly, the preparedness of the earth for man—its adjustment to man as he is, not to man as he is destined to be hereafter, because I had in my mind all the time through the reading of the paper a little sentence which shows that there is something yet coming, reserved till the end when He said, "I go to prepare a place for you." That shows that there is a long preparatory process going on now, perhaps through the relationship of our present earth, with its fellow-planets and sun, to other heavenly bodies; but there is this preparatory process going on whereby the habitation once prepared for man as he is will be adapted to man as he is to be, and there will be the same complete adjustment in the second case as in the first.

Another point which must strike everybody, I should think, as we have been through this paper, is the utility of fossils, because if all fossils had been reduced to nothingness, which would have been the case, no doubt, if all the rocks had been igneous instead of in most cases sedimentary, there would not have been a single trace of the animals and vegetation that have existed before the human period. What a serious loss that would have been!

The only other thing that strikes me is that after all I suppose we have only got some thirty-five miles down out of the eight thousand which would be requisite to carry us through the depths of the earth, and, therefore, we are only dealing with the crust of this wonderful globe on which we live. It is a good thing, sometimes, to remember that all this is the roof, as it were, that the building is beneath—and a wonderfully good roof it is, a roof that took a long time to prepare; but beneath are the phenomena touched upon in the earlier part of this paper, and I observe that the Professor said on his last page that all the later sedimentary rocks depend for their existence on the composition of the original rocks. So that there must have been in the composition of the original rocks everything that was required to produce all materials—a clear evidence of design in the formation of the earth.

After some observations by Mr. MARTIN ROUSE,

The CHAIRMAN.—I should like to ask Professor Logan Loblely about the *Dryopithecus* referred to on page 97. A great many genera are mentioned in connection with the period he there refers to. He says, "According to Gaudry, the first anthropoid ape, the *Dryopithecus*, appears"—the middle-sized monkey and the long-necked one, whether he considers the *Canopithecus* to be a

monkey or an ape. In the middle of page 97 he speaks of "the earliest allied form to monkeys," and later on he speaks of "the first anthropoid ape," which Owen thinks is more allied to the gibbons.

Professor LOGAN LOBLEY.—I am greatly indebted to you for the kindness with which you have listened to my paper. I am much obliged to Professor Hull for his very kind supplementary remarks and also for the very interesting remarks that were subsequently made.

It was a very great pleasure to me to prepare this paper and to read it, and I am especially glad to be here to-day to meet the Institute with this subject in hand.

I did not quite understand the question you asked me, Mr. Chairman, about the *Cænopithecus*.

The CHAIRMAN.—Whether you considered it to be more of a monkey than an ape?

Professor LOGAN LOBLEY.—More allied to the monkey. The anthropoid ape appears later. I do not know that I have any other question to reply to. I again thank you very much for your kindness.

The Meeting then terminated.

THE FOLLOWING COMMUNICATIONS WERE RECEIVED:—

From Colonel WILLIAM CAREY, C.B.:—

"I very much regret not having been able to attend Professor Loble's lecture on 'The Preparation of the Earth's Surface for Man's Abode.' I consider the same an exceedingly good one and most interesting, but his division of time into three epochs, viz., Hypothetical, Consequential, and Historical—without any particular reference to how the same fitted in with the six days or periods of creation as given in Genesis of our Scriptures—I think was a very great pity; and although he places the appearance of man about the time of the Glacial period, not only is no possible or probable date for it noted for the ignorant in geology, but at the same time it raises the question of a pre-Adamite man allowable by the accounts given in the first and second chapters of Genesis.

“Yet for all this his consequential and historical account is clear enough to demonstrate that the order of those periods agrees with the testimony of the Books.”

Mr. WILLIAM MILLER, Broughty Ferry :—

“‘The Preparation of the Earth for Man’s Abode.’—This is a very excellent summary of geological history prior to the advent of man, but I feel that the author does not bring out with sufficient clearness the fact that all the changes to which he refers appear to have had that advent in view as their principal object; that there was throughout the whole of their history a prophetic declaration of that object, and that man is the only being that ever existed who had sufficient intelligence to understand and appropriate for his own use the various natural productions which are now seen so beautifully to converge for his comfort and advancement in the world.

“Still further I would have liked to hear what he had to say as to the introduction of the domestic animals, the horse, ox, sheep, etc., immediately prior to the advent of man, for whose use I think they were evidently intended, to serve as his companions and servants,* but this may not have come within his subject, if he meant to confine himself strictly to ‘the preparation of the earth for man’s abode.’”

* See Genesis ii, 18, 19.

ORDINARY MEETING.*

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

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

ASSOCIATE :—Miss Eva J. Board.

The following paper was read by the author :—

ADAPTATION AND SELECTION IN NATURE: THEIR BEARING ON DESIGN. By WALTER KIDD, M.D., F.Z.S.

IT is a singular fate that befell the theory of evolution that its main terms have been not only ambiguous, but even incorrect, but it is probable that this has conduced greatly to its wide acceptance. We know well how the mind of man is captivated by a form of words or even an expression, and for good or ill, the leaders of mankind have known how to use this fact of human nature.

I refer to the four outstanding terms or conceptual formulæ inscribed on the banner of the evolutionist host, viz. :—

1. Origin of Species.
2. Struggle for Existence.
3. Natural Selection.
4. Survival of the Fittest.

3 and 4 being practically equivalent.

1. If Darwin had named his great work more modestly “Modification or Transformation of Species,” how different

* Monday, March 17th

might have been its reception! That species of plants and animals were mutable was well enough known before the "fifties" through the marvellous divergencies produced by breeding from the original wild stocks of horses, cattle, sheep, dogs, and from those of fruit-bearing trees and cereals. But *origin* was the title, and it threw down the challenge at once to older views and was on that account the more calculated to capture the restless mind of modern man.

2. The theatre in which Darwin claimed that this origin had occurred was the supposed struggle for existence. Here the obvious competition for means of livelihood and comfort raging among individuals and races of men, which had given rise to the remarkable essay on population by a clergyman named Malthus, was read into that struggle for existence among the lower forms of life which it was purely gratuitous to postulate. It ought to have been enough for the more candid and reasonable exponents of Darwinism to see that to talk of struggle for life between lower plants and animals, especially in that region which so much struck Darwin's imagination, viz., the survival of certain individual seeds out of a single plant, or of certain ova out of the million in each herring, was an unwarrantable liberty in the use of language.

3. The now familiar term Natural Selection was an inappropriate reading of a word, instinct with human purpose and will, into a process assumed and stated to be no more purposeful than the wind that blows, to use the simile of Darwin himself. This aspect of the familiar term has been forcibly pointed out by the late Duke of Argyll, and by strict logic and use of terms he was well justified, but it is held that the term is only the best that occurred to Darwin, and no sinister design of deluding the unwary is wrapped up in it. Professor Poulton has attacked the Duke rather bitterly in a work on Charles Darwin, for what he declares to be captious criticism.

4. The fourth great term in the evolutionist vocabulary is Mr. Herbert Spencer's equivalent for Natural Selection, viz., Survival of the Fittest. This resembles the other three in looseness and ambiguity, and the latter quality is acknowledged by Huxley.

The new meaning of the Survival of the Fittest has now to be taken to be "fittest to survive," or "fittest for the environment." It really might be rendered "whatever is,

is best," and it has a flavour of optimism which Mr. Spencer claims is an essential ingredient in his philosophy of evolution.

It is evident, then, that a somewhat amended dictionary is required, if one is to explain at all accurately the subject-matter of much of the writings of evolutionists, and it is not the least of their claims to be heard that they have dared, and successfully, to twist the meanings of three or four well-known words to their purposes of conveying a certain line of thought, and the meanings are now generally understood. One has no right to complain of this, and the Duke of Argyll's protest was of too academic a character to weigh with the scientific world, and accordingly it fell somewhat flat. But it is not out of place to mention this character of some of the evolutionist vocabulary, because certain of the terms in question will be referred to later in this paper.

Adaptation.—The conception of adaptation has become so widely used in biological writings as to deserve critical study, for through such comprehensive terms many errors of the first importance may be allowed to creep into our mode of thought.

Adaptation is a term in general use in scientific works on account of the ease with which any intelligent and personal element may be excluded from its application. No one can object to a literary tool being employed for business purposes, as long as no subtle root-error is thereby admitted into a system. In regard to this term "adaptation," there is some danger that this may happen, as I think will appear if we look at it closely. Adaptation has become in certain ways the equivalent of the older term "means," which always connoted the further idea of end. "Adjustment" is another modern term virtually synonymous with adaptation. The conception of adaptation is of immense range in biology, so much so that Weismann was well justified in his statement, "Everything is adapted in animated nature and has been from the beginnings of life." But in this great range of application comes in one element of danger.

The primary meaning of the word is "fitted to." This is a somewhat complex word, for it signifies that one thing is fitted to another thing or condition of things, and as used in general language before it was annexed by scientific writers, it contained the further idea of something being fitted to another by an active agent for a purpose. There are in it, then, properly four ideas:—1st. The thing adapted.

2nd. That to which it is adapted. 3rd. The purpose for which it is adapted. 4th. The agent who adapts it. The fourth of these ideas must be surrendered in the present day on account of the resolute way in which the word is used without any reference to a person or agent, and because scientists have adopted this term and must have their tools or conceptual formulæ with which to do their work. We must take adaptation as a term employed by the leaders of biology as one condemned to not more than three, and probably only two, of the four meanings which truly belong to it. We must also bear in mind that for their own convenience biologists have enlarged the abstract idea of adaptation further, and speak of "an adaptation" or "adaptations," as concrete nouns substantive, as formerly the word "means" was used.

It must be remembered that the term adaptation is further complicated because a thing may be (1) adapted as a whole to its surroundings, (2) a part may be adapted to the efficiency of the whole—the adaptation may be *extrinsic* or *intrinsic*.

The most usual, if not exclusive, application of the word in science is to the phenomena of organic existence; it is therefore the special tool of the biologist, and it is in his department of science that misapplications must be most carefully watched, more particularly because in the province of life such are the most important, as tending to belittle the teleological meaning of that part of the cosmos with which we are chiefly acquainted. One of the simplest instances of adaptation, and one which is confessedly a matter of pure chance, as we call it, and due only to the action of purposeless-mechanical causes, is the fall of an avalanche down a mountain side, the result of which is that various fragments of rock or ice roll on until they find their resting place and each is at rest in its suited position. These fragments may be said to be adapted each to its position for no purpose whatever. The fragments of various shapes and sizes settle down into such situations as suit their size, weight and character, from the mass of rock weighing several tons to each grain of sand, each disintegrated and set going by certain physical laws. This entirely mechanical case of adaptation connotes two of the four ideas only—the thing adapted and that to which it is adapted; purpose must be excluded. But it is just this form of mechanical adaptation, under certain chemical and physical laws which some extreme-

biologists would gladly apply, if they could, to the living, growing, developing organic life around us. But the facts of biology do not lend themselves to such simple handling, and by no less an authority than Weismann we are warned that in biology we come upon the unknown sooner than in any other branch of science, so that here, more than elsewhere, is a hasty making of ambitious "laws" to be especially guarded against.

But much more significant forms of adaptation meet us as soon as we turn from the inorganic to the organic, and the great range of the latter, and the immense diversity of their environments, are illustrated by a bacterium at one end, and man at the other, of the great chain of life. The former in its fluid medium can move, can absorb nutriment, and in response to certain simple stimuli can manifest what the extreme mechanically-minded biologist will call free-will and choice. The bacterium is adapted to its simple home, and the latter is adapted to the life of bacteria, among other properties it possesses. There are thus two of our meanings of adaptation fulfilled, and the third, viz., that of the purpose for which it is adapted, may be beautifully illustrated in the case of those simplest bacteria of putrefaction which from the beginning of life on the globe have exercised their beneficent function as scavengers of a decaying and developing world. It is needless to point out that if organisms require oxygen to respire, and nutriment to absorb, they require only in a little less important degree, when they die, to be disintegrated, for the benefit of the succeeding population of the globe, by means of these humble bacteria of putrefaction so recently discovered through the genius of Pasteur.

Between this lowly instance of adaptation, in which profoundly important issues lie enwrapped, and man himself, there lie open to our scrutiny and admiration a world of adaptations, extrinsic and intrinsic, incalculable in number and beneficent in purpose.

Another side of the question of adaptation is opened up when, in addition to the means to ends which every organism, vegetable and animal, presents for its own benefit, we look at the great question of the environments provided for these various organisms. The *means* are wonderful, the *ends* are beneficent, but they require a *field* in which to work. The key of a Chubb's lock is an instrument interesting enough to a mechanician, who may admire the finish and complexity

of the wards, but it is of vastly greater interest when the lock to which it is adapted is also investigated by one who is competent to understand its working and make. The two must be looked at together, and, broadly speaking, a key is for a lock and a lock for a key. This instance introduces the environment side of organic existence, and the latter is very largely ignored, or taken for granted, and its bearing on teleology not mentioned when adaptations, adjustments of the organisms themselves, are considered and expounded by a one-sided "law."

Before the bacteria of putrefaction could commence their beneficent work as scavengers of the globe, they require for their own life a measure of moisture, warmth, oxygen and organic material, before it becomes of the least importance whether or not *they* are adapted. The environments referred to must exist before they can do so. And so it is through the vast ascending series of protophyta, protozoa, metazoa up to man. Suited environments must *precede* the life of any one of these forms of life, which become adapted to them. When we scan in thought the immense stretch of geological time, and the size and variety of the globe which has been the theatre of an ascending scale of life, and remember that to a great extent the environments of one epoch are not fully suited to the needs of the preceding and succeeding flora and fauna, some dim idea of the importance of the environment side of the question of adaptation is reached. *Selection* has become the modern equivalent of the Creator in the thought of certain through-going scientists, and its range claimed to be from nebula to man, from the elements of matter to the productions of the human intellect. In biology it has several aspects. At first there was only known the natural selection of Darwin, then there came physiological or sexual selection. Later there was conceived by Roux a form of selection acting within the organism itself, between the different cells of which it is built up, and finally Weismann, recognizing the "lowering clouds" with which he saw Darwinism threatened, invented what he called germinal selection. There are, then—

1. *Personal Selection*, by which individuals among a group are selected as being generally more fitted to survive.

2. *Sexual Selection*, according to which certain individuals among higher animals select one another for some attractive qualities or characters, and so these are propagated. Darwin and Romanes are the authors of this form.

3. *Histonal Selection*, or the selection among the various cells of an organism, conceives the singular notion that within the organism there is a struggle of the parts going on, and certain cells are selected to survive, and relegated to their appropriate region of the organism. This is very much like a civil war, or a fight within a fight, a series of single combats for pre-eminence. This aspect of a house divided against itself, as Sir William Dawson calls it, is a strange and fanciful one when from such internecine strife is to emerge an harmonious, correlated, and perfect whole, such as an organism presents when developed.

4. *Germinal Selection* of Weismann is purely hypothetical, and declares that within the germ, among a host of indifferent variations, there are always present the necessary favourable variations for upward progress, and that these are selected to survive, and form adaptive modifications.

Of these four forms of selection the fourth may be looked upon as pure hypothesis, and only entertained because of its supplying a mode of thought which may, or may not, fit into an articulated whole.

3. *Histonal* selection of Roux is also too vague and supported by too insecure evidence to be of any more importance, except as a suggestion, than that of Weismann.

2. *Sexual* selection is obviously applicable only to the higher forms of life in animals, so as a factor in organic evolution it is of minor importance.

1. *Personal* or natural selection of Darwin is the real conception which mainly concerns us here, though it may be pointed out in passing how great is the importance in the modern world of the *sexual* form of selection under the guiding hand of man, which is responsible for all the wealth of beauty and utility arising from purpose and intention by man, in *artificial selection* of plants and animals.

Selection resembles adaptation in that it has been robbed as far as possible of all purposeful meaning, so much so that it has been applied by Professor Karl Pearson and Sir Norman Lockyer and others to the physical selection of chemical elements composing the heavenly bodies and our own planet, and to so-called "meteoritic evolution," and is in this form considered a leading factor in inorganic evolution.

In organic existence selection depends on three preceding conditions. *Living matter, organisms composed of this; variations among individuals of these organisms;* in addition to the equally momentous condition of *appropriate environments.*

Therefore, before selection can do anything it requires a good start, and when it is established as a working factor assumes an immense range in the minds of biologists.

Four years ago a controversy was carried on concerning the origin of living matter which was evoked by the remarkable address of Prof. Japp at the British Association of Science at Bristol. The outcome of this was that the agnostic evolutionists were driven to show that their scheme of life comprehended in the azoic period an accidental combination of symmetrical molecules in non-living inorganic matter, by which an asymmetrical compound was developed and became the groundwork of all life on the globe. Professor Japp's mature conclusion will better commend itself to our mind when he said, "I see no escape from the conclusion that, at the moment when life first arose, a directive force came into play—a force of precisely the same character as that which enables the intelligent operator, by the exercise of his will, to select one crystallized enantiomorph and reject its asymmetric opposite." In his reply to many criticisms from acute opponents of his views Professor Japp says tersely, "All my critics seem to be moving in that unreal world where a fount of type, if jumbled together sufficiently often, ends by setting up the text of Hamlet."

We are compelled to go back for the rudiments of selection to the primeval days when the so-called protista, neither vegetable nor animal, but with apparently infinite potentialities, were the sole population of a warm, homogeneous, watery environment. By some means not known these must have been differentiated into two great classes, which were to be the stock from which plants on the one hand and animals on the other were to be formed. Mr. Clodd takes it for granted that in some way or other the vegetable cell became possessed of a harder, tougher cell-wall, and as he says, "thereby sealed its fate." It must be borne in mind that according to the theory the earliest inhabitants of the globe were homogeneous, and no variation had as yet arisen, and we have also to consider a homogeneous environment. So that not only did the latter change in most momentous ways, but the former had to be modified so profoundly and with such far-reaching results into vegetable and animal one-celled organisms that the change equals any miracle of later days, and certainly there is no evidence whatever for it.

In course of time the slow modifications of the environments through physical and chemical processes must be supposed to have transformed these primitive organisms, but the former being homogeneous the latter could only be modified *en masse*, so that hitherto no place for individual variation has arisen. There is thus postulated a state of things in which various centres of life arose according as vast areas of the surface began to differ from one another, and large collections of minute organisms must be assumed to have been existing, marked off from one another by slowly developing geographical changes, the habitats of the different groups very slowly coming into contact with one another at their borders. These may be considered to have come together in the lapse of ages, but for immense stretches of geological time no reproduction of the organisms by conjugation would take place. Selection had not yet come into operation. I would here point out how large a demand must be made in this hypothetical account of primitive life on the globe, on the view that environmental changes affect organisms so that the variations are transmitted to succeeding generations, a proposition totally denied by the consensus of opinion of present day biologists. Even so late as last year, 1901, Professor Ewart in the presidential address in the zoological section of the British Association, said at Glasgow, "I do not believe there is any trustworthy evidence that definite somatic variations are ever transmitted." Hitherto the chain of life has not proceeded far, and it has been enormously assisted by hypothesis up to this point. Variations in individuals are not yet fairly accounted for at all. The fundamental cause of variation (which is the crux of the whole question of evolution, so much so that Bateson said lately "Variation is Evolution") is diversity of sex as Wallace, in *Darwinism*, p. 439, points out.

Also see Professor Adam Sedgwick at Dover in 1899.

I am not prepared to deny the great effect of external conditions in modifying plastic rudimentary forms of life any more than in the case of man himself, but it is necessary to picture to oneself the deeply purposeful issues involved in such changes in the protista that one branch of their stock was destined to produce the whole vegetable kingdom, which was to come, and the other the animal kingdom, bearing especially in mind the intimate and absolutely essential inter-relation between the two kingdoms.

Apart from Design this must be supposed to be involved.

in some fortuitous undirected change in the watery home of those early ancestors of ours! Well, it must be for each of us to ask himself calmly if his faith in the evidence of a mechanical theory of life will bear a strain such as this.

But Selection in course of long ages came into operation—whether in producing new forms of life or simply in maintaining, as I believe, certain breeds or groups of organisms according as we are Creationists or Evolutionists—and then took rank as a factor in the ascent of creation to its present phase. It is clear that at either end of the chain of life the province of a merely mechanical selection is greatly curtailed.

The bearing on the question of design in Nature of these two biological conceptions, Adaptation and Selection, is obvious. The least significant uses of the words are the most favoured in current science, as not postulating the operation of any Mind or purpose in Nature, and I would submit that our consideration of the former is eloquent of meaning of a most far-reaching kind, and the latter has a much curtailed province in which to operate. Professor Henslow, a great opponent of Natural Selection in the origin of species, goes so far as to say that Natural Selection is unnecessary, and at any rate, only a supplementary factor in organic evolution, and out of his immense knowledge of the botanical side of biology refers nearly all evolution to self-adaptation of plants through their protoplasmic response to environments. He would of course apply this theory also to animal life, and the conception finds a good measure of favour with such eminent zoologists as Professors W. K. Brooks of America, and J. Arthur Thomson of Aberdeen. Professor Henslow being a theist sees in this mode, by which organisms have developed to their present perfection, the operation of Divine directing power.

In the present consideration we are not compelled to choose between Creation and Evolution as rival theories of the origin of living forms, but we surely must see the necessity of admitting that Design is immanent in these marvellous chains of life, whatever be the way in which the links have been forged by the Divine Artificer. The ultimate reasons for it all, the final causes, may not be clear to us yet and may never be so, but the grand primary purpose opens before us the greater the range and the more profound the scrutiny of biological study. Whether it be by creation of groups of organisms at successive stages, by

the direct effect of environments, by variation, struggle for existence, heredity and selection between more or less adapted individuals, by geographical isolation, by self-adaptation to environments through protoplasmic response—whether each or all of these be admitted into our groping views of a tangled problem, they are but biological questions with a philosophical bearing, and must be settled by the *evidence* that is forthcoming. The greatest injury to truth may be done by haste in formulating cosmic theories too ambitious for the available evidence, which aim at embracing all Nature by a “law” which man has to conceive for himself, and which his successors may entirely contradict.

Surely it is Purpose here, there, and everywhere, which furnishes the missing link in all the problems of science.

If it did happen, indeed, in the Azoiic Age of this world that such a conjunction of chemical and physical conditions as Professor Karl Pearson supposes took place, and eventuated in the origin of life, if some remarkable environmental stimulus was followed by a branching out into vegetable and animal forms from the very undifferentiated masses of protoplasm which then constituted the population of the globe, if from that homogeneous mass of living forms there came by further environmental changes such a marvellous complex of life as a Foraminifer presents, and in due time the diverging and multiplying groups of organisms by Selection or other factors of organic evolution till metazoa appeared, and so the great drama of higher organic life was put on the stage of a changing world, till at last the human body and mind emerged from the great mammalian stock, and this mind of man after long ages of groping among the grosser rudiments of human life, began to read backward by the light of science its remarkable past—if all this took place without any “Special Creation,” “Creation by fiat,” “Creation by fabrication,” or any other form of creation which opponents may label with a needless adjective, found neither in Revelation nor reason—if all this did happen in the course of geological history, the mere inconceivable length of time and apparent simplicity (*on paper*) of the processes can never block out the light of Purpose which is seen after the event in every act of this fateful drama, even though many shadows of ignorance throw up more vividly the light we do see.

At each stage of the story a being endowed with a full measure of the knowledge of the twentieth century, who

might be supposed to survey the unfolding plot, whether he looked back or forward, could not fail to note the close correspondence of life with environment and preparation of environment for coming life at each and every stage. When these two corresponding and correlated sides of the matter are looked at fairly, the argument for Design in Nature goes beyond that of means to ends in particular cases, and the cogency of the proof is doubled at one stroke. The validity of the "Argument from Design" now rises to the height of moral certainty, perhaps never more than probable in the strict scientific sense, in the sense in which, as Jevons points out, the theory of gravitation is only *probable*. It is hardly too much to say that biologists, disguise it as they may, under the name of "natural laws," "energy," "response," "adjustment," "adaptation," "selection," "heredity," "struggle," "survival of fittest," do tacitly adopt this connecting link of Purpose in Nature as a working hypothesis, and when disavowing any form of teleology can never rid themselves of its common terms.

Though the progress of science is ever "Excelsior," and cloud after cloud of ignorance is penetrated by her growing light, a heavy mystery must always enwrap certain of her problems no less than those of religion. But it has been beautifully and ably shown by Ballard in his *Miracles of Unbelief*, that for those who abandon the guiding light of Revelation and faith in their study of Nature's secrets, the difficulties are vastly greater than for those who see Divine Purpose and Plan in Nature.

DISCUSSION.

MR. MARTIN ROUSE.—We heard just now in this paper that even the *bacterium* shows its adaptation to an environment, that it is required to go to work where it does go to work, and we know that a wonderful invention of man has followed on this discovery of Pasteur's by which corrupt refuse has been made to devour itself in what is called the Bacterial System of Sewage. By this admirable system the bacteria multiply to such an extent that they devour the rubbish and then eat themselves, so that finally there is nothing left! I may say for that alone, I have observed to my intense admiration, the wonderful provisions for cleansing

a desert. Some of us have noticed that in Algeria the rainfall is about the same as in London and around—about 27 inches. On the other hand the sun is intensely hot, the amount of daily sunshine being far greater. During the summer the streams dry up so that you may see in the middle of the waste a stream bed with nothing in it as we know. Everyone travelling in the East is familiar with these things. It was my lot last year to see them for the first time. As the camels travel across the desert, if there is no rain, innumerable little beetles fashion the droppings of the camels into balls in the dust and lay their eggs inside, and in half an hour there is nothing but dust. Of course these instances may be multiplied to a great extent when we care to study the subject, as Dr. Walter Kidd has done in his paper on "Design in Nature," for he has shown, over and over again, how wonderful are the personal adaptations of creatures to the universe.

Rev. F. A. WALKER, D.D.—The lecturer has made a very interesting remark on the inaccurate and inadequate formulæ or recognized terms in common use by scientists, and I very much wish that Dr. Kidd could give us some others. I think he has shown that he is well able to give us some other terms for those which certainly do not, to my mind, convey the meaning for which they are intended. I do not myself understand what is meant by "natural mimicry." I have already spoken here against that term. I take it that mimicry means the act of a conscious agent voluntarily copying another for a little time, and then dropping it again just at will. It means that we copy mannerisms, or words, or gestures, or tricks, or habits of our fellow-creatures. I do not call it natural mimicry because the moth is stamped, directly it comes from the chrysalis, with no volition on its own part, with the size or colour of the butterfly, because it still has a moth-shaped body. It is stamped by the Creator in that way, and it continues so to its death; perhaps the colour is a little faded in autumn. So with the dragon fly, known as *Sympetum flaveolum*, it is a little different in colour, but those are only minor matters of detail—there is no will of its own in the matter. What I should call mimicry, on the part of an organic object would be, for instance, if you take a chameleon as I have done, and put it in a box with little light. It then gets a dusky dark green, and if you tickle its cheeks it gets sulky and changes colour again. If you put it on a myrtle where it can

bask in the sunlight, it changes again. That is what I call mimicry; but you cannot call it mimicry just because changes take place naturally in an organism possessed of life.

Then the "survival of the fittest" is referred to in the paper: "The new meaning of the 'survival of the fittest' has now been taken to be the 'fittest to survive' or 'fittest for the environment.'" Some things exist on isolated islands that are the only fit ones for the environment. The thick-bodied moths of Iceland are adapted to their environment, and why? Because they go underground in winter, and the dreadful storms of rain and snow over their heads do not touch them, and they have also their food-plants. In Iceland there is no suitable shelter under which the butterfly can conceal itself. There are no hollows in large tree-trunks into which our common English butterfly can creep in bad weather and hibernate or hang up their chrysalis in a tree. There is everything to support the thick-bodied moth but nothing to support butterflies, and they are not found in Iceland in any quantity that could survive. In my opinion *survival* means those which longest survive the rest. So I should do away with *survival*, too, for it is not only that those things exist on the island, but others never existed there.

Professor LANGHORNE ORCHARD.—I am sure we all agree that we are indebted to Dr. Walter Kidd for this valuable and graceful contribution to the great argument for Design.

It is much easier for myself personally, at least, to note the many beauties of this paper than to attempt anything like a criticism. Dr. Kidd has rightly drawn attention to the fact that ambiguity and even incorrectness in the main terms of the theory of evolution have tended greatly to its wide acceptance, and I am sorry to say this has not been entirely unintentional on the part of evolutionists. Herbert Spencer himself, in his *First Principles*, says that the system of philosophy, as he terms it, which he proposes, would be more correctly described by the term *involution* than *evolution*, and he says he prefers the term *evolution* in order to make it square with a popular theory, alluding, obviously, to Darwinism; but, to my mind, it is scientific immorality—an offence against truth, to use a term with a meaning—an especially different meaning, to that in which it is accepted.

Dr. Kidd refers to the fundamental cause of variation being

diversity of sex. No doubt it is the fundamental cause, but I suppose he would not contend that it is the *only* cause. Variation may be produced by an individual himself and, surely, by environment also; though, doubtless, change of sex may be, as he points out here, the fundamental cause.

We might say it was almost comic, if it were not, in some respects, really somewhat tragic, to read Professor Karl Pearson's statement referred to by the author, which appears to be really put forward as a scientific conjecture. I greatly prefer such an expression as "special creation" to creation by this imagination of Professor Karl Pearson's. Indeed it is creation by imagination, because if this protoplasmatic mass existed from all eternity, then long, long ago it ought, according to his theory, to have evolved into different forms. So he is driven to assume creation somehow or other, and why should it be thought that the Creator could not create anything more important by His creative art? It is not only opposed to experience, but, with all respect to Professor Karl Pearson, to common sense. Even his absurd theory could not have been carried out actually—much less could the actual events have taken place, without there being, what Dr. Kidd so truly insists on, when he says "Purpose here, there and everywhere, which furnishes the missing link in many of the problems of Science," I should say in *all* of them. [Applause.]

The CHAIRMAN.—Before I call on Dr. Walter Kidd to reply or to make any further suggestions, I should like to point out that what seems to me to be the gist of the paper is this—that evolution, at any rate atheistic evolution, is not credible. All the words that have been discussed to-day are words which presuppose a designing mind: all this struggling—this selecting—this surviving of what is fit, this adaptation and the rest are mental processes. Take, for example, adaptation. We only see adaptation in nature because we have in ourselves a process of adapting one thing to another, and then we read into Nature what we find in ourselves. It is all mental, and the word "adaptation" implies reason and purpose.

Take another word that Dr. Kidd uses, though the discussion has not turned on it, viz., "Beneficence." Beneficence is very different to adaptation, although the two words go together so well. When you find Adaptation combined with Beneficence,

then you have got two strings to your bow, both converging to produce the great conclusion. Then "Purpose" is also used in a very tentative way by the persons to whom reference has been made. It may be immediate or something far distant, and the further distant it is the more mind is implied. If a thing is done for the immediate moment it may seem to be done casually; but if you do a thing to-day the result of which is not discovered for a hundred years, the action is read in its full meaning and then you see, at once, purpose. Now supposing that some far-reaching purpose, instead of being simple in its nature, is complicated; so much the more difficult it is to prove purpose or the opposite to purpose, mind or absence of mind; and if you test mind or mindlessness in creation, not by a simple case but by one great conglomeration of cases, and when you see a mass of what might be isolated instances of purpose running on into systems accumulating not only through space but through time, you have impressed on your mind that there is something not human, but superhuman, and you read the superhuman through the human. Thus, you read the Mind at the back of the universe through the mind that you have in your own selves.

Almost all the words, I think, that we have brought before us to-day were originally associated with ourselves as human beings. Then the evolutionist, not having any other words and not having the skill to invent any, as suggested just now, is compelled to utilize words and, as far as possible, to emasculate them and take out their sense, and to believe that such things as "beneficence" and "adaptation" are floating about somewhere in the universe, and if later on they happen to catch on somewhere, certain results follow. If that is so, the less reason we have the better. God has given us reason in order that we may investigate the laws of His universe, and the more we honour human reason the more we shall realize the magnitude of the Divine mind; not to recognize the Divine mind seems to me to be an abuse of one of the greatest gifts that we have in nature. There is another word that I should like Dr. Kidd to introduce a substitute for—it is hardly a mental word—I mean the word "tendency." It is a most convenient word for evolutionists. They say there is a "tendency" to do this or that. That is true, but they do not tell you the origin of the tendency at all. Suppose we say, "I believe that at a certain time there was a strong tendency in creatures

to vary, and then a strong tendency that those creatures having varied should vary no more"—so that from a few types you get first multiplicity of species—then fixity. Supposing there were this tendency in creation, then those tendencies are simply processes in creation; and you can never get rid of this—that all the words, even such an impersonal word as "tendency," have behind them the author of the tendency—the author of the law—the author of order, and the author of adaptation of means to ends; and so we are driven back, by force of our reason, to recognize Him who gave it to us.

Dr. WALTER KIDD.—I have very few adverse remarks to reply to. I am very much obliged for your kind reception of my paper. I quite agree with Dr. Walker as to the danger that comes in through a word like "mimicry." It is only another instance, added to those I mention here, of the way in which these expressions are handled and wrongly handled, and different words ought to be invented, though I do not care to undertake the task. I think "fittest to survive" does not apply to the mass but to individuals of any group, and that it is an unobjectionable term which we must allow to the evolutionists.

I quite think that Professor Orchard is justified in saying that there is a kind of scientific immorality in the way in which some of these terms are handled; and yet it is very difficult for evolutionists or ourselves to get rid of these terms, such as "purposeful" and other mental terms. It is only another way of saying that we are surrounded by divine mystery and purpose and divine immanence in all the affairs of the world. The illustration I gave of the fall of an avalanche is only a simple way of putting what I have called "purposeless mechanical causes," or what Spencer has called a power that sets going certain laws, though he has not the grace to admit it in words. I should agree with Professor Orchard that minute creatures like bacteria, as their environment changes, are potentially adapted to the coming change and are adapted from the first.

I think diversity of sex is being made too much of. I was there quoting Dr. A. R. Wallace, who states it so strongly, that he hardly allows any other cause of variation at all, and many hold that environment does not affect the individual so that variations are transmitted to posterity. Many of these are most eminent people, and they have not admitted any instances in which their favourite theory

has been contradicted, but I think they are bound to be admitted as time goes on. As I suggest in my paper, Professor Ewart has declared that no trustworthy evidence is forthcoming.

Professor ORCHARD.—The individual varies though the species does not vary.

Dr. KIDD.—The question is whether he transmits that to his posterity. I believe it is bound to be proved that that is so.

I infinitely prefer Professor Orchard's "special creation" to Professor Karl Pearson's "creation by fiat." I do not see that we need go beyond the term "creation" in general.

As to "spontaneous generation," I am afraid that Agnostic evolutionists have included it under the head of "unity of nature," assuming that spontaneous generation has taken place. It is in keeping with the rest of their science, observation and laws, that they assume it must have taken place; but all evidence is against it, as is well known.

The Meeting then adjourned.

ORDINARY MEETING.*

CAPTAIN HEATH, IN THE CHAIR.

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

ASSOCIATE :—Ivo F. C. Carr Gregg, Esq.

The following paper was then read by the author :—

THE PHYSICAL HISTORY OF THE NORWEGIAN FJORDS. By Professor EDWARD HULL, M.A., LL.D., F.R.S., F.G.S. (Secretary). (With Map.)

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* Monday, February 17th, 1902.

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ANALOGY BETWEEN THE CONDITION OF WESTERN SCANDINAVIA AND OF WESTERN EUROPE.

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2. River-valleys necessarily sub-aerial during formation, and inferences to be drawn regarding changes of level of Western Europe, etc. Silting up of sub-oceanic river-channels, both in the North Sea and the Eastern Atlantic.
3. General succession of events in the history of the Norwegian Fjords ; from Archaean to recent times.

INTRODUCTORY.

THE Fjords of Western Norway occupy an exceptional, perhaps unique, position amongst the physical features of Europe. These arms of the sea entering from the western coast penetrate for long distances into the very heart of the lofty snowcapped plateau of the Norwegian promontory, and while descending to great depths below the surface of the waters along their central portions, are often bounded by cliffs and walls of rock whose upper margins are sometimes decked by snowfields or glaciers, and which rise to levels above the surface almost as great as that of the floor below the same horizontal plane.

In no other country in Europe have we examples on so magnificent a scale of such profound channels invaded by the waters of the ocean ; bounded by such stupendous walls of rock, overlooked by perennial snowfields and ultimately merging into valleys, such as that of the Romsdal, lined by walls, generally precipitous, often vertical, and rising several thousand feet till culminating in some stupendous "horn" or peak ; or else forming the margin of that vast snowfield which covers as with a white sheet the surface of

the great central table-land. This central snowfield, visible from the sea at a distance of one hundred miles, sends down into the adjoining valleys glaciers, such as that of the Jostedalstraæ Glacier, unsurpassed in magnitude by any in Europe, and which in the northern part of the peninsula are almost bathed by the waters of the sea itself. Nor can we fail, when coasting along these great waterways, to notice from time to time the evidences both of former submersion to depths of several hundred feet below the present level, as also of recent elevation of the land. That the fjords were at a former period the channels of glaciers, on a vastly greater scale than those of the present day, is also shown by the polished and striated surfaces of the rocks down to the water's edge; first recognized by that enthusiastic glacialist, the late Professor James Forbes.* Here the *roches moutonnées* indicate the direction of the ice-movement, generally seawards; and the occurrence of moraines and perched blocks in various positions show where there have been pauses in the retreat of the ice into higher levels. On the other hand, the flat surfaces of terraces, lining the sides of the valleys, especially in protected spots, may constantly be noticed, occasionally affording a footing for dwellings and land for cultivation. That these terraces ("strand linien") are ancient sea-beaches cannot be doubted, and they show the extent to which the whole of Norway was submerged at a period preceding the present, amounting, according to Professor Reusch, to over 600 feet in the Christiania and Trondhjem region, but in other regions to a less extent.

2. *Depths of the Fjords below the surface of the Sea.*

But the subject which most strongly excites our interest and wonder is the profound depths to which these fjords (or gulfs) descend below the surface of the waters, reaching in the case of the Sogne Fjord to nearly 4,000 feet (665 fathoms) as shown by the soundings on the Admiralty Charts. If these gulfs were, as must be believed, the channels of former glaciers and filled with ice down to their very floors, and much above the present water-level as shown by the unsubmerged ice-worn rocks, the thickness of the ice would appear to have reached at least 5,000 to 6,000 feet in the

* *Norway and its Glaciers* (Edinburgh, 1853).

central portions of these profound sea-lochs which at the present day carry the ocean waters to the very roots of the central tableland; the source and origin of the glacier ice.

3. *Age of the rocks bounding the Fjords.*

Throughout their course the fjords and connected valleys are found only traversing rocks of the highest geological antiquity known under the name of Archæan and Silurian; consisting of granite, gneiss, hornblende and micaceous schists, quartzite and dolomite, generally presenting a rude, though decided, stratification. Nowhere are these valleys and fjords bounded by walls of Mesozoic or Secondary age, and it is only on the eastern side of the Scandinavian promontory that they penetrate strata of even Silurian age; as for example in the Christiania Fjord. Geologists and petrologists are well acquainted with the structure and composition of the Archæan rocks, the oldest of the world; but of their mode and conditions of formation, notwithstanding all that has been written on the subject, we are in comparatively profound ignorance, beyond the general inference that they were deposited under physical conditions differing widely from those in which the Palæozoic and later deposits were formed, and in which we find remains of animal and vegetable life. Needless to say, no organic forms have been found in these Archæan rocks; and between the period of their formation and that of the Silurian strata, a long lapse of geological time probably intervened.*

PART II.

1. *Original condition and formation of the Fjords.*

Having thus passed in rapid review the features and structure of the region of south-western Scandinavia in which the most important of the fjords occur, I now pass on to the next and more immediate part of my subject, namely: the physical history of these inland sea-lochs themselves; and from this history it will be clearly shown, if my views are correct, that the fjords are primarily the outcome of

* There have just been issued the sheets of the International Geological Map of Europe; *Carte géologique internationale de l'Europe*, feuilles 11, 17, and 18 (Berlin, 1902), on which the geological structure of the region now being described is admirably shown.

rain and river erosion, continued through long ages of geological history; modified somewhat by glacial action in later times, and to a less degree by changes in the relations of land and sea; in a word, that they are simply partially submerged river-valleys.* To many, this statement will appear merely a truism; and my apology for enunciating it here is, that from personal conversation on the subject, I find a great variety, not to say confusion, of thought and opinion on this subject which it is desirable to help in clearing up.

2. *First and earliest stage of formation. (Continental Period.)*

It is admitted by Scandinavian geologists that in Pre-silurian times the Peninsula formed a part of an extensive continent composed of Archæan rocks, and extending from northern Russia westwards into the British Isles. It was in its general form an undulating plateau, and under these conditions it would be subject to meteoric influences including those of rainfall and river-erosion. To this epoch we may probably refer the incipient formation of the larger valleys which naturally drained towards the ocean of the period, presumably lying somewhere in the position of the Atlantic. This period is too remote and too vague to allow of our doing more than alluding to it in a very cursory manner, so that we pass on to the next stage, which was one of subsidence.

3. *Second stage. (Silurian and Cambrian or Primordial.)*

At the close of the continental period just described, there appears to have been a gradual subsidence under the waters of the sea of a portion of the Scandinavian area towards the south, so as to allow of the deposition of the Cambrian or Primordial and Silurian strata, containing the earliest forms of marine life. These strata of Cambro-Silurian age have been so altered and folded in some places that it is difficult to distinguish them from the pre-Cambrian or Archæan formations. Probably only very small portions of the existing peninsula were unsubmerged during this stage, and the valleys of the continental period were but little extended.

* I am pleased to observe that this is the view of Lord Avebury, recently recorded in his work. He calls them "drowned river-valleys." *The Scenery of England*, p. 101 (1901).

4. *Third stage. (Re-elevation.)*

At the close of the Silurian epoch there was a re-elevation of the area, and this included not only the Archæan, but the Silurian tracts forming the Scandinavian peninsula and the adjoining regions both of land and sea. The almost complete absence of formations between the Cambro-Silurian and the Post-Tertiary, induces us to conclude that throughout this vast period of geological time,* this northern portion of Europe remained in the condition of unsubmerged land.† But it was none the less watered by rains, rivers, and probably snowfalls; and, therefore, the valleys were being constantly deepened by the streams descending from the tablelands, and, as we must suppose, finding an outlet in the primæval Arctic Ocean across the floor of the present North Sea. It is in this way we can account for the great depth and size of the valleys at the present day, though cut out of rocks of extreme hardness such as are those of which the Archæan system is composed. It is impossible to view the lofty cliffs of the Romsdal, the Gudvangen, the Sandven, and other valleys, rising from 2,000 to 4,000 feet on either hand, without being impressed with the fact that the erosion of such channels must have taken an enormous lapse of geological time for the streams to accomplish, even after allowance has been made for the effects of glacial action at a later period. Nowhere is the process of erosion more clearly exhibited than in some of these valleys where huge slabs and blocks, breaking off along joint planes, are continually widening the sides of the valleys, while the torrential action accompanied by magnificent cascades is cutting back and deepening the channels. These natural operations are grandly displayed at the profound gorge of Stalheim,‡ which

* Embracing the Devonian, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, and Tertiary periods.

† According to Dr. Reusch, Devonian beds occur amongst the islands north of Bergen; but are quite exceptional.

‡ Thus vividly described in Stanford's *Guide to Norway*, page 39: "On the left is the vast mass of the Jordalsnut rising 3,600 feet sheer out of the valley; on the right, the Kalda Fjeld and the Axeln rise in terrific precipices, down which in summer avalanches of stone frequently fall, and often sweep away the road. Close by, on the right hand and on the left, are two very beautiful waterfalls; that on the left is the Sevlefos, a fall which, though not one of the most famous in Norway, is certainly one of the most lovely to be found in any country; the dark rocks forming a wonderful background for the white masses of foam; and on the right the Stalheimfos."⁵ The quotation is slightly curtailed.

comes suddenly into view as the traveller approaches from the Vossvangen Valley, and which is calculated to impress him with a feeling, not only of admiration, but of awe; a feeling shared in by Professor James Forbes when viewing the Sogne Fjord into which the Vossvangen immediately descends.

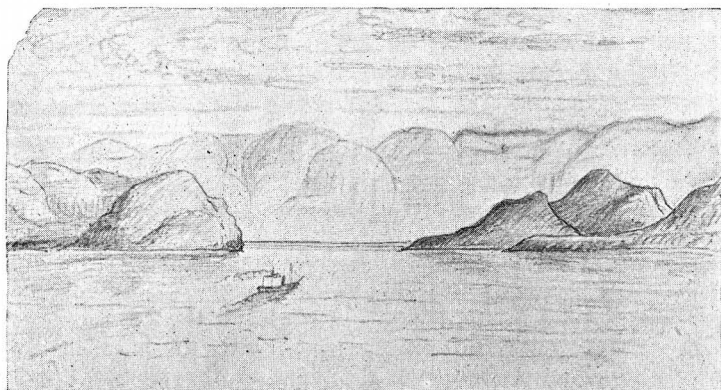


FIG. 1.—ENTRANCE TO THE HARDANGER FJORD.

5. *Unequal depths of the Fjords.*

The scenes described above belong to the land; but not less profound must be our astonishment when we come to consider the great depths to which some of the larger fjords descend below the surface of the sea. These depths, however, are very unequal; for, while that of the Sogne Fjord reaches to almost 4,000 feet (665 fathoms) the Hardanger Fjord a few miles further south, only descends to 2,750 feet (425 fathoms), the Volden Fjord to 2,298 feet (383 fathoms), and the Nord Fjord to 1,800 feet (300 fathoms); these two latter lying some distance to the north of the Sogne. Now, as the Sogne Fjord is by much the largest of the Norwegian sea-lochs, and drains a larger tract of mountain land, there would seem to be a clear connection between the size of these sea-lochs and their depths, as would be expected under the view that they have been formed by the erosive action whether of rivers, or of ice, or of both. But I must here refer for a moment to the Admiralty charts, from which we derive our knowledge of the depths of the fjords themselves.

6. *The Admiralty charts.*

These splendid charts, published by our own Admiralty from Norwegian surveys, and on a large scale, are well supplied with soundings, both over the area of the Atlantic Ocean as well as that of the inland channels and arms of the sea to their highest reaches. Making use of these soundings (which are all in fathoms) I have contoured the depths of the larger fjords, including those of the Hardanger, the Sogne, the Nord, the Volden and the Stor, with their branches. This process enables us to obtain almost at a glance a clear idea of the form of the submerged portions of these great arms of the sea; with the general result that we find that upon entering from the outer coast and islands with comparatively shallow floors, they rapidly descend to great depths below the surface, which they retain for considerable distances, only becoming shallower as they approach the upper limits where they pass into the valleys descending from the interior mountain plateau. This form of floor is especially characteristic in the case of the Sogne Fjord; and it will be noted on examining the charts, that the position of maximum depth is just where the fjord is bounded on either hand by mountain masses of great extent and elevation; where, if covered by snow and ice (as was once the case) of prodigious magnitude glacial erosion would be most powerful and effective. I may here at once state that the phenomena observable in Norway as elsewhere, support, as it seems to me in a convincing manner, the views of the late Sir Andrew Ramsay, and of Professor James Geikie on the effect of glaciation amongst the highlands of Scotland, Wales, and other countries including Norway, where glaciers existed in past times.*

PART III.

1. *Cause of the rapid shallowing of the Fjords seawards.*

According to the Scandinavian geologists, the cause of the rapid shallowing of the great sea-lochs on approaching their

* Ramsay: "On the Glacial origin of lakes," *Quart. Journ. Geol. Soc.* Geikie: *The Great Ice Age*. 2nd Edit. It was during a visit to the Earl of Ducie, F.R.S., that I first had an opportunity of studying the Admiralty charts of Norway, contoured with iso-bathic lines by Mr. Etheridge, F.R.S.

outlet in the North Sea, is the piling up of enormous masses of moraine matter by the former glaciers which descended these valleys.* This piling process was doubtless due to the presence of the remarkable chain of islands which follows the coast from Stavanger (latitude 59°) to the Trondhjem Fjord. That these islands are only unsubmerged portions of an extensive tract of Continental land is clear to anyone who has sailed along their shores; and the intensely glaciated character of their rock surfaces down to the water's edge is equally striking. In the former conditions of high elevation during the "Great Ice Age," the obstacle presented by these uprising ridges and bosses to the movement of the glaciers descending from the interior mountains would naturally result in the piling up of huge terminal moraines in the hollows now existing as navigable channels between the islands and the mainland.

This, however, does not fully solve the problem presented to us by the Norwegian Fjords. If we accept the view that they were originally river-valleys and as such must have been eroded under sub-aerial conditions, their descent or slope must have been continually seawards, as is the case with all river-valleys; and even giving due allowance for the deepening process by glacier action and the piling up process by moraine matter, we should naturally expect to find a continuation of the valleys themselves beyond the chain of islands across the floor of the North Sea and thus ultimately opening out along the margin of the Arctic Ocean. Strange to say, however, no such evidence is afforded by the soundings over the North Sea floor beyond slight indications in a few cases, and for short distances.† In fact, the 100 fathom contour runs along the coast for many miles with very little variation from a rectilinear course. We are therefore confronted with the problem how to account for the disappearance of these old river-valleys from the floor of the North Sea.

After much consideration the only answer to this problem seems to be that the channels do actually exist, thus connect-

* The entrance to the Fjords seldom exceeds 100 fathoms, and is generally less.

† Such as are presented by the Selbiorn's Fjord, Lat. $59^{\circ} 56'$, and the Bredsund Dybet, Lat. $62^{\circ} 30'$. If we allow in the case of the Sogne Fjord 1,000 feet for the additional depth of the channel due to glacial erosion, and this is probably in excess of the actual amount, we have still a channel 3,000 feet in depth to be accounted for.

ing the fjords with the Arctic Ocean, but do not appear on the charts owing to the fact that they have been filled up with various sedimentary deposits, while the floor has been reduced to a general level by the action of the tidal and other currents. As I have shown in the case of the sub-oceanic valleys which lie off the coasts of the British Isles and Western Europe this process of "levelling up" has repeated illustrations due to similar causes. The submerged valleys of the "English River Channel," of the Loire, and of other streams for several miles beyond the margin of the land are often concealed, owing to filling up by sediment, and it is only as we get far out to sea that they become clearly indicated by the soundings, and descend to great depths below the general surface of the Continental platform. Of this platform the North Sea is a part and continuation, and that its surface is deeply overspread by loose material derived from the waste of the adjoining coast and islands, as also by glacial mud, gravel and boulders, there can be no doubt; though to what extent the older solid rocks are thus concealed we have no means of judging. This view is supported by the evidence of former submergence as well

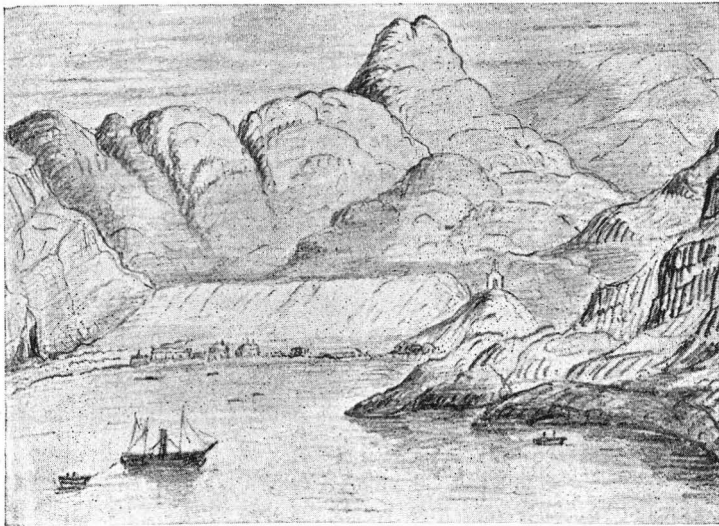


FIG. 2.—TERRACE AT MERAK. HEAD OF GEIRANGER FJORD.

as of glacial erosion to which we have already referred; and I shall now consider this evidence a little further.

2. *Former submergence; Formation of Marine Terraces.*

The existence of raised beaches, or marine terraces, at intervals along the margin of the land, whether of the interior fjords, the outer margin, or the islands off the coast has long been recognized, and indicates the extent to which the Scandinavian peninsula was at one time depressed below the present level.

According to Reusch and Hansen these terraces rise to a level of about 200 metres, about 615 feet, in the Christiania and Trondhjem districts, in front of the lakes in the east country, forming large plains, but to a lower level elsewhere. During my visit I took the level of two well-marked terraces: one at the head of the Geiranger Fjord (Fig. 2), the surface of which is 250 feet above the sea-level, the other at Naes at the entrance to the Romsdal Valley, where it is extensively developed and passes into old terraces of the river itself for many miles inland; here the level was found to be about 220 feet. Sometimes two or three terraces were distinctly observable from the deck of the ship, rising in succession above each other as at Otero Island; but I was unable to determine their levels. According to the observations of local geologists these "strand-lines" or raised beaches slope distinctly from a higher level along the inner portions of the fjords to a lower level along the outer coast. This is particularly observable in the Tromsø region where there are two raised terraces.* These terraces are composed of sand and gravel mixed with reconstructed moraine matter and boulders. Their relations to the glaciated rock surfaces show that they belong to a later period than that of the great glaciation of Norway; though "the marine shells found in the clays show a transition from the cold Arctic climate prevailing during the deposition of the older clays to the mild climate of the present day." Considering, however, that the waters of the sea must have penetrated much further inland towards

* Geikie states that according to Erdmann the terraces are found at a level up to 800 feet and more above the surface of the sea. *Great Ice Age*, page 388.

the interior snowfields and glaciers, during this depression of the land, and that the effects of the previous intense cold had not altogether passed away, we may well suppose that some of the glaciers actually entered the arms of the sea, giving rise to icebergs of greater or less size, as in Greenland at the present day, and then passing down the fjords, laden with boulders, stones and mud, would have carried these materials into the North Sea, and as they melted would have deposited their burdens over its floor. Indeed we may go further and suppose that the sea was crowded with small bergs and rafts of ice at this period, which though very recent was probably of long duration. In this way we may account for the spread of glacial detritus over the floor of the North Sea, which by the aid of the currents would naturally be carried into the channels and depressions of any river-valleys eroded through the solid rocks of which the floor was originally formed. In this manner then, we may account for the filling up of the channels which we may suppose are continuous with those of the fjords under the waters of the North Sea though undiscoverable by means of the sounding line. These conditions appear to have continued until a pause in the course of subsidence occurred; after which a reverse movement set in during which the land was re-elevated and ultimately arrived at approximately the position it holds at the present day.*

PART IV.

1. *Comparison of the Scandinavian features with those of Scotland.*

Allowance being made for the difference of size between Norway and Scotland, there is a remarkable similarity between the physical features of both countries, indicating what may be termed sympathetic incidents in their physical history. Briefly stated, the following are the points on which this similarity is founded:—

- a. In both cases the rocks are mainly either of Archæan, or of very ancient geological age.

* During the re-elevation there were doubtless pauses in the movement represented by the successive terraces to which I have already referred.

- b. In both, the mainland is sheltered from the outer ocean by a chain of islands.
- c. In both, the mountains are penetrated by sea-lochs or channels, shallower at their outlet than further inland towards the centre.
- d. In both the rocks are glaciated down to, and below the water-edge, and by the direction of the glacial striations and their form of surface show that the interior highlands were centres of dispersion for the snow and ice of the glacial period. Similar phenomena, such as moraines, perched blocks and boulders, are observable in both cases.
- e. In both the presence of marine terraces and raised beaches show that after the glacial period, the land was submerged to various depths below the present level of the sea.*
- f. In both there has been re-elevation and recession of glacial conditions, resulting in the case of Scotland, in the entire disappearance of the glaciers, but in the case of Norway, in their retreat into the higher valleys of the interior mountains.

2. *Special points of analogy.*

Without going very far into a description of these phenomena as they occur in Scotland, which would be foreign to the object of this paper, I will offer some observations on two of the above features, taking as my guide Professor James Geikie's admirable work, to which the reader is referred for fuller details.† It is unnecessary that I should specially refer to Nos. *a* and *b*, in the above points of comparison which can be inferred from an inspection of any geological map of Scotland or of the British Isles. I therefore pass on to the third of the above points, wherein it is stated that the Scottish mountains are penetrated by sea-lochs or channels, shallow at their entrance but deepening inland; thus showing that they are true fjords,

* Mr. T. F. Jamieson, in his excellent paper on the Glaciation of Scotland, has shown that the parting of the ice-flow eastward and westward took place at Craig Dhu in Inverness-shire in the valley of the R. Spean. *Quart. Journ. Geo. Soc.*, vol. 18, p. 170 (1862).

† *The Great Ice Age*; also *Scenery and Geology of Scotland*, by Sir A. Geikie, p. 125.

though on a small scale as compared with those of Norway. In both cases they are true rock-basins; that is to say, they are deeper near the centre than at the outlet formed of solid rock, due to the erosive action of some agent which is neither the original river, nor the sea, and which can, therefore only have been that of glacial ice, aided by sand, stones, and boulders imbedded in its mass, and under enormous pressure, wearing down the floor of the valley during a long period of geological time. The arguments of the late Professor Sir A. C. Ramsay,* supported and illustrated as they have been by Professor James Geikie, can alone account for the numerous examples of rock-basins, both in Norway and Scotland. The latter author takes all the suggested "explanations" *seriatim*, and discusses them in detail, showing that neither the action of the sea which planes the surface down to a level, or of rivers which "cannot run upwards," nor the local foldings or faultings of the strata, nor local subsidences which he truly pronounces "incredible" in the cases of such basins as those of the innumerable lakes of Scotland, Cumberland, Wales, Scandinavia, Finland, and Switzerland can account for the phenomena.† On the other hand it is easy to show that both in Scandinavia and Scotland glacial erosion has been most effective in the central or upper portion of each rock basin or inland fjord, where the mass of the ice descending from the interior valleys may be assumed to have reached its greatest thickness and weight; while farther out towards the sea, owing to gradual melting, the thickness of the ice had diminished, and with this the erosive effects. Thus were a glacier to continue to flow for a sufficient length of time, this unequal pressure upon the underlying rock would produce some effect; there would be a great deal more wear and tear where the ice had been thick than where it had been thin, and thus a rock-basin would eventually be formed.

* "On the Glacial origin of lakes," *Quart. Journ. Geol. Soc.*, xviii, p. 185.

† *The Great Ice Age*, p. 294. I have been tempted thus to dwell upon Ramsay's views and Geikie's defence of them longer than I had intended, as they have been subject to contention on the part of some less competent to form an opinion.

4. *Sea-lochs and Rock-basins of Scotland.*

Amongst the most striking examples in Scotland of sea-lochs which are also rock-basins as shown by the soundings, may be mentioned Loch Broom, which at Ullapool is only 9 fathoms deep, but higher up at Lacmelm descends to 26 fathoms; Little Loch Broom at the entrance is 18 fathoms, but towards the centre descends to 57 fathoms. The inner sound of Ramsay, which reaches a depth of 138 fathoms, but which would be converted into a lake were the region elevated to the extent of 100 fathoms. More fjord-like still is L. Etive, 20 miles in length and generally less than a mile in breadth, which at its entrance at Connel Sound is very narrow, and at half-tide the water rushes over the reef of rock with the roar of a cataract; yet half way up it descends to depths of over 70 fathoms. And, lastly, we have the case of one of the largest lakes in Scotland, L. Lomond,* which at its outlet is only a few feet above the sea-level, yet under Ben Lomond, where the ice must have been of enormous thickness, it descends to 90 and 101 fathoms in depth.

It is unnecessary to quote further examples to show that the fjords (or sea-lochs) of Scotland are like those of Norway, true rock-basins, and that in both cases the origin of these remarkable hollows in the solid rock must be attributed to the action of glacial ice during the Great Ice Age.

5. *Views of Scandinavian geologists on glacial erosion.*

The effects of glacial erosion in Norway are strongly insisted on by Scandinavian geologists.† To it is attributed the formation of that remarkable channel ("the Norwegian Channel") which curves round the northern margin of the Skagerak and the southern extremity of the Scandinavian peninsula, reaching a depth of 2,500 feet, and the origin of which is indicated by the direction of the glacial groovings and striæ of the adjoining coast. To glacier erosion is also

* Ramsay considered L. Lomond and L. Katrine as "large cases of glacier-erosion," *Quart. Journ. Geo. Soc.*, vol. xviii, p. 203. Geikie concurs in this view, *loc. cit.*, p. 295.

† *Norway*, article "Topography," by A. M. Hansan, pp. 18, 25. It is a remarkable fact first noticed by Horbye that between lat. 62° and 63½° the erosive agent moved from the comparatively lower ground of

attributed the formation of the numerous rock basins now existing as inland lakes, and the deepening of the beds of the fjords in their central portions below the level at which they must have reached when they were simply river-valleys continuously descending from their sources to their outfall in the sea or the ocean. To this agency also are referred the existence of the range of low islands and the intervening channels which lie off the western coast of Norway, and which bear the evidence of glacial erosion over their surfaces in a marked degree. Wherever we turn in Norway we are confronted with the evidence of the effects of ice movement at a former period which may be paralleled, but not surpassed, in any other country in Europe.

6. *Marine terraces or raised beaches of Scotland.*

The next point of comparison between the physical features of Norway and Scotland referred to above, is the occurrence of marine terraces, or raised beaches in both countries, indicating post-glacial submergence below the present levels.

All round the coast of Scotland, with occasional intervals along precipitous and exposed parts of the coast, there run one or more well-defined terraces, reaching to a height of 290 and even 350 feet near St. Andrews, and consisting of sandy, gravelly, or clayey material, sometimes containing shells, and sometimes bounded by cliffs perforated by caves now high and dry, while isolated sea-stacks rise above the surface of the terrace. Along the west coast of Argyllshire especially of Cantyre, two terraces are often to be observed, the higher about 40 feet, the lower about 25 feet above the high water line.* The higher terrace, which would be the older, is considered by Sir A. Geikie to date from the later part of the glacial period; the lower, or more recent, which is the most marked of all the terraces, may have been elevated since man became an inhabitant of the island, as it has yielded in several places works of human fabrication.†

Sweden westward over the Dovrefjeld towards the North Atlantic. *Sur les Phénomènes d'érosion en Norvege*, p. 40.

* Originally described by Maclaren in his *Geology of Fife*, and by Smith of Jordanhill.

† *Scenery and Geology of Scotland*, page 320. No fewer than eighteen canoes have at different times been dug out of this terrace, some of them amongst streets and houses. *Ibid.*, p. 324.

In Argyllshire, this terrace constitutes the sites for churches and other buildings, being the only approximately level ground in that part of Scotland. In other districts it has afforded ground for many towns and villages, such as Leith, Dundee, Arbroath, Rothsay, Greenock, Ardrossan and Ayr.

But the actual submergence of Scotland since the glacial epoch is not limited by the levels of the raised beaches above described. Marine deposits of sand, gravel and clay have been recognized at much greater altitudes. Professor James Geikie places the submergence of Scotland in later or interglacial times at not less than 1,238 feet as indicated by the Kames on the Fintry Hills; but in the south-east of the country the depression did not exceed 1,050 to 1,060 feet.* I myself have seen beds of stratified sand and gravel high up amongst the hills of Kantlyre. On the whole we may conclude that the depression of the land in interglacial times in Scotland was much about the same as that of Scandinavia, and it need scarcely be added that other parts of the British Isles partook, to a greater or less extent, of these terrestrial oscillations of level. In England and Ireland the interglacial and post-glacial beds are found at varying levels up to 1,300 feet above the level of the sea.

PART V.

1. *General Elevation of the land of Western Europe during the Glacial period.*

The subject of this paper would be more incomplete than is necessarily the case, did I omit to point out the evidence which Norway affords of a general and great elevation of the European land-area at an epoch just preceding the Great Ice Age and the connection of this extension of the land area with the conditions which resulted in a vast extension of snow and ice consequent on the refrigeration of the climate. In a series of papers published by the Victoria Institute I have described the existence of valleys physically, or inferentially, continuous with those of existing rivers which, after traversing the Continental Platform, open out on the

* *Great Ice Age*, p. 254. Prestwich states that the shell beds extend to an elevation in Scotland of 510 feet. *Geology*, vol. ii, p. 450, the amount of submergence was very unequal in different parts of the British Isles, having been 1,300 feet in North Wales, and 400 feet in Isle of Wight as shown by the gravel terraces at St. George's Downs and above "the Needles."

floor of the ocean at depths descending to 6,000 or 7,000 feet.*

These channels were determined by the aid of the soundings on the Admiralty charts and were shown to have all the characteristics in form and structure of some of the large cañons of Western America and other countries; and their resemblance to many of the Norwegian fjords is equally striking. They were shown to be traceable at intervals from off the Atlantic Coast of the British Isles, and of Spain and Portugal to that of Africa, where the Congo valley is continued for a distance of 120 miles out under the ocean, traversing the Continental Platform and opening out on the Abyssal Ocean at a depth of 1,200 fathoms, or 7,200 feet below the surface. These submerged river-valleys were found to be referable to those of the Loire, the Gironde, the Adour, the Douro, the Mondego, and the Tagus; this last, as well as the Adour, being actually continuous with the existing river-valley; this statement also applies to the Congo and to some of the rivers entering the Mediterranean from the European side; determined by the late Professor Issel of the University of Genoa.

2. *River-Valleys necessarily Sub-aerial.*

As river-valleys can only be formed under conditions of air and land the inference is inevitable that during their formation those tracts of the Atlantic below which they extend were under sub-aerial conditions, and that their present submerged position is owing to subsequent depression. Such depression must therefore have taken place to the extent of about 6,000 feet along the whole of the eastern border of the Atlantic; or to put the point conversely, the former elevation as respects the level of the ocean must have been about 6,000 or 7,000 feet, at which depth the base-level of the Continental Platform

* "Investigations regarding the submerged terraces and river-valleys bordering the British Isles," *Trans. Vict. Inst.*, vol. xxx, p. 305. "On the Sub-Oceanic Terraces and River-Valleys of Western Europe." *Ibid.*, vol. xxxi, p. 259. "On the Sub-Oceanic River-Valleys of the West African Continent, and the Mediterranean Basin." *Ibid.*, vol. xxxii, p. 147. Also, "Des investigations récentes relatives aux Anciennes Vallées envahies par la mer des Iles Britanniques et de l'ouest de l'Europe." *Comptes Rendus du Congrès Géologique International*, VIII Session, en France, 1901, p. 321.

is found where the side descends abruptly from the 200 fathom isobathic line. That Scandinavia and the North Sea partook of these great oscillations of the land is unquestionable. It is inconceivable that any portion of Western or Northern Europe could have remained approximately unmoved while the adjoining regions were undergoing such stupendous changes of level, and we are thus in a position to account for the great depth of the fjords even allowing for the effect of glacier-erosion over their floors. The fjords when river-valleys may be inferred to have entered the North Sea with channels of perhaps 2,000 feet or more, and to have crossed the floor of that sea in the direction of the Arctic Ocean, which descends very rapidly to a depth of over 1,000 fathoms; by this means alone could the rivers have been drained. But, as already stated, these channels are not now discoverable, to any important extent, by the soundings; which fact I have endeavoured to account for by supposing that they have been filled up with glacial mud, sand, gravel, and boulders carried down by floating ice from the interior highlands, and spread over the floor of the Continental (now the North Sea) Platform by the tides and currents. Similar silting of the original channels has taken place off the coast of Western Europe and the British Isles as I have shown when dealing with the sub-oceanic river-valleys of this region; but it may well be supposed that the effects would be even greater in the case of the North Sea which washes the coast of Norway and received the glaciers and icebergs which descended from its mountains. We may now conclude this necessarily brief account of these physical events by arranging them under the following stages:—

3. *General succession of events in the history of the Norwegian fjords.*

- (a) *Earliest stage* (Pre-Silurian.) Continental conditions; land formed of Archæan rocks. Erosion of river-valleys commences.
- (b) *Second stage.* Partial submergence during Silurian times.
- (c) *Third stage.* Elevation of land during later Palæozoic, Mesozoic and Tertiary times; with continuous erosion of river-valleys.
- (d) *Fourth stage.* (Glacial period.) Great upheaval of land and sea-areas accompanied by valley erosion.

Refrigeration of climate; extension of snowfields and glaciers which descended and filled the valleys and moved out over the north sea-floor; deepening of the valleys by glacier-erosion.*

- (e) *Fifth stage.* (Interglacial.) General subsidence of land and sea; amelioration of climate; marine terraces (or "strand-lines") formed along the coast of the submerged lands and fjords, the sea filled with floating ice and bergs.
- (f) *Sixth stage.* (Post Glacial.) Slight re-elevation of area, accompanied by recurrence of cold conditions but not to the extent of the fourth stage.
- (g) *Seventh stage.* (Recent.) Gradual re-elevation of land and amelioration of climate to present conditions; sea-beaches formed at intervals of emergence along the coast at commencement of human occupation of the country.

DISCUSSION.

The CHAIRMAN.—Now that we have heard Professor Hull's very interesting address, I hope some of those present may make any remarks they desire.

Dr. LOGAN JACK, F.G.S.—Mr. Chairman, I have had much pleasure in listening to the able exposition of the history of the Norwegian fjords that has been given by Professor Hull to-night. The difficulty is that anything I have to say can scarcely take the form of discussion, inasmuch as I agree with every word that has fallen from Professor Hull. It appeared to me that there are, however, some things that might have been, perhaps, more fully explained for the benefit of the general audience, such as why the ice became heaped up for these great depths, and this, I think the lecturer will agree, must have been on account of the strangulation which took place at the narrowing towards the mouths of the valleys, and that strangulation was followed by immediate relief as the ice escaped from the mouths of the valleys and, consequently, the pressure no longer caused the heaping up of the ice. One could suppose that the pressure would be the greatest immediately in advance of the point where the strangulation took place; but we must consider the nature of ice as an explanation of that.

* See page 254 for opinions of Professor Brögger and Dr. Nansen on the elevation of Norway at this epoch.

Ice is not a solid mass of iron, but is, to some extent, plastic, or at all events it follows the conditions of plasticity; and it is, sometimes, behind a barrier that the greatest heaping up will necessarily take place, and the impetus which could drive forward the enormous masses of ice is a thing that is difficult to understand under any conditions. A mass of ice 6,000 feet thick would require something very considerably thicker to drive it, and to drive it into those narrow valleys; but no doubt the fact that it has done so is proof that the ice had enormous force from behind (*vis a tergo*) and was capable of giving an impetus to those masses of ice that penetrated the valleys in the form of glaciers.

I have nothing further to remark, except that the outlets are the principal points of interest, and Professor Hull has shown very clearly how the moraines, aided by the ocean currents, have formed the marine terraces to which he has referred, so that they may have a foundation of rock; and yet they have been heaped up, and their height added to, by the moraines left by the glaciers themselves and the further accumulations of detritus banked up by the ocean currents.

[Mr. Martin Rouse having called attention to one of the diagrams, Professor Hull further explained the same.]

Mr. MARTIN ROUSE.—How are the islands represented there?

Professor HULL.—They are not represented there at all. *This* is the cause of the channel passing between the islands. [*Explaining.*]

Mr. MARTIN ROUSE.—Is there generally an opening in that case?

Professor HULL.—Oh, yes; it is generally quite open. [*Describing.*]

Mr. MARTIN ROUSE.—The Bay of Bergen: is that in the nature of a fjord?

Professor HULL.—Bergen is the place that I could not recall to my mind just now, when I digressed from my paper, and said that the snowfield of the interior could be seen from a point before you get into the harbour of Bergen, at a distance of 100 miles. It is called a fjord; but I do not know that the Bergen bay, or harbour, is properly called a fjord. It is one of the channels.

Mr. MARTIN ROUSE.—You say that fjords have their own winding channels out between islands?

Professor HULL.—Yes; they get out one way or another.

The CHAIRMAN.—We are much obliged to Professor Hull for his

interesting address. The only remark that I would like to make is with reference to the depths at the mouths of the fjords and, probably, the bays that Mr. Rouse has referred to. It seems to me to be analogous to the deposit of bars at the mouths of rivers.

When you get volumes of fresh water coming down and bringing deposit, directly it comes into contact with the salt water it is deposited, more or less; and you see the same thing in all rivers, to a more or less extent, at the present time. Why we see no moraine is, I think, as Professor Hull says, that the old channel at the mouth is bound to be obliterated. In the St. George's Channel and the English Channel you have a submerged channel because the tides run in the direction of the old channels and so keep them free.

I am sure you will allow me to convey your thanks to Professor Hull for his very interesting address. [Applause.]

Professor HULL.—I am much obliged for the manner in which you have received my paper, and am specially gratified that so experienced a geologist as Dr. Logan Jack is able to concur in my views regarding the physical history of the Norwegian fjords.

The Meeting then terminated.

COMMUNICATIONS RECEIVED.

The following communication from the Rev. Dr. Walker will be read with interest:—

COMPARISON OF THE ICELANDIC FEATURES WITH THOSE OF NORWAY.

(*Cf.* Part IV, p. 136, of paper.)

Why is no parallel drawn between the physical features of Iceland and Norway, which in several particulars present such a remarkable similarity?

1. Both countries alike possess a "Snaefell," a mountain covered with snow; in other words, Iceland itself has no fewer than three Snaefells: (1) Snaefell Jokull, whose glittering cone I have seen 70 miles away to the north-north-west when standing on the shore at Reykjavik in the innermost recess of the Faxafjorðr; (2) East Snaefell, as situate in the east of the island; and there is also a third Snaefell elsewhere.

As a rule a "fell" denotes among Icelanders a mountain of inferior elevation to a "jokull," which signifies a mountain per-

petually covered with snow. Hekla is spoken of as only a "fell." Snaefell in the south-west is, as above stated, a "jokull," though only somewhat over 4,000 feet in altitude, whereas East Snaefell, if I recollect rightly, reaches to a height of over 4,000 feet.

2. (p. 135) *Formation of Marine Terraces*.—There is, I believe, such a marine terrace on the north coast of Iceland, a few miles to the east of Hasavik, which place I have visited, but not the terrace. It is, I think, mentioned in Henderson's *Iceland* (2 vols.). That a missionary visited the island in or about 1818 on behalf of the B. and F. Bible Society and reports the occurrence in said marine terrace of a stratum of the well-known shells, *Cyprina Islandica*, of smaller size than those now occurring in such abundance in a living state at Isafjördr in the north-west.* I have little or rather no doubt that Professor Hull would at once discover many other such terraces alike in the interior fjords, the archipelago of islands, skerries, etc., that stud the sea to the west of Iceland, and the barriers of rocks that break the force of the tide to the south of the island. My own pursuit of entomology, and very imperfect knowledge, left me little leisure or capability for such matters.

3. (p. 133 of paper) *Deepening Process by Glacier Action and the Piling-up Process by Moraine Matter*.—I have on more than one occasion witnessed this "piling up of the moraine." Take the masses of moraine widely and thickly strewn on the banks of the Glára (pronounced *Glera*) as an example, close to where that river debouches into the Eyjafjördr (just north of Oddeyri itself, a suburb of and rather less than a mile north of Akureyri) and on the western bank of that fjördr. This river, which I visited on July 10th, 1890, is reduced to a mere thread in the summer season in the centre of the fields of moraine that it brings down when in flood. Iceland has been described as a land in which both frost and fire have done their worst, and correspondingly the moraine in question does not only consist of the ordinary stones rounded alike by glacier friction above and by the action of the watercourse lower down, but of obsidian pebbles which also owe their formation of vitrified lava to intense heat. The "deepening process by glacier

* Spelt Eyjafjördr on Thoroddsen's Geological Map which shows numerous raised beaches along the shores of the northern inlets and fjords.—ED.

action" may also be illustrated by the Glárafoss, the foss of the Glára, a mile or more above the mouth of the river, only reached after a painful and heavy trudge over the said beds of moraine, which crunch under the feet, and where the river thunders down a narrow and steep chasm. Yet a few hundred yards farther on and the stream is hemmed in here in the middle of July by a regular penthouse of drift snow, and I have no doubt issues from a glacier, and deepens its course in its constant and forceful cascade.

4. (p. 137) *Perched Blocks and Boulders*.—I noticed such a huge perched boulder of a different formation from that of the surrounding rocks in the Krisuvik desert in the south of Iceland. Its lodgment there is no doubt due to prehistoric glacial action, but on my inquiry of the under-guide as to how it came there, his reply was, "Gretlir's work." All such matters are set down to the surpassing strength of the national hero of Iceland.

5. (p. 137) *In the case of Scotland, in the entire disappearance of Glaciers*.—But the case of Iceland is far more analogous to that of Norway. Here the glaciers have not disappeared but have retreated into the higher valleys of the interior mountains. The snow mountains in the north of Iceland are farther inland and cannot be beheld from the coasting steamer like those in the south. Glacial action in the south is doing that, if I am not mistaken, now, which glacial action in the north did in a prehistoric age. Stand on the shore of Heimaerg (Home Island) the only inhabited one of the whole group of the Westmann Islands, and gaze northwards to the south coast of Iceland, and a perfect panorama of snow peaks will be beheld in succession, those of the Eyjafjadla jokull, the Myrdals jokull, and the Oraefa jokull, with their glittering pinnacles of ice spiring aloft into the cloudless arctic skies—inland, though not seemingly so, because the intervening lands between the base of said mountains and the coast only present a dead level.

6. There is great philosophical significance in the term that the Icelanders apply to his snow mountains in several cases and to some of his islands. Alone, stationary and immovable, whereas glaciers slip down, fjords are carved out, rivers wear down the rocks, Askja (the name for a bandbox in Iceland, or any circular

* Or Vestmannaeyjar on Thoroddsen's map.

receptacle) nearly split its crater to pieces in the east of the island in the last century by the quantity of scorïæ and other ejectamenta that it threw up. But *Dranga* in Iceland means something deeply and firmly fixed, and so we have *Dranga* jokull that dominates the fjords in the north-west; *Drangey*, the name of the island scene of Gretlir's abode when outlawed, at the upper end of the *Skagafjorðr*; *Drangr* and *Einarsdrangr* among the Westmann Islands. And now that one is on the subject of the *everlasting hills*, one may compare *Mount Pagus* in the rear of Smyrna and $\pi\eta\gamma\gamma\upsilon\mu\iota$, to fix or fasten; the Greeks conceived the very same idea, and our own "peg."

7. I could multiply these instances, but forbear; and only regret in conclusion, having myself visited South-West Norway and South Italy, and speaking with a personal knowledge of Western Asia, Northern Africa, and the greater part of Western Europe, that the one island which is *par excellence* the paradise of the geologist, and which certainly far exceeds South Italy in the variety and extent of area of its volcanic phenomena, and is to my mind at least equal to Norway in respect of fjords, illustrations of erosion, and of glacial action, should not have the personal travel, the great and accurate knowledge, and last, not least, the distinguished ability of a Hull or a Logan Lobley brought to bear upon it.

POSTSCRIPT.

Since the above was in type, the great work of Professor W. C. Brögger, LL.D., *Om de sen-glaciale og post-glaciale nivåforandringer i Kristianiafeltet** has reached my hands through the courtesy of its distinguished author. It has been brought out with special advantage to those to whom Norse is an unknown tongue by the addition of a "Summary of the Contents" in English. The various changes of level of the land from the commencement to the close of the Glacial period; the advance and retreat of the glaciers at successive stages; the submergence of the land during the formation of the marine terraces; and the changes of climate during these oscillations are here ably described and illustrated. To those who, like the writer, have

* Norges geologiske undersøgelse. No. 31.

endeavoured to prove the great changes of level of the Glacial period, the views of Professor Brögger are most satisfactory, as he shows that "the sea-bottom, during the time of the greatest ice sheet of Europe, must have been uplifted at least 2,600 metres (8,528 feet), higher than it is at present (p. 683), which even exceeds the amount of elevation deduced by the writer from the depth of the sub-oceanic river valleys, at the commencement of the Glacial period. On the other hand the extent of the submergence undergone by the land in the Kristiania region is determined to have been 215-216 metres (about 710 feet), at the period when the highest of the terraces was in course of formation; and at Mjosen it was even somewhat more, or about 768 feet.

E. H.

COMMUNICATION FROM CAVALIERE W. P. JERVIS, F.G.S.

Thus it is only this week that I have read with the liveliest interest your welcome studies. Since I have closely followed your several papers on the enormous changes of level throughout a considerable part of the Atlantic, I was prepared to learn much more with the like interest, and feel very pleased that you continue to examine a question which, though in consonance with all the teachings of science, has been so little understood by geologists—in fact, I believe, as I already expressed it, that it is high time for us to investigate the former conditions of that part of our globe which is now covered by the ocean.

It is to the future teachings of this important study, and to which I suggested the name of Thallassology, in view of the vastness of the subject, that I believe that geology will be incalculably indebted, in order to gain a clearer insight into the history of the globe.

Several points in your paper struck me as most important explanations of difficulties which I was unable before to understand.

I had not an idea that the raised beaches in Norway were of a nature analogous to those of the British Isles, and indicating so clearly, by sub-Arctic fauna along with glacial detritus, an emersion subsequent to the Ice Age, but before the rigidity of the climate

had passed away entirely, though so evidently not to be confounded with the former upheaval.

Until I read your explanation of the shallowness of the fjords, in many instances in their lower course, I was under the impression that it was due to a great extent to glacial boulders and detritus which did not reach the sea; but you so plainly show the manner in which the ice attained to prodigious thickness in the upper portion of the fjords as to have eroded to a far greater extent than further down, that no difficulty remains in one's mind, and the entire obliteration of the submerged channels beyond the present outlets of so many fjords into the North Sea (so far, at least, as my Norwegian soundings show) seems to be attributable to icebergs breaking off from the respective fjords at a remote period, but in a very insignificant degree, in proportion, to the action of the marine currents to which I had fancied that they owed their being filled in.

Such is the apparent uniformity of breadth and depth of the great channel skirting Norway in the North Sea, that it seems to me improbable that icebergs should have been carried out to sea westwards to such a vast extent as to have covered the floor of the North Sea to any great thickness with boulders or detritus; but we shall never know further on this subject.

Concurring with what Dr. Walker observed in his communication, I should greatly wish to find you now extend your investigations to Iceland, but more especially to Greenland and South Finland.

BOBBIO PELLICE, TURIN.

25th July, 1902.

ORDINARY GENERAL MEETING.*

MARTIN L. ROUSE, Esq., B.L., IN THE CHAIR.

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

MEMBER :—Herr Ole Theodor Olsen, F.R.G.S.

The following paper was read by the author :—

THE PHYSICAL HISTORY OF THE FJORDS OF NEW ZEALAND. By J. MALCOLM MACLAREN, Esq., B.Sc., F.G.S.

Introductory.—The fjord basins—locally termed the West Coast Sounds—of New Zealand are situated on the western coast of the Province of Otago, in the South Island. They lie approximately on the meridian of 167° E. Long., between the parallels of 44° and 46° S. Lat., and run with a general east to west direction, penetrating from ten to twenty miles into the mountains by narrow and tortuous channels, which vary in width from a few hundred yards to a mile and a half. They are some fourteen in number, the best known being Milford Sound in the north and Dusky Sound and Preservation Inlet in the south. Access to the majority can be had only from the sea, the steep mountain ranges, and the dense vegetation thereon, forming an almost impenetrable barrier to those approaching from the central Otago plain or from the Lake District. It is these ranges that furnish the *Notornis Mantelli*, or takahē, the rarest of all existing birds, with a habitat so secure that, since 1840, only five specimens have been obtained.

* Held Monday, March 3rd, 1902.

At Preservation and Chalky Inlets—the most southerly of the group—the shores of the sounds slope gently from the rounded mountain ridges to the sea level, but in all the others to the north, the fjord walls are steep and precipitous, and continue so for many fathoms below the surface. In Milford Sound, some of these cliffs rise perpendicularly to a height of 1,500 feet above sea level.

2. *Mountain ranges*.—Except in the neighbourhood of Milford Sound and immediately to the south, the mountain ranges at the heads of the sounds are neither high nor broad. In the south the highest peak is about 5,500 feet above sea level, and only eight or nine miles separates the headwaters of Doubtful Sound and one of the arms of Lake Manapouri, on the eastern slope of the main range. About Milford Sound, however, the watershed is much broader and the mountains much higher; here assuming a distinctly Alpine character, and culminating in Mount Earnslaw, 9,165 feet high. For this reason, therefore, it is only in the north that rivers of any important size flow into the heads of the sounds. These are the Arthur and the Cleddau, falling together into Freshwater Basin at the head of Milford Sound, and the Hollyford River, running into Lake McKerrow (or Kakapo), which, though now a freshwater lake, is really the fjord continuation of Martin's Bay. These three rivers are fed from the snowfields and glaciers of the Balloon Mountains and the Bryneira Range, both of which rise well above the snow line. As Pembroke Peak (6,710 feet), near Milford Sound, is permanently snow clad, the snow line in these latitudes may be set down at about 6,500 feet above sea level. As might be inferred from the height of the watershed and the shortness of their courses, the streams falling into the sounds are really mountain torrents, with considerable erosive power. In the southern sounds comparatively small streams have eroded deep ravines back almost to their sources.

3. *Cascades*.—In some places, and especially is this the case at Milford Sound, the fjord has truncated the lateral valleys, the waters of the latter pouring forth as cascades on the placid waters of the sound. Of this character are the Stirling and the Bowen Falls, in Milford Sound, the latter with 540 feet of sheer drop. In the mountains at the head of Milford Sound are the famous Sutherland Falls, which in a drop of nearly 2,000 feet (1,904) touch the cliff face but three times.

Wherever possible, the shores and mountain slopes of the New Zealand sounds are covered by an extremely dense and luxuriant impenetrable forest growth, the prevailing sombre hues of which add not a little to the grandeur of the fjord scenery. During December, however, the hillsides burst into a blaze with the crimson flower of the rata (*Metrosideros robusta et al. sp.*) the "Christmas tree" of the colonists, which forms in places a not inconsiderable portion of the forest growth. The luxuriance of the vegetation is due to the extreme humidity of these regions, the average annual rainfall being certainly not less than 125 inches. The forest, at 3,500 feet, gives way to grassy uplands, and these again, at a further 3,000 feet, to the perennial snow-fields.

4. *Depths of the Fjords.*—Probably the most remarkable point of resemblance to the Norwegian fjords is that which is apparent on mapping the isobathic contours of the New Zealand Sounds. Like the former, they are, without exception, much shallower at their mouths than in the interior. In no case is the depth at the entrance more than 76 fathoms, and the average depth there may be stated at about 35 fathoms. The maximum interior depth yet obtained is 288 fathoms, in Breaksea Sound. A reference to the following table will show these points clearly.

Sound.	Approximate Length.	Average Width.	Greatest depth at Mouth.	Maximum Inland Depth Recorded.	Average Depth along Channel.
	Miles.	Miles.	Fms.	Fms.	Fms.
Martin's Bay } 1. Lke. McKerrow }	12	.75	{ Alluvial flat } 15 feet above sea level	96	65
2. Milford ..	12	.5	24	214	120
3. Bligh ..	12	.5	44	75	65
4. George ..	12	.75	46	106	95
5. Caswell ..	11	.75	31	151	120
6. Charles ..	9	.5	36	113	80
7. Nancy ..	9	.5	32	126	100
8. Thomson ..	22	1.0	76	250	120
9. Doubtful ..	19	1.25	{ 52 } 24*	120	100
10. Dags ..	8	.5	25	91	75
11. Breaksea ..	20	1.0	35	288	160
12. Dusky ..	24	2.5	30	145	100
13. Chalky ..	16	1.5	20	136	120
14. Preservation ..	22	.5-2.0	14	90	55

* Entrance to Smith Sound.

Lake McKerrow or Kakapo, though now a freshwater lake 15 feet above sea level, and separated from Martin's Bay by an alluvial flat three miles wide, is included in the above table for the reason already mentioned.

After passing the bar at the entrance, the floors of the fjords run approximately level to near the head of the sound, when they rise either into a cliff face or into a very small alluvial flat, the former termination being perhaps more general.

Origin of the New Zealand Fjords.—On the origin of these sounds there is little room, I think, for speculation. They obviously are submerged river-valleys, and, as will be seen from a reference to the map, show all the characteristics of valleys so formed. Their arms, originally tributary streams, generally join the main sound at a natural angle, and the sounds themselves, while preserving the general direction, yet show minor deflections; both features characteristic of mountain valleys. Further, the change from the main sound into the arm is not marked by any appreciable change in depth, and consequently in the level of the old valley floor. While at a date subsequent to their erosion and anterior to their submersion, they were undoubtedly occupied by glaciers, few traces indeed of glaciation are still preserved. The islands in the sounds, though they show no rugged contours, at the same time show no appearance of *Stoss-* and *Lee-seiten*, nor do the smaller rocks furnish any positive evidence. Still, the fjord walls in a few places, notably at the Narrows, Milford Sound, and in Deas Cove, Thompson Sound, show evidence of polishing and striation by glacier action.* With regard to the latter place, Sir James Hector remarks (*loc. cit.*): "The rock here is a granitic gneiss, the hard surface of which has faithfully preserved the grooves and polished surfaces caused by ancient glaciers." The terminal moraines in the Cleddau Valley and elsewhere also furnish evidence of the former existence of glaciers, as also do the granite erratics, 15 to 20 feet thick, found at the mouth of Preservation Inlet among slates,† and which must have been brought down the sound by ice. Possibly the scarcity of glacial markings may be due to the land, now above sea level, being covered in the Glacier

* Hector : *Geological Exploration of the West Coast*, p. 453.

† Hutton and Ulrich : *Geology of Otago*, p. 68.

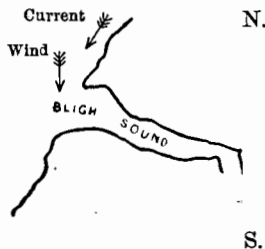
Period by snow-fields, while the old glacier beds are still submerged. The dense vegetation also prevents other than a cursory search for the signs of past glaciation.

5. *The effects of Glacier Erosion.*—The glaciers which occupied these valleys possibly, and indeed probably, augmented their depths. Nevertheless, for the New Zealand sounds, I have never been able to accept the glacier rock-basin theory, mainly because their cross sections do not coincide with my idea of those of a typical glacier excavated rock basin, which, I think, demands sloping instead of perpendicular sides; and also, because the singular isobathic contours may be explained much more simply than by calling to our aid such doubtful phenomena, in this case, at least, as glacier excavated rock basins. It is quite possible that some portion of some of the bars at the fjord mouths may be vestiges of terminal moraines, but if so, their presence at that point is probably accidental, and is in nowise essential to the formation of such bars as do occur. An ample explanation is derived from a consideration of the prevailing currents and winds on this coast. Along the western shore of the South Island there sets to the S.S.W. a current which runs at the rate of one to one-and-a-half knots per hour—and a current which is considerably accelerated when the prevailing N.W. wind is blowing. The two combined are sufficient to cause a southerly drift of shingle and gravel along the shore. It is from this cause that all the harbours on the west coast of New Zealand are bar harbours, and where breakwaters have been built and artificial harbours made, the result soon shows a struggle between nature and man for the mastery.

6. *Effects of Ocean Currents.*—The drift takes place until the mouth of a fjord is reached and, in the resultant eddy, the gravel and shingle are swept into the still water of the fjord, forming a bar, the inner slope of which is regulated by the slope angle which such materials assume in water under given conditions. As the rise and fall of the tides is here very small—from 6 to 8 feet only in springs—and the entrances to the sounds are not at all constricted, no strong “rip” or current is developed to keep the mouth clear. That the above has been the main, if not indeed the sole cause, of the shape of the fjord beds at their mouths may perhaps be more readily admitted when it is stated that an examination of some of the arms of the sounds shows bathymetric features similar to those already described. For example, in South Port—a cove in Chalky Sound—we have much greater

interior depths (36 fms.) than are shown on the sand bar at its mouth (9 fms.). It would certainly appear that, weak though the tidal currents of the outer sound may have been, they were sufficient to carry sand and gravel and to deposit it in the absolutely still water at the entrance to the cove. Now had these phenomena resulted from the filling of glacier excavated basins, similar basins, in the form of lakelets and tarns, would reasonably have been expected above sea level, but so far as I know, such have not yet been discovered.

7. *Form of entrance to the Sounds.*—Another feature of the fjord mouths, illustrative of the power and prevailing direction of the winds and current, is apparent on inspection of the chart. In nearly every case the north side of the entrance has a tongue-like projection to the south or south-west, while the opposite southern side shows a concave curve of erosion, as will be clear from the accompanying sketch of the mouth of Bligh Sound.



The only fjord of any size, the mouth of which has been silted up, is Martin's Bay and its fjord continuation, Lake McKerrow or Kakapo, and it is rather remarkable that this is the only old valley which faced directly to the north-west—or to the direction of the prevailing wind. It was, moreover, the first encountered by the coast drift in its southward journey. It is clear that the sand drifted into the bay had but little chance of escape against the prevailing wind, and was piled up until it formed a bar three miles wide, effectually ponding back the inner waters of the fjord.

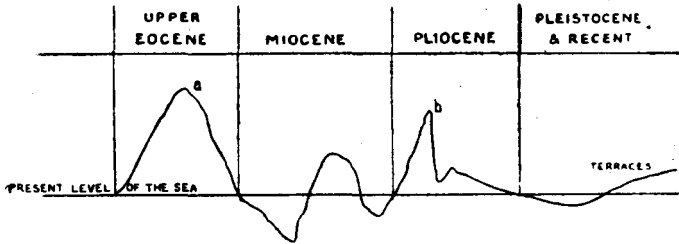
8. *Rocks lining the Sound.*—The rocks in which the sounds occur are eruptive granites and hard metamorphic gneisses, both well calculated to withstand the onslaught of nature's denuding agents for long ages. In Caswell Sound, a bed of marble, of poor quality, has been found. The restriction of the sounds to the comparatively limited area mentioned

at the outset is probably connected with the presence on the coast further to the north of comparatively soft, easily denuded rocks of Cretaceo-Tertiary and Lower Tertiary age.

9. *Form of the oceanic floor.*—So far, soundings have not been sufficiently numerous to show whether the submarine valleys are indicated by seaward channels in the ocean floor. But the probability of finding such channels is very remote, for the south-west coast of New Zealand, instead of standing on a submerged platform, as does Norway, slopes away sharply to the Thomson Basin, between New Zealand and Australia, with its average depth of 2,600 fathoms. This contradiction of the axiomatic expression of recent writers—that a deeply indented coast line stands on a submarine platform—is perhaps, after all, only apparent. For, from stratigraphical conditions in the Southern Alps, which need not, in this paper, be indicated further than to mention that the Southern Alps themselves are probably the eastern half of an anticline, the western position of which has disappeared, a great fault line, with a hade to the west, is assumed to pass down the west coast of the South Island of New Zealand. Such a fault would at once reconcile fact and theory, and would, *inter alia*, account in a measure for the extremely straight coast line shown in the sounds region.

10. *Geological History.*—The geological history of the southern portion of New Zealand, during the Tertiary period, is, thanks to the succession of marine and lacustrine beds in the south, and of marine beds in the north, comparatively easy to trace. The elevation which resulted in the initial formation of those river channels which are now occupied by the sounds, took place either in Lower or Upper Eocene times, according to whether we follow Professor Hutton or the officers of the New Zealand Geological Survey in the grouping of the Lower Tertiary rocks. The former insists on an unconformity, between the Waipara and Oamaru formations, representing a period of elevation at that time—equivalent probably to Lower Eocene—while the latter, broadly speaking, group the beds together as Cretaceo-Tertiary, thus throwing the unconformity into Upper Eocene time. Whatever the correct interpretation may be, it is certain, at least, that, in Lower Tertiary time, the Southern Alps received their final foldings and flexures accompanied by great upheaval, for all the beds since deposited lie more or less horizontally on their flanks and moreover are

deposited at some distance up the present valleys, thus proving the prior existence of the latter. During the Miocene period a depression of from 2,000 to 3,000 feet below the present level took place, resulting in the deposition of the Pareora beds. In Pliocene times, since no deposits referable to this age are found in the South Island, we must assume a period of elevation. It could not, however, have been of long duration, for in the North Island we find both Upper and Lower Pliocene beds—the Wanganui and Kai-iwi Series respectively. A depression in Pleistocene times is indicated by the deposits at Cape Wanbrow, Oamaru, and by the silt deposits of the Southland Plains. The major oscillations of the land surface during the Tertiary period may be graphically represented as follows:—



a.—Elevation during which present valley system originated.
 b.—Elevation during Glacier Period.

11. *Elevation of land during the Pliocene Period.*—As shown in the above diagram, the elevation of the land which led to the great *Glacier* Period (not *Glacial*, for New Zealand was never in Cainozoic time, at least, overwhelmed by an ice-cap) took place during the Pliocene Age, but whether in Early or Late Pliocene there is no evidence to show. Certain it is, however, that the glaciers covered then a very greatly extended area compared with that which they now occupy. In some places their moraines have been found within a few miles of the eastern seaboard, from which the present glaciers are now distant quite ninety miles. This glacier extension, with all its attendant phenomena, including the occupation and possible erosion of the fjord beds, is amply accounted for by the assumption of a greater elevation of the land of only some 3,000 to 5,000 feet—if indeed as much be required. For even at the present time, in lat. 44° S. (or equivalent to that of Bordeaux), the Fox Glacier, on the west coast, comes to within 700 feet of the sea level. Indeed, no other theory

seems tenable. For assuming, for the nonce, a colder climate to have existed at that period, and disregarding changes of elevation, the lower temperature requisite to extend the glaciers to their former bounds would also have been sufficient to extend them to the sea, and a boulder clay or stratified morainic matter would have resulted, of which some traces would surely have been found. Again in the well-developed marine upper tertiaries of the North Island there are species of shells which have persisted through Pliocene and Pleistocene times up to the present, a persistence hardly compatible with the assumption of a period of intense cold for the neighbouring South Island.

12. *Raised Terraces of Recent Age.*—With regard to recent changes of elevation in the Sounds district, I must confess that I am unable to adduce any evidence from personal knowledge. The subject has, however, been investigated by Captain Hutton, who mentions* distinctly formed terraces at the entrance to Doubtful Inlet, the highest being about 800 feet above sea level. Professor Park, who made an examination of the coast line near Martin's Bay,† saw there terraces 100 to 300 feet above sea level. At Coal Island, Preservation Inlet, there are sea-worn caves 10 to 20 feet above sea level, and at Green Island, in the same inlet, there is a pierced rock about 100 feet in height and completely perforated at the level of a terrace, now 40 feet above sea level. All these facts point, of course, towards elevation. Sir James Hector, however, many years ago, maintained that the coast was sinking. His evidence, so far as I remember it, was mainly negative, based on the failure to find certain estuarine beds which should have been found above sea level had the coast been rising. But the failure may have been due to other causes than non-elevation, and it must not be forgotten that in the fjords themselves the dense vegetation renders the determination of ancient terraces almost impossible. In any case the evidence in favour of elevation, being positive, by far outweighs that for subsidence. That oscillation is taking place at the present time, the gently sloping shore (25° to 40°) of the west coast furnishes conclusive proof, for otherwise the thundering billows of one of the most tumultuous seas in the world

* Hutton : *Geology of Otago*, p. 80.

† Park : *Report of Geological Survey of New Zealand*.

would long ago have worn back even these hard rocks to form a line of beetling cliffs.

[The author then exhibited a set of lantern slides to illustrate his subject.]

DISCUSSION.

The CHAIRMAN.—I think we are greatly indebted to Mr. Maclaren for these exquisite views of the New Zealand fjords. If we had only come to see those we should have been delighted; but we have, besides, had the scientific interest that attaches to the paper itself put so ably before us.

If any gentlemen wish to join in the discussion we shall be very glad to listen to them.

Dr. JACK, F.G.S.—I have listened with very great pleasure to the lecture which has been delivered on this interesting subject. It is true that neither the description nor even the photographic slides give one any adequate idea of the marvellous beauty of these sounds; but that is no discredit to my friend, the author of the paper, for I do not think that the human language can adequately describe the beauty of those sounds. I thank God that I have seen them, but I am quite unable to describe them.

I observe that Mr. Maclaren is sceptical about these sounds themselves being rock-basins—that is, having a rock-bound outlet; but I must say that I lean very much towards the theory that they are rock-basins, and evidence against it can, it seems to me, be only of a negative character. It is true that at the mouths of these outlets there are found accumulations, which in all probability are due to the heaping up of matter by the currents. They were possibly moraine deposits in the first instance; but even if there were no moraine deposits there would be quite enough material along the coast to form bars in such localities. But, at the same time, the evidence that there is no barrier of rock beneath those accumulations of drift is not clear. The fact is that nothing but borings could actually prove whether or not there is a rock barrier. I believe in all probability such barriers do exist as are found at the mouths of the rock-basins at the foot of the Alps. Mr. Maclaren justly pointed out that ice accumulations would imply, as a general rule, sloping valleys

rather than precipitous valleys with overhanging glaciers. There is no doubt in my mind that very extensive glaciers would produce valleys with soft slopes, and such valleys were probably produced at the period of the greatest extension of the ice; but supposing that to have been followed by a considerable period of less extension of the ice, *i.e.*, the ice sheet filling a less wide valley, then I see no reason why the attenuated ice-sheet should not go on grinding out a narrower rock-basin. I have seen modern glaciers overhung, in some places, by precipitous cliffs. So I do not think the evidence that glaciers are not even now scoring out valleys and making depressions which are bounded at their furthest extent by a rock barrier is quite conclusive. I do not for a moment deny the oscillation of level. That is abundantly proved by the evidence that Mr. Maclaren brought before us. The paper is one which gives rise to much ground for thought on our part, and I am much indebted, personally, to Mr. Maclaren for having brought the subject before us.

The CHAIRMAN.—To what Dr. Jack has just said I should like to add that from my little observation in Norway I have noticed that the fjords in some cases have exceedingly precipitous sides—as precipitous as they possibly could be, rising for several thousand feet, and sinking, as we were informed on my trip, 80 fathoms close to the shore.

We were told by Professor Hull, in his recent lecture, that these fjords show markings of glacial action near to the present level of the water, and he infers from their depths that they were true glacial beds after they had been river-channels. It seems to me that the record of depths in this table is not complete for drawing an inference. If you only give the depth at the mouth and then give the average depth afterwards, it is not evident whether the maximum depth coincides with the narrowing of the valleys at certain points. If the valleys became very narrow, then the heaped up ice caused by its pressure and erosive action a deepening of the valley. The ice, being throttled, would hollow out a greater depth. Of course water does that too if flowing rapidly. I understand the lecturer to say that in New Zealand glacial markings are not found low down close to the water in these lands. Is that so?

Mr. MACLAREN.—Yes; the few that have been observed have been found near sea-level.

Mr. ROUSE.—Then in that case it seems to me that they stand on the same footing as the Norwegian fjords, except for this drift, which may itself lie on the top of a moraine. There is nothing here to militate against it—in fact, one would rather infer that it was so from the immense contrast there is between some of the depths at the mouths and the greatest depths recorded.

If no other gentleman would like to take part in the discussion, I will call on Mr. Maclaren to reply. I have only to express our hearty thanks to Mr. Maclaren for his exceedingly interesting paper and his most exquisite photographic views of the New Zealand fjords.

Mr. MACLAREN.—I would only like to say with reference to the remarks of Dr. Jack and the Chairman that we have very little data to go upon, and I have put at your disposal all that we have. You must remember that in the West Coast Sounds region there are only a few people living, and it is reached only in the summer time by excursion steamers, and no scientific investigation has been made of the isobathic contours of the fjords. All I have to go upon are the few soundings that have been made by the Admiralty.

With reference to Dr. Jack's remark about the possibility of the shallowing of the mouth being due to moraine matter, I quite admit that; but it seems to me that the evidence is in favour of a coast-drift as I suggest. With regard to the character of the fjord walls; those precipices, no doubt, may owe their steepness to the action of glaciers, just, as Dr. Jack remarked, is the case with the glacier valleys in the Southern Alps, to which he referred. As I have already said, the fjords were undoubtedly occupied for a time by glaciers, which must have had some effect on the sides of the valleys.

The Meeting then adjourned.

POSTSCRIPT.

A letter was received from the Secretary, Professor Hull, stating his great regret that, owing to illness, he was unable to be present to hear Mr. Maclaren's paper on a subject in which he was much interested, and he desired to join in thanking the author for this communication.

ORDINARY GENERAL MEETING.*

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

The Minutes of the last Meeting were read and confirmed, and the following paper, illustrated by maps and lantern slides, was read by the author :—

ICELAND : ITS HISTORY AND INHABITANTS.

By Herr JON STEFANSSON, Ph.D.

GEOGRAPHICALLY and geologically Iceland is part of, a continuation of, the British Isles, for it is situated on the same submarine mountain ridge, stretching from south-east to north-west across the North Atlantic, the average depth on it being 1,500 feet to 2,000 feet, while north and south of it 12,000 feet is the average depth reached by sounding. According to Prof. James Geikie, land connection between Greenland and the British Isles must have existed in Cainozoic times, for relics of the same Tertiary flora are found in Scotland, the Faroes, Iceland, and Greenland. The deposits in which this fossil flora occurs are associated with great sheets of volcanic rocks. This so-called Iceland ridge (or Wyville Thomson range) was at all events greatly upheaved in the Tertiary period, and thus an island, misnamed *Iceland* in the ninth century, 40,450 English square miles in extent, the largest island in Europe after Great Britain, rose out of the Atlantic, distant only 450 miles from Cape Wrath, on the north-west coast of Scotland, to Stokknes, in the south-east of Iceland.

It is as rational to call this island Iceland as it is to call an

* Monday, April 21st, 1902.

ice sheet measuring several hundred thousand square miles Greenland. Iceland is not a bleak, arctic region, embedded in thickribbed ice, though its northmost peninsula, Rifstangi, projects about a mile north of the Arctic Circle. Situate between $63^{\circ} 24'$ and $66^{\circ} 33'$ north latitude, yet its thermic anomaly is such, owing to the Gulf Stream, that the mean temperature of the month of January at Stykkisholm, on the west coast of Iceland, is 34.5° F. higher than it should be in that latitude. It is surprising that January at Reykjavik is milder by $\frac{1}{2}^{\circ}$ than at Milano, North Italy, or 1° F. milder than at Munich on $48^{\circ} 9'$ north latitude, *i.e.*, $3\frac{1}{2}^{\circ}$ further south than London ($51^{\circ} 33'$ north latitude), while the mean annual for the same place is but 1° less than at St. John's, 16° further south, namely, 39.5° F., or as much as that of parts of Asia situate over 17° (over 1,000 miles) further south. Grimsey, off North Iceland, cut in two halves by the Arctic Circle, is 5° F. warmer in January than Stockholm. The coolness of the summer, however, reduces the annual mean. The mean temperature of summer at Reykjavik is only 53° F. (July, 59.20° F.). The sea round the south, west, and east coasts of Iceland is never less than 41° F., while on the north coast the nearness of Polar ice, pack ice drifting down from Greenland occasionally every four or five years, causes a fall in temperature.

It will thus be seen that Iceland has a temperate climate, while the clearness of its atmosphere rivals that of Italy. "A medium of matchless purity" this combination of sea and mountain air has been well called, and it is most bracing and exhilarating, "like drinking champagne," an English traveller says in her book on Iceland. It is freer from microbes than the air of any part of Europe, and, according to the researches of Dr. W. L. Brown, the blood of an Icelanders does, on an average, contain more hæmoglobine than that of other inhabitants of Europe.

No country on earth of equal size contains so varied and wonderful natural phenomena. The glaciers of Switzerland, the fjords, salmon rivers and midnight sun of Norway, the volcanoes, grottoes and solfataras of Italy—on a grander scale—the mineral springs of Germany, the geysers of New Zealand, the largest waterfall, next to Niagara, in the world, the Dettifoss, all are here. Nowhere has nature been so spendthrift in giving a geological lesson to man. If there be sermons in stones volumes lie unread here. Here we see her titanic forces at work building up a country.

Let us approach this wonderland. A high tableland out of which rise sharp peaks and glittering ice-fields, and into which run winding fjords, fringed by rocky islets on which the waves break in a white line of foam. You don't miss the forest which is not there, for the vivid brilliance of the air shows the glacier white and volcanic black, and sunset turns them to rich purple and violet.

Iceland is a plateau region, composed of older and more recent volcanic masses, not older than the Tertiary period, of an average altitude of from 1,650 to 2,000 feet, occupying thirteen-fourteenths of the island. It consists of basalt and palagonite tufa and breccia; the latter, the younger formation, in the centre and towards the south, while the greater part of the west, east and north coasts is of basalt, or nearly two-thirds of the island. The glaciers rise like broad domes from this plateau. In the south where the glaciers come down to the sea there are no harbours for 250 miles, from Djúpivogur to Eyrarbakki, for all the fjords have been filled up with detritus brought down by the glaciers. But the basaltic regions are cut and furrowed by numerous fjords. The basaltic formation is divided into two strata by the "surtarbrand"* formation of the miocene period, 60 to 100 feet in thickness, the fossiliferous layers occurring about midway up in the vertical faces of the basalt of the north-west. In these lignite strata have been found the remains of a vegetation of the American type when Iceland had a tropical climate.† The extensive forests of Tertiary times seem to have been overwhelmed by pumice, ashes and sometimes by flowing lava. Silicated tree stems are found in many places. The area of glaciers or ice-covered altitudes is estimated at 5,500 square miles, seven times that of Switzerland (710 square miles), comparable in size only to the glaciers of the polar regions. The Vatnajökull alone measures 3,300 square miles. The height of the snow line on the southern side of the plateau is 2,000 feet, on the northern side 4,300 feet, the air in the interior being much drier. The appearance of these glaciers is that of the Polar regions. The summits of the mountains are covered with flat or vaulted ice-fields from

* *Surtarbrandur* is the Icelandic name for fossilized tree trunks, a convenient name for the whole of the Icelandic lignite strata.

† This lignite band has its representative in the Island of Mull and Co. Antrim.—ED.

which glaciers branch out. The glacier explosions (*jökullslaup*, glacier leap) are peculiar to Iceland. They occur when there is an eruption of an ice-covered volcano. On such occasions extensive tracts of country are inundated and converted into an eddying current filled with floating ice. Within historical times fjords and bays have in this way been filled up. During the glacial epoch Iceland was completely overlain with an ice-roof or covering of at least 2,500 feet in thickness. Scorings and striations point to more than one glacial period in Iceland. There are many traces of the shifting of the shore in Post-glacial times, especially in the north-west; the highest shore line or raised beach being 250 feet above sea-level. There is a double raised beach in the north-west, and the coast is still receding.

On the harbourless south and south-east coast people live in little oases, isolated as islands, cut off from the rest of the isle by sand deserts and glaciers which come to their very door and threaten them perpetually—and under these sleep volcanoes. It is pleasant to find in this howling wilderness oases bright with flowers and fragrant with thyme and meadowsweet. Between the Skaptafellsjökull and the Skeiðarárjökull willows, angelicas and birches 21 to 22 feet high nestle in clusters, and there is even a mountain ash 30 feet high. All round every quarter of an hour is heard the thundering crash of ice blocks falling down on the muddy sands or into the yellow waters of Skeiðará, which changes its bed continually, moving over a mile, sometimes often in a day. Nowhere is it possible to study so well the geological conditions prevailing towards the close of the glacial epoch in Europe.

Iceland is the centre of a suboceanic volcanic region, and no region of the earth has an equal title to be called the *Land of Fire*. It owes its very existence to volcanic agency continued to-day and may be truly called the abode of subterranean heat. No spot on the surface of the globe of its extent exhibits marks of fire in such a multitude, in such a variety and of such a magnitude. None contains an equal number of volcanoes. Nowhere have eruptions of such magnitude occurred. Dr. Thoroddsen has counted 107 volcanoes, 83 of which are a series of low craters or crater-chains, eight are of the Vesuvius shape, and 16 of the Sandwich islands lava-cone shape; 5,000 square miles of land are covered with lava. The post-glacial lava alone would cover

Denmark with a layer 16 feet in thickness. The largest lava-desert is the Ódáðahraun, which covers an area of 1,700 square miles, and is from 1,600 to 3,500 feet above sea-level. This lava field has been formed by the eruptions of about 20 volcanoes. The cubic capacity of the lava ejected here would make a solid cube each side of which would measure about 50 miles. The most frequent form of manifestation of volcanic eruption is the formation of a series of low craters often several miles in length, along lines of cleavage in the crust of the earth. The longest is that of Laki, 20 miles long, containing about 100 craters. Sometimes lava has welled up out of fissures without craters. The largest of these is Eldgjá, north of Mýrdalsjökull, 19 miles long, 434 feet deep, in one place 656 feet deep, bottom 468 feet wide. The volcanoes are not, as was formerly supposed, limited to the region of palagonite breccia. On the Faxa-bay are many small volcanoes which have broken through the basalt. About twenty-five volcanoes have been active in historic times (900-1900). Vesuvius is dwarfed into insignificance, for the lava-flood of the last eruption in Iceland, in 1875, has been computed to contain 31,000 millions of cubic feet, while in the largest eruption of Vesuvius on record, that in 1794, only about 730 millions of cubic feet of lava were ejected.

The lava field of the crater chain of Laki covers some 220 square miles, and the lava current flowed 47 miles away from the place of eruption. The longest flow of lava in Iceland is that from the craters of Fiskivötn, 90 miles long. On March 12th, 1875, a lava torrent forced its way 620 yards up an incline of $0^{\circ} 25'$. On March 29th, 1875, the pumice ashes of Mount Askja were carried over 1,000 miles away to Norway in eleven hours forty minutes, and in another ten hours to Stockholm. The column of ashes rising from Hekla was measured on April 21st, 1766, and was found to rise 16,500 feet above the top of the mountain; on February 5th, 1846, it rose 14,350 feet. On April 5th, 1766, a fragment of basaltic scoria was hurled from Hekla to Vidivellir, a distance of 103 miles.

The geysers have been so much written about that I shall leave them out and treat more in detail of the volcanoes of Iceland. Several new geysers burst out during the earthquakes in 1896, while the well-known Strokkur disappeared, having been in existence 107 years.

The crater chains and volcanic fissures run in certain directions, and there are at present two lines in active

condition. The one runs from south-west to north-east and contains the craters of Reykjanes, the Hekla and other volcanoes of Southern Iceland. The second line runs from south to north and contains the Mývatn and Vatnajökull volcanoes. Hot springs and sulphur mines occupy the same lines, which are also taken by mountain ranges and submarine reefs. Earthquakes run in the same directions.

Eruptions are not so frequent as in the south of Europe. Hekla breaks out at intervals of seventy to eighty years, other volcanoes even less frequently.

Hekla, "The Cloak" (from its shape); the most famous of Icelandic volcanoes, is thirty-two miles inland from the nearest point of the coast, and situated west of Torfajökull. Its height is 5,108 feet. It is a longitudinally shaped mountain running south-west to north-east, piled up of lava blocks, pumice and ashes, with snow-filled craters standing in a row on top; it is an intermediate form between Vesuvius and a crater chain. Parallel with it run other mountain ridges of palagonite, breccia and tufa (1,000 feet to 1,500 feet) studded with craters. The Norwegian mineralogist, A. Helland, counted fourteen craters in a direct line near Hekla north-east to south-west, each with a lava stream of its own. Vast fields of lava extend round Hekla in every direction.

Of Hekla's eruptions eighteen are historically known, without reckoning three or four eruptions from craters in its neighbourhood.

The first known eruption of Hekla took place in 1104, the last in 1875. One of the most violent was the sixth eruption, July 13th, A.D. 1300. "The mountain was riven asunder lengthways, and out of this yawning chasm rushed forth columns of fire and streams of lava which ran nearly to the coast, 32 miles away, leaving here and there in the hollows on its course lakes of liquid fire. The crater vomited red-hot lava blocks to an unprecedented height. They cooled suddenly in the air and burst asunder with a thundering crash. . . . A strong south-easter carried the huge clouds of sand and ashes as far as 180 miles from the volcano so that they lay thick on the ground all that distance. The eruption lasted on unbroken for nearly a year. On December 28th, such masses of sand and ashes were thrown up that, at a distance of 225 miles, high hills and downs were formed by them and a violent earthquake laid waste the part of the district spared by the earlier eruption."

The ashes reached the north of Iceland. The air was darkened. Famine and loss of life followed, and houses were shattered by earthquakes.

The tenth eruption, July 25th, 1510, was so violent that huge blocks of lava were thrown out of the crater as far as Skálholt, 25 miles distant, and men were killed there by them. In May, 1554, at the time of the eleventh eruption, people were obliged to live in tents for the greater part of the summer on account of frequent earthquakes. The thirteenth eruption took place from January to March, 1579. Loud reports were heard for twelve successive days in the northmost parts of Iceland, and eighteen columns of fire were seen to rise simultaneously from the mountain. The ashes covered about one-half of the island. In the fifteenth eruption which began May 8th, 1636, thirteen craters broke out. The sixteenth eruption, in 1693, may be compared to that in 1300, and lasted February to August. "The earthquake was felt on the high seas, and endangered ships. Clouds of ashes changed day into pitch dark night, but glowing lava streams lit up the darkness with a red glare. Ashes were borne to Norway. The fall of ashes and down-pour of rain lasted all the time till Easter. The cattle saved from instantaneous death, having to eat the singed grass under the ashes, suffered from a scorbutic disease, and lost their teeth or perished."

The eighteenth eruption commenced September 2nd, 1845, and continued for seven months. Halley says the flames were seen in Orkney. The ashes were carried over to the Orkneys and the column of smoke ascending from the crater was found by the mathematician Gunnlögsen to reach a height of 14,000 feet. The lava stream was 80 feet in depth and covered 8 to 9 square miles. It moved on, scooping up hills of sand and earth in its way, the red-hot liquid breaking forth now and then from under the cooled surface with violent crashes. The lava ejected is computed at 14,400 cubic feet.

The peninsula of Reykjanes is volcanic throughout, containing no less than 300 volcanoes with about 700 craters. The ranges of volcanic peaks, some of which rise to 2,000 feet, run in the same direction as the Hekla range. They are mostly extinct; six of them have broken out in historical times. A number of volcanic springs and chasms cleft by earthquakes are also found in the peninsula.

Eldeyjar (Fire Isles) or Fuglasker, a cluster of volcanic

rocks, situate 10 to 12 miles off the south-west point of Reykjanes. Nine eruptions, the earliest in 1211, are known to have taken place in the bottom of the sea near these islets. In 1783, during the Skaptá eruption, an island called Nýey (New Isle), about 10 to 16 square miles, appeared near the Eldeyjar, about 150 miles distant from the seat of the eruption. This island was taken possession of by the Danes. The next year it had disappeared. The Geirfuglasker (or Skerrie of the Great Auk), one of these islands, was reported, in 1884, to have sunk into the sea.

Eldborg (Fire burgh, the fortress of fire) is a crater 179 feet high, and 636 feet in diameter, in the middle of a flat plain, from which a lava tract, now called Borgarhraun, issued. It is the first crater mentioned in history in a state of eruption (Landnama, about A.D. 900). From afar it looks like an old feudal castle rising in the midst of the plain, with battlements, alone and isolated. It rises gently till within about 80 feet of the summit, when it shapes itself into a steep and precipitous wall of black, glazed lava, crowned with lofty battlements.

Katla or *Köttlugjá*, in the eastern part of Mýrdalsjökull, is a volcanic chasm covered with ice between the eruptions. It has burst thirteen times, with prodigious inundations from 894 to 1860. These "glacier leaps" have carried down masses of pulverized lava and alluvial detritus, filling up fjords and bays, altering the coastline and causing the land to encroach upon the sea. The first eruption of Katla (894) laid waste two districts. Ruins of the farms, destroyed that year, were found at the beginning of the seventeenth century. During its third eruption, in 1245, glacier slips overran Sólheimasandur. The layers of ashes were half a foot thick. In 1311, fifth eruption, fifty-one homesteads were destroyed, and a whole district laid waste. In 1625, eighth eruption, ashes fell in Norway, inundations with icefloes, earthquakes and columns of fire, lightnings lit the darkness of ashes. Pasture land was two feet deep covered with pumice. 1660, ninth eruption. Such was the quantity of stones and detritus borne down with the glacier-slide that a dry beach was formed, where formerly people fished in a depth of 120 feet. The coastline was pushed over 6,000 feet out into the sea. The ice-blocks swept a church away, and it sailed out to sea in the midst of them. 1721, tenth eruption. The ice-blocks of the glacier-slip were grounded in a depth of 400 to 500 feet, 13 to 14 miles out at sea; a grassy

ridge of land was swept away and in its place was left a polished slab of rock 6,750 square fathoms. The ashes fell so thick that at farms 115 miles distant from the crater, light was obscured so as to make the reading of print impossible. 1755, eleventh eruption. Rocks of the size of a house were embedded in ice-blocks carried to sea. Fire and water issued from three craters, accompanied with such terrific explosions, that people thought the country was being blown up. A hail of burning stones and balls of fire fell. In the night everything seemed on fire and the air was filled with a sulphurous smell; fifty farms were destroyed. The south part of the country was covered with a layer of ashes half to four feet thick. The Sólheima-glacier seemed to rise and sink violently. It sometimes seemed to be raised double its height from the ground.

Eruptions of a magnitude unparalleled on earth in historic times took place from a chain of 100 craters, 20 miles long, about the valley of Varmárdalur, near the sources of the Skaptá, to the north-east of Myrdalsjökull. The lava covered an area of 220 square miles and the volume of lava ejected is estimated by Lyell, in his *Principles of Geology*, to be equal to that of Mont Blanc. Thoroddsen puts it at 15 million cubic metres. The eruption lasted from June, 1783, to January, 1784. The greatest length of the lava stream, which passes down the channel of the Skaptá and reaches Hnausar in Medalland, is 47 miles, greatest breadth 15 miles, the length of the second lava stream in the channel of Hverfisfljót is over 40 miles, breadth 9 to 10 miles. In places it fills valleys and chasms of a depth up to 600 feet, yet its average depth here is only 20 to 30 feet. It is said that 37 farms were destroyed and 400 people lost their shelter. Famine and scorbutic diseases raged, and animals died in great numbers; 9,336 persons perished, about one-fifth of the population. The loss of horses is reported to have been 28,018, or 77 per cent. of all horses in Iceland, that of cattle 11,461, or 53 per cent., and that of sheep 190,488, or 82 per cent. The mass of matter ejected is computed at 50,000 millions of cubic yards.

Along the borders of Vatnajökull volcanic eruptions have often taken place. Its greatest volcano is Öraefajökull, which has broken out three or four times with formidable glacier slips. In the middle of the fourteenth century—the annals disagree as to the date—the ice covering the top of

the mountain rushed down in a violent torrent towards the sea, bearing along with it so much of stones, sand and detritus that a sheet of water having a depth of 180 feet was changed into a dry sandy beach. Five fertile districts were totally laid waste. Forty farms and two churches were swept away out to sea with all that was in them in a few hours. Pumice and ashes were carried into the north and west of Iceland 200 to 300 miles.

Its third or fourth eruption took place 1727, August 3rd, to 1728, May 25th, from five to six rifts in the glacier. The people had to camp out and walked about with tubs on their heads, as the air was filled with burning embers.

The lava desert, Odáðhraun, which is 1,700 square miles in extent, has many craters, mostly unexplored, except those of the *Dyngjufjöll*, the largest volcano in Iceland, 4,500 feet in height, east of the centre of the desert. These mountains enclose a circular valley or crater Askja (the basket), 25 square miles in area, a vast crater, 17 miles inner, 24 outer circumference, a mountain built up by innumerable lava flows and upheavals to 3,800 feet, or 2,300 feet above Odáðhraun. Its bottom is 3,100 to 3,500 feet above sea level inclining eastward ($1^{\circ} 26'$) towards the mouth of the valley which opens into the surrounding lava tracts. Many active craters stud its bottom. An eruption took place here in 1875. In the south-east corner of this valley is a dip 800 feet deep in the ground, in which there is a round hot lake having a temperature of 72° F., and 4,000 feet in diameter when it was found in 1876. In 1884 it filled the whole dip and had become 10,000 feet long, but its temperature was only 56° F.

On March 29th, 1875, an eruption covered the whole of eastern Iceland with pumice and ashes. The crater from which the eruption proceeded is situated on the north-east edge of the dip, 300 feet in diameter, 150 feet in depth. Its exterior is a slope filled with ashes, its interior is round and perpendicular. It is now a mud cauldron, which no longer emits steam, but goes on boiling, in quaint colours, depositing sulphur. Craters in this lake emit steam with thundering noises, sounding in the far distance like the simultaneous letting off steam from innumerable pipes. Thoroddsen says: "Nature is here grander and more overawing than in any place in Iceland I have seen. He who once has stood on the edge of this earthdip will never forget the sight."

The steam pressure seems to have converted all the lava in this eruption into pumice and ashes.

North-east of the Odáðahraun is a mountain range in which the volcano Dyngja, which has given name to the whole groups of mountains, is situated. It is 3,600 feet high. The original crater is 1,500 to 1,600 feet in diameter and half filled with lava from which twelve columns of lava rise. In the midst of these is a crater 4,500 feet in diameter, 600 to 700 feet deep, with a terrific and startling look down. North-west of this Dyngja is another volcano also called Dyngja (Northern Dyngja).

North of the Dyngjufjöll in the lava tract Myvatns-öraefi (the Desert of the Mosquito Lake) an eruption took place in 1875, near Sveinagjá. A rift nine miles long appeared, along which some crater cones, 70 feet to 103 feet high, shot up and spread 10,000 cubic feet of lava over the plain.

No spot in Iceland is so crowded with craters, lava formations, solfataras and hot springs as the neighbourhood of Lake Mývatn, especially on its eastern shore. It is so thickly studded with extinct volcanoes and remainders of prehistoric convulsions as to look more like a landscape in the moon than anything else.

Eruptions took place there with short intervals in the years 1724-30. The chief volcanoes are Krafla and Leirhnúkur (Clay Peak) in a palagonite ridge running from south to north. Of these eruptions those from Leirhnúkur have been the most formidable.

In an eruption of Krafla, May 17th, 1724, great masses of volcanic matter issued from an explosive crater called "hell" (Víti), 1,030 feet in diameter. No lava was ejected. The fame of this volcano is derived from its crater of boiling clay, now a round lake with green cold water. Close to the crater are sulphur and mud springs.

Iceland has another and greater claim to your interest. It is, as William Morris said, the Greece of the North. It produced in the twelfth and thirteenth centuries a literature unparalleled after Rome before the golden age of England and France, in character drawing, in passionate dramatic power, in severe, noble simplicity, in grim humour. All the characters of the Sagas live and move to-day. Every hill and headland and valley in the island is full of their presence. The Icelander of to-day knows them by heart. It is as if every Englishman, from pauper to king, knew Shakespeare's historical plays and could retell them more or less in his or her own words. It has kept the national pride alive through evil times. It has preserved the language almost untouched by time and foreign intercourse.

Nowhere is the contrast between man and his surroundings so glaring as in Iceland. Buried in snow and darkness, deprived of every comfort, living on rancid butter and dried fish, drinking sour whey and milk, dressed like his servants, seeking in a little boat his food, yet a cultured mind, possessing an intimate knowledge, not only of the history of his own country but of Greece and Rome, a poet fond of throwing off satires, intellectually and morally the equal of his European guest, considering himself your equal and refusing to be ordered about by a rich Englishman, owner of several square miles of land and hundreds of sheep, with a pedigree going farther back than that of his visitor, a jack-of-all-trades, a blacksmith in his smithy, boat-builder and carpenter, an artist in filigree work, a carver in wood, an eager reader of books. He has universal education up to the degree to which it is useful for a man. There are no schools in Iceland, yet every child at twelve can read, according to the parish statistics. In no country in Europe are so many books printed and sold, in proportion to the population. A population equal to that of Hampstead, 76,000, has twelve printing presses, the earliest one being established as far back as 1530. About one hundred books annually, fourteen newspapers and eight periodicals are produced to satisfy the literary needs of this little nation.

Yet this literary people still live in a pastoral and Homeric civilization which is a modern lesson of the healthfulness of human life lived in close contact with the free, wild life of nature, such as would have delighted the heart of Rousseau or Thoreau. As a proof that this life is healthy I give the example of a clergyman who died four years ago, 113 years

old, having managed to live all his days healthy and happy on £30 a year, the average stipend in the Icelandic church. The sheep yield food and clothing. Their wool is pulled off in spring, carded, spun, woven in handlooms and worn undyed. You make shoes of their skin and spoons of the horns. Every opportunity is seized for the telling of stories and reciting of poems. Only the milk ewes are kept at home in summer, to be milked, the rest of the sheep are gathered in from the mountains in autumn, notice being given at church from the pulpit. These autumn gatherings, with people sitting on the walls of the stone enclosure telling stories, are quite Homeric. The winter evenings with each member of the family busy at work in the same room, the men shaving the wool off sheepskins on their knees, making ropes and nets of hair, the women using spindle and distaff, embroidering, etc., afford a still better opportunity for stories and poems.

There are even wandering minstrels, who gain their livelihood by reciting prose or poetry which they know by heart at various farmhouses till they exhaust their stock.

To conclude with a few statistics, the annual trade of Iceland is worth close on one million pounds, export and import together. The principal articles of export are salted cod-fish, wool, mutton, eiderdown. A large and increasing part of the trade is with Great Britain. In the fifteenth century all the foreign trade of Iceland was in English hands. Henry VIII. negotiated with Denmark, in 1518 and 1535, for its transfer to England, and its economic and strategic importance to Great Britain has been set forth as late as 1835 in the *Quarterly Review*, by Sir George Mackenzie and Sir William Hooker, who held that Iceland ought to be a British possession. It has been declared by experts that the fishing grounds of Iceland are richer than those of Newfoundland, and, though they are much nearer Great Britain, their annual yield is not more than £2,000,000, because they are not worked as they ought to be.

For close on 400 years Iceland was an aristocratic republic, ruled by the great families of the early settlers, among whom was a Norse queen of Dublin. A fourteen days' open-air Parliament of all Iceland met annually in June at Thingvellir and the Speaker of the Law (lög-söguman) used to recite from memory the whole of the unwritten, elaborate code of laws of the country to the assembly. In

1262-64 Iceland was united to Norway, and in 1380 with Norway to Denmark. The Danish rule ruined the island, economically, but since the granting of self-government and the re-establishment of the old Parliament, in 1874, at Reykjavik great progress has been made. The revenue of Iceland is now six times as large as 28 years ago, and it is probably the only country with *no* debt, but with 1,000,000 crowns of savings in its exchequer. Yet more has been expended on the ways and roads of the island since 1874 than in all the centuries down to that date. The Icelanders are keen politicians. Women have been in possession of the municipal vote earlier in Iceland than in any other country, and they do not change their names when they marry. The Parliament (*althing*) is composed of an Upper House of 12 members and a Lower House of 24. A minister for Iceland is to reside at Reykjavik in place of the Governor, who at present is the highest official in the island, and form the link between the Crown at Copenhagen and Parliament at Reykjavik.

The Icelanders are a religious and God-fearing people, but very averse to parsons' rule. It is a habit to criticize the sermon when you shake hands with the clergyman after the service. There is little crime. It is lawful for a farmer to steal his neighbour's hay when his cattle refuse to eat his own hay, and for this stolen food the cattle are said invariably to find an excellent appetite.

DISCUSSION.

The CHAIRMAN.—Before we go further, I am sure I may thank the author, in all your names, for the wonderfully interesting and detailed paper that he has read to us. I do not know what Dr. Stefansson may call the island in his own country; but he seems rather to disapprove of the name "Iceland." What do you call it, Dr. Stefansson?

Dr. STEFANSSON.—The same.

The CHAIRMAN.—It is a *multum in parvo* both from a geological and I think we may say a literal point of view.

[The lantern slides were then exhibited on the screen.]

The SECRETARY (Professor E. HULL, LL.D., F.R.S.).—Mr. Chairman, I am sure we have had a very great treat to-night, and I regret that we have not a larger number of members present. We particularly miss Dr. Walker, who has, as you know, a good deal of knowledge of Iceland. I fully expected he would have been here to take part in the discussion. However, no doubt, for some good reason, he is not present. I wrote to the Right Hon. James Bryce, M.P., to ask him to be present this evening as he has visited and written on Iceland, and has personal acquaintance with Dr. Stefansson. He replied thanking me for the invitation and the copy of Dr. Stefansson's paper which I had sent, and stating his intention to be present unless unavoidably prevented by his engagements at the House of Commons.

The only observations I will venture to offer upon this very interesting and elaborate communication will be in reference to the volcanic phenomena of Iceland. As the author has stated, the whole island is composed of volcanic rocks in great variety. Whether there exists a core of older rocks round which these volcanic lavas have accumulated we cannot tell; but we are safe in concluding that the eruptions of matter of which the island is composed are in the main of very recent geological origin; in fact, of Middle Tertiary Age; commencing with the Miocene period and continuing with interruptions down to the present day. As Lyell has observed* with regard to those of historic times, there is the most complete chronological record of the successive eruptions coming down from the ninth century of our era; and which go to show that since the twelfth century there has never been an interval of more than forty years without either an eruption or a great earthquake. So intense is the volcanic energy in the island that some of the eruptions of Hekla have lasted six years without cessation. Earthquakes have often shaken the whole island at once, causing great changes in the interior, such as the sinking down of hills, the rending of mountains, the desertion by rivers of their channels, and the formation of new lakes. New islands have been sometimes thrown up near the coast, while others have disappeared. The volcanoes of Iceland may be considered as safety-valves to the

* *Principles of Geology*, 11th edit., vol. ii, p. 48.

region in which lie the British Isles. There is reason, in fact, to suppose, that a great rift passes through the earth's crust connecting Iceland with Ætna and ranging through the volcanic districts of the west of Scotland, the north of Ireland, and the Auvergne region of central France. A few years ago it was observed, that the earthquake which passed through Devonshire and the coast of Ireland, was simultaneous with an eruption of Ætna, and (if my memory is correct) was felt in the Auvergne region. It is satisfactory to know that the great eruptions of lava which during Miocene times desolated the region lying along the coast of Scotland and that of Ireland have cooled down and ceased to flow, while the volcanic activity only survives at the extremities of the great rift, Iceland in the north and Sicily in the south.

While thanking Dr. Stefansson for his communication, I may mention that he is the author of an elaborate work on Iceland, *The Saga Steds of Iceland*, beautifully illustrated, and that he is at present engaged on a dictionary of the English and Icelandic languages. [Applause.]

Mr. MARTIN ROUSE.—I should like to say a few words. I remember reading in a standard work on geology, that at the close of the eighteenth or the beginning of the nineteenth century, ashes were carried from Iceland to Scotland and overspread Sutherland with fine dust which overlaid the fields, and that year was known as "the year of the ashes."

I should like to say that I agree with Professor Hull in what he said just now as to Iceland being a safety-valve for us.

I think it is very beautiful to see how the Icelanders have clung to their native island in the midst of their evil times. I think their love of the Holy Bible and their knowledge of Christ which has spread amongst them, have had much to do with the maintenance of their patriotism, side by side with their literary culture and the remembrance of the songs and compositions of their native authors. [Hear, hear.]

A MEMBER.—Would the lecturer kindly tell us to what race the Icelanders belong, where they come from, and what their language is?

Dr. STEFANSSON.—The Icelanders are Norwegians; but it is an interesting fact that many of the early settlers came from the British Isles.

Mr. MARTIN ROUSE.—Were they Danes and Anglo-Saxons that were not allowed to land?

Dr. STEFANSSON.—No, they had already settled in the island. But no doubt they brought many companions from the British Isles and no doubt the Irish and Gaelic people came with them to Iceland.

A MEMBER.—Is their language Norwegian?

Dr. STEFANSSON.—Yes. The Irish seem to have been in Iceland before the Northmen came. I am afraid it is not by our own free will that we act as a safety-valve to others! [Laughter.]

Mr. MARTIN ROUSE.—I have read that there is evidence that the Culdee preachers travelled as far as Iceland to preach the Gospel to the inhabitants.

Dr. STEFANSSON.—That is so.

The CHAIRMAN.—I am sure you will let me express in all your names our thanks to Dr. Stefansson for kindly giving us this lecture and information to-day. [Applause.]

The Meeting then adjourned.

ORDINARY GENERAL MEETING.*

MARTIN L. ROUSE, ESQ., B.L., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following elections were announced :—

ASSOCIATES :—John Hill Twigg, Esq., M.A. (Dub.), Commissioner, Bengal Civil Service (ret.); Rev. William Charles Penn, M.A., Noble College, Masulipatan.

The following paper was read by the author :—

ARTESIAN WATER IN THE STATE OF QUEENSLAND, AUSTRALIA. By R. LOGAN JACK, LL.D., F.G.S., late Government Geologist of Queensland.

1. INTRODUCTORY.

TO the pastoralists who occupied the western interior of Queensland, Nature presented a formidable riddle under her familiar sardonic condition of "Solve this or perish!" Underfoot were illimitable downs covered with the most nutritious grasses, and overhead a pitiless sky which refused to yield, except at long and irregular intervals, moisture enough to fill even these poor remnants of rivers which are known as "waterholes." Sometimes, indeed, the rain came in startling volume, and after such outbursts there might be waterholes enough to last for two or three dry seasons. The Diamantina is a chain of depressions, which may be ridden over, as I have done, in clear moonlight without the traveller being aware that he is in the presence of a river. Yet it has, within the memory of man, been fifty miles wide. In other parts, between the goldfield of Croydon and the Gulf of Carpentaria, I have seen miles of telegraph

* Monday, January 20th, 1902.

poles submerged, and a few years before my acquaintance with Queensland began, an area of over 12,000 square miles south of the gulf was flooded.

In what may be called ordinary dry seasons it was nothing uncommon to have intervals of 40 miles between one waterhole and the next. Travellers on horseback and on foot carried canvas water-bags, and the mail coaches were lumbered with barrels of water to carry the horses over the dry stages.

2. *Loss of Stock Owing to Droughts.*—But while the hardships incidental to travel could be mitigated by human foresight, the lot of the flocks and herds scattered over the vast area seemed to admit of no remedy. When the poor animals had “fed back” a few miles from the spot where they had last enjoyed a drink of water, thirst would compel them to retrace their steps. The area of available pasture was thus rigorously circumscribed, and the grass was eaten bare, eaten to the very roots, as I have seen sheep grubbing up the roots of the grassy tussocks like pigs, while, too far from water, and hence unattainable, were long leagues of grass untrodden by a hoof. Day by day the remaining waterholes were shrinking, and when the enfeebled cattle returned to slake their thirst they had to wallow through a sticky clay littered with the carcasses and bones of their fellows. Having drunk, if they were comparatively strong and lucky, after a life and death struggle they wallowed their way out again. Perhaps they did not; and the dingo was always waiting for his prize of a dead or helpless beast.

Frantic efforts were made to cope with the evil. When drought threatened, pastoralists or the Government made large dams or tanks, but it was very costly, and in some cases years elapsed before the rain came to fill them. Water was carted to incredible distances, but it is needless to say that the support of the draught animals themselves made sad havoc with the supply before it reached its destination.

3. *History of Boring Operations for Water.*—But this condition of things has been changed for the better. In 1881, while on a trip to meet the late General Fielding with a view to accompanying him on his “Transcontinental Railway” expedition, while travelling with the expedition to the Nicholson River, and while returning *via* Winton and Charters Towers, I had come to the conclusion that the basin-shape in which the Cretaceous strata were disposed

gave good grounds for the belief that artesian water would be found. Years before this Daintree and Tenison-Woods had founded a belief in artesian water on the presence of hot springs; but the argument was hardly logical, and perhaps the wish was father to the thought. A strong agitation in the Press began to make itself felt, and among others, Mr. W. Gibbons Cox, in 1883, insisted upon the experiment being made, arguing from its success elsewhere. In 1885 a drought had slain its hundreds of thousands of cattle, and was even threatening some of the western townships with extinction. The Government deputed Mr. J. B. Henderson, Hydraulic Engineer, and myself (I was then Government Geologist) to go to the drought-stricken district and make suggestions for the permanent or temporary mitigation of the distress. A more detailed examination than had been possible in the "Transcontinental Railway" expedition satisfied me that the whole of the western downs ought to be capable of yielding artesian water. Mr. Henderson indicated Blackall as the site of the first experiment, as that township seemed to him to be in the most immediate need of succour, and operations were commenced as soon as possible. Water was eventually struck at a depth of 1,645 feet, a supply of 291,000 gallons per day flowing over the surface with a pressure of 6½ lbs. to the square inch, although as a matter of fact, owing to an accident to the bore, Blackall was not the first to tap an artesian supply.

4. *Extent of Boring Operations*:—According to the latest statistics accessible to me, viz., those given in Mr. Henderson's Report for the year ending 30th June, 1900, there have been in all 976,711 feet, or 185 miles, of boring in search of artesian water in Queensland. Out of 839 bores 515 flow over the surface, while it must not be hastily concluded that the remainder are failures. Some are still in progress, some have been abandoned too soon, some yield only salt or otherwise defective water, some yield "sub-artesian" supplies of water; that is, water which rises, but not to the surface, owing to the hydrostatic pressure being insufficient. The deepest boring is the "Bimerah," No. 3 Whitewood, 5,045 feet, which gives a daily flow of 70,000 gallons. The warmest is the "Dagworth No. 1," 196° F., where a daily flow of 775,000 gallons was met with at 3,100 feet. The largest flow is believed to be that of the Coongoola (Longland's) bore, estimated at 6,000,000 gallons

per day, although the output has not been officially gauged. The water was struck at 1,900 feet. The total output of the 515 flowing bores is estimated at 321,653,629 gallons per day, or 117,403,574,585 gallons per annum. In cubic yards this is 695,724,886, *i.e.*, a cube of water with sides of about 900 yards. In other words, these artesian wells would fill a canal 100 feet wide, 20 feet deep, and 1,779 miles in length in one year, or fill up Loch Katrine in a year and a-half. Loch Katrine has an area of $4\frac{3}{4}$ square miles and a mean depth of 199 feet. The above figures represent no small achievement in the space of 16 years for a country with a population of 490,000 and an area of 668,497 square miles. It must be remembered that no feverish desire for oil or even gold led to the sinking of the 185 miles of bores, but only the necessity for water to drink. It is needless to say that 515 flowing wells of this description dotted over the previously dry country, large though it is, have already produced an important change in the conditions of life in the Queensland interior. The cattle-carrying capacity of the district has been enormously increased by the multiplication of centres from which the animals can reach pastures hitherto unattainable.

Before entering on questions strictly geological, I may state that the discovery of such a bounteous supply of artesian water does not furnish a perfect cure for all the evils of drought, as might at first be imagined. There may be—and unfortunately there has recently been—a drought so prolonged that not only the sub-aerial water, but even the grass itself, fails. Large as it is, the amount of artesian water brought to the surface, were it ten times as much, is a mere drop in the bucket to what would be required for the thorough irrigation of the vast pastures. The 695,724,886 cubic yards of water annually turned out by our 515 artesian wells, after all only represent a rainfall of .03 inch per annum on the 264,600 square miles of the area under which it is calculated that artesian water may be obtained. Nothing but the rain from Heaven will enable the grass to defy droughts of such virulence as that through which Queensland has recently passed.

5. *Variation in Pressure and Extent of Supply.*—A variation in the pressure and flow of some of the wells has been observed. It is possible that there may be some connection between the variation and periods of heavy and light rainfall on the intake beds, but until accurate measurements of a large

number of bores have been made over a series of years, speculation on the subject is hazardous.* The pressure of some bores has diminished and again increased. Some bores have ceased—perhaps temporarily—to flow over the surface. In some cases a diminished flow has been traced to wearing out of the tubing and consequent caving in. In others, the pipes have been more or less filled up with a mineral deposit. But in the great majority of cases there has been no failure in the flow.

6. *Geological Conditions.*—The greater part of the western interior of Queensland is composed of soft strata of Lower Cretaceous age, consisting of clay shales, limestones, and sandstones. These strata are so disposed that the lower members of the series crop out on the western flanks of the coast range, where not only is the elevation of the surface greater than in the downs to the west, but where also the rainfall is comparatively abundant. In the year 1894 I went out, accompanied by Mr. A. Gibb Maitland, now Government Geologist of Western Australia, with the view of delimiting the artesian-water-bearing area, and collecting information regarding the lower members of the series of rocks in which the water is found. We observed all along the eastern margin of the Cretaceous area a great thickness of an exceedingly porous sandstone so incoherent that when saturated with water a piece of it would crumble instantly into sand. To this rock we gave the name of the “Blythesdale Braystone.” Owing to the low dip, the outcrop of this ideally permeable stratum occupies a belt varying from five to 70 miles in width, but the “Braystone” finally disappears beneath the argillaceous and calcareous upper members of the series which form the soil of the downs to the west. Roughly speaking, there is a mean annual rainfall of 27 inches in the regions where the “Braystone” comes to the surface. Several great rivers, such as the Flinders, commence their career as running streams of considerable volume, but, except in wet seasons, disappear while crossing the outcrop of the “Braystone,” and the water must be carried, with the permeable stratum, beneath the clay-shales of the downs. The records of bores show, as a rule, that the

* In Lancashire and Cheshire the effects of dry and wet seasons do not show themselves in the deep wells of the new red sandstone till about six months after their occurrence, this period being required for percolation.—Ed.

artesian water is met with in "sand," and it has already been mentioned that the "Braystone," when wet, is sand and nothing more. It must be remembered that the "Braystone" not only takes in all the rain that falls on it, except what is accounted for by evaporation, but that it receives also what is poured into it by the rivers already referred to.

The outcrop of the "Braystone" is not visible for the whole of the distance from north to south to which our mapping extended, as it is partly concealed by nearly horizontal table-lands of what has been called "Desert Sandstone." The Desert Sandstone is an upper division of the Cretaceous formation and lies unconformably on the lower. Where it directly overlies the permeable Lower Cretaceous strata it does not, however, seriously interfere with the absorption of water by the latter, being itself of a fairly permeable nature.

But the loss of the rivers which flow across the outcrop of the Braystone is itself sufficient to suggest a serious difficulty. The water must, to some extent, escape, or the Braystone could not continue to absorb it, and the rivers would continue to run over the clay soil of the western downs. It follows that these *must* have some outlet; and, as has been pointed out by Professor David, of Sydney; Mr. E. Pittman, Government Geologist of New South Wales; and Mr. W. S. Griffith, there are strong grounds for believing that the underground water finds an outlet in the Great Australian Bight. The sea-bed is not open to observation, but if the water escapes where we suppose it does, the Blythesdale Braystone must, after dipping and undulating beneath the soil of the interior, crop out somewhere to the south of Australia. This conjecture, as will be shortly seen, is supported by observations on the water-pressures of the artesian wells themselves. It is now almost equally certain that a portion of the water escapes into the Gulf of Carpentaria.

7. *Mr. Maitland's Views.*—In a highly suggestive paper read before the Royal Society of Queensland in April, 1896, Mr. Maitland demonstrated that the principal artesian-water basins of the world "are not disposed in the shape of those ideal basins, sections of which have done duty for many years in geological manuals." The basins are, in fact, irregular, in so far as the rim of the trough varies in altitude. In other words the "basins" are in most cases "broken

basins," and the break gives rise to leakage either on land or beneath the sea.

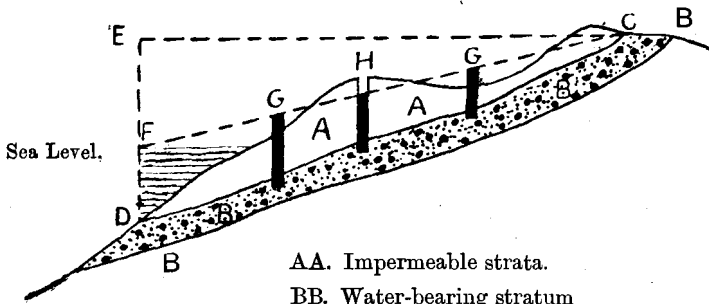
Speaking of the Tertiary beds of the Llaño Estocado, north of the Canadian River, Mr. Maitland says the leakage due to the broken rim of the basin supplies many of the rivers flowing from the Great Plains. Of the Gulf and Atlantic border regions the same author says:—"No discharge is witnessed from the water-bearing portions of the strata which crop out beneath the sea; but that such must be the case may be inferred from the fact that the pressure on the coastal deep wells is not nearly so great as it ought to be were the water confined in a sealed basin. The hydrostatic pressure of the body of water stored in the inland portion of the strata has a tendency to force the fresh water outwards, and thus to cause a permanent seaward flow. The water flows with a velocity due to the difference of level, the intake and the level of discharge, less the frictional resistance of the rock through which it flows."

8. *Theoretical Form of an Artesian Basin.*—In the case of a perfect artesian basin, with a rim of permeable strata of equal altitude all round, and with the necessary impermeable stratum above it—a condition of things which must be rare in Nature—the water would rise in a bore to the altitude of the intake or head of pressure. Should the surface of the ground at the site of the bore be lower than the head of pressure, the water would overflow. It has been found convenient to call "sub-artesian" water which rises in a bore but does not flow over the surface by reason of the site being higher than the head of pressure.

9. *Report on the Extension of the Underground Waters under the Mallee Scrub.*—In 1897, on the invitation of the Minister for Mines and Water Supply of Victoria, I joined Mr. James Stirling, Government Geologist, and Mr. E. Checci, Chief Assistant Engineer of Water Supply, in an investigation of the chances of the Queensland artesian water being found under the agricultural area of the Mallee Scrub. The conclusion arrived at was that, after flowing subterraneously southwards into New South Wales, the Queensland water was prevented from reaching the Mallee country by a bar of palæozoic rocks, and its possible outlet to the ocean was narrowed down to that part of the southern coast-line between the 124th and 134th meridians of each longitude. Mr. Checci took infinite pains in constructing a model showing, by means of wires planted on a

large map, the success of all the bores regarding which reliable information as to the altitude of the sites was available. In some cases, the wires protruded over the surface, denoting an artesian supply, while in others the wires stopped short of the surface, denoting sub-artesian water. We also drew diagrams, of which this is a generalisation, in which the line E C shows the hydrostatic

DIAGRAM TO ILLUSTRATE THE CONDITIONS GOVERNING THE RISE OF THE UNDERGROUND WATERS.



- AA. Impermeable strata.
- BB. Water-bearing stratum
- C. Intake of water-bearing stratum.
- D. Outlet of water-bearing stratum.
- EC. Hydrostatic surface.
- FC. Hydraulic surface.
- GG. Flowing bores (artesian).
- H. Non-flowing bore (sub-artesian).

surface, *i.e.*, the height of the head of water, to which height water would rise in a bore with a perfect artesian basin with no outlet, F C the hydraulic surface—a line drawn from the intake to the sea, being the line to which water should rise in a bore between the two points on the theory of an outlet to the sea, giving artesian water where the surface of the land is below the hydraulic surface and sub-artesian where the land surface is above the hydraulic surface. The piezometric height is represented by a vertical line dropped from the hydraulic surface through the site of the bore to the water-bearing stratum. The piezometric height is above the surface where there is artesian water and below the surface where there is only sub-artesian.

Actual measurements of pressure in the flowing bores—from which, of course, the height to which water would rise in a pipe can be calculated—show that the hydraulic surface of fact corresponds so closely with the hydraulic surface, on the theory of a submarine outlet, that I regard the theory as practically justified.

10. *Mr. Henderson's Iso-Potential Map.*—From the data afforded by the existing bores, Mr. Henderson (who watches the progress of the bores with paternal care) has prepared a chart, of which a second issue is given with his "Report for the year ending 30th June, 1900," showing what he calls Iso-potential lines, or lines along which the pressure would raise water to equal heights above the sea. The value of these iso-potentials cannot be over-estimated; for where the observations are sufficiently numerous to allow them to be drawn with accuracy, they enable an intending borer to judge beforehand, if he knows the level of his ground, whether he can hope to strike a flowing supply or whether his expenditure will be thrown away.

11. *Mr. Cameron's Equi-Altitudinal Map.*—Mr. Walter E. Cameron, of the Geological Survey of Queensland, has constructed an "Equi-altitudinal" map, in which, by treating the various bores as so many soundings, he has given a fair idea of the contour of the upper surface of the water-bearing beds at the base of the Cretaceous formation. From this map it appears that these beds come near the surface, or even reach the surface, on a saddle extending east and west from the Woolgar to the Cloncurry in a manner which is suggestive of a delta thrown across one of the narrowest parts of the sea which in Cretaceous times divided Australia into two islands. By referring all the bores to the sea-level, and making contour lines joining those in which the beds are the same height above or depth below the sea, Mr. Cameron brings out the fact that the water-bearing beds form two basins or scoops, one deepening northward to the Gulf of Carpentaria and the other deepening from Hughenden to the south-west, or towards Lake Eyre and the Great Australian Bight. This, to my mind, amounts to a demonstration of the seaward flow of the underground water.

12. *Regarding the Permanence of the Underground Supplies.*—The questions of the permanence of the present flow of subterranean water and how far it may be increased are of

vital importance. The progress of boring for 17 years, culminating in the present large output, has revealed no symptoms of a failure of the supply. I have no doubt that so long as rain falls on the intake beds, water will flow underground; *but to what extent?* It is on this question that I have recently been exercising my arithmetic.

It may be postulated, on geological grounds, that Queensland derives the whole of its underground supply from Queensland alone, and it may be assumed that the whole of it comes from the eastern outcrop of the basal strata of the Cretaceous formation. The assumption is based, first, on the comparatively low altitude of the western margin; and secondly, on Mr. Cameron's observation that in the west the basal strata do not come to the surface, but abut against the older rocks, and are overlapped by the argillaceous rocks, which succeed them in the Cretaceous series. Calculating the area between the line where the "Blythesdale Braystone" dips westward beneath the argillaceous beds and a line representing the eastmost extension of any rock which could possibly drain into the "Braystone," I have arrived at an area of 55,000 square miles as the absolute maximum of possible intake. The mean annual rainfall over this area being taken as 27 inches, we get (allowing nothing for evaporation) a total possible absorption of 127,776,000,000 cubic yards of water per annum. Of this amount we are, even now, recovering by means of artesian wells the $\frac{1}{183}$ rd part. It may be said that in $\frac{182}{3}$ we have still a large margin to be drawn upon. But there *is* a limit, and moreover it is unimaginable that by any conceivable multiplication of bores we could draw the whole supply to the surface, since an unascertainable portion of it must always escape to the sea. As for irrigating the whole artesian area, the entire 127,776,000,000 cubic yards of water (if we could raise it, which is impossible) would only be equal to an annual rainfall of $5\frac{1}{2}$ inches, which every pastoralist knows to be insufficient for the purpose.

DISCUSSION.

Mr. W. GIBBONS COX.—I have listened with particular interest to what Dr. Jack has said on the question of artesian water in Queensland, than whom there is no man better able to treat the

subject. I was one of the initiators of the movement for artesian water, having had five or six years' experience in the United States of America, following on a previous professional education in England, and when I arrived at Victoria and Melbourne in 1877, I and my colleagues did all we possibly could to get the pastoralists to take up this question of the vital importance of supply of water to the land. Unfortunately in Victoria there was no indication at the time of deep artesian water being there, and we had to put up with the "sub-artesian" or shallower water. From that experience I turned my attention to Queensland, and in 1883 I arrived there in the Government service. Working as we did with boring operations for the sub-artesian water, there were very clear indications of the existence of the deeper artesian supplies, and, as Dr. Jack has mentioned, there was an agitation in Brisbane at that time, in 1883, to further the deeper boring for artesian water, and I was connected with it as a hydraulic engineer. The matter went on until we arrived finally at the figures that the author has given, which are the official figures. Of course the work that had been carried out, the iso-potential map of Mr. Henderson, and the equi-altitudinal map of Mr. Cameron, were very good and necessary, but those had been based upon the actual borings; the data that had been arrived at by those gentlemen had been got from the actual borings themselves. I merely mention this so that some credit may be given to the actual borers themselves. (Hear, hear.) As far as the results go and the utilization of the water resulting from these bores, we know that over 800 bores have been put down, but only 515 are actually supplying up to the last report in 1901, yielding 351,000,000 gallons per day. That is an enormous output of water. Then the question arises, what has been done with that water? The water has been simply used for the direct requirements of the squatters in keeping the stock alive. In normal seasons the grass is of very highly nutritious quality, and in normal weather Queensland is probably as fine a feeding country as any in the world; but unfortunately droughts come occasionally, and then the whole country is dried up. All that the squatters have done, in fact, with that water has been to cut channels from the bores and lead the water into the different paddocks, so that at least the stock should be able to quench their thirst, otherwise they would have died right out. But having

entirely turned their attention and their money in that direction, they have neglected to irrigate even small portions from each bore, so as to grow fodder to feed their stock during the severe droughts. The amount of water in Queensland alone in the water-bearing rocks is inconceivable. There is the fact that there is an enormous outflow of water, even now, at what I might call the initial stages of the movement—an outflow of 351,000,000 gallons every twenty-four hours. Two-thirds of that would supply London itself, and one single bore discharging through a six-inch pipe would supply with water the city of Brisbane, the capital city of Queensland. I think the geology of the subject is extremely interesting, and of course, hydraulic engineers have to study the geological structure of the country, although it is simple as compared with gold-mining geology. I submit that the science of the thing is very clear. There is the fact of the water being there to the extent that has been stated; there is the fact, also, of the land of Queensland, taking that state alone, being of such high quality for pastoral purposes. I think this is one of the questions which is now arising connected with the welfare of the British Empire. (Hear, hear.)

Mr. JAMES STIRLING (Government Geologist for Victoria).—I am afraid I cannot add much of interest to the discussion. In the first place I know very little of the actual artesian water system of Queensland or of its geology; but in those matters I am quite content to rest upon the conclusions which my friend Dr. Jack has drawn, with his more intimate geological knowledge. I might say with regard to Victoria, as Dr. Jack has been good enough to refer to that part of Australasia, that the Victorian Government are very anxious if possible to ascertain whether those immense subterranean supplies of water extend from Queensland through Central Australia to Victoria, especially the western part of Victoria, a district where there is a very small rainfall and which would benefit very much by artesian supply. I have been very pleased to hear that in the early years geologists in Victoria were among the first to trace out the rocks in Queensland, but it seems that they had to wait until our friend Dr. Jack took control of the survey to get his advice in respect of artesian boring in Victoria. At any rate, the Government is so impressed with the magnificent work which Dr. Jack has done in Queensland, that they invited him to find out if such borings

could be equally successful in Victoria. I might say that it is not possible for the Queensland water to come down into Victoria. There happens to be a barrier of palæozoic rocks in New South Wales which seems to interfere with the flow. I was present when Mr. Checci was drawing the map to which Dr. Jack referred, in which he indicated by wires the success of the bores as to which reliable information was available as to the altitude of the sites. That map shows that the water would not rise to the surface of certain portions of Victoria. The map is now in the Geological Office in Victoria. With regard to the general question of artesian supply, there can be no doubt that Mr. Cox has given the meeting much information upon the matter, and there can be no doubt it is of great value to that portion of Australia. From observations that I have made in Victoria, I think it is just possible that in the extreme western portion of the Colony there may be sub-artesian supplies, but I do not think those sub-artesian supplies will come from Queensland; they will come from the watershed, say of the Australian Alps. The amount of rainfall over that area is very great, 60 or 70 inches a year; therefore there is a very considerable amount of water discharged from that area through the western portion of Victoria and underneath the Tertiary beds. Dr. Jack has shown clearly that there is a flow towards Central Australia on the one hand, and another flow northward to the Gulf of Carpentaria. I think that flow which goes southward will flow towards the Australian Bight.

Mr. E. T. SCAMMELL.—As representing, to some extent, the West Australian side of the question, I would like to press home a little more a matter to which Mr. Stirling has incidentally referred, and to ask whether there is any chance, according to Dr. Jack, of the West Australian people finding subterranean water anywhere in the direction either of the North Australian Bight or further north still, and if so, I should be very glad if Dr. Jack would say a word upon the matter.

Mr. WOODFORD PILKINGTON.—I think it would add greatly to the usefulness of the paper if Dr. Jack could make it so clear where artesian boring would be likely to be of service—in such Colonies as the Cape of Good Hope, for instance—that it would cause more useful attention to be paid to the subject than it now obtains. People are perpetually recommending artesian boring

as though it were everywhere applicable. Everyone said, "Oh, why don't you adopt artesian boring and get water?" where it was not to be found. If the geological conditions that are necessary for artesian boring were brought a little more fully into view, so as to lead one to see exactly where artesian boring can be practised with useful effect, I think the paper would have a very useful application indeed.

Dr. LOGAN JACK.—While the things are fresh in my memory, I had better begin with the last question and work back. Of course the paper might have been made very much more useful, and might have gone into greater detail, but for the necessity for fixing a limit to its length. It was not intended to cover the whole world with information regarding artesian water. In the first place, I was not competent to give such information, and, secondly, I was afraid it would have very much tired the patience of the meeting if I had gone over too much ground. But there are many ways in which the question might be answered to some extent. To begin with, if anybody put such a question to me as, "Is there artesian water in this particular land, in the Cape of Good Hope or elsewhere?" such a person should in the first place procure the best geological map of the district available, and should study especially the contour which the outcrop of the different *strata* took, and must consider where permeable beds come to the surface, and whether those permeable beds are covered by impermeable beds, which would keep the water carried down by them under such conditions that it could only be liberated by penetration by the boring rod. That is where the geologist comes in. Of course I might go to such a new country and give special attention to the question of artesian water. Geological maps are constructed for what they are worth, though they serve many purposes, among others that of throwing light upon artesian water. But it is not necessary to map out a district specially with a view to the bearing of the map upon the question of artesian water. Such mapping might very usefully be done specially with that object in such countries as have been referred to, such as the Cape of Good Hope. Another question was asked, as to whether artesian water could be expected in Western Australia. That question is of very considerable importance to Western Australia, and again, it is very much a question of mapping, but I think I can answer that where it is

mostly wanted in Western Australia is in the neighbourhood of the goldfields. It is not likely to be obtained, because just there the older rocks, as a general rule, come to the surface. I have no doubt there are many sub-artesian supplies of water to be found in portions of Western Australia, and perhaps in some cases not very far from the goldfields, where the water is most wanted. It is known that there is artesian water in, or near, the capital city of Perth; but where it is chiefly wanted is in the interior, where, unfortunately, so far as I understand (for I am speaking without having been on the spot), water is not likely to be obtained. Irrigation, as the Chairman has pointed out, has been very extensively practised in ancient times and in distant lands, and may yet be expected to be practised to a much greater extent in Queensland, where there is such a magnificent supply of water running, as it were, to waste. The stock of course benefits by it; but a great deal more might be made of it, as Mr. Cox has very forcibly pointed out. If, all along those rivulets, natural or artificial, where the water now runs for the supply of the cattle and then runs to waste, some use were made for agricultural purposes of the artesian water, it would be a very good thing indeed; but my object in referring specially to the subject of irrigation was to show the inutility of the hope that the whole of these western downs may be converted into rich pastures or enduring pastures by the use of artesian water, for which I contend that the supply, great as it is, is inadequate. I hope Mr. Cox has not understood, from anything which I have said, that I have not given full credit to the borers who have practically demonstrated the value of these supplies. Of course I depend very largely upon them for the information which I was constantly, while in Queensland, accumulating on the subject, and I watched the progress of each bore, so far as was possible.

After some remarks by the Chairman, a cordial vote of thanks to the author was unanimously carried, and the Meeting adjourned.

ORDINARY GENERAL MEETING.*

WALTER AUBREY KIDD, ESQ., M.D., F.Z.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

A paper entitled "Locusts and Grasshoppers" (illustrated by specimens from the author's collection), by Rev. F. A. Walker, D.D., F.L.S., was then read by the author.

LOCUSTS AND GRASSHOPPERS, WITH SPECIAL REFERENCE TO BIBLICAL SPECIES. (Illustrated by specimens from the Author's collection.)
By Rev. F. A. WALKER, D.D., F.L.S.

LOCUSTS and grasshoppers may be regarded as constituting two great families of one of the leading orders of insects known as Orthoptera, or straight wings, from the fact of the said wings being of one uniform width in this group, without angles, sinuosities, or scalloped edging.

Insects of this tribe possess four wings, the front pair being smaller than the hinder, and often leathery, whereas the latter are membranous, and the front wings moreover are frequently of a different colour from the hinder, being green, whereas the latter are pink or red, as in the instance of several tropical locusts, or dusky or mottled brown, whereas the latter are red or blue as in the instance of the continental genus of grasshoppers known as *Cedipoda*.

Locusts and grasshoppers themselves are divided into many different genera in their respective families, and several other tribes (as the Achetidæ, to which the crickets belong, the Blattidæ, which comprehend the cockroaches,

* Monday, April 7th, 1902.

the Forficulidæ, which include the earwigs), in addition to locusts and grasshoppers, go to make up what are ordinarily known as Orthoptera, and to the above-mentioned names may be added those of Mantidæ and Phasmidæ, and other subdivisions for which there exists no English equivalent, and which occur either in the regions adjoining the Mediterranean, or are else denizens of entirely tropical climes.

The only two sections of Orthoptera referred to in Holy Writ are the locust and the grasshopper. Some leading orders of insects are not even once mentioned in Scripture, and with regard to other orders that are spoken of, as Hymenoptera and Diptera, and possibly, but more doubtfully, Coleoptera and Hemiptera, the notices of such Orthoptera as locusts and grasshoppers occur as frequently as, and probably far more frequently than, all the passages put together wherein the other orders are alluded to.

Locusts and grasshoppers, it may be remarked, are more exclusively the inhabitants of warm countries than is the case with any other leading order of insects. Every other tribe is numerously represented in Britain, even though the highest beauty of colouring, the greatest variety of species, and the largest number of individuals be found, and found only in the tropics. With us the locust is unknown, except as a very occasional, solitary, and migratory visitor in some very hot summer. Our native grasshoppers are now scarce in the Metropolitan district, are mostly small in size, and, as a rule, inconspicuous in colour. One notable exception to this description, however, is the *Phasgonura viridissima*, a large grasshopper, with its fore-wings of a grass green, as its name imports, widely distributed, but not very common, probably found more often on our South Downs than inland, and certainly far more frequent in Switzerland and in regions bordering the Mediterranean than with ourselves.

One has only to journey to Switzerland to find there a far greater variety of species of grasshopper, and also a much larger number of individuals of each species, than are ever seen here. And then one has only to cross the Alps, and almost before the descent into Italy is completed, the hum of the cicada, and the short and rapid flights of the locusts in the vineyards or among the myrtle and cistus, seemingly so spasmodic and erratic, sufficiently demonstrate that we are among the fauna of the scientific zone known as the Mediterranean littoral.

Wherein, it may be asked, lies the difference between a locust and a grasshopper? Not to dwell on structural divergence and anatomical differences, the great discrepancy in size may be instanced. It is probable, but I do not assert it as a positive fact, that the largest grasshopper only equals in size the smallest locust; it is certain that many locusts, those in particular tenanted Brazil, Australia, and other distant lands, are far larger than any grasshopper, and indeed ranking among the very largest insects, of any order whatever, known to us. Add to this fact the greater swiftness and power of higher and more sustained flight on the part of the locust, its occurrence in far greater numbers, and in well nigh innumerable hordes in the case of some species, and the proportionally destructive results where all vegetation is concerned. Only too true are the words of the prophet in Scripture, "The land is as the garden of Eden before them, and behind them a desolate wilderness." In fact, when the swarm has taken its flight elsewhere, the country appears as it had been burnt with fire; hence the Latin name of this insect, *Locusta* (from *locus ustus*, a burnt place), is peculiarly appropriate, on account of their voracity.

One great difficulty which the translators of our Authorized Version had to encounter, a difficulty, moreover, which they were incapable of removing, and in no way to be regarded as an error to be laid to their charge, was how to render all the different words in the original Hebrew, each certainly signifying a different orthopterous insect, whether locust or grasshopper, probably the former in most instances, as the destructive results recorded as attending its onward march are specially characteristic of the locust hordes—how, I repeat, to render all the different words in the original Hebrew by a separate English equivalent. And the same remark applies to the different Greek words as used in the Greek version of the Septuagint.

Let it be granted that as many different kinds of locust or grasshopper were known to the ancients, and were spoken of by the prophets as there are different Hebrew and Greek words in the original, and indeed we cannot arrive at any other conclusion, and that the three words of Joel i, 4, translated respectively palmerworm, cankerworm, and caterpillar signified the creature in its immature condition, the larva and not the imago of three separate species of locust, the translators of the A.V. had not then—we have not now, with the sole exception of two species—any corre-

sponding English equivalent. And, moreover, the Latin names of the different genera and species in common use among scientists did not then exist as we possess them. Besides, what avails it that all the Mediterranean species of Orthoptera or those elsewhere also have each its English and its Latin name assigned, when we have no means of determining, either now or hereafter, the particular species designated by each different Hebrew word? No characteristics, either superficial or structural, are given to serve as an aid whereby to solve the difficulty. All that we are enabled to state with any measure of confidence is that we know what two species were *Acridium peregrinum*, the locust of the plague of Egypt mentioned in Exodus x, verses 4 to 6, and again, verses 12 to 15, and *Truxalis nasuta*, in all probability the bald locust of Leviticus xi, 22. *Nasuta*, of course, means "with snout or proboscis," and the term "bald" may have been bestowed in consequence of its elongated neck, head, and snout being almost of one uniform size and thickness—no lateral enlargement of head or goggle-eyes, as in the case of other species; and in quoting Leviticus xi, 22, it will be *apropos* to remark that the said passage may well be regarded as a *locus classicus* whereon to ground some remarks about the inevitable difficulties that befel the translators of the A.V. Four species, we are therein told, were permissible as an article of food. "Even of these ye may eat; the locust after his kind, and the bald locust after his kind, and the beetle* after his kind, and the grasshopper after his kind."

What was the locust after his kind? Probably the locust of the plague of Egypt, *Acridium peregrinum*, as the species at once by far the most abundant and destructive and the one that the Israelites would be the most likely to encounter of the four species here recorded. What was the bald locust? Probably, from its singular shape, the *Truxalis nasuta* above spoken of, and which I myself have captured in Corsica and elsewhere.

What was the beetle after his kind? Certainly not a beetle at all. Apart from the fact that the large majority of Coleoptera would afford absolutely no nutriment whatever, that the epidermis of the large majority of Coleoptera is entirely horny, it is well nigh a certainty that the beetle

* Cricket, R.V., four kinds of locusts or grasshoppers which are not certainly known.

belonging to Coleoptera would not be introduced between two species of the tribe Orthoptera, namely, the bald locust and the grasshopper. What is doubtless intended is some other kind of locust. In the Hebrew the word is "Chargol," and in the Greek Septuagint ὀφιομάχης—as the beetle has not legs above its feet to leap withal, and the locust both was and is a common article of food in the East. Thus in St. Mark i, 6, we read of St. John the Baptist, "He did eat locusts and wild honey." Such locusts constitute a chief article of diet in the case of the modern Arab, as in the days of old. The head and tail are pulled off as with shrimps, and the creatures are frequently dried and grated to powder.

What is the grasshopper after his kind? It may have been rightly rendered by the translators of the A.V. "grasshopper," but it may also mean another kind of locust which would prove fully as serviceable for diet as any grasshopper, and the same Hebrew word "Arbeh," here translated *grasshopper*, is rendered "locust" in 2 Chronicles vii, 13.

Again, the locust after his kind in Leviticus xi, 22. Though, as I stated, it almost certainly designated *Acridium peregrinum*, "the locust of the plague," it may have included other species also, e.g., *Acridium tataricum*, a smoky brown species probably more widely distributed than *peregrinum* throughout the Mediterranean, but not occurring in such appalling hordes.

The Rabbis assert that there are 800 species of Orthoptera in Palestine. Modern travellers compute with far greater likelihood 40. Possibly some of the larvæ have been regarded as other species instead of the same kinds in an early and undeveloped state.

One other passage occurs in the Pentateuch relating to the locust, Deuteronomy (ἐρυσίβη, lxx) xxviii, 42, "All the trees and fruit of thy land shall the locust consume." The *trees* are likely to be devoured by the locust in its perfect or mature state, when its wings are fully developed. The *fruit of the land* would be liable to the ravages of its larvæ likewise.

Respecting *Acridium peregrinum*, "the locust of the plague," once more, I captured male and female of this species at Tangiers in a vineyard on June 1st, 1891, and dead ones in worn and dilapidated condition in the hedgerows, doubtless benumbed and killed by a recent change in the weather. Cf. Nahum iii, 15 to 17, "As the great grasshoppers, which camp in the hedges in the cold day." That there had been three incursions of the locust hordes already that year at Tangiers, and that a fourth was expected,

speaks most highly of the extraordinary fertility of the country, as in spite of all these serious drawbacks, the condition of the maize fields and vineyards which I beheld was most flourishing. I have also been sent specimens of *Acridium peregrinum* from Jerusalem. Both male and female have the upper wings numerously spotted with brown. The upper wings of the male are of a daffodil yellow; those of the female are browner. Of two other species also previously mentioned, *Acridium tataricum* and *Truxalis nasuta*, I possess specimens of the former from Lido, Solfatara, and Beyrout, and of the latter from Lido, Bellagio, Florence, Ajaccio, Jaffa.

The historical books of the Old Testament and the Psalms contain five passages relative to the locust, to wit, Judges vi, 5, "For they came up with their cattle and their tents, and they came as grasshoppers* (*ἀκρίς*, lxx) for multitude; for both they and their camels were without number: and they entered into the land to destroy it"; 1 Kings viii, 37, "If there be in the land famine, if there be pestilence, blasting, mildew, locust, or if there be caterpillar"†; 2 Chronicles vii, 13, "If I command the locusts to devour the land"; Psalm lxxviii, 46, "He gave also their increase unto the caterpillar,‡ and their labour unto the locust"; Psalm cv, 34, "Locusts came, and caterpillars,§ and that without number, and did eat up all the herbs in their land, and devoured the fruit of their ground." *Apropos* of Judges vi, 5, the migratory habits of Orthoptera would seem to be indicated, and in reference to 1 Kings viii, Psalm lxxviii, Psalm cv, and also to other passages in the Prophets, the *larvæ* of locusts would seem to be signified by *caterpillars*, caterpillars being mentioned in the same clause, or at all events the same verse, as locusts.

There are five passages in which the locust and caterpillar are so mentioned together. What the larvæ had spared, the matured and perfect insects destroyed, and then again the larvæ. To translate the young of the locust by the word caterpillar is apt to give rise to a misconception, as caterpillar is only properly used when it designates the rudimentary condition of the butterfly or moth. Larvæ, on the other hand, refer to the first stages of all orders of insects.

* Locusts in R.V.

† ἐρυσίβη, lxx, red blight in corn.

‡ ἐρυσίβη in lxx, red blight in corn.

§ Cankerworm in R.V., βροῦχος in lxx, but this is really a locust without wings.

The word "grub" is used more appropriately in treating of the undeveloped state of Diptera, Hymenoptera, Coleoptera. *Palmerworm* and *cankerworm* are also understood as implying larvæ of locusts in Joel i, 4, though *cankerworm* is by some understood to signify *centipede*. *Palmerworm* and *cankerworm* cannot assuredly be regarded as conveying the meaning of the original, and yet it is hard to see what other English renderings the translators could have devised to denote the young of two different species of locusts. The term worm, indeed, is employed in a very loose and indefinite way to denote several orders of organic creatures that have no connection whatever with one another, but is then properly made use of when it is applied to the earthworm of our gardens, *Lumbricus terrestris*, and is of course etymologically associated with such Latin words as *vermes*, *vermicularis*.

In Jonah iv, 7, we read God prepared a worm.* The meaning doubtless is either a centipede or the larva of a locust. Both these creatures attack fruit. An earthworm can hardly be intended, as that would only attack the root or fallen fruit. Indeed, it may fairly be questioned whether earthworm is designated in any of the numerous passages of Holy Writ where "worm" is mentioned, save and except in Micah vii, 17—"They shall move out of their holes like worms of the earth."† (But ὄφεις lxx.)

But to resume. In the writings of the Hebrew prophets the following passages seem descriptive of the habits of the locusts:—Isaiah xxxiii, 4—"Your spoil shall be gathered like the gathering of the caterpillar: as the running to and fro of locusts shall he run upon them." Jeremiah xlvi, 23—"They are more than the grasshoppers, and are innumerable." Jeremiah li, 14—"Surely I will fill thee with men, as with caterpillars." Jeremiah li, 27—"Cause the horses to come up as the rough caterpillars" (four passages in major prophets). N.B.—The vast numbers, the movements, and the gathering together of Orthoptera are here referred

* σκώληξ the word in lxx means earthworm, *Lumbricus*.

† Canon Girdlestone reminds me of the same word in Deut. xxxii, 24, "Poison of serpents of the dust," A.V.; "poison of crawling things of the earth," R.V. But why is the same word in original translated serpents of the dust in Deut., and "worms of the earth" in Micah? in A.V. "Crawling things of the earth" in R.V. is a nice little non-committing rendering. He that sits in the room of the unlearned will doubtless regard "worms of the earth" as earth worms.

to. Only in one passage, namely, Jeremiah li, 27, the rough caterpillars possibly indicate the larvæ of *Arctia caja*, the common tiger moth, popularly known as "the woolly bear," and not the larvæ of the locusts, from the term *rough*, *hairy*, employed. The hairs of said larva have urticating and irritating properties, and the moth is common over all Europe. On the other hand, if destructive numbers are indicated, the larvæ of the locust far exceed those of any species of moths.

On turning to the writings of the minor prophets, we find therein three passages descriptive of the locust, or to speak with greater accuracy, of the locust and the grasshopper alike, and moreover of the locust and of its larva too, and also of different species of locust, both in the perfect and in the larval condition, *e.g.*, Joel i, 4—"That which the palmerworm (*κάμπη*) hath left hath the locust (*ἄκρις*) eaten; and that which the locust hath left hath the cankerworm (*βροῦχος*) eaten; and that which the cankerworm hath left hath the caterpillar (*έρυσιβη*) eaten." Amos vii, 1, 2—"Thus hath the Lord God shewed unto me; and, behold, He formed grasshoppers (locusts R.V.) in the beginning of the shooting up of the latter growth; and, lo, it was the latter growth after the king's mowings. And it came to pass, that when they had made an end of eating the grass of the land, then I said, O Lord God, forgive, I beseech Thee: by whom shall Jacob arise? for he is small." Nahum iii, 15-17—"Then shall the fire devour thee; the sword shall cut thee off, it shall eat thee up like the cankerworm: make thyself many as the cankerworm, make thyself many as the locusts.* Thou hast multiplied thy merchants above the stars of heaven: the cankerworm† spoileth, and fleeth away. Thy crowned are as the locusts, and thy captains as the great grasshoppers, which camp in the hedges in the cold day, but when the sun ariseth they flee away, and their place is not known where they are."

N.B.—The *forming* of grasshoppers recorded in Amos vii, 1, 2, is an interesting scientific fact revealing a state and degree of knowledge one might hardly have expected at that early period. Amos, it is true, owing to his vocation

* lxx βροῦχος; both locust and cankerworm rendered βροῦχος, wingless locust, ἄκρις rendered grasshoppers both in A.V. and R.V.

† lxx βροῦχος ἀτέλατος, a locust without wings in classical Greek.

as a herdsman and a gatherer of sycamore fruit, enjoyed exceptional facilities for observation of external nature.

Orthoptera, as it happens, of all the leading tribes of insects are the only one that increase in size and development of wings in the mature state, and this development in Italy and the warm lowlands of Switzerland is not completed till early September. Now, be it carefully noted that Amos does not only record the development of Orthoptera in the imago condition, but he also particularizes very carefully the exact period of the year when that development took place. The seer twice reiterates the same truth, that it was when the season was well advanced. The beginning of the shooting up of the latter growth—the latter growth, after the king's mowings, *i.e.*, the second hay crop, termed rowing in Hertfordshire, and aftermath in the north of England.

The Faroe Isles, so far as I am aware, constitute the northern limit of Orthoptera, and only one orthopterous insect, *Forficula auricularia*, the common earwig (itself one of the most rudimentary forms of the extensive family to which it belongs), is found in that archipelago. I took occasion to assure myself by testing the development of the earwig in the Faroes by collecting the *Forficula* from the blossoms of *Caltha eu-palustris*, which it had gnawed nearly down to the calyx, when my steamer anchored off the Faroes on her voyage to Iceland, and by capturing other specimens in the same place on my return thither five weeks later, and marking the increase of size in the interval. The locusts that according to Revelations ix, 3, came out of the smoke upon the earth may be only metaphorically so, with hair of women, teeth as of lions, crowns of gold, and stings of scorpions—at all events unlike any species now known to science.

There are seventeen passages in all in Holy Writ referring to Orthoptera.* And as far as we can infer nine species of locust are intended, though even as regards this assertion some uncertainty prevails because the same Hebrew word *gob* is rendered locust by our translators in Isaiah xxxiii, 4, and is rendered by them grasshopper in Amos vii, 1.

* More than this number, probably between twenty and thirty, but some of the remaining passages are not so graphic and descriptive as those here quoted.—F. A. W.

Then, again, *yelek*, the Hebrew word denoting licker of the grass, obviously denotes thereby the larva of a winged species of locust, and its mention occurs in five passages of the O.T., to wit, Joel i, 4; Nahum iii, 15; Psalm cv, 34; Jeremiah li, 14, and again in verse 27. In two of said passages it is translated cankerworm, and in the remaining three caterpillar—both renderings being erroneous.

To add to the confusion the Hebrew *yelek* is rendered *βροῦχος* in the Greek Septuagint, but the Hebrew *arbeh* is also rendered *βροῦχος* in the Greek Septuagint when in Exodus x the locust of the plague is mentioned, whereas two different Hebrew words, *yelek* and *arbeh*, are probably used on purpose to denote two different species of winged locust; and to add still further to the confusion *βροῦχος* is the very word used by Greek classical writers to signify the wingless locust, *Callimenus oniscus*, a species with which I am personally familiar, having captured it on the aromatic undergrowth of myrtle or cistus along the road to Marathon. It is a very handsome kind when alive, having broad bands of velvety black across a ground colour of apple-green, but as a cabinet specimen unfortunately rapidly fades to a uniform dusky brown, and is indebted for its Greek specific name *ὄνισκος*, a little ass, to the long curved shape of the dorsum, resembling that of a beast of burden.

Then, again, the word *arbeh*, rendered locust in Exodus x, and locust again in 2 Chronicles vii, is translated grasshopper in Leviticus xi, and grasshopper again in Judges vi. The Hebrew word *chasil* of Psalm lxxviii, 46, means a “consumer.” As it is included with the locust in that verse, it probably means the larva of the locust; in the A.V. it is translated caterpillar. The Hebrew word *gazam* of Joel i, 4, is translated palmerworm in the A.V. and appears as *κάμπη* in the Greek Septuagint.

Now *κάμπη* is a larva, and the word signifies not the larva of a locust, which is doubtless what the prophet intended, but the larva of the tribe of moths known as Geometridæ, which bends up its back to move, and hence its name of *κάμπη* (from *κάμπτεω*). *Chagob*, the Hebrew word in Leviticus xi, is generally rendered grasshopper and once locust. In the Greek Septuagint it is translated *ἄκρις*, which probably means grasshopper, but *ἄκριδες*, the plural of *ἄκρις*, signify locusts in Greek classical writers.

Additional matter might be adduced on this head, but what has already been stated will probably be regarded as

sufficient to demonstrate the difficulties arising from the same word being used indifferently to denote two or three species, or the same word being used indifferently to signify both the larva and the perfect insect, or the same word being employed for one kind in the Greek Septuagint, and another species in classical Greek. English is not so rich as Greek in the possession of many words only separated in signification from one another by delicate shades of meaning, and there is also another reason why the Greek Septuagint and the Hebrew originals should alike have many words at command to designate the Orthoptera of Scripture. It is almost certain that all the kinds recorded occur in Greece as well as in Palestine.

Nearly all the countries bordering the Mediterranean bear a remarkable resemblance to one another in many particulars of geology, botany, and insect fauna. But hardly a single species of the said Orthoptera occurs in England, and therefore could not have been familiar to the translators of the A.V. or be recognized on their part by a distinctive appellation in consequence.

I may instance in conclusion the locust of Deuteronomy xxviii, 42, for which the Hebrew word is *tzelatzal*, "the tinkler;" a word applied to the locust from the noise of its wings, and evidently formed to signify the sound that the creature makes. The late Professor Westwood regarded it as evidently from the name identical with the *Tsalsalya* or zimb of Bruce, the well-known traveller in Abyssinia. Most words coined to express the hum of insects commence with *Ts*, *Tz*, or *Z*.

To revert once more to the passage concerning grasshoppers in Amos vii, in verse 2 we are told, "And it came to pass, that when they had made an end of eating the grass of the land," what then? Are we to infer that they arose on swift wing, and betook themselves on high, afar, to pastures new? Aquatic Coleoptera are supposed to be provided with wings, that if their pond be dried up in time of summer heat, they are thus enabled to fly off to other waters. So we discern the import of the prophet's question, "By whom shall Jacob arise? for he is small"—he has no wings, he is as yet undeveloped, in other words he cannot raise himself.

On referring to the Rev. J. G. Wood's account in *Bible Animals* of the locust, pp. 596 to 604, and which I did not consult until I had drawn up my own observations already recorded, I conclude that his facts agree with mine in all

essential particulars. He rightly states that the Hebrew word *arbeh* (p. 597 of his book) occurs many times in the Scriptures, and aptly describes the locust as regards its vast multitudes, its sudden arrival, and its destructive power, and that even if there were any doubt about its signification, the context would be sufficient to denote its proper rendering. We are also at one as regards the statement that "*chagab*" is rendered both grasshopper and locust and mostly translated as the former. The inference that the author draws is doubtless correct when he says it seems to have been less in size than the *arbeh*, inasmuch as it is used as a metaphor to express smallness. See, for example, Numbers xiii, 31-33, where is recorded the false report of the spies whom Moses sent to inspect the land. The men who went up said, "We be not able to go up against the people; for they are stronger than we. And there we saw giants, the sons of Anak, which come of the giants: and we were in our own sight as grasshoppers (*chagabim*), and so we were in their sight." A similar metaphor is employed by the prophet Isaiah, "It is He that sitteth upon the circle of the earth, and the inhabitants thereof are as grasshoppers" (xl, 22) and in Ecclesiastes xii, 5, extreme weakness is forcibly indicated by the words, "The grasshopper (*chagab*) shall be a burden."

I am not so certain that I can concur with the author in his observation which immediately follows:—"Now the two principal species of locust which travel in bands and devastate the country are the common migratory locust (*Edipoda migratoria*) and the *Acridium peregrina*. If, therefore, the word *arbeh* expresses one of these insects, it is probable that the word *chagab* signifies the other." But by his showing *arbeh* is probably a larger species than *chagab*; the one a locust, the other a grasshopper. And as far as my own very imperfect knowledge goes, the two kinds, the migratory locust and the locust of the plague of Egypt, are of about the same size. Then, too, he has bestowed on the migratory locust the generic name of *Edipoda*, which may possibly be correct, but which title I had thought was confined to a genus of grasshoppers. That the genus of grasshoppers known by that name occurs in Palestine as elsewhere along the Mediterranean I am well aware, and it has received that appellation from a certain thickening in the joints of its legs, and the mythical hero *Edipus* is commonly reported to have sustained a swelling of the knee joints owing to his

having been exposed in infancy on the slopes of Mount Cithæron.

The following description of the appearance and habits of the locust, p. 599, by the same author is so graphic and true that I feel constrained to give it *in extenso* :—

“The appearance of a locust when at rest and when flying is so different that the creature is at first sight scarcely recognizable as the same creature. When at rest, it is a compact and tolerably stout insect, with a dull though delicately coloured body; but when it takes flight it appears to attain twice its previous dimensions. The front pair of wings, which alone were seen before they were expanded, became comparatively insignificant, while the hinder pair which were before invisible, became the most prominent part of the insect, their translucent folds being coloured with the most brilliant hues, according to the species. The body seems to have shrunk as the wings have increased, and to have diminished to half its previous size, while the long legs that previously were so conspicuous are stretched out like the legs of a flying heron.

“All the locusts are vegetable feeders, and do great harm wherever they happen to be plentiful, their powerful jaws severing even the thick grass stems as if cut by scissors. But it is only when they invade a country that their real power is felt. They come flying with the wind in such multitudes that the sky is darkened as if by thunder clouds, and when they settle, every vestige of green disappears from off the face of the earth. Mr. Gordon Cumming once saw a flight of these locusts. They often wheel three hundred feet from the ground, and come on in thick solid masses, forming one unbroken cloud.

“On all sides nothing was to be seen but locusts. The air was full of them, and the plain was covered with them, and for more than an hour the insect army flew past him. When the locusts settle, they eat with such voracity that the sound caused by their jaws cutting the leaves and grass can be heard at a great distance; and then the young locusts, which have no wings and are graphically termed by the Dutch colonists of Southern Africa ‘voet-gangers,’ or foot-goers, are little inferior in point of jaw to the fully developed insect.”

As long as they have a favourable wind, nothing stops the progress of the locusts. They press forward just like the vast herds of antelopes that cover the plains of Africa, or the

bisons that blackened the prairies of America, and the progress of even the wingless young is as irresistible as that of the adult insects. Regiments of soldiers have in vain attempted to stop them. Trenches have been dug across their path, only to be filled up in a few minutes with the advancing hosts, over whose bodies the millions of survivors continued their march. When the trenches were filled with water, the result was the same; and even when fire was substituted for water the flames were quenched by the masses of locusts that fell into them. When they come to a tree, they climb up it in swarms, and devour every particle of foliage, not even sparing the bark of the smaller branches. They ascend the walls of houses that come in the line of their march, swarming in at the windows, and gnawing in their hunger the very woodwork of the furniture.

Nothing can be more vividly accurate than the splendid description of the locust armies (Joel ii, 2-11). First we have the darkness caused by them as they fly like black clouds between the sun and the earth. Then comes the contrast between the blooming and fertile aspect of the land before they settle on it, and its utter desolation when they leave it. Then the poet-prophet alludes to the rushing noise of their flight, which he compares to the sound of chariots upon the mountains, and to the compact masses in which they pass over the ground like soldiers on the march. The impossibility of checking them is shown in verse 8, and their climbing the walls of houses and entering the chambers in verse 9.

Modern travellers have given accounts of these locust armies which exactly correspond with the sacred narrative. One traveller mentions that after a severe storm the locusts were destroyed in such multitudes that they were heaped in a sort of wall, varying from three to four feet in height, fifty miles in length, and almost unapproachable on account of the odour of their decomposing bodies.

The remainder of the chapter on locusts in *Bible Animals* (the whole of which well deserves perusal by all present on account of its fidelity and its numerous quotations from various authors, sacred and profane, ancient and modern, in reference to the locust) relates to the use of locusts as food. Notice has already been made of the Israelites, whose dieting was so scrupulously limited, having been permitted the use of the locust.

Herodotus, when describing the various tribes of Libyans,

mentions the use of the locusts as an article of diet and the way in which the said creatures are prepared for food by the Nasamcnes.

Palgrave, in his *Central and Eastern Arabia*, gives a description of the custom of eating locusts.

Mansfield Parkyns, in his *Life in Abyssinia*, mentions that the true Abyssinian will not eat the locust, but that the negroes and Arabs do so.

Signor Pierotti, in his *Customs and Traditions of Palestine*, states that locusts are really excellent food, and that he was accustomed to eat them, not from necessity, but from choice, and compares their flavour to that of shrimps; and Dr. Livingstone makes a similar comparison.

The article in the *Encyclopædia Britannica* on locusts may also be read with profit (vol. xiv, pp. 765-767), and which contains well executed figures of some of the most destructive species, to wit, *Pachytyles migratorius*, *Acridium peregrinum*, and *Calopterus italicus*, and the paragraphs on Orthoptera in Kirby's *Text Book of Entomology* should similarly be consulted.

DISCUSSION.

The CHAIRMAN.—I think we are all indebted to Dr. Walker for his interesting and learned paper, and particularly so as many of the insects referred to are illustrated before us by his own specimens.

I hope there are some present who will be able to further pursue the subject. May I ask Mr. Kirby if he will give us any remarks on the subject that may occur to him, as he has authority on the matter?

Mr. KIRBY, F.L.S.—I may say that I have listened with much interest to Dr. Walker's paper. There are a few points upon which I may be able to throw a little more light.

In respect to "grasshopper" and "locust" the terms are popular and almost synonymous. Popularly the smaller insects are called "grasshoppers" and the larger ones "locusts." There is really no very definite distinction between them—the former having long antennæ, or feelers, and the other, short ones.

I am not sure whether any list is published of the Orthoptera of the Faroe islands; but certainly there are a good many found in Lapland.

Locusts do not appear to be destructive in proportion to their size. The very large South American locusts, of which there are specimens before us, as far as I know are not noted for being specially destructive. Those large red specimens are about the largest, but they grow larger than that, and some of them are still more beautifully coloured; but I have not heard that they are specially destructive. Those which Dr. Walker refers to as most destructive in Southern Europe and Africa are of medium size, but there are two smallest species which are specially destructive. One is a locust which is common in the Mediterranean, but is especially destructive in Cyprus, and the other is the Rocky Mountain locust of North America. As far as I remember neither of these measure more than about two inches across the wings.

The SECRETARY (PROFESSOR EDWARD HULL, M.A., LL.D.).—I think, Mr. Chairman, that the special interest of Dr. Walker's paper lies in its endeavour to interpret the terms "locust" and "grasshopper" as they are used in Holy Scripture. One can well understand the extreme difficulty that the authors of the Revised Version must have had in dealing with these Hebrew and Greek terms for insects. It is something like the difficulty that the authors of the Authorized Version must have had in dealing with the names of precious stones. I once, at the request of some publishers, wrote an essay on the precious stones of the Bible, and I must say when I came to endeavour to discriminate between one kind of precious stone and another I was non-plussed in many cases, and a similar difficulty must have been present with the authors of the two versions.

It is a great misfortune, I think, that although the authors of the Revised Version were men of great eminence in classical knowledge, yet I do not know that they were advised when dealing with the names of special animal or vegetable forms. We do not know whether they were or not; but it occurs to me that probably they were not, and that they rested a great deal upon what might be called the ordinary sense, or at any rate on the meaning of the particular word, as inferred from the context.

I feel sure that in several cases Dr. Walker has thrown

considerable light on some of these names. The "palmerworm," and the "cankerworm" no doubt, as he says, mean the grub or larvæ of certain kinds of locusts; and I hope that this paper will prove of advantage to those who study these critical points of the natural history of Holy Scripture.

I am much obliged to Dr. Walker for having brought the subject before us. I never knew the origin of the word "locust" before, but it is very clear now that it has been explained by the learned author.

Professor LOGAN LOBLEY.—I am glad that Professor Hull has called attention to the difficulty arising from certain words that are used in the modern versions of the Bible, whether the Authorized or the Revised Version. We find such a word as "jasper," for instance, which is used very often in the Bible, and that evidently, from the context, means something transparent and brilliant. Now we know that jasper is neither transparent nor brilliant. It is really a most opaque form of quartz, and until you put upon it a high polish it has no shine or lustre whatever; and yet the term "jasper" is used in the Bible to signify something which is resplendent. That is an illustration of the want of scientific knowledge on the part of the translators of the Bible. That cannot be charged to them as a fault of course, for they had not that scientific knowledge when the Bible was translated which is common now, but still it is a warning to us not to take everything we find in the present version of the Bible just as we see it according to ordinary language now used. We must remember that the ancients used language that was appropriate to their knowledge, and that the language of the Bible now is only appropriate to their knowledge so far as the translators understood it.

Mr. MARTIN ROUSE.—I should like to say that having looked up many of the Greek names of various stones, although I have not the technical knowledge that Professor Hull possesses, I find that jasper, or *jaspis*, is compared to grass by at least three authors in the Greek classics, and so we find in the dictionaries; and therefore *jaspis* did convey to the mind something most restful, as well as beautiful; and the appearance the stones forming the foundation of the Holy City, and the light of it, are said to be like jasper, that is to say a beautiful clear green, like sunlight shining through the leaves of a spring day. That is the meaning of

the Greek word *jaspis*; but we, in course of time, have changed the application of the English word jasper and have applied to it the name of opaque quartz.

Mr. D. HOWARD, D.L.—I think we find that there was a curious tendency on the part of the early settlers in America to apply convenient names to the birds and plants they found there, and the chief thing of which we may be perfectly certain as to the popular names of plants or birds which they bear is their singular inaccuracy, and one must not be surprised if a Greek coming into a country where they speak Hebrew proceeds to apply a handy Greek word which might mean something totally different. It is one of the most difficult things to be quite sure what a very familiar word means. I sometimes think the more familiar a word is the more likely it is to be misleading.

Mr. KIRBY.—I meant to mention that the word locust is frequently applied popularly and, of course, entirely inaccurately to the *Cicadidæ*. They of course belong to a totally different order of insects, and have nothing to do with grasshopper or locust; but they are called locusts in the United States popularly and also in Australia, I believe.

Mr. HOWARD.—It is a handy word for a new insect.

Mr. MARTIN ROUSE.—When you said, Mr. Kirby, that you did not know of that large South American locust being destructive did you mean that there were no locusts that were destructive in South America, or that that was not one simply? Because I was thinking, from the description I read of the *Voyage of the "Sunbeam,"* of an enormous flight of locusts, probably bent on mischief, passing over the country and described by Lady Brassey, which were seen from a comparatively low height, with the sun shining above them making them look as if they were burnished gold.

Mr. KIRBY.—They are very destructive sometimes in Buenos Ayres and some parts of South America, but I never heard that those very large locusts which are found more in the northern parts of the country were specially destructive or that they migrated.

Mr. MARTIN ROUSE.—It would be a smaller sort then?

Mr. KIRBY.—Yes; I think so.

Rev. F. A. WALKER.—I think those large ones come from Brazil, but they may be in Buenos Ayres as well.

The CHAIRMAN.—I will now ask Dr. Walker to reply.

Rev. F. A. WALKER.—I am much obliged, in the first place, to

my friend, Mr. Kirby, for the very kind notice he has taken of my paper, and for the very indulgent way in which he treated any possible error in it.

I know there is a tribe of Orthoptera with long antennæ and another with short. One of the specimens with long antennæ I have here (*Phasgonura viridissima*), the largest grasshopper we have in our country; and here are Swiss specimens of the red and blue. The red and blue variety is one species called *Edipoda fasciata*, from a black band round the hinder wings, and it has a thickening of the knee joint. Some say they are of different tints in different positions, the red in the vicinity of autumn leaves and the blue occurring on blue clay or marl for self-protection.

Mr. MARTIN ROUSE.—How far can locusts fly without alighting?

Rev. F. A. WALKER.—Further than the length of this room. You should ask Mr. Kirby that question.

Mr. KIRBY.—I am afraid I cannot say positively. I do not know that there is any positive record on the subject.

Mr. MARTIN ROUSE.—You would make a distinction between locusts and grasshoppers—that locusts fly much further. I did not know whether their flight was caused voluntarily or whether sometimes by a strong wind; as it says in the Bible, “God caused a strong east wind to blow and locusts were brought by it.”

Rev. F. A. WALKER.—They can certainly fly across a wide road and as high as this room and up into trees.

Mr. MARTIN ROUSE.—We think of them coming in clouds from a great distance and blocking out the light. We read of it.

Rev. F. A. WALKER.—Their ordinary flight, when not frightened, is about the height of 15 feet for about 20 or 40 yards, and then they come down. I daresay if the wind set their way, or they were frightened, they could go much quicker and further. That is the flight I have seen them take. About the height of this room for 20 to 40 yards when they start from under your feet.

The CHAIRMAN.—I am sure we offer our cordial thanks to Dr. Walker for his paper. [Applause.]

The Meeting then adjourned.

absolute distinction—at least I venture to take this view—between Matter that is *living* and Matter that *does not live*.

Now, one has to bear in mind that the part of a living organism that is *alive* is, in proportion to its whole weight, something very small indeed—almost, in many cases, infinitesimal in comparison. Another point of great consequence is that there is no separate living particle in most animals and not one in man, that is much more than one two-thousandth part of an inch in diameter, and the greater number of living particles are less than this. In the smallest insects and in the very lowest organisms, it is doubtful whether the one five-thousandth part of an inch will not represent the dimensions of the largest distinct separate individual particle of living matter that can be obtained and examined, while the lowest protozoa, fungi and bacteria being still more minute, the individual living particles will be too small to be visible by the aid of any magnifying power yet obtainable.

In man and in the higher animals, life depends—not on the great part of the body which we can see, but upon those minute living particles which exist in all the tissues and organs, and which from their origin to their death live in darkness, and to the extent not only of hundreds or thousands, but millions. There are millions of these separate living particles in everyone of us. Most of them are well protected in the positions where they have grown. They are not in close contiguity, nor do they run into each other, but they are separate. They are arranged at an early period of development in collections or groups. In the germ stage, they grow and multiply enormously as development proceeds. If you study any particular tissue soon after death, you will be surprised at the enormous number of these little particles of living matter among the tissues, everyone of which has been formed from, and by, them. These particles used to be called “cells,” but it has been impossible to give an exact definition of a “cell,” and everyone who has attempted to do so, has failed. The original idea of “cells” was that they were like the bricks in a wall, but that is not so—for nothing in living organisms is arranged or built up, as it used to be said, like bricks in a wall. Every part *grows*.

Each little particle or so-called “cell” consists of matter in two distinct states—*living* and *not living*. In many cases there is an outer covering or envelope, which is permeable to air and moisture—and *within* this envelope is the *living*

matter. It is the living matter which has *formed* the envelope which is no longer living.

In many of the lower creatures and in plants that live in water, small particles of living matter derived from previously existing living matter may escape into the water; and the first thing that happens, is that a thin layer of the surface dies and becomes the so-called "cell wall." This protects the living matter within, which may go on growing for a considerable time. The envelope, as in many of the microscopic fungi, may gradually increase in thickness until a strong protective covering is formed like the capsule of a seed. In all, this covering, or envelope, is outside; but it is not deposited from a solution, or from substances *around it*, as in the case of the accumulation of a deposit or enlargement of a crystal, but the thickening is *always from within*. The *oldest*, the part of the envelope which was first produced, is *outside*.

If you consider the enlargement of a stone or a snowball, with which cells have been compared, the last part deposited, is that which is *outside*. You see then the absolute difference between what only can correctly be called *growth* in the *life world*, and *aggregation* or *deposition* or *precipitation* which occur in the non-living world. Herbert Spencer, years ago, advanced the doctrine that growth was a kind of deposition, but this is not so, and cannot be. In life there is always matter in an exceptional and peculiar state, *living matter*, or *Bioplasm*, from, and by which everything in living nature is formed. Years ago, when I brought forward the question of the nature of *life* and *growth*, and *formation*, I spoke of *germinal matter*; because the living substance universally present in every living organism like that in every "germ," is *alive*. *The material which was formed* from it but is *not living*, was termed, "*Formed material*." So you see that even in a single "cell" we are not dealing with living matter only. In all cases, we have a certain proportion of living matter within, which is protected by a thin membrane or layer of tissue, which in some cases becomes very thick, but all of which was *formed* from the living matter. This is outside, and it is never living.

This protective substance especially when thin, performs the office of a filter. Everything that is taken up by a living thing for nutrition is dissolved, and when the solution passes through the membrane, the access of solid particles is prevented, so that they do not come in contact with the living

matter. Of course there are very important and deep scientific questions that have been, and may be suggested as regards the state of the living matter which receives the solution of non-living nutrient substances—and there is room for difference of opinion. The nutritive matter in solution certainly passes through the “cell wall,” and actually “into the substance of the *living matter* of the cell.”

The living power or *Vitality* is the factor which selects from the water certain appropriate substances and causes their elements (?) to change their position and to be differently arranged. The elements being brought into new relations with one another, are so arranged that new living matter *immediately* results. Life power seems to be imparted by the already existing living matter, but without change in, or loss of its power, and some of the non-living matter *which was* in solution *lives*. The arrangement, as it seems to me, really depends on what we call *living* or *vital power* only, the actual nature of which has not yet been ascertained, and I do not know how it is to be discovered. You cannot isolate *life*, or separate it, or examine it, or investigate it, or study it, or cause it to change its form or mode, as you can heat, light, electricity, magnetism, etc. You can only judge by what vital power has effected. You can analyse the material which passes into living matter, and you can make out its composition by chemical analysis, but as soon as it gets into the *living matter*, it is changed—it *lives*—and then, if you try to find out what *living matter* is composed of you fail. *In fact the first thing you do is to kill it.* Some physical philosophers have said, the “protoplasm” consists of so and so, but I answer:—“the material you examine is *lifeless*, and is produced at the death of the living matter, and certain *non-living* substances result.” It is impossible to say what is the composition of living matter, because you cannot test it *without* first destroying its life, and therefore what you test is not living matter but only the substances which result from its death.

Now, I may venture to consider the question of water which is present in *every living particle in nature*? I hope some day, when there may be time, I may be permitted to offer some remarks on the broad question of air and its service to *life*. Water is a very broad question indeed, and I do not think it has been adequately considered during the past fifty years, in its relation to life. No living matter can exist—no living matter can be produced or originate—no

matter that is alive, can continue to live in the absence of water; and I think we may go so far, as to say, that throughout the whole world of life water is an absolute necessity. I will not go into the question of the origin of water or of life just now, for there is so very much to be said in regard to all living things *as they are—as we see them*—that it would be a pity to attempt the consideration of the much larger question of how they came to be, and I shall say nothing in reference to the question of the creation of life or of matter or water. Air and water must have existed at the moment when, or before, any living organisms appeared on this earth.

Now, think of the driest tissues of the body we can select; for example, the nails, the hair, the teeth, or the oldest part of the enamel or dentine of our teeth, or that of the ivory of an elephant's tusk, or piece of shell fully formed. All these textures are not only *not* living, although belonging, and of great importance, to the living organism—but they may have been lifeless for many years. They cannot increase or grow. They cannot produce more tissue of the same, or any other kind. Nail will not produce nail, hair develop hair, or the hard tissue of teeth give rise to tooth structure. All these things have *grown* and have been *formed* by, and from living matter. Not only so, but the whole of the material of the teeth, the material of the enamel, hard as it is, and the hard matter of the shell, was dissolved before their conversion into dentine or enamel, ivory or shell. Before the enormous tusk of the elephant began to assume the hard state, every particle of the hard matter must have been in solution. The phosphate and carbonate of lime and other inorganic, as well as organic matters, are selected by the living particles from their solution, and caused to assume definite form. Before the matter became part of the elephant's tusk—before it became part of the matter of the enamel of teeth, which is as hard as shell, and shell itself, it must have been taken up by structureless living matter which consists principally of water. Even the hard matter of the enamel of our teeth, must have been taken up by the particles of soft living matter, by which also, the solution was caused to flow towards each living particle, the inorganic matters being then deposited in the organic structure already formed by the living particles, and now ready for calcification. Dry and hard tissues composed of organic matter like horn, hair

and feathers, which, in their fully formed state, contain very little moisture, were all produced by moist living matter. Every part of the dry feather of every adult bird, just before each moulting period, was in the state of soft living matter, consisting principally of water, and so with horn, hair, nail and all other like structures in nature. But for the soft structureless living particles, the production of these tissues would have been impossible, so that, after all, the whole process seems to be comparatively simple. Certain materials are deposited in certain forms, and often in the most beautiful patterns, in some extremely minute organisms, and yet all these materials were at first dissolved in water and then taken up by the living matter of the particular living tissue, whatever it is destined to be, and arranged in its previously determined ultimate form. Thousands of diatoms can be identified and classed, according to the predetermined arrangement of the silicious particles, which is effected by the living matter of each class and species. These hard tissues, the hardness of which depends on organic or inorganic matter, exhibit widely different structures. The hair has a structure of its own; but not only so, but the hair of almost every hairy animal known, can be distinguished and identified by its microscopical characters. The external skin of insects, animal and vegetable hairs, and all such tissues were formed by living matter rich in water. Though our teeth *look like* the hard matter of shell, anyone seeing a thin section under the microscope would at once discover the difference from shell, ivory, and other structures. The difference of structure depends not on the properties of the material of which in its fully formed state it consists, but on the *Power* of the living matter by which alone its formation was rendered possible.

As I have remarked, a great many tissues are dry—we may almost say, perfectly dry in their fully formed state. Think of the wing or the very hard coriaceous outer covering of the body and legs of a butterfly or a beetle. The delicate muscles and far more delicate nerves within the dry outer sheath are all moist, and so indeed are they in not only in all classes of insects, but in all organisms. An acting dry nerve or muscle, is a thing unknown and impossible in nature.

It will be interesting, perhaps, if I may very briefly refer to the great and most wonderful changes which take place in the formation of an insect. From the moist matter of

the egg comes a larva, and this larva contains much water and is soft and moist, and possesses nerves and muscles, and many most elaborate organs and tissues, not yet half investigated. The larva eats voraciously and grows, but though it is an imperfectly formed immature thing for some time, its tissues are most perfect and its movements most delicate and wonderful. Sooner or later, it passes into a state of comparatively passive living existence as a chrysalis or pupa, which remains, sometimes for many months, as it is said, in a "dormant" state, within its dry outer envelope. But the living growing substance of the chrysalis is very moist and in many instances quickly undergoes the most wonderful *vital changes*.

Almost the whole of the inside of the chrysalis consists of moist living matter. The tissues which are gradually being formed are totally different in every respect from those of the larva, grub or caterpillar. These tissues become very distinct as the time for the great and final change approaches; when at last what is in fact a new creature with organs, structures, and powers different in nature, and even in the principle of living action, is evolved, and sees the light. In short, after wonderful constructive changes have been going on for some time, the various structures of which the imago, or final stages of the butterfly or beetle, or other insect, appear in perfection. The air tubes by which the insect breathes, the muscles, nerves and the more complex organs and structures of the imago are all developed in the chrysalis stage. An insect has no lungs, the air is conveyed to the ultimate parts of the different tissues direct, by little tubes or tracheæ, which open on the external surface of the insect. The air is drawn in and passes through these tubes, which extend to every part of the tissues and organs, by the movements of the body, and thus the fluids and tissues in all parts of the organism are supplied with air. The air is in fact taken direct to the tissues. In the act of breathing in the vertebrate animal and man, on the other hand the air is taken up by the blood as it traverses the blood vessels of the lungs, and after passing to the heart, the ærated blood is distributed to all parts and tissues by means of the systemic vessels. The air is dissolved by the blood, and the oxygenated fluid filters through the thin walls of the capillaries, and thus reaches all the different organs and tissues of the body.

Every part of the active living matter is moist and

receives all its nourishment dissolved in water. Nothing that is perfectly dry, lives. The scales of the butterfly's wing, the wings of beetles, flies, etc., and the hard external covering of the legs and claws of insects are dry, but the muscles and nerves, concerned in every movement and in every part that is moved, are always moist. The particular muscular movements and the degree of movement, as is in other creatures, depend entirely on the nerves, and nerve centres which are invariably moist.

It is the nerve, "current," which starts from the living matter of the nerve-centre, that determines and regulates the rapidity and degree of contraction of every muscular fibre. The anatomical arrangements are indeed very complex, but all nerve action is in its nature *vital*, and not to be accounted for by physics: but I must not attempt to discuss further this part of the question this afternoon.

With regard to plants, the proportion of water to the solid matter, especially in the growing state, is enormous. Many succulent vegetables, when fresh, probably consist of as much as nine-tenths of water, and the quantity of actual solid matter in leaves and flowers when dried, is very small. The power of growth in vegetables, as we all know, is wonderful. If you look at the growing extremities of a root as it makes its way through the moist soil, you always find the tissue very soft from containing much moisture. The active growing extremity of every rootlet consists, indeed, principally of water: but, nevertheless, this soft delicate growing part of the root may gradually make its way, as we all know, into furrows or fissures in rock, and even penetrate through some hard substances, and continuing to grow in a moist fissure, it may split very hard wood or even stone, or a very heavy mass may be lifted up. It has been thought that all this active pressure depends on simple imbibition, but no imbibition or absorption of water, as by a porous substance, will account for the facts. A piece of dry wood driven into a chink in a stone, and then caused to absorb water, will perhaps split the stone; but this is a process very different from that of the pressure exerted by a continually growing root or other part of a plant. By the force of vigorous living growth a stone weighing a hundred-weight or more may be forced out of its place. Some of the huge gourds of America exhibit this enormous power of growth in a remarkable manner.

Seeds, you may say, are surely *dry*. But this is only true

to a limited extent. Examine carefully the capsule or husk of a seed, and you will find its structure well calculated to resist for a considerable time external changes in temperature and moisture. Study the *growing* seed, and it will be found to contain much water in its living growing part. The shell or capsule, which exhibits great differences of structure in various kinds of seeds, is very striking. After being fully formed, the seed and its protective capsule gradually become dry, and if you carefully moisten it, you may discover several layers of different structure, one within the other. Each layer consists of a number of little so-called "cells," each cell in the dry state of each layer contains air. One cannot easily imagine anything better as a non-conductor than this arrangement of the "cells" of the capsule, by which the seed is protected for a time from heat and cold, and its living germ preserved from action, it may be, for a long time. But the seed, when kept moist or placed in water, will gradually imbibe it, but the capsule in its dry state would keep out the water for months. In some cases a long time passes before it is moistened. The living embryo may, in fact, for a long time be kept from becoming too dry or too moist in very dry, hot, or cold, or wet weather, by the remarkable structure of the layers of its capsule. The common cocoa-nut is a seed on a gigantic scale. Remove the very thick outside shell, with its thick fibrous layer beneath, and you come to a shell as hard as ivory, dead and most *impermeable*. Within this is a thick layer of moist firm tissue, which, as we know, may be eaten, and within this is the so-called "milk" containing much water. The life of the germ may be preserved without much change for weeks, months, or years, and in some cases probably for many years. I do not know that we can exactly fix the limit of life in many instances, but there is something connected with the small vital germ of the seed by which this is determined, for different germs may live in a quiescent state for very different periods of time. Some seeds should be planted very soon after their formation is complete, or they will not germinate. Others will not grow until, as we say, they are *ripe*. This power depends upon something in the economy of the particular seed which is inherited. Some seeds will not bear drought after they have once imbibed moisture. Others will become dry and may get moist again and again, without the death of the germ being caused, and more than one kind of seed will bear frost and wet, and alternate drought and cold during many months without its germ-

life being destroyed. It may be placed in water, or it may be scorched by the sun again and again, and it will not be killed. The common acorn is an example. It is a seed, the germ of which is most difficult to kill, and the growing embryo, at least in its early stages, is not easily destroyed. The constitution of the germ of the acorn, in fact, exhibits in its constitution that of the oak into which it is to grow. Of all the little plants loved by children, the oak, as it grows from the acorn, is one which will afford much interest. Many a tiny oak tree, when five or six inches high, may be treated carelessly and almost deprived of water for some time and yet survive, so vigorous is it in vital constitution.

In the education of young children, it is wise to allow them to grow a few plants in this simple way, and they should be encouraged to watch the growth of plants from year to year as they grow in water, or damp sand, or earth. Common mustard seed is very suitable for the instruction of children. It only requires to be placed in a saucer with a little water, or on a piece of damp flannel, or sponge, or blotting paper, so as to be prevented from getting absolutely dry--and the process of germination and growth may be studied and thought over day by day. The child will, in a few days, observe the little roots growing down, and the little stem growing upwards. Those who have watched such living growth in childhood never forget the wonders of life and growth. Chestnuts, peas, beans, and other seeds may be tried, but mustard seed, which is so easily procured, and may be grown even in mid-winter if placed near the window in a light warm room, is among the most interesting seed for schools. Poor, as well as rich, have the means of showing their children how living growth takes place; and may see how root, and stem, and leaves are formed.

Growth does not depend alone on the organic matter and various substances dissolved in common water, for you can grow the mustard plant from the seed placed in distilled water. If, however, the seed be completely immersed in water it may die, but if placed in a thin layer of water only, so that air also may reach it, the dry shell of the seed will imbibe the moisture, and by keeping it in a small shallow saucer under a shade or tumbler for some days it will grow. I do not say that you can grow *any* plant for a long time in distilled water alone, for as growth proceeds, more nutrient material than is contained already prepared for the seed, will be required.

The tissues of all plants and animals, in early life, contain much more water than when they are full grown. In all growing embryos the proportion of water is very considerable. There is a higher percentage of water in the tissues of the young child than in growth and in adult life. Everyone knows how easily young children are injured, in consequence of the softness of their tissues, consequent on the large proportion of water present. The same remark applies to many of those unfortunate cases which we see from time to time where local or general growth is too rapid.

In tissues and organs which increase with abnormal rapidity, a large number of bioplasts in a given area will be found, and these contain much water and may divide and subdivide and grow, very fast. On the other hand, when tissues undergo condensation and in some forms of "degeneration," they are found to contain a much higher percentage of solid matter than those which are healthy, and this point is of interest to physicians with reference to the highest and most complex organs of man.

The organ which does the most wonderful *work* in all living nature, and the highest work we ourselves are capable of, is that part of the brain which is near the upper outer surface of the cerebral convolutions. As I suppose everyone knows, there is a great difference in the brain structure in different parts. Broadly, the cortical or outer parts of the surface hemispheres of the brain, are grey and are called grey matter of the cerebral convolutions. This is very largely supplied with blood, the vessels being everywhere very numerous. Beneath this outermost layer of the brain structure, is a considerable amount of brain tissue which is of much firmer consistence than the grey matter, and supplied with far less blood. It is whiter in appearance, and here and there it exhibits lines, and has a distinctly fibrous appearance. In the direction in which the lines run, the tissue, which contains less water than the grey matter, may be in some cases easily torn. The blood vessels in this white matter, are not numerous, and the amount of blood distributed to the grey matter of the convolutions is very small in proportion.

In all the nerve "centres," sometimes on the surface, and sometimes in the substance, is soft and very moist matter which corresponds to the grey matter of the brain, and contains many living growing bioplasts—and matter which is much firmer and more fibrous—not actually dry but

containing a larger percentage of solid matter than does the moist more active growing tissue to which I have alluded. This thin layer, extending over the whole of the outer surface of the folded layer of the convolutions of the brain, which in most vertebrata is just beneath the skull, is covered by a delicate, highly vascular membrane, so that the soft part, the grey matter, is supplied with a very free distribution of blood of course associated with the free distribution and interchange of nutritive and oxydizing fluid. The action of this part of the nervous system never ceases, from early life to death in old age, in healthy organisms. In other words, the grey matter of the brain, which contains a vast number of "cells" or living bioplasts, is active all through life, except in alternating periods of healthy sleep, when it "rests" from action altogether and waste matter is removed. I suppose the reason why we require so much sleep, about one-third part of the twenty-four hours, is to make up for the waste which has taken place during the active period of the day, in consequence of the active vital changes which occur in the living matter of the innumerable "cells" of the grey matter. Now these "cells," to this day have not been sufficiently studied, but I think there is no doubt whatever that they do all the intellectual work of the body, while multitudes are actively concerned in every voluntary movement. These "cells" are also the seat of thought and will. Indeed in structure and arrangement these "cells" are as elaborate, and are as numerous as we should expect to find them considering the wonderful and highly important work they do. If the brain matter concerned in thought, every kind of intellectual action and voluntary movement, is not kept constantly supplied with a large amount of water, its action will be seriously deranged.

By the general arrangement in "convolutions" of the upper part of the human brain, the greatest amount of brain tissue and active brain matter is caused to occupy the smallest space; and every portion of it is well protected from injury. Take a very thin section, say an inch square and not more than the one five-hundredth of an inch in thickness, there will be perhaps fifty thousand or more of these remarkable "cells." Each "cell" is of very striking and complicated structure. From each one of them a large number of very fine nerve fibres proceed. Each "cell" in man is not more than one two-thousandth part of an inch in diameter, and you may, therefore, conceive what millions

and millions there must be in a very thin layer of a very small area of the grey matter of the cerebral convolutions of the human brain. Hundreds and thousands of these very minute cells act together—act consentaneously, not only in thought but in voluntary movements.

Cerebral action seems to depend on *the living matter of these "cells."* When the living matter is much injured, or poisoned by the presence of certain poisonous matters in the blood, their action is seriously deranged, or the result may be fatal. I daresay while I am now speaking the living particles of millions of my "brain cells" are actively engaged at the same time, for the same purpose and in the same direction. Of course I do not feel it, or understand it, but from the arrangement of the living matter structure one can see and study and think over, I cannot but feel pretty sure it must be so. There is, I believe, no other explanation; and the conclusion I have ventured to draw is certainly justified by the facts ascertained by microscopical investigation of the cortex of the cerebral convolutions of the human brain in excessively thin and well prepared specimens. If you were to see the actual appearances under the microscope you would I think come to the same conclusion. The statements involve much more than I am able to describe, for it would indeed take a long time to give but a short account of what I have seen in the course of my investigations. But the broad fact to consider is that the living matter of the "cells" we think with, must be freely aerated, as they receive a direct and very large supply of blood just oxygenated by having just passed through the vessels of the lungs, I think a larger supply than is received by most organs, except the lungs themselves. The delicate "cells" and fibres are separated from one another by fluid, thus being carefully protected from pressure or shock, and the living matter in the centre of each cell is constantly kept moist. As is well known, there is fluid not only around the brain and spinal cord, but in all the interstices of the brain tissues, by which the minute bioplasts and fibres are kept from pressing on one another, while probably many adjacent fibres may be carrying a nerve current in different directions.

A considerable quantity of water is required in all the changes connected with the living matter of all "cells." If you want to understand the action and movements of living matter you have only to look at some of the "cells" in

certain living plants. You may then see the *vital* movements of the living material, which used to be called protoplasm, whether living or dead, and is so still by some authorities. But the protoplasm of authority which is dead must be absolutely distinguished from actual *living matter* or *bioplasm*. Huxley used the term *protoplasm* very freely; but he did not distinguish the dead from living protoplasm. He went so far as to say that if he took the "protoplasm" into his body in the shape of roast or boiled mutton it would add to, increase, or replace the protoplasm of his body, which was being used up. But what he took was not *living*, but merely the products resulting from the death of the bioplasm, which had been roasted or boiled and then swallowed. This was dissolved and at length caused to live by living matter, and then became the "protoplasm" of his body. To this day Huxley's arbitrary fancy is received by many, and passes as if it were scientifically correct and true. (Applause.)

When water is exposed to the air for a certain time the ova or portion of the bioplast of many of the lowest, simplest, living forms, microscopic "protozoa," "bacteria," "fungi," etc., pass into the water, even if it is distilled water, and in a few hours or days, according to the time of year, you find minute living organisms in millions in a drop of the water. These minute creatures used to be termed animalcules, and are now called protozoa, but it matters little by what name they are known. Each consists of soft material with which is associated a very large proportion of water. If you took the water in which hundreds of these living organisms were in active movement and evaporated the water, you would probably find that perhaps ninety-nine per cent. had disappeared, leaving only this mere trace of dry solid matter. So that the bodies of these creatures must be composed almost entirely of water, incorporated with an infinitesimal amount of organic solid matter—or was the water itself incorporated with and an inseparable part of the living matter, and also *living*? The matter of all organisms and tissues in the early growing condition, as I have already remarked, consists largely of water. But the movements of the most minute living protozoa are of the most complicated and perfect kind. Not only are they wonderfully active, but you see them steering their way around and between obstacles; seldom coming into contact with them or with one another. Their unceasing activity is most remarkable. Many of the larger protozoa are easily

studied, and their movements are worth carefully watching for hours.

As I have said, everything that is taken up by living matter must be dissolved in water. Of that there is no doubt. But what is the state of the solid matter in these lowly but most minute, most elaborate and wonderful of living forms? Is it chemically "combined" with the water, or is the solid matter in such a minute quantity that the water as well as the organic matter must be regarded as actually alive? On this last supposition what becomes of the "atom," and where is the atomic theory? Is the matter as well as the water infinitely divisible, and, at least during life, the material atom non-existent? A *living atom* certainly exists not. An elementary material atom cannot even be thought of as alive in the present state of knowledge. A living atom is impossible in nature. The physicists, perhaps, would like to meet and discuss a broad, general question like this; but few physicists seem to care to enter into the consideration of any question of details connected with a purely *vital* possibility, and many seem opposed to discussion, and that every physical suggestion is a fact.

Let me, in conclusion, venture to offer one or two remarks with reference to water in relation to us and our ordinary and extraordinary food. There has long been what may be called a dead set in this country against "too much" water-drinking generally, and in particular too much water-drinking at the time of eating. Considering that every particle of food, which is to be of service to us, must, as I have already said, somehow be dissolved, water antipathy, and the idea of the desirability of combining or diluting water with something alcoholic, is foolish. We may of course take more water a day than is good, but probably most of us err in the opposite direction. If preferred, the water may be taken in the form of lemonade or weak tea; and as regards digestion, slightly warm fluids are preferable to iced or very cold drinks.

I am sure that many poor children are made miserable, because parents and guardians think they do themselves harm by imbibing the proportion of water they desire. Children as well as young animals require a good deal of water, or food mixed with milk or water, before it is taken. Plenty of fluid ought to be always passing to and from all growing tissues, if the young organism is to be kept in health. It seems to me almost cruel to allow children to suffer from thirst.

There is, I venture to think, yet another fashion almost as unfair to long-suffering adults. As I have reached a considerable age, I may perhaps be permitted, even at the risk of offending some of my friends who are but too kind on occasions of hospitality, in wishing me to partake of a diet which, considered from a vital or physiological point of view, must be termed "too liberal." Many who give dinner parties and invite their friends to enjoy a profusion of rich food, seem to have thought of everything but the necessary water required to dissolve and dilute it, before it can be assimilated, or become of any use physiologically to the organism, and for the want of dilution, some luxuries may act detrimentally. Every guest should have a small bottle of water in his immediate vicinity, so that he may help himself as often as he desires, during the feast, or even before the repast begins. The privilege of belonging to a City Company, or a dining-club, would I think be enhanced, and more highly appreciated, if plenty of water, lemonade and such beverages were not considered vulgar, or commonplace and inappropriate. On the few occasions, years ago, when I was able to indulge in dinners, I could seldom get water enough to dissolve even the small amount of food a person of my weight ought to take. Wine and beer and other alcoholic beverages that ought not to be asked for, or taken by a rational person desirous of easily digesting his food, were in excess, but water pure and simple, was not to be had. To ask for water under such circumstances was sometimes considered an offence. The waiters seem to detest water and even a little bottle of seltzer or other aerated water, is not often at hand.

Pardon me for thus attacking the anti-water custom—but when I think of the required solution of most of the constituents of our food soon after meals, before their assimilation is possible, and before they can be of service in the nutrition of our tissues, or of use in the physiological action of tissues and organs, I naturally look for a little modification of views widely entertained concerning eating and drinking in the case of man—the so-called *animal*. It will give me pleasure to hear any remarks on the questions I have brought forward, and I shall endeavour in answer to any questions arising to explain more clearly the views to which I have committed myself, as far as I am able to do so. (Applause.)

DISCUSSION.

A discussion followed in which the Chairman, the Rev. Canon Girdlestone, Mr. Martin L. Rouse, the Rev. J. Tuckwell, Professor Orchard and Professor Candy took part, and bearing chiefly on the origin of life; a subject not within the scope of the author's communication, and consequently, with the Chairman's concurrence, not here reproduced.

A cordial vote of thanks having been passed to the learned lecturer, the Meeting adjourned.

ORDINARY GENERAL MEETING.*

DAVID HOWARD, ESQ., D.L., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following paper was then read by the author :—

“*PROCOPIUS'S AFRICAN MONUMENT OF JOSHUA'S CONQUEST OF CANAAN*”; *Narrative of a visit to the Site.* By MARTIN L. ROUSE, Esq. (Barrister-at-Law).

TO most of my hearers, I think, as to the vast majority of thoughtful Britons, the existence at any time of the monument with which this paper deals is quite unknown. I myself, I will confess, had never heard of it until about three years ago, when I read in the religious newspaper called the *Morning Star* these words: “Somewhere or other Procopius has recorded that in his time there stood in North Africa a stone thus inscribed—‘We are they who escaped from Joshua the robber, the son of Nun.’”

The words lay dormant in my mind for a long time; if I thought of them, it was only to say to myself, “The information is too vague; and anyhow, such a stone must long have been buried in the sand or broken up for building material, its inscription worn away amid the vicissitudes of settlement, conquest, and reconquest by tribes who could not read its characters, and who had no reverence for antiquities other than the relics of Mahomet.” But at the beginning of last

* Monday, May 5th, 1902.

year the reflection forced itself upon me, “If the letters were so deeply cut as to be readable two thousand years after they were inscribed, why should they not be readable now? Is it not likely that the atmosphere of North Africa, so famous for its dryness, failed to destroy them as the atmosphere of the Orient has failed to destroy those of so many monuments of Babylonian and Assyrian kings?” My curiosity could no longer be restrained. I broke away from other studies at the British Museum to ransack the writings of Procopius for this allusion, which after all might be much more explicit than the rough quotation that I had read. And my search was presently rewarded by my finding in the second book of that author’s history of the Vandal War a good deal more information than I expected.

And now a word as to Procopius and his times. In A.D. 395 was made the final division of the Roman dominion into the Empires of the West and of the East, with their respective capitals at Rome and at Byzantium, or Constantinople; in A.D. 439 Carthage and the whole of Western North Africa fell beneath the arms of the Vandals; and in A.D. 476 Rome and its surrounding territory were finally absorbed into the Gothic kingdom of Italy. But the reign of the Eastern Emperor Justinian, between A.D. 527 and 565, revived the prospect of a renewal of the palmyest days of Roman rule. By means of his great generals, Belisarius and Narses and the armies that they raised, largely recruited from the newly settled barbarians, he not only kept all invaders from the Danube to the Tigris at bay, but wrested all Italy back from the Goths, and North Africa from the Vandals, restoring those countries to a domination that was called “Roman” still; while, like the most prudent of his predecessors, he covered his dominions with fortified towns, roads, and bridges, building also numerous churches and other ecclesiastical edifices. But his chief fame rests upon his procuring a complete codification of the Roman law and a digest of all Roman judicial decisions, which have maintained their authority in some European countries down to this very day, and provided a foundation for our first writers upon international law. Justinian’s predecessor, in the last year of his reign, appointed one Procopius, lawyer and teacher of rhetoric in Constantinople, to be “assessor”—that is evidently civil adviser—to Belisarius; and the assessor accompanied the great commander in all his wars in Armenia, Persia, Africa, and Italy.

The chief incidents of those wars, the building and road-making of Justinian, and other events of his times, have been most fully recorded by Procopius. It is from his writings that we almost entirely draw our knowledge of this stirring and momentous period. Of him the *English Cyclopædia* says: "Procopius was well informed and unprejudiced; he was a spectator of, and an actor in, most of the events which he narrates." The *Encyclopædia Britannica* has no remark upon his accuracy. Krumbacher in his work on Byzantine literature says: "Procopius unites a high degree of literary form with an admirable love of truth." Mr. W. S. Teuffel, in his *Studies and Character Sketches*, says: "Procopius takes among historians throughout an honourable position, both with regard to his sentiments and to his portrayal of events. He strove with earnestness and honesty to tell the truth. Kangeriesser, while on the whole he does not praise our historian so much as the other modern reviewers, has a note upon the topic in question most favourable to his accuracy therein, which note we shall quote in its due place.

In the first book of *The Vandal War* it is narrated how, chiefly by the aid of his Hunnish auxiliaries (whom Belisarius had contrived to discipline, although they seem to have inspired terror by their mere aspect), the great captain overthrew the armies of King Gelimir; how Carthage and other cities threw open their gates to the Byzantine host; and how anon Gelimir and a large number of captives sailed away: but how, alas! Belisarius, who would have stayed until perfect order was established, was himself obliged to depart for that city to clear himself from the slanders of the envious; although, fortunately, he left a good lieutenant-general—one Solomon—behind him. Meanwhile, the Moors, who had already made head against the Vandals, grew bolder in face of the feeble opposition of Libyans and Romans, who had served the Vandals; and many were their raids against persons and property. Before telling of these, and of the war that followed, Procopius, in his 2nd book,* says: "And, since our narrative has brought us thus far, it is needful to tell from the beginning whence the tribes of the Moors came into Libya, and in what manner they settled there. When the Hebrews had departed from Egypt and were near the borders of Palestine, Moses, the wise man, who had been their leader on the journey, died.

* Second Book, chapter 10.

But he was succeeded in the leadership by Joshua, the child of Nave, who led that people into Palestine, and, displaying a more than human valour, took possession of the country; and then, overthrowing all the nations [in battle], he easily captured the cities, and seemed altogether invincible. Now, at that time, the coast land from Sidon as far as the boundary of Egypt was unitedly called Phœnicia; and one king anciently ruled over the whole, as is agreed among all who have recorded the earliest doings of the Phœnicians. In that region had dwelt [until then] very populous nations—both Gergesites and Jebusites and other tribes, by whatever name the history of the Hebrews calls them. And when this people saw the invading army to be an irresistible host, rising up from the haunts of their fathers, they departed into the neighbouring land of Egypt. But, not finding room enough to settle in (since in Egypt there was abundance of people from of old), they journeyed on into Libya; and, building many cities, they took possession of all Libya up to the Pillars* of Hercules; and down to my time they have dwelt [there], using the Phœnician language.

“Moreover they built a fortress in a Numidian city, where now stands the city Tigisis, and bears the name; [and] near to its great fountain† there are two pillars* made of white stone‡ having Phœnician letters carved upon them and speaking in the Phœnician language thus: ‘We are they who escaped from the face of Joshua, the robber, the son of Nave.’

“There were also other tribes already dwelling in Libya who, because they had been settled there from ancient times, were said to be ‘sprung from the soil’; and thence it happened that Antæus, their king, who wrestled with Hercules in Clipeas, was called a son of Earth.

“Moreover, at a later time, all who migrated from Phœnicia in the train of Dido, because they had come among their kinsfolk already settled in Libya, were readily permitted to build Carthage and possess it. But, as time went on, the power of the Carthaginians grew great and their people numerous, and a battle was fought between them and their neighbours, the former colonists, who as

* Gr. στῆλαι, *buttresses, posts, or pillars.*

† Or *well*; Gr. κρήνη.

‡ Or *stones*; λίθων.

we' said, had come from Palestine, and are now called Moors; and the Carthaginians got the mastery of them, and forced them to live as far away from Carthage as possible. And, later on, the Romans, getting the upper hand of all men, in war, settled the Moors in the extreme confines of the inhabited part of Libya, and made both the Carthaginians and the rest of the Libyans subject to themselves for the raising of tribute. But, later still, the Moors, having won many victories over the Vandals, came to hold both what is now called Mauritania, stretching from Gadeira to Cæsarea [that is from opposite Cadiz to Shershel], and most of the districts in the rest of Libya. In much this manner did the phases of Moorish settlement in Libya follow one another."

But Numidia is a wide word. Does Procopius, I asked myself, give no other clue to the position of this stone record? Yes, I found that he adverted once, though only once, to the vanished Numidian Tigisis; and this allusion contains much to help us to fix its locality, besides being the pivot of a fascinating tale. At the outset of Chapter 13 of the same book, he says:—

"Now, while these things were happening in Byzacium, Jabdas, who reigned over the Moors in Aurasium, having gathered together 30,000 fighting men, was plundering the towns and villages of Numidia and carrying off many Libyans as slaves. And it happened that Althias commanded a guard among the regular troops attached to the forts there; and, being eager to release some of the captives from the enemy, he sallied out of his fort with the Huns that he commanded, being about seventy in number. But, deeming that in actual fighting he was no match with seventy men for so great a host of Moors, he aimed at seizing some narrow passage; so that, as the enemy were making their way through it, he might be able to rescue some of their prisoners. Now, since there is no such passage in that district (for round all its towns and villages there are only gentle slopes), he hit upon the following plan: there is a city somewhere* near, Tigisis by name, which was at the time well fortified and had a large fountain† standing in a narrow pass; this place Althias

* *nov*, which may possibly, however, mean *somewhat* (in contrast with the usage of *οὐδαμῆ*, see p. 239, note *).

† See p. 237, note †.

learnt how to seize, reflecting that the enemy, compelled by thirst, would be certain to come to the fountain, no other water being at all near. (To all who reflected on the disproportion in numbers his plan seemed that of a mad-man.)

"The Moors, after marching in column with hard toil and much stifling from the [heat of] summer-time, and probably from that cause suffering from the keenest thirst, came to the fountain with a great rush, not dreaming of any opposition. But, when they found the water held by the enemy, they all stood still, at a loss what to do, for most of their strength was already spent in their craving for water. Jabdas therefore came to a parley with Althias, and offered to give him the third part of the booty, after which surely the Moors might all quench their thirst. But Althias would by no means* accept the proposal, but demanded that the other should fight him in single combat on their behalf; and, Jabdas having accepted the challenge, it was agreed that, in case Althias was worsted, the Moors should drink."

I conclude in the quaint language of an old English translator:—

"Who were glad and confident, seeing Althias a lean man, not tall; whereas Jabdas was the goodliest and valiantest of all the Moors. They were on horseback; and Jabdas threw first his javelin, which Althias caught flying at him in his right hand (which amazed his enemy), and with his left hand bent his bow (being both-handed) and killed Jabdas' horse. The Moors brought their prince another horse, upon which he leaped up, and ran away; the Moors following in disorder. Althias recovered the captives and booty, and got a great name in Africk for this act."†

The fountain or well of Tigisis, then, was far removed from any other; it was in a narrow pass between two heights; and it was very well fortified. Having determined this, my next step was to consult Kiepert's classical atlas; in which I found the Numidian town of Tigisis at a point about 45 English miles north of the first slopes of Aurasium

* *οὐδαμῶς*, primarily *nowhere*, but freely used by the best authors for *in no wise* and *not at all* (*L. and S. Lex.*).

† Translation by Henry Holcroft, Knight (*Hist. Warres Justinian*, 1653, Book II, chap. ix, p. 37), verified by me, except that the first words ought to be "*The whole army of the Moors was glad.*"

(or the Aures Mountains), 185 miles south-west of Carthage, 96 miles west of the nearest point in the old province of Byzacium, and 53 miles south of the nearest coast town, Rusicade (or Philippeville), being identified with the Arabic settlement that bears the suggestive name of Ain el Bordj, or Well of the Castle. It must be carefully distinguished from Tigisi in Mauretania, which is found to have lain in the well-watered region of Kabylia, 373 miles from Carthage and 273 from Byzacium. Still less claim had Tingis, the modern Tangiers, to be considered the site of the monument, though travellers used to affirm it to be, since it lies more than 800 miles from Carthage and more than 900 from Byzacium.

At once I wrote to the editor of the ancient atlas, asking his reasons for the identification, and got a courteous reply from Herr Richard Kiepert, his father's successor in the great work, enclosing the evidence in the form of an inscription discovered at Ain el Bordj, which reads as follows :—

FLAVIO VALERIO
CONSTANTIO
NOBILISSIMO
CAESARI
ORDO TICISITANVS
[D]EVOTVS NVMINI
[M]AESTATIQVE EIVS
EX SVA CONLATIONE
POSVIT IDEMQVE
DEDICAVIT *

Turned into English it would run :—

"To Flavius Valerius Constantius, the most noble emperor, the senate of Ticisis, devoted to his divinity and majesty, have, by subscription among themselves, set up and dedicated this monument."

The writing of C in TICISITANVS instead of G may be an imitation of the primitive Latin forms of inscription, wherein C stood for the sound or sounds of G, because this letter was not brought into the alphabet until B.C. 233; but it is much more likely that the sound in the name was variously pronounced by different nations or tribes, even as *weg* and *tag* in divers parts of Germany are made to end with the hard *g*, the *k*, or the *kh* sound, and even as, strange

* *Capus Inscrip. Lat.*, VIII, p 960, n. 10,820.

to say, the Arabs pronounce the name of another settlement *Tagasa*, while the French call it *Taxas*; of which more anon.

The explorer who found this important tablet was, as I have since learnt, a Monsieur Luciani; and his discovery was first reported in the *Journal of the Constantine Archæological Society* for 1878.

This, said Herr Kiepert (and I have since confirmed his words), was the only inscription found at Ain el Bordj that alluded to Tigisis; but he referred me to a Latin account of the bishops of Numidia which mentions Tigisis as a see (*Notitia Episcoporum Numidiæ*, N 89). A subsequent inquiry whether any effort had yet been made to recover the Canaanite pillars Herr Kiepert could not answer, but referred me for perusal to a description of North Africa, undertaken by order of the French Ministry of Public Instruction and of the Fine Arts, and to a history of Byzantine Africa by Charles Diehl. Of the Constantine Archæological Society and its labours I knew nothing; but these two books I decided to peruse after a pressure of other work was over in the summer months, and then in the month of October, when a European could walk and dig in Algeria, to spend a holiday in seeing what had been done or what could be done at the Arab village of the Well of the Castle to find the long-forgotten record.

There was then little question in my mind as to the accuracy of the story about the pillars; and there is less now. Kanngiesser, in the note before alluded to, says: "Procopius speaks of the pillars at Tigisis not as he is wont to do when he is dealing with doubtful and unauthenticated accounts, but with certainty. Even if he did not, as is likely, see those pillars himself, the ambassadors that came from the Moorish chieftains, and the hostages whom they brought, may well have given him precise information, while the Roman officers may have easily convinced themselves of their existence." Procopius, again, after accompanying Belisarius upon his first expedition to Africa, as he positively tells us, in all probability returned with him as his assessor, when two years later he crossed over from Sicily to quell a mutiny: the lawyer and assessor would naturally be required to help him in the trial of accused soldiers. The exploit of Althias, by which he won "so great a name in Africk," must, when it was known, have drawn many leading Byzantines to visit the scene of it, the well of Tigisis; and if Procopius

was not one of these, as well he may have been, there would at least be many to report to him how strangely that well was adorned. Now Augustine of Hippo tells us that in his time the Carthaginians and the peasants around Carthage called themselves Canaanites, and that the language of the Carthaginians was just like Hebrew; while Jerome also says that the Punic (or Carthaginian) and the Hebrew tongue differed little from each other; and Jerome died as late as 420 A.D., and Augustine ten years later still.* Are we to suppose that this Phœnician language, which had survived the Roman yoke for 500 years, was crushed out by Vandal rule in 100? Of course not. Therefore there were plenty of educated men of Punic (Phœnician or Canaanite) speech who could interpret the words upon the pillars to Althias and Procopius.

But an accidental circumstance greatly hastened my departure for Numidia. Early in the month of May I learnt that a friend of mine, long settled in Tunis, was about to start for a fortnight's recreation, or change of employment, in visiting the chain of Mount Aures (the Aurasium mentioned in the second quotation) that he might gain a first knowledge of the Shawia language for a missionary society under whom he works; and, as he has an exceedingly good knowledge of Arabic in its various dialects, and I had none, I thought the opportunity of combining our travels was not to be missed. So, finding, through correspondence, that he would be in Constantine by Saturday, the 25th, I started from London on the evening of the 21st, reached Marseilles very early on the 23rd, leaving thence at noon, crossed the Mediterranean in 31 hours to Philippeville, and very early the next morning wound my way up through the mountains to that wondrous city on a rock, Constantine, the ancient Cirta.

The following Tuesday morning saw us rumbling in the train to Taxas, which I had ascertained to be the nearest railway station for Ain el Bordj, from which it is 14 kilometers distant in the great plain of Beheira el Twila. But, finding on his way that the Arabs called this station not Taxas but Tagasa, and that there was a well 4 kilometers off to the south (from which it had evidently taken its name) called by them "Ain Tagasa," my friend reminded me that

* Quoted in the *Annuaire of the Société Archéologique de Constantine* vol. xix, pp. 103-104.

there had been a bishopric of Tigisis, and urged that possibly the title on the stone at Ain el Bordj "senate of Tigisis" referred to a whole district which had really taken its name from the well still called "Ain Tagasa." We therefore decided to visit this well in the first place. Arriving at the spot, we found the ruins of a Roman well—many squared stones forming a right angle about the spring; while a single squared stone about six feet long by two wide and thick was lying prostrate hard by. I wished at once to lift this and examine the hidden side; but I was told that we must wait until an official, who lived in a house close by, had returned home, in three hours' time. So, being informed that there were ruins upon a ridge within a kilometer of the well and remains of a wall, we ascended the ridge which rose from a point about a quarter of a mile away and presently came, upon its crest, to the bases of several houses, from which parallel walls, seeming to continue theirs, ran on for a great distance, keeping to the top of the ridge. We learnt at the same time that a great quantity of stone from former ruins there had been carried off to make roads with; so we were the more convinced that what we saw were the bases of demolished walls. Moreover, on the crest of a parallel ridge starting from the other side of the well there seemed very clearly to be a wall standing up several feet above the short grass all the way along. But when we had covered about 5 kilometers up to another small set of ruins in the intervening valley, and saw the parallel walls on both ridges running more than as far again without meeting, we were convinced that, after all, our walls were only denuded edges of rocky strata! On the opposite ridge, by which we returned, we found the phenomenon still more striking, for the face of the rocky wall was divided into oblong blocks in two tiers with joints both vertical and horizontal, the vertical joints not being continuous in the two tiers, but a joint being over a block and a block over a joint. It was only when one carefully examined the top of the rocky wall that one was undeceived by seeing the joint end about two feet back and two blocks unite into one great block in the rear. On subsequent journeys I saw once or twice like formations on other hills.

Picnicking upon this ridge with our Arab guides, we had a short siesta, and then returned to the well, where the French official now allowed and superintended the raising of the stone. Alas! there was no writing upon it; and he declared

that upon two other blocks that he had carted away there was also no inscription, for he had strict orders to take every inscribed stone to the museum at Sigus, a town about eight miles to the west of Taxas, where many antiquities have been found. But on other grounds I perceived that Ain Tagasa could not have been the well spoken of by Procopius; for, even if a town fenced in by the two ridges had guarded the approach to the well, the well itself was in no narrow pass, but on the open plain.

That evening, as we waited at Taxas station until eight o'clock for the second up train of the day (so scanty is the passenger traffic upon those railways), my friend met with Shawis in an Arab house—one of the half-dozen dwellings that surround the lonely station of Taxas. They gladly gave him a host of Shawia words, which he marshalled according to sense in columns parallel to those culled from other Berber dialects, soon finding Shawia to be a true Berber language; and meanwhile the goodman of the house had kuskuss prepared for us and steeped coffee, and presently I was called over from the station and warned not to wound the hospitable feelings of the goodman by offering any payment. This friendliness was the more remarkable in that my companion had not shunned to deliver them the message of his Lord and Saviour. Thus, sitting down with crossed legs upon mats spread upon the earthen floor, we enjoyed our novel food and our well-brewed drink, when what was my pleasure to learn that our entertainers knew of another ancient well only 4 kilometers on the opposite, or northern, side of Taxas station, and one which Europeans never approached, therefore all the more likely to have by its side the undiscovered pillars of Procopius. The name, too, by which it was known to the French Government—"Ain el 'Atâsh"—was most suggestive; for did not this mean Well of Thirst, and was it not likely that by some old tradition it got the name in memory of the baffling by Althias of the thirsty Moors? It is true that present-day Arabs had forgotten this tradition, if it ever existed, for they instead called the spot El G'soor—the strongholds, while the name "Well of Thirst" may have been given to it simply because the French map makers found the well dry, as it has long been. But we were determined to see and search for ourselves. Unfortunately there was no sort of inn at Taxas; so we had to return that night, more than two hours' journey by rail, to Constantine. But we were determined

to come back the next morning, hire horses, and visit both Ain el Bordj and Ain el 'Atâsh, which lay almost on the way to it. I may add that the usual route for Ain el Bordj was not through Taxas but through Sigus, so that Ain el 'Atâsh was seldom or never seen by Frenchmen, few of whom know even that there is such a place as Ain el Bordj. Tourists of course never visit these mere ruins, which contain no restored temples, baths, and gateways like those of Lambessa and Timgad.

Alas! when we returned early on the morrow, and my friend had gone to the Arab's house and asked him to find horses for the expedition, a stranger introduced himself to him as the Kaid of Ain el Bordj, who had control both of that settlement and of Ain el 'Atâsh, and said that no one must visit either place without his permission; nor could he give it unless he first received instructions from the administrator of Ain M'lilla—to which place if we had gone by rail, we reckoned that we should have lost two days. The end of it was that we had to employ our horses to take us first about 20 kilometers out of our way, so that we might get permission, if possible, from the brigadier, or chief constable, at Ain Fakrun. Armed with his permission, we returned to Ain el 'Atâsh. At this place we found a very large round well with a well preserved wall about it; but at a depth of about 50 feet the stones I threw in sank into mud. On two sides of it the ruins stretched, nine in number. They were stately ruins with large chambers, around which the broken walls stood up frequently 5 feet high, with posts 6 and 8 feet, and many a pillar, trough, and pipe cut in stone, the outer and inner inclosure of an atrium being distinctly traceable in one case by the rows of pillars still erect. We both searched carefully for inscriptions; but not one did we find, until when the sun was nearly setting, and our muleteer had twice urged us to depart, and when it was too late to send to the nearest Arab camp for a pick and shovel (if, perchance, they had any), I lighted upon a stone buried nearly to its head but clearly faced with a hard black cement as though for carving on. I made a note of its position and have since told the Constantine Archæological Society about it. But, whatever it will show, it can hardly be the inscription of Procopius; for it was not near the well, nor did this well lie in a narrow pass between two heights, but still far into the same great plain.

Thus false scents and official hindrance had prevented me

hitherto from reaching my longed-for destination (although our visits to Ain Tagasa and Ain el 'Atâsh had been negatively useful); and the exigencies of the programme of my missionary friend, Mr. George B. Michell, forced me when next we quitted Constantine to accompany him and another missionary, Mr. James Lochhead, who had been my host there, upon a tour to the south and south-east to view the tomb of Massinissa, the city of Timgad, and other ruins nigh thereto.

But on the 9th of June, with the full sanction of the Prefect of Constantine, and accompanied by Khoodhir, a Christian Arab youth, I made my way to Ain Abid, a market town fifteen miles north of Ain el Bordj, meaning to sleep at its inn, so as to start early in the morning and look round Ain el Bordj before the heat of the day. At a quarter to five we were in the saddle; and, mostly walking but sometimes trotting or ambling, we crossed a great plateau covered with barley and bearded wheat for a little over six miles, and then pierced a range of hills and wound our way down and through them for three miles more, until at half-past seven we were watering our horses at the French fountain of Ain el Bordj, adorned with a Roman pillar at its head.

We were standing at the mouth of a pass, and looking up it to the north we saw on the left the heights down and around which we had been coming, and on our right a steep slope covered with the ruins of an ancient city, while another hill was seen beyond it severed from it by a deep ravine. About 200 yards up the pass was a Roman fountain with a set of stone troughs feeding one another, and to the left and a little behind it a solid piece of wall about 4 feet high, probably Roman, covered with slabs and forming a right angle that embraced a tiny pool, while about 200 yards farther the first traces of the spring were to be seen amid moist, rank grass.

On the other hand, as we had crossed the upper plateau from Ain Abid and descended through the hills, covering $9\frac{1}{2}$ miles, we had not passed a single well, or seen one to the right hand or the left, still less any stream of water; and our Arab guide assured us there was not one. The only house that we saw all the way—a new farmhouse upon the northern slope of the hills, with a group of new buildings about it, the property of a French settler—may have possessed a new well recently bored; but the guide declared

that it had none, and in any case it must have been quite a recent boring. Again, south-eastward and south-westward along the hills we had crossed there was no spring as far as Ain Fakrun, eleven miles off one way, and probably as far as Sigus, ten miles off the other way, while southward there was not one up to the muddy well of Ain el Atash, $6\frac{1}{2}$ miles distant; and the little stream that flowed forth at our feet spent itself in a couple of miles on the thirsty ground. The hills near at hand looked arid, but especially the further of two that encroached to the south upon the plain of Behira el Twila; from top to bottom it showed not the slightest sign of vegetation, and was consequently known as the Bald Mountain.

Thus at Ain el Bordj were two of the special features of the well of Tigisis most clearly displayed. The third was also visible. A large fragment of the city wall, about 20 yards long and 18 feet high, crowned the slope on the east side of our pass, while fragments stretched along the descending brow of the cliff until they almost touched the Roman fountain. Right easy must it have been to protect the fountain from all intruders by means of archers posted on the wall. And how substantial that wall was! It had a facing of squared stones both inside and outside 18 inches thick; while between the facings lay 4 feet of rubble stones, mostly of great size. The squared stones that had once covered the rest of the wall were strewn over the ruined site of the town in vast confusion.

That site itself measured about a third of a mile from south-east to north-west by a quarter of a mile from south-west to north-east, and the series of Arab huts upon it and as many more dismantled huts were walled with its fragments and sometimes upheld by its pillars.

The Arabs were eager to show me inscriptions, and I copied in all seven Latin ones, which I show you to-day; but I could not hear of a single one in any characters but Roman, although I carefully drew both Phoenician and cuneiform characters and showed them to our guides as patterns.

Our guides were tolerably exacting, for they made me pay in all 4 francs 50 centimes for the privilege of looking at and copying the stone writings; but a man brought us a bowl of sheep's milk and charged us nothing therefor. The Arabs in Algeria regularly milk their ewes. It was the second time in my life that I had tasted sheep's milk; and this time I found it delicious.

It took me a good while to visit the different inscribed stones, clear away rubbish in some cases with a pick or a knife, and copy them, examine the size of the city, photograph the wells, and pay an abortive visit to the house of the Kaid, a mile and a half away. So I was glad of a two hours' break in the middle of the day, during which I lay on a mat in an Arab hut propped against a Roman pillar, and presently enjoyed kusskuss and hard-boiled eggs. In return for these comforts I handed my host two francs, being careful to use a phrase that I had learnt to be customary, "For your son!"

The sun had just sunk to rest and the Arab dogs were barking merrily and running wildly about as our horses once more entered the precincts of Ain Abid. I had seen and confirmed the identity of the fountain of Tigisis; and, if funds had permitted, I could scarcely have done more, for the Prefect had told me that without the sanction of a Department of State I might not lift a single stone from the ground.

I returned to Constantine next morning; and, before quitting my hospitable headquarters, I explored the wonderful Gorge Rhummel which half encircles the town at the back and is 400 feet deep. There I saw the two baths of warm mineral water, passed under the tunnel in the limestone rock, 150 feet high and 200 yards long, beneath which the river pursues its hidden way, and observed the Roman forum, gateway, and aqueduct built upon the tunnel, and yet more than a hundred feet below the graceful bridge which now leads from the city to the railway.

That bridge I crossed for the last time at six o'clock on the morning of the 13th of June. I was in Philippeville about nine, and had just time to visit the Roman theatre and eat a lunch when the steamer started which carried me back to Marseilles.

Arriving in Paris on the night of Monday, the 16th, I next day called at the office at the Ministry of Education which has control of public monuments; and its head presently referred me to Professor Cagnat, of the *Institut*, "whom," said he, "we should ourselves have to consult ere we gave permission to an outsider to excavate." The professor was most kind, and gave me a very long interview; in the course of which we consulted all authorities, and found that five out of the seven inscriptions that I had copied, although not of great consequence, had not been seen by Europeans

before, as also that the Archæological Society of Constantine (of which I now for the first time heard) had made some search for Procopius's pillars in 1880, but had had to abandon the search for want of funds. They had, however, as they expressly said, been encouraged to look further; for, after digging at a certain point three trenches 1 metre 40 cm. wide and about 100 metres in total length and meeting as a triangle, they had come upon a group of pillars of many different heights and diameters, which had evidently been brought together from divers parts of the city; and they judged it likely that the inscribed pillars of Procopius had been brought to the same point along with them. The report of the same society tells that the Arab historian Bekri, who wrote in the eleventh century, speaks of this Tigisi as a flourishing city in his time: and it is likely that some Berber chieftain of those days gathered pillars from divers quarters to adorn the forecourt of his palace; and, if so, he probably, for curiosity's if not for beauty's sake, carried the fountain pillars bearing that strange inscription in a forgotten alphabet along with them.

Again, the desire to preserve what still was regarded as a tribal heirloom from the risks attending the numerous sieges of those days may equally have led to its being carried from its exposed position by the well to the heart of the city, where the group of pillars was found.

The professor's advice to me was to get English antiquarians and students of Bible history to help the Constantine society to complete their task rather than attempt to carry it out myself alone or with English friends; since the Arabs would charge Englishmen for every foot of earth they stirred, whereas the French society has a legal right to dig where it will. And, indeed, a society that directly the site was identified surveyed it and began excavating upon it ought rightly to be treated as captains in any further digging into this mine of history.

At the end of last September, after further perusing the reports of the Constantine Archæological Society at the British Museum, I wrote to the Society's President, Mons. Gustave Mercier, telling him of my visit to the three possible sites of the Numidian Tigisis, and how I had confirmed Mons. Luciani's identification of it with Ain el Bordj, expressing my gratitude to them as pioneers of the important search, and giving weighty reasons why they should renew it; and two months later I got a most cordial

and gratifying reply, in which the President said that the Society had resolved after reading my letter to incorporate its substance in their annual report, and at an early date to recommence the digging at Ain el Bordj. To this I quickly replied with hearty thanks, and a question whether monetary help from England would be agreeable to the Society, in case they had not funds enough to complete the work; and an answer came in February that the Society were deeply touched by my offer to raise funds for them, but to accept funds from a foreign source would tend to create difficulties for them (doubtless because of the strong anti-English feeling recently shown in Algeria). On the other hand, wrote the President, if the Society's fresh operations did not bring the precious monument to light, my English friends and I should apply direct for permission for ourselves to excavate at Ain el Bordj. Unfortunately the Society's funds would allow them to make only a "summary" search, but Ain el Bordj was "inscribed on the programme of their next operations." In his former letter Mons. Mercier had said that he would let me know what were the results of their fresh excavations; and, if those are in the least encouraging, the Christian men of England, the lovers of Bible antiquities who desire to make the stones bear further witness to the Divine record, should not rest until they have searched every corner of this ancient Libyan town.

If this old stone record is again brought to light, it will not only give us another striking proof of the truth of Bible history, but it will most probably establish a momentous point of chronology. We can hardly suppose that the two pillars jointly contained the one bare sentence quoted by Procopius. Rather is it to be expected that they contain the whole narrative of the migration of the bands of Canaanites which he himself recounts; and, if so, in telling that these failed to settle in Egypt, does not the inscription say what king of Egypt refused them a dwelling-place there? Thus we should establish from Israelitish and Egyptian sources combined the precise date of the Exodus; thus would be ended the seeming conflict between the lapse of time noted at the founding of Solomon's temple and the period obtained by summing-up the years of the Judges; and thus, too, we should make sure whether the Tell Amarna tablets do or do not recount from Canaanite contemporaries the Divine conquest of Canaan by the hand of Joshua.

DISCUSSION.

The CHAIRMAN.—I am sure we shall all join in thanking Mr. Rouse for the very interesting account he has given us of his researches, and we shall be glad to hear any remarks upon it.

The SECRETARY (Professor EDWARD HULL).—I might mention that the late Sir Lambert Playfair, who was Consul-General of Algeria for a number of years, and whom I had the pleasure of knowing, and meeting at the British Association from time to time, has written a very fine work on these Aures mountains and the remarkable Roman remains that are found therein.

I do not know whether I might give you a little anecdote that he told me himself. On one occasion when his party were about to explore these mountains they entered one of the valleys and seated themselves on the grass, and having brought out their provisions for the mid-day meal the wild inhabitants came down from the neighbouring mountains and assumed a threatening attitude towards them. They stood around and became more and more threatening. The explorers hardly knew what to do; but one of the party suggested a plan which was absolutely successful. They brought out some pots of jam, and opening them, they distributed the jam amongst the natives, with the result that they became friendly and no longer offered any opposition to their proceeding. [Laughter.]

The CHAIRMAN.—I think we are all extremely indebted to the author of the paper for the minute and accurate observations which he has made in regard to this very interesting passage of Procopius's. It is true that we have not got the stone yet; but we have evidence of that accuracy of mind on the part of the historian that leaves little doubt that he is describing what he had seen, and that no doubt he was a witness to the truth of that which he had observed. It is wonderful how, since I was a boy, the discoveries in Nineveh, Greece, and other places have verified the old historians, and in some cases more than verified them. Careless writing was certainly not a characteristic of those writers, and I think there is great reason to accept this statement of Procopius.

Professor ORCHARD.—The lecturer has done three things. He has helped to establish the veracity and trustworthiness of Procopius as a writer. He has done something in finding certain evidences of Tigisis and of these wonderful pillars. And he has

done something in getting into touch with the Constantine Archæological Society. I am sure we wish success to that society in its future efforts to discover these wonderful memorials of Joshua's conquest in Canaan. If that society does not find them we shall heartily desire that our lecturer, or another gentleman equally well fitted, should go out with the object of completing the investigations. That these pillars exist cannot, I think, be doubted; so we shall look forward with hope, as well as interest, to the future.

Mr. WOODFORD PILKINGTON, C.E.—I must say that I think the lecture we have heard to-night is one of those instances of the great use of popular institutions of this kind. The Victoria Institute was so called after her late gracious Majesty, and I only hope it may continue to be as popular in the present reign as it was in her own long reign. Institutions of this sort, which are outside purely technical institutions, render a great service to the country. I belong to one of those technical institutions (the Civil Engineers), and it is very difficult to awaken popular interest in them, because they are so purely technical. But institutions of this kind can be made popular, and I think our experience to-night affords a remarkable instance of the way these institutions may do so. Some may say, "Well, Mr. Rouse went after a stone that he never found." But he found a great many interesting facts in connection with that stone, and got himself connected with societies in France which I hope will lead to its ultimate discovery.

I do think Mr. Rouse has developed a gift, latterly, very much in the direction in which a kind Providence has invested him, viz., a power to make himself generally useful.

The subject to-night as regards the history of these stones of Joshua is very interesting. The discovery of stones in modern times has done much, as we all know, towards throwing light upon the statements of the Bible in days when rationalism is doing so much with the object of disproving them. The Moabite stone is a case in point of peculiar interest. One of the most wonderful discoveries of this age was the reading of the hieroglyphics of Egypt when a Frenchman found out their interpretation.

I hope every opportunity will be given to Mr. Rouse to prosecute his work, and I am sure we must all be deeply grateful to him for bringing forward this interesting subject.

Mr. ROUSE having replied, the Meeting separated.

ORDINARY GENERAL MEETING.*

REV. F. A. WALKER, D.D., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The following elections were announced :—

The SECRETARY (Prof. E. HULL, M.A., LL.D.) read the following on the "Submerged River-Valleys of the Atlantic" :—

A COMMUNICATION ON THE

SUBMERGED RIVER-VALLEYS OF THE ATLANTIC.

By the SECRETARY, Professor EDWARD HULL, LL.D., F.R.S.

THOSE members who have taken an interest in the investigations I have had the honour to lay before the Institute from time to time on the above subject, will probably be pleased to learn that I have recently had two confirmatory statements regarding my conclusions drawn from distinct and independent sources. It will be recollected that from the plan of tracing the isobathic contours (or lines of equal depth) on the Admiralty charts, I was able to show that most of the river-valleys opening on the North Atlantic Ocean from the coasts of the British Isles and Western Europe—and, indeed, of Africa as far as the Congo, after traversing the Continental Platform and descending to great depths, opened out on the floor of the abyssal ocean at a general depth of 1,200 fathoms (or 7,200 feet) below the surface of the ocean; and from this it was inferred that at the time when these

* Monday, May 12th, 1902.

channels, or cañons, were being eroded down to their floors, the region must have stood about 7,200 feet higher than it does at the present day. A great many leading geologists and men of science have, to a greater or less extent, accepted my conclusions as borne out by the contour lines—but there are others who doubt or disbelieve them altogether.

Amongst the former was, till recently, Lord Avebury, F.R.S., who has just brought out an elaborate and interesting work on *The Scenery of England*, of which his lordship was so good as to present me with a copy. I was gratified to find that my investigations had received recognition in very handsome terms, but with this was added a statement of caution to the effect that I had, perhaps, carried the argument farther than the facts entirely warranted. On seeing this, I wrote to Lord Avebury to say that if he would allow me I would be glad to show him the charts with the contour lines in order that he might satisfy himself as to whether the caution was justified. Accordingly, on a prearranged day, I took the charts to his house, and for half-an-hour he went over them very carefully, satisfying himself on the various points of interest or difficulty—and I left the charts for some days in his keeping. The result was that I received from him a note dated 27th April, in which he says in reference to the new edition of his book which he is preparing, that after seeing my charts he is omitting the sentence (p. 106) in which he expresses the "cautious doubt" above referred to; practically recognizing that the conclusions I had arrived at were justified.

The second confirmatory statement is of a totally different nature, and though confirmatory of the view of the great elevation of the European lands at which I had arrived, is based on physical or biological evidence. Professor W. C. Brøgger of the University of Christiania, in a recent work *Om de Senglaciale og Postglaciale nivåforandringer i kristianiafjellet*, states (p. 683) "the occurrence at great depths in the Norwegian sea of the high Arctic fossil shallow water mollusca of the Yoldia-fauna is explained by the hypothesis, that the sea-bottom during the time of the greatest ice-sheet of Europe, must have been uplifted at least 2,600 mètres (8,328 feet) higher than it is at present. In a discussion of this hypothesis, Dr. Frithjof Nansen concludes that the explanation of the occurrence of these arctic shallow water fossils at great depths in the Norwegian sea by the theory of transportation by

floating ice or icebergs is extremely improbable. If so, no other explanation is left than the supposition of a former uplift of the sea bottom." It will be observed that the *amount* of the uplift, as well as the special *epoch* referred to, closely coincide with those which have been determined in my essays read before the Institute, namely, 7,200 feet of uplift at the commencement of the glacial epoch. The great uplift and the glacial epoch are, as it appears to me, contemporaneous, and clearly stand in the relation of cause and effect.

The following paper, by Thomas Chaplin, M.D., on "Some Diseases mentioned in the Bible," was then read by the Secretary in the absence of the author :—

ON SOME DISEASES MENTIONED IN THE BIBLE.

By THOMAS CHAPLIN, ESQ., M.D.

THE diseases mentioned in the Bible, especially those of the Old Testament, form a study of much difficulty. In some instances only the name of the disease is given, and the precise meaning of the term has to be inferred from its etymology, its rendering in early translations of the Scriptures, or the traditional interpretation of it handed down by the Jews. In other cases only certain local affections or symptoms are mentioned, which may or may not be sufficient to determine the nature of the disorder. Thus we are told that King Asa "in the time of his old age was diseased in his feet," but there is nothing to show what was the character of the disease; whilst the account in 2 Kings iv., 18-20 of the death of the Shunammite's child leaves little room for doubt that the cause of death was either sunstroke or inflammation of the membranes of the brain from exposure to the sun in the harvest field. Such cases are of frequent occurrence in that country at the present day. A further difficulty arises from the fact that, in early Biblical times, even the wise and learned did not yet know how to describe diseases with perspicuity and accuracy. Medicine as a science was not yet born. It is partly owing

to this that, even to the present hour, many doubts and differences of opinion exist as to the nature of the "leprosy," so called, of the thirteenth chapter of Leviticus. In some instances, also, such a word as "plague" or "pestilence" is used without any attempt to indicate its nature, and sometimes it is simply told that the angel of the Lord smote the people.

The age in which the New Testament was written was more cultured. The Greeks had then already taught the world to use terms with precision, and medical writers had learned to describe diseases accurately, and had given names to some which have continued in use to the present day. St. Luke was himself a physician, and his allusions to diseases are marked by the use of words and phrases which only a physician would have used. So marked is this characteristic of the third gospel and the Acts of the Apostles, that it has been put forward as evidence that these books were written by the same author, and that he must have been a medical man.

1. *Blindness*.—Diseases of the eyes are very prevalent in Egypt and Palestine. Probably in no other countries are there larger proportions of blind people. At the British Ophthalmic Hospital at Jerusalem almost every kind of eye disease comes under treatment. The most common is severe inflammation, which prevails especially in summer and autumn. It is thought to be caused by the "bloom" or the saccharine matter of fresh figs and grapes, by the intense light and heat of the sun, by air filled with dust, and especially by the damp winds of evening and the dew. It is very contagious, and a frequent cause of blindness, especially if neglected. It also produces chronic and often incurable disease of the insides of the eyelids, rendering people tender-eyed, as Leah was. Another kind produces small ulcers, which sometimes penetrate the cornea, and lead to the destruction of the sight. It is not uncommon to see two blind men walking hand in hand, each feeling the way with his staff. As in our own country, children are often leaders of the blind.

The man who was born blind probably had cataract, which is sometimes congenital. St. Paul's temporary loss of vision was miraculous; yet, as the Almighty frequently works His wonders through natural causes intensified or brought specially into operation, we may suppose that the "light from heaven above the brightness of the sun"

paralysed the optic nerve, and produced *amaurosis* or *gutta serena*. The blindness of the men of Sodom (Gen. xix., 11) and of the Syrian army (2 Kings vi., 18) was in all probability of a similar kind; perhaps also that of the sorcerer Elymas (Acts xiii., 11).

2. *The Boils and Blains* from which the Egyptians suffered because Pharaoh would not let the people of Israel go (Ex. ix., 10) were, in all probability, the result of blood-poisoning. For, first the waters of the Nile had been "turned into blood," and the fish in it died and stank; next came the plague of frogs, which "died out of the houses, out of the villages, and out of the fields. And they gathered them upon heaps; and the land stank"; after this followed the plagues of lice and flies, and then a "very grievous murrain" occurred, so that "all the cattle of Egypt died," and much polluted flesh was doubtless consumed by the people. In Hebrew the word translated "boils" is שֶׁחִין (*shekhin*), which signifies to be hot, burning, or inflamed; and the "blains" זַבְעָנוֹת (rendered by the LXX. φλυκτίδες) are the pustules containing matter or a small "slough," which "break forth" from the inflamed base of the boil. In modern medical language this Greek word has its representative in a term which is defined to be "an acute pustule with an inflamed base." Boils are sometimes epidemic, even in civilised lands, and are very prevalent in such countries as Egypt. The kindred disease called *ecthyma* is also common. It has been suggested that these boils and blains were smallpox, or perhaps a kind of carbuncle (*anthrax*) allied to that caused by handling the fleeces of diseased sheep, and known in England as "wool-sorter's disease" when occurring in man, and "splenic fever" in animals. But it is not certain that smallpox existed at that early period, and as none of the Egyptians are reported to have died of the "boils and the blains," it is probable that a less severe, but very painful and distressing malady is indicated. Yet it is remarkable that it affected animals as well as men.

3. *Bowel Disease. Bloody Flux.*—The disease threatened in the writing which came to King Jehoram from the prophet Elijah (2 Chr. xxi., 15) was apparently epidemic dysentery. "Until thy bowels fall out by reason of the sickness day by day" is a graphic popular description of one of the most serious symptoms of this disease. It is also scientifically correct in reference to those cases in which the lining

membrane of the bowels mortifies and is cast off. Dysentery is a very common disease in Palestine and other countries bordering on the Mediterranean, and is frequently accompanied by copious discharges of blood. The *bloody flux* of which St. Paul healed the father of Publius at Malta (Acts xxviii., 8) is called by this name and may have been of this character. But the use by St. Luke of the plural (*πυρετοῖς*) for the fever which attended it has been thought to indicate some form of remittent or intermittent fever. Possibly it was a case of typhoid (*enteric*) fever, in which hæmorrhage from the bowels is of frequent occurrence.

Herod Agrippa is said by Josephus (*Antiquities of the Jews*, xix., 8, 2) to have died of an acute and violent disease of the belly, which carried him off in five days. Whether this was dysentery or not it is difficult to decide, and as the disease was attended by another very remarkable symptom—"he was eaten of worms" (Acts xii., 23)—the subject will be discussed below. Among the symptoms of the complicated disorder of which Herod the Great died, ulceration of the bowels is mentioned, and the chief violence of the pain lay in the colon (Joseph. *ib.* xvii., 6, 5). Antiochus Epiphanes also is reported (2 Macc. ix., 5 *et seq.*) to have died of "a pain of the bowels that was remediless."

4. *Consumption*.—It may be doubted whether the word thus translated in Lev. xxvi., 16, refers to a disease or to a condition of social want and suffering. The LXX. has *ἀπορία*, the Vulgate *egestas*, both of which terms might be rendered "poverty." Consumption (*phthisis*), however, is not uncommon in Egypt and the coast towns of Palestine, and other forms of wasting diseases are frequently met with there.

5. *Demoniacal Possession*.—Much difference of opinion has existed with reference to this subject. On the one hand, the symptoms manifested by some persons said to have been possessed with a devil being not unlike the symptoms of insanity or epilepsy, or some allied disorder, the expression "possessed with a devil" has been thought to be merely the popular way of speaking made use of by the inspired writer, without indicating the actual existence of such possession. On the other hand, those instances in which the devils spoke, and especially that in which they besought the Lord to send them into the herd of swine, can be explained on no other supposition than that of actual demoniacal possession. Our Lord certainly recognized the fact of "possession" (Mark v.,

8, 9), and it cannot be supposed that He was ignorant of the true nature of these cases, or could give any countenance to popular error respecting them. It has been observed that it is chiefly at the time of our Saviour's ministry on earth that people are said to have been thus "possessed," and that the phenomenon ceased at an early period after His ascension, as if the prince of the devils had then been permitted to make special efforts to counteract the influence of the presence and power of the Son of God. If this is the right view, the question of demoniacal possession becomes removed from the category of mere bodily diseases, and is foreign to the subject of this essay.

In Palestine there still occur remarkable instances of mental and nervous disorder, which are ascribed by certain classes to possession; not always possession by a "devil," but by the spirit of some deceased person or of an animal. Such a spirit is called by the Jews *dibbuk*, something that *cleaves* or *sticks*.

6. *Fevers* of various kinds are exceedingly frequent in Mediterranean countries; and in Palestine itself, which has in its small extent a great variety of climatic conditions, almost all the known varieties of febrile disorder are met with, except one or two which occur only in the tropics. Typhus and typhoid, remittent and intermittent fevers in their several forms, scarlet fever, smallpox, measles, dengue (or break-bone fever, called by the Arabs "the father of knees," because of the knee-pains which accompany it), are some of the fevers which every now and then become epidemic, and (with the exception of dengue) lead to great destruction of life. There is reason for believing that many of these were known in ancient times, and are signified by various words used in the Holy Scriptures. The "fever," the "inflammation," and the "extreme burning" of Deut. xxviii., 22, are doubtless forms of fever known by those names at the time the book was written. קָדַחַת (*kaddokhath*), translated "fever," is a word still in use with the same signification among the Jews of Eastern Europe and the Levant who mingle Hebrew with their ordinary speech, I have even heard it used in London. דָּלֵקֶת (*daleketh*), "inflammation," probably indicates a violent fit of ague, as denoted by the *πίρρις* of the LXX.: whilst חֲרָחַר (*harhür*) may mean some internal inflammation, such as pneumonia or pleurisy, or possibly a cutaneous affection producing great.

burning or irritation, like erysipelas, prickly heat, or itch (*ψωρα*), which is the rendering of the Septuagint. Rashi, the great Jewish commentator, calls it "a disease which makes the body very hot, and produces thirst for water."

There is nothing to show what kind of fever the mother-in-law of Peter (Matt. viii., 14) or the son of the nobleman at Capernaum (John iv., 52) were afflicted with, except that St. Luke calls the first "a great fever," and the severity of the latter may be inferred from the statement of the father that his son "was at the point of death." In all probability both were suffering from some grave form of continued fever, perhaps typhus or typhoid. There does not seem to be any ground for supposing that the disease was in either case intermittent fever, and that the subsidence of the fever was a natural termination of the paroxysm. The Greek physicians divided fevers into the *greater* and the *lesser*, and St. Luke would not have used the term "great fever" for an ordinary ague; whilst, as to the other case, boys seldom or never die of ague.

7. *Leprosy*.—Of all the diseases which afflict humanity, leprosy is one of the most terrible. It infects the whole body, producing hideous distortion of the features, falling of the hair of the eyebrows and face, swellings, ulcerations, contractions of the fingers and toes, which often drop off, leaving only the stumps of the hands or feet, loss of sensation, so that the affected parts can be burned without the patient feeling it, diminution of muscular power, hoarseness of voice, the sufferer speaking in a strange, unearthly whisper, a repulsive odour, and lingering death, which is usually preceded by a kind of dysentery. Two principal forms of the disease are described; one in which tubercles form in the skin of the face, ears, arms, and legs, and often in other parts of the body also, and the other attended by peculiar eruptions and ulcerations, with loss of sensation and muscular power. The former is called *tubercular*, the other *anæsthetic* leprosy. They do not appear to be essentially distinct diseases, as mixed cases occur partaking of the characters of both. Nothing can be more loathsome than persons in the advanced stages of this frightful malady, and in every age they have been objects of abhorrence, and forced to live apart from their fellow men. There is no reason to doubt that the lepers who sat at the gate of Samaria (2 Kings vii., 3), the kings Uzziah and Azariah, who "dwelt in a several house," the ten men who were healed by

our Lord on His way through Samaria (Luke xvii, 12-14), and others were afflicted with this disease.

But from ancient times down to a quite recent period, persons suffering from other loathsome diseases besides true "leprosy" or *elephantiasis* were banished from their homes and sent to live amongst the lepers. It is said that in Europe, at one time, as many as 75 per cent. of the inmates of the Lazar houses were not afflicted with *elephantiasis*.

A very great deal has been written about the leprosy of the Bible, more particularly with reference to "the law of the leper" in the 13th chapter of Leviticus. Yet it must be owned that the subject is even now by no means clearly understood. The circumstance that the expression נגע צרעת *neg'a tzar'aath*, has been rendered in the translations by the terms *λεπρα*, *lepra*, *leprosy*, appears to have caused much misunderstanding, and led expositors astray. *Lepra* is explained by all medical writers to be derived from *λεπτις*, a *scale*, and it has therefore been supposed that this so-called "leprosy" must be one of the numerous skin diseases accompanied by the formation of scales on the surface of the cuticle. Yet there is not a word distinctly referring to scales in the whole chapter, though doubtless certain scaly diseases would be amongst those which were to be brought to the priest. Then, as the term "leprosy" is applied pretty generally to the dreadful disease known to physicians as *Elephantiasis Græcorum*, efforts have been made to bring the descriptions in Leviticus into accordance with the appearances of that disease, and this has proved a bewildering and hopeless task. *Neg'a tzar'aath* does not mean "leprosy" at all, but simply an evil or malignant plague or stroke, and the object in the first 44 verses of Leviticus xiii. is to lay down clearly and succinctly what appearances come under this head, and render the sufferer *tâmeb*, or unclean. No one disease is fully described, but a considerable number of diseased conditions is included, some clean and some unclean; *elephantiasis*, at least in some of its stages, being no doubt among them. The things which constituted the uncleanness appear to have been—(1) unsightliness; (2) loathsomeness, as from open sores; (3) contagiousness; and (4) an active force in the disease which caused it to spread.

The word נגע *neg'a*, a plague, or stroke, is from נגע to touch, which in the Piel form means to strike. צרעת *tzar'aath* is from צרע, which also means to strike, or strike down.

It is not, like *neg'a*, used in a general sense, but only as indicating a specific and malignant condition. It is, however, to be observed that this condition did not always arise from the same disease; just as a person may become *comatose*, or "insensible," from a number of different morbid conditions, so a man might become *matzoor'ah*, or "leprous," from different morbid conditions.

The words translated "a rising," a "scab," a "bright spot," were apparently general and popularly understood terms which included all the various forms of skin eruptions. The *saeth*, or rising, might be a pimple, a boil at its commencement, the papule with which the eruption of smallpox begins, the tubercle of tubercular, the papule or the "bleb" of anæsthetic leprosy, or any eruption elevated above the general level of the skin. The *sapakhath*, or scab, might be the scaly patches of psoriasis or eczema, the crusts of ethyma, rupia, tinea (scalled head), or such an eruption as smallpox, chicken-pox, etc., whilst the *baheretñ*, or bright spot would be any striking change in the colour of parts of the skin, whether white or red, and might include not only leuce, psoriasis, the dusky red eruption of tubercular leprosy, and the pale, slowly-spreading patches of the anæsthetic kind, but possibly even such eruptions as those of erysipelas, or measles. For it is to be noted that the diseases which were to be brought to the priest were not all chronic, much less incurable, affections. On the contrary, some of them were such as change either for the worse or the better in the course of seven or fourteen days, and even the graver kinds which had been adjudged "leprous," or at least some of them, were susceptible of cure.

The first and most remarkable of the diseases indicated as "unclean" was distinguished by a rising, a scab, or a bright spot, affecting the deeper layers of the skin, and turning the hair of the affected place white (ver. 2, 3). Such a disease was called by the ancient Greek physicians *leuce*, *λεύκη*, and by the Romans *vitiligo*. It is not infrequent in Palestine at the present day. The writer has seen several instances of it.*

At a period when these diseases were perhaps more common and more dreaded than they are now, any discoloured patch occurring on the skin would naturally arouse suspicion, and persons who were affected only with some

* *Lancet*, 1868, p. 656, "On a case of Leuce." By Thomas Chaplin, M.D.

harmless and ephemeral eruption would often be brought to the priest by anxious or officious relations or neighbours. It is significant that the suspected person is not ordered to *come* to the priest, but to *be brought*.

The signs of a non-malignant or "clean" eruption were (ver. 6) that after a period of seven or fourteen days the spot was not deeper than the skin, did not spread, had no white hair in it, and was fading away (כִּהְיֶה, "somewhat dark," A.V.). This was merely "a scab," *sapakhath*, in which term, as already mentioned, many forms of skin affection might be included. But if this "scab" spread much abroad (ver. 8), it became unclean, even though it had no other unfavourable sign.

In verses 9-11 directions are given as to a "rising" in which the hair is turned white, and in which "quick, raw flesh," that is, excoriation or ulceration, had appeared. Whether this is the same disease as that of verse 3 it is not easy to determine. Probably it was. It is important to remember that the Lawgiver is treating the matter *judicially*, and that doubtless every effort would be made by afflicted persons to escape condemnation as unclean. The appearance of a pimple, pustule, or sore in an "old leprosy" might lead to the supposition that there had been a mistake in the *diagnosis*, that the case was not really one of *tzar'aath*, and hence a fresh appeal to the priest was enjoined, when the case was at once condemned if white hairs and raw flesh were present.

That a local outbreak of *tzar'aath* in the skin should be unclean, and that when it had covered all the skin it was to be pronounced clean (vers. 12, 13), seems at first somewhat puzzling. The explanation probably is that although, like all skin eruptions, it was regarded as unclean whilst spreading, for spreading was always an evil sign, it ceased to be so when it could no longer spread. There is no mention of white hairs in this case, which seems to be, not the severe and malignant *leuce*, but a form of "white disease," *leucopathia* or *albinism*, which is common in warm countries and is not of a malignant character, although unsightly, especially when portions only of the skin are turned white. Albinos are usually born such, but in other instances the whiteness of the skin (*leucoderma*) comes on later in life, gradually spreading over the whole body.*

* *Diseases of the Skin*. Erasmus Wilson. London, 1847. P. 701. *Ib.* H. Radcliffe Crocker. London, 1893. P. 183.

Even this harmless affection becomes unclean if ulceration occurs (ver. 14).

Thus far the law of leprosy refers mainly to one diseased condition, namely, that in which there is a turning of portions of the skin, and of the hairs growing upon them, to white. It has been often said that this is a characteristic of anæsthetic leprosy. But the affected surface of the skin in anæsthetic leprosy becomes pale, not white, and the hairs upon it, if there are any, do not turn white. The Jewish tradition, indeed (Mishna, *Negaim*, i., 1), is that the signs of these "plagues" were of different degrees of whiteness, namely, a bright spot bright as snow; a rising like white wool or the shell of an egg; a spot whose whiteness was like wine mixed with snow, and another like blood mixed with milk. Yet it seems hardly possible that the eruption of anæsthetic leprosy can be included in the spreading whiteness alluded to in verses 12, 13, for it never spreads over the whole body, and if it did, the person would not be clean, but very decidedly unclean, from the ulcers and other symptoms which mark the disease.

At verse 18 we are introduced to a difficulty which would be sure to present itself from time to time. A person with the suspicious signs would affirm that the spot was merely the mark of a boil (*shekkin*) which was healed, and directions are given as to the means of deciding in such a case. Whether the expression "lower than the skin," שָׁפֵל מִן הָעוֹר, denotes something different from "deeper than the skin," עֲמוֹק מִן הָעוֹר, is not quite clear. But probably the scar (*tzarebeth*) of the boil modified the appearance and induced an actual depression or "pitting" of the spot, like that which so often occurs after smallpox and *ecthyma*. The Arab writers described under the name *baras el abyad* or *white baras*, a disease which produced pits or hollows in the skin.*

In verse 24 another complication is dealt with. If there be a burning of fire, *mikvath aish* ("hot burning," A.V.), and the suspicious signs appear in it, the person is to be brought to the priest to be examined, and if the usual signs of white hair and deepness are there, he is to be condemned as unclean: it is *neg'a tzar'aath*, the plague of "leprosy." Nothing is said as to whether the burn was accidental or

* *Avicenna*, iv, 7, 2, 9.

intentional, and one cannot but suspect that a class of cases is referred to in which the anxious sufferer seeks to destroy the first signs of the dreaded disease by burning the affected part with a hot iron. The writer has known several instances in which the endeavour has been made to obliterate by this means the first signs of elephantiasis, and thus to prevent, or postpone, the person being sent away from his village into the abode of the lepers. Note in verses 21 and 22, 26 and 27, that "spreading" alone is sufficient ground for condemning the case as unclean, even though there be no white hairs, and the place be no lower than the other skin.

At verse 29 we come to a quite different kind of disease, namely, a plague upon the head or beard. The "yellow, thin hair" suggests at once a form of ringworm, which is described in almost the same words by modern physicians; the hairs "on the patch being of a yellowish-grey colour, dry, shrivelled, bent, and withered." The word translated "scall" signifies to pull out, and is remarkably appropriate to a disease in which the affected spot soon becomes "more or less denuded of hair." Spreading; the deep parts of the skin, that is, the true *dermis*, being affected; discoloured, weak, and brittle hairs; are still the signs by which the physician judges that this disease is not yet cured, and it is only when hair of the natural colour begins to grow on the affected spot that he pronounces the case healed. Other forms of spreading skin disease of the scalp and beard are doubtless included here. At verse 36 the priest is instructed not to look for yellow hair "if the scall be spread in the skin," the person being by that sign alone known to be unclean. It is noteworthy that these spreading diseases in which there is no yellow hair are not called *tzar'aath*, but only said to be "unclean" (ver. 36).

The harmless "freckled spot" in the skin (ver. 39) is still, in Arabic, called by the same name, *bohak* (بُهَاق).

The white or reddish spot, or rising, in the bald head (vers. 42-44), which is to be pronounced "utterly unclean," may be the tubercle of elephantiasis, or epithelial cancer, or some other kind of malignant sore or growth. King Uzziah's leprosy began in his forehead (2 Chron. xxvi., 19).

It may be remarked in passing that the extreme importance attached to the strict observance of the laws relating to leprosy (Deut. xxiv., 8) did not rest solely on sanitary considerations. Then, as in later times, "leprosy" seems to

have been looked upon as a type of impurity, perhaps of sin, and was, in certain instances, the immediate result of the divine displeasure, as in the case of Miriam (Numb. xii., 10), Gehazi (2 Kings v., 27), Azariah (2 Kings xv., 4, 5), and Uzziah (2 Chr. xxvii., 19).

8. *Lunacy*.—No doubt, as already remarked under “demoniacal possession,” many who were “possessed with devils” manifested symptoms of lunacy or insanity. The child mentioned in Matt. xvii., 15, is thought by some to have been “epileptic,” that being the commonly accepted signification of the Greek word employed. But “lunatic” is a literal translation of it; epileptics being supposed to be influenced by the moon. King Saul appears to have suffered for many years from intermittent attacks of the form of insanity known as *melancholia*, and seems to have ended his life by suicide, as such sufferers often do. King Nebuchadnezzar was afflicted with an aberration of intellect well known to those who make insanity their study. His pride and haughtiness; his delusion when he (probably) fancied himself an ox and ate grass; his neglect of his person, until “his hairs were grown like eagles’ feathers, and his nails like birds’ claws”; his slow recovery during a period of seclusion and freedom from care, resemble phenomena constantly observed among the insane at the present day.

9. *Palsy or Paralysis* is in its various forms the same everywhere, and only one or two cases mentioned in the Bible require a word of comment. The drying up of Jeroboam’s arm was miraculous and supernatural. In ordinary cases of paralysis the muscles waste from inaction, but the process is gradual, whereas the wicked king’s arm seems to have dried up suddenly and to have been as suddenly restored.

The impotent man who lay at the Pool of Bethesda and was healed by our Lord (John v., 2, 9) may have been suffering from a well-known disease in which there is progressive wasting of the muscles, producing inability to walk or stand, and eventually even to lift the hand to the mouth. Such cases often last many years. They are perhaps more frequent in Palestine than in the more northern regions of the temperate zone. The fact that this man’s infirmity had existed for thirty-eight years accounts for his being more helpless than even the other impotent folk, and renders his sudden restoration to health and strength the more striking. The admonition given to this man: “sin no more lest a

worse thing happen to thee," seems to indicate that his disease was due to an immoral life; a not improbable circumstance. To another palsied person whom He healed at Capernaum our Lord said "thy sins be forgiven thee," as if his disease also was the result of wrong living. The writer has known similar cases which were certainly caused, at least partially, in this way.

The woman mentioned in Luke xiii., 11, who "had a spirit of infirmity eighteen years and was bowed together and could in no wise lift up herself," was probably suffering from the result of chronic inflammation of the bones of the spine, such as may not infrequently be seen in our own country. It occurs more especially in delicate people who stoop much at their daily work. Farm labourers are peculiarly liable to it as they grow old.

The "crookbackt" person of Lev. xxi., 20, may have suffered in this way, or may have had destructive disease of the vertebral bones, or been born a "hunchback."

10. *Pestilence and Plague* are frequently mentioned in the Bible, and in some instances the two terms are used as synonymous (1 Chron. xxi., 14, 22). Four out of the five Hebrew words translated plague are from roots signifying *to strike*, like the English word plague from *plaga* and *πληγή*. The disease to which this term is now restricted (in so far as it has reference to disease) is the terrible "bubo-plague" or "Oriental plague," which has been known for many centuries in Egypt and Syria, and was perhaps known in the time of the Exodus. But there is nothing to show whether the plagues of the Bible were of this kind. That with which the Israelites were punished after eating the quails (Num. xi., 31, *et seq.*) may not improbably have been caused by the flesh of those birds having become poisonous from their feeding on some poisonous food. Pliny refers to this danger from eating quails. Or it may have been that the flesh had undergone some septic change which led to the formation of compounds (*ptomaines*) very deleterious when eaten. Isolated cases of this sort occur in our day, especially with tinned provisions. If this great mortality may thus be referred to known and secondary causes, this does not in the least throw doubt on its having been inflicted by the hand of Jehovah Himself.

The question naturally arises whether cholera may not have been one of the forms of pestilence mentioned? We do not know. There is nothing to indicate such a disease.

And the probability is that cholera had not at that early period spread westward from its birthplace in India.

11. *Herod Agrippa's Disease* (Acts xii., 23).—Much ingenuity has been employed in endeavouring to fix upon a disease to which the description "eaten of worms" would apply. But the probability is that the worms did not constitute the disease itself, but were only an accidental (Providential) accompaniment of it. Josephus (*Antiq.* xix., 8, 2) states that Agrippa suffered from severe pains in his body, probably dysentery, and any excoriations which might be caused by the discharges would very likely become infested with "worms." Such occurrences are very common in those lands. Herod the Great suffered in the same way (Josephus, *Antiq.*, xvii., 6, 5), and Antiochus Epiphanes is reported (2 Maccab. ix., 5-9) to have died under similar conditions. The writer has seen many instances of the presence of "worms" (maggots) in wounds and excoriations, and the rapidity with which they develop is marvellous. In one case the worms were found burrowed in the "proud flesh" of a neglected wound in the scalp; in another two or three dozen were taken out of a deep ulcer in the cheek; in a third a fresh crop presented themselves every morning in ulcers between an old man's toes, much to the surprise and vexation of the nurse, who thought their appearance might be attributed to his want of care. The flesh of Job was "clothed with worms" (Job vii., 5). During the Crimean war, at one sad period when the wounded soldiers could not be attended to without delay, their wounds were found "crawling with insects."

12. *Hizekiah's sickness, shekhin*, was probably a severe carbuncle, such as often proves fatal. A plaster or poultice of figs is at the present day a common application to boils, carbuncles, and abscesses, in Palestine. It has, however, been suggested that the disease was quinsy: the words "like a crane or swallow, so did I chatter," indicating a change of voice like that produced by the latter affection.

13. *Job's Disease* is by some confidently assumed to have been elephantiasis, or true "leprosy," but the Hebrew word שחין, *shekhin*, which is applied to it, is universally allowed to mean a burning ulcer or boil, which is not a characteristic of elephantiasis. It is perhaps impossible to come to any certain conclusion with reference to the precise nature of the infliction, but the following considerations may lead to a probable opinion. (1) Although supernaturally inflicted,

there is no reason to suppose that the disease itself was of an unknown or supernatural character. (2) It was painful, unsightly, covering the whole body, and disfiguring the features. (3) It seems to have poured out matter or formed scabs, which the sufferer scraped off with bits of broken pottery, or the "scraping" may have been to allay itching. (4) It was accompanied by severe constitutional disturbance, producing loss of sleep; emaciation; depression of spirits; weariness of life; (5) The patriarch's system had no doubt been weakened by the bereavements and losses he had sustained.

All these symptoms are characteristic of the disease known as *ecthyma* in an aggravated form. A distinguished modern writer on skin diseases describes *ecthyma* as "an eruption of large pustules dispersed over the body and limbs, beginning with itching and tingling, then bursting and forming a yellowish-grey scab. When the scab is removed a painful, ulcerated, and often sloughing surface is exposed, the crust which afterwards forms over it being black, with thin and livid edges. It is slow in progress, very painful, and of long duration. This disease in its severe form is of a cachectic character, associated with symptoms of general disturbance of health, and more or less fever of the irritable or hectic kind."* We seem in this description to be reading a summary of the sufferings of Job.

DISCUSSION.

The CHAIRMAN.—We are very much indebted to Dr. Chaplin for the light he has thrown on diseases recorded in Holy Writ and for his contribution to our knowledge of the Bible in regard to them derived from his long stay in Jerusalem and his exact medical knowledge of several of those diseases mentioned several centuries ago.

I shall await any remarks that any of you may like to make upon it.

Professor LIONEL BEALE, F.R.S., F.R.C.P., in response to the

* *Diseases of the Skin.* Erasmus Wilson. London, 1868. Pp. 309-10.

Chairman, said: I am afraid I have very few remarks to make on Dr. Chaplin's most interesting paper, but perhaps I may be permitted to offer one or two general observations. It seems almost certain that some of the diseases which occurred in those early days afflict man now. Some of the features that are described are features with which we are acquainted, dysentery, for instance, and typhoid fever. Typhoid, dysentery, and perhaps, cholera occurred in those days, but the symptoms of course would be described somewhat differently. We must not forget that the treatment in ancient times was very different from that which we should now advocate, and the great care taken of the sick in our time is beyond comparison with anything that could then have been provided.

It may be said generally that diseases are much less severe and more under control than formerly, but the actual changes in the human body were probably in their nature much the same as regards the changes in the blood and the tissues and organs.

Again, there is one thing very remarkable to notice with regard to contagious diseases. It is only one person among many who falls a victim to many of the poisons, and in former days the active material which entered the body, was much more virulent than that which we meet with, and those ministering to the sick were much more likely to contract the disease than is the case now. But unfortunately it is not possible to determine who is, and who is not, susceptible. Some individuals seem exceptionally liable, while others seem almost proof against the influence of the poison, or its entrance into the body. What determines the unusual "susceptibility" or the resistance to attack is not certain. The only answer that I have ever heard to the question is that the individual attacked is "unduly susceptible"; or the equally vague suggestion that he is unusually "vulnerable"; but exactly what was meant by those who were so much more learned than the rest of us has not been made clear. That some of us do escape in a wonderful way in spite of exceptional exposure is certain. In very early days we used often to have three or four cases of disease in a ward of twelve or fifteen beds, and many of us, though sometimes exposed for several hours daily, passed through perfectly scatheless. Many of us have been amongst all kinds of fevers and other contagious diseases without contracting one; and I do not believe I have ever had even the

mildest attack of scarlet fever though for many years I was daily exposed. How many of us escaped I cannot tell you, but I have no doubt that in some measure the apparent immunity depends on the healthy condition of many of the living particles of the organism, and their power to resist the action of the contagious living particles, and their power to destroy them even though they gain entrance to the body in health; its new tissues being everywhere pervaded with fluid in constant motion, and the products of decay and disintegration being removed as fast as they are formed, may possibly be the explanation.

Professor ORCHARD.—Would “phagocytes” have anything to do with it?

Professor LIONEL BEALE.—By eating up the bacteria?

Professor ORCHARD.—Yes.

Professor LIONEL BEALE.—But everybody does not suffer from bacteria. They only take hold of one of us here and there; but a great many absolutely escape without injury by the minute pests. It would be very interesting and nothing could be more important if we could only find out why it is nurses, physicians and medical students seem to withstand the bacterial armies of invasion. The probability is that in steady good health the noxious organisms, by the constant interchange of fluid, and the impossibility of stagnation of the general and interstitial circulation, the living particles are soon destroyed if we are healthy. In every part of the living body except the dry tissues on its external surface, and part of the tooth structure, new nutrient particles are being constantly caused to live and take the place of the matter that dies. The products of tissue decay, and the matter resulting from death of the old particles *must* be removed; and I conclude that those persons in whom there is a free and proper removal of the products resulting from the death and disintegration continually proceeding, are more likely to escape than those who do not take care to introduce into their organisms sufficient fluid to dissolve the nutritious matter required and to carry away the products of vital activity and tissue disintegration and decay, are more likely to suffer than those in whom the circulation of fluid throughout the organism is free. In short, I believe that those who take a proper quantity of water in the course of every twenty-four hours are more likely to enjoy continuous good health, and to resist the influence of noxious bacteria and other deleterious agents, than those

who take strong drinks and a liberal amount of very solid food, more than their organisms need. It is interesting to find that some of the very ancient diseases (particularly leprosy) were probably much the same and quite as terrible as in modern times. Leprosy is very obstinate, and is an example of a contagious disease which is perhaps only contagious after long and frequent exposure. Few seem to take the disease who merely visit the sick, and the physicians who look after these cases usually, I believe, escape altogether. Only those who live in a very insanitary manner for a considerable time are attacked. The disease is attributed, I believe, to bad dried fish. The germs probably grow and multiply in this unsatisfactory food.

The SECRETARY.—I would like to ask one question of Professor Beale. Dr. Chaplin has stated that he does not think small-pox existed in the days of our Lord, or before that period. Could he give us some idea as to when and where small-pox originated? We know it has been a terrible scourge, particularly amongst the aboriginal tribes where Europeans have entered into their country and mingled with them, as it was in North America; but when small-pox was first known in Palestine, and, I suppose, other Eastern countries (for it is a terrible scourge in India at the present day) is a question that I should like to have answered. As to one point he raised I have always believed that doctors and clergymen are under a special Providence when performing their important duties.

Professor LIONEL BEALE.—It is very difficult to answer our Secretary's question about small-pox, for I have not looked up what has been ascertained concerning the origin of small-pox. The disease has existed for some centuries. In some instances the recent epidemics seem to have been terribly severe, and about twenty years ago I saw one of those sad cases, and heard of others of what used to be called hæmorrhagic small-pox, which had been contracted in Paris, and was fatal in less than a week from the first symptoms of illness. The disease is very likely to be taken by persons unprotected by vaccination, of whom, however, there ought not to be now one in any part of the country. The minute living contagious particles may be introduced through the breath, and are so light that they may be carried long distances through the air. The living particles do not belong to the bacterial class. No bacterium can be identified

as the factor of the disease. But in small-pox lymph and also in vaccine lymph are very minute particles of living matter which I believe to be the actual disease-carrying germs. These are figured in my work on *Disease Germs*, published about thirty years ago, and also in my report on the cattle plague to the Royal Commission.

Unfortunately the public are not aware that vaccination is practically harmless and absolutely certain in its action as a safeguard. I do not believe that it would be possible to find a single person who had been successfully vaccinated a few years before, would take the disease if exposed to small-pox. The risk of the vaccinated taking the disease after several years is infinitesimal. But this fact, I regret to say, is not as widely known as it should be; and just as there are people whose main object in life seems to be to oppose or object to many things that are reasonable, there are some who condemn vaccination, and object to anyone studying the circulation of the blood in a frog's foot and many other harmless and very instructive proceedings. Can there be a greater reproach to us than the terrible epidemic now raging, and which we all know to have been preventible? I feel sure that if the advice of the medical profession had been taken years ago the present epidemic would not have been possible. The enormous sums required for taking proper care of, and treating the unfortunate patients who have contracted this absolutely preventible disease, perhaps amounting to two or three hundred thousand pounds, might have been saved.

I am sorry not to be able to offer any opinion whether any of the diseases described by Dr. Chaplin should be regarded as small-pox. The description which has come down to us seems scarcely definite enough to enable us to judge.

The CHAIRMAN.—Perhaps I may be allowed to make a few remarks. I am not an M.D., but I can quite endorse what has already been said that I believe medical men and clergymen, nurses, and attendants on the sick are under a special providence and enjoy a very marvellous immunity from disease. I have worked under five bishops in London, and in various parishes, and I do not think I have shrunk from visiting any form of ailment except small-pox. I *did* "fight shy" of houses where I heard there was small-pox. In my humble capacity I can bear testimony to what has just fallen from Professor Beale,

that certain persons are more susceptible to certain diseases than others from their habits of life. When I was an East-End curate, in my early ministry I remember it was said that sailors were more amenable to cholera than others because of their intemperate and free-and-easy living. I suppose that is so.

On page 256 of the paper Dr. Chaplin says, "Diseases of the eyes are very prevalent in Egypt and Palestine. Probably in no other countries are there larger proportions of blind people." I can testify to Jerusalem and Cairo and Damascus, that although many are not totally blind, there are as many, perhaps, with one eye as two orbs.

There is one matter that I think Dr. Chaplin has omitted as to the cause of blindness, or originating ophthalmia, and that is the flight of the common house-fly from one person to another, and especially in the case of infants. The fly carries the ophthalmic germ from one infant, whose sight is nearly gone, to another wretched infant. The mother does not care to brush them off, she says it is "Allah fated."

In regard to lepers I have seen them between Jaffa and Jerusalem. They do not stand "afar off" now, unfortunately, crying out, "Unclean! Unclean!" but they come and clutch you by the shoulder. There are no police to order the beggars off, and it is therefore very awkward. The Russians have built a hospital there for them.

Professor ORCHARD.—The author at page 263 of the paper, the beginning of the last paragraph, says, "That a local outbreak of *tzar'aath* in the skin should be unclean, and that when it had covered all the skin it was to be pronounced clean, seems at first somewhat puzzling"; but I suppose the explanation might be that when the disease had covered all the skin it had exhausted its energy. That would seem to be the natural explanation. This reminds me of a remark of Lord Bacon's on speaking of the leper. "A leper, when all covered over with sores, might be pronounced clean; but when he was partially leprous he was pronounced unclean because when he was covered with leprosy people would be aware of him, but when he was partially so they would not, and so he might do great harm in spreading disease."

With regard to demoniacal possession, on page 259, Dr. Chaplin seems to doubt whether the thing goes on in the present day; but I read, not very long ago, accounts written by missionaries of the

presence of this kind of thing in China and also in Africa, and, for aught one knows, it may be in this country too. I could have wished that Dr. Chaplin had written a little more with regard to this interesting and mysterious subject. It would appear, as far as I know, that it never takes place unless there is, first, a surrender of the will on the part of the human being. He must surrender his will to the devil before anything of this kind ever takes place.

I am sure our thanks are heartily due to Dr. Chaplin, and hardly less so to Professor Lionel Beale for the valuable remarks he has made to us.

REV. JOHN TUCKWELL.—I would just call attention to the fact that with regard to what has been said concerning Bacon's remark, in the case of Gehazi, who is said to have gone out from the presence of Elisha "a leper as white as snow," he was afterwards admitted into society; so that he was brought into contact with society at the time, and they do not seem to have thought of contagion from him, for he was afterwards relating the wonderful things done by Elisha. So that it hardly seems that Bacon's explanation is worth anything.

As to demoniacal possession it certainly should not be confounded with madness or with epilepsy, for in the Gospel of St. Matthew you have, in one verse, the two things used, demoniacal possession and *σεληνιακός*, the Greek word for lunacy. It is peculiar, too, that in three languages, the Greek, Latin, and our own, we have lunacy connected, in some way or other, with the moon. The Greek word is "moon-struck"; the Latin word is "moon-struck"; and we have the term "moon-struck" in our time.

Leprosy seems to have gone back to an early period. It seems to have produced the growth of long white hairs. So that in the early history of our race we seem to have an allusion to some of those very remarkable and interesting diseases.

I think the paper is very suggestive, and a very valuable one, and I am also glad to have heard such remarks as those from Professor Beale.

COMMUNICATION.

The following note on Dr. Chaplin's paper has been forwarded by Dr. E. W. GURNEY MASTERMAN, F.R.C.S., D.P.H., of the English Mission Hospital, Jerusalem.

The "uncorrected proof" copy of Dr. Chaplin's paper, "On some diseases mentioned in the Bible," has just reached me to-day, May 21st, and therefore too late for me to write before the meeting. As I have for the greater part of the last ten years been practising as a medical man in various parts of the Holy Land, I venture to add a few criticisms.

It must always be, as Dr. Chaplin points out, a matter of much uncertainty to identify the "diseases of the Bible" from the extremely meagre descriptions we hear. This identification too is all the harder from the fact that the accounts given are quite unscientific. A medical man to-day would often find it hard to recognize a disease from the brief account of a layman, specially one entirely ignorant of science. In this land of Palestine I almost daily receive descriptions of diseased conditions, which, on examination of the patient, turn out to be utterly incorrect. Then, secondly, it is now generally recognized that there has been a slow evolution of disease, some may, nay, probably have, disappeared, others, unknown in Old Testament times, are now prevalent. Tubercular diseases, specially phthisis (*i.e.*, consumption) which are now increasingly rampant in the cities of Palestine, would appear to have been quite rare early in last century. Influenza here, as in Europe, has been recently re-introduced, and receives the name among the natives to-day of *Abo rikab*, *i.e.*, the father of the Knus, which, in Dr. Chaplin's time, seems to have been compared to dengue. Scarlet fever is exceedingly rare, and many doctors of great experience in the land deny that it occurs, but German measles, which closely simulates it, is a common epidemic.

While then it is hopeless to be scientifically sure regarding diseases in such ancient times, the best hope we can have of coming to a right conclusion lies in studying, as Dr. Chaplin has done, those diseases which are common in the land, and specially among the Jews, to-day.

Without committing myself to any theological opinion regarding the vexed question of *demoniacal possession* I would point out that

all, or nearly all, forms of madness are almost universally to-day asserted by the people of Palestine to the work of demons, or *jinn*s. The very word used for lunacy being *mejnūn*, meaning literally "possessed by devils." Among all classes, Christians, Jews, and Moslems, this is the pathology of lunacy, and the remedy always, unless the case speedily recovers spontaneously, or while taking "franju" medicine, is exorcism in some form or another. In some cases patients are left at sacred spots dedicated to *El Khudr*, *i.e.*, "The Green," the Elijah of Jews and Moslems, the St. George of Christians. Such places are usually underground caves, as those at El Khudr (the Convent of St. George) near Jerusalem, at the Convent of Elijah on Mount Carmel, and in the Synagogue of Joba, near Damascus. In other cases more definite exorcism is performed distinctly with the idea of drawing or driving out the demon causing the disorder. It is a favourite trick of these exorcisers, who are usually Moslem sheiks, to graphically describe to the patient how the devil is gradually drawn downwards till finally he quits at one of the great toes. I have had it gravely described to me that the toe from which the devil was finally expelled became inflamed shortly afterwards, showing clearly his malignant influence at the moment when he had to abandon his victim. The Spanish Jews of Jerusalem have an ancient and elaborate ritual called "Indulca," which is used for such cases. It is manifestly a form of exorcism. The *mejnūn* are, if harmless, treated with a considerable amount of respect for fear of the demon, but if violent they are avoided as much as possible. A violent maniac is not uncommonly chained up and his food passed to him through a crack in a closed door.

Any European doctor curing a case of madness would certainly be described by the ignorant *fellahin*, Eastern Jews (*e.g.*, in Damascus) and a large proportion of the ordinary townspeople, as having turned out the devil from one "possessed."

Fever and bloody flux are so commonly associated along the Mediterranean that there is little need to look for an interpretation, such as must occur to a doctor practising only in England, of typhoid with hæmorrhage. A very large proportion of unlocated cases of malarial fevers end in dysenteric symptoms, *i.e.*, the passage of blood and slime from the bowel, and before the days of quinine this must have been still more common.

Herod Agrippa's disease has long seemed to me to admit of a more natural explanation than that Dr. Chaplin gives, that "excoriations . . . would very likely become infested with worms," *i.e.*, maggots—as we read of occurring in the case of Herod the Great. Two observations made in Palestine to-day appear to me to throw light on the occurrence. Firstly, that among the common people (I find it every week when I see the *fellahin* of Siloam at my dispensary there) almost all severe abdominal pain is put down to "worms," *i.e.*, to the "round worms" and "tape worms" with which the people, specially the *fellahin*, are infested. Secondly, that it is quite common, I have witnessed it myself, that when a patient is extremely ill, for large quantities of these worms to be discharged both by mouth and rectum shortly before death. Sometimes indeed the worms themselves give rise to the most alarming symptoms, as I witnessed in a patient who was only relieved when she vomited up between fifty and sixty "round worms." The first idea and then the appearance of the worms would readily give rise to the *popular* version (notice Josephus does not mention it) that Herod Agrippa was "eaten of worms." The version of his death which we have in Josephus would fit it best with a "strangulated hernia," or some other form of abdominal obstruction.

Regarding *Job's disease* I quite agree with Dr. Chaplin, but mention it because I have seen it suggested that the disease may have been a form of "Oriental boil." This "boil" known as the "Aleppo button," "Baghdad date," etc., never occurs in Palestine *de novo*. I have seen hundreds of Jews from both Aleppo and its neighbourhood and Baghdad and have never failed to find evidence of the "boil" either actually discharging or in the form of a scar—usually on the face; I have even known a child who suffered for many months who was only in Aleppo for, I think, fifteen days. Further the "Oriental boil" in such cases is usually either single or at most in half a dozen places, and though chronic and unresponsive to treatment does not cause any great suffering.

Dwellers in Jericho are apt to get a crop of chronic boils ("Jericho boils") at some seasons of the year, but it is very doubtful if this is in any way a "specific disease."

The most original and by far the most important part of Dr. Chaplin's paper is that in which he gives his views on *leprosy*.

It has always seemed to me that the attempt to square the accounts in Leviticus with the physical signs of the disease *Elephantiasis Græcorum*, popularly known as leprosy, is quite hopeless. I think that Dr. Chaplin is quite correct in his opinion that in the Old Testament descriptions we have references to a number of skin diseases then considered contagious, such for example as "ringworm" and "favus," both of which are exceedingly common among the Jews of this land to-day. It is probable, however, that as the conditions of life have been largely changed the manifestations of disease may be so much altered that we cannot recognize familiar diseases, or, equally probably, some of the particular diseases here referred to may have been stamped out.

There is some probability that the leprosy of the New Testament may have been the disease we now know; indeed the references we have to the lepers are constantly being brought to one's mind by seeing the wandering groups of lepers in the land to-day. Leprosy, *i.e.*, *Elephantiasis Græcorum*, is not now a common disease in Palestine, but for many reasons the lepers are very much in evidence. They are all segregated in four centres, *viz.*, Ramleh, Jerusalem, Nablous and Damascus, where they have houses provided for them by the Government. They, however, live by begging, and haunt for that reason the most public places as well as freely mixing with the general population in the roads and markets; probably in the land, *i.e.*, in the "Holy Land" proper, there are not more than 150 individuals.

With the exception of those gathered in the Moravian Leper Hospital in Jerusalem, at present numbering fifty-four, these unfortunates receive no medical aid; it is freely offered to them by the Moravians and others, but they do not care for it. One medical man in the land told me he had made persistent efforts to help them, but they will not continue any treatment except when under the discipline of a hospital, and to that many object. Most of the lepers are *fellahin* from the villages and the cases usually appear to occur sporadically. I have, during the past ten years, seen but three genuine cases of leprosy among Jews.

Many of the analogies made popularly between leprosy and sin are unfortunate. Leprosy is (1) *not* inevitably fatal; cases of anæsthetic leprosy may after long years spend their violence, as it were, leaving the patient a wreck it is true, but free of that

disease to die of quite other causes. (2) It is *not* hereditary. When children are isolated from leprous parents at once they may grow up quite healthy to my knowledge; and (3) it is only very slightly *if at all* contagious.

The SECRETARY.—The next meeting will be the Annual Meeting to be held on 26th May. The date is earlier than usual because it is to meet the convenience of the distinguished man who is to give us the annual address, viz., General Sir Charles Wilson, and I hope we shall have a good and successful meeting, which will depend on members all doing their best to make it so.

The Meeting then adjourned.

LETTER TO THE SECRETARY FROM CHEV. W. JERVIS, F.G.S.

“ Luserna San Giovanni,

“ 26th April, 1902.

“ My dear Sir,

“ It is only this month, during the continual rainy days in the Alps, where I am come for a short time, that I have had a moment's time to read vol. xxxiii of the *Transactions of the Victoria Institute*. I am deeply impressed by the very high class of the papers read there, from many of which I have learned a great deal, and with the statements expressed, in the greater part of which I fully concur, or consider to be most plausible, so far as my knowledge, which is so limited, can judge of. In the discussions, which are often excellent, many too hazardous statements are courteously signalled. Thus I feel what a privilege it is for me to belong, as a modest Associate, to an Institute in which science and belief in divine inspiration are not considered to be divorced, much less antagonistic and contradictory.

“ What a field lies before the Members in the more accurate study of ethnology, physical geography, geology as elucidating the former coast lines and orographical conditions, the Tertiary constitution and conformation of the bed of the then existing seas, which study I ventured to propose to style ‘Thalassography’; ancient history of the most ancient races, as it were but now unearthed, after lying buried for a score or two of centuries! The choice of the subjects, taken in general, appears to me to be extremely wise, and moreover to be such as to interest one in most cases, since the

very varied studies converge to one grand centre. Few *Transactions* of general academies gave such little trouble to the single student in picking and choosing such memoirs as may be useful to him individually. They are all rich materials for thought.

"It is only since the publication of my lecture *On the Creation and Revelation* that I have read some remarkably analogous convictions expressed by the authors of the papers in vol. xxxiii, quoted above, as also by members during the discussion.

"Twenty-two years ago, in my lectures *On Gold*, printed in 1879 I laid stress on the antediluvian high civilization, and in my conviction that our first parents were created as the most glorious type of humanity, possessed of a grasp of mind and knowledge such as could be compatible with their pure, sinless condition, in continual contact with God, and exempt from sickness, suffering, and error. In various writings I have sustained that, as the crowning work of the terrestrial creation, logic itself would go to prove—apart from what we all know as certain—that man was not cast as a shipwrecked mariner, destitute of all knowledge or experience, on the unfriendly, unknown shores of the world, to dispute his bare existence with the beasts of the forest.

"As in geology we find the most magnificent types in the Cambrian and Silurian fauna, so the volume alluded to adds to our faint knowledge of the grandeur of prehistoric relics of human art, and proves the rashness of those who have affirmed that civilization is but an outcome, an 'evolution,' of the most contemptible stage of degradation and savagery. Could anyone holding such belief of primitive mankind conceive of the prophecy of the incarnation of the Son of God made to Eve in the Garden of Eden? Could the brain of an anthropic bastard gorilla be capable of realizing that glorious promise? I do not see one sound argument for any form of 'evolution,' I see no chain of life, no generic or even specific transition. Can we not learn some day that specific names have frequently been given to mere varieties? Of course, scientific, wise caution renders this often prudent until our knowledge on the particular subject can justify our identifying individual forms manifesting immaterial differences. Only of late, while studying the latest *Memoirs of the Geological Survey of India*, I was impressed by seeing that a magnificent series of Brachyopoda were illustrated, and not one of them had a specific name attributed to it identical to European

species; but the remark was frequently put: "allied to such an European species." Since Murchison, Verneuil, D'Orbigny, and others give lists of mollusca from the Crimea identical with those of France and England, since they are also found in many intermediate localities, so it may yet some day be seen of Indian Brachyopoda. May not local conditions likewise modify the typical forms within slight limits, without affecting specific characteristics? In fact, it seems quite possible to consider immaterial differences as specific, from a too conscientious and minute examination; nor are we able to find a sufficient proportion of buried individuals to enable us to prove how far such minute variations were or were not confined and perhaps transient. Mr. Whidborne in his lucid, mathematical criticism of the vaunted bugbear of 'evolution,' has rendered a true service to science by pointing out the incalculable danger of forming pet hypotheses, and then bending truth; to endeavour to pronounce as facts what are mere day-dreams. His magnificent geometrical figure comes to me as a grand and convincing novelty. Heartily do I agree with him when he acknowledges the fascinating results obtained by 'evolutionists' by their hypothesis that all existing forms of fauna sprung, fan-like, from one original protoplasm. Unfortunately these 'evolutionists' admit no examination of their assumptions, but boldly put their Q.E.D. before us, scorning all examination. But if they are just they must take up the gauntlet thrown down so courageously by Mr. Whidborne with his parallel lines. The same figure may be made to illustrate numerous palæontological facts, which Mr. Whidborne is well fitted to demonstrate to us.

"He insists wisely on our very scanty knowledge of the palæontological records, and would not this be fatal to evolution in such cases as the types of Cephalopoda and Saurians? For in either instance, whether we look at the number of species or of the genera, it would appear to me that in the successive ages of the world the geometrical figure would represent converging lines directed forward. Many of the families which possessed the highest development have long ceased to exist leaving no kind of successors.

"In the Preface of my work *I Tesori sotterranei dell' Italia*, vol. iv, I insisted on the outer agency of man in producing variety within the limits of species. There is nothing in the animal

kingdom equivalent to mind. Yet I almost fancy that Mr. Whidborne concedes far too much to evolutionists. There is an immense difference between a noble mastiff and an Italian greyhound, yet no naturalists even dreamt of giving them two specific names; the same of man himself in the case of the negro and the Caucasian. In both these instances the descendants are prolific; but man, in his unnatural desire to improve upon creation, is powerless to obtain a prolific mule by evolution forced upon individuals belonging to kindred but distinct species.

"I see that Dr. Walker, in connection with a paper on *Art in Australia*,* declares that man, as he came forth from the hand of his Creator, had he been a savage, he did not think he could have got any further, but that he thought the essence of humanity of the best type was in him, though his higher powers and the actual thoughts of his mind would be, naturally, developed at a later stage. Such I firmly believe to have been so. Many years ago I described Adam to have been a gentleman, and in my lecture *On the Creation* as having, through his intimate converse with God, and his pristine exemption from imperfection, a mind superior to Newton, Galileo, or Laplace.

"What of our present knowledge of the ethnographical and archæological records? The opening rolls which are the most important on account of their high antiquity, have never come to light. In comparison, I consider the geological records to be even better known to us.

"After reading the paper on *Eolithic Implements*, my confidence was especially shaken by seeing that the so-called Eolithic works of man were invariably obtained from excavations made in a line of gravel pits. Apart from the presumed antiquity, I should desire to learn some plausible explanation of such strange circumstance. How could man's work become buried in the very place whence he obtained the materials for making it with supposed care and trouble? What carelessness! Again: Since such great numbers of such implements have been collected, would it not go to prove the existence of an immense population, accurately peopling a given geological zone, but of which we never found a single trace of another kind, nor even these objects in other parts? Major Angelucci showed me a most extensive collection of flints which

* R. W. Mathews, "Pictorial Art in Australia," vol. xxxiii, 308.

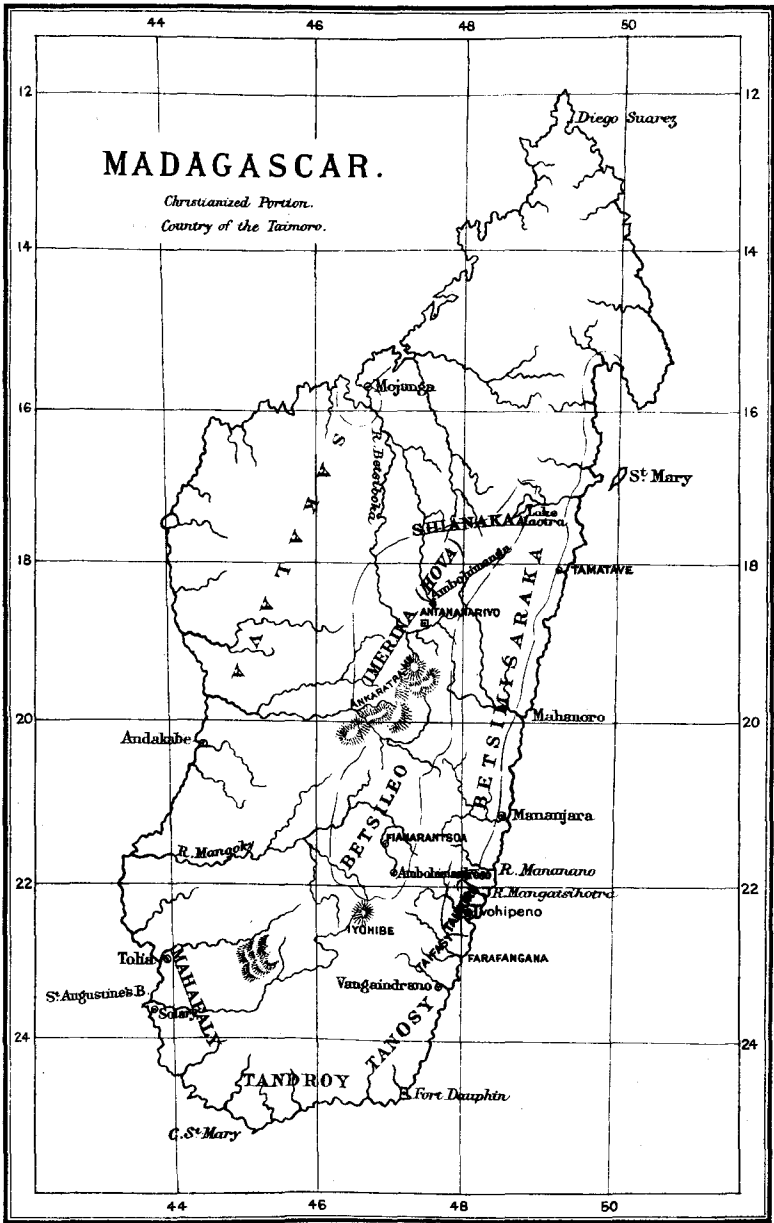
he had found on Monta Gargano (Foggia). He drew and described them as prehistoric implements, ascribing uses to each type of form. He said that they could be picked up there everywhere with a careful search. I saw nothing in them but naturally fractured chert, or a variety of flint so abundant in the compact Cretaceous limestone. I consider all these Eolithic objects to be exclusively natural forms. I myself picked up a piece of obsidian in the island of Lipari so like a knife or other cutting implement that I was long tempted to forget that I could have freighted a ship with obsidian at that spot. A flint of like shape I found at Langrune, in Normandy, of mere accidental form. Enthusiasts too often look to mere form. Many 'palæolithic objects' were never handled by archæan man.

"The more interesting and reliable papers on ancient races in Western Asia, Australia, and Oceania seem to point plainly to the decadence rather than to the progress of man in certain parts of the world. They may yet afford similar materials for research to Nineveh and Troy. I have not ever seen stress laid on the impulse which *power* and *wealth*, as also *commerce*, had given to the development of artistic or well-formed objects. What inducements have poor, defenceless races, without commerce, to spend their time in learning the useful arts? The riches of Greece, Rome, etc., encouraged and paid skilful artisans. I received at the Royal Industrial Museum, as a gift of King Humbert, a most remarkable collection of toys, made in Calabria by the semi-barbarous natives. It is ethnographically invaluable. You might well take it to be pre-Roman, were you not to recognise an object evidently intended to be the maker's conception of a railway locomotive. What different workmanship at commercial Naples? In all times, I presume, there must have been rude objects contemporaneous with the finest works of art and industry.

"I am, my dear Sir,

"Yours faithfully,

"W. JERVIS."



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This map was omitted unintentionally from Vol. XXXIII but is here inserted for reference to paper by the Rev. G. A. Shaw F. Z. S. on "The Arab Immigration into S. E. Madagascar Vol. XXXIII p.

CORONATION ODE.*

Is there a man of British birth,
 No matter how or where he fares,
 Who does not feel to-day the worth
 Of all he is and all he shares.
 What though he walk 'neath alien skies,
 The old traditions 'round him cling,
 The patriot spirit in him cries
 Aloud, God save our Gracious King !

The monarch, with majestic rites,
 Assumes his vast inheritance,
 The vows and pledges he recites,
 Which consecrate him to advance
 The glory of this ancient throne,—
 A splendid but a solemn thing,
 He needs a strength beyond his own,
 Wherefore we pray, God bless the King !

The reverent service, praise and song
 Of those in supplication bowed,
 The countless multitudes who throng
 The streets, the plaudits of the crowd.
 The beacon fires on every peak
 Which through the night their radiance fling :
 All these one aspiration speak,
 May God preserve and guard the King !

In far-off lands and distant coasts
 Unnumbered hearts rejoice to-day,
 Thanksgivings rise from wondrous hosts
 Who gladly live beneath his sway.
 Wishes and hopes, like homing birds,
 Fly through the world on eager wing ;
 And loyalty, in deeds and words,
 Delights to say, God keep the King !

May he live long. And may the crown
 Derive new lustre from his reign.
 Let honour, righteousness, renown,
 His glorious legacy remain.
 Our hearts are his. It is our pride
 And joyful privilege to sing
 In weal or woe, whate'er betide,
 We love, and may God bless, the King !

GERTRUDE DARLOW.

Los Angeles, California.

* This fine ode from across the Atlantic was composed by its gifted author for Coronation Day, June 26th, and reached the Editor's hands on the eve of the actual Coronation, August 9th. To its merit and opportunity it owes its place in this Volume for 1902.

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