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ARTICLE IV.

SCIENTIFIC AUTHORITY: ITS USE AND ABUSE.

BY J. F. SPRINGER.

TO-DAY is a time in which it is peculiarly true, that many of the enemies of the cross of Christ, in opposing him, who is himself the truth, are persistently and vigorously, not to say clamorously, claiming that their opposition is founded on truth. As these claims, making thus their appeal to truth, and apparently in good faith, are causing deep distress among multitudes of serious and earnest Christian people, it will be a service well worth the performance, if it can be made clear just what is at the foundation of a large class of these claims. In doing this, one can scarcely do better than (1) to point out that one great reliance of the opposers of the doctrine of the immediate revelation of God in Christ is found in Scientific Authority; and then (2) to proceed to an exact, if not exhaustive, analysis of the strength and weakness of this same Scientific Authority.

A brief illustration of (1) must suffice. It is a fundamental proposition among the destructive higher critics, that the use of two distinct names for God in Genesis i. and ii., taken in connection with other less clearly definable circumstances, affords evidence competent to establish the inference of plural authorship. Now the weighing of the significance of this distinction in names,—whether it points to one author with two purposes, or opposes unity of authorship,—and the consideration of the other more evanescent, but perhaps not less

ambiguous, circumstances, evidently make our assurance of the truth of the inference dependent, not upon scientific criteria and methods which we ourselves may re-apply and which have been established with a high degree of certainty, but upon such personal factors as human judgment, feelings, and moral tendencies of truth. A proposition, the evidence of whose validity is thus dependent upon personal testimony, may truly be said to be based upon Authority; and, if the authority is that of scientific men, we may say, loosely, that it is Scientific Authority. I wish, at this juncture, not to make any appraisal of Scientific Authority, but to point out that there is a very large class of propositions, assurance for whose truth has practically no other basis. It is important to see that a direct consequence of this is that such propositions are entitled to precisely that credence which a sound analysis of Scientific Authority would grant them,—no more and no less. A proposition having no other foundation than such Authority has precisely the same value as that possessed by the personal testimony upon which it rests.

I do not wish to decry Scientific Authority. It has its value, and oftentimes it is a very great value. At the same time, the cause of truth will be served by pointing out the limitations to which it is subject. Let us then consider the Use and Abuse of Scientific Authority under the two divisions of (1) Uncorroborated Scientific Authority and (2) Corroborated Scientific Authority. But, before doing so, it will be of value to explain why it is often necessary to have recourse to Authority at all.

In the first place, the immediate subject-matter of many propositions of the deepest import to mankind is, on account of its complexity and difficulty, inaccessible to all but experts. The method may be simplicity itself, and yet the character of the subject-matter may be such as to confine its consideration

to specialists. Again, the methods may be so involved, and difficult of application,—even though the subject-matter be simple,—that none but persons gifted and specially trained are competent to deal with the questions. Of course the exclusive character is all the more increased when both methods and subject-matter present difficulty. So, for the reasons adduced, we are often compelled to resort to Scientific Authority. But this very necessity should impress us with the indispensability of just and exact ideas as to the appraisal of personal testimony. Let us now proceed to the consideration of

UNCORROBORATED SCIENTIFIC AUTHORITY.

Now, in order to secure just and exact ideas of the value of testimony, it is necessary to have recourse to one or two elementary propositions in the mathematical theory of probability. For the benefit of those who have made no serious study of this subject, let me observe that this science does not aim, when properly understood, to say how things really *are*, but what our attitude should be with such and such evidence before us. Thus, if the reliability of a witness is such that we may depend upon his testimony nine times out of ten, and is therefore valued at .9, we do not mean that his next ten testimonies will certainly, beyond all peradventure, be nine true and one false. The theory of probability cannot be expected to be such a system of infallible prophecy. What is to be understood is this: We do not know how the next ten testimonies will be. They may all be true, or all false, or half may be true and half false, when we come to the trial itself. In fact, the actual outcome, in the absence of full information as to the contributing causes, neither probability nor any other scientific system will enable us to foretell. But we may have to act—either by yielding assent or in some other way. What should our attitude be with incomplete evidence before us?

This is the question that probability does answer, and answer with great precision. Our attitude, in the case presented in our illustration, should be that of expecting nine true testimonies and one false one. This is the best that can be done with the available evidence. But if more evidence comes into play, a previous estimate of probability becomes immediately worthless, and the new one which takes into account the whole evidence at hand is the only one that should control our attitude. It will thus be seen that probability deals with the subjective side. And it is all moonshine to expect anything else of it.

It may seem to some that, this being so, no very great value is to be attached to its results. That this is not the case becomes apparent when we reflect that it is very seldom—perhaps never—that we act with full evidence. When, for example, I recognize my friend and greet him, I act on very incomplete evidence, indeed,—simply upon the concurrence of a few familiar patches of color, together with the forms, sizes, and disposition of the same. When I mail a letter—or even go to the additional precaution of registering it—I am acting with incomplete evidence of what will become of it. But, in such cases, act we do, and act we must. Complete evidence will never be forthcoming. It is, therefore, a matter of very great importance, indeed, that we should make the very best use of what evidence we do possess, and assume the attitude that this evidence bids us. This is the object of probability.

I would beg the friends of truth, then, to bear with me in the consideration of a mathematical formula or two in the course of this article. Consider first the formula

$$P=p_1 \times p_2.$$

In this formula P , p_1 , and p_2 all represent probabilities. As the symbol of absolute certainty is 1, these probabilities are,

as a rule, proper fractions, that is, have a value between 0 and 1. To illustrate the meaning of this formula: If the probability (p_1) that your friend A is a pretty truthful man is .95, and the probability (p_2) that he is a man of great intelligence is .85; then, by means of this formula, the probability (P) that A is *both* pretty truthful and very intelligent is $.95 \times .85$. That is $P = .8075$. To put the matter more generally, if p_1 represents the probability of the occurrence of an event, and p_2 the probability of the occurrence of an entirely disconnected event; then the value of P, found from the formula $P = p_1 \times p_2$, is the probability of the *occurrence together* of these two independent events.

Recall now that in general p_1 and p_2 are each less than 1, and observe that the product of two fractions each less than unity is a value less than the smaller of the fractions. In our numerical example, the product of the fractions .95 and .85 gave a result, .8075—less than either. That is, it is less probable that A is *both* pretty truthful and very intelligent than it is that he is either pretty truthful or very intelligent.

I hope that this brief mathematical explanation may not seem so forbidding in character as to be passed over by earnest and thoughtful persons; for it has a very important bearing upon the Use and Abuse of Scientific Authority, and should not be neglected by those desirous of a clear understanding of our subject.

Now, in every case of uncorroborated Scientific Authority, we must—if our belief is rightly to be claimed—have a very strong assurance of the concurrence, at the time of rendition of testimony, of two factors: (1) veracity and (2) logical competence, including accuracy in statement. That both are essential, a little consideration will show. Testimony will have no value if there is not in the witness a resultant of his

conflicting motives, tending, on the whole, to a preference for the truth. Nor will it be valuable, if there is not logical competence to review the evidence, and perceive what it justifies and what it does not justify. Both must concur in the one witness, because, *ex hypothesi*, there is but one. And these two factors are independent, for the moral tendency to truth does not imply logical competence even to a small degree; nor does logical competence imply that the motives are in the direction of truth.

The probability, then, that we have, in any given case, Scientific Authority worthy to claim our assent, is precisely the same as the probability that we have combined in one individual, at the moment of testifying, a net tendency to truth and of logical control of the question. That is to say, we take the probability that our scientific witness had, when he uttered the proposition, a residual inclination to truth, and multiply this by the probability that at the moment in question the same person possessed logical control of the matter in hand. This will yield the probability of the truth of the proposition.

Now it is to be especially borne in mind that this process of multiplying together two probabilities, each less than unity, will yield a result smaller than either factor alone. That is, the probability that the proposition is valid must necessarily be less than whichever is smaller of two other probabilities, viz. that of a net moral tendency to truth in the witness, or that of his logical control.

We are to bear in mind, then, that, in any case of uncorroborated Scientific Authority, two points are to be settled with all possible precision: (1) the value of the probability that the moral tendency (conscious and unconscious) of the witness at the moment of affirming the proposition was towards the truth, and (2) the value of the probability of the logical

control of the same witness at the same moment. It is useless to seek to evade these requirements. Testimony involves two factors,— a moral and a mental. Does the resultant of my motives impel me to truth? Am I competent to see it? The cause of truth in general will be advanced by a frank acknowledgment that the value of testimony is directly dependent upon the answers to these questions.

The problem now before us is to estimate the values of the probabilities of the existence of these two factors.

First, the moral question.—It can scarcely be questioned, that here there is often what, for practical purposes, we may fitly describe as a conflict of motives. It matters not that some motives may exercise their influence unconsciously. We are concerned to find the resultant of all the moral tendencies towards or against the truth. It is no part of our business to settle whether a given tendency is a conscious one or not, or what is the moral responsibility. Now in this conflict we shall find the love of truth for its own sake contending in the direction of veracity. This is a very important motive; and, when it can be established as existent in a high degree in a scientific man, it will have a tremendous effect upon the value of his testimony in so far as that testimony depends upon morality. Sir Isaac Newton was such a man. Then there is the sense of individual responsibility to God. This motive would, perhaps, include the first. Where it exists, it is a powerful stimulus to the truth. Responsibility to one's fellow-men is a similar motive, which, when rightly followed, tends to truth. To these may be added the fear of exposure. This last is a powerful motive with many men, and, in the absence of the higher moral tendencies, may give strength to an otherwise poor case. It is, perhaps, the only tendency for the truth that we may safely assume as existent in strength in scientific men

in whose cases we have no direct evidence for strong, high motives.

The existence of the higher motives I have cited may sometimes be shown by the presence of a habit of moral self-criticism. If we can discover evidence that a man brings his motives to the bar of conscience and subjects them to the light, then we have justification in assuming that he will not consciously assert what is untrue.

But against the motives that make for truth are other moral tendencies which frequently come into play. Thus, there is the tendency to tone down and modify a statement if the naked truth would have the effect of discrediting some personal theory or scientific position previously held,—and especially if it has been publicly held. Pride and obstinacy, you say; and, you add, such motives are not to be ascribed to scientists. Are they not, though? Read a chapter or two in the history of science, and see whether there is any reason to think scientific men are exempt from such ugly motives.

And perhaps it would be as well to include under these same motives of pride and obstinacy those moral tendencies which impel one unduly to emphasize or magnify results which are in the direction of his preconceived opinions and public announcements. Then, again, ambition may impel one to seek the overthrow of old results and the establishment of new ones,—not because the old are false, but because there is fame to be gained in the process.

The interplay of such motives as those we have been considering will yield a net tendency towards or from the truth in any particular case. This may be termed the moral resultant. In seeking an estimate of the probability of the existence of such a resultant in the direction of truth for the case of any particular proposition, we should make use of all pertinent

evidence, taking care, where one motive involves another, not to count both. Now in making the estimate it is evidently to the point to consider what is the relation the particular proposition bears to the personal interests of the witness,—that is, it is pertinent to consider how the witness's prejudices, preconceptions, ambitions, jealousies, previously announced opinions and theories, and also his pecuniary affairs, are affected by an affirmation or denial of the proposition,—and, of course, evidence from the witness's previous record in confirmation or rebuttal is relevant.

I am well aware that this is a sword that cuts both ways. But surely those who follow Christ will want the truth, whatever the cost. However, to return—in case the moral attitude of the witness at the moment of testifying cannot be determined because there is no evidence to this point, then recourse must be had to his previous life. His moral record—failures and successes—will furnish pertinent evidence. But even this resource may fail because of inaccessibility of the desired information. We then turn to mankind in general, and from a broad estimate of human nature make our valuation of the probability that the average man would deal with this proposition fairly and so seek the truth. If it is clear that no personal interests are involved, I judge that this would yield quite a high result. For I think we are safe in assuming that men desire to speak the truth in the absence of any personal advantage from a contrary course. But, if personal advantage is at stake, then it is incontestable that all history warrants us in rating the probability of the existence of a moral resultant in the direction of truth as very low.

Now with regard to logical competence.—I observe, in the first place, that all men have more or less logical ability, especially where the subject-matter is well understood. On the

other hand, it is no less true that all men possess some defects which tend to give their inferences uncertainty. Where the inferential result is obtained only by complicated and abstract processes, natural ability alone cannot be depended upon. And even where the processes are simple and the subject-matter is understood, our inherent but obscure mental defects sometimes lead us astray. So, whether the object be to discover the hidden defects of mind or to become familiar with the methods of inference, recourse must be had to the science of Logic, in order to correct and supplement natural equipment. Without serious study of this subject or its equivalent, the testimony of no witness testifying to a question involving difficulty in inference is entitled to any appreciable weight. Let it be especially noted that evidence of the witness's familiarity with the subject-matter is, as a rule, irrelevant. Such familiarity will not replace ignorance of, and want of practical training in, the processes and safeguards of Logic. This familiarity, no doubt, makes the application of methods of inference easier. But, whether the application is easy or difficult, the methods themselves must be learned, and facility in their use acquired. Nothing can replace this, and it is idle so to pretend.

Thus, the fact that a man is an extraordinarily competent Hebrew scholar is no evidence of logical competence sufficient to enable him to pronounce against the integrity of Genesis. Testimony to such a question requires a high degree of logical training, in order that he may judge of the relevancy of the evidence, and appraise its value and import. Linguistic ability alone,—though valuable, and perhaps even indispensable, as an aid,—would be entirely insufficient. In all cases of complexity and difficulty the knowledge of two things is essential. These things are: (1) the conditions of valid inference, and (2) the tendencies of the mind to error. And this knowl-

edge must be both theoretical and practical. It is quite true that familiarity with the subject-matter is also an essential. But this is so well understood and insisted on, generally, that I do not dwell upon the point.

In proceeding to a valuation of the probability of the presence of logical competence to handle any particular case, we should, if possible, seek to make the estimate with reference to the very proposition under consideration. To do this it is relevant to weigh the difficulties and complexities of both subject-matter and logical processes. It is scarcely necessary to discuss the question of the subject-matter. I confine myself to the matter of the inferential problem. It is to the point to consider in this connection the training of the witness, in so far as this may be judged from the past intellectual history. If, for lack of evidence, the probability of the witness's capability for the particular case in hand cannot be estimated, it will be necessary to go into his previous record, and seek to ascertain the probability of his competence in the present instance from consideration of his competence in similar cases in the past. If evidence fails here also, there is nothing to do but fall back upon a valuation of the logical competence of men in general. If the proposition involves matters of difficulty, this recourse to the average man will have the effect of totally disqualifying the witness.

Without going further into details or attempting to be exhaustive, I think we may safely conclude that, in any difficult question of inference, no uncorroborated scientific authority is worthy of attention, unless we have sufficient evidence to establish for the particular case in hand two probabilities, each and both of which must approximate certainty. That is, it must be approximately certain, (1) that the residual moral tendency is in the direction of truth *and* (2) that the logical ability is

competent to deal with the questions of inference involved. I may emphasize the point, that negative evidence is practically worthless. We do not commit matters requiring high moral integrity to persons of whom our only information is that nothing bad is known of them. Nor in intellectual things—as legal matters—do we intrust important interests to those who are merely negatively indorsed. What folly, then, it was to accept the uncorroborated *dicta* of the author of the "History of Creation" without first ascertaining his moral worth and logical competence! His undoubted minute and extensive knowledge of biological matters in general furnished no presumption of any especial logical ability. And it would be absurd to imagine that such knowledge afforded any basis for an estimate of moral character.

Now it may be that it would usually be very difficult—not to say impossible—to secure sufficiently precise valuations of such matters as moral tendencies and logical equipment, in order to estimate approximately the probabilities of the occurrence of the two essential factors. But in any matter of difficulty it is absolutely necessary to do so, if we wish to claim for uncorroborated scientific authority any real weight. The approximate determination of the probabilities of the presence of the two factors is a *sine qua non*. It would seem, then, that the scientific authority of a single individual, unsupported by other evidence, is, in the vast majority of cases, useless, and to employ it thus is to abuse it.

CORROBORATED SCIENTIFIC AUTHORITY.

But individual testimony may be supported in two ways: (1) by the confirmation of objective facts, and (2) by the corroboration of other testimonies. With the first we have nothing to do, and to the second the reference must be brief.

While it is very true that individual authority, when stand-

ing alone, is rarely of such high character as to possess any appreciable value, yet when considered in connection with other personal testimonies it has a very distinct value. In fact, the theory of probability has established the principle that the testimony of any witness is of value *in corroboration* if his reliability amounts to more than .5. This inferior limit is quite low. In fact, it means no more than that the testimony of the witness is just as probably right as wrong. Still, it is a value that many scientists do not reach, where the question is complex and personal interests come adversely into play. For observe, this value .5 arises from the product of two probabilities, each less than unity,—viz. the probability of the truth resultant and the probability of logical competence. If neither of these rises higher than .7, a reliability of .5 is not reached. For $.7 \times .7 = .49$, which is less than .5. Now .7 would be quite a high value for the probability of the existence of a residual tendency to truth where a man's personal interests are opposed, unless there is strong evidence in favor of high morality. For this value means he will choose the truth seven times out of ten. Likewise .7 is a high value for logical competence in the absence of substantial proof of the training of the witness, if the question is one of inferential difficulty.

But if the reliability of a witness can be assumed as above .5, then this witness adds strength on whichever side he ranges himself. Thus, if the reliability of five concurring witnesses is no more than .6 each, the theory of probability calculates the probability of the truth of their concurrent testimony to be .88. If the reliability of each is .8, the probability that they have testified to the truth is .999.¹

¹ The formula for concurrent, independent testimony is

$$P = \frac{P_1 \times P_2 \times P_3 \times \text{etc.}}{P_1 \times P_2 \times P_3 \times \text{etc.} + (1 - P_1)(1 - P_2)(1 - P_3) \text{etc.}}$$

where $P_1, P_2, P_3, \text{ etc.}$, represent the several reliabilities of the indi-

We are to remember, however, that *all* witnesses whose reliabilities are severally more than .5 must be allowed to participate, both those *for* and those *against*. Those whose reliabilities are each below .5 are to be counted, but on the other side. The theory of probability warrants the statement, that in estimating the probability of the truth, as between witnesses *for* and *against*, those on opposite sides whose reliabilities are equal neutralize each other. Both are to be disregarded *in toto*. This is a principle of great importance, especially if we observe that a witness, the probability as to whose logical competence is less than his opponent's, may yet offset him, if he has sufficient advantage in point of truth-seeking.

It seems, then, to me that those who contend for Christ need not fear for the outcome. For, although we are engaged in a warfare in which intellectual ability and equipment are essentials, and in which our foes may equal us, still in this same warfare the love of truth also counts mightily. "Stand, therefore, having your loins girt about with truth."

vidual witnesses obtained as previously explained from the formula $P = p_1 \times p_2$. Where witnesses testify, some *for* and some *against*, this formula may be made available by remembering the principle, that if P is a witness's reliability *for*, then $1 - P$ is his reliability *against*, and *vice versa*.