of that witness. To those who have paid some attention to the nature of evidence it will be a matter of interest to learn, first, that additional witnesses and additional instances do not strengthen a case; and second, that the trustworthiness of witnesses is of no consequence. What a lot of bother men of science would have been spared if they had only known this before; for it is unnecessary to point out that the history of science abounds in accounts of efforts to gather evidence and to determine the weights of various pieces of evidence.

So far as the article 'Woodcock Surgery' affords a cross-section of its author's style of reasoning some of his universals seem to be: (1) Action that results in a causal correlation of antecedent and consequent is intelligent action in the sense that the agent understands the principles involved in the correlation; (2) any phenomenon which *B* has not witnessed *A* can not have witnessed; (3) unless an event is of common occurrence it can not occur at all.

Whom the gods wish to destroy they first lure into premises of this sort.

As regards the 'nature-study' classes in our schools, Mr. Wheeler may be spared that part of his anxiety which relates to the effect of such books as 'A Little Brother to the Bear' and 'Wilderness Ways.' One may well wish that every boy and girl in the land might become acquainted with Killooleet and Cloud Wings and Hukweem. Children and mere lovers of nature on the one hand, and comparative psychologists on the other, owe no small debt to men like William J. Long who have the patience and pluck to spend years in the wilderness home of birds and beasts in faithful observation of their life and habits.

Ellen Hayes.

THE PRESENT STATUS OF SOIL INVESTIGATION.

An address delivered on this subject before the Association of American Agricultural Colleges and Experiment Stations, November 17, 1903, and immediately published as Circular No. 72 of the University of Illinois Agricultural Experiment Station is discussed by Dr. F. K. Cameron in Science, February 26, 1904, page 343. Dr. Cameron states that the criticisms of his Bulletin 22 (Bureau of Soils) which have appeared are to the effect that the authors of the bulletin (Whitney and Cameron) 'have concluded that the use of fertilizers is of no value in affecting the yield of crops.' He further states that 'these criticisms have generally been copied from Circular No. 72, Agricultural Experiment Station, University of Illinois.'

As a matter of fact this statement does not occur in Circular 72, consequently, the objection to 'inexcusable carelessness of misquoting results and statements in a controversial paper' is strictly applicable to Dr. Cameron's own first paragraph. It is not believed that Cameron or any other theoretical chemist is so ignorant of agricultural science and practise as not to know that the use of fertilizers is of value in effecting the yield of crops. The statement in Circular 72 is that Bulletin 22 is commonly understood to teach that the use of fertilizers 'has little or no tendency toward permanent soil improvement, and that even the effect which they do produce is due very largely, if not entirely, to improved physical condition of the soil.' It is certainly safe to say that scientists and agricultural editors and practical farmers are all agreed that this is the teaching of Bulletin 22 regarding the use of fertilizers.

It will thus be seen that Doctor Cameron devotes much valuable space to a matter which is not pertinent to the discussion.

Both Bulletin 22 of the Bureau of Soils, Washington, D. C., and Circular 72 of the Illinois Experiment Station, Urbana, Ill., are available to the reading public, and consequently it is quite unnecessary and unreasonable to expect Science to reproduce any large part of those publications. The following direct quotation from page 59 of Bulletin 22 fairly illustrates its teaching:

> In the truck soils of the Atlantic coast where 10 or 15 tons of stable manure are annually applied to the acre, in the tobacco lands of Florida, and of the Connecticut Valley, where 2,000 or 3,000 pounds of high-grade fertilizers carrying 10 per cent. of potash are used, even where these applications have been continued year after year for a considerable period of time, the dissolved salt content of the soil as shown by this method

is not essentially different from that in surrounding fields that have been under extensive cultivation.

In England and in Scotland it is customary to make an allowance to tenants giving up their farms for the unused fertilizers applied in previous seasons.

The basis of this is usually taken at 30 to 50 per cent. for the first year, and at 10 to 20 per cent. for the second year after application, but *in the experience of this Bureau, there is no such apparent continuous effect of fertilizers on the chemical constitution of the soil.**

This quotation from Bulletin 22 is not referred to in Circular 72, but many other quotations are made which show this same general teaching and which Dr. Cameron now holds 'are utterly at variance with the complete context and plain meaning of the bulletin.' Of course, the 'complete context' can not be quoted here, but, so far as I am able to judge, this quotation, as well as all others which I have made, are fair samples of the accepted meaning of the bulletin as a whole.

In this connection attention may well be called to the fact that the above quotation is quite out of harmony with the statement on page 64 of Bulletin 22, to the effect that the conclusions of the authors are 'strictly in accord with the experience of good farm practise in all countries.' Probably there is no better farming practised in any country than in England and Scotland. After a full half century of agricultural investigation at Rothamsted Sir Henry Gilbert says,† regarding the effect of farm manure on certain plots of ground:

It has been seen that the unmanured plot has declined in yield and fertility; but there can be no doubt that the farmyard manure plot has, on the other hand, increased in fertility. *Analyses** of the surface soil at different periods *have shown** that it has become about *twice as rich in nitrogen** as that of the unmanured plot. It has, indeed, been shown that a large amount of the constituents of farm manure *accumulate within the soil.**

* Italicized by C. G. H.

† U. S. Dept. Agr., Office of Expt. Stations, Bull. 22, pages 149 and 150. (This most valuable bulletin written by the late Sir Henry Gilbert, himself, giving results of fifty years' investigation at Rothamsted, should be read by any one who reads Bulletin 22 of the Bureau of Soils.)

Again, Sir Henry says:

Referring first to the results obtained on the farmyard manure plot, the average annual produce over the [last] forty years was 34⅞ bushels, and over the fifty years 33½ bushels; in the one nearly 7 bushels and in the other 5½ bushels more than the average of the United Kingdom under ordinary rotation; in both not far short of three times the average produce of the United States, and more than two and one half times the average of the whole of the wheat lands of the world.

Without any manure whatever the average annual produce was 13 bushels over the [last] forty [years], and 13½ bushels over the fifty years.

Dr. Cameron apparently admits, as shown in Circular No. 72, that 'it has been possible on the basis of chemical analysis to advise the use of fertilizers containing potassium on certain Illinois soils with improved yield of crop,' but by the same system which he has so successfully applied in using strictly selected data from the Rothamsted experiments, he evidently overlooked the fact that on the same page of Circular 72 is shown an equally striking case where the chemical analysis of other soils plainly shows the need of nitrogen, the addition of nitrogen to these soils having increased the yield of wheat more than eight fold.

Regarding the use of potassium, however, Dr. Cameron adds:

A soil containing according to analysis an enormous amount of nitrogen (67,000 pounds per acre), an abundant amount of phosphorus (2,000 pounds per acre) but what is regarded as a deficient amount of potassium (1,200 pounds per acre) *produced no corn** when either nitrogen or phosphorus or both [or nothing] were applied; yield about the same, 36 bushels when *potassium,** 40 bushels when *potassium** and nitrogen or 38 bushels when *potassium** and phosphorus were applied. But when *potassium,** nitrogen and phosphorus were all applied, the indications of the analysis were flatly contradicted by a yield of 60 bushels.

This is, indeed, a most peculiar statement both chemically and otherwise. The 'indications of the analysis,' instead of being 'flatly contradicted by a yield of 60 bushels,' are thereby confirmed, for if sufficient potassium

* Italicized by C. G. H.

is applied to this soil, which already contains such an abundance of nitrogen and phosphorus, the yield should certainly rise to 60 bushels or more. Of course, there are reasons why the plots yielding 36 to 40 bushels did not yield 60 bushels instead of only 36 or 40. These reasons are fully explained in Illinois Bulletin No. 93, 'Soil Treatment for Peaty Swamp Lands.' Soils may all look alike to the theoretical chemist, but any one who is familiar with agricultural science and practise recognizes that there are differences in soils. Indeed, it seems pertinent to state that these differences were fully understood by the practical farmers who watched the experiments, and who are now using carloads of potassium salts with very great profit on these soils. In 1903 five plots not treated with potassium yielded 15, 7, 4, 5 and 4 bushels of corn, respectively; while five other plots, with potassium applied, yielded 73, 71, 73, 67 and 70 bushels.

All agricultural chemists will agree with Doctor Wiley's statement wherein he says: "When a man sends to me a specimen of a given soil and writes, 'Please analyze this soil and tell me what crops I can grow on it,' I send him word, 'Ask your soil itself what you can grow on it; in that way, asking your question directly of the soil, you can get your answer, and in no other.'"

Chemists recognize that soils have physical as well as chemical properties. On the other hand, no agricultural chemist of standing will agree with the statement of Whitney and Cameron, 'that a chemical analysis of a soil, even by these extremely delicate and sensitive methods, will in itself give no indication of the fertility of this soil,' understanding that the use of the word *even* is intended to convey the meaning that no other known methods need be thought of if these fail. Furthermore, it is certainly pertinent to the discussion to state here that Professor King, a recognized authority on soils and a careful and exact investigator, found that the chemical analysis of soils, *even by these methods,* furnishes much information regarding the fertility of soils. According to notes which I made from Professor King's address on the differences between some southern and northern soils in the United States, read before the Association of American Agricultural Colleges and Experiment Stations, he found that the northern soils contained 2.39 times as much water-soluble plant food as the southern soils and he also found that the yields of crops produced on the northern soils were 2.47 times the yields produced on the southern soils. This is in direct contradiction to the conclusions drawn by Whitney and Cameron from the very miscellaneous and discordant data reported in Bulletin 22. The investigation by Professor King and his assistants is evidently the most systematic accurate and valuable work which has yet been done by the Bureau of Soils; and it is certainly to be hoped that these investigations will soon be published in full, even though, being connected with the Bureau of Soils, Professor King can not 'anticipate the publication of the proceedings' of the Washington meeting.

The only just criticism of Circular 72 which Doctor Cameron makes in his ten-column article in SCIENCE is in regard to the statement concerning the methods employed by the Bureau of Chemistry in analyzing the Rothamsted soils. These statements were based on notes taken from the public discussion by the author of the *Journal* article* at the Washington meeting. Either Mr. Moore misspoke himself in saying 'fifteen hours' extraction' and 'gravimetric method,' or he said 'five hours' extraction' and 'volumetric method' and I misunderstood him; and I humbly accept Doctor Cameron's scathing rebuke for not having looked it up in the original paper. Cameron also insists upon having mention made of the twenty minutes allowed for settling in his water extraction.

The corrections suggested by Doctor Cameron being accepted the obnoxious statement regarding the work from the two bureaus on the same soil samples would then read as follows:

> It will be observed that the Bureau of Soils by twenty-three minutes' extraction with distilled water at room temperature reports from two to thirteen times as much soluble phosphorus from

* *Journal American Chemical Society,* 24, 94 (1903).

these soils as the Bureau of Chemistry obtained by five hours' extraction with dilute acid of 40 degrees centigrade.

This correction will be made in the third edition of Illinois Circular No. 72. Analytical chemists will recognize how little force there is in this single just criticism in its application to the principles under discussion.

To illustrate his difficulty in finding suitable material for criticism, Doctor Cameron says:

> It is not at all clear why the phosphorus as determined in the two investigations should be compared on the basis of an acre surface with a depth of seven inches, for it is inconceivable that any one at this day, and in view of the well-known work of Darwin and others, would suppose that the same identical seven inches of soil would remain at the surface for any considerable period of time.

This criticism is neither pertinent nor consistent. First, it may safely be assumed that neither earthworms nor crawfish were active in these particular samples of soil during the interval between the two investigations, hence the criticism has no bearing on the point. Second, all results and comparisons reported in Bulletin 22 of the Bureau of Soils are based upon soil samples taken to certain depths; hence the critic is inconsistent. Reports of soil investigations which are written for the benefit of agriculture and agricultural people are best given on the acre basis, because this is the basis used in measuring crop yields, in applying manure, fertilizers, etc. The classic agricultural investigations of Lawes and Gilbert are practically all reported on the acre basis. Seven inches is a common depth for good plowing and this method of reporting results is in accord with the methods* adopted by the Association of Official Agricultural Chemists for collecting soil samples, which recognize that there are differences between soils and subsoils, whereas the arbitrary method of soil sampling, 0–12 inches, 12–24 inches, and 24–36 inches, in depth, as used by the Bureau of Soils (see pages 23–33 of Bulletin 22) commonly mixes surface soil and subsoil in one of the samples.

* U. S. Department of Agriculture, Bureau of Chemistry, Bulletin 67, p. 152.

While it is true that, in the early publication of his paper, Doctor Hilgard anticipated the proceedings of the Association of American Agricultural Colleges and Experiment Stations and of the censorship of the Bureau of Soils over the publication of those proceedings, it is also true that his arguments are unanswerable, as are, likewise, those of Director Hall of the Rothamsted Experiment Station, whose criticism of Bulletin 22 appeared in *Nature* last November, although it is entirely ignored by Cameron.

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SPECIAL ARTICLES.

ON A LEPTOCEPHALUS OF THE CONGER EEL.*

DURING late July, 1900, the first eel eggs taken outside of Italian waters were secured by the Fish Commission schooner *Grampus* on the surface of the Gulf Stream off Newport. The development of these eggs was described in the Bulletin of the U. S. Fish Commission for 1901.

The largest larva reared measured about 11 mm. in length. The larvæ were characterized by the projecting lower jaw, the arrangement of the spots and the number of protovertebræ. Since writing the account which appeared in the bulletin the larvæ have been mounted on slides and a more satisfactory count of the protovertebræ made possible. There is still some doubt about the number of caudal protovertebræ. The count as near as it is possible to get it is $64+86$, $64+91$, $66+89$, $67+82$, $67+89$, $68+81$ and $70+86$ in seven larvæ.

On July 31, 1902, the *Grampus* collected a *Leptocephalus* 65 miles south of No Mans Land. It has a total length of 21 mm. and is undoubtedly the same species reared at Woods Hole in August, 1900. It agrees with the 1900 specimens in the projecting lower jaw, the general plan of the coloration, and has approximately the same number of protovertebræ. The protovertebræ are definitely 73 for the abdominal portion of the

* Contributions from the Zoological Laboratory of Indiana University, No. 54.