

tended as far as possible into the field of animal production.

Poultry furnish excellent material for vitamin studies; swine are also conveniently usable; and there is some evidence that a vitamin in forage is intimately related to the utilization of mineral nutrients by ruminants.

The effects of feeds, and of methods of production of feeds, on the vitamin content of the milk and the tissues and organs of animals should also be investigated.

VII. DIET AND REPRODUCTION

Evidence is gradually accumulating which suggests that diet is a factor of greater importance than has been understood in relation to reproduction in farm animals. While it appears that mineral nutrients and vitamins may contribute to the specific effects of feeds, in this relation, we do not have evidence to indicate that these effects are due to these two factors alone.

Poultry, swine and cattle are conveniently usable for the investigation of this problem, and there are indications that the general system of farming, as determining the feeds available, contributes in important ways to efficiency of reproduction in livestock. So important a situation must challenge the researcher in the field of animal production.

IN CONCLUSION

The members of this sub-committee, individually, and the sub-committee, as such, have given especial attention to methods of experimentation in animal nutrition. The sub-committee offers its cooperation to any who may desire it, in the making of detailed plans for investigations in any of the fields suggested.

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THE CONFIRMATION OF THE EINSTEIN PREDICTION¹

IN the year 1916 Professor Einstein extended his theory of relativity to include gravitation. Einstein expresses the law of gravitation in a form very different from Newton's inverse square of the distance. But in nearly all applications to the movements of the heavenly bodies the two laws give identical results. Had it not been so, the new theory could not have been right, for Newton's law is able to predict the movements of the sun, moon and planets with the utmost precision. But Einstein pointed out three refined observations in which his law differed from Newton's. The first of these is a small rotation of the orbit of the planet Mercury, discovered by Leverrier and, in spite of many attempts, was not satisfactorily explained. Einstein's law agreed with the observations and accounted for a small divergence from Newton's law. This remarkable achievement aroused the interest of astronomers in the new theory.

Einstein pointed out that not only matter, but also light was subject to gravitation. A ray of light which in its journey to the earth passes near the sun will have its path appreciably bent. If a photograph could be taken showing the stars surrounding the sun, these would be in slightly different relative positions from those they occupy in a photograph taken when the sun is in another part of the sky. Owing to the great light of the sun such a photograph can only be taken during a total solar eclipse. It was pointed out by Einstein that with Newton's law also the light passing near the sun would be deflected, but only to half the extent predicted by the generalized theory of relativity.

Two British expeditions went out in 1919 to observe the eclipse of May, Professor Eddington and Mr. Cottingham to Principe on the West Coast of Africa, and Dr. Crommelin and Mr. Davidson from Greenwich to North Brazil. There were three possibilities. Would the light be deflected at all, or by the amount Einstein's law required, or by half this amount? The observations are not easy, because the quantity to be observed is very small. A star on the photographic plate is a small dot, and the displacements to be expected only amounted to

¹ From the *London Times*.

quantities ranging from one third to one tenth of the diameter of one of these small dots. The observers in Brazil had extremely good weather and the expedition was a brilliant success. The observers felt that there was no ambiguity about the result. Einstein's prediction was verified. The observers in Africa were not fortunate in the weather, but obtained photographs showing a few stars, and they confirmed the results found in Brazil.

An account of the expedition was given to the Royal Society in November, 1919, and copies of some of the photographs taken in Brazil were circulated to representative astronomers. Generally speaking, those astronomers who were used to refined stellar photography agreed that the British astronomers had verified Einstein's prediction beyond any reasonable doubt. A certain number remained unconvinced and it was generally considered that in a matter of such great scientific importance further verification was desirable. Accordingly arrangements were made for the observation of the total solar eclipse of September, 1922. The British expedition to Christmas Island, Mr. Jones and Mr. Melotte from Greenwich, had the disappointing experience of a cloudy day. The American and Australian parties had better fortune. The photographs taken by the Australian astronomers have not yet been measured. The results of the Canadian party were recently received in this country from Professor Chant of Toronto and as far as they go confirm Einstein's law.

The best equipped of the parties was that from the Lick Observatory, consisting of Professor Campbell, Professor Trumpler and a number of other astronomers, who occupied a somewhat inaccessible spot on the northwest coast of Australia. Happily, the enthusiasm, time, labor and money devoted to this expedition have been rewarded. I received a cable message yesterday from Professor Campbell saying that they had completed the comparison of three photographs taken during the eclipse with three which had been previously taken of the same part of the sky. They find for the amount of displacement of a ray of light which would just graze the sun values from 1.86 seconds of arc to 1.59 with a mean value 1.74

seconds, agreeing exactly with Einstein's prediction.

The astronomers of the Lick Observatory are convinced that Einstein's law has been verified sufficiently and propose to devote themselves to other problems at the next eclipse. It is very satisfactory to have a complete agreement on the second of Einstein's crucial tests. It can hardly be doubted that Einstein's law of gravitation is correct, whatever difficulties may be found with other parts of his theory of relativity.

FRANK DYSON

ASTRONOMER ROYAL

The confirmation by President Campbell (for in addition to remaining the Director of the Lick Observatory he is now president of California University, to which the observatory is attached) of the Einstein prediction may be fairly said to settle this important matter. This does not, however, mean that our English observers, who obtained a similar result four years ago, had themselves any lingering doubts, but they knew that in any kind of scientific work it is only too easy to arrive at conflicting results, and when this situation arises the experiments or observations must be continued and varied until the source of conflict is detected and removed, so that all the final results are accordant.

For laboratory experiments such repetition involves little more than industry, for the opportunities are unrestricted; but when the only opportunity for making a test happens to be the rare occasion of a total eclipse of the sun the matter assumes a very different aspect. Each experiment involves a costly expedition to some distant part of the world for which funds may be hard to find; it also may involve discomfort and may end in disappointment. The American observers camped for a month in an unattractive part of the Australian desert, but were fortunate in their weather; our English observers spent six months on Christmas Island, only to have a cloudy day at the last. In addition to such drawbacks it was known that each successive eclipse was, for years to come, a less favorable opportunity for making the Einstein test than the one before.

The best of all was that of 1919, and to the Astronomer Royal belongs the credit of drawing attention to its specially favorable character during the blackest time of the war, when the prospects of utilizing it seemed very remote. Fortunately this dismal outlook did not prevent preparations from being made which enabled the English observers to take full advantage of the opportunity which the Armistice enabled them to grasp, with the well-known result which startled the world.

It was, however, such an amazing surprise that demand for confirmation was in every way reasonable and accordingly parties from Australia, Canada, England, Germany and the United States all prepared to observe the eclipse of last year. There were undoubtedly those who thought the English observers had made a mistake in 1919 and who wished to test the matter for themselves. I think it may not unfairly be said that President Campbell was on the skeptical side, which makes his present testimony the more valuable. Had conflicting results been obtained there would be no alternative but to go on repeating the tests. There is an eclipse this autumn visible in the United States, for which some preparations have already been made, though probably they will now be abandoned. But each successive opportunity, as already stated, offered less than the one before: 1922 was not so good as 1919; 1923 not so good as 1922; others in the future so far as they have been scrutinized less favorable still, so that the announcement of a discrepancy which must be tracked to its source with continually diminishing chances of tracking it would have been a little disheartening.

The telegram to the Astronomer Royal is thus doubly welcome: not only is there natural satisfaction at the accordance of entirely independent testimony on an important matter, but there is also relief from the threat of an arduous campaign, which even confidence in ultimate victory could not altogether compensate. The faces at the meeting of the Royal Astronomical Society yesterday were perceptibly brighter than usual.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SPRING MEETING OF THE EXECUTIVE COM- MITTEE OF THE COUNCIL

THE regular spring meeting of the Executive Committee of the Council of the Association occurred at the Cosmos Club in Washington on April 22. The following members were present: J. McKeen Cattell, H. L. Fairchild, W. J. Humphreys, B. E. Livingston, D. T. MacDougall, Herbert Osborn, Charles D. Walcott, Henry B. Ward. Dr. Simon Flexner and Dr. A. A. Noyes were unable to attend. President Walcott was in the chair during the first part of the meeting, but was obliged to leave before all the business was completed. Dr. H. L. Fairchild took the chair after Doctor Walcott's departure. The following items of business were transacted:

1. The minutes of the last meeting of the Committee and the minutes of proceedings carried out by mail ballots in the interim since the last meeting had been previously circulated to the members and were accepted without being read.

2. The permanent secretary presented his semi-annual report, which will be summarized elsewhere in *SCIENCE*.

3. The general secretary reported that the committee on Photosynthesis, authorized at the Boston meeting, has been organized with the following members: D. T. MacDougall, chairman; S. E. Sheppard, secretary; W. G. Abbott; F. G. Cottrell; Moses Gomberg; W. J. Humphreys; E. E. Slosson; H. A. Spoeher. This committee hopes to act as a focus for bringing together ideas and suggestions that may lead to substantial progress in our knowledge of photosynthesis and it hopes to serve by facilitating cooperation among research workers in this field. (See *SCIENCE* for May 4, page 522.)

4. The general secretary reported that he had conferred with the secretary of the Pacific Division with regard to the preparations and plans for the approaching Los Angeles meeting and that the preliminary work for the meeting is progressing very satisfactorily. It was noted that the Los Angeles meeting will be of special interest on account of program features dealing with the solar eclipse that will have oc-