

tuberculate mammals occur, however, on the upper horizons, and may still have existing representatives. H. F. Osborn discusses the "Close of Jurassic and Opening of Cretaceous Time in North America" (Bull. Geol. Soc. America, vol. xxvi., 1915, p. 295), as an introduction to a symposium on the Morrison formation. This discussion has a special application in England to the Purbeck-Wealden question.

The Wisconsin Geological and Natural History Survey has reported on the north-western area of the State (Bulletin No. 45, Madison, 1915), where very little geological work had been done prior to the official entry of Mr. W. O. Hotchkiss and his assistants in 1913. Since the area lies in the Lake Superior iron district, great stress has been laid upon a continuous magnetic survey, the principles of which are set out in chapter iv. This illustrated essay of sixty pages will be of service to mining students in general. The ores are the well-known sedimentary masses of Huronian age, and the extent of the Huronian beds beneath the glacial drift has been largely determined by magnetic readings. Bush-covered ground and rivers, as indicated in the sympathetic pictures of geologists at work, have often hindered observation, and only the most careful organisation could have carried out the survey in so comparatively short a time.

G. A. J. C.

THE ZOOLOGICAL SURVEY OF INDIA.

WITH the sanction of the Secretary of State the Government of India has recently converted the professional staff and entire working machinery of the zoological section of the Indian Museum into an autonomous Government department, under the name and style of the Zoological Survey of India.

This conversion, if it were—as to superficial view it might appear—merely a change of name, could pass without comment in a momentous time like the present; but inasmuch as it effects a long-desired and fundamental improvement in the prospects and official status of zoology in India—a country where, private enterprise in the domain of natural science being undeveloped, no branch of science that lacks independent and avowed recognition in the highest official quarters can hope to expand to its full extent—it deserves some notice.

In times not very long past the zoological section of the Indian Museum was administered by trustees, on the model of the British Museum, an arrangement ill-suited to a polity where, outside official circles, trustees with the necessary academic experience are not easy to find. One of the most unsatisfactory results of this system was that, although all ate of one salt and owned the Government as their father and mother, the zoological officers—irrespective of professional seniority or length of service—had always to be the official subordinates of their *confrères* in kindred scientific departments, who were constantly associated with the museum as trustees.

This anomaly was rectified by making the senior zoological officer eligible for the office of trustee, a resort to legal fiction which, although it placed zoology in proper official perspective, was calculated to offend tender consciences.

All such fictions are now obviated by bringing the whole zoological staff and its appurtenance into line with other scientific departments of the Government of India, and placing the senior representative of zoology on the same footing as the directors of the kindred scientific surveys—a position in which his opportunities of advocating and initiating research are much augmented and his responsibilities as an independent scientific adviser to Government are distinct and direct.

In notifying this auspicious change the Government expresses the hope that the establishment of a zoological survey will be of value to India; and when it is remembered—apart from all the economic reflections of the matter—that in territories like India more than 75 per cent. of the annual mortality is due either directly or proximately to noxious animals and animalcules, so that rural sanitation in such countries must rest in the first instance upon accurate and comprehensive zoological foundations, there seems every assurance that this hope will be justified.

Apart from these internal changes, which bring field-work from a precarious position in the rear into the very front rank of the duties of the staff, and transform the trustees from responsible guardians into authorised visitors of the collections, the zoological section of the museum as a going concern will not be altered in any way. Nor is any extra expenditure anticipated for the immediate future, since the available museum grant is ample for the intended purpose, and the collaboration of the Marine Survey Department and the close co-operation of the Forest and Agricultural Departments are assured.

Under the new régime the national zoological museum of India promises to be, like some other Indian official organisations, an institution of an exemplary kind.

GENETIC STUDIES IN PLANTS.

IN a paper on "Growth and Variation in Maize" (*Zeitschr. f. indukt. Abstammungs- und Vererbungslehre*, xiv., 1915, Nos. 3-4), Drs. Raymond Pearl and F. M. Surface combine the statistical and individual methods of inquiry. "We have tried," they write, "by studying the growth of the individual to analyse the adult variation curve into its component elements." Height is the character chosen for investigation; the relative variability as observed throughout the season "shows a marked progressive diminution," and the authors believe that the maize plant grows "in a series of cycles." In a second part of the paper they discuss the relation of variation to growth, and from the distribution of small, medium, and large plants conclude that the manner of growth is dependent on Mendelian factors.

Maize is also the subject of a paper in the *Journ. Agric. Research* (vi., No. 12) by G. N. Collins, who deals with "correlated characters" in the species. Eleven characters were selected for study, and of fifty-five possible combinations twenty were found to show significant correlations; but in all but five these appear to be physiological rather than genetic, and in no instance is the coefficient higher than 0.5. The author fears, therefore, that the method of isolating types is inapplicable to maize, though desirable characters derived from different parents may be easily combined.

The "Suppression of Characters on Crossing," illustrated by experiments on species of wheat, is discussed in a paper by R. H. Biffen (*Journ. of Genetics*, v., No. 4). He finds that dominant features, such as grey-ness of chaff or redness of grain, may be suppressed, so that "recessives make their appearance in F₂ generations from crosses of parents showing dominant characters only." This may perhaps be due to the existence of more than one factor giving rise to apparently the same dominant character, and the consequent possibility that two factors determining the recessive may meet in some of the zygotes that give rise to the F₂ generation.

Dr. T. Tammes contributes a paper to the Proceedings (xviii., No. 7) of the Kon. Akad. v. Wetensch. Amsterdam "On the Mutual Effect of Genotypic Factors." She has experimented by crossing varieties of flax differing in colour (blue or white) and breadth

of the petals. The results are complicated, and not readily summarised, but they confirm a generalisation already established by work in hybridisation among both plants and animals; that "views on the presence and action of factors obtained by an investigation of one single crossing are liable to modification when one of the forms investigated is crossed with a third form. Hence it is necessary to cross the same form with more than one partner in order to arrive, step by step, at the truth."

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

THE first of the two organised discussions arranged for this section was on "Gravitation." The discussion followed immediately after Prof. Whitehead's presidential address, and it happened that the arrangement was appropriate, for the president's exposition of the logical texture of geometry had carried us far from the ordinary conceptions of space, and paved the way for the revolutionary ideas associated with the space-time world of Einstein and Minkowski. Mr. E. Cunningham, who opened the discussion, and Prof. A. S. Eddington, who followed, dealt with Einstein's recent work, which brings gravitation within the scope of the principle of relativity. If an observer is in a closed lift, it is well understood that an acceleration of the lift upwards is exactly equivalent to an increase of the force of gravity, so far as mechanical phenomena inside the lift are concerned. There would, however, be minute differences in the optical phenomena according to the ordinary theory; relatively to the accelerated lift the path of a ray of light would seem to be curved, whereas for the stationary lift it would be straight if the increased gravitational field makes no difference. Accordingly, the first suggestion towards a relativity theory which shall include gravitation is that the path of a ray of light must be bent by the gravitational field, just as it is apparently bent by an acceleration of the framework of reference. The curvature to be expected is extremely small—amounting to a change of direction of 1.7" in the case of a star seen close to the sun's limb—and it has not been possible to prove or disprove the hypothesis directly. Meanwhile the theory has been elaborated and generalised by Einstein, who has at length been able to throw the laws of motion, of electrodynamics, and of gravitation into a form which makes the sequence of phenomena entirely independent of any particular framework of reference. The result has been to yield a very striking confirmation of the theory, for it is found to predict a motion of the perihelion of Mercury amounting to 43" per century—just the amount of the hitherto unexplained discordance. The new theory removes what is probably the most celebrated of the few cases of failure of gravitational astronomy. The discussion afterwards turned to the experimental side. Dr. P. E. Shaw gave an account of his experiments which appear to indicate a change in the constant of gravitation with temperature, and Prof. R. A. Sampson urged that astronomical evidence is not capable of denying this possibility. Dr. W. G. Duffield read a report of the Committee on the Determination of Gravity at Sea, considering especially the difficulties attending the use of the aneroid method, and the possibility of improvements in future attempts.

A paper by Sir Ernest Rutherford on the "X-Ray Spectra of the Elements" was of special interest. He referred particularly to the researches of Siegbahn and Friman, who have extended the work of Moseley to the elements of high atomic weight from gold to uranium by examining the L spectra. It appears

that there are ninety-two elements up to uranium. By finding the atomic number of lead it has now been possible to assign the whole series of radio-active products to their places in the scheme. Sir E. Rutherford further described the work done in America with the Coolidge tube, which provides a steady high voltage. It is found that the maximum frequency of the rays which can be obtained follows closely the quantum relation $Ve=hc$, the accuracy between 20,000 and 100,000 volts being one per cent. To excite the characteristic radiation of a substance a rather higher voltage is needed than that given by the quantum relation, as though it were necessary to expend some energy in disturbing an oscillator.

Prof. H. H. Turner read a paper on the "Measurement of Time," dealing with daylight saving and justifying the innovation from a scientific point of view. The paper elicited an interesting speech from Prof. J. Perry, who admitted that he had formerly rather thoughtlessly opposed the scheme, and urged the warning against being led by authority in science. Other members, however, professed themselves still unconvinced.

Prof. T. H. Havelock gave a review of recent work on the "Propagation of a Signal in a Dispersive Medium." He described the approximate methods of calculation which have been used, showing the relation between the recent methods of contour integration and the older work of Hamilton and Kelvin. The precise nature of the "forerunner," or minute disturbance which travels through the medium in advance of the main signal, is a matter of special difficulty, and an exact solution for any particular cases that may prove tractable would be a great help towards progress.

The absence of several speakers who had been expected to take part rather detracted from a discussion on "Osmotic Pressure," opened by Prof. A. W. Porter. There were many other interesting papers, most of which we must pass unnoticed for want of space, but special mention may be made of Prof. J. C. McLennan's paper on "Ionisation Potential," continuing and extending the results communicated last year; also of Sir F. W. Dyson's "Mean Parallaxes of Stars of Different Magnitudes," which in the main confirm the well-known formulæ given by Kapteyn in 1901. At a separate meeting of the department of mathematics Prof. G. N. Watson gave a general survey of the recent developments of the theory of asymptotic series.

A new departure, which it is hoped may lead to important results, was the formation of a committee representing Sections A and E to consider the needs of geodetic research. This arose from the presentation of a report by Col. Close, Sir F. W. Dyson, and Col. Hills, prepared at the request of the Organising Committee of Section A. The report brought out clearly the lack of organisation and general neglect of higher geodesy in this country, and there was a unanimous feeling that steps should be taken towards the constitution of some committee or association responsible for stimulating this branch of science.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION D.

ZOOLOGY.

ABSTRACT OF THE OPENING ADDRESS BY PROF. E. W. MACBRIDE, M.A., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

THE decision of the Organising Committee to devote the sittings of the section chiefly to the economic and medical applications of zoology must not divert us from the task of research into fundamental laws. The laws of heredity had been intensively studied for the