

April and May 1854, October 1855, and not at all in 1856. In 1852 Mars passed rapidly through the constellation, but in 1854 he was nearly a month in exactly the position—"on the Lion's breast"—described by Tennyson. From internal evidence alone, therefore, the time referred to in the poem can be fixed as the spring of 1854.

NOVA AURIGÆ. — In a brief note to *Astronomische Nachrichten*, No. 3209, Mr. Martin Brendel says that he has found Nova Aurigæ upon an auroral photograph taken by him at Greifswald, Norway, on January 5, 1892. It will be remembered that Dr. Anderson announced his discovery at the end of January 1892, and that Prof. Pickering afterwards found the object upon photographs taken in December of the previous year.

AGRICULTURAL EXPERIMENT STATIONS.

THE general British public regards with suspicion the granting of State aid for scientific experiments. But though the reluctance to give such assistance to pure science may be partly understood, it might reasonably be expected that the shop-keeping instinct would have led to the adequate endowment of an applied science like agriculture. An article by Mr. James Long, however, in the January number of the *Record of Technical and Secondary Education*, shows how unfavourably England compares with other countries as regards institutions in which the scientific principles of agriculture are taught. We have two or three excellent agricultural colleges carried on by private enterprise, but it is a question whether they supply the requirements of the practical farming class. Compare this with what has been done abroad. "Some thirty years ago," says Mr. Long, "the Government of the United States made grants of land to each State for the purpose of establishing colleges. At the time, the proportion handed over was 30,000 acres for each senator or representative in Congress to which the State was entitled according to the census of 1860. In addition to this grant, large and frequent money grants in connection with the agricultural sides of these colleges and to the experiment stations, which have also been established, have been made. Figures, which have been furnished to me by one of the officials of the U.S. Government, show that in some instances the value of the permanent endowment of each college exceeds £100,000, while the interest brings in amounts reaching, in some instances, to nearly £10,000 per annum. To this may be added the value of the buildings which have been erected from funds supplied by the Central and State Governments, which vary from £20,000 to £200,000, and these values are constantly increasing. The first systematic attempt to teach agricultural science in America was conducted at Yale, which, from time to time, was followed by Michigan, New York State, Kansas, and Massachusetts. There are now some fifty State agricultural colleges, conducted upon a recognised system by men of capacity, and generally equipped in a manner which leaves little or nothing to be desired."

The work of these colleges is not restricted to the instruction of students in the science and practice of agriculture, for to each college a State experiment station is generally attached. In England experimental work in agriculture has been left entirely to private enterprise. As Mr. Long remarks, were it not for Rothamsted our scientific work in agriculture would have been sorry indeed as compared with that accomplished by the people of other countries. In the United States there are more than fifty experiment stations maintained by grants from each State and the Central Government.

One of the stations visited by Mr. Long, that of Geneva, in New York State, has an income of £4000 a year, from which it pays in salaries £1650, and in wages £1200. There are six chemists on the establishment, in addition to the director, an assistant director, a horticulturist, a pomologist, a clerk, and a staff of workmen. No wonder that a large amount of valuable work has been performed at the station during the last eight years.

Canada possesses five experimental farms of considerable size. Roughly these farms cost £15,000 a year, or £3000 a year each, omitting salaries. Coming to this side of the Atlantic we find that France has three important agricultural colleges. To the chief of these, that in Grignon, near Paris, a large farm is

attached upon which experimental work is conducted. Italy possesses the experiment station at Lodi (Reale Stazione Sperimentale di Caseificio), where instruction is given in science and practice, and chemical investigations are conducted, the funds being provided by the Government and the Province and Commune jointly. Germany is full of agriculture experiment stations. The station at Kiel is supported by grants from the Central and Provincial Governments, and combines instruction with experimental work. In Denmark experimental work is carried on in the laboratory at Copenhagen, in experiment grounds, and at the Lyngby agricultural school and experiment farm, which is a good example of the Danish colleges. In Sweden and Norway Mr. Long visited the agricultural schools and stations at Ultuna and Alnarp. In addition to the usual farm, the former possesses an experiment station conducted somewhat on the Canadian lines. The best class of scientific investigations seems to be carried on at the chief station near Stockholm. Mr. Long also briefly refers to the systems of agricultural instruction adopted in Switzerland, Holland, and Belgium. His report shows clearly that Great Britain is behind other nations, both as regards State provision for instruction in agriculture and the establishment of experiment stations. It is quite time that the necessity for these stations was recognised by the Government.

THE SPENCER-WEISMANN CONTROVERSY.¹

AS most readers of NATURE are aware, a very interesting controversy has arisen between Mr. Herbert Spencer and Prof. Weismann. The subject, although many minor issues appeared, is that apple of discord of modern biology, the existence of an inheritance of acquired characters, and in necessary association with that, the extent of the operation of natural selection. The two approach the questions in sharply contrasted attitudes. Mr. Spencer looks at the problems of biology in their philosophical aspect as part of the large field of abstract thought which he himself has done so much to analyse, synthesise, and codify. Prof. Weismann, although best known by his theories, has been above all things a minute investigator of structural details. In the present controversy, Spencer maintains that the weight of evidence and argument in favour of the inheritance of acquired characters is so great that "unless there has been inheritance of acquired characters there has been no evolution." Weismann believes that there are insuperable difficulties in the way; that there is no evidence for such an inheritance; that natural selection is an all-sufficing cause.

Mr. Spencer's first argument is drawn from the gradations of tactual discriminativeness in the human skin. These gradations range from the ability of the tip of the tongue to recognise double contact in the points of a pair of compasses when their points are one-twenty-fourth of an inch apart, to the ability of the middle of the back which requires the points to be two and a half inches apart before double contact can be distinguished. It is a fair statement that these gradations are so distributed on the skin that those parts which are more used to the opportunity of discriminating are more capable of discrimination than parts with lesser opportunities. Spencer points out the difficulty or impossibility of believing that minute increases of tactile discrimination, as, for instance, distinguishing contact as double when the points are one-twenty-fourth inch apart instead of when they are one-twentieth inch apart, could not determine the existence of animals, and so could not have been selected. On the other hand, were the effects of use inherited, the gradations are explained. Against this, as against other individual cases, Weismann points out that there are not sufficient data; we know little or nothing of how variations occur, and what are the least variations that have value in selection. In the particular case of the tongue, one must remember that the tongue is one of the most highly specialised organs of the highest exist-

¹ "The Inadequacy of Natural Selection," by Herbert Spencer. *I. Contemporary Review*, February, 1893. II. id. March, 1893.

"Prof. Weismann's Theories," by Herbert Spencer. *Contemporary Review*, May, 1893.

"A Rejoinder to Prof. Weismann," by Herbert Spencer. *Contemporary Review*, December, 1893.

"Die Allmacht der Naturzüchtung. Eine Erwiderung an Herbert Spencer." Van August Weismann. Jena: Gus'av Fischer, September, 1893. (Of this an English rendering appeared in the *Contemporary Review* for September and October, 1893.)

ing type of mammalia, and we know nothing of the myriad changes that have taken place during its evolution. Spencer urges that Weismann has made no reply to the difficulty of the distribution of tactile discriminativeness over the skin. But even were it an established fact that the effects of use are inherited, Mr. Spencer's suggestion would bring us no nearer an explanation, as it cannot be supposed that increased use would multiply the number of tactile end organs. If the origin of the end organs be left unaccounted for, and it be said that these changes in the brain that are the result of practice in discrimination are accumulated by inheritance, still the argument is not cogent. For a variation in the brain leading to the slightest increase of discrimination in interpreting the messages from the peripheral sense organs certainly have a value in selection.

In the matter of Panmixia, Mr. Herbert Spencer has misunderstood Weismann completely. Panmixia does *not* imply selection of smaller varieties, but the cessation of the elimination of smaller or more imperfect varieties. The discussion of the variation of cooperative parts leaves the issues open. In the case of the giraffe, Mr. Spencer thinks that the main points of its extraordinary structure must be due to natural selection. Nägeli some time ago selected the case of the giraffe as a special instance of the inadequacy of selection. But in the giraffe, and in many other cases, as in the horns of a stag, increase of an organ to be of any use must be accompanied by modifications of a multitude of cooperating parts. For such cases of coadaptation, natural selection without the inherited results of increased use, Mr. Spencer believes inadequate. Weismann's chief reply is drawn from a study of neuter ants. In them there are many structures different from the corresponding structures in males and females, and of these some imply the harmonious modification of cooperating parts. Following those who have investigated ants most fully, Weismann believes that most of these modifications arose subsequently to the loss of reproductive power by workers and soldiers, and that, consequently, we have here an instance of modifications involving coadaptation where there is no possibility of the inheritance of acquired characters. Against this, Spencer has set forth "certain views concerning the origin and economy of social insects, which differ from those that are current." According to these views reproductive power was lost by neuters subsequently to the appearance in them of the new characters, and consequently upon his theory the inheritance of acquired characters is not excluded. Thus, on his view the issues are still open.

When Mr. Spencer brought forward a set of instances supporting the popular belief that offspring to a second sire occasionally show traces of the first sire, he was apparently unaware that Weismann had already discussed a number of such cases, grouping them under the name "telegony." In the famous case of Lord Morton's mare it appears that the only resemblance to the first sire was zebra-like stripes, and it has been known for very long that such stripes not infrequently appear. Settegast and Nathusius, two very great authorities on questions relating to the breeding of animals, deny that there is proof of the existence of telegony, and for the present at least it cannot be said that it forms an argument against Weismann's theories. Moreover, the suggestion made by Prof. Romanes, and accepted by Weismann, provides an intelligible explanation of the hypothetical facts. To anyone who has seen under the microscope the intricate method in which nuclear matter prepares for division, Spencer's suggestion that it passes from cell to cell, leaving the embryo and reaching the tissues of the mother, must seem absurd, and his comparison of the wanderings of microbes will not render his supposition more intelligible.

The discussions of the "immortality" of the Protozoa, and of the exact meaning of division of labour, are largely academic, and do not admit readily of being summarised. But it is clear that unless *generatio æquivoca* be admitted, many existing Protozoa have been reproducing by simple division since at least tertiary times, and that is a length of life certainly amounting to the concept of "immortality" as used by Weismann. And if there be a material basis of heredity at all (a view which is by no means peculiar to Weismann), the material basis whether it be called germ-plasm or not, and whether it be modified in each ontogeny or not, stretches from animal to animal since the beginning of things, and has a dower of life immensely greater than the dower of life of somatic protoplasm.

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ANCIENT EGYPTIAN PIGMENTS.¹

THE red pigment used by the Egyptians from the earliest times is a native oxide of iron, a hæmatite. Most of the large pieces found by Mr. Petrie are an oolitic hæmatite. One specimen, on analysis, gave 79.11 per cent. and another 81.34 per cent. of ferric oxide. The pieces to be used as pigments were no doubt carefully selected, and the samples that I have examined, mostly from Gurob and Kahun, are very good in colour. All the large pieces were of a singular shape, having one side smooth and curved; and in all cases this side was strongly grooved with striae, giving somewhat the appearance to the mass of its having been melted, and allowed to cool in a circular vessel. No doubt the explanation of this smooth-curved surface is, that these pieces had actually been in part used to furnish pigments, and having been rubbed with a little water in a large circular vessel, had been ground to this shape. By experiment it was found that these pieces of the native hæmatite yielded, without any further addition by way of medium, a paint which could readily be applied with a brush, as it possesses remarkable adhesive properties, and it resembles exactly, in every particular, the red used in the different kinds of Egyptian paintings. In addition to these samples of the pigments, all of which are native minerals and in their natural conditions, there are other reds, finer in colour and smoother in texture, evidently a superior pigment; these apparently have been made from carefully selected pieces of hæmatite, which have been ground and washed, and dried by exposure to the air. Some of these pieces are very fine in colour, and it would be difficult to match them with any native oxide of iron that is used as a pigment at the present day. There is every reason to believe that this is the earliest red pigment which was used, and it remains to this day the commonest and most important one; it is a body unattacked by acids, unchangeable by heat, and even moisture and sunlight are unable to alter its colour. At the present time many artificial products are used to take the place of this natural pigment.

Yellow Pigments.—These, again, are natural products, and by far the most common yellow used by the Egyptians is a native ochre. These ochres consist of about one-quarter of their weight of oxide of iron, from 7 to 10 per cent. of water, and the rest of their substance is clay. When moist they have a greasy feel, and work smoothly and well with the brush. There is no evidence of these bodies having changed colour, but undoubtedly they are chemically not nearly so stable as the red form of oxide of iron. Many of the pieces of this pigment, found at Gurob and at Tel-el-Armarna, are very fine in colour.

Some of the specimens of the very earliest colours of which the exact history is known, appear to be an artificial mixture of these two colours, the red and yellow, thus producing an orange colour. These samples were found on a tomb at Medum, which, according to Prof. Flinders Petrie, was built by Nefermat, a high official and remarkable man at the Court of Seneferu. Seneferu is known to have lived in the fourth dynasty, about 4000 B.C. and to have preceded Khufu, the Cheops of the Greeks, who was the great Pyramid builder. Now, on Nefermat's tomb the characters and figures are incised and filled in with coloured pastes, which I have been able to examine, and it is of interest to know that this use of colour was a special device of Nefermat, for on his tomb is stated that: "He made this to his gods in his unspoilable writing." In this unspoilable writing the figures are all carefully undercut, so that the coloured pastes, so long as they held together, should not be able to drop out. All the pastes used are dull in colour, consisting entirely of natural minerals. Hæmatite, ochre, malachite, carbon, and plaster of Paris appear to be the materials used. Chessylite, as a blue, probably was known even at that date, but the artificial blues seem hardly at this period to have come into use; certainly they are not found in the specimens of the Nefermat colours which I have examined. Another yellow pigment, far brighter in colour, was also often used. It is a sulphide of arsenic, orpiment; it is a bright and powerful yellow, again a body found in nature, but a much rarer body than ochre, and consequently, probably was only used for special purposes, when a brilliant yellow was required. As far as it is known at present, this pigment did not come into use until the eighteenth dynasty. Gold might even be placed among the yellow pigments, for it was largely used, and with wonder-

¹ A lecture delivered at the Royal Institution of Great Britain, on March 17, 1893, by Dr. William J. Russell, F.R.S.