

would be found filled by gravel; but this difficulty is inherent in all theories which assign the valleys a pre-glacial age. However the glens were formed, they must once have contained river gravels, and the fundamental difficulty in the pre-glacial history of Scotland is due to the removal of the earlier gravels during the glaciation. The author objects that by a mistake the view that the Central Valley of Scotland was a rift valley due to trough faulting has been attributed to him; but he stated so in the East Lothian memoir (1910, p. 10), referring to the time "when the Central Valley was originated as a structural feature directly influencing the scenery, a true rift valley, in fact, recalling that which at the present day includes the Great Lakes of Africa."

Within the area of this memoir are many interesting igneous rocks and structures, notably the cauldron of Glen Coe. The survey of the area by Mr. Bailey and his colleagues has shown that this formation



FIG. 2.—An Steall, the waterfall from a hanging valley, tributary to Glen Nevis. Water-worn crags on left due to stream tumbling down marginal crevasse. By permission of the Controller of H.M. Stationery Office.

was due to the subsidence of a block of ground along a circular fault, up which welled a ring of igneous rocks.

The memoir also contains an important contribution to the correlation of the Dalradian rocks of this area. Mr. Bailey explains the difficulties by assuming great recumbent overfolds. His colleague, Mr. Carruthers, on the other hand, adopts a simpler explanation based on a different classification of the rocks. Mr. Bailey recognises that Mr. Carruthers's interpretation is of equal standing with his own, which is advanced tentatively. It is difficult to judge the arguments without the map, the issue of which is delayed by the war. The discussion as to which of this series of schists is the oldest and which the youngest, and of their true succession, will probably be settled in areas further east, where the problem is simpler, as the rocks have been less disturbed by the complex earth movements and prolonged igneous activity to which the Ben Nevis district owes so much of its interest and beauty.

J. W. GREGORY.

### THE GENETICS OF SILKWORMS.<sup>1</sup>

FEW animals lend themselves more readily to breeding work than the silkworm moth, and many valuable contributions to our knowledge of their genetics have been made by Japanese workers, among whom Dr. Tanaka has been one of the most successful. The present memoir deals with the inheritance of a number of characters. It is in part an amplification of data previously published by the same author, and in part a collection of new material. Tanaka has dealt for the most part with larval characters. He has worked out in detail the heredity of the patterns peculiar to the various races where his analysis has led him to the detection of seven Mendelian factors. Certain of these are inherited independently, but there are others forming one of those little groups about which there is at present such keen discussion in connection with multiple allelomorphs. In the present case there are four characters belong-

ing to the group, viz. striped, moricaud, normal, and plain (or, in the absence of the P factor, striped quail, moricaud quail, quail, and pale quail). As in the other cases of similar nature, either the hypothesis of multiple allelomorphs or that of complete coupling covers the facts equally well.

One of the most interesting of Tanaka's earlier publications dealt with the peculiar relation existing between the factor for yellow cocoon and certain factors for larval pattern. In the present paper this relation has been worked out in great detail, and has involved the breeding of more than 100,000 individuals. Briefly, the results are as follows: The factor for yellow shows linkage with any one of the group of four characters mentioned

above. In the female, linkage is complete, e.g. a female *ex* yellow striped  $\times$  white normal forms yellow striped and white normal ova only, while a female *ex* white striped  $\times$  yellow normal forms only white striped and yellow normal ova. In the male, however, the linkage is partial. The majority of the sperms are of the two parental types, but about one-quarter belong to the two other possible combinations. Thus a male *ex* moricaud yellow  $\times$  striped white forms the four types of gamete, moricaud yellow, moricaud white, striped yellow, and striped white, nearly in the proportion 3:1:1:3.

In *Drosophila*, as is well known, a similar relation exists between sex and certain characters, but here it is always the male which shows complete, and the female partial, linkage. The significance of the parallel is brought out when it is remembered that in

<sup>1</sup> "Genetic Studies on the Silkworm." By Yoshimaro Tanaka. Journal of the College of Agriculture, Tohoku Imperial University, Sapporo, Japan, vol. vii., part 3, June, 1916. Pp. 129-256 + plates 1-vi.

*Drosophila* it is the male which is heterozygous for sex, while in moths it is the female.

The larval patterns investigated by Tanaka, though definite and distinct from one another, show in some instances much variation with respect to the intensity of their pigmentation. The normal and quail patterns can exist in several grades, so that a continuous series can be formed between the lightest and the darkest. Nevertheless, these grades are definitely transmitted, and Tanaka considers that his experiments afford good evidence that these apparently continuous series can be explained on the assumption of very few genetic factors.

An interesting section is that on the inheritance of moulting. In certain cases the three-moult behaves as a simple dominant to the four-moult character; in other cases the relation is more complex, though Tanaka considers that the facts can be explained by regarding the genetic difference here as one involving two factors. In any case, definite experiments show that the number of moults is much subject to environmental changes.

Records are given of a number of cases of mosaics and gynandromorphs, many of which are illustrated. In view of their importance for theories of sex-determination and fertilisation, it is to be regretted that no pedigrees are given.

Embodying as it does the greater part of our knowledge of the genetics of the silkworm, the memoir deserves careful study by the practical breeder, as well as by the professed geneticist, and we look forward to the publication of the author's analysis of cocoon characters which he promises upon some future occasion.

NEW DETERMINATIONS OF PROPER MOTIONS OF STARS.<sup>1</sup>

THE author of the catalogue before us is carrying out the suggestion of M. A. Donner that those observatories that finished their astrographic catalogue plates in good time should now repeat them, in order to determine proper motions. The Helsingfors plates were taken between 1892 and 1896; they were repeated, at similar hour-angles and calendar dates, between 1909 and 1913, giving an average time-interval of seventeen years.

The corresponding pairs of plates were examined simultaneously in the Blink apparatus, all cases of apparent shift being noted, and afterwards verified by measurement. A selection was made on each pair of eight faint stars that showed no shift; these stars were taken as the zero point to which the motions were referred. This method does not eliminate the small systematic effect due to the solar motion, or other common drift which the region may have. Correction was made for these effects by comparison with Boss, there being forty Boss stars in the region discussed (R.A. 9h. to 12h., N. dec. 39° to 47°). From these he adopts the corrections to his centennial motions, in R.A. -0.07s., in dec. 0". There are eighteen additional stars in Porter's catalogues, which give centennial corrections -0.34s., +0.8". Porter's proper motions do not claim to be reduced to an absolute system. A further comparison, not used by the author, is afforded by twenty-nine additional stars in the revised Groombridge catalogue. These give the centennial corrections to Helsingfors (small, but systematic) -0.15s., +1.1". These tests show that the Helsingfors results are quite satisfactory, considering

<sup>1</sup> "Recherches sur les Mouvements Propres des Etoiles dans la zone photographique de Helsingfors." Par Ragnar Furuhjelm. (i) Clichés de 9h. à 12h. 4to, pp. 190. (Helsingfors: Imprimerie de la Société de Littérature Finnoise, 1916.)

the shortness of the time-interval; they give us a useful list of 1016 proper motions, of which at least 900 are new. The following large motions of faint stars are noteworthy:—

R.A. 1900	N. Dec. 1900	Photo. Mag.	Centennial Motion	Pos. Angle.
h. m. s.	° ' "	m.	"	"
8 58 54	39 13	10.2	48	182
9 17 35	40 35	9.3	38	262
10 0 40	42 13	11.0	48	211
10 25 29	46 3	8.8	84	225
10 50 25	42 26	9.0	74	248
11 5 50	45 58	11.1	75	234
11 29 18	40 43	10.6	64	223
11 31 17	39 45	10.1	60	130

The author gives an examination of the mean parallaxes of stars of various magnitudes, and of the solar motion. The latter must be considered premature until the results for the whole zone are available. The mean parallaxes for magnitudes 3 to 7 are 0.032"; magnitudes 7 to 9, 0.021"; magnitudes 9 to 11, 0.017". These are much larger than those of Kapteyn, which is explained by the fact that the present catalogue contains only those stars that show a sensible shift in seventeen years; these are comparatively near us.

ANDREW C. D. CROMMELIN.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

CLASS IV. of the Estimates for Civil Services for the year ending March 31, 1918, dealing with Education, Science, and Art, has now been issued as a Parliamentary Paper. We record the main items of these estimates of expenditure, with details relating to scientific investigation and higher education.

It will be noticed, as has been pointed out already in these columns, that the grant in aid of scientific and industrial research has been increased to 1,038,050l., an increase of 998,050l. on the grant for the year 1916-17.

United Kingdom and England.  
BOARD OF EDUCATION.

	£
Administration	206,902
Inspection and examination	217,158
Grants in respect of public elementary schools, etc.	12,669,455
Grants for training of teachers	357,900
Grants towards expenditure on secondary schools and pupil teachers and bursars, etc.	962,600
Grants towards expenditure on other aided institutions, schools, and classes, and on assistance in choice of employment	613,960
Imperial College of Science and Technology and Chelsea Physic Garden (grants in aid)	33,650
Royal College of Art	7,743
The Victoria and Albert Museum	59,682
Science Museum	13,598
Geological Museum	3,171
Geological Survey of Great Britain	14,387
Bethnal Green Museum	2,249
Gross total	15,162,455
Deduct—	
Appropriations in aid <sup>1</sup>	2,675
Net total	15,159,780
Net decrease	26,952

<sup>1</sup> In addition, receipts from sale of catalogues and other publications supplied by the Stationery Office, estimated at 400l., will be paid to the Vote or Stationery and Printing.