The Genetics of Wheat Species.

RECENT years have witnessed important advances in our knowledge of the wheats, which are now recognised to fall into three well-marked groups, differing in their chromosome numbers and rust resistance, and showing inter-sterility when members of different groups are crossed. Much genetical work has been devoted, not only to crosses between hexaploid and tetraploid or tetraploid and diploid species, but also to crosses between species having the same chromosome numbers. In the latter series of crosses, in which there is relatively full fertility, various investigators, including Tschermak, Nilsson-Ehle, Engeldow, Percival, Kajanus, and Malinowski, have taken part. The results of these crosses between wheat species having the same chromosome numbers have been much simpler than might have been anticipated, and they raise some interesting questions concerning the relationships between these species, the nature of the differences involved, and the manner in which these differences are germinally represented.

Some of these questions are discussed in a recent paper by Prof. E. Malinowski (*Jour. of Genetics*, vol. 17, No. 2), in which he propounds the view that the phenomena can be explained by assuming linkages between different pairs of chromosomes. Such linkages would resemble in some respects those which are known to occur between many of the chromosomes of Oenothera species. Such connexions between chromosomes have not yet been described as regular occurrences in the wheats, although much cytological work has been done on this group, and there are other difficulties with the hypothesis proposed, which, nevertheless, will doubtless lead to a further analysis of the differences between species of wheats.

In 1914, Malinowski found that a cross between the two hexaploid wheats, *Triticum Spelta* and *T. vulgare* (each with 42 chromosomes), gave an intermediate F_1 and an F_2 which contained *T. Spelta*, the intermediate type, and *T. vulgare* in the ratio 1:2:1, although an independent factor for *T. compactum* (club wheat) was also present. Kajanus confirmed the 1:2:1 result. Now *T. Spelta* has longer ears than *T. vulgare*, and its glumes and spikelets also have a different shape. Hence, in spite of the monohybrid behaviour, it appears probable that a number of (linked) genetic differences are involved. Whether it is necessary to assume that these factors reside in independent chromosomes which have become linked, as Malinowski suggests, remains to be seen.

In crosses between *T. polonicum* and *T. dicoccum*, both tetraploid species with 28 chromosomes, the same 1:2:1 ratio is obtained in F_2, although here again an independent factor for long or short glumes may be present. The same ratio obtains when *T. polonicum* is crossed with *T. durum*, another tetraploid species.

When a tetraploid is crossed with a hexaploid wheat, the results are much more complicated. For example, in *T. polonicum* × *T. vulgare* the F_1 pentaploid hybrid is intermediate, but the F_2 segregates into a great variety of types, including *T. dicoccum*, *T. durum*, and *T. polonicum* ($4n$ chromosomes), as well as *T. Spelta* and *T. Vulgare* ($6n$). Some of the F_3 families show segregation between two species in a 1:2:1 ratio. But they are always both tetraploid or both hexaploid species, *i.e.* they might be *durum* and *polonicum*, or *dicoccum* and *polonicum*, or *vulgare* and *Spelta*. The least complicated segregation between forms having different chromosome numbers is in crosses between *T. dicoccum* and *T. Spelta*. This yields in F_2 *dicoccum*, *Spelta*, and two other types which resemble these respectively.

In his explanatory hypothesis Malinowski assumes that the tetraploid wheats have two linked chromosomes, while the hexaploid forms have three, and that certain of these linked chromosomes are common to different species, *e.g.*, *T. dicoccum* having *a* and *c* linked, while *T. Spelta* has *a*, *c*, and *e* linked. As it seems probable that the hexaploid wheats have arisen at some time through a doubling of the chromosomes in a sterile hybrid between a diploid and a tetraploid species, the tetraploid and hexaploid wheats might be expected to have certain chromosomes in common. Whatever the explanation, these apparent linkage phenomena in wheat species are of much interest, and their elucidation may well mark another step in the advance of genetic theory.

Tschermak and Bleier (*Ber. Deut. Bot. Gesells.*, vol. 44, p. 110) have recently obtained a constant fertile octoploid hybrid by crossing *Aegilops ovata* with *Triticum dicoccoides* and *T. durum*. This they believe supports Percival's hypothesis that the hexaploid wheats arose from crosses of *T. dicoccoides* with Aegilops. But Percival (*Jour. Genetics*, vol. 17, p. 60) has found that Aegilops itself contains species with $2n$, $4n$, and $6n$ chromosomes.

Another set of results bearing closely on these problems is derived from the work of Prof. G. C. Meister with his wheat-rye hybrids (*Saratov Agr. Exp. Station*, I, p. 220, 1923). Six generations have been grown from the original natural crosses and a multitude of forms has been obtained, but the 'F_2' consisted of uncontrolled back-crosses with the parents. The parent wheat was hexaploid and the rye diploid, the hybrid F_1 being tetraploid. Chromosome studies combined with genetical examination of the later generations should make possible an analysis of what is happening—whether merely recombination of factors already present or whether germinal changes of various possible kinds are responsible for the appearance of some of the new types. How, from a single species of wheat when crossed with rye, a whole series of wheat species and varieties, some of which are already well known, should arise, is not at present clear; but the elucidation of this problem should add much to our understanding of the relationship between different species of wheat. One of the forms thus obtained is very similar to *T. persicum*, a tetraploid wheat. A full study of the chromosomes in these hybrids may be expected to throw light on the relation between crossing and mutation, and also on the relationships between wheat species.

R. RUGGLES GATES.

The Recolonisation of Krakatau by Animal Life.

THE gradual recolonising of the island of Krakatau with plants and animals subsequent to the catastrophe of 1883 is a subject of great biological interest. Dr. K. W. Dammerman, of the Buitenzorg Museum, tells us that after studying the new fauna of Krakatau it was desirable to compare it with that of some similar neighbouring island which had remained unaffected by volcanic convulsions. After taking various islands into consideration, the nearest suitable *terraine* for such comparison appeared to be Durian—a member of the Rhio-Lingga archipelago. It has about the same area as Krakatau and is situated between the bigger island of Sumatra and the Malay Peninsula (just as Krakatau lies between Java and Sumatra). The whole island is clothed with virgin forest, it has been little interfered with by man, and, for a very long time, no volcanic eruptions have devastated its fauna and flora. The fauna of Durian proved somewhat disappointing, owing to the poor soil and the resulting rather scanty vegetation. No Ficus of any kind, for example, was detected on the island, and, it may be added, trees of the fig tribe are one of the most attractive for birds, insects, and other animals.

Dr. Dammerman states that the research on the fauna of Durian [1] was wholly planned for the purpose of comparing it with that of Krakatau—to ascertain what Krakatau's fauna possibly was before the eruption, and what it is likely to consist of in future. Taking the whole fauna into consideration, he finds that the total number of species of animals on Krakatau at present is about 62 per cent. of that of Durian, but, with regard to individual groups, very different figures reveal themselves. As regards the vertebrates, Krakatau is far behind Durian with 47 per cent., but considering terrestrial forms alone, and excluding birds and bats, Krakatau has only 21 per cent. of the forms inhabiting Durian. With the invertebrates the poorness of Durian Island is noticeable, as Krakatau already has 93 per cent. of the number of invertebrates of Durian. Of insects only, Durian has a great majority, having about 40 per cent. more than Krakatau.

The remarkable conclusion of Dr. Dammerman's comparison is that Krakatau has regained about 60 per cent. of its normal fauna after a lapse of about forty years, on the supposition that the fauna of Durian is a normal one for the comparison. He maintains that the fauna of Krakatau will be complete, not after centuries, but within a comparatively short time, much shorter than might reasonably have been anticipated. The fauna is likely to become much richer than that of Durian to-day, on account of its more fertile soil and luxuriant vegetation.

[1] K. W. Dammerman, "The Fauna of Durian and the Rhio-Lingga Archipelago." *Treubia*, vol. 8, liv. 3-4, July 1926, pp. 281-326.

Excluding bats, of which certainly many more species will reach Krakatau in future years, nine terrestrial mammals occur on Durian against only one on Krakatau. This species, the common Malay house rat, seems to have come in about 1917, but when the island was revisited in 1924 it appeared to be on the verge of extinction. This conclusion is in accordance with the theory that house rats are unable to thrive away from human dwellings. The field rat, and possibly other species, are to be expected together with the Malay macaque and the commoner kinds of wild hogs. Of the birds, it is anticipated that the fauna will become about twice as rich as it is nowadays, but fresh water being absent on Krakatau, such birds as are dependent thereon will have no chance of survival should they arrive on the island. Among the reptiles, the lacertilian *Lygosoma atrocostatum* is now abundant, whereas in 1921 the species is stated certainly not to have been there, and the same applies to the crocodile. Among the insects, Hymenoptera are not anticipated to show rapid increase of species in the future, but Coleoptera and Lepidoptera are still far from their maxima.

In short, it appears that on new land, carnivorous animals are later invaders than vegetable feeders, and on Krakatau there are as yet no insectivorous bats or other carnivorous mammals, Cicindelidæ, or predaceous flies. Other groups of raptorial insects such as Mantidæ and Neuroptera are rare. The exception appears to be the spiders, which are unusually abundant. This is explained on the basis of the extraordinary ease by which Araneæ are spread, and the fact that they thrive largely on flying insects, which are those which would reach the island early in the process of repopulation.

It is noteworthy that three species of Oligochæta (against two species on Durian) have reached Krakatau, but, as might be expected, there are no freshwater Crustacea or Mollusca, but land members of the two latter groups are represented by three and six species respectively.

A. D. IMMS.

British Industries Fair.

THE British Industries Fair, which is organised annually by the Department of Overseas Trade, was held on Feb. 21-Mar. 4 at the White City, London. A section of the Fair was held at the same time at Birmingham, mainly for hardware and engineering exhibits. Evidence of the increasing popularity of the London fair was provided by the Department being able to issue a detailed catalogue six weeks before the opening, all the exhibiting space available having been reserved by that date.

The dominating exhibit of the chemical section was arranged by the Imperial Chemical Industries, Ltd., the combine recently formed by Brunner, Mond and Co., Ltd., Nobel Industries, Ltd., the United Alkali, Ltd., and the British Dyestuff Corporation, Ltd. The exhibit was designed to show the wide range of products obtained from raw materials in general use, such as sulphur, coal, brine, and limestone. Nitram, Ltd., a subsidiary company, demonstrated in an interesting way the new principle in use for fertilising grazing land.

Another exhibit of chemical interest was the new fresco medium (silicon ester fresco) which by offering the artist a new medium may revive an ancient art some of the secrets of which have been lost. Silicon ester is said to form as convenient a medium as oil, and to combine the fluidity and facility of water colour with the strength and depth of oil. It is hoped that this discovery will lead to a revival of large mural decorations. The firm interested in silicon ester fresco—Messrs. Albright and Wilson, of Oldbury—are also promoting the use of silicon ester for consolidating and protecting the surface of decaying stone and for imparting a new siliceous face to terra-cotta in the early stages of decay. The silica is deposited in an adhesive and non-crystalline form. Remarkable success has been obtained in the restoration of decayed stone-work in old buildings by the use of this material.

Improvements in the reproduction of sound by gramophone were shown by Messrs. C. Gilbert and Co.—a Sheffield firm—who demonstrated their tone reflector, an instrument for producing great volume of sound without distortion. Among the radio exhibits the Priory loud speaker made by a Newport Pagnell firm deserves a word of commendation.

Several firms exhibited aids for the deaf. The National Institute for the Deaf has strongly advised sufferers to consult an ear specialist to ascertain whether the deafness is of a type likely to be helped by an artificial aid and to deal only with a firm willing to allow a home trial of two or three weeks before purchase. This warning is without doubt necessary, and should be widely advertised to prevent the exploitation of sufferers. Good progress is being made in electrical aids, but older forms of aid are also receiving attention. Mr. Geo. W. King, proprietor of the British Acoustic Co., himself a sufferer, showed