The Genetics of Cereals.

THE volume of published investigations on the genetics and cytology of cereals continues to increase, and some important problems of variation and relationships in these forms are being solved. One of the most recent of these discoveries relates to oats.

The sporadic origin of fatuoid or false wild oats from cultivated varieties has been an agricultural problem for forty years. They resemble the wild oat, *Avena fatua*, but differ in not having delayed seed-germination. An extended study of the genetics and cytology of fatuoids by Dr. C. L. Huskins (*Jour. of Genetics*, vol. 18, No. 3) has resulted in the important discovery that these are mutations resulting from chromosome irregularities in normal oats. While ordinary oats (*Avena sativa*) has forty-two chromosomes, Dr. Huskins has found that in different fatuoid strains the chromosome numbers range from forty to forty-four.

The commonest type of heterozygous fatuoid has forty-two chromosomes and segregates into normals, heterozygous and homozygous fatuoids in a 1 : 2 : 1 ratio. The segregated fatuoids frequently have a single trivalent and a univalent chromosome or, in homozygous forms, a quadrivalent. Probably such fatuoids arise through the formation of a quadrivalent chromosome in which the elements are not segregated in their proper pairs in the reduction division. Another fatuoid type has forty-one chromosomes and produces a few sterile dwarfs with forty chromosomes. The type with forty-three chromosomes produces a few sterile dwarfs with forty-four.

This work constitutes a new and striking case of correlation between chromosome content and genetic behaviour. Numerous similarities are pointed out between fatuoid oats and speltoid wheats, which also arise as variations. Both conditions apparently arise through aberrant chromosome distributions. The practical possibility is suggested that a strain of oats may be produced which does not give rise to fatuoids.

Novel results are obtained by Mr. A. E. Watkins (*Jour. of Genetics*, vol. 18, No. 3) in the study of crosses between Rivet wheat (*Triticum turgidum* with 14 pairs of chromosomes) and *T. vulgare* (vars. Yeoman and Iron) with 21 pairs. The F_1 is partially sterile, but was back-crossed with both parents reciprocally. Chromosome counts in these hybrids show that while the F_1 fertile egg-cells usually have a chromosome content intermediate between 14 and 21, the F_1 pollen grains with intermediate numbers are largely sterile. Thus while the eggs tend to be genetically intermediate, the 14-chromosome pollen grains are found to be carrying chiefly the *turgidum* characters, while the pollen with 17-21 chromosomes carries mainly *vulgare* characters. The keel on the glume, which distinguishes *turgidum*, can be transferred to *vulgare* by crossing. The view is expressed that there are not many factor differences between the *turgidum* chromosomes and the 14 *vulgare* chromosomes with which they pair, the *vulgare* characters being associated with the extra chromosomes. The view is therefore upheld that there is a simple polyploid relationship between the two species.

The interesting discovery is made that in some of these back-crosses the germination of the grain is largely determined by the chromosome content of the endosperm. Grains from the cross 42-chromosome ♀ × 28-chromosome ♂ are plump and germinate well, while from the reciprocal cross they are wrinkled and germinate badly. Successful germination depends on the relations between embryo and endosperm. The conclusion is reached that germination is good if all chromosomes are present in the endosperm in the diploid or triploid condition, but bad when some of them are only represented once.

In a continuation of this work (*Jour. of Genetics*, vol. 19, No. 1), Mr. Watkins has studied the inheritance of such features as waxy leaves, keeled glume, and susceptibility to *Puccinia glumarum* in F_1 *T. vulgare* × *T. turgidum* back-crossed with *turgidum* or *vulgare*. The results lead to the conclusion that the two species carry homologous factors in homologous paired chromosomes, while the extra *vulgare* chromosomes carry another set of very similar if not identical factors.

In crosses between the tetraploid *T. durum* and *T. vulgare*, Prof. W. P. Thompson (*Genetics*, vol. 10, p. 285) found in F_2 and F_3 some plants resembling *T. durum*, some like *T. vulgare*, and some intermediate. They have chromosome numbers corresponding to their external appearance, and the forms with intermediate numbers and appearance tend to be eliminated in F_3. The correlation between the *T. durum* characters and rust-resistence was broken, but since resistance evidently depends on more than one factor, it will be very difficult to get full rust-resistance in *T. vulgare* types.

Various crosses between wheat (21 chromosomes) and rye (7 chromosomes) have been made in recent years. Prof. Thompson (*Genetics*, vol. 11, p. 317) describes the cytology of a cross, using an unspecified variety of wheat as mother. This particular cross, he finds, is easily made. In the hybrid, no chromosomes pair at reduction, but the 28 separate into two groups and split lengthwise either before or after this separation. Very few F_2 plants were obtained, as the pollen sterility is almost complete.

Prof. G. K. Meister and his collaborators at the Saratov Experiment Station on the Volga have published a series of papers on wheat-rye hybrids, beginning in 1918, which should be more widely known. Their most recent contributions in Russian, with English or German résumés, are contained in *Jour. Exp. Agric. S.E. Eur. Russia*, vol. 4, Part I. They find that the reciprocal crosses between *vulgare* wheat (var. *erythrospermum*) and rye can be made, and they give identical results. The rye × wheat cross was made by using the local winter rye and the pollen of a winter wheat. The F_2 from these crosses was grown in large numbers in 1926, and many of the plants showed greatly increased fertility.

The cytology of the hybrid between *T. monococcum* ($n = 7$) and *T. turgidum* ($n = 14$) has been investigated by Prof. W. P. Thompson (*Jour. Genetics*, vol. 17, No. 1). In the pollen formation of this triploid hybrid, three to seven bivalent chromosomes appear, the remainder being unpaired. Sax, using another variety of *turgidum*, has previously reported the regular occurrence of seven bivalents. The later history of the chromosomes is also different, Thompson finding that after the bivalents separate the univalent chromosomes arrange themselves medianly and split. In the homotypic division these univalents lag, fail to divide, and wander irregularly to the poles. Sax, however, found the univalents dividing in the second division and not in the first. Thus a small difference in one of the parents appears to make a great change in the chromosome behaviour. These two varieties of *turgidum* ought to be crossed together and the hybrids studied.

Reference may be made to one more paper on wheat hybrids, by Miss Melburn and Prof. Thompson (*Amer. Jour. Bot.*, vol. 14, p. 327). In *T. spelta* ($n=21$) × *T. monococcum* ($n=7$) the hybrid is completely sterile, and the heterotypic division shows from five to no bivalent chromosomes. The remainder mostly split, but in the second division they lag and form extra nuclei. The hybrids between different types of wheat can thus be arranged in a series according to the amount of pairing of chromosomes and the irregularities in the behaviour of the univalents.

R. RUGGLES GATES.

The Introduction of Civilisation into Britain.

AT the anniversary meeting of the Royal Anthropological Institute, held on Tuesday, Jan. 24, the outgoing president, Mr. H. J. E. Peake, delivered an address on "The Introduction of Civilisation into Britain." He said that it seems certain that the art of agriculture, the first step in civilisation, was first practised in the Near East, more probably in Asia than in Africa, and that the first grain-growers were also potters. At an early date both these arts were introduced into the Ægean area and into the Plain of Hungary, and Prof. Childe has shown how they spread from the latter area to Switzerland, to the Rhine, and to the country around Liège.

Dr. Frankfort has recently pointed out the existence of a trade-route in Early Minoan times; this started from the head of the Gulf of Corinth and reached southern Italy and Sicily. Along this route passed commodities from the second city of Hissarlik. Frankfort suggests that this trade was carried farther west, and Childe has noted the presence of Early Cycladic beads in Portugal. This indicates that the elements of civilisation had reached the Atlantic coast before 2200 B.C.

Prof. Bosch-Gimpera has shown that early in the Copper Age there were two small centres of civilisation in the Iberian peninsula, one at Almeria in the south-east and the other in the south of Portugal, and that between them the Capsian natives used a rough pottery, based on leather models. These people had evidently learned the first elements of civilisation from the eastern traders, and had developed a rude civilisation that Bosch-Gimpera calls "la civilisation des grottes." He has also shown that this type of rude pottery spread so far as the Maritime Alps.

It is believed that agriculture and the potter's art reached Britain at the dawn of the Neolithic Age, and this view, as we shall see, is justified. In 1910, Mr. Reginald Smith described some round-bottomed bowls, one of which came from Mortlake, and some similar fragments from Peterborough, and pointed out that pottery of that type has been found in Finland and East Sweden. In 1925, Mr. T. D. Kendrick described two neolithic wares, one of which was found at Rodmarton and other sites in Gloucestershire and Wiltshire, the other at Mortlake and Peterborough, and in the same year Prof. O. Menghin also described these wares under the names of *Grimston-keramik* and *Peterborough-keramik*, suggesting that the former is earlier than the latter. Quite lately Mr. E. Thurlow Leeds has discussed the problem, criticising Menghin's terminology, and claiming that the first ware arrived from the south and the second from the north-east about the same time.

The best evidence comes from Windmill Hill, Avebury, now being excavated by Mr. Alexander Keiller, who has kindly allowed this information to be published. Here have been found three concentric rings of intermittent ditches, resembling those at Michelsberg, but without the distinctive tulip-shaped vase of the latter site. Pottery was found abundantly in the ditches, but in two layers separated by an almost sterile interval.

In the top layer, along with fragments of beakers, were found a number of pieces of the *Peterborough-keramik* and many sherds resembling the *Grimston-keramik*. In the lower layer, however, the prevailing ware is different, but the paste somewhat resembles that of the *Grimston-keramik*. Mrs. Keiller has restored several pots, which resemble closely some found in the lake-dwellings of Switzerland, and are called by Reinerth the *Westische-keramik*; these seem to have been introduced into Switzerland from the basins of the Rhone or Saône.

It appears likely that the elements of civilisation passed up the Rhone valley into Burgundy, where this *Westische-keramik* developed among a people who lived in fortified villages of the Michelsberg type. Thence the potter's art, and the elements of agriculture, spread into Switzerland, through the Belfort Gap into the Upper Rhine basin, where it developed into the characteristic Michelsberg type, and into the north of France and Belgium, where it spread over a large area, in which was a culture called by Bosch-Gimpera "la civilisation du silex." From this last region it reached the south of England some little time before the arrival of the *Peterborough-keramik* on the north-east coast.

Marine Oil-Engines.

IN the first Thomas Lowe Gray lecture, delivered before the Institution of Mechanical Engineers on Jan. 6, Prof. C. J. Hawkes makes an interesting survey of the past development, present status, and probable future development of the marine oil-engine. Past development is but briefly outlined. In regard to the present position, attention is directed to the fact that recent improvements in fuel consumption of marine steam turbine installations have reduced the advantage in this respect held by the oil-engine. In the tests conducted by the Marine Oil-Engine Trials Committee, the Still airless-injection two-stroke engine, consuming 6880 B.T.U., and the Doxford airless-injection opposed piston two-stroke engine, consuming 7570 B.T.U. per brake horse-power per hour, were the best performances, and it is shown that while the former has a less efficient fuel combustion, this is more than balanced by the energy recovered from the jackets and exhaust gases. It is estimated that the minimum consumptions possible at the present time are 6240 and 6820 B.T.U. per brake horse-power hour for the Still and Doxford engines respectively.

In a discussion of possible improvements it is regarded as doubtful whether the installation of waste heat boilers for the purpose of increasing the overall efficiency is justifiable. The employment of high speed engines transmitting power through hydraulic clutches and mechanical gears, which effects a saving in weight, etc., is considered to be limited to four-stroke trunk-piston engines of moderate power. The four-stroke single-acting engine has much to recommend it for moderate powers, and for larger powers, the two-stroke single acting is preferred to the four-