sex. In the main part of the book Castle sets forth the essential facts of genetics. Here he lays stress on the unit character principle—a principle whose importance is not proving to be as great as was anticipated. Apparently particular genes no more produce exclusively particular unit characters than particular endocrine glands affect merely particular somatic qualities. But there are prevailing or characteristic somatic effects which we associate with the presence or absence of particular genes. Castle would perhaps not accept this view, although it would help his own interpretation of his selection experiments. But that interpretation is now abandoned by Castle for that of gene mutation and multiple factors; and his presentation of the hypothesis of multiple factors is particularly clear. Many other complications in heredity are considered fully and clearly, such as mutations both in gametes and in soma (bud mutations). Inbreeding and cross-breeding are fully discussed; and the ground for the settlement of the long-standing controversy as to harmfulness of inbreeding is shown. Heredity of sex is rather fully considered.

Castle passes then in some new chapters very briefly to certain applications of genetical discoveries; improvement of live stock and of the human species. To the latter a whole part of the book is devoted, but this has not been greatly changed from the second edition. Finally, to the bibliography a large addition has been made, giving concrete evidence of the continued fecundity of genetical research.

Castle's "Genetics and Eugenics" is probably the standard college text-book covering the whole field in broad fashion. Its popularity is well deserved. If any criticism were to be suggested it might be directed toward a certain over-conservatism. Thus Castle concludes that mutation by variation in the number of chromosomes can not be a satisfactory general explanation of the origin of species. But neither can gene mutation, which he appears to regard as sufficient. He overlooks the large array of facts showing that in the species of a genus the chromosomes not infrequently differ by multiples of the smallest number in the genus. Also that the formation of tetraploids in mutations meet all the conditions for species formation; a new assemblage of several characters, more or less infertile with the parent species. A tenacity of views leads Castle to print for the third time (on page 43) his opinion that Darwin inherited a "good mind"—not a tendency toward natural history; this despite the great progress in the last few years in demonstrating the fundamental difference in special capacity (like music) of different strains of mankind.

The success of Castle's "Genetics" is largely due to his innate capacity for and experience in teaching. No doubt the need of putting things so that even immature college men can understand them has resulted in the marked clarity of the book. As a teacher he has seen the need of bringing the student into first-hand contact with the phenomena of genetics and so he has prepared an outline for a laboratory course in genetics. By use of the rapidly breeding banana fly and of dried ears of corn he has been able to bring students into contact with the methods and results of genetics within the span of a half year's course. This "outline" pamphlet includes valuable tables of deviation divided by probable error and the relative probability of occurrence of each genetic ratio; also of probable errors due to chance alone from various genetic ratios taken from Emerson. This "outline" will do much to put genetics on a proper pedagogic basis.

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SEGREGATION OF CARBOHYDRATES IN MAIZE POLLEN

KIESSELBACH and Peterson[1] in two recent articles have attempted to disprove the results of previous investigators with respect to visible segregation in maize pollen and to the occurrence of more than ten haploid chromosomes in maize.

It is now generally accepted that the stored carbohydrate in the seeds of waxy maize stains red with iodine in sharp contrast with the violet reaction of the starch of non-waxy varieties, a condition first pointed out by Weatherwax and fully corroborated by other investigators. The waxy character behaves as a simple Mendelian unit recessive to the horny form, and back-crosses of heterozygous plants clearly show that one half of the pollen carries the gene for waxy and the other the gene for the horny allelomorph. Further, if pollen from F_1 plants is stained with a dilute solution of iodine, approximately half the grains give the characteristic violet color of starch, while the other half stain a reddish brown, a phenomenon clearly analogous to the distinction found in the seeds.

This differential staining of the pollen has been reported by Demerec,[2] Brink and MacGillivray,[3] and

[1] Kiesselbach, T. A., and Petersen, N. F., "The chromosome number of maize," *Genetics*, 10: pp. 80–85, 1925; "The occurrence of starch and erythrodextrin in maize and their segregation in the pollen of hybrids," *Genetics*, 10: pp. 86–89, 1925.

[2] Demerec, M., "A case of pollen dimorphism in maize," *Amer. Jour. Bot.*, 11: 461–464, 1924.

[3] Brink, R. A., and MacGillivray, J. H., "Segregation for the waxy character in maize pollen and differential development of the male gametophyte," *Amer. Jour. Bot.*, 11: 465–469, 1924.

Longley,[4] while Kiesselbach and Petersen have presented the sole dissenting view. They contend that the pollen of plants heterozygous for waxy endosperm can not be differentiated, by staining with iodine, from that of either homozygous form.

Any one who has seen a properly stained sample of pollen, heterozygous for Wx, will not doubt that the grains can be separated into two clearly marked classes.

The stage at which the two classes are most sharply separated is just before anthesis, but the distinction exists at all times when there are grains of carbohydrate stored in the pollen grain. Very old pollen has such a small amount of solid carbohydrate remaining that the classification of individual pollen grains may be difficult. But with flowers kept dry for over a year the pollen stained sufficiently satisfactorily to make certain the identification of horny, waxy and heterozygous individuals.

Practical use has been made of the differential staining of the carbohydrates in maize pollen which furnishes direct evidence of the reality of the distinction. The pollen from 200 plants grown from the horny seeds of an F_2 hybrid of waxy x horny was examined to detect those individuals heterozygous for Wx. This population, of course, was composed of both heterozygous and homozygous individuals and it was desired to confine hand pollinations to heterozygous plants. One hundred and thirty-three plants were found that produced two sorts of pollen when stained with iodine. These plants were all hand pollinated and without exception proved to be heterozygous for the waxy character, furnishing conclusive proof that the segregation had been recognized in the pollen. The sixty-seven plants classed as homozygous horny from the pollen examinations were discarded, but since this number corresponds very well with the expected one third there can be little doubt of the accuracy of the method. These results appear to provide a complete demonstration of the actuality of the observed differences in the pollen.

With respect to the chromosomes of maize Kuwada[5] alone has reported other than 10 as the haploid number. My early chromosome determinations as published[4] are in agreement with those of Kiesselbach and Petersen, but in the past season further studies have revealed that in four strains, two sweet and two starchy, other numbers occur. These are characterized by 21/2, 11, 23/2, 12 and even 13 haploid chromosomes at diakinesis, thus substantiating this phase of Kuwada's investigations.

[4] Longley, Albert E., "Chromosomes in maize and maize relatives," *Jour. Agric. Res.*, 28: 673–681, 1924.

[5] Kuwada, Y., "Die chromosomenzahl von *Zea Mays* L.," *Jour. Coll. Sci.* (Tokyo Imperial University), 39 (Article 10): 1–148, 1919.

Curiously enough, the plants with extra chromosomes were not visibly different from those having the customary number. One strain in which extra chromosomes were found had been self-fertilized for fourteen generations, but the plants of this progeny were not uniform with respect to chromosome number.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF BAKELITE IN THE PRESERVATION OF FOSSIL MATERIAL

IN considering some of the problems of the preservation of fossil material it occurred to the writer that Bakelite might be used in many cases in which shellac is unsatisfactory. In the course of the experiments the writer has been aided by Dr. Geo. W. Baekeland and the research staff of the Bakelite Corporation, both by advice and by the donation of material for use in the experiments. These courtesies are gratefully acknowledged.

Bakelite is superior for the purpose suggested because it is practically indestructible after hardening and because it is more elastic than shellac. The process of treatment is very simple; the varnish is thinned with the "thinner" furnished by the company, most successfully by a 50 per cent. addition, and the specimen after preliminary draining and drying is baked at a temperature of approximately 220° F. in an air bath for from ten to fifteen hours. Fortunately the temperature is not a critical but an approximate one and the air bath need not be closely watched. In the present experiments an electrically heated oven of good capacity was used. The Bakelite penetrates the material and leaves no accumulation upon the surface to obscure details; the color of specimens is slightly, but very slightly, darkened.

The first attempts were directed toward the preservation of very rotten and fragile specimens of Pleistocene and Recent bones, such as mastodon, buffalo and human bones. In this success was very apparent. In the most porous specimens the Bakelite was used without thinning and poured over the specimens, or the specimens immersed in the Bakelite, until they were thoroughly impregnated, then they were allowed to drain and dry for some hours, then heated for ten to fifteen hours at the proper temperature. It is necessary that the specimens, especially if of large size, be allowed to drain and dry before heating, as the varnish is apt to froth if heated before the thinner has evaporated. Also the specimen must be sponged with the thinner before baking to remove any varnish on