

university year 1920 there were 1,505 students; in the year 1921 there were 2,415, and at present there are over 2,600, and there is every prospect that the increase will continue. Provision for further development has been made there by 175 professorships in the place of 90 chairs before the war.

CLAUDE BURTON HUTCHISON, professor of plant breeding of Cornell University, has been selected by the regents of the University of California to head the activities of the branch of the College of Agriculture at Davis and to become professor of plant breeding.

DR. D. H. DOLLEY, professor of pathology at the University of Missouri, has been appointed director and professor of pathology in the St. Louis University School of Medicine. Dr. R. L. Thompson has resigned as director but will continue in the department.

DR. H. R. DEAN, professor of pathology and pathological anatomy in the University of Manchester, has been appointed to the university chair of bacteriology at the University of London, tenable at University College Hospital Medical School.

## DISCUSSION AND CORRESPONDENCE

### SELECTIVE FERTILIZATION AS AN INDICATOR OF GERMINAL DIFFERENCES

It has been argued from time to time that the qualities which separate species are essentially different in kind from the visible variations which the geneticists are now busily describing in terms of genes. The position of those who take the affirmative side is fairly stated, I believe, in the following quotation from Bateson's recent address before the American Association for the Advancement of Science:

Analysis [of the hereditary traits of animals and plants] has revealed hosts of transferable characters. Their combinations suffice to supply in abundance series of types which might pass for new species, and certainly would be so classed if they were met with in nature. Yet critically tested we find that they are not distinct species and we have no reason to suppose that any accumulations of characters of the same order would culminate in the production of distinct species. Specific differences therefore must be regarded as

probably attaching to the base upon which these transferables are implanted of which we know absolutely nothing at all. Nothing that we have witnessed in the contemporary world can colorably be interpreted as providing the sort of evidence required.<sup>1</sup>

At this time lack of knowledge concerning the primary factors of evolution makes the stand of the agnostic undoubtedly a safe one and the one which may be the most conducive to real progress in the end. At the same time there is some evidence which should be considered in connection with the statements made in the quotation.

It has been shown conclusively in one species that fertilization takes place less readily when the gametes come from unlike forms than when homogeneous unions are made. The discrimination becomes more pronounced as the germinal differences of the uniting individuals are greater.<sup>2</sup> Maize is better material than most plants to show this because of the large number of seeds it produces with one application of pollen, and because the source of the pollen is soon apparent in the characters of the immediately resulting seeds. Mixed pollinations carried out with this organism have shown that the individual's own pollen, when acting in competition with pollen from other individuals of different constitution, is more effective in accomplishing fertilization.

When two different plants of similar type are compared the selective action is small. For example, when two varieties of maize having the same size and form of plant, equal length of growing season, similar seed shape and texture of endosperm and differing only in minor details are tested, the inequality in fertilizing power of the two kinds of pollen is slight although significant. The small difference in genetic make-up of these plants is also shown by the fact that there is very little heterosis exhibited in the increased weight of the crossed seed compared to the self-fertilized seed. But when a small-growing variety having non-starchy endosperm is paired with a larger variety which differs markedly from it in habit of growth, has starchy corneous seeds of very

<sup>1</sup> SCIENCE, 1922, N. S. Vol. 55, pp. 59 and 60.

<sup>2</sup> *Biological Bulletin*, 1920, Vol. 38, pp. 251-289.

different size and shape and possesses important differences in nearly all parts of the plant, the discrimination against the foreign pollen is very pronounced. The result is almost complete non-functioning of the pollen from the dissimilar plants although such pollen when acting alone is capable of normal fertilization. The greater genetic diversity of these two types is also indicated by the fact that the amount of heterosis shown in the increased weight of the crossed seeds is much more than in the previous case of the similar varieties.

There is here exhibited the working of a tendency which acts to set individuals apart. Besides *Zea mays* three other species, representatives of different orders of the two main classes of angiosperms, show the same phenomenon. It is paralleled in the assortative mating of animals from the lowest to the highest. It is not inconceivable that when carried far enough there may be created an impassable physiological barrier separating different groups. As far as can be judged the differences shown by the types used for illustration are the usual qualitative and quantitative characters which we have been thinking of in terms of Mendelian units. Such hereditary characters may not be directly concerned with the selective action but may be merely associated with differences in more fundamental qualities, but whatever these are they are transferable.

Of course this tells us nothing as to how the differences which are correlated with inequality in fertilizing ability arose. But however diverse were the forms which entered into the ancestry of maize they must have been sexually compatible. Individual members of this species which are quite diverse in form and behavior are now showing a marked tendency towards sexual incompatibility. The degree of selectiveness may be no greater now than it was when the species was first founded but the fact that there is a condition of measurable physiological aloofness is reason to suppose that the accumulations of characters of the same order would culminate in different groups being clearly set apart. Given sufficient time specific differences may finally result.

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### GRAVITATIONAL ABSORPTION

THE experiments of Majorana<sup>1</sup> on gravitational absorption having attracted considerable notice, it seems well to direct attention to the large amount of experimental evidence to the contrary.

Russell<sup>2</sup> in a recent article has shown that astronomical and tidal phenomena would limit any gravitative absorption to one-thousandth or less of the amount announced by Majorana.

Eichelberger and Morgan,<sup>3</sup> of the U. S. Naval Observatory, have recently published the results of clock observations from 1903 to 1911, reduced so as to show a difference, if any, between the day and night rate. It appears from these results that such a difference can not exceed 0.005 second, about one-tenth that previously announced by the Lick Observatory<sup>4</sup>. The writer is verbally informed that the Naval Observatory results from 1913 to 1918, reduced but not yet published, bring this slight difference to a still smaller figure.

The existence of gravitative absorption should cause a pendulum clock to run slower by night than by day, on account of the absorption by the earth of the gravitative action between the pendulum bob and the sun. Taking Majorana's coefficient of absorption ( $6.7 \times 10^{-12}$ ) the average absorption of gravitation by the earth during the night would amount to about three per cent. of the solar gravitative acceleration at the distance of the earth, which is about 0.0006g. The total gravitative acceleration to which the pendulum bob is subjected would therefore be reduced at night by about 0.00002g, or 2 parts in 100,000, and the average time of swing increased by 1 part in 100,000.

Taking 0.005 second as the greatest permissible change in 12 hours, the observations of Eichelberger and Morgan would limit the change in time of swing to something like 1 part in nine million.

Majorana himself, in a later series of experi-

<sup>1</sup> *Phil. Mag.*, 39: 488, 1920. *Atti della Reale Accademia dei Lincei*, 28, 1919, and 29 1920.

<sup>2</sup> *Astrophysical Journal*, 54: 334, 1921.

<sup>3</sup> *Astronomical Journal*, No. 795, January 1922.

<sup>4</sup> *Lick Observatory Bulletin*, No. 330, April, 1921.