UNIVERSITY AND EDUCATIONAL NOTES

BEQUESTS amounting to about $700,000 to Princeton University, the University of Pennsylvania, the Presbyterian Hospital and Bryn Mawr Presbyterian Church are made in the will of Harold A. Freeman, a business man of Philadelphia.

A GIFT of $500,000 has been made to the Hill School in Pottstown, Pennsylvania, by Mrs. Alexander Hamilton Rice for a general science building as a memorial to her son, Harry Elkins Widener. In addition to the usual scientific facilities, the building will provide small private laboratories for the use of gifted students.

DR. A. G. BLACK, associate professor of agricultural economics at the University of Minnesota, will become head of the department of agricultural economics at the Iowa State College at Ames on July 1.

DR. E. G. CONDRA, head of the conservation and survey division of the University of Nebraska, has been appointed dean.

A. O. HICKSON, of Brown University, and E. R. C. Miler, of Rice Institute, have been elected assistant professors of mathematics at Duke University, effective September, 1929.

THE full Board of Curators of the University of Missouri on April 7 upheld the dismissal of Dr. Harmon O. DeGraff, assistant professor of sociology, for his part in the circulation of a sex questionnaire among students. It granted reinstatement to Dr. Max F. Meyer, professor of psychology, who, however, was ordered suspended for one year.

DISCUSSION

CRITERIA OF HYBRIDITY

CRITICISMS of certain phases of genetical research have from time to time been made in this journal and elsewhere on the ground that the material is "abnormal" or of hybrid nature. Leaving aside for the moment any wider considerations, it may be of interest to examine the value of the criteria of hybridity upon which the critics base their arguments.

Sterility, once thought to be a very good criterion of hybridity, is now admittedly a difficult one, owing to the possibility of confusion with incompatibility which in certain cases causes "self-sterility" and failure of matings between individuals genetically identical in respect of the incompatibility factors.

The more recently invoked criteria of hybridity are irregularities in the maturation division, or meiosis, and pollen sterility of plants. The former has been especially invoked by Professor Jeffrey against *Drosophila melanogaster* (SCIENCE, 62 (1592): 3–5, 1925; and *ibid.*, 68 (1758): 233–235, 1928). Profesor Jeffrey first stresses the difference between the body-cell and the germ-cell divisions in hybrids. This difference, interesting as it is from the cytologist's point of view, is surely irrelevant when the issue is the determination of hybridity. With few exceptions the body-cell divisions are regular regardless of the "purity" or hybridity of the organism or of the character of its germ-cell divisions. A feature common to both hybrids or abnormal forms and to pure species can scarcely be of value as a criterion for distinguishing between them.

Irregularity of the maturation divisions is very frequently associated with a hybrid condition, but again it can not be accepted as a satisfactory criterion of hybridity. First, hybridization between distinct species may give offspring with regular maturation divisions, even though the hybrids are in some cases sterile; and secondly, irregularity of the maturation divisions can be brought about by agencies other than hybridization. A few instances may be cited in illustration of these points.

The cross *Primula floribunda* × *P. verticillata* produces the form known as *P. kewensis*. The immediate offspring of the cross are sterile diploid plants having the same chromosome number as each of the parents, *viz.*, eighteen, and they have apparently normal maturation divisions. In the fertile, practically true-breeding form of *P. kewensis*, which has arisen from the doubling of the chromosome number, the maturation divisions are relatively regular, though slightly less so than in the sterile diploid form (Digby, *Ann. Bot.*, 26: 357–388, 1912; and Newton and Pellew, *Jour. Genetics*, 20: 405–469, 1929). In passing, one may note the bearing of this case upon the relative importance of the parts played by hybridization and chromosome irregularity in the production of new forms. Hybridization directly produces the type form *P. kewensis*, chromosome doubling renders it fertile, and the occasional irregularities of the maturation divisions produce variant forms.

A number of animal species hybrids which have regular maturation divisions are also known. One recent and interesting example of these is the hybrid between *Metopsilus* (*Chaerocampa*) *porcellus* and *Chaerocampa elpenor* described by Federley (*Hereditas*, 9: 391–404).

Some personal cytological observations on aberrant tomatoes produced by my colleague, Mr. M. B. Crane, may serve to illustrate the point that abnormality of the maturation divisions may be produced by agencies other than hybridization. Normal tomato plants, having the diploid chromosome number twenty-four, were cut back and from the subsequently formed callus surface adventitious shoots arose, which mostly

had twenty-four chromosomes in their somatic cells, but in a number of cases had forty-eight, and in two instances had about thirty-six. The maturation divisions of these latter triploid plants are as "abnormal" as are those of triploids produced by hybridization.

Sudden chilling and other agencies have also been found to upset the regularity of meiosis, but these cases need not be described in detail.

An illustration involving an intermediate degree of irregularity may be drawn from oats and wheat. *Avena sativa* and *Triticum vulgare* each have forty-two chromosomes which form twenty-one pairs, and with only very rare exceptions behave normally at meiosis. Occasionally plants arise, presumably through one of the rare irregularities, which have only forty-one chromosomes. In these there is normal pairing and separation of forty of the chromosomes at meiosis and "abnormal" behavior of the odd chromosome. Such divisions of course give rise to many gametes with twenty chromosomes instead of the normal twenty-one, and the mating of these in self-fertilization produces dwarf plants with forty chromosomes. In these plants, however, the chromosome pairing is very erratic and the maturation divisions are extremely irregular (Huskins, *Jour. Genetics,* 18: 315–364, 1927; and *ibid.,* 20: 103–122, 1928).

Although cultivated wheat and oats are, in my opinion, almost certainly of hybrid origin, it can scarcely be argued that it is hybridity as such which is responsible for this difference in behavior between the immediate parents and their offspring produced by self-fertilization.

With reference to the criterion of pollen sterility, a case in Rubus is particularly interesting. This genus contains very many hybrid forms, and hybridity in it is often very closely *correlated* with pollen sterility. Yet in a cross made by Mr. M. B. Crane between *R. rusticanus inermis* and *R. thyrsiger,* one of the first generation offspring had very much better pollen than either of the species. Not only has the hybrid better pollen than its parents but its fertility and seed germination are also exceptionally high. The cytological and breeding behavior of this case is described in detail by Crane and Darlington, *Genetica,* 9: 241–276, 1927.

From these and many other instances it seems clear that it is not hybridity as such which causes irregularity at meiosis or pollen sterility, but rather that regularity depends upon a balanced condition which *either* hybridization *or* other agencies may or may not upset. The presence of two complete sets of homologous chromosomes seems to be the prime requisite for regularity of the maturation divisions, but this is a matter apart from the present issue. It seems clear that there is no one satisfactory criterion of "hybridity" in the commonly accepted sense of the term,[1] and that arguments based upon any one of the supposed criteria above mentioned must lack general validity.

Apart from the doubtful validity of the premises upon which criticisms of research on "hybrid" or "abnormal" forms have been based, the arguments in themselves are of very questionable value. The relative importance of hybridization, mutation or "abnormality" in species formation is still a matter of dispute. The significance of the term "hybrid" depends very largely on one's definition of a "species," and until we know more about what constitutes the normal, the charge of abnormality makes a precarious foundation for argument. The elucidation of these points is one of the primary objects of genetical and cytological research.

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OBSERVATIONS ON THE SYNCHRONOUS FLASHING OF FIREFLIES IN SIAM

FROM time to time there have appeared in the pages of SCIENCE various references to the remarkable phenomenon exhibited by certain fireflies of flashing in unison. Both Dr. E. W. Gudger[1] and Dr. E. S. Morse[2] have reviewed the literature of the subject in a very thorough manner, and it would be quite outside the scope of this note to repeat their references.

During the course of a three-years' period of residence in Bangkok, it was possible to make some rather close observations on the nature of this synchronism and to determine in which respects the theories that have been advanced to explain the phenomenon fit the observed conditions.

The synchronism, as one finds it in the Far East, undoubtedly is very different from that reported from this country.[3] In the Orient it is distinguished by the fact that it is quite a common occurrence in certain well-defined areas, and furthermore, in that it involves vast numbers of insects, neither of which conditions is usually observed in the synchronism reported from America. In fact, in the latter locality the phenomenon has apparently been of such unusualness as to call forth comment.

During the months of July, August, September, and until the heavy rains set in, on any dark night it is possible to see whole stretches of the river or canal

[1] It seems probable to the writer that many mutations, especially of polyploid plants, which are now commonly attributed to gene mutation, will be found to owe their origin to some physical nuclear aberration such as chromosome interchange, loss, or gain, or segmental duplication or deficiency. Since such aberrations produce only recombinations of existing factors, they might be classified as phenomena of "internal hybridization." This would, however, constitute a definition of hybridity beyond that in common acceptance.

[1] E. W. Gudger. SCIENCE, N. S., 50: 188 (1919).

[2] E. S. Morse. SCIENCE, N. S., 44: 169, 387 (1916); 59: 163 (1924).

[3] H. A. Allard. SCIENCE, N. S., 44: 710 (1916).