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.

C. LEONARD HUSKINS
JOHN INNES HORTICULTURAL INSTITUTION,
LONDON, S.W. 19

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).

banks lit up by the flashing of myriads of insects. These areas of synchronism may extend for several hundred yards at a stretch or may be confined to single trees, glowing and being extinguished with surprising regularity. Actual timing of this intermittence showed that luminescence occurs at the rate of approximately 120 times a minute.[4] During the period between the flashes the light of the fireflies reached almost complete extinction, the intensity being so low that at a few feet from a tree of actively luminescing insects it is quite invisible.

Perhaps one of the first things which is called to the attention of the observer is the fact that this synchronism is confined to localities bordering on streams, or to low, water-saturated ground. This fact was first pointed out by the late Sir John Bowering,[5] who made the significant observation that "they have their favourite trees." Around Bangkok it is commonly known that the synchronal flashing of fireflies is confined to one particular tree, the "ton lampoo" of the Siamese—*Sonneratia acida*. In all of the observations which the writer has made, no exceptions to this have been found, but whether this particular tree is the gathering-place of the insects in cases of synchronism reported from other parts of the East is a question.

The fact that *Sonneratia acida* is the tree on which the insects congregate around Bangkok leads one to question the statement that has been frequently made to the effect that the synchronal flashing of the fireflies is a mating adaptation. *S. acida* is found both in mangrove associations, and also as a solitary tree growing along the banks of streams. In these latter cases the roots of the tree are often immersed in water, the tree at times standing several feet from the bank. If the females of the species are wingless, as is the case with the majority of the North American *Lampyridae*, there would be no opportunity for them to approach the tree. Furthermore, at no time have females been found on a tree of actively synchronizing insects, or within its vicinity. Observations on this point have been repeatedly made and have been corroborated by local entomologists who have become interested in the problem.

Among the various theories which have been advanced to explain this concerted action on the part of the fireflies is the effect of slight currents of air on the position of the body, due to the occurrence of synchronism only when the insects are at rest on some tree. The belief has arisen that slight currents of wind might so change the position of the body that the luminous organ would be exposed for a short period of time, only to be covered again when the body was allowed to return to its former position. Synchronism has been noted not only on nights when there was absolutely no wind, but also on quite windy nights.

Perhaps one of the most popular theories is that of "sympathy." According to this idea there is some particular insect which acts as a pace-maker for the rest, and they follow him, regulating their flashes by his. However, due to the fact that the insects are scattered quite generally over a tree and are not within sight of any one particular animal, this appears to be quite impossible. Furthermore, any follow-the-leader action on the part of the insects would result in a wave of light passing over the tree and originating from a definite point, a fact which is not the case once the synchronism has begun.

It is possible to inhibit the synchronism of a tree of insects by exposing them to a bright light for about a minute. When the light is turned off, the synchronism returns, having its origin, apparently, in some individual or group generally located in the central part of the tree. From this group, then, the synchronism extends over the entire tree in an irregular wave until all of the insects are flashing in unison.

Synchronism usually begins shortly after darkness has set in, the fireflies emerging from the nearby thickets and flying in an indirect course to the Sonneratia trees. During this flight to the trees there is no sign of a concerted flashing, the actions of the insects being similar to those found in our local forms during flight.

T. F. MORRISON

PRINCETON UNIVERSITY

THE KEEPING QUALITY OF HENS' EGGS

THE preserving action of carbon dioxide on eggs as observed and reported by Sharp[1] seems to be the principle of the old and well-known domestic method of preserving eggs by burying them in some cereal grain, especially oats. Since cereals are known to expire carbon dioxide under practically all ordinary conditions of storage, it is obvious that eggs buried in them are surrounded by an atmosphere composed largely of carbon dioxide. Accordingly, the old household method of preserving eggs in cereal grains is equivalent in principle to the procedure discussed by Sharp.

O. S. RASK

SCHOOL OF HYGIENE AND PUBLIC HEALTH,
THE JOHNS HOPKINS UNIVERSITY

[1] SCIENCE, 69: 278, 1929.

[4] O. A. Reinking (SCIENCE, 53: 485, 1921) has described the flashing of fireflies from another district of Siam. He has identified the form as belonging to the genus *Calaphotia* and reports the rate to be from 105 to 109 times a minute.

[5] Sir J. Bowering. "The Kingdom and People of Siam: With a Narrative of the Mission to That Country in 1855." 2 vols., London, 1857. (vol. I, p. 233–4.)