period, expressing it again as dry grass on the basis of Hall's analysis, the amount required would be 27,420 pounds per acre or, expressed as hay containing 15 per cent. water, 15.7 tons. Again, using Ebermayer's determinations for the depth of 70 centimeters (27.6 inches) and 120 days, the computed loss of carbonic acid from the soil below this depth would be represented by that carried by 31,960 pounds of dry grass or 17.3 tons of hay per acre. In speaking of the first instance cited the author says: "We may say, then, that, in this case, carbonic acid is escaping from the soil at the rate of about 0.04 cubic foot per day per square foot and therefore that this was the rate of production of carbonic acid in the soil at this place below the depth of six inches." The amount of carbon thus carried out of the soil, according to the assumption and calculation, would be greater than the amount we have calculated above by whatever was produced in the surface six inches. It is clear, however, that no such losses of carbonic acid, resulting from the decomposition of organic matter, could be maintained year after year, as the amount of organic matter in the root system of a crop is not equal to that produced above ground, at least usually, and the amounts produced above ground are only rarely equal to the amounts computed; indeed they are seldom more than one third of those quantities. It must be concluded, therefore, that the laboratory observations and methods of computation give a rate of diffusion of carbonic acid from the soil of a field much greater than actually occurs as a seasonal average. It should be noted that in getting these enormous losses of carbonic acid from the soil we have included only one third of the year, while Ebermayer's observations show that the amounts present in the soil at all seasons, including even winter, are large.

In view of the relations to which we have called attention it is clear that the generalizations cited require critical field trials to be made, bringing them to suitable tests before they should be accepted with full confidence.

F. H. KING.

MADISON, WIS.,
September 16, 1905.

THE QUESTION AS TO WHETHER FALCONS WHEN SOARING INTERLOCK THEIR PRIMARY WING FEATHERS.

THE observations of Mr. Trowbridge upon the habit of hawks when soaring to overlap their primaries (*i. e.*, on the upper side of the wing) have several times been commented upon adversely. And a well-known ornithologist has objected that this behavior of feathers has not been previously observed, in spite of the voluminous field notes as to the habits of hawks, and that no one has been able to confirm the observation of interlocking feathers. Accordingly, I am led to jot down the following notes in favor of Mr. Trowbridge's results, —for my observations are at first hand and were made, I believe, under quite favorable conditions.

It so happened that we were coming up the narrow canal from Sakai to Matsue in the face of a strong wind, so strong, indeed, that our small steamer labored to make headway against it. At one point we disturbed a kite, *Milvus melanotus*—a very common bird, by the way, along Japanese waterways—which rose slowly in the face of the wind and after making several circles followed the margin of the canal, flying and soaring, almost opposite the boat and making about equal headway. It did not occur to me at the moment that the opportunity was a favorable one for watching the wing feathers (for the bird was sometimes as near as a hundred feet), when my eye was caught by the behavior of the primaries. The hawk was flying low, about the height of the eye, and when the wing passed through the plane of the horizon I could see as the wing flapped that several primaries stood out sharply, finger-like, *dorsal* to the plane of the descending wing. This was so conspicuous, indeed, that it seemed difficult to conclude that these feathers could fold *under* one another when, in face of a strong wind, the wings became passive in soaring. Nevertheless, the distance of the bird was so great that I could not convince myself that the interlocking actually took place; I was only sure that the primaries were bowed, so that in soaring this part of the wing must have been greatly strengthened by the closely opposed feathers. For several minutes the hawk thus flew alongside of the boat, with quite regular periods of flapping and soaring; then, suddenly shifting its course, it circled out, soaring, passing over my head at a distance of about twenty feet. I could then see plainly that the primaries of one wing (right) were interlocked—the condition of the other wing I had not time to observe.

My conclusion, therefore, is that the interlocking of the primaries of hawks takes place, as Mr. Trowbridge has shown, under the conditions of soaring in the face of a strong wind.

Bashford Dean.

Rinkai Jikenjo, Misaki-Miura, Japan,
September 3, 1903.

SPECIAL ARTICLES.

THE CHROMOSOMES IN RELATION TO THE DETERMINATION OF SEX IN INSECTS.

Material procured during the past summer demonstrates with great clearness that the sexes of Hemiptera show constant and characteristic differences in the chromosome groups, which are of such a nature as to leave no doubt that a definite connection of some kind between the chromosomes and the determination of sex exists in these animals. These differences are of two types. In one of these, the cells of the female possess one more chromosome than those of the male; in the other, both sexes possess the same number of chromosomes, but one of the chromosomes in the male is much smaller than the corresponding one in the female (which is in agreement with the observations of Stevens on the beetle *Tenebrio*). These types may conveniently be designated as *A* and *B*, respectively. The essential facts have been determined in three genera of each type, namely, (type *A*) *Protenor belfragei, Anasa tristis* and *Alydus pilosulus,* and (type *B*) *Lygœus turcicus, Euschistus fissilis* and *Cœnus delius.* The chromosome groups have been examined in the dividing oogonia and ovarian follicle cells of the female and in the dividing spermatogonia and investing cells of the testis in case of the male.

Type *A* includes those forms in which (as has been known since Henking's paper of 1890 on *Pyrrochoris*) the spermatozoa are of two classes, one of which contains one more chromosome (the so-called 'accessory' or heterotropic chromosome) than the other. In this type the somatic number of chromosomes in the female is an even one, while the somatic number in the male is one less (hence an odd number) the actual numbers being in *Protenor* and *Alydus* ♀ 14, ♂ 13, and in *Anasa* ♀ 22, ♂ 21. A study of the chromosome groups in the two sexes brings out the following additional facts. In the cells of the female all the chromosomes may be arranged two by two to form pairs, each consisting of two chromosomes of equal size, as is most obvious in the beautiful chromosome groups of *Protenor,* where the size differences of the chromosomes are very marked. In the male all the chromosomes may be thus symmetrically paired with the exception of one which is without a mate. This chromosome is the 'accessory' or heterotropic one; and it is a consequence of its unpaired character that it passes into only one half of the spermatozoa.

In type *B* all of the spermatozoa contain the same number of chromosomes (half the somatic number in both sexes), but they are, nevertheless, of two classes, one of which contains a large and one a small 'idiochromosome.' Both sexes have the same somatic number of chromosomes (fourteen in the three examples mentioned above), but differ as follows: In the cells of the female (oogonia and follicle-cells) all of the chromosomes may, as in type *A,* be arranged two by two in equal pairs, and a small idiochromosome is not present. In the cells of the male all but two may be thus equally paired. These two are the unequal idiochromosomes, and during the maturation process they are so distributed that the small one passes into one half of the spermatozoa, the large one into the other half.

These facts admit, I believe, of but one interpretation. Since all of the chromosomes in the female (oogonia) may be symmetrically paired, there can be no doubt that synapsis in this sex gives rise to the reduced number of symmetrical bivalents, and that consequently