founded on careful investigation. In his valuable paper of April, 1907, "An Ornithological Cross Section of Illinois in Autumn," the account of a trans-state survey in which 4,804 birds were counted, it is stated that the number of birds per square mile of woods was 785, and in pastures 1,551. While a mere coincidence, yet it is of interest that these figures bear the same relation to each other as do the numbers of the principal food elements.

Another point of interest in connection with the close investigation of the surface fauna relates to dead insects. Insects number so many, that even if we admit, as we do in the case of other animals, the death of each is a tragedy, it stands to reason that this tragedy can not in every case be enacted by captor and prey. Many must die of other causes and simply fall to the ground. What becomes of them? Some are eaten by sarcophagous insects, but are any to be found? The question was raised in the writer's mind by the finding of some suspiciously old and apparently weathered fragments of insects in bird stomachs (segments of Millipeds in the mourning dove, a practically entirely vegetarian species, and of adult June bugs in winter stomachs of some other birds). Were not these possibly picked up as fragments? It is now the writer's opinion that this is more than possible.

At any rate there is no lack of dead insects to be picked up by any bird desiring them. On the plot of forest floor were found nine dead invertebrates entire, and the fragmentary remains of 36. Fewer of such remains were found in the meadow, perhaps because the multitude of ants disposed of a large proportion of them. But even here there were 8 intact bodies and 14 broken. On the basis of these figures there are tangible remains of 240,030 departed insects on each acre of meadow and 488,925 on each acre of woods. Of both the living and the dead there are a host, but the dead of ages reduced to dust are insignificant beside the living of a single season.

W. L. MCATEE

QUOTATIONS

AGRICULTURAL EDUCATION

To one very important condition of success both advocates and opponents of *la petite culture* in England pay, we suspect, too little regard—namely, the improvement of agricultural education, for the heads as well as for the rank and file of the industry. In too many of our country districts it is hardly yet realized that education is necessary at all. Landowner and tenant-farmer are alike disposed to lay blame for the rural exodus on such education as is given to the laboring classes—an education which, it may be admitted, has not always been best adapted to fit them for a country life and pursuits. But they forget that education is, after all, but an incident of the great social and economic changes that have come over English life in the past half century; and that, if all our elementary schools could be restricted to-morrow to teaching "the three R's" and all boys sent out to farm work at ten or eleven years of age, there would still remain the daily newspaper, the bicycle, and the excursion train to give the laborer that wide outlook and "progressive desire" which is what really draws him away from the land. So far from there being, as Squire Oldacre and Farmer Hodge are apt to think, too much education already, what is needed is much more of it, but of a different kind; education in the elementary school that will bear directly on country life and inspire some taste for it; education continued afterwards in evening schools or technical instruction classes to widen the knowledge and sharpen the wits of those who are to cultivate the soil, and to instil into them at least the beginnings of scientific method. The day of rule-of-thumb is over, in agricultural as in other industries; the day of science—that is, of trained and organized knowledge—has begun, and the nation or class that despises it must fall behind. It is not undue treatment in freight charges, or unpatriotic preference for foreign goods, that enables the small Danish butter-farmer, for instance, to undersell the Englishman on his own markets, but superior education and scientific method applied

to the organization of his industry; and we may be sure of this, that it will be useless to keep a man on the land, or to bring him back to it, by the inducement of ownership or any other attraction, unless we can educate him to do the best for himself and for the land, in an age which calls for cultivated intelligence and scientific method.—The London *Times*.

CURRENT NOTES ON LAND FORMS

RELATION OF VALLEYS TO JOINTS

THERE have been various articles published on the relation of drainage lines to joints, involving a problem of which the gorge of the Minnehaha below its falls may be taken as an example. It is sometimes pointed out that the course of this gorge has been determined by the arrangement of the joints in the horizontal rock series through which the gorge has been cut. There can be little question that the process of weathering has taken advantage of the joints in the widening of the gorge, and that its walls exhibit joint faces more or less frequently; but it is also evident that the gorge has been cut backward along the course that the stream had on the drift cover up-stream from the falls; and that the relation of the gorge to the joints is therefore one of accidental superposition, and not of submissive guidance.

On the other hand, it is often plain that a group of master joints may guide the development of a new (subsequent) branch stream which grows by headward erosion in the bare walls of a young valley; for in such cases there is no stream falling into the valley from the upland above. Subsequent streams of this origin may be common in some districts; but if they pass into maturity, they will probably wander on their flood plains so as to depart more or less from the guiding joints beneath the valley floor; and if afterwards rejuvenated by elevation, it is eminently possible that they may stray away from the joints that originally led them. The chance of such straying will increase with the lateness of the stage at which the first cycle of erosion is interrupted by rejuvenating elevation.

VALLEYS OF SOUTHWESTERN WISCONSIN

E. C. HARDER presents a discussion of part of this problem in a thesis entitled "The joint system in the rocks of southwestern Wisconsin and its relation to the drainage network" (Bull. Univ. Wisc., no. 138; Science series, iii., 1906, 207–246). He first determined by numerous observations the dominant joint directions in a certain part of the Wisconsin driftless area; he next determined, apparently from maps, the dominant stream directions of the same district. Then he compared these two sets of dominant directions, independently determined, and finds that "the prominent directions of jointing correspond with the prominent drainage directions" (p. 232). "Many other forces [than joints] may have been present to modify the result," but their influence is thought to have been small (p. 234). Further investigation is looked to for additional results.

In all cases of this kind, in which the more or less precise coincidence in the directions of a large number of lines is the chief guide to the conclusion, several critical questions arise. First, what are the limits of error in the determination of the measured directions, and what are the limits of discordance in cases that are classed as coincidences? Second, what are the possibilities of coincidence by chance instead of by causal relation? Third, is the conclusion that a causal relation exists between the two sets of lines whose directions coincide, supported by independent evidence that the supposed cause can produce the inferred effect? Fourth, are other causes shown to be inoperative?

Joint directions are determinable easily within small limits of error; but stream directions are much less easily determined, because stream lines are as a rule so irregularly curved. Moreover the curved streams of the mature valleys of driftless southwestern Wisconsin demonstrably depart to-day from their earlier courses to a greater or less extent; and it is therefore not clear whether the present or the earlier courses are to be regarded as joint controlled. Some close analysis, with a quantitative statement as to the percentage of total