

cated their intention to continue it throughout a third year; the progress of the others has exceeded that of the first two and has surpassed expectations.

Most of these fellowships have arisen through letters of inquiry from the various companies. I have not gone out seeking fellowships in general. Had I done so it is not unreasonable to suppose that by this time there might have been from thirty to fifty. Owing to the fact that these fellowships have no relation to ordinary fellowships and that the scheme is essentially a new one, it has been deemed advisable to establish them at intervals. Proceeding in this way, and learning as one went, the scheme has undergone a natural and advantageous development. The degree to which it has been systematized, its effect upon the chemical department, the results of the relations of the different researches and researchers to one another, and the wholly unexpected interactional relation of the donating companies to one another I shall reserve for a future communication. While it should be said that as yet this scheme of industrial fellowships is wholly experimental and tentative, it ought also to be said that the two years' experience has not shown that it is any other than a sane and practical relation between the university and industry to the advantage of all concerned.

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ELEMENTARY EMBRYOLOGY COURSES

THE publication of Professor Lillie's "Development of the Chick," and the excellent character of his treatment of the subject, suggests comment upon the custom of using the chick for introducing students to embryology. Since the days of von Baer and before, the chick has been used for embryological study more than any other form. This has probably been due in part to its familiarity and to the ease of obtaining embryos of any desired age. Foster and Balfour's very valuable, though poorly written, "Elements of Embryology," based on the chick, for so long the only avail-

able text-book for immature students, fastened more firmly the custom of using the chick in introductory embryological courses. Now comes Lillie's fine treatment of the same subject, which is likely to establish the chick in almost undisputed possession of these courses.

Chick embryos are easy to obtain and easy to manipulate and much has been written about them; they also have decided resemblance to human embryos. Yet in spite of these advantages I can not but feel that chick embryos are peculiarly ill-adapted to the use of students beginning the study of embryology. The embryo chick is a highly specialized form adapted to a very peculiar environment within an egg shell and still further distorted from the general vertebrate type by the presence of the huge yolk mass. These special adaptations are of great interest, but it has been my experience that they assume an undue prominence in the minds of students and prevent their readily grasping the general phenomena of development of vertebrates, unless some less specialized form, as for example, the frog, has first been studied.

The first three years I taught elementary embryology we began with the chick and used it chiefly, if not exclusively. Since then, each year, after a brief consideration of the cell, its organs, and its behavior in mitosis, and a rapid survey of cleavage and gastrulation in half a dozen forms, we have taken up the embryology of the frog, using Marshall's "Vertebrate Embryology," modified and supplemented, of course, by the lectures. The laboratory work has covered the same ground as the classroom work. After completing the study of organology in the frog, two weeks to four have been given to the chick and two or three lectures to comparisons with the development of mammalia.

The point I would like to emphasize is that I have found that the students in these later courses got a far better grasp of the embryology of the chick in two weeks' study following careful work upon the frog, than they ever succeeded in obtaining when they began with the chick and devoted all the time to this subject, and of course they got a far more adequate conception of the embryology of verte-

brates. The difference in the results obtained by the two methods has been so great that I could not be induced to return to the former method. The course of the second type has, in its results, utterly outclassed that of the first sort at all points, even in pure training in observation, for observation must include a conception of the adaptations in the phenomena observed. Even students who plan to study medicine are, I am sure, far better prepared to study with intelligence human embryology than if they had given their attention wholly or chiefly to amniote embryos in which the space relations of the organs are so distorted by secondary influences.

Material for the elementary cytological work and the study of cleavage and gastrulation is easy to prepare and also can readily be purchased, and there is no difficulty, of course, in obtaining frog embryos and larvæ. The yolk in the earlier embryos necessitates careful work in preparing sections, but, by avoiding absolute alcohol and by using an oil that does not make the yolk too brittle, good preparations are readily obtained. The labor of preparing sections of frog embryos and larvæ seems no greater than that of preparing chick sections. At any rate, the labor is not such as to lead one, in order to avoid it, to choose less instructive material for study.

Perhaps no clearer text-book has ever been written than Marshall's "Vertebrate Embryology." In spite of some inaccuracies, and of not being up to date, it is still usable, but its cost is considerable, and it contains more than most introductory embryological courses can cover. Holmes's volume, "Biology of the Frog," gives insufficient treatment to the embryology, and Marshall's little book, "The Frog," is no more adequate on this side. Morgan's "Development of the Frog's Egg" is not adapted for an introductory embryological course. We greatly need an embryology of the frog. A revision of Marshall's chapters on this subject, and their publication as a separate volume would well meet this need. Were there such a volume obtainable, one would not fear harm from the publication of Lillie's "Development of the Chick," for courses of each type would then have a satis-

factory text-book and an unbiased choice would be possible; but under present conditions one does fear that the very excellence of Lillie's book will serve to perpetuate an unfortunate tradition and will delay the general coming of embryological courses that are a better preparation for general morphological study.

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THE COUNTRY BOY AGAIN

IN SCIENCE, February 12, in discussing industrial education, I made the statement that with only 29 per cent. of our population actually living on the farm, with miserably poor school facilities as compared with our city population, this 29 per cent. furnishes about 70 per cent. of the leaders in every phase of activity in this country. This statement was quoted from memory and was in error to the extent that I should have said 29 millions of our population instead of 29 per cent. Dr. Frederick Adams Woods, in SCIENCE, April 9, quotes this statement and adds some criticisms.

First, I want to assure Dr. Woods that I appreciate very fully the magnificent work he did in his study of heredity in royalty. It fell to my lot to review Dr. Woods's book, and I found it one of the most interesting treatises on heredity we have. He has demonstrated, I think, beyond cavil, that "native ability and natural impulses of human beings are as much a matter of heredity as are any physical characteristics."

The above quotation is from my review of Dr. Woods's paper in my article on Mendel's law, which will appear soon in Volume V. of the American Breeders' Association. In that review I say further:

Prodigious effort has been made by the human race to better its condition but this effort has been wholly in the direction of improving the environment. While Dr. Woods has shown that it is really an unimportant factor in determining natural impulses and native ability, it is true that when environment is unfavorable it may prevent the development of natural tendencies or may warp them, and it may also result in great