of *Ochlerotatus detritus*, together with a large number of pupæ. Titration experiments carried out by Mr. Lyon Turner showed that the salinity of the water was 49 per cent. that of pure sea water.

After estimating the volume of the water as 20,000 gallons, it was decided to use the larvicide in the proportion of 1 in 16,000, the quantity required being therefore 1.25 gallons. The result of the experiment was entirely satisfactory, a thorough examination on the following day failing to detect a single live larva or pupa. Further examinations were made with the same result on April 26 and May 2, and on May 5 the success of the experiment was further confirmed by an examination made by Mr. P. G. Shute (Ministry of Health Laboratory).

Two other ponds badly infested with the larvæ of *Ochlerotatus detritus*, and containing a large number of pupæ, have since been treated with like success, a thorough examination of both ponds being made on the following day without a single live larva or pupa being found.

It was noticed during the experiments that the addition of the larvicide to one of the ponds in which the water was only slightly saline, produced the characteristic "miliness" associated with the use of disinfectants of this class. In treating the other ponds where the water was of greater salinity, this cloudy appearance was not produced, although the results obtained in all the three experiments were equally successful. A series of laboratory tests showed that the "miliness" occurred whenever the proportion of sea water to fresh water was less than 1 in 7, the cloudy appearance being uniformly distributed through the water treated. When the larvicide was added to water of greater salinity, it diffused in the form of minute globules. It was suggested by Mr. P. G. Shute that, in cases where the proportion of sea water exceeded one-seventh, the miliness (and the accompanying uniform diffusion of the larvicide) might possibly still be produced if the larvicide were diluted with a small quantity of fresh water before use. Experiment showed this to be the case, and this preliminary dilution is obviously to be recommended whenever the larvicide in question is to be added to water of appreciable salinity.

It is probable that successful results will be obtained with even smaller proportions of the larvicide than those employed up to the present, since the effects produced with dilution of 1 in 48,000 indicate that the limit has been by no means reached. Further experiments in this direction are now in progress.

It is important to note that water treated with this larvicide in the proportions mentioned is quite harmless to human beings or animals drinking it accidentally.

The comparative cost of "larviciding" and "paraffining" in any given case depends, of course, upon the depth of water to be treated. In cases where the water is shallow there is little to choose as regards expense, even when the larvicide is used in as large a proportion as 1 in 16,000. If d be the depth of any particular sheet of water in inches, n the "dilution" (or the number of parts of water which can be treated by one part of the larvicide), and c the ratio of the cost of the larvicide to that of paraffin, then the ratio of the expense of "larviciding" to that of "paraffining" has been shown by Marshall (*Science Progress*, January 1922, p. 468) to be given by the expression

$$(1500 \times c \times d)/n.$$

In the case of the first pond referred to above, d was 3 inches and n was 16,000. The price of the

fluid was 5s. 9d. a gallon, so that c may be taken as 4. Hence the relative cost of the operation, compared to paraffining, was

$$(1500 \times 4 \times 3)/16,000, \text{ or } 1.125,$$

the actual cost of treating the 1420 square yards of pond being about seven shillings. It should be noted, moreover, that as the water surface in this case was much exposed to wind, paraffining carried out on previous occasions had proved quite ineffective.

Since a cubic yard is the space occupied by 168 gallons, it will be found that the number of gallons in any piece of water is $(A \times d)/3$, where A is the surface area in square yards and d is the depth in inches. So that, if the larvicide is to be used in the proportion of 1 in n , the number of gallons required will be $14/3(A \times d)/n$ gallons. This is a useful formula for calculation, particularly when a definite value of n has been decided upon for treating a number of ponds.

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The Teaching of Natural History in Schools.

IN an article which appeared in *NATURE*, May 13, p. 628, dealing with the memorandum of a British Association Committee on this subject, the following statement occurred: "It devolves on the teachers of zoology to show in detail the kind of zoological syllabus that can be put into operation in schools as a basis for zoological teaching." May I be allowed, as one whose privilege it has been to teach zoology to some hundreds of boys, to offer one or two suggestions for such a syllabus?

The writer of the article was entirely favourable to the spirit of the memorandum, as indeed are a great number of persons responsible for the direction of education. With regard to the younger generation, the learners, the question is answered with no uncertain voice. I have put the choice of zoology or botany to forms of boys of all ages from 14 to 18, and have found invariably that 90 per cent. or more vote for the teaching of zoology. It may be that the boys scent my personal leaning towards zoology (though I try to be impartial) or, again, that they regard the study of animals as a more masculine pursuit than the study of plants. At the same time, it is evident that the boy's mind shows a genuine thirst for a knowledge of animal life.

There are two aspects of the application of zoology to the school curriculum. On one hand, there are the older boys who are being trained for some definite profession—medicine, agriculture, biological research, and so forth. On the other, there are large numbers of younger boys, very few of whom will ever require zoology as a professional subject, who are being taught biology as part of their general education. Zoological syllabuses for the professional examinations are issued by the various universities; moreover, in the Higher Certificate Examination zoology may be offered as a group subject. Thus, in the case of senior boys the biology master has ample guidance in the general requirements of a zoological education, and can develop and extend his teaching accordingly; but in teaching zoology to younger boys the master has to evolve his own syllabus and to form his own standard of attainment. It is with the latter aspect of the subject that I propose to deal.

The boy of fourteen when he comes to the study of biology requires something more substantial than

what is generally implied by "nature study." He is perfectly capable of appreciating the elementary conceptions of anatomy and physiology. He is, moreover, fully alive to questions of sex, and is ready to assimilate a clean scientific view of its meaning. Personally I should find it very difficult to teach either botany or zoology apart from one another to these young boys.

Botany may be offered as a subject both for the Lower and School Certificates; but there is no indication from higher authority as to what should be included in a course of zoology for boys of this standard. It has been necessary, therefore, to substitute special syllabuses in biology of our own making, in order to enforce the inclusion of zoology in the examinations. Two examples are quoted below of the zoological content of biological syllabuses for the Lower Certificate:

A. Boys of 14½-15½, working four hours a week for three terms.

Elementary outlines of anatomy of following: Earthworm, Frog, Rabbit.

Prevention and destruction of insect pests, Elaters (wireworms), Tipulidæ (leather jacket), Aphididæ (woolly aphid).

Special scheme of Research Work.

(a) British Bird Life: (i.) Embryology; (ii.) General Anatomy of Birds. The mounting of specimens, examination of beaks and crops in connection with cultivation.

(b) Coleoptera, Lepidoptera, Hymenoptera.

(c) Anatomy of Farm Animals.

(d) Diseases of Animals; Blood.

(e) Insect Pests of English Fruit Trees.

One group only has been taken by any boy. Special work has been done by the whole form in preparation of charts, recording agricultural operations, bird life, etc., during the different seasons, and meteorological observations taken daily.

B. Boys of 14-15, working two hours a week for three terms.

A general knowledge of the Natural History of animals, with special reference to British forms (*e.g.* Rabbit, Pigeon, Frog, Snail, Butterfly, Spider). The study of pond life.

The general facts of fertilisation, and embryology of the frog and chick.

Use of the microscope for the study of Protozoa and Crustacea, also for parts of higher animals (*e.g.* scale of fish, feather, squamous epithelium from human cheek).

A general idea of organic evolution.

The above syllabuses, and others of a similar nature, have been successfully carried out. They are, however, open to criticism as not being suitable for wide application, especially in schools where monetary considerations constitute a limiting factor. In the absence of a recognised syllabus for a first introduction to zoology, and with a view of showing how the subject can usefully be introduced in any school, the writer has prepared a small text-book, the zoological syllabus of which is as follows:

Frog—External features, mode of life, respiration, alimentation. Development; breeding, segmentation, tadpole life, metamorphosis.

Earthworm—Habitat, mode of life, external features, general dissection, reproduction, soil action.

Fishes—Dogfish and Cod; habitat, mode of life, external features, development. Scales as a means of age-determination.

Arthropods—Crayfish, Bluebottle Fly, Garden Spider; habits, external features, life-cycle.

Comparative table and summary of leading characteristics of each class.

Insect Pests—(An introduction to economic zoology.)

Cabbage White Butterfly, Winter Moth, Cockchafer, Bean Weevil, Click Beetle (wireworm), Bean Aphis, Crane-fly (leather jacket), Larch Saw-fly.

Skeleton of the Vertebrate Fore-limb—Perch, Frog, Pigeon, and Rabbit. Comparative table.

Elementary conceptions of Variation and Heredity. Evolution.

The Microscope—Its use; suitable objects for observation. The nature of living matter; the cell. (For schools where the microscope is available.)

This syllabus is in close accordance with the general scope of teaching advocated by the British Association Committee, but is so condensed as to be covered by one hour's work a week throughout one school year. Types which, either through their limited distribution or their expense, may be difficult to obtain have been omitted; it is fatal to begin the study of zoology from a book instead of from an animal.

Finally, although a precise syllabus is necessary for the successful prosecution of class work during school hours, the best interests of zoology will never be served by that means alone. The museum and the aquarium must be going concerns, continually renewed and augmented by voluntary labour cheerfully given out of play-hours.

E. W. SHANN.

The School, Oundle, May 16.

EVERY teacher of biology in public schools will naturally welcome both the original memorandum of the British Association and also the article signed F. K. in NATURE of May 13, p. 628. The greatest difficulty in the teaching of biology at public schools at the present time is the position of the teacher. Unlike the teacher of so many other subjects the biologist is not turned out more or less a master of his subject, but is just in a position to begin to learn it, and the subject or subjects are so vast that if he is to do his work conscientiously he has a life's task before him. Of course this is more or less true of every other subject, but I think I am not in serious error when I say that a man with a good classical degree probably finds himself sufficiently well equipped to cope with the really intelligent boys of the upper sixth of the average public school.

So vast is the subject of biology, however, that the teacher cannot hope to cope with the really clever boy unless he is a real student of his subject, and even then of course his influence is that of a slightly superior but at the same time a fellow student, and not that of a master.

The teacher of biology, if he is to carry on his work successfully, must have an average knowledge of a great deal besides his text-book of botany or zoology. He must have a practical working knowledge of microscopy, pond-life, marine biology, field botany, including a reasonable knowledge of mosses, lichens, rusts, and other fungi. One knows, of course, that the mind of the average schoolboy is somewhat limited, but there are always a few that are capable of doing really good work, and for such boys the position of the master must be either one of suppression or that of a fellow-student, and one is seriously led to think that too often the work of the teacher is an act of suppression.