In the section dealing with insecticides and so-called repellents, the results of the great mass of experimental work are tabulated in detail, an unavoidable course owing to the wide diversity of method employed by the various workers. In these experiments lice and nits were immersed in, brought into contact with, and submitted to the action of the vapour of various substances and preparations.

We heartily congratulate the author on this valuable and exhaustive paper, and commend its careful study to all those concerned with the suppression of body-vermin.

MARINE BIOLOGY AT PLYMOUTH.

THE latest issue (vol. x., No. 4, May, 1918) of the Journal of the Marine Biological Association contains several papers of interest to fisheries investigators. Mr. D. Ward Cutler writes on the question of age-determination in fishes by inspection of the growth increments in the scales. The latter are built up of "sclerites," which are arranged in concentric, or rather confocal, bands, the focus being somewhere near the middle of the scale. Some of the bands of sclerites (those formed during the summer months) are relatively wide; the others that are formed during the winter months are relatively narrow. Thus the scale shows "annual rings of growth."

Mr. Cutler graphs his measurements of the sclerites, but gives a very bare account of the construction of the figures, so that his charts are not easy to understand. Plaice and flounders were kept in tanks artificially heated or cooled or of normal (seasonal) temperature. Some of the normal tanks were well supplied with food, and others were scantily supplied. Thus it became possible to distinguish between the temperature and the nutritional factors of growth. The latter do not affect the formation of broad (summer) and narrow (winter) bands. Abundant food leads to the production of many sclerites and meagre nutrition to few, but the relative width of the sclerites (and therefore of the confocal bands) is independent of food supply. On the other hand, the temperature of the water in which the fish lives influences directly the size of the sclerites, for those formed during phases of relatively high sea-temperature are large, while those formed during colder periods are small. They are formed in bands, and so the relative width of the latter reflects the annual wave of temperature change—even, Mr. Cutler suggests, the aperiodic fluctuations of the latter. All this is in line with other work on the metabolism of marine animals; it is really a case of velocity of chemical reaction, being proportional to some function of the temperature at which the reaction occurs. When the sea is relatively warm assimilation is speeded up, respiratory movements in a fish are quickened, and feeding increases. Decrease of temperature reduces tissue waste, and events happen in the opposite direction. But assimilation increases absolutely during the warmer phases, and so the marine fish "puts on flesh" during the summer months.

In the same journal Miss Marie Lebour gives extensive lists of the nature and relative abundance of the organisms forming the food of small, larval, and post-larval fishes of various species. She confirms, in general, but greatly amplifies, the observations of previous workers on the same subject. Even in quite small fish of some species, and with variety of food available, there is selection and quite evident preferences for certain food organisms. The paper is illustrated with some very admirable drawings of the heads of post-larval Pleuronectid fishes. J. J.

SCIENCE IN HORTICULTURE.

THE third annual report of the Nursery and Market Gardens Industries Development Society, Turner's Hill, Cheshunt, shows that continuous progress is being made in the application of science to horticultural practice. The fertiliser experiments are of considerable interest, and bring out the marked effectiveness of nitrogen compounds, especially of stable manure, in the growth of cucumbers, and their relative ineffectiveness in the growth of tomatoes. It is not definitely settled whether this result arises from some fundamental difference in the method of nutrition of the two plants, or simply from the relative drafts they make on the soil. The ineffectiveness of phosphates, both on cucumbers and tomatoes, is remarkable, and merits closer attention. An important technical matter is the demonstration that a relatively inexpensive mixture of artificial fertilisers gave larger returns than a mixture made by some of the best growers based on the best practice of the district. Fertiliser trials need considerable time for their execution, and it must be some time still before the experiments have yielded all the information they are capable of giving. They seem to support the old idea of an antagonism between fruiting and vegetative growth, for the methods which would normally produce the largest plants do not necessarily produce the largest amount of fruit.

Some interesting observations are recorded on the physiological conditions in cucumber-houses. There was found to be an appreciable correlation between the area of the seed-leaves and of the first rough leaf, and also a small correlation between the size of the seed-leaves and the dry weight after thirty days. Seedlings with the longest stems gave the largest crops. All these points are of great importance; it is remarkable that the later history of the plant should be so intimately bound up with its early properties. The grower has room in his houses only for a very limited number of plants, and he cannot afford to keep unprofitable seedlings.

Further experimental work was also undertaken on methods for the partial sterilisation of soil, and a serious combined effort is being made to solve the problems arising when these are applied in practice.

THE PALÆOBOTANY OF NEW ZEALAND.[1]

THE late Dr. Arber's memoir on the earlier Mesozoic floras of New Zealand is a particularly welcome addition to our knowledge of a much-neglected subject. In 1913 Dr. Arber published two papers on fossil plants from New Zealand, but the present paper covers a much wider field and deals very fully with a considerable number of species from Triassic-Rhætic, Jurassic, and Cretaceous strata. The specimens are the property of the Geological Survey of New Zealand, the British Museum, and the Sedgwick Museum, Cambridge.

The author shows that no Palæozoic plants have so far been discovered, and no undoubted examples of Glossopteris are included in the material examined. The genus which most nearly resembles Glossopteris is Linguifolium, instituted by Arber in 1913, but the author does not believe that the two are closely allied. The arguments in support of his view are, however, not conclusive. It is assumed that New Zealand did not form part of Gondwanaland, this term being used by Arber for a Palæozoic continent only, a more restricted usage than that adopted by Suess and some other authors.

[1] "The Earlier Mesozoic Floras of New Zealand." By Dr. E. A. Newell Arber. New Zealand Geological Survey: Palæontological Bulletin, No. 6, 1917.

Dr. Laurent, of Marseilles, contributes descriptions of a few Angiosperms from Neocomian rocks. The account of the Jurassic flora of Waikawa, Southland, includes an interesting description of a remarkable petrified forest composed chiefly of trees of an Araucarian type associated with petrified Osmundaceous stems. Forty-eight species are figured; of these at least fourteen are regarded as new, the remainder being widely distributed Mesozoic types. The admirable drawings and photographs are well reproduced, and there is an excellent bibliography.

This latest contribution by a palæobotanist whose untimely death is a serious loss to science is of great value from the point of view of phytogeographical problems; the author has cleared up several difficulties and corrected erroneous statements frequently quoted from the meagre literature on New Zealand plants. It is to be hoped that this thorough piece of work will stimulate New Zealand students to do their best to obtain additional material from the various localities in the islands, and thus provide data for the continuation of Dr. Arber's memorable work.

A. C. S.

VIBRATIONS: MECHANICAL, MUSICAL, AND ELECTRICAL.[1]

V.—*Brass Instruments and the Low "F."*

LEAVING the pendulums which have only two vibrations at a time, the case of brass instruments with a number of simultaneous vibrations was next considered. It is well known that the vibrations from most musical instruments are what is called compound. They consist of a series of tones of commensurate frequencies sounded together. Thus if the pitch of the note is said to be 100 per second, there is not only a prime tone of this frequency, but also a second tone of 200 per second, a third of 300 per second, and so forth. This law applies to strings, to open parallel pipes, and to a complete cone with its base open. It also applies as a close approximation to the brass instruments in general use. This approximation is traceable to the departure from the strictly conical forms as regards the mouthpiece, the bell, and the special shape of the intermediate portion.

In these brass instruments the possibility of this compound tone, or multiple resonance, is utilised for the production of distinct notes. Thus out of the tones possible to the instrument the player may elicit the set 200, 400, 600, 800, etc.; or the set 300, 600, 900, 1200, etc. These would be said to have the pitches of their primes or lowest components, 200 or 300 respectively. Or, to put it musically, they would be the octave or the twelfth of the fundamental (or *pedal*) possible on the instrument. The pedal of the instrument is not usually employed for musical purposes, but can be sounded if specially wished. Now there is a tradition among players of brass instruments that a note called by them a low "F" can be sometimes obtained. This note would have on the foregoing scheme the frequency $133\frac{1}{3}$. At first the possibility of this "F" seems scarcely credible to the theoretician. But after hearing and producing the note the necessity of accounting for its possibility was forced home.

Really the explanation proves very simple. It usually depends upon two points:—(*a*) The *spread* or *diffused resonance* of the pedal, and (*b*) its intentional *mistuning* with respect to the other notes of the instrument. These are taken in order.

(*a*) For theory shows that, other things being equal, the lower the note of such an instrument, the easier it is to force its vibrations out of tune, sharper or flatter. Thus with the pedal the range of resonance is such that the note may be sounded at any pitch whatever over a range of five or six semitones.

(*b*) Since the law of frequencies 100, 200, 300, 400, etc., is only approximately true for these instruments, in order to secure good relative tuning of the higher notes which are in constant use the pedal (which is not used musically) is purposely mistuned. On some instruments it may be, say, D or E♭ instead of C.

Hence, if the central pitch of the pedal is sharpened two or three semitones—and it is possible to force this note both up and down two or three semitones—it becomes possible to sound the pedal of true pitch C, to sound the low "F," and to sound notes of every pitch between. (This was demonstrated by Mr. White on a euphonium, kindly lent by Messrs. Boosey and Co.) The low "F" is also possible on the bombardon. Both these instruments are characterised by large conical tubing, and the low "F" is obtained by the spread resonance of the sharpened pedal.

In the case of the trumpet, cornet, and French horn with much narrow tubing the pedals are flattened, so that a pedal of true pitch can be obtained only by the spread resonance, and the "F" is impossible. On the trombone, which has much small parallel tubing, the low "F" may be obtained occasionally by the downward-spread resonance of the second partial (or note number two), which is an octave above the pedal. (Demonstration.) The pitches of the notes which have been obtained on six types of instruments by four experimenters are shown in Table II.

VI.—*Monochord Vibrations.*

Consideration was next given to the vibrations of stringed instruments, beginning with the monochord because of its striking simplicity

From the work of mathematicians (with a little help from experiment) the various possible vibrations of strings, whether plucked, struck, or bowed, have long been well known. But a little reflection will show that many other problems are still left confronting the physicist. For identical strings, excited in the same way, but mounted on different instruments, will produce very different effects on the ear. In other words, the worth of a violin does not lie in its strings, but in its sound-box.

This leads to the inquiry as to what happens to modify the vibrations as, passing from the strings, they reach in turn the bridge, the belly (or soundboard), and the adjacent air.

It is easy to see that this problem is somewhat complicated, since it presents so large a number of variables. Thus there lie at the experimenter's disposal the pitch of the string, its material and dimensions, the place and manner of excitation, the material and disposition of the associated parts of the instrument, the place of observing the belly, the portion of the bridge observed and the directions of its motions, and, lastly, the spot at which the motion of the air is observed. In this way a scheme for more than a thousand observations could be sketched, even for an instrument with but one string.

Hence, no exhaustive treatment of the problem can be quickly obtained. But a beginning has been made, and by very simple means.

In a series of experiments simultaneous records have been photographically obtained of the vibrations of the string and of some other part of the instrument. The monochord was placed on a table and light from a vertical slit was focussed upon the string near its centre. The real image of this slit, crossed by the shadow of the string, was then focussed by a

[1] Abstract of a discourse delivered at the Royal Institution on Friday, March 8, by Prof. Edwin H. Barton, F.R.S. Continued from p. 439.