of avoidable trouble in electric furnace work. The furnace shown in operation at the meeting consumed 100 amperes at 10 volts when running at 2000° C. This temperature was attainable in two or three minutes. A home-made transformer with about 100 primary turns wound in two halves and three separate secondary coils that can be connected in series or parallel enables the furnace to be run off almost any ordinary lighting circuit.

Mr. R. S. Whipple, among other speakers, testified to the value and convenience of this simple form of carbon tube furnace. It was stated that Northrup in America was using a similar furnace on a larger scale for gear hardening in a motor-car factory. A thermo-couple is attached to each piece of gear and the temperature is run up until the hump on the curve shows the recalescent point to have passed. The gear is then removed and quenched. One of the furnaces exhibited by Dr. Harker was made for a steel foundry at Sheffield for standardising optical pyrometers, of which a very large number were stated to be in use.

The discussion emphasised the fact that the great desideratum at the present moment for many requirements, both in the laboratory and the works, is a furnace that will have all the advantages of the carbon tube furnace, but which will not evolve carbon compounds. Dr. Rosenhain had used a vacuum furnace wound with tungsten wire for melting pure iron (melting point 1525±5° C.), but the tungsten became brittle after heating, and was soon useless. A resistance furnace using granular tungsten working in hydrogen or nitrogen was suggested as one substitute, and another was a carbon tube furnace with an inner tube and an indifferent gas between the two. It appears, however, that zirconia tubes are being experimented with, and a successful outcome of this work is hopefully anticipated. Zirconia is one of the best refractories known, and if it can be obtained pure in granular form almost any temperature will be possible with surface combustion. Dr. Rosenhain made the useful suggestion to coat carbon electrodes or tubes—even in ordinary commercial electric furnaces—with metallic copper, iron, or aluminium by means of the Schoop spray process, as a means of ensuring good electrical contacts.

For temperatures up to 1000 or 1200° C., tube or muffle furnaces heated with nickel-chromium wire were recommended by several speakers, some of whom have abandoned gas-heating altogether for temperatures below 1000°. On the other hand, some of the modern gas burners, of which several types were described, appear to give excellent results at high temperatures. Air under high pressure is essential, and so it appears is violent mixing of the air and gas—the cause of the great noise made by these furnaces. Mr. S. N. Brayshaw described the ingenious burner which bears his name, which is displacing the oxy-hydrogen flame, too local in its heating, for melting platinum. For many experimental metallurgical purposes the Richmond gas furnace was recommended.

INSECTS IN AFRICA AND THE EAST.

AN accurate description of the Indian lac insect (*Tachardia lacca*), founded on new observations of its life-history and habits, has long been wanted by students of economic entomology. They now find this provided in the recently issued Indian Forest Memoir (Zoology, vol. iii., part 1) by Dr. A. D. Imms and Mr. N. C. Chatterjee. The various stages are illustrated by beautifully executed coloured figures, and there are enumerations of the insect's food-plants and analyses of its important secretion. A remarkable feature is the dimorphism shown in the male, which may be either winged or wingless—the latter condition very rare among Coccidæ. The Tachardia is attacked by an alarming array of enemies, of which the caterpillar of a noctuid moth, *Eublemma amabilis*, is the most formidable. It is aided in its destructive efforts by several other caterpillars of Lepidoptera, a large number of beetles and their larvæ, and a host of hymenopterous parasites.

To the December part (3) of the Bulletin of Entomological Research (vol. vi.) Dr. J. W. Scott Macfie contributes observations on the bionomics of *Stegomyia fasciata*, the mosquito that is well known as the alternate host with man of the yellow fever parasite. The female insect pairs soon after emergence, and then must have a meal of blood before laying her eggs. Fertile eggs may continue to be laid for thirty-seven days without necessity for a second pairing. The prevalent belief that this mosquito sucks blood by night only is not confirmed, "but sometimes she refuses an offer to feed in daylight in favour of the next opportunity to feed in the dark." The male's taste is gentler, as his staple food is honey.

The same part of the Bulletin contains also notes, by Dr. W. A. Lamborn, on the habits of *Glossina morsitans*—the tsetse-fly that carries sleeping-sickness trypanosomes in Nyasaland. The insects are by no means confined to the mapped "fly-belts." The preponderance in number of males among flies captured on the wing, which contrasts with the close equality of the sexes as bred from puparia, is explained by the author as due to the male's habit of pairing as the result of violent capture rather than of courtship; hence the females shun the society of the opposite sex. The slimy secretion of the Glossina larva is believed by Dr. Lamborn to afford some protection against the attacks of certain ants. Puparia are rarely found parasitised by larvæ of Mutilla and other Hymenoptera, and the adult tsetses are sometimes caught and devoured by dragonflies. Dr. Lamborn described how a dragonfly, *Orthetrum chrysostigma*, hovered around his party of six "boys," swooping down and picking off a tsetse from the back of one who stooped to drink at a pool. Many specimens of the Orthetrum were captured in the act of devouring tsetses, which appear to be equally acceptable, whether fasting or filled with freshly-ingested blood, and this species of dragonfly is evidently very expert in catching Glossina. Another kind of dragonfly (*Crocothemis erythraea*), on the other hand, handled a tsetse so clumsily as to convince Dr. Lamborn that it is a novice with this special type of prey. A description with figures of several species of chalcids which Dr. Lamborn has reared from the Glossina puparia is given by Mr. J. Waterston (*t.c.* part 4).

An addition to our knowledge of the distribution of tsetses is contained in Dr. Schweiz's paper in the third part of the bulletin; he has traced *G. morsitans* in the Katanga district of the Belgian Congo far to the west of the great river. Dr. Schwetz writes also on the range and habits of *G. brevipalpis*—a fly often overlooked as it flies before sunrise and after sunset.

G. H. C.

INTERESTING FORAMINIFERA.

IN a fine memoir[1] on Foraminifera from the Kerimba Archipelago, Portuguese East Africa, Messrs. Edward Heron-Allen and Arthur Earland deal with no fewer than 470 species and varieties, of which thirty-two are new to science. There is a striking resemblance between the general facies of the gatherings at Kerimba and that of the late Mr. F W. Millett's collection from the Malay Archipelago. The

[1] Trans. Zoological Society of London xx (1914), pp. 363–90, 3 pls.; and *Ibid.*, xx. (1915), pp. 543–794, 14 pls., 3 figs. *See also* Proc. Zoological Society of London, 1915, pp. 295–8.

leading zoological feature is perhaps the great abundance of Miliolidæ, of which 122 species are reported, seventy-seven in the single genus Miliolina.

The authors have been fortunate enough to discover some very interesting new types. Thus there is Iridia with a diaphanous chitinous envelope covered over with very fine particles of mud and sand. It seems to be an Astrorhizid, is usually attached to sand-grains or shell-fragments, and may attain to the gigantic size of 8 mm. in diameter. Strange, probably abnormal, forms occur with a clear area on each side of the shell, perhaps indicative of liberation from between two large sand-grains. Similar, possibly identical, forms have been described by Rhumbler from a depth of 400 metres in the Antarctic, and named *Vanhoeffenella gaussii*, the "windows" being interpreted as adaptations to the very scanty rays of light. But this would not apply to the fierce glare of the Kerimba shore. Another remarkable new type is Nouria, with several species, some of which show very effective treatment of the material selected for shell-making. Thus in *Nouria harrisii* the test is entirely composed of sponge spicules arranged in a single layer with their axes more or less parallel to the long axis of the test, but so as to form a perfectly tapered neck and a regular fringe projecting around the mouth. There are sometimes spicules projecting aborally, which may serve to keep the animal erect in the surface layer of mud.

Experts will be interested in what the authors have to say in regard to D'Orbigny's *Pavonina flabelliformis* and his *Rotalia dubia* (seen again after ninety years!), in their revision of the lituiform species of Peneroplis, and in their very successful study of the double shells of Discorbina (apparently due to a kind of budding), and of the development of the peculiar dual nature of the terminal balloon-chamber which Earland noticed some years ago in *Cymbalopora bulloides*, D'Orbigny. But we shall rather refer to the remarkable discovery of specimens of *Cymbalopora tabellaeformis*, occupying little pits in mollusc shells. Each Foraminifer seems to be able to enlarge its crypt as its test grows; nay, more, to excavate tunnels in the mollusc shell. These tunnels radiate round the crypt and may attain to a length many times its diameter. They are for the accommodation of the pseudopodia. It is interesting that the living matter which habitually secretes carbonate of lime should also dissolve it, and the possibility is suggested that the solution may be helped by carbon dioxide given off (at night?) by the symbiotic Algæ which are usually associated with this Foraminifer. The authors are to be congratulated on the use they have made of their fine material, in connection with which the skill and energy of Dr. J. J. Simpson, who made the collection, should be remembered.

SCIENTIFIC EDUCATION AND INDUSTRIAL RESEARCH.

SEVERAL professional bodies have devoted attention lately to education and science in relation to industrial development; and it is not too much to say that they all appreciate the need for action in order to prepare for the strain of competition which may be expected to follow the cessation of hostilities. On Tuesday, March 14, the subject was discussed at the Institute of Journalists by the Circle of Scientific, Technical, and Trade Journalists, under the title, "The Sphere of the Scientific and Technical Press in Relation to Technical Education and Research," Mr. L. Gaster, chairman of the circle, presiding. The discussion was opened by Dr. W. Garnett, late educational adviser to the London County Council, and by Mr. A. P. M. Fleming, who has recently made a tour of inspection of research laboratories in the United States. Dr. Garnett's main suggestions are as follows:—

(1) Education in elementary and secondary schools must be more directly associated with *things* so as to develop self-reliance and resourcefulness, not to teach trades.

(2) A considerable proportion of teachers should devote a third year of training largely to practical work under conditions enabling them to become acquainted with the practice of some trades.

(3) A general knowledge of the phenomena of nature and of processes applied in industry must be more widely diffused by means of popular lectures and otherwise.

(4) More completely organised courses of instruction, without breach of continuity, must be provided for industrial workers of all classes, including the leaders of industry, together with the necessary scholarships, fellowships, or bursaries to enable the best students to carry on post-graduate research.

(5) Existing institutions must be improved and some new institutions must be provided, especially in the chemical trades, to enable scientific discoveries to be developed sufficiently to demonstrate the conditions under which they can be made commercially successful.

(6) Some alterations must be made in the patent law to enable the profits arising from investigations conducted wholly or partly at the public expense to be fairly divided between the State, the scientific worker, and the manufacturer.

(7) Trades should be organised for the purpose of superintending the research work in which they are interested, for the collection and dissemination of information and the distribution of work among firms in the manner in which it can be most effectively and economically carried out in the interest of the industry as a whole.

(8) The trade associations should be in close touch with the Advisory Council for Research, and the council should, where necessary, recommend the award of Parliamentary grants in aid of industrial research carried out under the direction of the associations and make provision for such work in cases in which trade associations are not available, but the Advisory Council should utilise to the utmost the services of societies.

(9) As an alternative the Advisory Council for Research should appoint technical committees representative of trades, or groups of trades, to assist it in the organisation of industrial research.

(10) The National Physical Laboratory should be the central institution for all physical measurements and standardisation, but for chemical processes a separate institution for a trade or group of trades will frequently be required for the work intermediate between the discovery of a new product or reaction in the research laboratory and the adaptation of the process to commercial manufacture.

(11) Some method of financing new processes which have been approved by a competent authority, other than the ordinary method of floating a company, is desirable, and this may be provided by some form of industrial bank.

It will be noticed that, among other points, Dr. Garnett pleads not only for increased specialised courses of training in science and technology, but also for a knowledge of natural facts and phenomena as part of the education of all. When this has been secured, it may be hoped that "members of Parliament will cease to wonder whether we shall *ever* know why the moon appears to change her shape, and we shall not be told that lard has only just been discovered as a source of glycerine, that mineral oil from Galicia