out that any attempt to determine molecular weight of the protein by any of these means would yield abnormally large values.

In the sphere of host-virus relations, Ernest L. Spencer, of the Rockefeller Institute for Medical Research, demonstrated that the rate of virus multiplication is closely bound with the nitrogen metabolism of the host. Tobacco plants growing in pure culture, and supplied with a relatively large amount of nitrogen, allowed the virus to attain about five times the concentration found in normally fed plants. The effect was not due to an increased growth-rate of the plant, and it was also demonstrated with older seedlings. James M. Wallace, of Riverside, California, dealt with the development of resistance to the curly top virus of Turkish tobacco. He showed that plants recover from an attack by the virus, a certain time after inoculation. Such plants, when re-inoculated, do not again develop severe symptoms. Transmission from a recovered to a healthy plant by means of insect vectors induced severe symptoms in the healthy plants, but grafting merely transferred the mild symptoms typical of the recovered plants. Resistance, therefore, appears to be due to some interaction which is set up between host and virus.

INDIAN SCIENCE CONGRESS ASSOCIATION*

MADRAS MEETING

ASPECTS OF THE MYXOPHYCEÆ

Prof. Y. Bhâradwâja, presiding over the Section of Botany, considered the peculiar group of algæ known as the Myxophyceæ. These algæ present many problems, both economic and botanical, and in spite of the extensive literature there is scarcely any authoritative statement that can be made concerning any aspect of their study at the present time. Owing to the peculiar properties of their cells, many of them are able to exist under high-temperature conditions and are largely tropical in their distribution, so that India is a particularly suitable centre for their study. With the active investigations that are being carried out by Prof. Bhâradwâja and other algologists at Madras, Lahore and Benares, it is hoped that much light will be thrown upon their peculiar features.

A special interest of this group for India is the way in which the Myxophyceæ at times undergo extreme development and give rise to the condition known as 'water-bloom'. On death and decay, such masses of algæ give disagreeable tastes and odours to the water and may render it unfit for drinking purposes, in fact there are records from many parts of the world of serious effects produced upon man and animals by drinking such water. In India, water-blooms are of common occurrence in ponds, pools and tanks, the water of which is used for consumption by humans and domesticated animals; though no serious effects have so far resulted in India, it is obviously a subject requiring investigation. Such points as the conditions favouring the development of the blooms, the contributing organisms, methods of control, and the manner in which the organisms persist all require workers in India.

Prof. Bhâradwâja also directed attention to the problems played by Myxophyceæ in soil ecology. These algæ occur in considerable numbers in the soil flora and some of them, notably Nostoc and Anabæna, are capable of nitrogen-fixation. In the Indian rice fields, the same crop is grown year after year without addition of manure, and it has been discussed whether the abundant development of these algæ during inundation may be a factor of any importance. Fritsch and De came to the conclusion that their part in this connexion was probably relatively insignificant, but the problem needs further study.

*Continued from page 471.

The Myxophyceæ are also in need of closer study and revision from the botanical point of view. In many cases the generic distinctions are unsatisfactory, as they are not applied logically and allow of too much intergrading. Their cytology has received considerable attention lately and most workers are now agreed that the central body may be regarded as a nucleus.

Systematic study of the group involves such problems as their relation to the isolated group of the Chamæsiphonales and also to the Bacteria, especially such types as the sulphur bacteria.

Prof. Bhâradwâja's address points out the wide scope for workers in this field, and his survey of the present position of knowledge of the group will be a valuable basis for anyone attracted to further the study of the Myxophyceæ.

AIR-BREATHING FISHES

The presidential address to the Section of Zoology was delivered by Prof. B. K. Das.

In a comprehensive survey of present knowledge of the phenomenon of 'air-breathing' in fishes, Prof. Das developed the theory of structural adaptation in response to environmental change. "The habit of swallowing air," he says, "being long continued, becomes deeply engrained in the constitution of the species, generations after generations, and is gradually improved and eventually leads to structural modifications, usually in the form of reservoirs adapted to lodge the inhaled air. These reservoirs are of very different forms and quite independently evolved, in each and every species of fish. . . ."

Six main types were described of progressive adaptations, which are to be seen in modern air-breathing fishes, namely, modifications of the buccopharynx; pharyngeal 'lung'; opercular chambers; opercular 'lung'; specialized parts of the alimentary canal (stomach and intestine); and the air-bladder. These accessory respiratory organs are regarded as the physiological forerunners of the true lungs of the terrestrial vertebrates, evolved in consequence of a lack of oxygen in the water.

The views of Carter and Beadle are supported and quoted verbatim: ". . . A power of breathing air must have been a necessary preliminary to the possibility of migration to land. It appears probable

that the development or the preservation of aerial respiration in fishes of the tropical fresh waters was a response to the shortage of oxygen in the water, and that it occurred while the fish was still purely aquatic. The fish was then ready for the later changes which completed the migration. The stimulus for these was probably provided by the droughts to which any animal living in such waters must have been subjected. That this has been the course of the later stages of the migration on to the land is generally accepted, but it does not seem to have been so generally realized that the first stage in the process of migration was the evolution of adaptations to aerial respiration, first instigated by the lack of oxygen in the shallow tropical fresh waters in which the fish lived."

This presidential address in its printed form, with its extensive bibliography and liberal quotations from the work of other investigators, is to be welcomed as a helpful handbook of reference to a subject of general biological interest.

ECOLOGY AND CONTROL OF INSECTS

Dr. Hem Singh Pruthi, in his presidential address to the Section of Entomology, discussed the general principles of insect ecology and, in particular, the application of such knowledge to insect control. As he pointed out, if we know the conditions of environment of an insect pest and the influence of changes thereof on its population, it may be possible to predict the outbreak of the pest in advance or to evolve methods which would keep the injurious species under control. Of the various physical factors of environment, temperature is undoubtedly the most important single agency. In order to illustrate the influence of this factor and to indicate how such information can be utilized by applied entomologists, examples are given of Zwolfer's critical work on the nun moth, *Lymantra monacha*, of Bodenheimer's studies on the Mediterranean fruit-fly and of several other works.

Next in importance to heat, the fundamental necessity of insects, as of other animals, is the moisture content of their environment. Too low or too high humidity is injurious to their existence. On the basis of such information, the Imperial Agricultural Research Institute has shown that good and well-spread rains do not reduce the spotted boll worms of cotton directly, but indirectly by raising the atmospheric humidity, which is inimical to the bollworm and conducive to the multiplication of its parasite *Microbracon lefroyi*. Afzal Husain and Haroon Khan's work on the ecology of pink bollworm of cotton in the Punjab illustrates the combined effect of temperature and humidity on insect prevalence. They found that temperatures between about 18° C. and 26° C., with a relative humidity of more than 70 per cent, are most suitable for egg production and oviposition. Those parts of the Punjab where temperature and humidity conditions approach the above figures during July–October, which is the active period of the pest, are badly infested with the bollworm, while in canal colonies and the western Punjab, where the conditions are different, the pink bollworm does not occur as a pest.

Insects are not only exposed to climatic factors but also to biotic factors such as parasites, predators, competitors, types of surrounding vegetation, etc. The importance of natural enemies in reducing the population of insect pests is well known and is being exploited by workers on biological control of pests. The basic principle underlying this method is the differential behaviour of a pest and its parasite under the same ecological conditions. This is illustrated by Shelford's work on the aphid, *Toxoptera graminum* and its parasite, *Lysiphlebus tritici*, and by the researches of several other workers. Even small differences in the rates of development of the host and parasite may cause the extinction of one or the other.

The control of malaria-transmitting mosquitoes by ecological methods has had undoubted success in certain areas and has possibilities of more general application. The fact that most of the vector Anophelines do not breed in sewage-polluted waters is exploited by turning industrial wastes, etc., into clean breeding waters. On the same principle the filling of pools and streams with cut vegetation, termed 'herbage package', which not only acts as mechanical obstruction but also pollutes the water, and brings about other changes, has been made use of as an anti-malarial method. Strickland recently showed that streams shaded by forests, in Assam, breed only non-vector harmless mosquitoes, and when these shades are cleared the malaria-carrying species at once appears and begins to breed. Therefore, shading of streams by growing low hedges of lantana, etc., is being extensively practised in India, Malaya and other countries. These observations also emphasize the necessity of preserving original shade and adding more trees to natural jungle as an anti-malaria measure.

Dr. Pruthi's address, it may be added, is well documented with a bibliography of the literature bearing upon the subjects under discussion.

ANTHROPOLOGICAL AND ARCHÆOLOGICAL STUDIES IN INDIA

The presidential address to the Section of Anthropology was delivered by Rao Bahadur K. N. Dikshit, who discussed "The Scope of Prehistoric and Anthropological Work in India".

It is to be hoped that the association between archæology and anthropology which has been exemplified in this session of the Indian Science Congress will be a more abiding one, and will react to the mutual advantage of both the sciences, and that all universities and research institutions, which have provided facilities for work in one, will always extend them to the other branch of humanistic studies. In this vast country there is unlimited scope for these studies, and the danger from the extension of cultivation and rural expansion in a more sophisticated mode of life is equally felt by both. It is, therefore, all the more necessary that the future research programme should be speeded up and properly co-ordinated.

So far as expenditure is concerned, although archæology looms somewhat large among the scientific departments of the Government of India, an infinitesimal amount is available for expenditure on work of a scientific character. The personnel ought to be strengthened with a view to the extension of scientific activities in prehistoric archæology and anthropology. Many of the museums are doing good work in the educational sphere, but there is scarcely any scope for the acquisition of scientific knowledge regarding man and very few research facilities.

Sir Leonard Woolley has directed attention to the want of sufficient contact between the Archæological Department and the anthropologist. He has

suggested the possibility of unravelling the problems of the past by significant survivals among existing peoples, as, for example, the ancient burial customs in South India. A common plan pursued by workers in the field should, he holds, result in a more intelligent collection of anthropological material, and the task of the archæologist would be made simpler if the museums of India were to collect and preserve, not only ancient pottery and handiwork, but also that produced up to to-day by the primitive peoples of India. The idea of a central ethnological museum in New Delhi unfortunately has been allowed to lapse, and India is still without either an anthropological, ethnological or archæological central museum.

Turning to the field of prehistoric archæology, it is now more than seventy years ago that the first human artefacts associated with the bones of extinct mammals were found in the cliffs of the Nerbada and the Godaveri. It is unfortunate that further investigations were not carried on in the light of new discoveries in every part of the world. The attention of the Government and the universities should be directed towards the necessity of the systematic conduct of such work under trained prehistorians. It is unfortunate that the systematic survey of the Yale-Cambridge expedition under Dr. H. de Terra has not been continued.

The most interesting and well-developed phase of the prehistoric civilization of India undoubtedly is that represented by Harappa and Mohenjo-daro. It is unfortunate that there is no prospect of further work in this field to discover tribes with earlier and later cultures. Further systematic work at Dambbuthi would be rewarded with rich results unravelling an earlier civilization than Mohenjo-daro, whereas bridging the gap between Mohenjo-daro and later civilizations will occupy generations of workers.

The problem of Aryan invasion has as yet received no light from excavation in Sind and the Punjab, while the proper study of the sequence of metallurgical knowledge has yet to be established, and the place of the copper culture of the Gangetic valley and the iron industry of, for example, Bellary in the south has yet to be determined. Further research alone will show what the exact relation between the stone and metal ages of North and South India must have been.

In South India, the scope for work is greater owing to the abundance of material suitable for the manufacture of tools for palæolithic and neolithic man; while in every district one or other phase of pre- and protohistory is present in examples which must be systematically studied before many of them meet destruction at the hand of man. Among such subjects of research are the rock-shelters and the rock-paintings and carvings which lead up to the culminating splendours of Ajanta and Bagh.

One of the greatest difficulties facing the physical anthropologist in India is that of obtaining material for determining the racial characteristics of the ancient people of their country. The dearth of students in this highly interesting branch of knowledge is very keenly felt. In anthropometry, much interesting work has been done in the various provinces and among the different castes or tribes; but it is no exaggeration to say that barely the fringe of the problem has been touched. For the anthropologist there can be no more interesting country than India to study, although he would probably be overwhelmed by the immensity of the task and the diversity of the material before him. When in India every stage of the entire progress of the human race from the humblest beginnings to the greatest spiritual elevation can be studied with greater ease and facility than in any other country, is it too much to expect that the proud possessors of this wonderful heritage will not neglect their patrimony and will not leave entirely to others the task of studying themselves, their racial composition and age-long cultures?

CROP PRODUCTION IN INDIA

The presidential address to the Section of Agriculture was delivered by Prof. Jai Chand Luthra, who took as his subject "Some Problems of Crop Production in India". Prof. Luthra began by reviewing the condition of Indian agriculture up to the time when the Government took steps to organize some aspects of it on scientific lines, that is about the beginning of the present century. He stressed the fact that India's farm produce is meant primarily for local consumption, and agriculture must therefore remain India's basic industry; there is, however, a demand for the establishment of secondary industries, such as those processing grain for breakfast food.

In the nineteenth century agriculture suffered a setback, of which the chief cause was the indifference of the farmer to the quality of seed. This neglect is of comparatively recent date, for at one time India was famous for the fine quality of its cotton. The merit and the constitutional structure of seed is of fundamental importance in crop husbandry. In India there is no legal safeguard of germination percentage, and pressing need is felt for a Seeds Act. Prof. Luthra reviewed some factors bearing on seed quality. Experiments at Lyallpur have shown that a predominance of yellow in the seed of berseem is an indication of maturity and of good germination; and the proportion of yellow seed bears an inverse relation to the number of cuttings taken from the crop left to seed. A similar correlation of colour to viability has been observed in seeds of shaftal (*Trifolium resupinatum*) and of lucerne.

Selection and breeding have done a great deal for Indian agriculture, but have brought about peculiar difficulties. One of the most important crops of the Punjab and the United Provinces is gram (*Cicer arietinum*). When the two best gram selections, evolved after twenty-five years work, were introduced into cultivation, blight disease was confined to the northern part of the Punjab. For the last four years, gram in other parts of the province has been stricken so severely by blight that one popular selection has been affected up to at least 50 per cent. The growers get alarmed when they find crops damaged by unaccustomed diseases, and it is no wonder if the growers remark that agricultural departments create the diseases. However, in Burma the serious wilt of gram has been overcome by the discovery of a resistant type that now occupies the entire area under that crop.

The wealth of India lies in its innumerable villages; as Tagore has said, "In the keeping of the village lies the cradle of the race". For effecting real improvement in agriculture, it is necessary to take stock of the economic conditions of the farmer. The village is working under many disabilities. There is everywhere an earnest desire that the farmer should raise his standard of living, but so long as he is unable to increase his earning power this will remain a wish. Some measures are necessary for affording relief to the growers of food crops. In the Punjab

the average size of a cultivated holding is scarcely 10 acres, and as many as six or seven persons live on it. Considerable labour is therefore being wasted on an unremunerative occupation.

NUTRITIVE VALUE OF RICE

Dr. W. R. Aykroyd devoted his presidential address to the Section of Physiology to the subject of rice. Rice is the staple food of the majority of the population in the provinces of Assam, Bengal, Bihar, Orissa and Madras. The diet of many other peoples in the East is also based on rice; in fact, it is stated that rice is the staple food of about half the human race. Yet, by modern standards, the rice-eater's diet falls short of such standards in almost every important constituent. In India he consumes in addition to his staple cereal, which supplies 80–90 per cent of the total calories, only very small quantities of other foods such as pulses, vegetables, fruits and meat; milk and milk products are taken in negligible quantities or not at all.

Rice, compared with most cereals, has a low protein content, although the proteins are of high biological value. It is poor in fat and carotene, calcium and iron; the amount of phosphorus present is fairly high. Milling reduces all the above constituents; in many parts of India, however, rice is prepared for consumption by hand-pounding, when the losses are less. Hand-pounded rice retains 50–75 per cent of the pericarp, the germ being usually completely removed. Raw rice when milled loses about three-quarters of its vitamin B_1 and two thirds of its nicotinic acid; these losses are considerably reduced if the rice is parboiled first. Parboiling is the steaming or boiling of unhusked rice after soaking; this splits the woody husk and renders its subsequent removal easier. After parboiling, the rice is pounded or milled in the same way as raw rice; during the steaming some of the vitamin B_1 and nicotinic acid diffuses through the grain and cannot be removed by subsequent milling. This fact is of great importance and, since most of the rice-eaters in India consume parboiled in preference to raw rice, explains the relative rarity of typical beriberi in most parts of the country. Washing the rice results in further losses of essential foodstuffs. The losses are of the following order: calories, 15 per cent; protein, 10 per cent; iron, 75 per cent; calcium and phosphorus, 50 per cent; vitamin B_1 and nicotinic acid, 40–50 per cent.

Dr. Aykroyd finally considered how rice diets can be improved. He is of the opinion that the development of strains of high nutritive value is unlikely to improve rice diets, since rice will always be deficient in certain food factors. He considers the easiest way of raising the nutritive value to be by minimizing the losses brought about by milling, washing and cooking. On the other hand, the introduction of high-yielding strains will reduce the pressure on the land and enable the production of supplementary foods to be increased. When parboiled rice is consumed, there is little difference in nutritive value between hand-pounded and machine-milled, although the former is to be preferred. Highly milled raw rice is a danger to public health, and its use should be discouraged. Dr. Aykroyd suggested that milling beyond a certain degree should be prohibited; a suitable standard might be not less than $1 \cdot 5\,\mu$gm. of vitamin B_1 per gm. Once-polished raw rice has a vitamin B_1 content of this order; use of such a rice would prevent the appearance of beriberi.

Rice must, however, be supplemented by other foodstuffs. Dr. Aykroyd suggested that ragi, a millet, should substitute rice in part, and that the intake of pulses and green leafy vegetables should be increased; the latter supply vitamin A and calcium. Milk is the best supplement to rice diets; if fresh milk is not available, milk reconstituted from skimmed milk powder may be recommended. Milk supplies calcium, or this element can be provided in the form of calcium lactate; such a supplement (about one gram daily) definitely improves the state of nutrition of children on a rice diet. Vitamin A can be provided in green leafy vegetables, milk-fat, fish liver oil or red palm oil. Dr. Aykroyd suggested that it might be possible to blend the latter with common Indian vegetable oils to produce a palatable product with a vitamin A activity corresponding to that of good butter. Finally, he emphasized that the development of an efficient fishing industry would provide India with a valuable supplement to poor rice diets.

PSYCHOLOGY AND EDUCATIONAL RESEARCH

In his presidential address to the Section of Psychology, Dr. D. D. Shendarkar said that although psychology is a comparatively young science, yet it has already found application in many fields, of which education is of vital importance. Results of investigations into such educational problems as scholastic and intelligence tests, examinations, and learning processes, are evidence of the value of psychological methods and knowledge to the efficiency of the teacher. Education is becoming more scientific in method. The suggestion, though, of practical problems and the testing of the experimental results in actual practice must rest with the teacher. Unfortunately, the psychology taught in training colleges for teachers is often too theoretical, and the young teacher does not see the connexion between the science and the problems of the class-room.

There is an urgent need for a central institute of education where training in research methods could be obtained, and where modern research sources in educational topics would be available for reference. Such a body would serve both as a training and consultative body as well as a centre for research. Although learning is the central problem in education, yet research into the learning processes is inadequate, largely because experiments in learning have been studied in psychological laboratories, and the materials employed have too often been of an artificial nature. Research into testing for intelligence has yielded practical results, and now intelligence tests are used in selection for admission to different types of schools, for vocational guidance, and for diagnosing feeblemindedness and backwardness. The problem of admission to different types of higher secondary schools is in reality one of discovering the type of education most suited to the capacities and interests of the pupils, so that they may be classified according to mental ability rather than according to scholastic attainments. Little, however, is known of the abilities required for the various vocations.

Psychology has made considerable development in regard to children's problems and child guidance, and it attempts to diagnose and treat the underlying causes of the various symptoms instead of dealing with the symptom alone. The utilitarian study of psychology has not, however, kept pace with its academic study; what India needs at the present juncture is that the knowledge available should be applied.