

solid angle of ~ 1 steradian, so that the flow of power in band-width $d\nu$ across unit area is $\sim \alpha k l (\nu^2/c^2) d\nu$ —where α , a factor depending on the attenuation due to scattering between the critical level and outer space, is of the order of 10. Since the critical frequency changes with height at ~ 1 cycle/metre when $\nu \sim 100$ Mc./sec., the average electromagnetic power generated per metre³ in the largest bursts is $\sim 10^{-3}$ ergs/sec. The thermal kinetic energy of the medium at this level is $\sim 4 \times 10^4$ ergs/m.³, so that a drift velocity 10^{-2} that of the mean thermal velocity would transport 4×10^3 times more energy across unit surface in unit time than is radiated from unit volume. [Aug. 16.]

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SCIENCE MASTERS' ASSOCIATION

ANNUAL MEETING AT LIVERPOOL

BY the kind invitation of the Council of the University of Liverpool, the annual meeting for 1952 of the Science Masters' Association was held there during January 2-5.

The meeting opened with a presidential address from the vice-chancellor of the University, Dr. J. F. Mountford, upon the subject of "Speech and Language". Dr. Mountford said that every year the relations between the schools and the universities are growing closer and that in the strengthening of those links the Science Masters' Association has played and continues to play a notable part. Through the *School Science Review*, the *Modern Science Memoirs* and other publications and reports, the Association has made a positive contribution to the enlightened teaching of science, and no teacher of science in the universities that he had met had not gladly acknowledged the indebtedness which the universities owe to its work in improving the quality and range of achievement of the university freshmen. It is a matter of vital concern to the universities, he said, that the students who come from the schools should not only have acquired a satisfactory body of factual information about scientific subjects, but also that their minds should have been trained in the fundamentals of scientific method and outlook. It is, indeed, a matter in which the Association can take pride that, alongside the improvement in pedagogic techniques for which it has been so largely responsible, it has always taken a wide view of the aims of science teaching and has related its own special interests to that general culture and enlightenment which it is the aim of all educational activities to ensure.

Dr. Mountford said he was happy to be numbered among the presidents of the Association. His own life had been spent in an endeavour to understand, through the medium of their written memorials, the thoughts and civilization of two ancient peoples who had contributed so much to the foundations of

Western culture. Words, and ideas they convey, had been his main concern, and the works of the Greek and Latin poets, philosophers, orators and historians had been his laboratory.

For the practical purpose of everyday life, Dr. Mountford said, the average man is in no way handicapped by his pragmatic acceptance of language as he finds it; he no more needs a theory of language in order to communicate verbally with his fellows than he needs a knowledge of physiology and mechanics to be able to walk. Yet for those of a philosophical turn of mind, language cannot be exempt from examination and analysis. Dr. Mountford examined the many factors involved in speech—the many syllables each comprising several speech sounds all demanding separate movements of the vocal organs and yet all adjusted in a complicated pattern within an exceptionally brief space of time. Upon this are superimposed breath modifications, and changes in the oral cavity, together with stresses placed with uncanny accuracy by native speakers but providing serious pitfalls for the foreigner; and finally, there is superimposed upon all these intricacies the general tune or intonation, the effective mastery of which is often the most difficult of the operations involved in the learning of a foreign language. It is only possible to suggest the stage in man's development when language emerged; but Prof. R. J. Pumphrey, of the University of Liverpool, has recently argued with some force that the likely time is the Aurignacian period of the Upper Palaeolithic age, some 100,000 years ago.

Dr. Mountford said that there can be no doubt that the development of the human mind has been closely bound up with the growth of our power over language. This is particularly evident in the case of the abstract concepts which have become crystallized in linguistic symbols and have become the units by means of which we erect larger constructions of thought. It is interesting to note that this complex relationship between our mental processes has been seized upon as the basis of a modern literary technique. James Joyce, for example, in a confused sequence of words, tries to capture the misty borderland which lies between inchoate thought and literary expression; no logical analysis will provide the true interpretation of a passage such as this: "By earth and the cloudy but I badly want a brandnew bank-side, bedamp and I do, and a plumper at that!"

Many words are emotionally neutral, as are the technical terms of the sciences; but others possess a penumbra of associations. In the laboratory 'water' is a label for a particular combination of elements, and it has no emotive function or significance. But when it is used by an author in describing a shipwreck or an adventure in the desert, the same word may be intended to arouse feelings of terror and of pity. It is in poetry that we find the most striking use of emotive language; but in science it is far different. Science is concerned with measurements rather than with values, and the findings of science do not make allowances for penumbras of meaning; if they did they would be of little worth. In the language of science, symbolism has gone far, and the language of formulæ has become a very potent extension of man's power of thought, so that they have become more and more difficult to recast into the verbal forms of normal language. In achieving advances in human thought, culture and comfort, language has been one of our most powerful instruments; and the study of language can never fail to

be an absorbing topic for anyone who is interested in the fascinating panorama of human progress.

In addition to the presidential address, lectures were given by six members of the academic staff of the University. Prof. G. Stephenson conducted a party over the new Civic Design Building. This was a most interesting experience as it allowed the visitors to understand the principles which are governing the many unusual features incorporated into the building. In the lecture which followed, Prof. Stephenson showed some examples of actual and projected planning from the early seventeenth century onwards, and followed this by discussing the problems facing those who are dealing with the re development of large cities at the present time, from which it was evident that those who would rationalize the lay-out of Greater London have an almost impossible task.

Prof. R. M. Gordon welcomed the Association to the "oldest School of Tropical Medicine in the world". He said that during the fifty-two years of its existence, the School has been called upon to investigate many problems of tropical medicine. In most cases it proved to be the non-medical biologist who led the way which later the physician followed. Hence the necessity for the combination of medicine and biology in the field of research in tropical medicine. Prof. Gordon then described two investigations being carried out at the present time in Africa, in which he is being helped by Prof. T. H. Davey, who later in the morning showed a film on "Ngana" (trypanosomiasis infection of animals in Africa).

The first investigation is being conducted in the Gezira, the vast cotton-growing area of the Anglo-Egyptian Sudan. Last year a world record crop was almost lost because of labour shortage attributed to the ill-health caused by schistosomiasis or bilharziasis. This worm infection invades the bladder and causes hæmorrhage; the eggs of the worm pass out in the urine, and if they reach water they hatch out and undergo further development in a freshwater snail. After some six weeks development the larva escapes back into the water and in its new form is capable of boring through the unbroken skin of anyone coming in contact with the water. The problems involved are so many that it was recommended that a research team consisting of a medical man and a freshwater ecologist should be appointed to co-operate with the large and highly skilled team of botanists and chemists now serving with the Gezira Cotton Scheme. It is pleasing to record that the Sudan Government has agreed to the appointment of such a team.

The second investigation is being carried out in the Cameroons. This area, though free from malaria and, on the whole, very healthy, is subject to loiasis, due to the loa-loa worm. The female worm lives in the human body and produces larvæ which get into the blood stream, from which they are taken up by the extremely common biting fly, *Chrysops*, known locally as the red fly. These biting flies then transfer the larvæ to another human subject, where the life-cycle is continued, producing much invaliding and suffering among both the native and the European populations. As the flies live in the forest canopy some 60 ft. above ground level and feed on the blood of monkeys, it seems that humans are only attacked on sight. Thus the forest canopy could be cleared back from human habitations provided sufficient undergrowth remained to keep the human population invisible to the flies. With insufficient knowledge, widespread control might be dangerous. Hence the

need for the combined efforts of medical men and biologists to solve this problem.

Prof. C. E. H. Bawn startled his audience by saying that all chemical reactions are oxidations and reductions, and that the uptake of oxygen is one of the fundamental activities both of Nature and of chemistry. He described in detail some of the work carried out in the Chemistry Department of the University and showed how many reactions depend upon the formation of free radicals and of the derivatives of hydrogen peroxide.

Dr. J. D. Craggs thrilled his audience with lightning displays. Dr. H. D. Parbrook surveyed the whole field of acoustics and indicated that the classical work of Sabine is now considered inadequate to describe the acoustic characteristics of a building, the simplest form of which demands equations involving 65 functions.

Dr. J. W. Jones described and showed a film of his original work on the spawning of salmon. This was a brilliant lecture.

The customary exhibitions were held, including one of apparatus devised by members. This, as usual, showed many ingenious devices all of which, this year, were of use for the younger pupils. In addition, the Nuclear Physics Department of the University was open for inspection, showing the giant cyclotron under construction. The Engineering Department gave a demonstration and the Physics Department showed a wide range of experiments which was greatly appreciated.

Nearly thirty teaching films were shown, and some of the senior pupils of the local grammar schools were invited to see them.

The Mersey Docks and Harbour Board invited a party to see its installations, and many firms in the neighbourhood conducted parties over their works.

On January 3, the Lord Mayor and the Lady Mayoress of Liverpool gave a civic welcome in the Town Hall to the Association. This was a most brilliant occasion, in the magnificent setting which the old Georgian suite of rooms permits.

Finally, the Vice-Chancellor invited the Association to a reception in the University. This was a charming event which included a recital in the delightful Arts Theatre.

Discussions, both formal and informal, filled the remaining time, and one can be assured that the teaching of science in all parts of Britain will have been stimulated by the excellence of this annual gathering of the Science Masters' Association.

WILLIAM G. RHODES

FURTHER EDUCATION AND THE NEEDS OF GREAT BRITAIN

IN his Will Harvey Memorial Lecture on "The Place of Further Education in the Public Services", given in the City Training College, Sheffield, on September 29, Sir Harold Hartley suggested that further education should be conceived not as a compound of vocational training with education for leisure but as education for co-operation and efficiency, for an understanding of the issues we face to-day, and for the defence of individual freedom and justice. In Great Britain national service in the Armed Forces has presented a new opportunity and fresh responsibilities, and it is a challenge to the Services so to use those vital