

CRYSTAL PHYSICS

THE presentation of the frontier regions of modern physics to an audience with a variable appreciation of scientific and mathematical ideas is, inevitably, a difficult task. None the less, it is one which should not be shunned, unless we are inclined to assume the semantic barrier to be impassable between the pure scientist and the educated public. In the realm of crystal physics with its many facets, the choice of electron-states in crystals as a topic for a discussion by Section A (Physics) of the British Association at the recent meeting in York, did not minimize the difficulties of communication. However, in the first lecture of the session, I attempted to wean the audience from a 'billiard ball' conception of atomic particles and, with little more than de Broglie's hypothesis and the Bragg reflexion law to assist me, to carry them into the mysteries of the energy-band theory of solids. It was not too difficult to begin a discussion of the wave behaviour of electrons in the ordered periodic-field of a crystal lattice, but the going became somewhat harder when the unavoidable introduction of wave vector space occurred. However, the vagaries of the effective electron mass were a little better appreciated by adding the visual aid of a bubble in a spirit-level as an analogy of the positive hole. It was inevitable that such treatment by analogy involved a considerable loss of rigour, but to me it proved to be a valuable exercise in transmitting the important results of the wave mechanical theory of solids without recourse to the mathematical building-materials allowable to the postgraduate seminar room.

The niceties of the band theory for electrons in a perfect crystal were soon disturbed by the reversion to practical situations. The next phase of the lecture dealt with the various crystal imperfections, their effect on electron and hole behaviour and their importance in semiconductor electronics. Again, treating the matter non-rigorously in terms of simple electrostatic forces, brings the problem of donor- and acceptor-levels and types of lattice vacancies into a relatively familiar perspective, and in this instance introduced some of the ideas to be used in the following lecture given by Dr. V. Hesketh.

Many of the important foundations of both experimental and theoretical solid-state physics were laid by the pioneer work of Prof. R. W. Pohl and his research school in Göttingen using the simplest of crystals, the ionic alkali halides. For an audience raised by this stage of the proceedings into the 'thin

but bracing air' of wave mechanics, the appearance in a place of honour among beautifully coloured single-crystals of a familiar packet of common table-salt provided a 'down to earth' relief. The theme of Dr. Hesketh's lecture was the alkali halide crystal as a model solid for investigation. Such a claim appears to have been justified by the subsequent discussion. Optical, electrical and other studies provide some of the most certain evidence on the nature of lattice vacancies, single or in aggregation, in solid-state physics to-day. An important feature of this talk was the link which it indicated between such electronic investigations and those concerned with mechanical properties and the role of dislocations in crystals. A connexion with another interest of Section A, magnetism, was in evidence in the paramagnetic-resonance studies of alkali halides. From the general discussion which followed the lecture there was a hint that a 'North eye' was being turned towards dislocations by those, like Prof. L. F. Bates, who follow the motion of magnetic domains. It was a pity that there was no opportunity to demonstrate other links which are rapidly being forged between different branches of solid-state physics and those under examination.

If one might, in conclusion, offer an overall impression of this session in the proceedings of Section A at the York meeting, it is that the conditions of limited time and contact of the meetings have a very stultifying effect on any attempt to make an effective contribution to the communication of new physical concepts to a wider audience of educated people. On this occasion, in spite of the central position occupied by wave-mechanical ideas in the session, it was not a mathematical but a time barrier which blocked the transmission of information. Perhaps this will be borne in mind by the Association in framing a new position for itself as a most important medium for translation as well as transmission of scientific information. From my own limited experience, there is no doubt that courses extended over the year, making use of the facilities offered by extra-mural departments of the universities and similar organizations for further education, would provide a means of digestion for the strong meat of modern physics. As a corollary, the lecturer must bend his rigour of thought to breaking point so that he may admit familiar, though inadequate, analogies as carriers across the semantic obstacles.

G. F. J. GARLICK

SCIENCE BY THE UPPER FORM

AN innovation of Section X (Assembly of Corresponding Societies) of the British Association, whereby a selected panel of young scientists of sixth-form status are able to present short papers on projects with which each has been connected, was continued for the fifth successive year at the York meeting of the Association. This year there were five speakers drawn from Yorkshire schools, each one representing a school team engaged on the acquisition

of scientific knowledge in the field, under competent leadership.

Ampleforth College, York, led the way with a paper by M. L. M. Wright on "Physiography and Scenery of the Isle of Eigg", excellently illustrated by colour slides showing the rugged grandeur of an isolated area along the western Scottish coast of only some twelve square miles in extent. Life is hard for the humans living there, and precarious for plant and

animal life, dictated by Nature over countless years. The object of the expedition was to study the influence of land formation and climatic conditions on the vegetation of the island, even to an investigation of soil-salt content, which was found to vary considerably at different levels, the highest percentage of salt being at 500 ft., with diminishing amounts down to sea-level. Members of the party collected some 250 species of plant life, but no new records were discovered. Further work in the area is to be undertaken.

In a joint effort, the two speakers who followed (A. N. P. Butland and P. A. Crossley, of St. Peter's School, York) dealt with "Some Scientific Aspects of the River Ouse", the former confining himself to the work of the analytical chemist in connexion with water supply; a work in which he had taken part. Methods adopted in order to detect any possible contamination were described, and the results obtained at various points were given, from which it was apparent that the purity of Ouse water is well safeguarded.

P. A. Crossley concerned himself with 'foaming' in rivers and canals, a natural phenomenon the reason for which was explained, but in these days very much accentuated by the growing use of detergents. The River Don was said to foam much more than the Ouse; the Trent slightly less. Excellent slides were shown to illustrate foaming along these rivers, with graphs to present results of investigations made. Each speaker presented an interesting picture of problems involved.

"The Sedges of Askham Bog" formed the subject of Shaun Firth's paper, excellently illustrated by colour slides. The area investigated is well known to naturalists and close to York. It carries a variety of sedges but, so far as the speaker knew, no systematic study of them had been carried out, interest having ranged only around the rarer species, such as the handsome *Carex appropinquata*. In consequence a group of boys from Bootham School, York, including the speaker, undertook to remedy the omission. The aim was to compile a full list of species and, if possible, "to account for the presence and performance" of the sedges. "We are aware," remarked the speaker, "we have come nowhere near an exhaustive treatment of the subject . . . what made our study of the sedges so enjoyable was the fact that new data came to light with practically every visit to the Bog, to upset our rashly formed theories and force us to observe further and think again." So this, it would seem, is but the introduction to a hitherto neglected subject.

The Bar Convent Grammar School, York, was well represented by Nancy G. Proctor, who, after only

eighteen months residence in the City, has absorbed much of its history, having received an introduction by becoming an assistant to Mr. Wenham, history master of St. John's College, York, who is carrying out an excavation under the ægis of the two local archaeological societies. Thus Miss Proctor has in a short time been able to increase her knowledge of Roman antiquities, and to add this to her main interest in the archaeological field which embraces the works of prehistoric man, in particular the study of promontory forts. Her work in York, even of so short a period, enabled her to trace the City's growth from the time when there was only an "insignificant wooden fort founded on the site in 70 A.D.", and to describe graphically recent investigations which she and members of her school have undertaken.

Another well-known Yorkshire educational establishment supplied both speaker and illustrator for the final paper, "The Seasonal Rhythm and Behaviour of the Birds of Bempton Cliffs", the former in the person of Eileen Burton, and the latter Joanne Littlefair, pupils of the High School for Girls, Bridlington. A bird-watching group visited Bempton at weekly, or twice-weekly, intervals during the year, where along an eight hundred feet stretch of the highest cliff, members studied the seasonal variation of population and the behaviour of six species of nesting seabirds—kittiwake and herring gulls, gannet, guillemot, razorbill and fulmar petrel. The date of the arrival of each species was carefully noted, together with time of egg laying and hatching, and departure. A count made along 200 ft. of the cliff showed the kittiwake to be the commonest species present during May (915), followed by guillemot (543), razorbill (18), fulmar (15), gannet (13), and herring gull (5). Five gannet chicks were hatched and reared in 1959, and as a pair of this species nested on a new ledge there would appear to be hope for an extension of the nesting area, which is the solitary British mainland station, all others being found on islands. A study was made of bird display at various times, methods adopted during time of incubation, and of the feeding of young, which gave Miss Littlefair an opportunity of producing drawings of remarkable quality, which were used to illustrate the talk in wall-chart form.

The Countess of Albemarle, president of Section X, occupied the chair throughout the meeting and in her closing remarks complimented the sixth-formers on their powers of observation, method of presentation and keenness in the respective tasks undertaken, a tribute not only to the young people but to their teachers and leaders as well.

J. A. S. STENDALL

THE MUSEUMS ASSOCIATION

THE sixty-fifth annual conference of the Museums Association was held at Worthing during June 15-19. The proceedings opened with an informal reception in the entirely re-organized Museum and Art Gallery and members were particularly interested in the additional accommodation provided by a new gallery, laboratory, workshop and storage space.

The Conference continued on the following day with an official welcome from the Mayor, Councillor Horace W. Bradley. This meeting, as the others, was

held in the spacious and attractive rooms of the Assembly Hall placed at the disposal of the Conference by the Corporation of Worthing.

Dr. W. E. Swinton, British Museum (Natural History), in his presidential address, after outlining the early struggles of the Association, emphasized the value of television and urged both museums and art galleries to use it extensively. It was, he said, the acceptable medium of to-day, 'easy, lazy but direct'. There was abundant evidence that already it had