hazard, he caused some uncomfortable shuffling by asking how many of the participants in the symposium already have a death certificate signed by poor laboratory techniques. Dr D. A. Mathewes (Western Carolina University) gave a delightfully stimulating account of his classes in what can only be called remedial chemistry; Britain's use of 'Alka-Seltzer' has obviously been too unimaginative.

The most thought-provoking paper came from Dr Richard Whitfield (University of Cambridge). Since 1966 the International Association for the Evaluation of Educational Achievement has been studying science achievement among pupils and students in three age ranges (10+, 14+ and 17+) in twenty different countries. Detailed results will be published later this year (by Almqvist and Wiksell/John Wiley) and they are certain to cause controversy, for they have direct social and political implications. In all countries, variables connected with the cultural environment of the student determine his or her achievement in science to a far greater extent than variables connected with teaching.

MOLECULES

Microwave Spectroscopy

from a Correspondent

THE continuing need for regular meetings on microwave spectroscopy was the motivation for the Second European Microwave Spectroscopy Conference, held at the University College of North Wales, Bangor, on September 18 to 22. This meeting was supported by the Royal Society, through its European Science Exchange programme, and about 140 scientists from fourteen countries, almost equally divided in their formal allegiance between physics and chemistry, gathered to discuss minute details of molecular anatomy and energetics, which, at this degree of magnification, can expose the lameness of generalizations which chemists are inclined to take for granted.

The measurement of radio spectra of gases at wavelengths between about 10^{-1} m and 10^{-3} m has been one of the principal sources of detailed knowledge of molecules for twenty-five years. The past decade has, however, seen a rapid expansion of such work in Europe at a time when molecular spectroscopy in general has become too diverse to serve, without subdivision, as a basis for useful meetings. The first conference on a European scale devoted entirely to microwave spectroscopy was duly held, also at Bangor, in 1970.

The interaction of molecular rotation with internal molecular motions of large amplitude is now a dominant theme in about half the current work. Professor E. Hirota (Kyushu University, Japan) described outstanding contributions to the analysis of spectra, complicated by such interactions, in terms of unusual force-field information. It is perhaps not widely known that there are variations of orders of magnitude in the energies required to rotate or invert groups within molecules, and to bring about other conformational changes, and that information on such details is elusive to the point of requiring prolonged investigation and computation. The rate of acquisition of such information is now increasing rapidly. In other invited talks, Dr J. K. Tyler (University of Glasgow) discussed inversions of the NH_2 group and their dependence on chemical structure, while Professor I. M. Mills (University of Reading) dealt with anharmonicity effects in force fields with special reference to microwave studies. The closely related contributions of rotational spectroscopy to precise knowledge of molecular geometry were illustrated in an invited lecture by Dr L. Nygaard (University of Copenhagen) who reviewed the distinguished work of the Copenhagen group on ring structures. Among recent advances in the elucidation of molecular electron distributions, none has been more outstanding than those made through the study of the microwave Zeeman effect, and Dr W. H. Flygare (University of Illinois) reviewed how these methods have sharply cast new light on familiar themes. The parts of molecules in which the positive and negative ends of their electric dipoles lie can now be found directly from experiment, while such terms as aromaticity and antiaromaticity can be quantified in terms of measured parameters in the electron distribution.

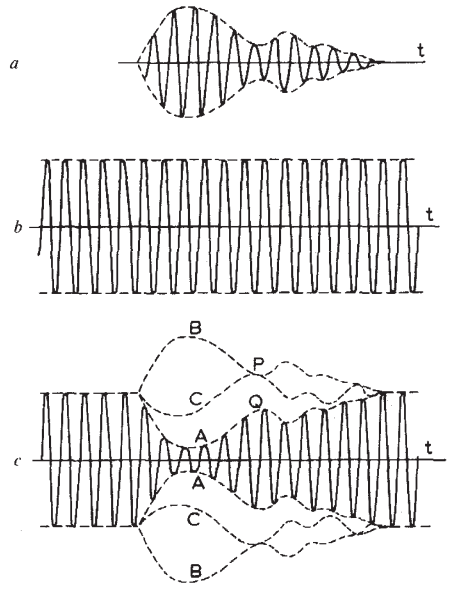
There was considerable interest in the latest experimental advances. These included not only commercial instrumentation and analytical microwave spectroscopy, but also several sophisticated developments, notably that of a computer controlled spectrometer described in an invited talk by Professor W. Zeil (University of Ulm).

In a programme of sixty-seven contributed papers, emphasis followed the general areas covered by the invited talks, but other aspects such as the spectroscopy of molecules in outer space, time-dependent effects in which processes of energy transfer are observed, and the shapes and intensities of spectral lines, were also represented. Microwave spectroscopists, perhaps through a past sense of isolation, form a very "clubbable" group of people who enjoy their conferences more than most.

Europe has become one of the chief areas of activity in this field, competing effectively with the United States. To use terms familiar to all who study rotation spectra, this would have displaced the centre of gravity of such work to somewhere in the middle of the Atlantic, were it not for the simultaneous rapid developments on the other side of the world in Asia and Australia. While it is clear that conferences on a world scale are a regular requirement, it is important that, within the continent of Europe, a firm decision has been made to hold regular specialist meetings.

Probing the Antarctic Ice Sheet by Radio

IN next week's *Nature Physical Science* (November 6), Nye, Berry and Walford describe how the technique of radio echo sounding may be adapted so that changes in the thickness of the Antarctic ice sheet can be measured to an accuracy of about 5 cm. What they have done is to reflect a pulse of radio waves (~35 MHz) off the bedrock beneath the ice and then mix the returned pulse with a continuous wave from the oscillator. The result is a modulation of the continuous wave that is sensitive to the vertical position of the transmitter and receiver (and therefore to the thickness of the ice). The diagram shows the effect of various relative phases.



It is already well known that the position of a transmitter-receiver system can be located in a horizontal plane relative to the bedrock by noting the exact shape of the returned pulse. This changes markedly over horizontal distances of 5 m or so—the wavelength of the radio waves in ice—and the position can again be assessed to about 5 cm.

Nye and his colleagues point out that an accuracy of 3 parts in 10^9 would be required in measurements of g—which essentially compare distances to the centre of the Earth—to obtain the same sensitivity.