

RADIOPHYSICS CONFERENCE AT PISA

By D. J. E. Ingram

DURING the period September 12-17 a large number of physicists, chemists, and electronic engineers gathered at Pisa to discuss recent advances in radio-frequency spectroscopy. This meeting was of a truly international character, with participants from many Eastern European universities and research institutes, including those at Warsaw, Leipzig, East Berlin, and Ljubljana, as well as members from all the Western European countries, the United States, and India. The 1960 conference itself was one of a regular annual series organized by the European "Colloque AMPERE (Atomes et Molécules Par Etudes Radio-Électriques)" which was initiated some years ago mainly due to the enthusiasm of Professor Freymann, and now has its secretariat headquarters, headed by Professor Béné, at the Institute of Physics in Geneva. The entire planning, organization, and control of the present conference, however, were carried out by Professor Gozzini, of the Institute of Physics at Pisa, to whom very considerable praise must be given for the smooth running of such a large international meeting.

The ready mixing of participants from many countries and the temporary raising of "the iron curtain" are probably among the most valuable features of these conferences, since it is not only possible to hear at first hand of the research work being carried out in Eastern Europe and elsewhere, but also to make a considered assessment of it and of the scientists performing it—the latter being probably by far the most useful function of any conference. This intermingling of different languages and ideas can be instanced very well by the fact that Professor Gorter, of Leiden, was heard to address one group at breakfast with a sentence which contained three different languages and yet served to make his meaning clear to all who were listening!

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All the different branches of radio-frequency spectroscopy were considered at this meeting, including microwave gaseous spectroscopy and dielectric studies at lower frequencies, as well as nuclear and electron magnetic resonance and nuclear quadrupole resonance. Owing to the large number of papers that were presented it was necessary to hold two concurrent sessions each morning and afternoon, which was the only slightly unfortunate feature of the conference. The papers had been arranged, however, so that most of the participants would not find that they would really like to be in two places at once—but, even so, it is unlikely that cross-fertilization of ideas between different specialists will be best brought about when half the papers are automatically eliminated for any one participant. This drawback was partially offset, however, by holding specially invited papers of general interest at the beginning of each session before the conference split into two. These papers were given by internationally established authorities in their own lines of research, the first being presented by Professor Gorter on short waves and low temperatures, in which the general relation of quantum effects on high-frequency studies at low temperatures was considered. Professor Bloembergen, of Harvard, opened the afternoon session with a general paper on cross-relaxation effects in magnetic resonance, a subject which is becoming of increasing importance in the interpretation of magnetic-resonance spectra and in the design of maser devices. The third general talk was given by Professor Grivet, of Paris, on nuclear magnetic resonance in weak magnetic fields, and the practical application of these latest techniques was very well illustrated by reference to the magnetic-field mapping carried out by the American satellites. The other general lectures were given by Professor Giulotto, of Pavia, J. G. Powles, of London, and E. E. Schneider of Newcastle, on the respective subjects of nuclear relaxation in liquids, magnetic resonance in liquids, and electron-resonance studies of solids, the latter dealing mainly with the various different forms of defects that



it is now possible to investigate and identify by electron resonance.

OVER one hundred and twenty papers were presented during the main sessions of the conference, and it is only possible to comment on one or two of these that appeared to be of particular interest. In the first session, devoted to nuclear magnetic resonance, the most recent work of Professor Andrew's group at Bangor, on the narrowing of absorption lines by crystal rotation, was of particular significance. The nuclear-resonance absorption lines obtained from samples in the solid state are usually broadened by dipolar interactions and it is therefore normally not possible to apply "high-resolution NMR" which has been such a powerful analytical tool in the case of liquids. If, however, such solid crystals are rotated at high speed some of the intensity of the absorption is separated into sidebands, spaced away from the main absorption line at a frequency interval determined by the speed of rotation. The main undisturbed absorption line narrows at the same time, and it is possible to separate this "fundamental" line from its sidebands completely. Moreover if the sample is rotated about an axis making $54^\circ 44'$ with the axis of symmetry of the nuclear surroundings, the dipolar broadening can, in principle, be reduced to zero if the rotation is fast enough. This "magic angle" is the one that makes $(3 \cos^2\theta - 1)$, the dipolar broadening factor, equal to zero. Professor Andrew and his group showed that the line width is not only reduced in exactly the way predicted by this theory, but also that it was then possible to obtain "chemical shifts" from such rapidly rotating crystals. The case of two resonance lines observed for the chlorines in PCl_5 was quoted as an example, these being attributed to the equal numbers of PCl_4 and PCl_6 present in the unit cell. The observation of chemical shifts in solid samples in this way promises to open up a wide range of new studies by nuclear-resonance methods.

Among the various papers presented in the sessions

on electron-spin resonance was one by Dr. K. Hausser on the production of very high resolution in ESR spectra of liquids. It appears that the presence of dissolved oxygen often has a considerable broadening effect on the electron-resonance lines, and, once this is removed, very much narrower lines can often be obtained. This is an "obvious" effect, once it has been pointed out, and it is surprising that no careful thought has been given to it before, but this quite often happens in the development of many fields of research. The very well resolved spectra shown by Dr. Hausser indicate that high-resolution ESR is now going to take its place along with high-resolution NMR. One feature stressed in this connection was the need for the greatest possible sensitivity for the spectrometers used in this work, since concentrations of the active compounds must be kept low to prevent spin-spin broadening. The actual design of low-noise spectrometers was considered in several papers, and Professor Gozzini opened the last session on the Thursday afternoon with a paper on this subject. Recent advances in gaseous microwave spectroscopy were reported by several groups, and a large number of interesting papers on dielectric studies at lower frequencies were also presented.

The conference closed with an organized trip to visit Siena, and it was a rather amusing sight to watch the faces of the Italians in the villages between Pisa and Siena as six large coach-loads sped through in formation! Before a detailed tour of this historic city a final general lecture was delivered by Professor Lösche in the main hall of the University of Siena on the conference that was held at Leipzig earlier in the year. This was followed by a very lavish lunch in the Italian style, provided by the municipality of Siena.

The hospitality and goodwill that marked all these occasions was one of the main features of the conference, and its setting close to the Italian coast and amidst the historic treasures of Florence and Siena added a touch of real cultural interest which all the visiting scientists seemed anxious to imbibe!