

associated techniques may well tip the scales in favor of the time-of-flight method in many types of experiments. The healthy competitive spirit between advocates of each method was readily apparent at SINS, and one panelist remarked that if nothing else, the rapid improvement and competition from time-of-flight techniques has made the conventional-method people think a lot harder! With the anticipated availability of intense pulsed sources, it will be most interesting to see how these two techniques compare a few years hence. This competition in structure studies will be especially important in the study of biological and organic compounds, a most challenging and important field that is just beginning to receive attention.

Slow neutron scattering. A panel was devoted exclusively to inelastic scattering of thermal or subthermal ("cold") neutrons. This technique is used to determine the dynamics of matter and thus the interatomic forces that underlie dynamics. In this complex field, precision and high resolution are particularly necessary, and presently available sources are barely adequate to study dynamics of even the most basic crystals. Since resolution varies extremely slowly with source strength, at least an order-of-magnitude increase in neutron intensity is needed for these studies. Here again, competition between conventional and time-of-flight techniques is strong, with the present advantage probably going to the more highly developed and more precise conventional techniques. It should be noted that severe engineering problems prevent the use of simple cryogenic moderators with high-flux reactors, but since the heat dissipation is far less, this is more straightforward with pulsed systems.

In the panels devoted to nuclear, neutron and fission physics, the following were cited as fields of research where higher neutron intensities are required:

- (a) fundamental neutron-nucleus interactions
- (b) studies with polarized neutron beams
- (c) capture gamma-ray studies in the thermal and resonance regions

(d) fission studies in individual resonances

(e) investigations of intermediate structure for fast neutron interactions.

In general, it appears that neutron cross sections for reactor design can be adequately measured using presently available and planned sources. Obviously, however, higher-intensity sources at all energies would enable more accurate and rapid measurements to be made and simultaneously would make new fields accessible to measurement, for example, in multiparameter measurements. Needless to say, stronger sources are a necessity in the case of very small or highly radioactive samples.

The development of more intense sources must be accompanied by a commensurate effort to develop better experimental techniques and improved instrumentation in order to take full advantage of available sources. It was repeatedly emphasized that improvements in instrumentation can often bring the equivalent of a many-orders-of-magnitude increase in source intensity—a dramatic case in point is the lithium-drifted germanium detector for high-resolution γ spectroscopy. This does not negate but enhances the need for more intense sources, and also emphasizes the need for a balanced effort in the areas of techniques and source developments.

The seminar provided a stimulating atmosphere and clearly testified to the strong interest and potential in the use of neutrons in many research fields. The enthusiastic support of leading representatives from many laboratories, often in quite different ap-

proaches, added considerably to the value of the meeting. The preceding summary can hardly do justice to the 26 manuscripts, four panels and many hours of lively discussions that will be included in the proceedings. The proceedings for SINS will be published by ENEA (38 Blvd. Suchet, Paris 16^e) early in 1967. The Los Alamos Scientific Laboratory was the host of the Seminar in Santa Fe and also has the responsibility of editing the proceedings.

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References

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3. *Inelastic Scattering of Neutrons*, Symp. proc. (Bombay, 15–19 Dec., 1964), (2 vols.), STI/PUB/92, IAEA, Vienna (1965).
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Three meetings on crystals: 1. IUC congress in Moscow

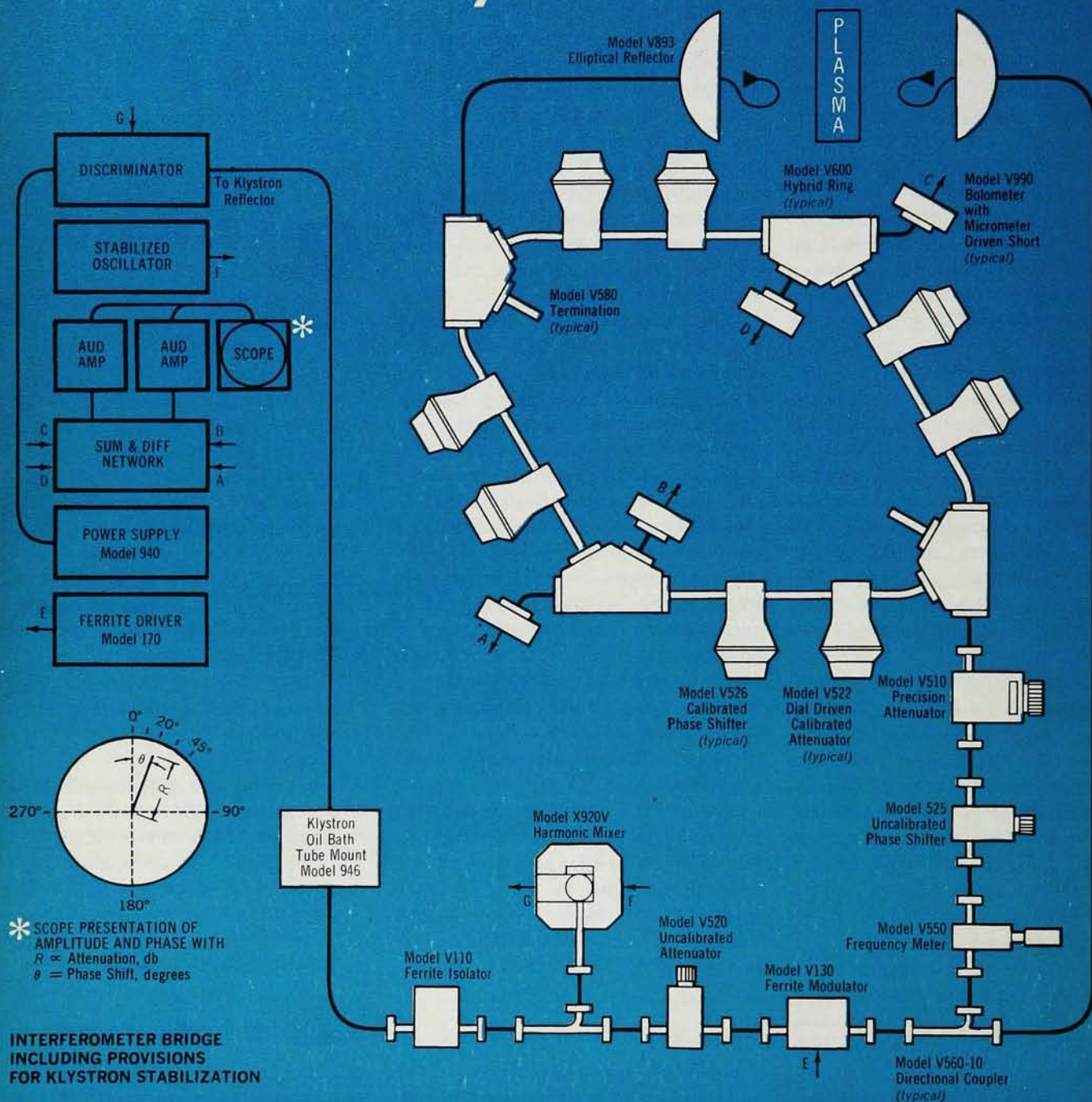
The seventh triennial congress of the International Union of Crystallography drew 3000 crystallographers, 200 from the US, to Moscow last July. 830 contributed papers were classified into 17 subject divisions as follows: theory of structure analysis; theory of diffraction of x rays, neutrons and electrons; symmetry and crystal structure; dynamics of the crystalline state; crystal structures of inorganics; structures of metals and alloys; structures of or-

ganics; magnetic structures; coördination compounds; protein structures; breakdown of ideal structures; phase transitions; apparatus and techniques; computing; partly ordered structures; thermal motion; and miscellaneous.

A congress discourse on antisymmetry by A. V. Shubnikov (USSR) was read in the author's absence by a colleague. Five general lectures were interspersed among the other papers. G. N. Ramachandran (U. of

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Madras) discussed anomalous dispersion as a tool in structure determination, dealing with experimental and theoretical studies of phase determination based on deviation from Friedel's law. W. N. Lipscomb (Harvard) summarized the present knowledge of the structure of boron polyhedra and the complex chemistry of boron hydrides. A. I. Kitaigorodskii (Institute of Organic Compounds, Moscow) discussed the possibilities of calculating thermodynamic properties of crystalline compounds from structural data. N. V. Belov (Institute of Crystallography, Moscow), president-elect of IUC, spoke of new ideas of isomorphous replacement. Hugh E. Huxley (U. of Cambridge) discussed studies of biological systems by x-ray diffraction and electron microscopy.

Computers. A large number of crystal-structure determinations, increasing complexity of structures investigated and generally more precise results showed increasing use of fast computers. Proteins and other biological substances attracted much interest; 44 papers from almost as many laboratories dealt with protein crystal studies. Relatively few structures determined by direct methods were reported, but the number is clearly increasing rapidly.

At sessions on x-ray-diffraction theory interest centered on dynamical theory and anomalous transmission through perfect crystals (the Borrmann effect). Automatic single-crystal diffractometry was a major topic in sessions on apparatus and techniques. That crystallographers are concerned not only with rapid, automatic data collection but also with intensities was obvious; attendance at an open meeting on the subject of the Crystallographic Apparatus Commission had large attendance and lively discussion. Another well attended meeting discussed x-ray powder diffraction and the powder data file.

Scientific sessions were supplemented by an excellent book exhibit in a Moscow State University library, and an exhibition of apparatus and synthetic crystals. Unfortunately no American and few west European manufacturers were represented (apparently because of Soviet requirements that all apparatus displayed be sold or otherwise disposed of in the Soviet

Union). Crystallographic equipment at the exhibit was unimpressive (with the exception of displays by one Dutch and one Japanese manufacturer). In contrast Soviet-built crystal-growing equipment and Soviet-grown synthetic crystals were impressive.

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2. Crystal growth in Moscow

A symposium on crystal growth in Moscow followed the congress described in the preceding report. A session of invited papers was followed by parallel sessions on morphology, impurities, epitaxy and techniques.

At the plenary session P. Hartman (U. of Leiden) spoke on structure dependence of crystal morphology. He has extended the ideas of Gabrielle Donnay (Johns Hopkins) and David Harker (Roswell Park) and now classifies crystal faces by considering the uninterrupted strong-bond chain lying in the face. If a given chain (called the "periodic-bond chain," PBC) is linked to another PBC by strong bonds, this face will be important in the crystal if certain external factors are absent. With this and similar ideas one can make predictions about the morphology of a surprising variety of materials. Although the connection is at present obscure, the approach, if considered only for its ability to give rules applicable to the morphology of many materials, is arresting.

R. Kern (U. de Nancy) spoke on crystal growth in the presence of impurities, pointing out that morphological modification is not dependent on their incorporation into the crystal but only on their adsorption on growing faces. He showed that interpretations of habit modification can be based on thermodynamic, kinetic and crystal-chemical considerations.

G. I. Distler (Institute of Crystallography, Moscow) emphasized that electron microscopic examination of such materials as silicon, germanium, mica, quartz and sapphire shows various active centers usually associated with impurities. These active centers are thought to be essential determinants in many surface properties of solids such as reactivity and epitaxial overgrowth. On occasion blocking of

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