This work was only theory until von Laue, together with Friedrich and Knipping, carried out his famous experiments on x-ray diffraction in which the pattern on a photographic plate made by x-rays as they passed through a crystal showed the crystal to be an orderly and symmetrical arrangement of atoms.

Nowadays electrons and neutrons are also used to investigate a crystal lattice and C. G. Shull, of the Oak Ridge National Laboratory, surveyed techniques and application of neutron diffraction. X-rays are scattered by the electron cloud surrounding the atomic nucleus and the scattering can be calculated by wave mechanics. Neutrons are scattered by the nucleus and their interaction cannot be calculated. Their scattering power is determined by experiments on known structure. While neutron diffraction may be more difficult experimentally, the fact that no connection exists between neutron scattering power and atomic weight means that some heavy elements have a lower scattering power than some light elements. Determining the crystal structure of compounds made up of light and heavy elements is thus easier with neutrons than with x-rays where the scattering power of the heavy elements is predominant and light atoms are difficult to locate. For example the scattering power of hydrogen atoms for neutrons is quite high, and so it is easy to locate hydrogen atoms.

The question of chemical bonds was treated by R. Brill of the Phillips Petroleum Co., Bartlesville, Oklahoma, who gave a summary of his former work with Grimm, Hermann, and Peters on the x-ray study of electron distribution in crystals. The electron distribution is connected with chemical bond type. In the case of the covalent bond, for example, a certain accumulation of electrons between the two atoms is to be expected, whereas, in the case of the ionic bond (between oppositely charged ions), the minimum density of electrons between atoms should become very small. In a transition state, neither the one nor the other type should be realized but a state between them. By accurate intensity measurements of x-ray diffractions, small concentrations of electrons between the atoms can be found. Results on different bond types were given and it could be shown, for example, that a continuous transition in bond type seems to take place from the first element of a horizontal row of the periodic system to the last one.

The last lecture, given by W. L. Bragg, dealt with the behavior of metals. Plastic deformation in a very wide range is typical for metals. This behavior was investigated by Bragg on a model which hardly could be simpler and at the same time more efficient. It consists of small soap bubbles whose surfaces form exactly the same closely packed arrangement in two or three dimensions that we find in metal structures. There are even attractive forces present between the bubbles if they are close enough together.

The model thus is well suited to demonstrate the mechanical and thermal properties of metals and the influence of impurities and other imperfections of the lattice. (See ilustrations for the article in this issue, "The Physics of Metals.") By putting a strain on the bubbles, elastic and plastic deformation can be seen. Plastic deformation consists in a slip of one row of atoms against another one. The movement is not simultaneous along the whole row but begins on one end with a dislocation which runs along the slip line through the crystal. This was even shown by a moving picture and it was very interesting to see how fast such dislocations can travel. These observations explain, in agreement with former theories, the fact that the forces necessary to produce plastic gliding in a metal are so small.

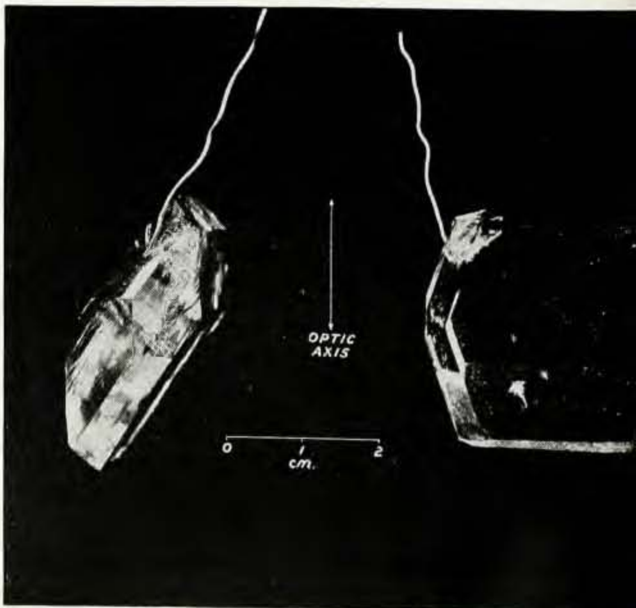
Everybody got the impression that a deep insight might be gained by such simple experiments if they are carried out in the right way. —R. Brill

High Fidelity

During the Cleveland meeting of the Acoustical Society, the morning of November 6 was devoted to a panel discussion of what constitutes high fidelity reproduction. It was fairly generally agreed that, from an idealistic viewpoint, high fidelity reproduction constitutes bringing to each ear of the listener an exact facsimile of the original sound he would have heard in the auditorium where it was produced.

It was not easy, however, to evaluate how much departure from this ideal could be permitted without noticeable deterioration of the original quality of speech or music. Among the many factors discussed which influence quality were reproduction of sound as heard with one ear as compared with two ears and also as heard in perspective. Although it was contended that a single channel reproducing system can never recreate the spatial characteristic of the original sound, it was also conceded by a fair majority that a single channel system transmitting frequencies uniformly between about fifty and twelve thousand cycles, with negligible harmonic distortion, could achieve a very high degree of quality and practically every type of sound thus reproduced could be completely recognized.

Limitations in frequency range as well as distortions in the recording and reproducing process were also dis-



cussed, and there were various opinions about the average listener's preference for a limited frequency range in the presence of these distortions. The relative intensity level of the reproduction as compared with the level of the original sound also affects quality. When sound is reproduced in a theatre at higher intensity levels than its source, for example, the reproduction seems to exaggerate the high and low frequencies and both must be attenuated to preserve a natural quality.

After the invited papers, which were given by W. B. Snow, D. P. Loye, H. F. Olson, and S. J. Begun, F. V. Hunt of Harvard University opened the discussion. Members of the audience mentioned economic factors, such as the cost of equipment, as having a great effect on the public's acceptance of "high enough" fidelity in preference to true high fidelity. They also called attention to the unfortunate fact that radios or phonographs are often selected primarily as articles of furniture, and quality of reproduction is given secondary consideration. Improper installation of good equipment, they said, was another serious practical problem.

As evidence of the great interest in this highly controversial symposium, many hands were still up after about an hour and a half of general discussion, when the chairman had to bring the meeting to a close. After the session, many members said they thought this kind of open forum symposium should be held more often, to bring out widely different viewpoints. —Frank Massa

Industry's Stake

The stake of industry in basic research was the theme of an address by T. Keith Glennan, President of the Case Institute of Technology, to the Acoustical Society at its dinner meeting November 5, 1948 in Cleveland, Ohio.

In a strong speech outlining the changing relationship of academic, government, and industrial laboratories to research, Glennan said that industry must contribute to basic research in greater measure than it is now doing, if it is to reap the fruits of applied research. "If government takes over the fundamental research of today," he said, "it may make claim as well to the applied research of tomorrow."

Glennan reported that, while industry's contribution to research and development dropped to thirty-eight percent in 1947, and the share of academic institutions shrank to less than four percent, that of government increased to half the total amount. The speaker suggested that the emphasis on fundamental research should be increased in academic institutions—especially institutes of technology—with applied research left largely to the industrial laboratories.

To bolster both the contribution and responsibility of industry in basic research, Dr. Glennan proposed that industry, which obviously cannot greatly increase activities in its own laboratories, sponsor basic research programs in academic institutions and support fellowship programs. Industry would thereby increase its sphere of influence in this area of scientific activity.

"Industry has come generally to some realization of the stake it has in the training provided by technical schools for the engineers of tomorrow," Glennan said. "It has a similar stake in the basic research activities of these schools of technology."

Crystals and Rust

Westinghouse researchers have been working on the preparation of thin single crystals of metals and are able to produce crystals only ten mils thick but as large as a half-inch square. This will make easier x-ray and electron diffraction studies on the precise effects of chemical reactions and external disturbances.

In another development, Westinghouse materials engineers have turned up a method for using iron oxide coatings as dependable electrical insulators between the laminations of generators and motors. Previously the composition of the oxide varied according to the temperature at which the oxide was formed—if it was above 570 degrees centigrade the oxide had a low resistance. By annealing electrical sheet steel and then bringing it down below this temperature for steam oxidation, the oxide film was kept uniform and thus made more suitable as an insulator.

Standardized

As the culmination of thirty years' effort, an agreement unifying screw thread standards was signed by representatives of Canada, the United Kingdom, and the United States on November 18 at the National Bureau of Standards. The agreement fulfills all requirements for general interchangeability of threaded products made in the three nations. Manufacturers were formerly required to supply different parts for each separate market area and so the new agreement is expected to contribute to the expansion of commerce between cooperating nations.

Geophysics and Geography Committee

A new Committee on Geophysics and Geography has been formed by the Research and Development Board,

Continued on page 32

SYNTHETIC QUARTZ: Early in the fall, the Brush Development Company of Cleveland, Ohio delivered to the Signal Corps Engineering Laboratories at Fort Monmouth the largest single crystal of synthetic quartz essentially free from defects known to have been produced from any artificial source. The greatest dimensions of the sample are equal to the diameter of a silver dollar. The supply of the special grade of quartz crystals used for stabilizing the oscillation frequency of radio circuits comes largely from Brazil and is diminishing, so that there has been an increasing interest in the attempt to produce high grade crystals artificially. As reported at a recent meeting of the International Union of Crystallography by Danforth Hale, a supply of inexpensive silica, a number of quartz crystal "seeds," and water with other special additives, are charged into the pressure vessel, which is then tightly closed and heated at the bottom constantly for a period of days or weeks. The pressure builds up as long as the temperature is rising, resembling the action of a kitchen pressure cooker. In one of the experiments a seed plate about half an inch square and one-sixteenth inch thick increased in weight twelve times in about sixty days, forming a handsome rock crystal. Experimentation on the project is continuing and is expected to lead eventually to a commercial process.