# RESEARCH FACILITIES AND PROGRAMS

### *Architectural Acoustics*

**A method** for simulating the acoustics of auditoriums and concert halls with the aid of a digital computer and an anechoic chamber has been developed by M. R. Schroeder of the Acoustics and Visual Research Department at Bell Telephone Laboratories. As reported in November at the 62nd meeting of the Acoustical Society of America, the technique allows the acoustic effects of planned architectural arrangements to be heard and evaluated before a structure is built.

The first step in the procedure is to draw, on a plan of the proposed hall, all of the paths that sound waves may follow (including single and multiple reflections) from a chosen point on the stage to a typical seat in the audience and to determine the times of flight for the sound waves over the various paths. Calculations can then be made of the structure's reverberation time (the period required for a sound impulse to decay to $1 \times 10^{-6}$ of its initial intensity. The information thus gathered is used to program a computer so that it will operate upon a sound in the same way as the actual auditorium. Samples of speech or music are recorded on digital magnetic tape and fed into the computer. After the computer has performed the programmed alterations, the output tape is translated into a sound track suitable for playback on a tape recorder. By playing this tape in the echo-free environment of an anechoic chamber, the planner can hear how the sample would sound in the projected auditorium and draw any necessary conclusions about changes required in the architectural design.

The system not only represents a possible saving of effort and expense in the construction of new halls, but also can be used to aid the alteration of existing ones. The computer can be programmed to simulate the effects of proposed architectural alterations. After a recorded sample containing the effects of the changes is made, it is played back in the unaltered room. This combination allows the acoustic effect of both the existing structure and the proposed modifications to be heard.

In cases where acoustical modification through changes in construction is impractical, electronic systems may be used to add artificial reverberations to the sound. The computer method is also useful for simulating the effects of these systems while they are still in the planning stage.

### *Low-Energy Facilities*

**Yale University's** new, million-dollar electron linear accelerator was formally dedicated September 14. Designed to operate normally at 40 Mev, the linac may reach energies greater than 80 Mev for currents smaller than its normal 25 kw. Under the direction of Howard L. Schultz, professor of physics, and associate physicists Charles K. Bockelman and James E. Draper; researchers will use the new facility for studies in such areas as photonuclear reactions, nuclear structure, neutron bombardment, and high-energy electron scattering. Designed and built by the Applied Radiation Corporation of Walnut Creek, Calif., a subsidiary of High Voltage Engineering Corporation; the linac is housed in the Yale Accelerator Laboratory.

**Recent advances** in the theoretical description of the atomic nucleus, together with recent design improvements in cyclotrons and Van de Graaff accelerators, have stimulated a special National Science Foundation program for the establishment of low-energy nuclear physics research facilities and for the improvement of existing low-energy equipment. The Foundation announced in late November that the first six grants awarded under the new program will provide a total of more than $4 million to support the construction of accelerators at the University of Chicago, Michigan State University, the University of Pittsburgh, the University of Washington (Seattle), Ohio State University, and the State University of Iowa.

Three of the grants provide for medium-power Van de Graaff machines. The University of Chicago's 4-Mev accelerator will be used primarily in collision experiments involving bombardment by heavy particles. The use of accelerated lithium ions was initiated by the Chicago group in 1956, and even more complex particles are expected to be available with the new equipment. At Ohio State, a new 5.5-Mev machine will be used in conjunction with a 6.5-Mev cyclotron and a 3-Mev Van de Graaff and is expected to add great versatility to the research effort. The cyclotron group has been engaged in studies of proton and gamma-ray correlations, and with the new machine they will be able to extend the measurements to other energies and include similar deuteron interactions. A 5.5-Mev Van de Graaff will also be built at the State University of Iowa and will be used for heavy-ion bombardment in an effort to gain more information about cross sections and nuclear energy levels.

The new Michigan State machine, a 40-Mev sector-focused cyclotron, is designed to achieve higher intensity and sharper energy resolution and collimation for proton beams in the 20–40-Mev range. The design involves a new "resonant-deflection" technique developed by the Michigan State group. Oscillations of the particles about the center of their path will become unstable at full cyclotron radius, and this feature, com-