THE DEUTSCHES MUSEUM AND HOW IT SUCCEEDS

With exhibits that combine historical perspective and current practices, the largest and probably best institution of its kind offers an overall view of exact sciences to the widest possible audience.

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THE DEUTSCHES MUSEUM in Munich is probably the best scientific and technical museum in the world. In any event, says its scientific director, it is the largest. With its busy and interesting halls of exhibits, it probably introduces more nonscientists and nonphysicists, especially young ones, to science and physics than any other institution.

Having often wondered about its success, we arranged to pay it some more visits on a recent trip through Munich and to talk with the scientific director, Hermann Auer. He is responsible for all scientific programs of the museum and is also a professor of physics at Munich University. The two positions are independent of each other.

During our visit we spent most of an afternoon talking with Auer about the history and philosophy of the museum, its makeup and its methods. Afterward he guided us on a quick tour through some of the scientific exhibits, and on the following day we went back to take a more careful look at parts of the physics section.

An institution in three parts

The museum, which was founded in 1903, now occupies its own large building with 89 000 square meters of floor space on an island in the Isar River, right in the heart of Munich. It operates with an annual budget of $2 million and receives 700 000 visits a year. The staff comprises 324 persons.

Three parts make up the institution: a meeting hall with 2400 seats, the library and the exhibits. The library is one of the largest specialized libraries of the world with more than 500 000 books on science and technology in addition to its collection of manuscripts, autographs and patent applications. It includes also an institute for the history of science and technology. Its materials are always available because nothing goes out on loan.

On the exhibits, though, depends the great fame of the museum. They are intended to represent all of exact science and technology (although biology is notably absent) to the widest possible public, and they range from mining and processing of raw materials to such applied technologies as printing and telecommunications.

We asked Auer what other museums of the world are comparable with the Deutsches Museum. He called the Chicago Museum of Science and Industry second. (It has about 57 000 square meters of floor space.) Paris has two scientific museums, the Palais de la Découverte devoted to teaching but not history and the Conservatoire des Arts et Métiers devoted to history but not to teaching. Other good but smaller scientific and technical museums, he said, are in Stockholm, Vienna, Milan, Moscow, Los Angeles, Boston, London and San Francisco. The Smithsonian in Washington is different in purpose, being concerned only with accomplishments in the United States. In the Deutsches Museum only the honor hall with busts and pictures of great scientists and engineers is limited

ORIGINAL APPARATUS on display. 16 horses once failed to separate these hemispheres evacuated with this pump.

BUILDING on an island in center of Munich has 89 000 square meters of floor for exhibits, library, and auditorium.

SCIENTIFIC DIRECTOR HERMANN AUER (right) discusses with the author the Deutsches Museum in Munich. Its reputation as best in the world comes from the way it combines exhibits devoted to the facts, methods and history of science.

to Germany. The remainder of the institution is entirely international.

The physics exhibits

Physics occupies a bigger share of the exhibit space than any other subject, about a fifth of the area or perhaps a bit more if you include astronomy, the planetarium and geodesy. Like other subjects it is represented in three ways: displays of original apparatus, historical reproductions and actual demonstrations. You enter the physics section through a room in which attractively arranged and lighted glass cases set in the walls display early instruments of physics, mathematics, astronomy and geodesy. Next is a survey room. It is dark, and lighted cases show some important principles of mechanics, oscillations, heat, electricity and optics. An otherwise unsupported ping-pong ball bounces around in a jet of air from a nozzle inclined at 45 deg to the vertical; a string vibrates in its first harmonic; lenses illuminate and project a slide.

Then you come to Galileo's laboratory, the reconstruction of a room in which he worked. Near it are demonstrations of some of Galileo's discoveries about motion. By winding a crank you can make two rods move, one in uniformly accelerated vertical motion, the other horizontally at constant velocity. Their intersection traces the parabola of a projectile. Beneath this apparatus you can drop a steel ball into a tube. When it emerges at the bottom end it bounces, and its motion follows a parabola traced on a board behind it until it lands in a leather pouch. Separate portions of the museum are devoted to such other subjects as machines; energy; optics; photography; heat; electro- and magnetostatics; currents, x rays and oscillations; sound; musical instruments; nuclear physics and technology; astronomy; geodesy; weights and measures; time measurement. This list does not include nonphysics subjects that the museum treats—such as chemistry and a multitude of technologies.

Experiments from history

Original apparatus on display includes pieces used by H. G. Magnus, Otto von Guericke, Wolfgang Gaede, Rob-

ert Mayer, George S. Ohm, Werner von Siemens, André M. Ampère, Wilhelm K. Röntgen, Heinrich Hertz and Thomas A. Edison. With the Magdeburg hemispheres, about 51 cm in diameter, and his own vacuum pump, von Guericke demonstrated that 16 horses could not separate the hemispheres against the atmosphere.

We heard Otto Hahn describe the apparatus he used to discover fission while we looked at the apparatus: neutron source, paraffin moderator, exposure flask and an array of counters and meters. Hahn's voice came from a tape recorder, and spotlights came on in sequence to point out each piece of the apparatus as he described it.

Demonstrations include exhibits for the participant to watch, those that follow a sequence after he pushes a button and those in which he does it all. For example, with pulleys, weights, levers and springs you can test the laws of statics and simple dynamics. By pushing a button you can cause cylinders full of water to rise as a golden crown is balanced against a lump of gold. Another button causes the vacuum in a discharge tube to improve gradually as the dark and bright spaces become shorter and more numerous. With a crank you can move a light bulb along two parallel wires and, as it dims and brightens, observe a standing wave pattern. With another you can move a thermal element under a spectrum and see that the greatest heat is delivered out beyond the visible in the infrared. A few experiments require a demonstrator.

The director's philosophy

"I am no friend of complicated apparatus," said Auer as he discussed his models. He went on to say that simplicity is easy to achieve in displaying the simple laws of physics. It becomes more difficult when one is showing the complexities of technology.

Recently in a speech before a group devoted to all kinds of museums, Auer revealed his own philosophy. He emphasized three themes representing three relations: between science and the cultural climate of its period, between science and technology, and between science and the fundamental laws of nature.

The ideal museum arrangement, he says, is a series of concentric shells. At the center one displays basic phenomena. Outside this come the sciences; one shows the visitor how physical laws and mathematics describe the phenomena. Then in an outermost ring comes technology—a demonstration of how exploitation of natural laws meets needs. The Deutsches Museum is aiming at this kind of layout.

Successful education

"We try to give an education in science," said Auer, explaining that in addition to exhibits and library the museum has courses and lectures that listeners can attend for small fees—typically 25 cents for a lecture. Wolfgang Kaiser, formerly a physicist at Bell Labs and now a physics professor at the Munich Technical Institute, recently gave a lecture on the laser; it is now available from the Munich publisher R. Oldenbourg in a German-language monograph for $1.10.

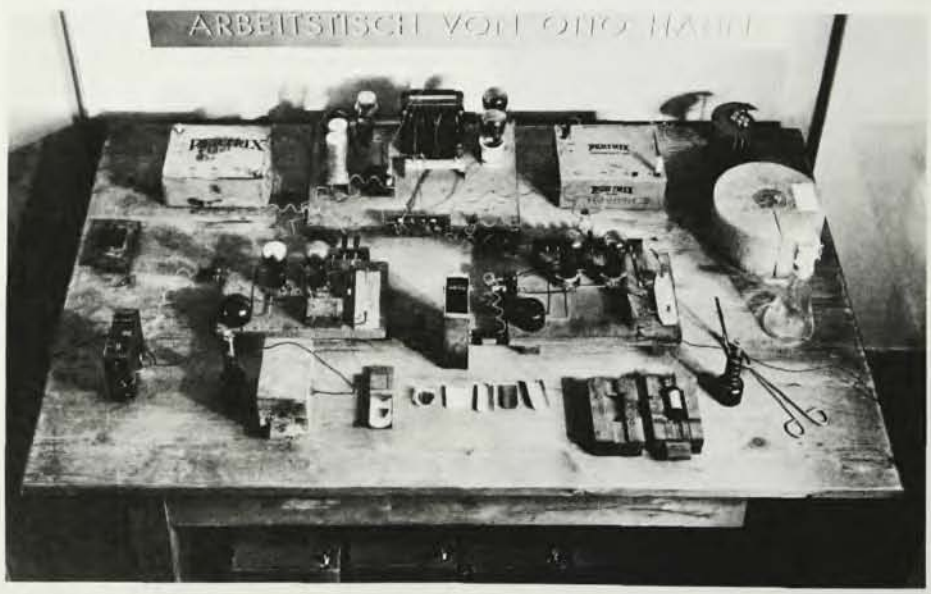
Success of the program is not easy to measure, says Auer with unnecessary modesty. Frequently a student who registers for science courses at the university and technical institute says that his first contact with his subject was at the Deutsches Museum. The lectures, says Auer, are always fully attended. Also full, when we were there, was the parking court. It was a rainy day, and in addition to five or six large buses that had brought groups of students, a few dozen automobiles occupied all available spaces. Of course Munich residents can come easily by trolley car; so the buses and cars represented a small fraction of the visitors.

A particularly successful and useful program is one that brings scholars and industrial apprentices from more distant parts of Germany. A privately financed travel foundation transports about 800 participants a year and pays housing and maintenance for five days in Munich. In return each participant must appear five times at the museum (for as long as he likes) and write a critical report of his visit. Criticism may be favorable or unfavorable, and Auer feels that the museum staff learns a lot from what the reports have to say. About 70% of the travelers under this program are from German gymnasia (the schools that precede university) and the remainder are from industry.

A museum in motion

Motion is everywhere in evidence as one talks about the museum program; nothing is static. Most of the physics exhibits have been revised to bring them up to date. An exception is optics, which now displays mirrors and lenses but will soon be changed to include lasers and more recent discoveries. An astrophysics display will soon join astronomy, and geophysics will be added alongside geodesy.

A plan for the near future will roof over two large inner courts that stand within the library building. These roofed courts will then become display areas for aeronautics and space travel, providing volumes needed for rockets and airplanes now housed in the main display area. Some displays can then be shifted so that the visitor progressing through the museum will find a more ordered sequence as he progresses from subject to subject. □



OTTO HAHN'S WORK TABLE shows the experiment that discovered fission. Hahn's voice from a tape recorder describes experiment while spotlights come on in sequence to call listener's attention to different parts of the equipment on display.