academic associations. The location should be one accessible by travel over short distances from one or more additional universities. This is to encourage use of the facility by groups of individuals during sabbatical years and nonteaching periods. To this end, some residential quarters would be desirable.

Conclusion

To complete the first phase of the work of the Biotron Committee it would be desirable to get further expression of the needs and specific requirements from biologists all over the United States. To this end, the Biotron Committee invites suggestions and ideas pertinent to the planning of national biotron facilities so that no possibilities will be overlooked. The committee is specifically charged with the investigation of large-scale facilities and should not primarily concern itself with individual controlled-environment chambers. Thus far our considerations have been completely independent of actual cost. It is assumed that, provided that the need for biotron facilities is unequivocally demonstrated, funds will be forthcoming.

To assist the National Science Foundation in arriving at realistic cost figures for biotrons, the committee is now drawing up preliminary designs for a large installation in which studies of environmental effects on both plants and animals can be undertaken. It is also intended to design an installation for small nonaquatic animals as a prototype. A modification of the Pasadena phytotron to incorporate the experience gained through its present operation and to permit some studies of animals will be undertaken. In this last case, attention will center on the possible application to ecology since the degree of interest is great. Finally, design of some type of box units will be considered. These designs will be available, in the final report of the committee, to groups that are interested in creating such facilities.

Reference

1. F. W. Went, *The Experimental Control of Plant Growth* (Chronica Botanica, Waltham, Mass., 1957).

European Science Museums

A tour shows how they cope with the problems of displaying famous apparatus of the past and present.

Robert P. Multhauf

Among the many treasure houses of Renaissance Florence still to be seen in that city is one easily overlooked by the uninitiated visitor, although to reach it he has but to proceed to the Arno through the court of the Ufizzi Gallery and turn left to the rear of that building. Here is the Palazzo Castellani, once the residence of the Podesta of Florence and now the home of the Museo di Storia della Scienza. Here the visitor can wander through quiet rooms housing the fragile three-century-old glass apparatus familiar from the pages of the *Saggi* of the Accademia del Cimento, the first scientific academy in Europe—a forceful reminder that the *Saggi* and similar publications are not the sole evidences of the work of the busy experimenters of the nascent age of modern science.

The oldest collection of apparatus displayed here is the legacy of the house of Grand Duke Ferdinand II, where these relics of the curious hobby of the illustrious ancestor rested quietly for a century after his death until their first exhibition in 1775. As a result of subsequent accretions in the course of its evolution into the *museo* of today, this is a somewhat motley collection, including, as well as some apparatus illustrated in the *Saggi*, mechanical, electrical, and pneumatic apparatus for the demonstrations dear to the heart of the 18th century scientific enthusiast and the telescopes and microscopes favored by connoisseurs of baroque craftsmanship. Many of these pieces came from other early Italian centers of scientific activity and were acquired in 1929, at the time of the National Exposition of the History of Science. Relics of such distinguished Italian scientists as G. B. Amici, Felice Fontana, and Paolo Mascagni comprise the bulk of these collections.

The fever of enthusiasm for experimental natural philosophy which spread across 17th century Europe has left material traces elsewhere, in museums and, increasingly rarely, in private collections. An air pump of von Guericke can be seen in Munich (at the Deutsches Museum) (*1*). The Boyle-Hooke pumps have been lost, but an early pump modeled after Boyle's first one can be seen in Leiden (at the Netherlands National Museum of the History of Science), and the fashionable designs of the Abbé Nollet and of Senguerd can be seen in many places. The earliest electrical machines seem not to have survived, but many examples remain from the flowering period of electrical experimentation, among the most notable being Hawksbee's (in the collection of the Royal Society of London) and the great machine of van Marum, in Haarlem (at the Teyler museum).

The optical and mechanical preoccupations of the age are similarly represented. The telescopes of Galileo in Florence and the reflector of Newton in London (in the collection of the Royal Society)are only the most famous of the many telescopes preserved. Of the very large instruments, understandably, scarcely anything remains, although the barrel of Herschel's great reflector still exists at the Observatory House, Slough, England. The pre-, or anti-, telescopic observers have also left few relics, although instruments associated with the name of Brahe exist in Kassel, Munich,

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and Prague. Some of the instruments from the early days of the observatories in Paris and London remain, both at the old observatories themselves and in the respective national museums (the Conservatoire Nationale and the Science Museum).

Examples of that other epoch-making optical instrument, the microscope, abound in European museums in the multitude of forms dictated by utility, economy, and style. An original Leeuwenhoek instrument can be seen at Leiden (*2*) as part of an excellent historical display of instruments by Leeuwenhoek and other early makers. Early examples of the work of the famous English makers of commercial microscopes are especially evident in the English museums.

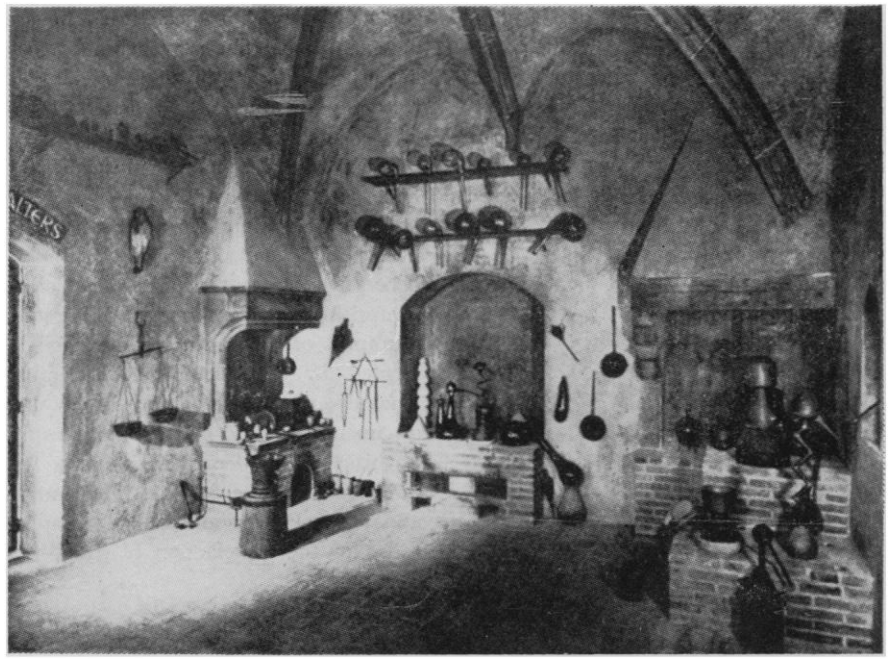
In mechanics, much remains from the period of the spread of Newtonianism, in the form of more or less elegantly constructed demonstration apparatus, sets of pulleys, inclined planes, and the like. Perhaps the oldest set preserved is that made by the Musschenbroek family, in Leiden. The mechanical clock, displayed to show its works, can be seen in many places, notably in the well-kept Huygens room at Leiden, where one finds some of Huygen's original timepieces and replicas of others. At Greenwich (at the National Maritime Museum), the four chronometers of John Harrison tick again, and the Kassel Landesmuseum boasts a clock by Joost Bürgi.

Most of the older museums are relatively small and fail, understandably, to maintain the richness of their collections far into the 19th century. That century saw the rise of national museums of science, notably in France and England, where an attempt was made not only to continue the preservation of scientific and technological relics but to provide a home for such of the earlier materials as were in danger of being lost. The national museums have grown to a size discouraging to the visitor with limited time. This disadvantage, however, is merely a reflection of the corresponding expansion of science itself. Today most of these museums are engaged in programs of renovation in an effort to differentiate the reference collections of interest chiefly to the specialist from the halls designed to appeal to the general visitor.

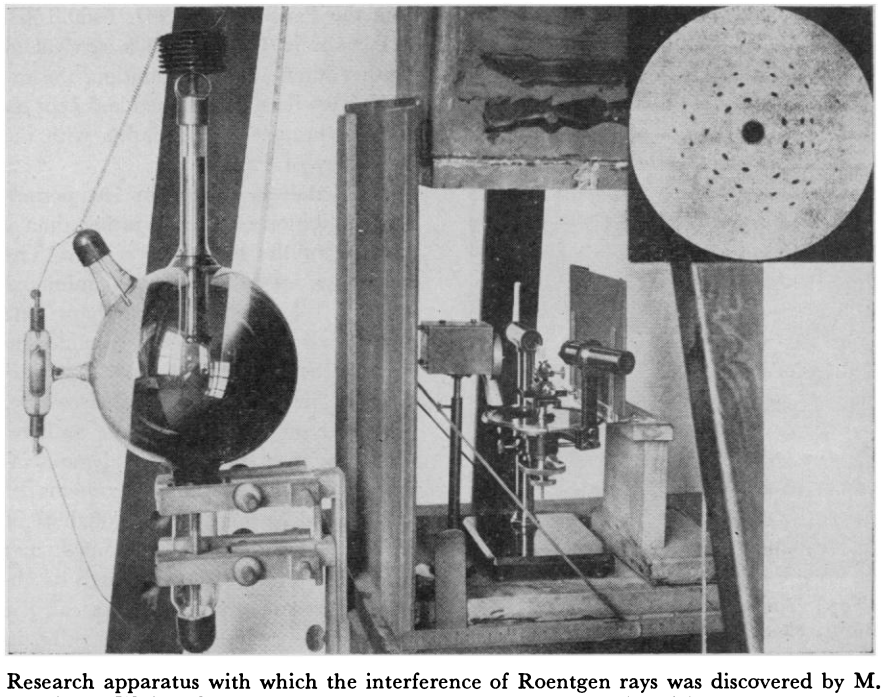
In addition to the museum in Florence, I visited a number of the other museums in Europe in the course of the tour upon which this article is based (*3*).

Paris: Conservatoire National des Arts et Métiers

The Conservatoire National des Arts et Métiers was created in 1794, by order of the National Convention, as a school for study of the applied arts and sciences. A collection of machines was assembled, notably those used by Jacques de Vaucanson (who died in 1782) for the training of workmen. Its existence as a significant science museum dates from 1814, when great quantities of scientific relics were received. Through the 19th century, apparatus was steadily added, much of it through the initiative of some of the great personalities of French science. From time to time other outstanding collections were acquired, such as that of the Académie des Sciences, in 1866. Since 1799 the Conservatoire has occupied the 11th-century



Alchemical laboratory of the 16th century. Full-sized reconstruction in the Deutsches Museum, Munich. [Courtesy of the Deutsches Museum]



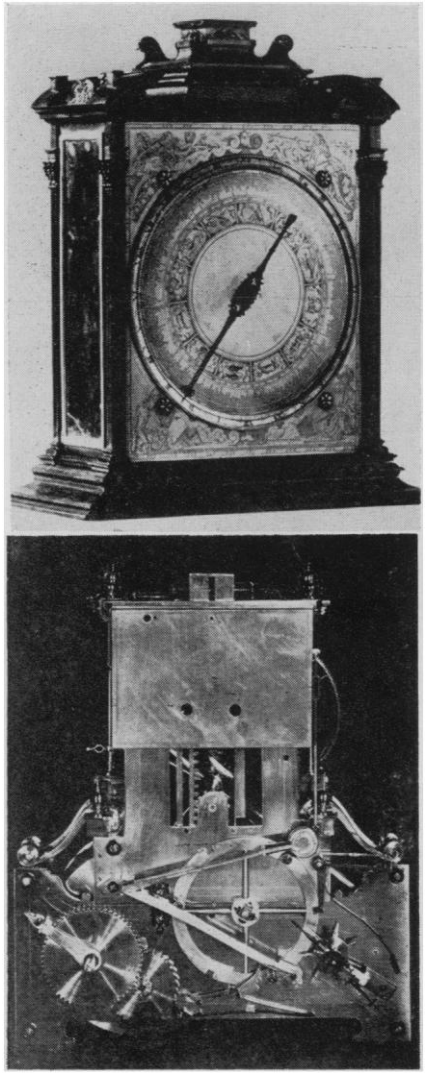
Research apparatus with which the interference of Roentgen rays was discovered by M. von Laue, W. Friedrich, and P. Knipping, in 1912. (Left) tube; (right) spectrograph; (inset) Laue diagram of zinc blende. [Courtesy of the Deutsches Museum, Munich]

Benedictine priory in Saint-Martin-des-Champs. Its quaint halls have long since suffered the overcrowding which tends to convert a museum into a warehouse, and today even the historian of science is likely to feel the onset of museum fatigue as he peers down its long corridors of massed cases. The critic would do well, however, to remind himself that here, more than anywhere else, have the *sine qua non* of a museum of science, the materials themselves, been preserved. The mute testimony of this museum speaks more emphatically of the seriousness with which science has been cultivated in France than many a eulogistic literary account of *la science française*.

The scientific collection is rich for the end of the 18th century, especially in the odds and ends of scientific work; in the field of optics, for example, the catalog lists 68 mirrors, prisms, and lenses received in the initial collection of 1814, not counting those which are parts of instruments. If it can be assumed that most of these represent the 18th century (the catalog is unfortunately of no assistance here), it would appear that this museum constitutes the richest source of working—as opposed to decorative—apparatus from that century.

Although associated from its origin with a school, this is fundamentally a study collection for specialists. The use of scientific exhibits for teaching, which has been initiated in the museums of Germany, Austria, and Sweden, has been undertaken in France through the establishment of a separate museum, the Palais de la Découverte.

Among the more spectacular items in the scientific collections are the highly decorative apparatus of Abbé Nollet, comprising one of the most interesting examples of the scientific cabinets esteemed by the wealthy 18th-century amateurs of science, and, scarcely less ornamental, the original apparatus of Lavoisier. Less decorative but no less interesting are the original refrigeration apparatus of Carré and Cailletet's apparatus for the liquefaction of gases.



(Top) An observatory clock of Joost Bürgi, about 1590; (bottom) rear view of the same clock, with the case removed. [Courtesy of the Hessisches Landesmuseum, Kassel]

Paris: Palais de la Découverte

The Palais de la Découverte had its origin in the scientific exhibits shown in connection with an international exposition, the Paris fair of 1937. Established in the Grand Palais, itself a survival of another international exposition, the exhibits have been maintained and kept up to date through an association with the University of Paris.

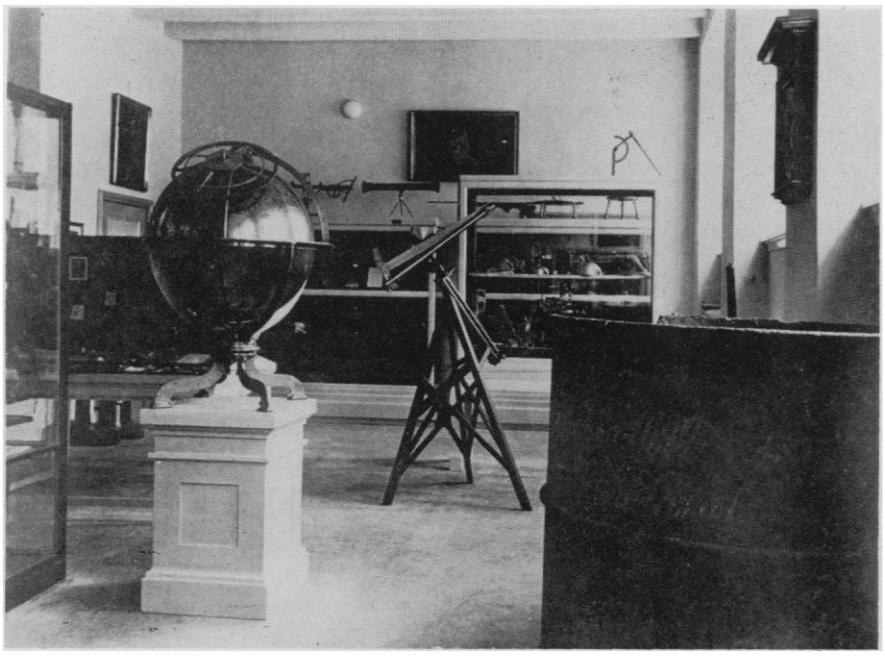
The Palais is a more or less permanent exhibition of science rather than a museum of the history of science. The conception of setting up an animated textbook of science—or perhaps one should call it a laboratory extended in space rather than time—has been carried out in varying degrees elsewhere, but never on so grand a scale as here, where one may see animated demonstrations not only of the experiments of Galileo and Newton but also of those of de Broglie (undulatory mechanics) and Langevin (ultrasound). Although its objectives are not primarily historical, the Palais has encountered the necessity, in the arrangement of such exhibits, of bringing in the historical background, and some of the exhibits are highly historical in character. Little effort, however, is made to emphasize historic apparatus.

So comprehensive a display requires a vast allotment of space, and the Palais is vast, although it occupies but a minor portion of the Grand Palais. It also requires curatorship of a highly specialized character, and this it is able to obtain by virtue of the relationship existing with the University of Paris. One may surmise that the feasibility of maintaining such an exposition depends upon its location in a great metropolis near the geographical center of the country.

London: Science Museum

Following the Great Exhibition of 1850, a proposal was made by the Prince Consort for the establishment of a museum of science. The consequent plans were implemented in 1857 through the establishmnt of the South Kensington (after 1899, the Victoria and Albert) Museum, wherein were exhibited, among a great many other things, collections illustrating foods, animal products, building materials, and educational apparatus. The Science Museum in its present form originated in the famous 1876 Special Loan Exhibition of scientific apparatus, much of which was subsequently acquired by the museum. Fortunately, historic apparatus and machinery had been sufficiently esteemed in England to make possible the assembly of an extraordinarily complete series illustrating the development of the sciences and technical arts; this collection has occupied independent quarters, under the name of the Science Museum, since 1909.

In 18th-century materials this museum appears to be less rich than the Conservatoire in Paris. Through successive enlargements of its quarters, however, the Science Museum has succeeded to a degree not equaled elsewhere in encompassing the 19th century. Only here can the student of technology in its ebullient adolescence expect to find a sufficient representation of the successive development of machines to serve as an adequate record of that prolific century. Science is nearly as well covered, although its relatively less materialistic character is reflected in the collections. The most comprehesive group of instruments is the "King George III" collection, so-called because of its connection



A portion of the Astronomisch-Physikalische Kabinett of the Hessisches Landesmuseum, Kassel. Shown are (left to right) a celestial globe of Joost Bürgi (1585), an astronomical sector of John Dolland, and the steam-engine cylinder attributed to Denis Papin. [Courtesy of the Landesmuseum]

with that monarch. The collection comprises over 300 instruments, the principal part of which was assembled from 1740 to 1768 by Demainbray, a tutor to the royal family. Many of the instruments are designed to demonstrate Newtonian philosophy as expounded in Desaguliers' *Experimental Philosophy*—in fact, some of them may have been built by Desaguliers himself. George Adams is, however, the principal constructor represented. Notable among the later materials are original apparatus of Ramsden and other founders of scientific surveys; apparatus of Graham, Ramsay, and other British chemists; and electrical materials from researches of the later 19th century. By no means all of the historic scientific apparatus in London has gravitated to the Science Museum. Hawksbee's vacuum pump and Newton's reflecting telescope are in the library of the Royal Society, and a considerable number of relics of the scientific work of the luminaries of the Royal Institution (such as Rumford, Davy, Faraday, Tyndall, and Dewar) are on display in that venerable institution. A very handsome display of instruments is also to be found in the Navigation Room of the National Maritime Museum, Greenwich.

As it has to all technical museums, the 20th century has presented a formidable challenge to the ingenuity of the staff of the Science Museum. The vast sequences of instruments and machines which have long been the resort of the student of technological development are in danger of termination through lack of space. Whereas most of the earlier materials are original, the machines of today are often represented by models or demonstration exhibits. A new wing is under construction, but the new exhibits are, out of sheer necessity, forced into a pattern similar to that introduced in Munich and Vienna, in which the history of a science or art is ancillary to an exposition of principles, or at best is presented in its main lines, at the expense of the subtleties which the specialist seeks for further elucidation of a story he already knows.

Oxford: Museum of the History of Science

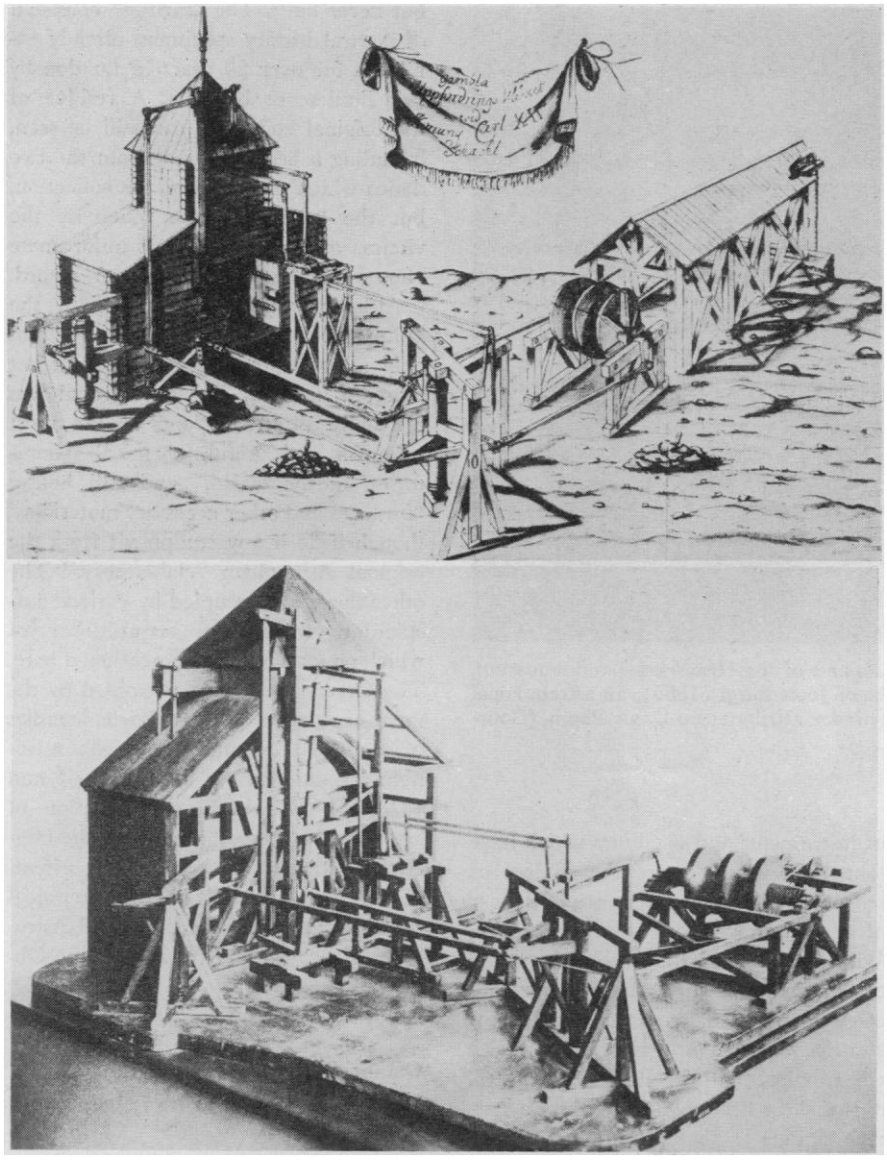
Possibly the most impressive single collection of antique scientific instruments, the Museum of the History of Science, in Oxford, had its genesis in the bequest to Oxford of the collections of Elias Ashmole. "Mr. Ashmole's Rarities" were put on exhibition in 1683 in the present building, adjacent to Wren's Sheldonian Theatre, a building which is supposed to have been influenced in design by the College of Science planned, by Wren, for construction in London, but never built. The "rarities" consisted of natural history specimens already exhibited for over 20 years in London by the Tradescant brothers. A residue of the original collection can still be seen, including a head and foot from the two dodos which once graced the collection, but the "rarities" were otherwise the victims of one of the most unfortunate "house-cleaning" operations on record.

Although originally a museum, the building has had a varied career and only assumed the form of the present museum in 1949. The lower room was originally fitted as "one of the most beautiful and useful [chemical laboratories] in the world," and still houses "furnaces and other necessary materials," though little if any equipment from the original Ashmolean "elaboratory." The other floors are occupied by various outstanding subsequent acquisitions, of which only a few can be mentioned here. The Orrery collection, assembled by the great-nephew of Robert Boyle, consists of about 20 instruments, chiefly astronomical, dating from between 1658 and 1710. The Lewis Evans collection of astrolabes and sundials contains the largest collection of the former ever assembled in one museum. Other astronomical collections derive from the Royal Astronomical Society and from Radcliffe Observatory.

Cambridge: Whipple Museum; Museum of the Cavendish Laboratory

The Whipple Museum of the History of Science, in Cambridge, was organized in 1949, on the basis of a sumptuous collection of instruments assembled by Robert Whipple of the Cambridge Instrument Company between 1919 and the date of its presentation to the University of Cambridge. Especially noteworthy in this impressive exemplification of the possibilities which existed so recently in scientific-instrument collecting are an 8-inch reflecting telescope made by William Herschel about 1800 and two refractors made by Christopher Cock, the maker of Hooke's microscope. There is also an original Cock microscope, part of a large and continuous series of microscopes dating from 1650 to 1850. Interesting also is a set of geometric models, by George Adams, to illustrate Euclid's books xi and xii on solid geometry.

The number of instruments originating in Cambridge does not appear large



Christopher Polhem's ore conveyor, as used in the "Charles XII shaft," Falun, Sweden; drawing (top) by Samuel Sohlberg and model (bottom) in the Tekniska Museet, Stockholm. [Courtesy of the Tekniska Museet]

—perhaps a reflection of the newness of the museum. A most impressive showing of Cambridge instruments is, however, to be seen in the halls of the Cavendish Laboratory. Here are exhibited original equipment from Maxwell, Rayleigh, J. J. Thomson, C. T. R. Wilson, Lord Rutherford, and F. W. Aston, probably the most notable assemblage of relics of the history of modern physics to be found anywhere.

Vienna: Technisches Museum für Industrie und Gewerbe

The inclusion of both scientific and technological materials, which characterizes the national museums in Paris and London, despite the differences in their titles, is to be found to a lesser degree in the Vienna museum. More than any other museum, this one attempts to cover in its exhibits the entire range of technical subject matter, including fields, such as the technology of food production and processing, which are very sketchily touched upon elsewhere. The museum opened in 1918, after a natal period of 45 years, during which time various independent museums of railways, post and telegraph, and industrial hygiene came into being and were integrated into the plan for the Technisches Museum.

While the fundamental purpose of the museum appears to be the exposition of the principles of contemporary technology, reliance for the accomplishment of this has been placed upon the illustration of its historical development, and upon the use of operating and demonstration models. This would appear to have been the first museum to utilize visitor participation extensively. In the physical sciences the majority of the exhibits are demonstration experiments performed by guides at standard laboratory tables, the historical approach being utilized to a lesser degree than in Munich. The quantity of historical materials exhibited is also considerably less, a fact which is presumably attributable in part to the existence of two fine collections of antique instruments elsewhere in Vienna, the cabinets of the Kunstgewerbe and Kunsthistorisches museums.

Munich: Deutsches Museum

Founded in 1903, as a museum "to show the great influence of scientific research on technology and the historical development of the various industries," the Deutsches Museum of Munich recently celebrated its fiftieth anniversary, having survived World War I, which delayed its opening until 1925 (although portions of the collection had been exhibited much earlier in the Bavarian National Museum), and World War II, in which it suffered the destruction of most of its exhibit halls through bombing. On the credit side, it is perhaps worth mentioning, as noted in the anniversary publication, that World War II may have saved the museum from the increasing pressure of the Nazi party to divert its purposes to other ends (*4*).

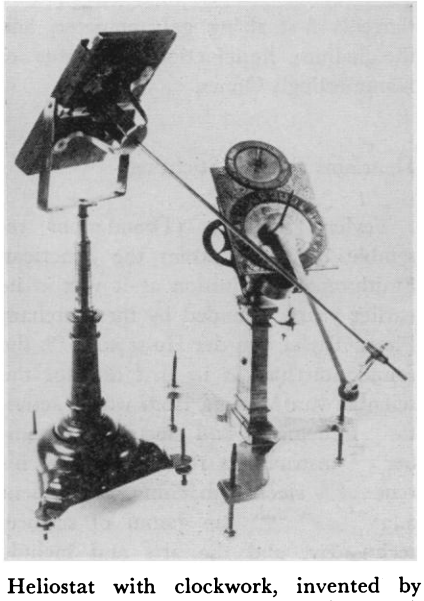
Like the Technisches Museum in Vienna, the Deutsches Museum was designed to instruct in the principles of science and technology as well as to show the history of science and technology. The latter museum has led in the art of the cleverly contrived push-button exhibit and, since the war, in the replacement of strictly utilitarian exhibits with elegant and sometimes spectacular displays which seek to exploit the beauty as well as the technical interest of the machine. This new concept of display, which was anticipated in the Stockholm Tekniska Museet, has had great influence on most of the other technical museums. On the debit side, it involves a reduction in the number of specimens on exhibit.

The hall of physics was very nearly the only one to survive the war intact, and it remains in its original condition, an interesting example of prewar museum technique in this otherwise new

museum. The hall of chemistry is new; halls of astronomy and geodesy are partly completed. The over-all reconstruction of the museum was about half completed in the spring of 1956.

The outstanding original scientific specimens in the museum are in the hall of physics. Here one can see von Guericke's air pump and the famous Magdeburg hemispheres, Ohm's static electric machine, Meyer's calorimeter, Hertz's resonators, the telegraphic apparatus of Soemmering and Steinheil, and von Laue's apparatus for x-ray interference. The great refractor built by Frauenhofer for the Pulkowa Observatory in 1838 may be seen in the astronomy section, and the work table of Otto Hahn in the section devoted to chemistry. Unlike the corresponding museums in London and Paris, the Deutsches Museum has many reproductions of apparatus, in part because it got off to a late start in collecting, but principally because any attempt to use historic apparatus systematically in an exhibit of the history and principles of science must inevitably involve finding some way to solve the problem of the nonavailability of all of the important objects which should be shown.

A feature of the exhibit of chemistry is a "family tree" of important chemists who were, directly or indirectly, associated with the laboratory of Liebig at Giessen. A visit to this laboratory, which is still preserved at Giessen in a convincing approximation of its original state, must be a high point of any chemist's tour of European museums. Nonchemists, too, should find it a worth-while experience, for, so far as I know, nowhere else is such a thoroughgoing attempt made to preserve the environment of the scientific laboratory of a century ago.



Heliostat with clockwork, invented by s'Gravesande and constructed by Jacob van der Cloese at Leiden. Height to mirror axis, 35 cm. [Courtesy of the Rijksmuseum voor de Geschiedenis der Natuurwetenschappen, Leiden]

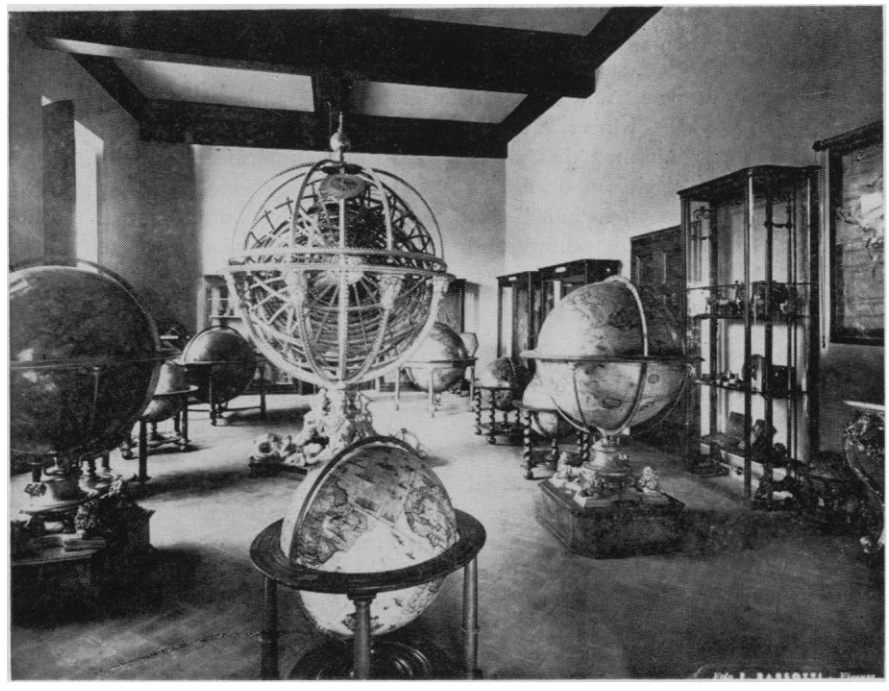


Exhibit of globes in the Museo di Storia della Scienza, Florence. The ornate armillary in the center was made by Antonio Santucci in 1588–93. [Courtesy of the Museo di Storia della Scienza]

The Giessen Museum comprises the famous teaching laboratory and amphitheatre, gross preparation rooms, library, and Liebeg's study, all well set out with apparatus. So great was Liebig's influence on the laboratory teaching of chemistry that his laboratory does not appear especially out of date when compared to many in our own colleges, at least of the period up to World War II.

Kassel: Hessisches Landesmuseum

The Astronomisch-Physikalische Kabinett in the Kassel Museum represents the longest continuous period of history of any large collection in Europe, having had its beginnings in the astronomical interest of Landgraf Wilhelm IV just after the middle of the 16th century. His observatory was visited by Brahe in 1575, and a portable quadrant which remains from that time may have been constructed after Brahe's advice. Another famous visitor, Joost Bürgi, was engaged as royal clockmaker in 1579 and has left several examples of his work. Other relics remain of the scientific interests of subsequent landgraves—interests which were not uniformly physicoastronomical—and from Johann Christian Breithaupt, 18th-century founder of the scientific instrument industry in Kassel. Most of the later materials shown are demonstration apparatus from the late 19th century, from the Kasseler Hohern Gewerbeschule, the academic home, at various times, of Wohler, Bunsen, and Kohlrausch. As most purely scientific collections contain a few odds and ends of "pure" technology, this contains an iron cylinder described, although not without some reservation, as the remains of a steam engine deriving from another notable visitor to Kassel, Denis Papin. If authentic, it is the oldest existing relic of the steam engine.

Kassel, one of the most ill-fated of German cities in the late war, has made a remarkable recovery, but the scope of the reconstruction task is stupendous, and only a portion of the above-mentioned collection was visible in 1956 in the reconstructed Landesmuseum. A few unspecified large items are said to have been destroyed during the war, but the bulk of the collection, and all of the most important items, seem to have survived.

Certain instruments were built in the Kassel workshops in the time of Wilhelm IV for the Kunstkammer of his fellow

monarch Kurfürst August I of Saxony (who died in 1586). These instruments and others, constituting one of the finest collections of this type, were exhibited before the war in the Zwinger Pavillion in Dresden. I am informed that all or some of them are again on display in Dresden. This collection included over sixty items from the 16th century and contained apparatus from Kircher, Schissler, and Leupold.

Stockholm: Tekniska Museet

Opened in 1938, after 14 years of planning and organization of financial support, the Tekniska Museet in Stockholm is in many ways the most remarkable of the national museums of science and technology, being largely, if not completely, privately supported and serving as a general repository for the archives of Swedish industries.

More nearly than in any other museum except for the Technisches Museum in Vienna, the exhibits here comprehend the entire range of technology. Emphasis is on modern technology in most of the topical exhibit halls, historical materials being chiefly shown in commemorative displays of various Swedish inventors, such as Polhem, De Laval, and Ericsson. Some of these halls are especially interesting from the point of view of exhibition technique, in the development of which this museum has been particularly active.

The Kungliga Modell-Kammaren, a collection of about 250 models of machines from the period circa 1700, is of special interest for the unique evidence it furnishes of the work of the engineer of that period. Most of the models derive from Christopher Polhem, Sweden's outstanding early mechanical genius.

The exhibits in physical science are largely instructional rather than historical in character (*5*). Outstanding among these is the "Atomarium," a hall devoted to operating exhibits and lecture demonstrations of atomic science.

Entrance to the hall in the Museo Nazionale della Scienza e della Tecnica, Milan, in which drawings and models illustrating the work of Leonardo da Vinci are exhibited. [Courtesy of the Museo Nazionale della Scienza e della Tecnica]

Leiden: Rijksmuseum

Leiden's Rijksmuseum voor de Geschiedenis der Natuurwetenschappen, founded in 1931 and given the status of a national museum in 1947, is one of the best known to historians of science through the excellent publications of its staff. Like the museums in Florence, Oxford, and Cambridge, it is particularly concerned with the history of science, and despite its relatively recent foundation, the Rijksmuseum has succeeded remarkably well in acquiring a really significant collection of historical materials.

The displays of the work of Huygens and of that of the Dutch microscopists are unusually well-conceived demonstrations of the possibilities of effective museum display of the history of science. Included here are original clocks, a telescope and lenses of Huygens, and an original Leeuwenhoek microscope. Also of special interest are the 'sGravesande-Musschenbroek apparatus for the demonstration of Newtonian physics and Leyden jars and a pyrometer from Petrus van Musschenbroek. The series of early air pumps at Leiden is probably the best to be seen anywhere. Certain instruments from important Dutch researches of modern times are also shown, such as the electromagnet used in the discovery of the Zeeman effect, Einthoven's first string galvanometer, and the helium liquefaction apparatus of Kammerlingh Onnes.

Haarlem: Teyler's Stichting

Teyler's Stichting (Foundation) resembles to some extent the American Smithsonian Institution as it was in its earlier years. Founded by the merchant Pieter Teyler van der Hulst in 1778, the foundation had as its first director the scientist van Marum, from whose activities in chemistry and electricity a number of instruments remain, notably his renowned electric machine. Subsequent acquisitions run the gamut of science, technology, and the arts and include many interesting items; the collection is somewhat lacking in systematic display but retains uniquely the atmosphere of the era which saw the genesis of the idea of the scientific institution.

Visitors to Haarlem, however peripheral their interest in technology, should not fail to visit the nearby museum of the Cruquis steam engine, near Heemstede. The museum is devoted to the history of land drainage in Holland, a story which it tells very well. It is built around a most remarkable Cornish steam engine, in which a high-pressure cylinder is located within, and concentric to, a low-pressure cylinder, the whole operating a series of eight rocking-beams which operate eight pumps arranged equidistantly around the circumference —truly a chef d'oeuvre of 19th century technology!

Milan: Museo Nazionale della Scienza e della Tecnica

The National Museum of Science and Technology of Italy is Western Europe's newest museum in this field, having been established in 1949 in the Monastery of San Vittore, Milan (*6*). The monastery, which was left in a ruinous condition by bombardment in World War II, has been elegantly reconstructed; the general form and some of the details of a monastery have been preserved, but the severely simple style of interior decoration characteristic of postwar Italy has been adopted. In its organization the museum follows a unique concept, the exhibition of the work of Leonardo da Vinci in the multifarious fields cultivated by him being taken as a point of departure for display of the subsequent development of the various sciences and technologies.

The difficulty of outfitting a technical museum at this late date is, understandably, reflected here. Not only is the establishment of exhibits a time-consuming process but the collection of suitable specimens is a matter of great difficulty. In the field of physical science, however, the museum has been most fortunate in acquiring a large number of instruments from the scientific collections of the University of Padua, many going back to the 18th century. Reproductions have also been made of a number of the instruments in the museum at Florence.

In the spring of 1956 these exhibits were in process of being installed, and were not on public exhibition. The most spectacular exhibit on public view consisted of finely made models constructed after the drawings of Leonardo. These models are beautifully shown in what must be one of the longest single halls in any museum. This museum will be spectacular indeed if that standard of exhibition is maintained.

Notes

1. Another of von Guericke's air pumps is reportedly at Lund, Sweden (see *5*).
2. Other Leeuwenhoek instruments are in Munich, Jena, Utrecht, Antwerp, and Paris. See P. van der Star, *Descriptive Catalogue of the Simple Microscopes* (Leiden, Netherlands, 1953), p. 24.
3. This tour was made in the spring of 1956 and covered all of the larger and most of the smaller museums of science and technology in Western Europe, with the exception of those devoted to particular sciences or technologies, such as medicine and pharmacy, horology, communications, transportation, and marine. Emphasis in this article is placed upon the scientific materials in the museums visited.
4. *Fünfzig Jahre Deutsches Museum* (Deutsches Museum, Munich, 1953), p. 16.
5. The principal collection of early scientific instruments in Sweden is that of Triewald, now at the University of Lund. Martin Triewald spent the years 1716–26 in England, returning to Sweden in the latter year to introduce the steam engine to that country. While in England he made the acquaintance of Newton, Desaguliers, and others, and assembled the collection of "philosophical apparatus" which is now at Lund. An original von Guericke air pump is also in the collection. See J. G. Tandberg, "Die triewaldsche sammlung . . .," *Lunds Univ. Arsskr.* 9 (1920).
6. A predecessor existed in Turin as early as 1862 but had been relatively inactive in the 20th century and suffered the loss of most of its remaining collections in World War II.

Arda Alden Green, Protein Chemist

Arda Alden Green had a remarkable record of achievement in biochemistry. This record was only recently recognized by the American Chemical Society, which, at its September 1957 meeting in New York City, announced that she would be the next recipient of the Garvan Medal, the highest honor accorded for achievement in chemistry by an American woman. The citation for this award, which was presented posthumously at the April 1958 meeting of the society in San Francisco, reads as follows: ". . . for her many contributions in the field of protein isolation and characterization, including her classical studies on hemoglobin, the plasma proteins, the muscle enzymes and the enzymes responsible for bioluminescence."

Arda Green was born in Prospect, Pennsylvania, on 7 May 1899. She obtained her A.B. degree in 1921 at the University of California in Berkeley, where she received highest honors in chemistry and honors in philosophy. After one year of graduate study in philosophy, she decided to study medicine. During her first two years of medical studies at Berkeley, she became acquainted with Herbert M. Evans, who recognized her potentialities and encouraged her to interrupt her medical studies in order to spend a year in research at Harvard University Medical School, in the laboratory of Edwin J. Cohn. Evans was instrumental in obtaining for her the Leconte memorial fellowship of the University of California, which she held during the year 1924–25.

She spent the following two years at Johns Hopkins University, where she completed her medical studies and obtained the M.D. degree in 1927. While a medical student there, she became acquainted with Leonor Michaelis, then a biochemist in the department of medicine, and did some research in collaboration with him and A. A. Weech on the conductivity of electrolytes within membranes, a study which became the subject of her first publication.

She then returned to Cohn's laboratory at Harvard as a National Research Council fellow in medicine for the period 1927–29. During this period she completed her classical studies on the equilibrium between oxygen and hemoglobin and its relation to changing hydrogen ion activity. These studies, carried out in collaboration with Ronald M. Ferry, had been initiated in 1924 during the tenure of her Leconte memorial fellowship. They served as the