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 basis for some of Pauling's views on the structure of hemoglobin.

During the next 12 years, 1929 to 1941, she remained at the Harvard Medical School, for the first five years as a research fellow in the laboratories of Cohn and L. J. Henderson, and for the next seven years as a research associate in pediatrics with C. F. McKhann. During all of this period she maintained a close association with the members of the Cohn laboratory and played an important role in the development by that group of its elegant methods for the isolation of the blood proteins. Of particular importance were her remarkably thorough studies of the solubility of hemoglobin under varying conditions of ionic strength and hydrogen ion activity. These studies, published in 1931 and 1932, remain today the best model for investigations of this kind and provided the basis at that time for the development of rational methods for fractionation of the plasma proteins by the Cohn group.

In the period 1933 to 1937 she published other fundamental studies on hemoglobin, dealing with its combination with carbon dioxide, its combination with carbon monoxide, and its amphoteric properties. During her period of collaboration with McKhann, she investigated the immunological application of human placental extracts for the prevention of measles and worked out fractionation procedures for the globulins of normal and immune sera. Her final publication in this period concerned the equilibrium between calcium and purified globulins and was carried out in collaboration with Nancy Drinker and A. Baird Hastings.

During this highly productive 12-year period of research activity she served, in addition, as tutor in biochemical sciences at Radcliffe College. In this type of teaching she was extremely effective, by virtue of her great sensitivity to the individual problems of her students as well as the beautiful clarity and incisiveness of her reasoning. During this period she exerted great influence in directing some of the women who were her students into productive careers in medical research.

The next important phase of her career was in the laboratory of Carl and Gerty Cori at Washington University (St. Louis) during the period 1941 to 1945, when she served as research associate in pharmacology. During the period 1942 to 1945 she also served on the faculty as assistant professor of biological chemistry. Here she was instrumental in introducing sound methods for the purification and characterization of the muscle proteins. Early in this period she developed the method for the isolation of the crystalline enzyme phosphorylase, thereby facilitating the elegant studies of Cori and Cori on the mechanism of polysaccharide synthesis, for which they received the Nobel Prize in 1946. It is noteworthy that she developed this method in the short space of ten weeks, after three other investigators in the same laboratory had devoted three fruitless years to the same problem. During this period she also collaborated with G. T. Cori and John F. Taylor in the crystallization of rabbit muscle aldolase. Her presence in the Cori laboratory at this particular time had a tremendous influence on the development of enzymology in this country, since many of the investigators who studied in that laboratory then or subsequently (Ochoa, Kalckar, Leloir, Kornberg, Najjar, and others) learned directly or indirectly from her the importance of enzyme purification in the elucidation of enzyme mechanisms.

She then joined the laboratory of Irvine Page at the Cleveland Clinic, where she served as a staff member in the research division from 1945 to 1953. Here her attention was drawn to the presence in serum of a vasoconstrictor substance, which she isolated and characterized in collaboration with Page and M. M. Rapport, in 1948. This substance, which they named serotonin and which was later identified by Rapport as 5-hydroxytryptamine, is, of course, recognized today to be of great importance as a regulator of the activity of the central nervous system. This accomplishment, which sparked what Woolley has termed "the revolution in pharmacology," illustrates that Arda Green's laboratory talents were not limited to the isolation of proteins.

While in the same laboratory she was concerned for several years with the purification of proteins believed to be involved in renal hypertension. She succeeded, in collaboration with F. M. Bumpus, in the extensive purification of renin substrate (hypertensinogin) from serum and of angiotonin (hypertensin), the pressor polypeptide which is released from hypertensinogin by the action of the kidney enzyme renin. She also worked hard but unsuccessfully on the isolation of the latter enzyme. In the course of this work, several unidentified crystalline proteins were obtained from hog kidney. The methods for obtaining these crystalline proteins have, unfortunately, remained unpublished.

In 1953 she joined W. D. McElroy at the McCollum-Pratt Institute of Johns Hopkins University, where she began her work on the purification of enzymes involved in bioluminescence. Her outstanding achievement in this area, announced in April 1956, was the successful crystallization of the enzyme luciferase from firefly lanterns. This work led to the elucidation of the role of adenosinetriphosphate, luciferin, and coenzyme A in light emission. The discovery of an adenyl-luciferin intermediate in the reaction established the basic similarity between the firefly enzyme reaction and the universally occurring enzyme reactions for the activation of acetate and amino acids.

Her last laboratory project was the purification of the enzyme responsible for bacterial luminescence. She had succeeded in purifying the enzyme extensively and had described its properties in 1955. However, she continued with her usual tenacity toward her goal of isolation of the protein in crystalline form, and no one can doubt that she would have had her usual success if time had not run out.

In addition to her research duties in the McCollum-Pratt Institute, she played an important role in the training of graduate students. This was due not only to her authoritative lectures on the proteins but, even more, to the warm personal relationship which she established with the students, who recognized her as a friend to whom they could bring both scientific and personal problems.

During this last phase of her career she served also as a consultant in biochemistry to the department of pediatrics of the Sinai Hospital. Here she exerted an important influence in guiding clinical research along sound biochemical lines.

Arda Green did not always receive the recognition which she deserved, partly because she always worked in the shadow of men of great scientific reputation. The uniformly high quality of her research over the years makes it clear that she had a unique talent which was responsible for her success in the isolation of pure proteins. Her success in this field was in part due to her conviction that the purification of proteins was a sufficiently important goal in itself to deserve a life-time of concerted effort. More important was her ability to consider problems of protein purification in a logical manner—an ability based on her broad knowledge of their physicochemical properties. Many have attributed her success in crystallizing proteins to her "magic touch." Some even suggested to her that her secret lay in some mysterious seeding effect of the ash falling from the cigarette which never left her mouth when she was working. She enjoyed these jibes, but she felt very strongly that protein purification should be divorced from the mystery which is usually associated with it. She felt that it should be based, rather, on the application of "horse sense," an attribute which she admired in others and with which she herself was endowed to a remarkable degree.

Arda Green lived a full life outside of the laboratory. With the same vigor, enthusiasm, and thoroughness with which she attacked her laboratory problems, she devoted herself at home to cooking, dressmaking, music, and entertaining. It was she who always saw to it that no unattached members of the laboratory staff ever went unfed on Thanksgiving Day. Her genuine concern for others and her deep devotion to her family always showed itself not just in words but in practical, helpful gestures. Even during the crippling illness which marred the last year of her life she continued to devote herself to doing things for her family and friends, almost to the day of her death, on 22 January 1958.

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News of Science

Final Form of Congressional Action on Federal Aid to Education

Pursuing a course of action formally initiated by the President last January, the House of Representatives and the Senate have passed legislation which gives federal aid to the educational effort of the country. The two houses, working in a preadjournment flurry of activity, accepted separately two differing measures. These were reconciled in a conference meeting of the relevant House and Senate committees, and the final form of the legislation has now been elaborated.

Earlier House Action

On 8 August the House of Representatives, after lengthy and occasionally raucous debate, passed HR 13247, the National Defense Education Act, but not before the scholarship provision, one of the major elements of the bill, was eliminated. No funds, however, were subtracted from the bill. Rather, on a motion offered by Representative Walter H. Judd, (R-Minn.), those funds originally alloted for the scholarship provision were shifted to increase substantially the student loan fund provided for under title 3 of the bill. The effect, in short, was this: while federal expenditure for aid to education was to be at the same level as was called for by the original provisions, the money was to go out to students in the form of a loan, to be repaid after graduation, rather than in the form of a grant of money. This form, loan with repayment after graduation, is one currently in use by many colleges and universities.

Title 3 of the original bill—loans to students in institutes of higher education—read in part as follows: "For the purpose of enabling the Commissioner [of Education] to stimulate and assist in the establishment at institutes of higher education of funds for the making of low interest loans to students in need thereof to pursue their courses of study in such institutions, there are hereby authorized to be appropriated $40 million for the fiscal year ending 30 June 1959, $60 million for each of the three succeeding fiscal years, . . ." As passed by the House, title 3 called for an additional $20 million to augment each of the original appropriations, for a total basic loan fund of $300 million.

Earlier Senate Action

The Senate, ending debate on its form of the education bill at 12:05 A.M. on the morning of 14 August, passed a bill which retained, on a diminished scale, the scholarship program. By its approval of an amendment offered by Senator Cooper of Kentucky, the Senate reduced the cost of the program from $17.5 million to $5 million, by reducing the grants to individual students from $1000 a year to $250 a year. The 4-year program would have benefited about 23,000 students a year.

Reconciliation

On 21 August a compromise between the House and Senate measures was worked out in conference. This compromise constitutes the final form of federal aid to education legislation. It calls for a 4-year, $887,400,000 program with no scholarship provision. Aid to individual students would come from a loan fund of $295 million over a 4-year period. The fund is to be administered by the institution of higher learning at which the student studies, rather than by a state board as the Senate bill had stipulated.

In addition to the loan fund, the compromise bill calls for $300 million, to be matched by the states, for the purpose of helping schools, public and private, to purchase equipment for the teaching of scientific subjects.

The bill also authorizes funds for the following: institutes for teachers to learn educational counseling; centers for training foreign-language teachers; fellowships, including allowances for dependents of recipients; guidance, counseling, and testing for precollege students by the states; centers for teaching little-known modern languages; research and experimentation on better educational use of television, radio, and audiovisual aids; vocational education in skilled trades necessary for defense; and improvement of state educational statistics.

Both Senator Hill and Representative Elliot, the sponsors of the bills in the two houses, expressed some degree of satisfaction with the result of the compromise. But Senator Hill and Senator Smith of New Jersey deplored the loss of the scholarship provision and the corollary defeat of the attempt to give national recognition to intellectual achievement by means of it.

Merit or Need

Earlier forms of this legislation had reflected a variety of attitudes toward the question of the proper basis for awarding aid to the individual student.