(2) The occurrence of dental caries is not determined by the structural quality of the tooth nor by the degree of cleanliness of the mouth.

(3) Dental caries is definitely favored by certain phases of civilized life.

(4) Dental caries is related to certain constitutional states of the individual, such as inherited characteristics, age and bodily health.

(5) A small percentage of people are hereditarily immune to *B. acidophilus* and by the inhibition of the growth of this organism in the mouth are thereby protected from dental caries, irrespective of all other considerations.

To this list may also be added the fact that certain dietary programs appear to be inhibitive of dental caries. The manner in which diet exerts a controlling influence on the disease; whether it is through the determination of the character of the local food residues in the mouth or through the production of metabolic states which determine the activity of the aciduric organisms in the mouth is not known. Nor, indeed, has it been determined precisely what types of diets are most beneficial in this regard.

At the present time the greatest promise for the ultimate solution of the problem seems to lie in the study of the chemistry of the saliva and its immunologic reactions against the organism of dental caries, and in a further study of diet in its relation to dental disease. To this end it is highly desirable that group studies be made in which the allied sciences, chemistry, nutrition, bacteriology and dentistry may be correlated in a truly scientific attack on this very difficult and important problem in human welfare. It is only by studies of this broad nature that any adequate concept of the nature of this disease or the means of its prevention may be attained.

# THE ENGINEERING FOUNDATION

By ALFRED D. FLINN
DIRECTOR

## OBJECTIVES AND POLICIES

THERE are basic laws of nature in the field of ethics that are as certain in operation as the natural laws in the field of physics. Engineers are as vitally concerned with economics, which lies partly in each of the fields of ethics, engineering and finance, as with mechanics, in the field of physics.

The Engineering Foundation devotes its resources, therefore, to human as well as technical aspects of engineering problems of wide interest. It promotes research and other activities having as main objectives "the furtherance of research in science and engineering and the advancement in any other manner of the Profession of Engineering and the good of mankind," in the language of its deed of gift.

The foundation's aid to the advancement of the profession extends to activities aimed at better understanding and application of natural laws fundamental to both physics and ethics. Hitherto emphasis has been on technical research, although humanic subjects have received attention, too. Such appeared to be the preponderance of need in our country's development until recent years—or rather that was the need of which engineers and industrialists were most conscious. Within a few years the consciousness of need has shifted, and consequently the emphasis in the foundation's program may advisedly be shifted correspondingly.

Leadership, cooperation and effectiveness are keynotes in the foundation's policies. They are personal traits of its founder, Ambrose Swasey, of Cleveland, Ohio.

## ORGANIZATION AND ADMINISTRATION

The founder is one of the surviving organizers of The American Society of Mechanical Engineers. For several years he considered how best to make a gift to assist his fellow engineers, through his own society or some other organization, in working out problems for which no means had then been provided. After consulting friends competent to advise, he anonymously proffered a gift in May, 1914, to the United Engineering Society, now known as United Engineering Trustees, Inc. This corporation was created in 1904 under a special act of the New York legislature by the three national societies of mining, mechanical and electrical engineers to hold and administer for them jointly real estate and funds, "to advance the engineering arts and sciences in all their branches, and to maintain a free public engineering library." The American Society of Civil Engineers became a member of this group in 1916. Since the tenth of August of that year there have been four founder societies.

Mr. Swasey's conception was unique. He committed his gift not to a self-perpetuating board, but to a group of national engineering societies. He avoided the inclusion of any personal name in the name of the foundation. He did not wait until the end of his life. He gave while he could enjoy the satisfaction of seeing his money at work. He added to his first

gift others in 1918, 1920 and 1931, bringing his total to three quarters of a million dollars. He intended his gifts to be the nucleus of a large endowment, to which many other persons would contribute as years passed.

By the terms of the deeds or letters of all gifts for endowment the principal is committed to United Engineering Trustees, Inc., for safe keeping and administration, but the net incomes of the funds created by the gifts are controlled and administered by the foundation board. The board of trustees has twelve members, three appointed by each of the so-called founder societies, namely, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers and American Institute of Electrical Engineers, having together a membership of more than 60,000. The foundation board has sixteen members, of whom thirteen are representatives of the societies named and three are members-at-large. Members of the foundation board and the trustees are appointed for terms of three years with eligibility for reelection. The legal status of the foundation board is that of a committee or department of the corporation, United Engineering Trustees, Inc. Contributions of money, services or materials for current use may be made to The Engineering Foundation directly. The foundation board has discretionary power in the disposition of moneys and other contributions received by it from the board of trustees or from other sources.

The Engineering Foundation provides for combining the gifts of many persons under one management, for common or diverse purposes, in perpetuity or for limited periods, as may be stipulated by donors. Thus it is a "community trust" for a community delimited by common interests, those of the profession of engineering, instead of geographical boundaries. In the form of organization of the foundation hence inheres the following advantages: Conservation of resources by continuity of service of experienced trustees and advisers; prevention of such obsolescence of funds as has often occurred through attempts of donors to foresee far ahead in an evolving world; avoidance of restraint of action of future generations; advantages of doing things on a larger scale; wisdom in use of resources through advice of the well-informed; continuance of activities under unified direction to useful ends; breadth of purpose and of benefit.

## RESOURCES

The foundation's endowment has increased from $200,000 in 1915 to $880,000 in 1933 and the income thus provided from $5,000 to $40,000, the total for 18 years being $459,000. Expenditures from this income totaled $449,600, and $187,000 in money contributed for current activities passed through its treasury. In addition, contributions of money, services and materials were made by organizations and individuals cooperating in activities which the foundation aided. Of these contributions no accounting was feasible, but they have been roughly estimated as having a value of $2,000,000. The total money measurement of the cost of activities in which the foundation participated may thus be put at more than two and a half million dollars. But money units can not measure the true value of the benefits to the community of even those projects in which substantial sums were involved, and much less of the innumerable incidental services in which the expenditures were negligible.

For administration of endowment the cost per annum has averaged less than 0.2 per cent. of the principal, or 3.6 per cent. of the gross income, in recent years, including investment advice, custody of securities, accounting and audits by certified public accountants annually. The foundation's funds are exempt from New York and federal taxation. Contributions to the foundation are deductible from the contributor's total income for the year in computation of federal and some state income taxes, up to 15 per cent. of the contributor's net income.

Legacies totaling approximately a half million dollars are definitely known to be destined for the foundation in due course.

Besides money, the resources of the foundation comprise the special abilities of members of engineering societies and their willingness to serve on committees and as advisers; the organizations and the union of its founder societies; the good-will of other technical societies and of scientific associations; the cooperation of many universities, of other institutions and of governmental bureaus; the financial and other support of numerous industrial companies and of some trade associations; and its own accumulating experience.

## EXAMPLES OF ACTIVITIES

What the foundation has been doing, as an instrumentality of its founder societies, since the first meeting of its board in April, 1915, in addition to developing plans and policies in a unique sphere of activity, can be shown by examples of "work done."

World war developments in their early stages brought to American scientists and engineers a realization of the importance of the advancement and application of all the sciences. The National Academy of Sciences took steps at its spring meeting in 1916 toward organizing for services to our country in war and in peace a body whose membership should embrace representatives of many sciences and arts. National engineering societies promptly cooperated in creating the National Research Council. Money was lacking with which to begin action. The Engineering

Foundation met this emergency and thus assured the establishment of the council. This was the foundation's first notable undertaking. It has continued to the present time its relationships with the council. Articles in the issues of SCIENCE for April 14, May 26, June 9 and 30, July 14, August 4 and 25 and September 8, 1933, have informed its readers comprehensively on the National Research Council. These articles supply a basis for estimating the value of this first undertaking.

The founder societies in 1919 cooperated with the National Research Council in establishing its division of engineering in the after-war reorganization. Some members of this division always are also members of the foundation board. The foundation has provided offices for the division in Engineering Societies Building, New York, since May 1, 1919, and has cooperated with the council in a number of research projects, including organization of Advisory Board on Highway Research, American Bureau of Welding and Personnel Research Federation; fatigue (endurance) of metals, marine piling, molding sands for foundries, pulverizing of ores, cements and fuels, heat transfer and electrical insulation; also compiling a directory of research laboratories in the industries of the United States.

For spreading understanding and appreciation of science, invention, engineering and their applications the foundation published *Research Narratives* from January, 1921, to December, 1932. These tiny leaflets contained very short stories of interesting achievements, contributed by eminent scientists, inventors and engineers from their personal experiences.

Betterment of engineering education has been promoted through assistance to the Society for the Promotion of Engineering Education in investigations of institutions, methods and needs, and its summer schools for engineering teachers. Through the education research committee, representing six national engineering societies and the foundation, there was produced in November, 1932, a booklet entitled "Engineering: a Career—a Culture, a Message to Young Men, to Parents and Teachers." It is spreading all over the country and has received encouraging endorsement for its practical usefulness.

An adventure in adult education January to June, 1933, achieved a good measure of success. Ten "Courses for Disengaged Engineers" were given without charge in Engineering Societies Building on technical, financial and personnel subjects, under the auspices of the foundation, as a part of the services of its founder societies to their members and other engineers suffering from the business depression. Columbia and New York Universities, the Polytechnic Institute of Brooklyn, the Stevens Institute of Technology, the College of the City of New York, the Personnel Research Federation, a committee of the disengaged engineers, numerous companies and many individuals provided the instruction, administration and other services gratuitously. Incidental expenses were provided by the professional engineers' committee on unemployment and private subscriptions. Leaders in industry, engineering and education gave their public endorsement.

More than 600 engineers registered in the classes. Attendance was well sustained. Both students and teachers declared that these courses constituted one of the most useful aids rendered to engineers without employment, particularly in sustaining their morale and broadening their views of life and the profession.

To economic problems the foundation has at various times devoted some attention, but has as yet not participated extensively in any project.

To many technical researches of its founder societies it has given financial and other assistance. In the field of civil engineering a ten-year investigation of arch dams has just been terminated; a study of concrete arches and another of steel columns, for bridges and buildings, are nearing completion, and a fundamental and technical research in earths and foundations is progressing in this and other countries, yielding many practical benefits as it goes forward.

In mining and metallurgical engineering a collation of information on mining methods and a basic research in iron blast furnace slags produced results useful to engineers and industries; a novel experimental study of mining and strata problems, utilizing specially designed centrifuges, is progressing encouragingly, and the alloys of iron research is critically reviewing the world literature in many languages, making carefully selected information readily accessible with great economy of time and effort of industrial, scientific and engineering workers, and pointing out gaps that need laboratory research on alloy steels and irons.

Among mechanical engineering researches may be mentioned properties of steam, lubrication of machinery, strength of gears, use and care of wire ropes in elevators, construction operations and mining, effects of temperature on the properties of metals and the cutting of metals in manufacturing operations.

The electrical industry is so closely related to its basic sciences and has so many notable laboratories that there are relatively few problems for which the American Institute of Electrical Engineers seeks aid from the foundation. In insulation there have been researches in the fundamentals of dielectrics, and in electric welding, basic researches on pure iron electrodes and on nitrogen in welds.

Increase among engineers and manufacturers of

understanding of the possibilities and benefits of real research has been a result of great value from these society research activities, in addition to the specific technical knowledge gained.

### RESEARCH INCIDENTS

For the arch dam investigation an experimental dam 60 feet high was built on Stevenson Creek, a feeder of the San Joaquin River, in a wild gorge of the Sierra about 60 miles from Fresno, California. This dam was elaborately equipped with instruments and subjected to many tests. Several floods sent water over its top to a depth up to three feet or more and partially filled the little reservoir with boulders and sand. Nevertheless, although only two feet thick for most of its height, this dam built in 1926 survives without serious injury. Tests of tiny celluloid models at Princeton University and of a large mortar model at the University of Colorado, made independently, gave results in almost exact agreement with the tests of the dam. Models of dams built by the Bureau of Reclamation also were made and tested. A number of large dams built for water supplies of cities, for irrigation or for power development were tested with special instruments. These dams were of extremely various types, including one composed of three domes and others of arches ranging from very small top thickness to thickness wide enough to carry a highway. The many difficulties in testing large dams in service and the excellent results from tests of models demonstrated the dependability as well as the great economy to be realized from intelligent, skilful use of models.

In studying concrete and reinforced arches some small and some very large models were built and tested to destruction in laboratories. Extensive observations were made also on some large highway bridges. Among them was a bridge of several spans on a highway within a reservoir site, which would have to be abandoned. This bridge was subjected to a number of tests to limits that could not have been allowed on bridges in service, and, having withstood them all, finally was destroyed by bombing attack from the air. All these tests, including the final destruction, were carefully recorded and studied. Ohio State University, University of Illinois and the U. S. Bureau of Public Roads collaborated in this research.

In the investigation of arch dams and concrete bridges the plastic flow or deformation of concrete was noted in some instances. This phase of the behavior of concrete became the subject of extensive experimental research at the University of California and in other places.

Pure iron electrode experiments led to discoveries of new phenomena in electric arcs, at Lehigh University.

The use of a specially designed centrifuge and auxiliary apparatus is demonstrating that problems involving phenomena of rock strata and masses of earth can be studied in a laboratory and results obtained that correspond with the occurrences in nature. This has been a field which many thought defied all possible endeavors for laboratory study. This research is being conducted at the School of Mines, Columbia University.

### COLLABORATION

Certain general investigations can best be undertaken by the engineering societies and The Engineering Foundation, or organized by them on cooperative plans. A single company, for self-evident reasons, will rarely undertake projects of this kind. Many such projects are beyond the possibilities of private organizations. Some are outside the fields of governmental bureaus or would suffer delays beyond the control of bureau heads. Always there will be work to be done by an impartial institution of professional engineers.

In most projects in which the foundation has participated active collaboration or financial assistance was contributed by engineering societies, universities, governmental bureaus, research institutions, industrial corporations, trade associations, bankers and individuals, including a few in other countries. In numerous instances the foundation's efforts and money constituted the starter needed for preliminary exploring, organizing and financing. Other undertakings the foundation has assisted in critical periods.

The foundation aids researches and other enterprises in a variety of ways, but in the main refrains from direct management. It has no laboratories nor staff nor other facilities for conduct of research. Cooperatively, however, all needed facilities for projects in which the foundation has participated have been made available.

Activities of the foundation have direct connection with human life. Knowledge gained flows through four channels: the engineering colleges, by teaching and reports of research; the profession, by practise; industries, public utilities and public works, by supply of community needs; and the engineering societies, by meetings and publications.

The term "Engineering Foundation" stands for four concepts: First, a body of representatives of its founder societies, associated for the purposes of fostering research and the application of the sciences through engineering, and the performing of other functions under its deed of gift, "for the good of man-

kind"; second, an endowment fund owned by United Engineering Trustees, Inc., as trustee for the founder societies; third, a department of United Engineering Trustees, Inc., based on the intellectual and physical resources of the engineering societies, comprising men, means, activities and good-will; fourth, an integral part of the united organism of its founder societies.

# OBITUARY

## DR. E. N. LOWE

DR. EPHRAIM NOBLE LOWE was born near Utica, Mississippi, in 1864, the son of a physician and planter. He received the degree of bachelor of philosophy from the University of Mississippi in 1884, and the degree of doctor of medicine from Tulane University in 1892.

He practised medicine and did geological and biological work for some years in Colorado and other parts of the Middle West, where among the mountains, the plains and the streams he deepened that love for nature already acquired in his native state.

Returning to Mississippi, he continued the study of geology and natural history and soon became connected with those departments in the university, spending several summers in the meantime in study at the University of Chicago.

He was made state geologist in 1909 and head of the department of geology in the University of Mississippi in 1924, and continued to hold both these positions till his death on September 12, 1933. He was laid to rest two days later among his native hills and in sight of the stately home where he was born.

Dr. Lowe published many bulletins on the geology of Mississippi, the last of which came from the press in the present year. He published also an important volume on the botany of the state, called "Plants of Mississippi" (1921), especially valuable because it is a pioneer work in that field.

Dr. Lowe may be called the last of that fine school of naturalist-geologists of this section, which was represented by Dr. Eugene W. Hilgard ("Geology and Agriculture of Mississippi," 1860), Dr. James M. Safford ("Geology of Tennessee," 1869), and Dr. Eugene A. Smith, whose many reports on the geology of Alabama are well known. The author of this appreciation did not know Dr. Hilgard personally, but he counts it among his priceless memories to have been thrown closely as a student with Dr. Safford and to have known and loved Dr. Smith and Dr. Lowe in his later years—all most enthusiastic scientists, most loyal friends and most lovable of nature's noblemen.

In the death of Dr. Lowe the state has lost a painstaking scientific investigator, the university an able professor and society an excellent member.

Dr. Lowe was a fine example of sweet reasonableness in all things. His was a beautiful character. He was gentle and charitable, yet true to his ideals and absolutely fearless. He was a patient and careful student of nature, an inspiring teacher, a loyal friend and a delightful companion. In him there was no ostentation and no offense. He loved the fields and the woods, the birds and the beasts and the flowers; all nature was to him a book wherein to read, and his enthusiasm was an inspiration to others.

CALVIN S. BROWN

## MEMORIALS

THE centenary anniversary of the birth of Cyrus Fogg Brackett, for thirty-five years professor of physics at Princeton University, was celebrated on October 24 at a meeting of the Princeton School of Engineering, attended by former students of Dr. Brackett. The principal address was made by Dr. Howard McClenahan, secretary of the Franklin Institute, Philadelphia, and director of the museum and Benjamin Franklin Memorial.

THERE was dedicated in Paris on October 11 a monument erected in memory of Charles Mourea, professor of chemistry at the Collège de France. M. Mourea was for twenty years editor of *la Revue scientifique.*

A BUST of Fritz Pregl, professor of medical chemistry and Nobel laureate, who died in 1931, has been placed in the hall of the University of Graz.

THE three hundredth anniversary of the birth of Anthony van Leeuwenhoek was recently celebrated at Delft. Addresses were delivered by Professor Gutterink, rector of the senate; Professor D'Arcy Wentworth Thompson, delegate from the Royal Society; Professor J. van der Hoeve, president of the Leeuwenhoek national committee. A wreath was laid on the grave of the scientist in the old church at Delft.

ACCORDING to *Nature,* a memorial to Sir Charles Parsons, who died on January 12, 1931, has been unveiled at the works of Messrs. C. A. Parsons and Company, Limited, at Newcastle-on-Tyne by his daughter, Miss Rachel Parsons. The memorial is formed of a medallion portrait of Sir Charles, in profile, carved in Bianca del Mara stone; this is surmounted by the family coat of arms. At the ceremony Miss Parsons said that the memorial was erected on the site of the room in which her father spent so many hours of his