furnish heat to the boiler. He made a practical operating model that gives promise of working satisfactorily in certain locations. One must select a place where sunshine is abundant, as in the southwestern states, so its field of application is limited. Since it requires the direct radiation from the sun for its operation it can be used only about half the time.

INFRARED SPECTROSCOPY

Spectroscopy in the visible and ultraviolet regions has been used for several decades in detection and analysis of some inorganic elements. During the last 10 years infrared radiations have become useful commercially in a similar manner, but with these radiations one can carry out investigations with organic substances that have hitherto been impossible by any other means. Some atoms or special groups of atoms forming component parts of a complex organic molecule are favorably situated to vibrate as small individual units uninfluenced by the molecule as a whole. Hence these groups may be identified by their absorption spectra in the infrared part of the spectrum.

The water molecule has a strong absorption band at 3.0 microns because of the hydroxyl or OH radical. Other absorption bands are found for water at 1.5, 4.75 and 6.0 microns. Minerals having water of crystallization in the crystal structure should reveal the presence of water by absorption bands at some or all of the places where the water molecule shows strong absorption. Two substances such as selenite ($CaSO_4 + 2\ H_2O$) and anhydrite ($CaSO_4$) illustrate the phenomenon nicely. Anhydrite shows strong absorption at 4.55 microns which is caused by the sulfate (SO_4) radical but does not show the strong water bands. Selenite, however, shows a strong SO_4 band and in addition shows the strong water bands.

Opal ($SiO_2 + H_2O$) shows the characteristic bands of quartz (SiO_2) and also the strong water bands. The CO_2 band at 4.28 microns, the 4.6-micron band of CO and the CH_3 band at 3.43 microns are characteristic of these chemical groups.

In the study of organic substances, infrared spectroscopy is a powerful and useful tool. In the study of plastics and hydrocarbons infrared spectra have added much useful information. In a series of hydrocarbons each single substance gives its own characteristic absorption band. A mixture of two or more such substances registers the composite structure. Having built up a library of absorption-band patterns of many simple substances it is relatively easy to match an unknown pattern to the known patterns to discover the composition.

Because of difficulties of manipulations, infrared radiations have not been studied as intensively as visible and ultraviolet radiations, but with increasing interest centered upon them they will yield much knowledge that can not be obtained by any other method of attack.

OBITUARY

JOSEPH CHARLES ARTHUR

THE death of Joseph Charles Arthur at Brook, Indiana, on April 30 removes one of the pioneer plant scientists in the United States and one of the foremost students of plant rusts in the world. He was connected with Purdue University for fifty-five years as professor of botany, botanist to the Indiana Experiment Station and emeritus professor.

Joseph Charles Arthur was born in Lowville, N.Y., on January 11, 1850, the only son of Charles and Ann (Allen) Arthur. His parents went westward when he was about six years old. They located first near Sterling, Ill., then at Charles City, Iowa, and later at Spirit Lake, Iowa. He received his bachelor's and master's degrees from the Iowa State College and his doctor's degree from Cornell University. He was a member of the first class to be graduated at Iowa State (1872), and his doctor's degree (1886) was the first conferred by Cornell University in the field of science. He studied also at Johns Hopkins, Harvard and Bonn. Later he received honorary degrees from the University of Iowa, Iowa State College and Purdue University.

The ambition to become a botanist developed early in the life of Joseph Charles Arthur. He had that goal in mind before he went to college and was greatly disappointed to find that botany was not being taught when he enrolled at Iowa State College. During his sophomore year Dr. Charles E. Bessey became a member of the faculty at Ames and an immediate friendship developed between the two men. A gifted and inspiring teacher gave an enthusiastic student his introduction to botanical science. Professor Bessey's courses in vegetable physiology and economic plants and lectures on weeds and parasitic fungi were an excellent foundation for a long and distinguished career in applied botany, plant pathology and mycology.

In 1872 the subject of botany had not been recognized by many colleges and universities in the United States, the state agricultural experiment stations had not been founded, and there were no state or national departments of agriculture. Little wonder that a graduate of that time found difficulty in obtaining a botanical position. The modern era of botanical teaching and research was in its infancy.

Young Arthur, however, did not become discouraged in his determination to make botanical science his life work. Eventually it fell to his lot to take up the study of applied botany, he made early contributions to its development, and he was spared to devote an unusually long life to its advancement.

In 1884 he was appointed botanist to the newly founded Agricultural Experiment Station at Geneva, N. Y. For such a research position he was well prepared. He was the first person in America to hold such a position. His study of pear blight carried on there was pioneer work in the field of plant pathology.

In 1897 he was called to Purdue University as professor of botany. The next year his title was changed to professor of vegetable physiology and pathology and botanist to the Indiana Agricultural Experiment Station. In 1901, while serving in this capacity, Dr. Arthur was married to Emily Stiles Potter, of Lafayette, Indiana, who died in 1935. In his immediate family he is survived only by a sister, Mrs. Charles Tradewell, of Lakefield, Minn. Although Dr. Arthur formally retired in 1915 he continued his research and laboratory work at Purdue uninterruptedly for the next twenty years. During his declining years he kept his home in Lafayette but spent the winters either in California or Florida.

During the earlier years of his service at Purdue Dr. Arthur taught courses in plant physiology and in plant pathology. He was much interested in designing and building apparatus to aid in the teaching of plant physiology. Later he devoted most of his time to research in plant pathology and mycology. His work on the cereal smuts and on potato scab was of considerable economic importance. He introduced formaldehyde as a fungicide and was the first investigator to use it for the prevention of potato scab.

Although an important contributor to other fields of botanical science, Dr. Arthur is best known for his studies on the group of parasitic fungi known as the plant rusts. His first paper on the rusts was published in 1882, the last in 1936. During this long period he was continuously investigating the rusts, their life-histories, relationships, distribution and economic importance. In 1899 he began a special series of culture studies which he carried on for nineteen years. The life-histories and host relationships of a hundred or more species were revealed by these experiments. A summary of this work shows that about 2,400 collections were used and that approximately 3,750 cultures were made, each involving the use of a potted plant growing in a greenhouse. During these years a large number of correspondents contributed specimens and field observations. A large percentage of these correspondents were not professional botanists, and many of them acquired their interest, ability and inclination to assist through personal contacts and correspondence with Dr. Arthur. It is a marvelous example of the enlistment of voluntary assistance through boundless enthusiasm and fine inspiration. Throughout his long career Dr. Arthur's work was never limited to the facilities and resources of his institution but extended far beyond that range.

In 1905 a new classification of the plant rust order was published. In 1907 the preparation of a complete taxonomic treatment of the North American rusts was begun for the North American Flora (published by the New York Botanical Garden). This ran into eleven parts consisting of 765 pages and required twenty years for its completion. He published two books on the rusts—a biological treatment in 1929, "The Plant Rusts" (in collaboration with F. D. Kern, C. R. Orton, F. D. Frome, H. S. Jackson, E. B. Mains and G. R. Bisby, all former associates in his laboratories) and a taxonomic treatment in 1934, "Manual of the Rusts in the United States and Canada." In addition to these larger publications he brought out a long list of papers dealing with the varied aspects of the rusts. He determined and reported on collections not only from the United States but also from Cuba, Puerto Rico, Mexico, Guatemala, South America and the Philippines. He made collecting trips to New England, several southeastern states, the Rocky Mountains, Texas, New Mexico and Arizona. He made numerous trips to Europe partly because he was fond of traveling but mostly to look up type specimens in some Old World herbarium, to obtain access to some rare literature, to confer with fellow workers or to attend an international botanical congress where botanical nomenclature was under discussion. He was a delegate to the Congresses in Vienna in 1905, in Brussels in 1910 and in Cambridge in 1930. In 1925 a trip was made especially to confer with European mycologists who had special interests in the plant rusts. It was the privilege of the writer to accompany Dr. Arthur on this trip. Visits were made with twelve botanists in Germany, Sweden, Norway, Switzerland and England. A paper in SCIENCE (Vol. 43, pp. 558–560) entitled "Conversations with European Mycologists" reported the results of the exchange of opinions with fellow workers. This was one of the links in a long chain of cosmopolitan activities forged by Dr. Arthur.

Dr. Arthur belonged to numerous organizations to which he gave at all times his loyal and active support. He was a member of Sigma Xi; the American Society of Naturalists; the American Philosophical Society; the Academy of Natural Sciences of Philadelphia; the Indiana Academy of Science (president, 1893); the American Association for the Advancement of Science (vice-president, 1895); the Society for the Promotion

of Agricultural Science; the Torrey Botanical Club; the Botanical Society of America (twice president, 1902, 1919); the American Phytopathological Society (president, 1933); the Mycological Society of America; the Deutsche Botanische Gesellschaft, and the Russian Botanical Society.

The life and work of Dr. Arthur illustrate the attainments which may be achieved through real resistance to discouragement, industrious habits, sound scholarship, unflagging persistence and high purpose.

FRANK D. KERN

THE PENNSYLVANIA STATE COLLEGE

RECENT DEATHS

SIR JOSEPH LARMOR, from 1903 to 1932 Lucasian professor of mathematics at the University of Cambridge, died on May 19 in his eighty-fifth year.

A REUTER dispatch from Moscow to *The New York Times* dated June 6 reads: "Vladislav Vanchura, Czech author; Professor Storkan, authority on zoology, and Professor Selber, of the Czech Technological Institute, were among those killed by the Nazis in reprisal for the assassination of Reinhard Heydrich."

SCIENTIFIC EVENTS

REPORT OF THE COMMITTEE ON SEDIMENTATION

THE report of the committee on sedimentation of the Division of Geology and Geography of the National Research Council for the year 1940–1941 has just been published. The work of this committee is to prepare summary reports of progress in different fields of sedimentation and to increase the fund of knowledge on special problems. The report this year contains 10 such articles. The most important of these is a set of two charts prepared by R. Dana Russell listing the physical properties of more than 150 minerals that are commonly found in sedimentary rocks. The data are arranged in a new order, which experience has shown enables students to determine minerals more rapidly than formerly. Every student of petrography will find these charts useful.

Another article of special interest is a report by F. J. Pettijohn on the present state of knowledge of quantitative studies of sedimentation. Two reports on diagenetic changes in sediments are included; one by W. P. Kelley on soils and the other by George A. Thiel on calcareous sediments. Other articles are: current literature on recent marine sediments by H. C. Stetson; research on sedimentation in the Soil Conservation Service by C. B. Brown; research on sedimentation in the Gulf Coast region by F. W. Rolshausen; the sediments of Lake Provo, Utah, by H. J. Bissell, and two papers on statistical compilations of quantitative data on sediments, one on alluvial gravels by W. C. Krumbein, and the other on Mississippi delta sediments by August Goldstein, Jr.

The report is issued in bound mimeographed form of 110 pages. The price is $1.00, which includes a set of the two charts. Separate copies of the charts are 50 cents. Orders for the report or charts should be accompanied by remittance and addressed to the National Research Council, 2101 Constitution Avenue, Washington, D. C.

WALTER H. BUCHER

COLUMBIA UNIVERSITY

THE DEDICATION OF THE BAUSCH HALL OF SCIENCE AND HISTORY

THE Bausch Hall of Science and History, the new home of the Rochester Museum of Arts and Sciences, as reported in *Museum News*, was formally dedicated on May 23 with an address by Vilhjalmur Stefansson.

The building, the gift of Edward Bausch, with the property on which it stands, has been planned for complete provision of up-to-date facilities for exhibition, educational work and all the other activities of a modern museum. It is three stories and basement, 115 feet wide and 180 feet long, of buff Indiana limestone.

The equipment includes air conditioning by which the air is completely changed every fifteen minutes and can in case of necessity be changed in the entire building in five minutes, case lighting, concealed fluorescent lighting in the auditorium and on the first floor, under-floor duct system of electrical connections, and ceilings of acoustic plaster and floors of mastic tile. Provision is made for future additions to the structure.

Director Arthur C. Parker has plans for a progressive series of natural science exhibits beginning with astronomy and geology and covering all phases of life on the earth, special displays on man, and an exhibition series on culture history and social science; he has also made provision for cooperative programs with Rochester schools and with clubs and associations engaged in educational, scientific, cultural and civic activities.

THE DEDICATION OF THE TECHNOLOGICAL INSTITUTE OF NORTHWESTERN UNIVERSITY

THE formal dedication of the building of the Technological Institute of Northwestern University took place on June 15 and 16.

The dedicatory ceremonies included a series of industrial and educational conferences, attended by