whose house was the center of delightful hospitality to many Americans, studying at Leipzig. He found great happiness in his home life, in his children and grandchildren, and also in the numerous friends, whom he attached not only by his unusual abilities but by his personal charm. He was social by nature, keenly humorous, warm and faithful in his attachments, full of the zest of life. He was profoundly modest and seemed never to know how high his abilites were estimated by others. He never quarrelled, but was for every good cause he championed a good fighter. Perhaps his most distinguishing trait was his remarkable combination of keen practical sense in the use of means with enthusiasm in the pursuit of ideal aims. With all his buoyant vitality, with all his eager interest in men and affairs, he was essentially an idealist, who won the love and admiration of many friends both in Europe and America.

C. S. MINOT

SAMUEL FRANKLIN EMMONS

THE death of Samuel Franklin Emmons at his home in Washington, D. C., on March 28, 1911, after an illness lasting only five days, removed from the ranks of American economic geologists the one who, by virtue of his influence on the progress of his branch of science and by his long and illustrious service, worthily stood at their head. For the last few years Mr. Emmons's increasing infirmity had given concern to his friends, but his own cheerfulness and serenity were unaffected by bodily weakness and when his colleagues missed him from his desk at the Geological Survey offices during the few days before his death they believed merely that a cold in conjunction with unseasonable weather confined him to his house. None foreboded the fatal ending of his illness.

Born on March 29, 1841, in Boston, Mass., the home of his ancestors since 1640, Mr. Emmons at his death lacked one day of his seventieth year. His great-grandfather, Samuel Franklin, after whom he was named, was a first cousin and close friend of Benjamin Franklin.

Mr. Emmons graduated from Harvard College in 1861 and went abroad to continue his studies, first at the École Impériale des Mines in Paris and afterwards at the Bergakademie in Freiberg, Saxony. He returned to the United States in 1866 and after spending eight months in visiting the mining districts of the west he joined Clarence King as a volunteer assistant in the United States Geological Exploration of the fortieth parallel, receiving his official appointment in the winter of 1867–8. For nearly ten years he remained with this organization, seeing varied service, gaining that wide knowledge of the geology of the west that he afterwards turned to such good use, and contributing to the published results of the exploration. With Mr. Arnold Hague he was joint author of the second volume of the great fortieth parallel series, entitled "Descriptive Geology" and he had a part also in the preparation of Volume III., "Mining Industry." His work carried him to Virginia City in the winter of 1867–8; to Mono Lake in March, 1868; to the unknown mountain ranges of central and eastern Nevada and of western Utah in the following summer; to the Wasatch Range and to the region adjacent to Great Salt Lake in 1869; to Mount Rainier in 1870, and to the Uinta Mountains in 1871 and 1872.

Having accomplished his duties in connection with the fortieth parallel survey, Mr. Emmons, in the autumn of 1877, returned to the west and engaged in the then stirring business of raising cattle, near Cheyenne, Wyoming. When, however, Clarence King in 1879 organized the United States Geological Survey and became its first director, he sought out his friend and associate of earlier years and placed Mr. Emmons in charge of the economic geology of the Rocky Mountain division with instructions to make a detailed survey of the newly opened Leadville district. During the field-work at Leadville, which lasted until 1881, Mr. Emmons collected the statistics of the precious metals in the Rocky Mountains for the Tenth Census and in Volume XIII. ("Precious Metals") of that publication, jointly with Dr. George F. Becker,

introduced the plan of presenting outlines of the geological relations of the ore bodies in connection with the statistical data.

The monograph and atlas on the "Geology and Mining Industry of Leadville" were published in 1888, although an abstract of results had appeared as early as 1882. This great work established the reputation of its author, not only with men of science, who recognized the care and thoroughness of the basal observations, the essential soundness of the deductions and generalizations, the breadth of view displayed, and the masterly treatment and presentation of the material, but also with the miners, who found that they could sink shafts with the certainty of finding contacts and faults substantially as Emmons had drawn them in his remarkably accurate sections. The passing years, while they have necessitated some modifications of the theoretical conclusions advanced in this monograph, have brought out more and more clearly the sound basis of honest ability and conscientious workmanship upon which lasting fame must rest. The Leadville report was preceded in publication by Becker's monograph on the "Geology of the Comstock Lode and Washoe District" and by Curtis's less extensive report on the "Silver-lead Deposits of Eureka, Nevada," but with these, and probably more decisively than these, it marked the beginning of a new era in economic geology and became the model for the numerous monographic reports on western mining districts that have since been published by the United States Geological Survey.

Up to a few years ago Mr. Emmons continued in general charge of the investigations on western ore deposits carried on by the U. S. Geological Survey and many studies were planned and completed under his supervision and with his suggestive advice. In some reports he appeared as collaborator—notably in those on the "Economic Geology of the Mercur Mining District" (U. S. Geol. Survey Ann. Rept., 1895); "Economic Resources of the Northern Black Hills" (Professional Paper No. 26), and the "Economic Geology of the Bingham Mining District, Utah" (Professional Paper No. 38); in others his share was less patent, although perhaps scarcely less important. In the series of folios of the Geologic Atlas of the United States he wrote part of No. 9, "Anthracite-crested Butte, Colo.," parts of No. 38, "Butte Special, Mont.," and No. 65, "Tintic Special, Utah," and the whole of No. 48, "Ten-mile Special, Colo." During this period of administrative and directive work he collaborated also as senior author in the monograph (No. 27) on the "Geology of the Denver Basin, Colo." (1896) and published a paper on the "Mines of Custer County, Colo." (1896).

Among the many important contributions made by Mr. Emmons to scientific journals and to the proceedings of societies may be mentioned "The Genesis of Certain Ore Deposits" (1887); "Notes on the Geology of Butte" (1887); "Structural Relations of Ore Deposits" (1888); "On the Origin of Fissure Veins" (1888); "Orographic Movements in the Rocky Mountains" (1890); "Geological Distribution of the Useful Metals in the United States" (1894); "The Secondary Enrichment of Ore Deposits" (1901); "Theories of Ore Deposition Historically Considered" (presidential address, Geological Society of America, 1904); "Los Pilares Mine, Nacozari, Mexico" (1906), and "Biographical Memoir of Clarence King" (read before the National Academy of Sciences in 1903, published in 1907).

The paper on the secondary enrichment of ores was the outcome of observations and study extending over many years and it is characteristic of Mr. Emmons's largeness of mind that he discussed this principle freely with his assistants and showed no haste to secure to himself priority in announcing results whose great scientific and practical importance he fully realized.

At the fifth session of the International Geological Congress, held in Washington in 1891, Mr. Emmons served as general secretary and was the author of a large part of the geological guide prepared for the excursion by members of this congress to the Rocky Mountains. He was also vice-president at

the sessions of the congress held in 1897 and 1903.

Mr. Emmons became a fellow of the Geological Society of London in 1874 and joined in 1877 the American Institute of Mining Engineers, of which organization he was thrice vice-president. While engaged in his early work in Colorado, with headquarters at Denver, he helped in 1882 to organize the Colorado Scientific Society, was elected its first president, and contributed extensively to its proceedings. He also took part in the founding of the Geological Society of America, of which he was chosen president in 1903. In 1892 he was made a member of the National Academy of Sciences and he filled the office of treasurer of that body from 1902 to the time of his death. He was a charter member of the Mining and Metallurgical Society of America and held active or honorary membership in many other scientific societies in this country and abroad. In 1909 both Harvard and Columbia universities conferred upon him the honorary degree of Sc.D.

During the later years of his life Mr. Emmons, freed from the cares of official administration, returned to his studies at Leadville and, in association with Professor John D. Irving, of Yale University, was engaged in extending his earlier results in the light of the additional facts brought out by extensive mining operations continued through two decades. Although some of this newer material was published in 1907 as Geological Survey Bulletin No. 320 on "The Downtown District of Leadville, Colo.," Mr. Emmons did not live to see the publication of his final results which will, however, before long be issued by the Geological Survey.

He was one of the founders, in 1905, of the journal *Economic Geology* and continued his able and enthusiastic cooperation in its behalf up to the time of his death.

Tall in person, with a figure suggestive of activity and endurance rather than of robust strength, naturally dignified in bearing and distinctive of face, Mr. Emmons, notwithstanding his genuine modesty, was a man to attract notice in any assembly. One element of his forceful character was a peculiar shyness recognizable by his friends in a certain constraint of manner and bluntness of speech likely to be misunderstood by those who were unaware of his real kindness of heart and of his genial outlook on life. A steadfast and devoted friend, he appeared to be incapable of cherishing resentment and his mind rose high above those petty considerations of priority and credit that too often vex and humiliate the souls of scientific men in spite of their better natures.

The chief characteristics of his work were thorough painstaking honesty of method, wide and penetrating vision in the interpretation of his facts, remarkable soundness and stability of judgment, and clarity of exposition. Himself able to express his thought in unusually clear and felicitous language, Mr. Emmons was an invaluable critic, not only of substance but of form, and those geologists who in their younger days were so fortunate as to receive his kindly yet keen criticism, have found their appreciation of what he did for them grow more and more with the passing years and will ever hold him in grateful remembrance. His own writings are an eloquent protest against the view that sound science can find appropriate expression in slovenly writing.

Mr. Emmons was three times married—in 1876 to Weltha Anita Steeves, of New York; in 1889 to Sophie Dallas Markoe, of Washington, and in 1903 to Suzanne Earle Ogden-Jones, of Dinard, France, who survives him. He left no children.

In the course of his long life Mr. Emmons had seen the far west that he knew and loved so well make astonishing progress, especially in the mining industry, and he had the satisfaction of knowing that by his work he had materially advanced this development. He had received unsought and bore modestly the honors that men of science most prize. His name not only stood high on the rolls of science, but was known to miners throughout the Rocky Mountain region as that of the man who more than any one else had applied geological knowledge in a way to convince them

of its value. Increasing physical disability neither embittered his cheerful spirit nor diminished his interest in science or in the general affairs of life. When he withdrew from activities in which he would once have joined it was with the unobtrusive thoughtfulness for others that foresaw some possible hindrance that his presence might occasion. His scientific associates have lost his genial sympathy, his ever ready help in worthy effort, and his ripe judgment in decisions of moment; but the inspiration of his life and character remain and probably each of those who loved him has had the heartfelt wish that when his own turn came death might summon him with like gentleness, after a life of usefulness and honor.

F. L. RANSOME

THE CONGRESS OF TECHNOLOGY

THE fiftieth anniversary of the Massachusetts Institute of Technology was celebrated on April 10, 1911. On the afternoon of April 10 President Maclaurin read the address given above. It was followed by an address by Professor W. H. Walker on the spirit of alchemy in modern industry, and by one on technology and the public health by Professor C.-E. A. Winslow. On Tuesday an elaborate program of special papers was given as follows:

SECTION A—SCIENTIFIC INVESTIGATION AND CONTROL OF INDUSTRIAL PROCESSES

Chairman, Professor W. H. Walker

"The Conservation of our Metal Resources," Albert E. Green, '07, electro-metallurgical engineer, American Electric Smelting and Engineering Co., Chicago.

"Some Causes of Failures in Metals," Henry Fay, professor of analytical chemistry, Massachusetts Institute of Technology, Boston.

"Metallography and its Industrial Importance," Albert Sauveur, '89, professor of metallurgy, Harvard University, Cambridge, Mass.

"Thirty Years' Work in Boiler Testing," George H. Barrus, '74, expert and consulting steam engineer, Boston.

"Coal Combustion Recorders," A. H. Gill, '84, professor of technical analysis, Massachusetts Institute of Technology, Boston.

"An Electric Furnace for Zinc Smelting," Francis A. J. FitzGerald, '95, consulting chemical engineer, Niagara Falls, N. Y.

"Improvements in Cotton Bleaching," Walter S. Williams, '95, textile expert, Arthur D. Little, Inc., Boston.

"The Work of Engineers in the Gas Industry," Frederick P. Royce, '90, vice-president, Stone & Webster Management Association, Boston.

"The Chemist in the Service of the Railroad," H. E. Smith, '87, chemist and engineer of tests, The Lake Shore & Michigan Southern Railway Co., Collinwood, Ohio.

"The Control of Thermal Operations and the Bureau of Standards," George K. Burgess, '96, associate physicist, Bureau of Standards, Washington, D. C.

"The Debt of the Manufacturer to the Chemist," Hervey J. Skinner, '99, vice-president, Arthur D. Little, Inc., Boston.

"Prevention and Control of Fires through Scientific Methods," Edward V. French, '89, vice-president and engineer, Arkwright Mutual Fire Insurance Co., Boston.

"Research as a Financial Asset," Willis R. Whitney, '90, director, Research Laboratory, General Electric Co., Schenectady, N. Y.

"The Utilization of the Wastes of a Blast Furnace," Edward M. Hagar, '93, president, Universal Portland Cement Co., Chicago.

"Development in Paint and Varnish Manufacture," E. C. Holton, '88, general chemist, The Sherwin-Williams Co., Cleveland, Ohio.

"Reclamation of the Arid West," Frederick H. Newell, '85, director, U. S. Reclamation Service, Washington, D. C.

"Some Problems of High Masonry Dams," John R. Freeman, '76, consulting engineer, Providence, R. I.

"Some New Chemical Products of Commercial Importance," Salmon W. Wilder, '91, president, Merrimac Chemical Co., Boston.

SECTION B—TECHNOLOGICAL EDUCATION IN ITS RELATIONS TO INDUSTRIAL DEVELOPMENT

Chairman, Dr. Arthur A. Noyes

"The Elevation of Applied Science to an Equal Rank with the So-called Learned Professions," Mrs. Ellen H. Richards, '73, instructor in sanitary chemistry, Massachusetts Institute of Technology, Boston.

"The Engineering School Graduate; His Strength and His Weakness," H. P. Talbot, '85,