you all know. Such studies, the results of which can be carried over to glucose breakdown in bacterial metabolism with necessary modification for any given case, and then perhaps brought into relation to muscle metabolism, would be a real triumph for a more useful understanding of the mechanism of such actions.

It would be possible to go on indefinitely in this strain. However, just one more thought will be presented. One of the points which it is desired to emphasize here is the action of added substances on enzyme actions. In other words, in these phenomena of living matter and of life processes it is the system as a whole which must be considered. This thought is not new, but it is frequently overlooked or ignored, possibly because of the aim to make the study of chemical phenomena objective as far as possible. In another field of chemistry, the simple ionic theory which treated of ions as independent entities has come to be modified to include the properties and actions of the solvent, of the ions on each other, of the influence of nonionized substances on the properties of the solvent and of the ions, etc. It would be possible to give many other chemical illustrations, especially from the field of organic reactions. In every case, for a proper understanding of the reaction, all the factors and their interrelationships must be included. It is therefore obvious that in the complex mixtures of living matter the reciprocal influences of the constituents must be considered. For life processes, therefore, the understanding of the functioning of any one of the parts, and consequently also of the functioning of the whole, must necessarily treat of the system as a whole. This point of view is in contradistinction to the present trend of physics, to work down toward the ultimate particles of energy or matter. These two aims are not in contradiction, both are needed for a complete understanding of the phenomena involved. But further, in considering the system as a whole and the influences of various substances on enzyme actions and the surprising results obtained at times, it might appear as if these studies are being developed from the view of "Emergent Evolution." Although the latter might perhaps be considered as a philosophy of ignorance, yet it sets definite problems and raises questions which may or may not be answerable.

If the mechanism of enzyme actions were better understood, it would be an approach from the chemical side to the science of life itself. The biologist is working toward simpler units of cell constituents. Apparently, the genes are the simplest such units so far achieved. Their molecular weights are perhaps in the neighborhood of 50,000. Davenport[19] considers that they probably are enzymes and presents views relative to their development and actions, analogous to some of the views presented here. This is a tempting subject, and much of interest may be expected in this field in the near future.

Finally, in considering the mechanism of enzyme actions as outlined here, several specific questions may be asked. What is meant by "protein molecule" and by "pure protein"? What new concepts of forces or means of combination must be developed to account for the reactions observed? How do proteins, and perhaps other substances, act in modifying certain enzyme actions? And finally what sort of a mechanism in the living organism permits of the continuity of the enzyme formations and actions which are needed for the continuance of the given life process?

OBITUARY

MICHAEL IDVORSKY PUPIN

In the small village of Idvor, not far from Belgrade, in the Austrian province of Banat, now a part of Yugoslavia, Michael Idvorsky Pupin was born on the fourth day of October, 1858.

His parents, Constantine and Olympiada, were Serbian peasants who could neither read nor write; they were prosperous and highly esteemed members of the community. From them he inherited a remarkably strong physique, an exceptional mental endowment and an oriental imagination.

His formal education was begun in the village school of Idvor, where he learned reading, writing and arithmetic, and was continued in the schools of Panchevo and Prague.

Eventually, while a student in Prague, he became so incensed at the Teutonic oppression of the Slavs in Bohemia that he decided to emigrate to America, where, he had come to believe from what he had learned in the schools at Panchevo and Prague, real freedom was to be found, and where, he thought, a young immigrant might make his way to fortune.

Late in March of the year 1874 he landed, practically penniless, as an immigrant in New York City. Shortly after landing, in an encounter with a crowd of newsboys, whose gibes at his headgear, a red fez, had aroused his resentment to fighting pitch, he demonstrated his ability to take care of himself. An onlooker, a Delaware farmer, impressed by his performance, offered him a job on his farm, which he declined, since his duties would have included the milking of cows, which in accordance with Serbian tradition was a job for women. Another offer of a job, on a Delaware farm, bearing a satisfactory stamp

[19] C. B. Davenport, *Scientific Monthly*, August, 1934, pp. 104–108.

of masculinity, was presently made him and was accepted.

His job was to assist in the cultivation of the land by driving a pair of mules. Presently, a young woman of the farmer's family interested herself in his welfare, and under her tutelage he rapidly acquired a considerable knowledge of the English language and some acquaintance with American history and customs.

After a few weeks he set forth on a search for new experiences, and in the course of a few days he obtained another farm job, driving a pair of mules, in southern Maryland. After a month he left it and returned to New York City, where, he thought, his chances for advancement would be better than on a farm.

It was summer in the year 1874, and the country was still in the midst of the depression which started with the financial panic of 1873. Thousands of unemployed men patrolled the streets in search of jobs, and for many days Michael Pupin was one of these. In the course of time he found work doing odd jobs, such as transferring coal from sidewalks to cellar bins, and painting cellar walls. Through the winter of 1874–5 in one way or another he managed to pay his room rent and provide himself with fairly regular meals, though sometimes a meal was nothing more than "a bowl of soup and a chunk of brown bread."

Eventually, he found steady employment in the New England Cracker Factory in Cortlandt Street. Here, among the employees of the factory he made two friends who exerted no little influence on his career. These were Jim, the boiler engineer, a man with little education but nevertheless a philosopher and a wise counsellor, and Bilharz, a man with a fine education, particularly in the classics, but broken in spirit through some misfortune, and reduced to his present lowly employment. These friends encouraged him to prepare himself for college. This he did by studying Greek and Latin grammar in his spare time under the guidance of Bilharz, attendance at the night classes held in Cooper Union and later by full-time attendance at the Adelphi Academy in Brooklyn. In the fall of the year 1879 he passed with high standing his entrance examinations for Columbia College.

In college he won scholastic distinction in Greek, mathematics and physics. He devoted comparatively little time to athletics, but through his prowess in wrestling and boxing he won the approbation of his classmates, who elected him president of the class for the junior year. In his senior year his interest in physics was greatly stimulated through the lectures of Professor Ogden Rood, and he decided upon a scientific career.

On the day preceding his graduation from Columbia in 1883 Michael Pupin received his naturalization papers and became an American citizen.

Although he had been offered fellowships which would have enabled him to continue at Columbia for three years, he finally decided to go abroad for graduate study in physics.

In June of the year 1883 he embarked for Europe, nine years after his arrival in America as an immigrant. After a preliminary visit to Cambridge he returned to Idvor for his first visit home since his departure for Prague in the year 1872. He found his mother "much older, and much more beautiful" and, of course, eager to hear from his own lips the story of his life and achievements in America. His father had died during his stay in Prague.

He returned to Cambridge in October and began his studies in mathematical physics under the preceptorship of the celebrated coach John Edward Routh, fellow of Peterhouse College. Rayleigh and Stokes were lecturing on mathematical physics, but Pupin was not yet prepared for the advanced courses which they were giving. Under Routh he acquired a mastery of dynamical methods which was an invaluable asset in his later scientific activities.

After two years in Cambridge he decided to go to Berlin for laboratory work under the direction of the celebrated von Helmholtz. Fortunately, at this time Pupin was offered by President Barnard of Columbia a John Tyndall fellowship. He accepted without delay, and thus became the first John Tyndall fellow.

In October, 1885, he arrived in Berlin with letters of introduction from President Barnard and Tyndall, and was kindly received by Helmholtz. During his first year in Berlin he attended the course on experimental physics given by Helmholtz, and also lectures on the theory of electricity and magnetism given by Kirchhoff, who had not yet, however, given his adherence to the views of Faraday and Maxwell, with which Pupin himself was now in full accord.

At this time he had become interested in the new science of physical chemistry, and was cognizant of the work of J. Willard Gibbs, which he brought to the attention of Helmholtz. He received his Ph.D. degree from the University of Berlin in 1889, submitting a theoretical dissertation dealing with the subjects of osmotic pressures and free energy.

In the fall of the year 1889 he began his long teaching career at Columbia University with the title of "assistant teacher of mathematical physics in electrical engineering." In 1892 he was made adjunct professor of mechanics, and in 1901 was advanced to a full professorship, with the title of professor of electro-mechanics. When in 1905 the departments of mechanics and physics were united, he became a member of the department of physics, with which he remained in active service until 1929, when he was made professor of electro-mechanics in residence.

His own predilections were for research rather than teaching. The dominant and magnetic personality with which he was endowed was a great asset in his teaching, which was characterized by a remarkable skill in bringing out the physical significance of mathematical formulae.

In 1889, when he joined the newly created department of electrical engineering at Columbia, Pupin and his friend, Francis B. Crocker, constituted the teaching personnel of the department. The basic theoretical courses were given by Pupin in morning lectures, and he was also required to assist in the laboratory instruction in the afternoons. Notwithstanding this heavy teaching load, he found time in the evenings to carry on with experimental research.

His earliest work was concerned with the phenomena associated with the discharge of electricity through gases, and his experimental investigations in this field led to results which had an important bearing on the electromagnetic theory of the solar corona.

He next occupied himself with the experimental investigation of the peculiarities exhibited by wave forms of alternating currents to which Rowland of Johns Hopkins had called attention. His familiarity with the methods of Helmholtz in detecting the harmonics in vowel sounds enabled him to develop corresponding methods for the analysis of alternating current wave forms. This he accomplished through the use in electrical circuits of adjustable induction coils and condensers. He was thus led to the discovery of the methods of tuning which are essential in the art of radio broadcasting and communication. The results of this important investigation were published in the Transactions of the American Institute of Electrical Engineers for 1894.

In December, 1895, Roentgen announced his epoch-making discovery of x-rays. Two weeks later, on January 2, 1896, Pupin obtained the first x-ray photograph made in America. With the aid of a fluorescent screen, furnished by his good friend, Thomas A. Edison, superimposed upon a photographic plate, he was enabled to obtain an excellent x-ray picture with an exposure of but a few seconds.

In a communication to the New York Academy of Sciences on April 6, 1896, he announced the discovery of secondary x-ray radiation, and is now generally accorded priority for this discovery.

On April 15, 1896, Professor Pupin was stricken with pneumonia, and for several days was critically ill. The necessary months for convalescence from this dread disease he spent in the beautiful town of Norfolk, Connecticut, in the Berkshire Hills, to which he became greatly attached. Several years later he acquired possession of a farm near the town, and using stones from the fields, he built his picturesque summer home, to which he was accustomed to go whenever possible, not only for rest, but also for the opportunity to work free from the distractions of city life.

Upon recovery from his illness he returned to the consideration of a problem which had occurred to him on a summer vacation journey through Switzerland in 1894. While in Cambridge ten years previously he had read Lagrange's paper, "Recherches sur la Nature et la Propagation du Son," in which the solution was given of the problem of a vibrating string fixed at both ends and loaded at equal intervals with equal masses. He now proposed to attack a new problem, obtained by generalizing the conditions imposed by Lagrange, through assuming the string itself to have weight and the medium surrounding the string to exert a dissipative reaction to its motion. Not realizing at the time the tremendous practical importance of the problem, if it could be solved, he nevertheless attacked it with great vigor and eventually found its solution.

The solution of this problem furnished the solution of a precisely analogous problem relating to the propagation of electromagnetic signals over a telephone line periodically loaded with inductance, and with distributed capacity. Professor Pupin's solution of this analogous problem consisted essentially in showing that the malevolent influence of the capacity and resistance of the line in causing distortion and attenuation of signals could be nullified through the introduction of inductance coils at specified intervals along the line. It led to an invention which was of the first order of importance in the telephone art. For it enables telephone engineers to design their lines so as to avoid undue distortion and attenuation of signals. In fact, it makes possible long distance telephony by overhead lines or by undersea cables, and the replacement of overhead lines when desirable by underground cables, as, for example, in cities and large towns. In Germany telephone lines equipped with the Pupin inductance coils are called "pupinizierte linien," in France "les lignes pupinizé."

In order to obtain an experimental confirmation of the mathematical theory of his invention which would convince practical engineers of its utility he was forced to construct an "artificial" telephone line in his own laboratory. The mathematical theory of his artificial line was communicated to the American Institute of Electrical Engineers in March, 1899.

The American patent rights to Professor Pupin's telephone inventions were acquired by the American Telephone and Telegraph Company on terms not fully commensurate with the value of the invention but highly satisfactory to him, and which enabled him later to foster many philanthropic enterprises in which he was deeply interested.

Not long afterwards he disposed of the patent rights relating to his wireless inventions to the Marconi Company of America.

For a number of years following the first announcement of his telephone invention he was absorbed in the mathematical consideration of problems connected with the theory of telephonic communication, and in laboratory research connected with the improvement of the toroidal inductance coils which are used on loaded telephone lines. He was thus diverted from active participation in the epoch-making developments which were meanwhile being made in physics during the first decade of the present century.

In 1909 he began to take an active interest in Serbian activities in the United States and became president of the society established in the interests of Serbian immigrants, serving in this capacity until 1926.

At the outbreak of the Balkan War in 1912 he was made honorary consul of Serbia in New York. He started at this time at his own expense a Serbian daily newspaper, mainly for the purpose of keeping Serbian immigrants informed as to the war movements in the Balkans. He also organized a Serbian sisterhood whose members were encouraged to collect contributions in aid of the Serbian Red Cross; and, in the interests of the Serbian National Defense League, to inspire volunteers for war service. In 1914 this work was extended throughout the United States, and highly satisfactory results were achieved.

When the United States entered the war in 1917, Professor Pupin organized a Columbia University group of scientists for the purpose of developing methods for the detection of submarines. He himself, notwithstanding his active duties as a member of the Committee of Aeronautics of the National Research Council, devoted much time and effort in the laboratory to the development of highly sensitive receiving devices for high frequency sound waves in water.

In 1919 he organized in New York City a Slavonic Immigrant Bank through which were reported daily in Slavic newspapers throughout the United States the rates of exchange for the currencies of the Balkan states, thus protecting immigrants from the predatory activities of unscrupulous money-changers. In 1920 he founded the Serbo-American Bank in Belgrade.

At the request of Premier Pashitch, Professor Pupin served as a representative of Serbia at the Paris Peace Conference in April, 1919. Here, in collaboration with his colleague Professor Douglas Johnson, of Columbia University, he was able to advance cogent arguments which resulted in extending materially the proposed boundaries of the newly created Kingdom of the Serbs, Croats and Slovenes—now known as Yugoslavia.

In 1922, at the age of sixty-four, he decided to write the story of his eventful life. In 1923 his autobiography, "From Immigrant to Inventor," was published. Here he unfolds the narrative of his life in a manner which holds the interest of the reader from beginning to end, and in a literary style which is remarkable for its naiveté and poetic imagery. The appeal of this book to the general public far exceeded the expectations of the author. It has been translated into several foreign languages, and letters of appreciation from all over the world gave the author the comforting assurance that the time and labor which he had bestowed upon its preparation were not in vain. On account of a persistent demand an abridged edition of this book was prepared, suitable for use in the public schools.

In 1927 his second popular book was published under the title, "The New Reformation," with the sub-title, "From Physical to Spiritual Realities." The book consists of a series of seven popular disquisitions on science, or narratives, as the author designates them, written with a purpose in view which can be inferred from the concluding words of the author's prologue—"It is hoped that by strengthening our understanding of the physical realities the narratives will reform our mental attitude and make it better prepared for the recognition of the truth that physical and spiritual realities are the fruit of the same tree of knowledge, which was nurtured by the soil of human experience." In this book he has revealed the simple and rational philosophy of life to which he adhered and the spiritual sentiments which were a part of his religious faith.

But brief mention can be made of the many philanthropic enterprises which he fostered. Among these was a foundation for the Royal Serbian Academy in Belgrade in memory of his mother; one for the education in agriculture of young Serbs of Voyvodina; one for the restoration of old Serbian monasteries; and one for the establishment of a community house in his native town of Idvor.

In recognition of his scientific and literary achievements Professor Pupin was honored by the bestowal upon him of numerous honorary degrees by universities in America and Europe; he was also the recipient of many honorary medals; and in 1925 he was elected president of the American Institute of Electrical Engineers and also president of the American Association for the Advancement of Science.

In the latter years of his life Professor Pupin was afflicted with a paralysis which deprived him almost entirely of the use of his legs. This infirmity he bore with cheerful fortitude, and despite it continued his intellectual activities until stricken with the illness which resulted in his death on the twelfth day of March, 1935.

In his memory and honor the trustees of Columbia University at their first meeting subsequent to the death of Professor Pupin voted to name the recently-erected physics building the "Pupin Physics Laboratories."

A. P. Wills

Columbia University

SCIENTIFIC EVENTS

ANNUAL MEETING OF THE TRUSTEES OF SCIENCE SERVICE

At the annual meeting of Science Service, held in Washington on April 25, three new trustees were elected as follows: Dr. Harlow Shapley, director of the Harvard College Observatory, representing the National Academy of Sciences; Dr. Henry B. Ward, permanent secretary of the American Association for the Advancement of Science, representing that organization; Dr. Ludvig Hektoen, director of the John McCormick Institute for Infectious Diseases, representing the National Research Council.

Trustees reelected were: Dr. R. A. Millikan, of the California Institute of Technology, representing the National Academy of Sciences; R. P. Scripps, of the Scripps-Howard Newspapers, representing the E. W. Scripps Estate, and Marlen Pew, editor of *Editor and Publisher,* representing the journalistic profession.

Dr. J. McKeen Cattell, editor of Science, was reelected *president.* Other officers reelected were: Dr. W. H. Howell, of the Johns Hopkins University, *vice-president* and *chairman of the executive committee;* H. L. Smithton, of the Scripps-Howard Newspapers, *treasurer,* and Watson Davis, director of Science Service, *secretary.* Dr. C. G. Abbot, secretary of the Smithsonian Institution, and Mr. Pew were reelected members of the executive committee.

Dr. Vernon Kellogg, secretary emeritus of the National Research Council, who retired as a trustee, was elected honorary vice-president in appreciation of his long service in the office of vice-president. Dr. William E. Ritter, of the University of California, is honorary president.

The following resolution was adopted upon the death of Dr. David White, of the U. S. Geological Survey, who at the time of his death was a trustee of the service:

Resolved, That the Board of Trustees of Science Service desire to express their sincere feeling of sorrow and personal loss in the death of Dr. David White. His long and valuable services as a trustee, as a member of the Executive Committee and as chairman of the Executive Committee are recognized and deeply appreciated by his fellow members as constituting an important factor in the successful initiation and development of the work of Science Service. It is ordered this resolution be entered upon the minutes of the meeting of April 25, 1935, and that a copy be sent to Mrs. White.

Annual reports of Science Service for its fourteenth full year of operation, ended on March 31, 1935, showed that news and interpretations of scientific progress are furnished to over 6,000,000 readers through newspapers utilizing news and feature reports, issued by telegraph and mail daily, weekly and monthly. The weekly magazine, *Science News Letter,* gained in distribution, now having over 16,000 circulation.

Various books and magazine articles written and edited by members of the staff were produced during the year, notably the book entitled "The Advance of Science." Two radio talks each week were arranged over nationwide networks of stations.

Progress was made toward an extension of the work of the service in the British Empire and arrangements for the exchange of news with the Tass Agency of the U.S.S.R. were made.

Research aid activities consisting of the collection of earthquake information, the distribution of cosmic data, and the investigation of archeological and anthropological discoveries were continued.

The cost of operation during the year was slightly over $110,000. The endowment provided by the late E. W. Scripps yields $30,000 a year and the balance was more than covered by earnings.

ANNUAL MEETING OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

At the annual meeting of the American Academy of Arts and Sciences held in Boston on May 8, Dr. Roscoe Pound, dean of the Harvard Law School, was elected president. He succeeds Dr. George H. Parker, professor of zoology at Harvard University. The following were reelected vice-presidents: James Flack Norris, Walter Bradford Cannon, Edwin Francis Gay and Arthur Stanley Pease. Joshua Whatmough succeeds Robert P. Bigelow as editor. Councillors elected for four years are: Dugald C. Jackson, Ralph H. Wetmore, Arthur N. Holcombe and Kenneth J. Conant.