Gilbert T. Walker

GILBERT JOHN FOWLER

(1868–1953)

Foundation Fellow 1935

GILBERT JOHN FOWLER was born on January 23, 1868, in Paris, France. He was the son of Robert John and Priscilla (Alleston) Fowler.

EDUCATION AND ACADEMIC CAREER

Fowler was educated in Sidcot School, Somerset, and Owens College, Victoria University, Manchester, and University of Heidelberg. He took his B.Sc. degree in 1886 and was awarded the Dalton Prize for his research on silver suboxide in 1887. He took his M.Sc. degree in 1889.

Young Fowler's scientific outlook and attitude were, as he once told one of us (S. C. P.) in the course of conversation, greatly influenced by the delightful lectures of the famous biologist T. H. Huxley, and the eminent chemist, Sir Henry Roscoe. Fowler also studied iron and steel industry in Cleveland, District of Yorkshire and metallurgy in Freiberg, in the Harz District, and in the University, and in the University of Sheffield during vacations. In 1904, he was awarded the D.Sc. degree by the University of Heidelberg on a thesis on *purification of sewage*.

MARRIAGE

Dr Fowler married Miss Amy H. Scott in April 1900. They had two sons. Their married life was largely happy and complete.

APPOINTMENTS HELD IN ENGLAND

Fowler was appointed Demonstrator in Chemistry in Owens College, and Chemistry and Physics Tutor in Dalton Hall, 1888–96. In 1892, he became assistant Lecturer in Metallurgy in Owens College; and in 1893; he was examiner in chemistry, Union of Lancashire and Cheshire Institutes.

In 1896, Fowler was appointed as Chemist and Bacteriological Assistant to the Rivers Committee, Manchester City Council. Later in 1899, he was made Superintendent and Chemist, Manchester Corporation Sewage works; and in 1904, he became Consulting Chemist to the Rivers Committee. In the same year he was appointed Lecturer in Sanitary Chemistry, Public Health Department, University of Manchester.

In 1912, Dr Fowler was appointed Lecturer and Examiner in Bacteriological Chemistry and Director of the Frankland Laboratory; and in April 1914, at Manchester, he and his associates, E. Arden and W. T. Lockett, developed the activated sludge process of sewage treatment and in the science of sanitation.

Dr Fowler did much consulting work in the England, Egypt, Shanghai, Hong Kong, Africa, Malaya, India, China, Canada and U.S.A. resulting from his pioneer development of the activated sludge method of sewage treatment.

Appointments held in India

From 1906, Dr Fowler was periodically invited by the Municipalities or Corporations of Calcutta, Bombay and Madras to advise them on problems of sewage treatment and admission of trade effluents into municipal sewers. In 1916, he was invited by the authorities of Indian Institute of Science, Bangalore, to become Professor of Applied Chemistry at the Institute. In 1921, he was appointed as the first Professor of Biochemistry at the Indian Institute of Science, Bangalore. It was at this Institute that the first Chair of Biochemistry in India and in the East was created. Professor Fowler retired from the Indian Institute of Science, Bangalore, in 1924.

Even after his retirement from the Institute, Professor Fowler continued to take keen interest in the work of the Department of Biochemistry, particularly on sewage, activated sludge, waste disposal, biochemistry of soil processes and agriculture. One of us (SCP) was associated with Professor Fowler from December 9, 1935 until his last days who passed away on March 21, 1953.

In 1926, Professor Fowler was invited by the Harcourt Butler Technological Institute, Kanpur, to become the Officiating Head of the Research Department at that Institute, of which he became the Principal for two years, 1927–29. After his return from Kanpur, Professor and Mrs Fowler took up permanent residence in the Central Hotel in Bangalore. They were there till the end of Professor Fowler's life, except for periods when he was away in connection with his professional work.

Professor Fowler was invited by the Patna University to give a course of lectures as Sakhraj Ray Reader in Natural Science at that University in 1931–32. He chose as his subject "The Biochemistry of Nitrogen Conservation", since the main objective of his scientific and professional career was to solve the problem of satisfactory utilization of nitrogenous waste material. His scientific philosophy or motto was : "Nitrogen conservation, it will be seen, is a major factor in the world's prosperity; indeed, Nitrogen thus conserved, together with the energy, mental and physical, liberated by an adequate food supply, is a real measure of the Wealth of Nation."

Honours

He was a Fellow of the Royal Institute of Chemistry, 1897; Examiner in Biological Chemistry, 1910–14; and Member of the Council, 1914–16. He was also the Honorary Secretary, Advisory Committee for India, 1921–51. He was Fellow of the Chemical Society of England; Fellow of the Royal Sanitary institute (now the Royal Society of Health); Fellow of National Institute of Sciences, India (now the Indian

National Science Academy); Honorary Member of Manchester Literary and Philosophical Society.

He was President of the Chemistry Section of the Indian Science Congress in 1918, London Chemical Society in 1927, and the Society of Biological Chemists, India, 1947–49. He was member of Industrial Research Council of the Government of India, 1937–39. He was also a consultant to the Government of India and various State Governments and Examiner for the various Indian Universities. He was Technical Representative of Messrs Activated Sludge Limited, London, for India and the East from 1925 until his death, and Consulting Chemist for Vinegar Production, Cross and Blackwell Ltd.

During 1925–53, Fowler was responsible for the installation of about a dozen activated sludge plants of different sizes in different parts of India. The largest of these plants was put up in 1938 at the Government Gun and Shell Factory, Cossipore, near Calcutta with which one of us (SCP) was closely associated. It happened that under the working conditions of this new plant, a mechanism in the process of sewage purification was also discovered, which was later worked out at Bangalore in all its details for the benefit of sanitary science and technology.

During 1938–42, Dr Fowler was away at Madras where he stayed on to impress upon the authorities of the Corporation of Madras on the efficiency and value of the activated sludge process of sewage treatment and to persuade the authorities to put up an activated sludge plant for the treatment of sewage of Madras, and also of Madurai, which was a growing city in Madras State (Tamil Nadu). However, he did not succeed in persuading the authorities at Madras or at Madurai to put up an activated sludge plant. Dr Fowler returned to Bangalore in 1942 and continued to live in the Central Hotel until the day of his death on March 21, 1953.

Scientific Work

As a lecturer in the University of Manchester and Consulting Chemist to the Rivers Committee of Manchester Corporation from 1896 to 1916, he had the opportunity of acquiring deep knowledge and wide experience in sanitary chemistry and he became the leading sanitary chemist of his time. During this period (1896–1916), he was responsible for the treatment of sewage and trade effluents of Manchester. He won international reputation when he and his associates, E. Ardern and W. T. Lockett, developed at Manchester in 1914 the activated sludge process.

On problems of sewage disposal Dr Fowler was consulted by the cities of New York, Cairo, Shanghai and Hong Kong and by the Government of Federated Malay States. He became a well-known expert in the field of waste water treatment.

One of the important lines of work in the Department of Biochemistry at the Indian Institute of Science, Bangalore from the time of Dr Fowler's association with it was naturally concerned with the scientific control of water supply and of sewage and refuse disposal in all its aspects, including its relation to agriculture.

A visit to the Rothamsted Experimental Station, England, during his leave period in 1921 enabled Dr Fowler to become acquainted with the so-called ADCO Process

(Agricultural Development Company Process) of preparation of organic manure. He returned to India with great interest in the production of compost which later became one of the leading manurial activities of the Country. Many students of the Biochemistry Department at the Indian Institute of Science have taken an important part in this work.

Dr Fowler applied the principle of the activated sludge process to the production of compost under aerobic conditions or "activated compost", as he termed it. He was continuously interested in activated sludge, in compost and in other aspects of recovery of nitrogen from waste materials for soil fertilization and crop production. In scientific articles, in lectures and addresses, he developed and enlarged his most favourite theme of nitrogen conservation.

In 1922, Dr Fowler designed and set up an activated sludge plant (alongwith septic tanks and a sewage farm for comparative study) at the Indian Institute of Science. This plant, which dealt with the sewage from the Institute campus of about 400 persons, also served as a useful experimental installation for the study of the mechanism of the activated sludge process. In addition to being an experimental set up, it was also a model plant for providing practical instruction and experience to the students of engineering and medical colleges and other institutions and persons interested in public health and preventive medicine in different parts of India, who periodically visited and studied the operation of this sewage purification plant and other treatment systems. The facility of this activated sludge plant at the Institute is not available now. It should be pointed out that the activated sludge plant proved useful not only in understanding the mechanism of the activated sludge process but also in elucidating the biological principle of aerobic purification of sewage in general and microbiological oxidation of organic matter in waters and soils. Dr Fowler endeavoured to awaken in his students an enduring interest in the biochemistry of life-processes and in harnessing "the forces of biotic energy in the service of man."

Contributions to the Science and Practice of Sewage Management

Dr Fowler played a leading part in the practical development of the activated sludge process of sewage treatment which indeed is a continuing chapter in environmental science and technology. But his theories of the activated sludge process "*can be referred entirely to bacterial activity.*" He described it as "*a process of intensive bacterial oxidation, consisting broadly of three operations : a clotting or clarifying action, a rapid carbon oxidation, and finally nitrification.*" He added that it was not "*necessary to push clarification to the point of nitrification in order continuously to obtain stable effluents.*" He pointed out, however, that the mechanical and absorptive effect of a large mass of flocculent material must greatly assist clarification (A. J. Martin, *The Activated Sludge Process,* Macdonald and Evans, London, 1927, p. 131).

But later investigations by others did not confirm the view of Professor Fowler that the activated sludge process could be referred entirely to bacterial activity. They have collected more convincing evidence on the nature and extent of microbiological activity in the activated sludge process.

According to Dr Fowler, the relatively high nitrogen content of activated sludge with reference to other sewage sludges was due to the nitrogen fixing bacteria in the activated sludge tank which idea though convincing is perhaps yet to be confirmed by later investigations. The mechanism of concentration of nitrogen in activated sludge was later studied by other investigators who showed that certain protozoa in the activated sludge utilize the organic nitrogen, including the amino acids, in the sewage and thus concentrate and contribute to the relatively high nitrogen content of activated sludge.

Fowler's observations that oxygen in the nitrate in the purified or oxidized sewage effluent could be useful in the oxidation of organic matter in sewage led to later demonstrations of the necessity of dissolved oxygen for microbiological oxidation.

But the advent of the activated sludge process was, in the historical perspective, a momentous development. Until this development, sewage treatment was not regarded as a scientific discipline or subject, because the earlier methods of sewage disposal or treatment, like the dilution method (discharge of sewage into a body of water), treatment of sewage on an extensive area of land, lagooning or oxidation pond, chemical precipitation, or treatment on special beds or filters, e.g., the "contact bed", trickling or percolating filters, were rather empirical and did not evoke any interest as in a scientific reproducible process or as in a truly scientific reproducible process or as in a truly scientific principle. The development of the activated sludge process gave a new dimension to the whole field of sewage treatment in which a wider circle of scientists—chemists, microbiologists, engineers and others became interested in the investigation of the activated sludge process.

It is, however, deeply interesting that simple aeration of successive portions of raw sewage, a grossly polluted water or a polluting liquid or a manurial suspension and solution, gives rise to a material having a most remarkable purifying power which has been greatly appreciated and utilized for better sanitation and public health in the larger cities of the world. Consider, for instance, the conditions around a large city in the United States and the effective improvement by an activated sludge plant as described by Dr Fowler. He observed : "North of Chicago lies Milwaukee whose sewage at one time poured untreated into Lake Michigan fouling the water supply of this city and its neighbours. Now an immense activated sludge plant converts all this impurity into clear effluent and into fertilizer valued at £100,000 per annum. The sludge which used to defile the bright waters of the Lake now reappears as wheat on the wide acres of western prairies or as smooth rich turf on countless golf greens" (G. J. Fowler, *An Introduction to the Biochemistry of Nitrogen Conservation,* Edward Arnold and Co., London, 1934, p. 242.)

Referring to a smaller activated sludge plant at the Government Rifle Factor at Ishapore, near Calcutta, Dr Fowler observed that fish were grown in a tank on the estate of the Factory, into which for some time the effluent from that activated sludge plant had been discharged and that the fish had "grown freely and healthily under these conditions, and were stated by European consumers to be of excellent quality" (G. J. Fowler, *An Introduction to the Biochemistry of Nitrogen Conservation,* Edward Arnold and Co., London, 1934, p. 244). Dr Fowler was one of those few who conceived that the changes proceeding in fertile soil are similar to the changes

occurring in sewage during purification—a concept of great fundamental activated sludge plant put up by Fowler in 1922 at the Indian Institute of Science, Bangalore, as indicated, proved very valuable not only for elucidating the principle of the process of purification but also in demonstrating the value of the sludge as an organic fertilizer or manure and as a feed supplement for poultry.

Here then lies the major contribution of Dr Fowler in the development of the activated sludge process, the significance of which has been increasingly realised during the last 66 years as a compact and efficient system of treatment of sewage and other organic waste waters and the impact it has had on soil science.

Services to Science

In addition to being a leading sanitary chemist of his time, Dr Fowler was also a great educationist, a popular speaker and writer. By his speeches and writings he, more than any of his contemporaries, awakened great public interest in the subjects of sewage disposal and sanitation and production of wealth from waste. His popular articles are characterized by a keen sense of humour, breadth of view and a lucid style. Even as he dealt with scientific and technical aspects he had his own way and style of putting across his ideas in a most interesting and memorable manner. For instance, in explaining the behaviour of polycellular and polyenzymic organisms he wrote in his monograph on *An Introduction to the Biochemistry of Nitrogen Conservation,* 1934 (Edward Arnold and Co., p. 23) :

"The more highly organized plants and animals may be termed poly-cellular and monoenzymic, in the sense that different cells exercise quite different functions, and excrete entirely different enzymes, the whole organism being, as it were, a controlled community whose members were exercising different functions working in harmony with one another. A simple illustration of what is meant by this description is afforded by an experiment which can be made on any dog and to which no objection can be taken either by the dog or his friends. If a dog is given a piece of toast he will chew it carefully and at some length before he swallows it; if he is given a piece of meat, on the other hand, he will swallow it instantly without mastication. The dog presumably has no knowledge of biochemistry, but in fact he behaves in accordance with its laws, since the enzyme which dissolves the starch and carbohydrate of the toast is contained in his saliva, while the *pepsin* which breaks down the albuminoid of the meat is particularly active in his stomach, so much so that he has found preliminary mastication to be unnecessary."

Finally, it may be stated that for over 57 years, from 1896 to 1953, Dr Fowler ceaselessly worked and wrote on purification of water, treatment and utilization of sewage and other wastes in agriculture and thus roused the interest of the public in environmental sanitation and production of wealth from waste. Professor Gilbert J. Fowler will, therefore, be remembered as a great figure in environmental science and technology and its applications for the benefit of mankind.

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*The details of this publication were obtained by the kind courtesy of Dr A. L. Downing, Partner, Binnie & Partners, Consulting Engineers, London, and Mr John Pickford, Department of Civil Engineering, University of Technology, Loughborough, Leicestershire, U.K., to whom the authors' thanks are due.

The authors' thanks are also due to the Librarian and his staff of Indian Institute of Science, Bangalore, for their kind assistance in obtaining the details of some of the other publications.

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