Although the range of his mathematical interests was wide and led him to significant advances, for example, in logic, mechanics and potential theory, there is no question that his main impact on mathematics has been through the closely related fields of harmonic analysis and the theory of stochastic processes.

Wiener's interest in the first field was first stimulated by his association with Hardy and Littlewood at a time when their deep and pioneering work on Tauberian theorems for the classical summability processes still appeared to lack a general and unifying principle. This Wiener supplied in the form of his famous general Tauberian theorem and the equivalent result on the closure of translations of integrable functions on the real line. This was recognized immediately as a result of great significance in the study of convolution transforms, including as it did the classical results of Hardy and Littlewood as special cases, and it remains one of the most central and beautiful theorems of analysis. Indeed, it has come to occupy an even more central place in modern mathematics through the achievements of Gelfond and others in fitting it and its many generalizations into a more fundamental algebraic framework. Although Wiener himself never expressed his results in the terminology of the theory of Banach algebras that is now customary, it is clear from his proofs that the essential idea of convolution as an algebraic operation in an appropriate function space was very much in his mind, and many of the methods and techniques that he introduced are still the most natural and powerful ones.

The successful use of the Fourier transform in Tauberian theory led Wiener to the deeper examination of the nature of harmonic analysis and the major new concepts set out in his book *The Fourier Integral* (1933). His aim was to examine how far, and under what conditions, a general function $f(x)$ could be "analysed harmonically" as a Fourier integral $\int e^{itx} dF(t)$. His results in this direction and through the concept of the "harmonic spectrum" of a function have proved of vital importance in physics and other applications, and have provided a great stimulus in the development of contemporary theories of distributions and abstract harmonic analysis.

The methods of this first book were taken into wider and even more difficult fields by his work with Paley on the *Fourier Integral in the Complex Domain*, and published jointly in a famous book of that name.

These two books contained also Wiener's first formulation of the third major theory which occupied his attention for the rest of his life. This was the theory of stochastic processes and, as was natural and inevitable, their harmonic analysis. He was very much influenced in all his work by physical problems and had long been interested in certain problems of statistical behaviour and, in particular, in the phenomenon of Brownian motion of small particles suspended in fluids. There was at the time no satisfactory mathematical formulation of this, or even the tools to make it possible, and Wiener's great achievement here was to provide such a formulation in a way which made good sense physically and was mathematically rigorous and capable of wide and fundamentally important generalization. The mathematical result was the proof that a random function (or stochastic process) could be described by the specification of a measure (in the Lebesque sense) in a space of functions in such a way that the measure of certain sets could be assigned. This is still one of the main problems in the modern theory of stochastic processes.

The idea of the harmonic analysis of a random process may well be regarded as the synthesis of his work, because it is on this that his contribution to the theory of cybernetics is based. His main ideas have been set out in many papers and, in shorter form, in the books *The Extrapolation, Interpretation and Smoothing of Stationary Time Series* (1949), *Non-Linear Problems in Random Theory* (1958) and *Cybernetics* (1948 and 1961). He has often been described as the "father of cybernetics", and there is no doubt that his work and his advocacy have both had a decisive influence on the whole development of the subject. He was one of the first to see the close connexion between the physical theories of transmission of information, feed-back and control and the action of the human brain; and his work in this direction over the past years has done much to establish what is plainly to become a vital field of fundamental research.

Wiener was conscious in all his work of its possible applications and effects, and he was particularly concerned about the long-term implication of automation, which he clearly and quite rightly saw as one of the basic social (as distinct from scientific) problems of our age. In fact, this concern was only to be expected of a man who had always a very deep social and moral sense and who was as strongly incensed by injustice or cruelty in any form as by political folly and stupidity.

The same quality showed in his relations with individuals. He was, it must be said, a truly formidable personality, both on account of his immense erudition in fields unexpectedly far from his own and by the intensity of his feelings and reactions: but this was fully matched by the depth of his concern for others (particularly when in difficulty or trouble) and by his habits of friendly and unaffected kindliness to the many who asked his help or sympathy.

He was, above all, as a friend and teacher an inspiration to a whole generation of younger mathematicians, and those who knew him best in this way will be most conscious of the privilege that was theirs and the debt that they owe him.

H. R. Pitt

Dr. Georges Blanc

North Africa is a fertile region for parasitologists; the story began with Alfonse Laveran, who discovered the malaria parasite in Algeria, and thereby stimulated a succession of his fellow countrymen along the coast to achievements almost comparable with his own. Thus in Tunis, Constantine, Algiers and Casablanca, Charles Nicolle, A. F. X. Henry, Edmond Sergent and Georges Blanc, respectively, have made fundamental discoveries in tropical medicine during the course of this century. Georges Blanc died last year, and now, of these great Frenchmen, only Sergent and Henry remain.

Georges Blanc was born in 1884 at Vauvers (Gard), and died on April 13, 1963. He graduated in science in 1907 and in medicine in 1911. He learnt his formal parasitology under Blanchard, in the Faculté de Médecine of Paris, his protozoology as a junior colleague of Chatton, and his field work with Nicolle in Tunis. Nicolle said affectionately of Blanc that of all his pupils Blanc was the one who most resembled himself. With Chatton, he detected structures in *Toxoplasma*, almost submicroscopic in size, which, many years later, were found by electron microscopy to provide a new classification of the Sporozoa.

For twelve years (1920–32) Blanc was the director of the Pasteur Institute of Athens, where he investigated parasitological problems of the northern coast of the Mediterranean; then for the next thirty years he directed the Pasteur Institute of Morocco, working on the allied problems of the southern coast. During the Second World War, he was marooned in France, but succeeded in getting back to North Africa with his cultures of micro-organisms; he reached Toulouse by train and then had to travel on foot for the next 400 km across the Pyrenees into Spain.

Blanc was an eclectic worker, and any subjects that he investigated became illuminated in unexpected directions. His observations on plague led him to believe that human fleas and lice play a much greater part in transmission than is usually thought, and that the organisms remain virulent in their excreta and corpses. He developed vaccines or sera against this disease, typhus and toxo-

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plasmosis, and he may well have been the figure who inspired Camus to write *La Peste*, though Blanc himself violently disagreed with its amateur epidemiology. Like most parasitologists of this epoch, he was drawn to the study of animal reservoirs of human infections, and made notable contributions to our knowledge of their importance in toxoplasmosis, *Q* fever and *fièvre boutonneuse* (from which his wife suffered severely in Morocco), leishmaniasis and relapsing fever. These diseases require arthropods for their transmission, and Blanc spent much time in the Neffik Forest trying to disentangle the complicated network linking ticks, mites, rodents, rickettsiae, etc., with man. In this forest, he isolated the virus of choriomeningitis in wild rodents and of myxomatosis in ticks. He early reached the conclusion that the sexual cycle of an organism in the arthropod provides the key to its systematics. Blanc had to be an entomologist as well as a bacteriologist, and both a protozoologist and a mammalogist.

He will perhaps be best remembered for his demonstration of the life-cycle of the causative organism of *Q* fever in wild rabbits and *Hyalomma* sp., the transovarial passage of the rickettsiae through *Rhipicephalus* sp., the first use of a living vaccine against typhus, and his interesting theories about the epidemiology of plague. Almost his last paper analyses the causes of the present-day eclipse of plague. His friends will remember him for his generosity of spirit and good companionship. P. C. C. Garnham

Dr. R. S. J. Hawes

The death of Dr. R. S. J. Hawes, lecturer in zoology in the University of Exeter, occurred in London on July 22, 1963. After leaving school, he started a business career and entered the office of an oil company. In a few years, however, he decided that his vocation lay in the scientific world. He took a zoology degree at King's College, London, under the late Prof. D. L. Mackinnon, and was awarded the degree of Ph.D. in 1943 for research on eye structure and reaction to light of the cave amphibian, *Proteus anguinus*.

His first investigations were on the cavernicolous fauna and he took part in an expedition to Yugoslavia, a country which he visited again to collect specimens of the cave salamander, *Proteus*. However, the interest in Protozoa, first stimulated by Prof. Mackinnon, was his major field of study.

His published works were few in number, dealing with cave fauna, and with *Trichomonas vaginalis* and parasitic amœbæ. On the other hand, he was interested in all aspects of protozoology, as shown by the article published posthumously on sexuality, and a text-book. The book, *An Introduction to the Study of Protozoa*, probably represents his major achievement. It was commenced by Prof. Mackinnon, and on her death was completed by Dr. Hawes. It has now established itself as one of the best introductory texts on Protozoa.

Dr. Hawes took an intense interest in the progress of his students, most of whom were unaware of the despondency and the elation which their efforts caused. Dr. Hawes had more than his fair share of personal tragedies, but he did not allow these to affect his morale. He was a man of wide acquaintance and varied interests. For him, there was no barrier between the "two cultures" and he was equally at ease among scientists, High Church dignitaries, writers, musicians and artists. He maintained uncompromising æsthetic standards throughout his life. A great conversationalist, he delighted his friends by recounting stories, often of a slanderous nature, in his inimitable manner.

It is a tragedy that his death came at a time when his work seemed to be reaching an authoritative status.

R. A. Neal

Mr. F. J. Wilkins

Mr. F. J. Wilkins died suddenly on March 24. He joined the Distillers Co., Ltd., in 1938 as a chemical engineer in the Technical Development Department. After periods of service with the General Works Department and with British Industrial Solvents, Ltd., at Hull, he returned to the Research Department at Great Burgh, Epsom, and finally became manager of process development. As such he was responsible for chemical engineering and pilot plant operation, and contributed much to many major projects of the company.

He was prominent in the activities of the Institution of Chemical Engineers, being a member of Council and its Board of Examiners. He was also chairman of the Distillation Panel of the Association of British Chemical Manufacturers.

Mr. Wilkins leaves a widow and two sons, to whom his many colleagues and friends extend their deepest sympathy.

NEWS and VIEWS

The American Geophysical Union: Awards

The twenty-sixth *William Bowie Medal*, the American Geophysical Union's highest honour, has been presented posthumously to Prof. J. Bartels, who, until his death on March 6, was professor of geophysics in the University of Goettingen and director of the Max Planck Institute for Aeronomy, for "unselfish co-operation". Early in his career, Prof. Bartels developed statistical procedures especially suited to the needs of geophysics. His investigations led to a clear discrimination between geomagnetic variations arising from wave and particle radiation from the Sun. He also developed measures for the solar wave radiation, and derived indexes for the effects of solar particle radiation on geomagnetic variations. The widely used planetary indexes, K_p, were prepared by Prof. Bartels for each three-hourly interval since 1932. He applied his statistical methods to provide an understanding of the periodic effects of the Moon's gravitational influence on atmospheric tides and their influence on geomagnetic and ionospheric variations. He used these variations to investigate the 27-day variations in geomagnetic activity associated with the solar period of rotation and found that they were unrelated.

The third annual *John A. Fleming Award* has been presented to Dr. E. O. Hulburt for his "original research in geomagnetism, atmospheric electricity, and aeronomy, and his leadership on the national and international levels". Until his retirement in 1955, Dr. Hulburt pioneered atmospheric and ionospheric research as the first director of research in the U.S. Naval Research Laboratory in Washington, D.C., and inspired the growth of its programme of space research. While he was with the U.S. Naval Research Laboratory, he became well known for his scientific contributions to the solutions of naval problems related to optics of the sea, visibility through the atmosphere, target detection, and camouflage, for which he received the Navy Distinguished Service Award in 1945. Dr. Hulburt in 1925 deduced the structure of an ionosphere varying in density with height and capable of returning radio signals by refraction. His work led to an explanation of the origin and behaviour of the ionosphere under the influence of solar ionizing radiation.

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