Porton, with whom we have kept in close contact during the years 1939–45.

The following have taken part in these investigations at Cambridge:

H. McCombie; B. C. Saunders.

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| F. J. Buckle. | G. J. Stacey. |
| N. B. Chapman. | F. E. Smith. |
| H. G. Cook. | F. Wild (part-time). |
| R. Heap. | I. G. E. Wilding. |
| J. D. Ilett. | S. J. Woodcock. |
| F. L. M. Pattison. | |

The physiological action on animals of most of the compounds described above were examined at the Cambridge Extra Mural Testing Station by:

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|---|---|
| E. D. Adrian. | B. A. Kilby. |
| K. J. Carpenter. | M. Kilby. |


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[2] Saunders, B. C., Ministry of Supply Meeting (London, Dec. 11, 1941). See also Report No. 1 on Fluorophosphonates to Min. of Supply by McCombie, H., and Saunders, B. C. (Dec. 18, 1941).

[3] McCombie, H., and Saunders, B. C., Report No. 2 on Fluorophosphonates to Min. of Supply (Feb. 27, 1942).

[4] McCombie, H., and Saunders, B. C., Report No. 3 on Fluorophosphonates to Min. of Supply (March 28, 1942).

[5] British Secret Patent. Min. of Supply. H. McCombie, B. C. Saunders, N. B. Chapman and R. Heap (April 17, 1944).

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[8] McCombie, H., and Saunders, B. C., Report No. 7 on Fluorophosphonates to Min. of Supply (Jan. 16, 1943).

[9] McCombie, H., and Saunders, B. C., Report No. 8 on Fluorophosphonates to Min. of Supply (March 1, 1943).

[10] British Secret Patent. Ministry of Supply, H. McCombie, B. C. Saunders (Sept. 15, 1943).

[11] Sutton Oak Report at Ministry of Supply Meeting (London, March 22, 1944).

[12] McCombie, H., and Saunders, B. C., Report No. 6 on Fluorophosphonates to Min. of Supply (Sept. 30, 1942).

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# GEOLOGICAL STUDIES IN GREECE


By Prof. G. GEORGALAS

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In geological research Greece has lagged behind the rest of Europe. This is mainly because, since its liberation in 1830, little attention has been paid to the exploitation of its natural resources. The opinion which persisted for nearly a century that the subsoil of Greece did not contain mineral wealth contributed to a great extent to the belief that the geological study of the country was valueless.

The few geological studies of particular regions which had been written up to 1910 came mainly from foreign men of science, and only a very few, principally by C. Mitzopoulos, Socrates Papavasiliou and Th. Skouphos, from Greeks. Many of the trunk roads and railways were projected without any previous geological survey to determine the nature of the rock to be cut, the possibility of landslides, etc. In the Corinth Canal, for example, there are frequent falls of great masses of rock from the sides, which are nearly vertical. The geological composition of the region was not studied beforehand in order to determine the proper inclination of the banks.

The compilation of a detailed geological map of Greece has not yet been begun. There are only geological maps, drawn to large scale (mainly 1 : 300,000) of some areas of Greece, made mainly by foreign scientific workers, particularly by the German, Prof. A. Philippson.

Greater interest in geological research in Greece began after 1910, inspired by my predecessor, Prof. C. A. Ktenas. Up to 1935, when he died, Ktenas had surveyed several regions of Greece, investigating the possibilities of exploiting industrial minerals, and also from a purely scientific point of view.

Both Ktenas and his predecessor, Prof. Mitzopoulos, had many years previously stressed the need for setting up a Geological Survey in Greece. Thanks to the persistent efforts of Ktenas and myself, it became possible for me to establish, in 1919, the present Geological Survey of Greece, which I directed until 1936. The Survey has experienced great difficulties. It began its work with a very small number of scientific workers and the sums provided by the State were always very meagre. Nevertheless, to date many serious studies have been made which have contributed to a fuller knowledge of some of the sources of natural wealth of the country. The following notes refer to some of the principal investigations which have been made.

I studied for the first time and announced the existence of deposits of bauxite in Greece. Up to 1922, these deposits were regarded—owing to incorrect chemical analysis—as deposits of iron ore rich in quartz ($SiO_2$) and therefore unsuitable for exploitation. The announcement was followed by the discovery by others of deposits of bauxite in various regions of Greece. It is at present known that there are deposits of bauxite in Phthiotis-Phokis (massif of Parnassos-Ghiona), the Island of Amorgos, near the town of Eleusis and elsewhere. The reserves of bauxite in Greece are estimated to be of the order of hundreds of millions of tons. In Phthiotis-Phokis alone it is estimated that there are more than fifty million tons of bauxite. The fact that these particular deposits are found near the falls of the River Acheloös, which could generate enormous electric power, promises the possibility of developing an aluminium industry in Greece.

I also studied the lignite deposits in Greece. The existing reserves are estimated to be of the order of several million tons. Research has still to be carried out on how and where Greek lignite could be used.

I have also investigated the outcrops of petroleum which occur in many places in Greece, especially in the region of Jannina (Epirus) and in western Thrace. Prospecting carried out at the expense of the National Bank of Greece in western Thrace did not give satisfactory results. The War unfortunately prevented prospecting in the Jannina region.

The personnel of the Geological Survey recently began to study the beds of kaolin on the Island of Melos in the Cyclades, but this work was also interrupted by the War. The quality of the kaolin is excellent and it only remains to determine the potential amounts available for exploitation.

The Geological Survey, both through myself and its other geologists, has assisted many small towns and villages in Greece on the question of a supply of drinking water. Assistance has also been given to the State services when measures had to be taken to rebuild inhabited areas devastated by earthquake, as for example, those of Chalcidice, Corinth and Heraclion in Crete, etc.

The need for compiling a general geological map, even on the scale of 1 : 300,000, which would be of fundamental assistance to the various State services and to private individuals requiring general knowledge of the geological formations of each area, led me to begin the publication of such a map in 1936. In this work I made use of all the geological surveys made by foreign and Greek geologists published up to that time. All my maps were produced to a scale of 1 : 300,000 with identical conventional signs. So far only six sheets of this geological map have been published.

I have studied the geological formations and the hydrogeological conditions of the region of the dam and artificial lake of Marathon, from which the city of Athens to-day is supplied by water. I have also made geological surveys of some river valleys to investigate the possibilities of building dams to harness these rivers for electric power.

The Geological Survey now has a fully equipped chemical laboratory for the chemical analysis of the ores and rocks of the country and also for the physical, chemical and physico-chemical study of the mineral waters of Greece.

Greece is extremely rich in hot springs. The principal springs had already been examined chemically and classified, but on an out-of-date scientific basis ; the Geological Survey has therefore classified each spring on modern scientific principles. These studies brought to our knowledge for the first time new varieties of spring as, for example, the radioactive springs of Kammena-Vourla (with a radioactive capacity of 120–300 Mache units) and of the Island of Icaria (with a capacity of up to 400 Mache units).

The Geological Survey of Greece has also carried out purely scientific studies. It observed and studied the two eruptions of the volcano of the Island of Santorin which took place in 1925–26 and in 1928. The results of the investigation of these eruptions were published, together with those made by the German Scientific Mission which came to Santorin, in Berlin in three volumes under the title "Santorin".

I organised a special section within the Geological Survey for the study of Greek soils. This section examined and classified the various soils in Greece and published several original monographs on some of the types of soil.

In my capacity since 1936 as professor of mineralogy and petrology in the University of Athens I have studied the phenomena of the latest eruptions (1939–41) of the volcano of Santorin. Only one provisional paper, read before the Greek Academy of Sciences, has been published so far. The study of the prehistoric volcanoes of the Egean Sea and their lava flows, begun by my predecessor, Ktenas, has been continued by me.

In the last twenty years, a number of posts for scientific workers have been created in the Laboratories of Mineralogy, Petrology and Geology of the University of Athens. Here students are working with enthusiasm and energy on the minerals, rocks and geological formations of the country. Thus an adequate scientific geological staff to-day exists in Greece, able and willing to give its services in the study of the soil of Greece and to evaluate its wealth in the new era of struggle now beginning for my country—the struggle for the reconstruction of Greece and the creation of a new and higher Greek civilization.

# OBITUARIES

## Dr. Francis William Aston, F.R.S.

Aston's name is associated in the minds of men of science with the mass spectrograph and the discoveries concerning isotopes to which it led. In the history of British physics it is rare that a man's work should thus be associated with an instrument, though it is common enough to be almost the rule among the great names of American science. Though, in fact, in Aston's case the instrument was devised to test a specific theory and not developed for its own sake, it is yet true that Aston's mind was fundamentally that of an instrumentalist to whom experimental methods and actual manual dexterity are a joy in themselves approaching that to be gained from the results they give. This habit of mind can be traced throughout his life, and the skill of hand that went with it found expression as well in games and in music.

F. W. Aston was born in September 1877 at Tennal House, Harborne, Birmingham, which is still occupied by a member of the family. He was the second son and third child of a family of seven. From an early age he showed a passion for mechanical toys. After a preparatory education at Harborne Vicarage School, he went for two years to Malvern College, where he began the study of science. He left in 1893, head of the school in chemistry and physics and in the highest mathematical set, to enter Mason College, Birmingham. Here he worked under Tilden and Frankland for chemistry, and under Poynting for physics, of whom he often spoke with affection in later years. At Birmingham, too, he laid the foundation of his skill as a glass-blower which was to be so important to him later on. In 1898 he was awarded the Forster Scholarship and worked on the preparation and optical rotatory properties of a complex tartaric derivative, the results of which were published in collaboration with Frankland in 1901. For financial reasons he then took up fermentation chemistry and was engaged for three years at a brewery in Wolverhampton. During this period his thoughts were turning to physics under the influence of the new science that followed the discovery of X-rays. Quite naturally his interest expressed itself in terms of apparatus. He designed and made a new pattern of Sprengel pump, and with it exhausted small focus tubes, made from chemical test tubes, in a tiny workshop at home. The Sprengel pump led to a Tœpler, also of new design, and he discovered a type of rectifying valve depending on a gas discharge.

In 1903 Aston definitely returned to physics, with a scholarship to the University of Birmingham, as Mason College had by then become, where he worked on properties of the gas discharge, in particular of the dark space. His measurements of the length of the Crookes' dark space and its variation with current and pressure are still classical and appeared in the *Proceedings of the Royal Society* of 1905. Two years after, he discovered the narrow region which appears in some gases inside the Crookes' dark space and is known as the 'Aston dark space'. Then came a tour round the world, as the result of a legacy, which confirmed him in a love of travel, and especially of ocean travel, that never left him and was the source of much happiness.

In 1909 Aston took the step which, as it turned out, determined his future scientific career, by accepting the invitation of J. J. Thomson to work as