

between oppositely charged volumes of cloud maintaining their charge steadily for some seconds at least.

(The Discourse was illustrated by a number of experiments with a 500,000-volt impulse generator; in the darkened auditorium the positive and negative leader strokes were shown at different stages of development, the influence of electrode shape on leader strokes was demonstrated, and examples of the 'protective action' of a pointed electrode on the space around it were shown. The influence of the nature of the terrain on the incidence of lightning was illustrated with a sand tray model.)

¹ Simpson, *Proc. Roy. Soc.*, A, **111**, 56 (1926).

² Schonland and Craib, *Proc. Roy. Soc.*, A, **114**, 229 (1927).

³ Wormell, *Proc. Roy. Soc.*, A, **115**, 443 (1927).

⁴ Schonland and Allibone, *Nature*, **123**, 794 (1931).

⁵ Allibone, Hawley and Perry, *J. Inst. Elect. Eng.*, **75**, 671 (1934).

⁶ Allibone and Schonland, *Nature*, **134**, 736 (1934).

⁷ Allibone, *J. Inst. Elect. Eng.*, **82**, 513 (1938). Allibone and Meek, *Proc. Roy. Soc.*, A, **166**, 97 (1938).

⁸ Allibone, *J. Inst. Elect. Eng.*, **82**, 513 (1938).

⁹ Schonland, *Proc. Roy. Soc.*, A, **164**, 132 (1938).

¹⁰ Allibone, *Nature*, **161**, 970 (1948).

THE HISTORY OF ALUM

A HISTORY of almost any common material could be made the framework of a general history of civilization, both in its political and economic aspects, and hence could serve as a kind of heuristic method of teaching general history. This would be a very uneconomic method, since every specialist author would have to repeat a large mass of material already traversed by every other author; and it may be suggested that a historian of science or technology might profitably assume that the political history (taking the name in its widest sense) with which his studies bring him more or less intimately in contact can be sought elsewhere. There are notable exceptions to this; some works on the history of science, such as Meyer's "Geschichte der Botanik", deal in detail with various aspects of general history in a way which makes them still very useful to the professional historian when he happens (as is rarely the case) to know of their existence. The history of alum is a subject which lends itself very well to a plan of fitting it into a general picture of the conditions and movements of the times traversed, and an author working up this subject has a good opportunity of doing this if he feels inclined towards it. It may be said that Dr. Charles Singer has, in fact, incorporated a substantial amount of such material, including a general history of the alum trade, in his recently published account*, and this will make it especially valuable and interesting to the general historian.

An author taking up a study of the history of a material will find that his subject will fall into one or other of three large groups. In the first, the basic information is already well known and exists in adequate detail; such, for example, would be the history of iron. In the second, practically no coherent and collected information is available, and the author is compelled to go through an immense number of likely and unlikely sources, assemble a mass of unconnected and generally contradictory statements, and then attempt to reduce the material to some kind of order, carefully avoiding any tendency to

arrive at general conclusions before this has been done, so as to prevent the possibility of making a framework into which the material must, at all costs, be fitted. In the third group, the material has already been treated, but imperfectly and often at a date when important information relevant to it was not available. It may be suggested that the history of alum belongs to this third group. Its main outlines have been drawn by such authors as Beckmann and Heyd, and the main sources to which a modern author might turn for his materials have been stated by them. It is then essential to re-examine the data and, in completing it and adding what is new, to draw more correct conclusions. Beckmann, for example, although he makes use of nearly all the material now available, drew a completely incorrect conclusion from it, namely, that alum was unknown in antiquity.

The history of science can be presented in various ways. Those who have read the previous publications of Dr. Singer will be aware of the general guiding principles which he follows, and will know what to expect. An author may confine himself to an account of his subject proper, or he may include what may be called the external machinery of science, such as the foundation and growth of scientific societies, the relation of the personalities with whom he deals with religion or politics, when they happen to have had such relation, and in such cases to deal with these wider aspects of the subject. Some sciences lend themselves more easily to such treatment; astronomy in particular is one, and such personalities as Galileo offer an almost inexhaustible plenitude for repetitious treatment in such a way. This type of writing, however, is more suited to the general historian, or the author who sees in the history of science an opportunity of conveying to his readers, many of whom he may hope are relatively uninstructed, his cherished beliefs or creeds. Such writing is not in the category of history of science proper, and does not advance in any way the study of this subject.

In his publications Dr. Singer has followed a middle path. He has available a wealth of detailed knowledge such as the specialist would use in producing a severely professional account of the subject, and at the same time he has a feeling for the picturesque and attractive marginal aspects, in particular of the value of illustrative material, which make his works so attractive and readable. Much of this material is drawn from little-known and inaccessible sources such as manuscripts or books, the existence of which is unknown to the general historian of science. In the present work, in the preparation of which Dr. Singer has been fortunate in being able to draw on such sources, he has given a selection of illustrations, including many in splendid colour, which puts the book into a class of the highest interest, and makes it, even to those not much drawn to the general story of alum, one which must have a lasting value as a fine book, in the production of which the artistic craftsman has played a notable part. In the appearance of the book, as a book, everyone concerned must take a justified pride. Dr. Singer always takes care to accompany every illustration with an adequate description, and this feature of his authorship is fully continued in his latest work.

The book is divided into five main parts: antiquity, medieval technical and chemical lore, medieval trade, monopolies and empirical methods, and the rise of scientific industry. As stated above, although the guiding theme is the history of alum, an opportunity

*The Earliest Chemical Industry: an Essay in the Historical Relations of Economics and Technology illustrated from the Alum Trade. By Charles Singer. Pp. xviii+337. (London: Folio Society, 1948.) £10 10s. 0d.

is taken in each section of presenting information from other departments of knowledge, which makes it, in itself, a valuable source for the student of each period as a whole, although the quotations from texts are, in the main, those dealing with alum. There are 361 references collected at the end of the book, an arrangement which, although perhaps necessary on æsthetic grounds, is very inconvenient to the reader in search of information. There has been a tendency among old-fashioned authors, particularly in Britain, to show a degree of shame in exhibiting detailed knowledge; this is perhaps a relic of their own school days, when such accidentals of scholarship were looked upon with disfavour. Such reticence is out of place in modern works on the history of science, when precise documentation is necessary and expected. Dr. Singer, as usual, takes a middle way, giving us in many cases only the title of the work, without a page reference. His bibliography is very satisfactory; only in one or two cases would one have wished for slight additions, as when he refers to D'Arcy Thompson's "Glossary of Greek Fishes" for the murex and omits to mention the special treatise by Moatsou (Alexandria, 1932); but even the narrowest specialist will find himself baulked at every turn in his search for omissions of sources in Dr. Singer's impressive list.

A reviewer is expected to find at least a few faults with every work, and to show good faith to his kind, the present writer will hurry over a few slight trivialities of this sort. The *bain Marie* of the Greek-Egyptian chemists was not a water-bath, and the original figures of the *kerotakis* would have been better than the supposed reconstructions (p. 10); *trichitis* (p. 19) is not alum, as the author knows in another place; *realgar* is not red sulphide of mercury (p. 52); 'saturated alkali' (p. 39) is probably ferrocyanide. Agricola was not a technological expert and cannot be expected to understand all he describes, and his portrait is not contained in any original edition of his book the reviewer has seen (pp. xv and 227); phlogiston is named before Stahl's work of 1703 (not 1702, as stated) (p. 249), and the dephlogisticated part need not be a 'fixed' body—in sulphur it was sulphuric acid; Lavoisier did not think the alkalis were oxides of unknown bases (p. 267); Davy's first name for potassium was 'potasium' (p. 268); Wöhler's aluminium was not very impure, and the metal was also obtained by Ørsted in 1826 (p. 268). These are all trifles. The style of the book is clear, concise and attractive; only in one or two cases has the author been hypnotized momentarily by his text, as in the Germanic "they dyed always the yarn before weaving" (p. 265). The reader should not omit to look up the references, where additional information is often to be found.

The story presented by Dr. Singer is, in brief, the following. Alum was known to the ancient Egyptians and Assyrians, who used it medicinally and in magic. Its use as a mordant in dyeing is described at least as early as Pliny (who, by the way, gives the first record of galls as an indicator long before Fallopius, p. 244), and from that time the history of dyeing is intimately connected with the history of alum, so that the book is valuable to those interested in dyes. It is shown that knowledge of chemical substances in the classical period was much more extensive than is sometimes thought, and not a few, alum notably, were known in quite reasonably pure condition. An account of ancient baths is given. Puteoli (modern Pozzuoli, on the Bay of Naples) was a source of alum,

its baths long being famous. The information about technical arts in the medieval period is drawn from several treatises compiled in that period by non-literary authors, giving recipes for dyeing, etc.

After a concise account of Arabic alchemy (in which the strange difference between the "Secret of Secrets", an alchemical work thought to be by al-Rāzī, from his medical works is not noticed), and its continuation as the so-called Latin alchemy, Dr. Singer deals with lapidaries and handbooks such as the "Hausbuch" and the problematical "Plictho". A long and detailed account of medieval trade brings together much information about the rivalry of the Italian centres. In this period the import of alum from the East increased, although European alum, less esteemed than the Asiatic, was still made in significant amount. Exports from the Eastern Mediterranean, Phocœa, and the Black Sea became important, and there is an interesting account of Phocœa in Pegolotti. The rise of Venetian trade under a grant of privileges in the Byzantine imperial domains is linked with the influence of the Crusades. In the fourteenth century Florence had a trading supremacy, and the connexion between alum and wool turned a new corner on the way of technology and trade. Western sources of alum were now productive.

In 1461 large quantities of alunite, a mineral from which alum can be made, were found at Tolfa in Papal territory, and the famous Papal alum monopoly was established mainly by the efforts of Giovanni de Castro and Pope Pius II. The profits of the trade helped to subsidize the war against the Turks. The purchase of 'infidel' alum was anathematized, and indulgences were based on such motives. It is perhaps not generally known that the famous indulgence on which Luther acted was of this character. The monopoly of the Papal alum factory was later broken by the northern countries making alum from other sources. A financial contract between the Medici and the Apostolic Chamber in 1466 began a period when alum was not infrequently mingled with the hopes of mankind for felicity in the hereafter. This story of the Papal monopoly is fairly and clearly told; it had interesting ramifications. The works at Pozzuoli are well described, the illustrations of this volcanic region being most interesting. Some splendid coloured plates are reproduced from the work of Sir William Hamilton, who visited the district in his capacity of British Ambassador to Naples in 1764, as well as an interesting drawing by Madeleine Hortemels (aged seventeen) of the Grotto del Cane in a guide book of 1707. For this source of alum we have the well-known book "Metallotheca" by Michele Mercati (1717).

The working of alternative European sources of alum in the seventeenth and eighteenth centuries is described, with an interesting excursion on the history of mining (which is just beginning to pass out of the second category mentioned at the beginning of this review) and mineralogy, including mineralogical collections and museums. Alchemy was now giving way to chemistry, and for that reason the alum industry, which is perhaps the earliest chemical industry of all, could become scientific. Dyeing also became scientific, and the description of the sources and uses of the natural dyes is one of the most interesting sections of the book. The British alum industry had its rise in the exploitation of the carboniferous shale of the Yorkshire coast and Scotland. Peter Spence (1806–83) was the pioneer of this

industry, and his descendants are among the premier alum manufacturers of the world. The preface of Dr. Singer's book, by Mr. Derek Spence, explains how it was wished in 1946 to celebrate the hundredth anniversary of the company by a lasting memorial to Peter Spence, and the present splendid volume is the result. In achieving their object they have at the same time, thanks to the unrivalled knowledge and literary skill of Dr. Singer, added a lasting contribution to the history of science for which they deserve the warmest thanks of all those interested in its welfare. This book will take its place among the great classics of the subject.

J. R. PARTINGTON

OBITUARIES

Dr. A. D. Imms, F.R.S.

AUGUSTUS DANIEL IMMS, who died on April 3, 1949, at the age of sixty-eight, was well known to zoologists and entomologists throughout the world, and there are few, if any, modern zoological text-books with a wider circulation than his famous "General Text-book of Entomology". Imms graduated at Birmingham in 1903 and shortly afterwards went to Christ's College, Cambridge, as an 1851 Scholar. Here he obtained a B.A. degree by research in the days before the institution of the Ph.D., and came much under the influence of Dr. David Sharp and Sir Arthur Shipley. From being an assistant demonstrator in zoology under Prof. Gamble at Birmingham, he went to India in 1907 as professor of biology in the University of Allahabad. Later he was for three years forest zoologist to the Government of India.

These seven years in India influenced profoundly his further development as a zoologist, adding to his sound morphological attainments breadth of view in biology and an understanding of the complexity and urgency of the problems of agricultural and economic zoology in the tropics. While in India, Imms produced his best research work, among his papers at this time being a fine study of the morphology and biology of *Archotermopsis*, a primitive member of that most fascinating group of insects, the termites, the stupendous colonies and elaborate social organisation and caste system of which have been the marvel of zoologists since the end of the eighteenth century when entomologists first began to explore systematically the faunal riches of the tropics.

But it was not as an original investigator that Imms was to make his real mark. In 1913 he returned to England as reader in agricultural entomology in the University of Manchester, and he there commenced work on the great "General Text-book" already referred to. This was held up by the First World War and was not finished until 1925, by which time its author was chief entomologist at the Rothamsted Experimental Station. The text-book, a monumental work, has gone through many editions; it is in every way comparable with and in many respects superior to its famous predecessors, Packard's "Text-book of Entomology" (1898), Henneguy's "Les Insectes" (1904) and Berlese's "Gli Insetti" (1909). In this book Imms found full scope for his particular combination of qualities: an encyclopaedic knowledge of his subject, a meticulous accuracy, a sound morphological insight and a well-balanced critical faculty. Indeed, it is the critical acumen and the balance of the book which are perhaps its most

outstanding features, although the balance was somewhat upset in later editions by the immense growth of physiological investigation, a field in which Imms was less especially interested and which he left to others to summarize in text-book form. Imms was also the author of other valuable books, notably "Recent Advances in Entomology" (first edition 1930) and "Insect Natural History" (1947), and he produced the excellent articles on entomology in the "Encyclopædia Britannica".

Imms was elected a fellow of the Royal Society in 1929, and in 1931 he went to the Department of Zoology at Cambridge as first incumbent of the newly created readership in entomology. Here he built up a new sub-department and, during his time as reader, served on the Council of the Royal Society. He was president of the Royal Entomological Society of London and of the Association of Economic Biologists. When the main burden of text-book writing and the work of organising the sub-department was ended, Imms returned once more to personal research, and produced some valuable memoirs bearing particularly on morphological problems fundamental to questions of the ancestry of insects and phylogenetic relationships of the main orders. These included work on the growth processes in insect antennæ, on the constitution of the maxillæ and labium in the Mecoptera and Diptera—a study which throws a great deal of light on the relationships of the latter order—and an admirable short paper on the biology and relationships of that most puzzling insect *Braula caeca*, the 'bee louse'.

Personally Imms was reserved, and probably few people knew him intimately. Although he stimulated an immense quantity of valuable research through his writings, he was sometimes apt to appear discouraging to undergraduates, seeming on occasion to dishearten and chill by an apparent lack of enthusiasm. But in reality he was an excellent judge of promise in young research workers; he knew the real investigator directly he saw him, and he recognized and appreciated the type which would respond to criticism in the right way and whose ardour nothing would damp. A student of this quality could count on him for unwavering support and friendship.

Imms was elected a Fellow of Downing College in 1940, and his work for the College and his relations with its society constituted perhaps one of the happiest episodes of his career. When the Second World War came and the younger Fellows of the College left for war service, he unhesitatingly undertook the arduous duties of bursar and steward, thus entering on work with which he was previously altogether unfamiliar. Nevertheless, he made a real success of it and impressed all his colleagues with the rapidity and efficiency with which he got things done; he was particularly clever in making the most of the scanty time at his disposal, and it was astonishing how he contrived to carry this heavy burden of College work without apparently decreasing the time available for his scientific activities and without ever becoming in the least 'ruffled' over the sometimes irksome jobs which arose in the course of his duties. On his retirement from the University readership in 1945, Imms received the honour of election to an honorary fellowship at Downing. He was also honorary member of a number of learned societies in foreign countries, including France, Holland and Finland. The climate of Cambridge never suited Imms, and on retirement he therefore settled in Devon in the hope that he would enjoy better health