of penicillin, although presumably the supply is too limited for this treatment to be used extensively. Relapsing fever due to *Trep. recurrens* has caused trouble in Abyssinia and the Middle East; in some places, the response to neo-arsphenamine has been disappointing, and stovarsol, tryparsamide or bismuth have been more satisfactory. When the medical history of the present War can be described in full, because peace has come, it will include many interesting features.

F. HAWKING.

ANTOINE LAURENT LAVOISIER, 1743–1794

By PROF. J. R. PARTINGTON, M.B.E.

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ANTOINE Laurent Lavoisier, the architect of modern chemistry, was born in Paris on August 26, 1743. His father was an advocate and his mother the daughter of an advocate. The fortunes of the family of Lavoisier had progressed from employees in the postal service, through trade, to the legal profession, and although the father was not wealthy, the maternal grandmother had ample means and arranged for the boy's education. He attended as a day scholar at the famous Mazarin College in Paris, then notable in providing excellent teaching in science. Here he remained to the age of seventeen, when he began to prepare to enter the profession of law. His teachers, Guettard in geology, Bernard de Jussieu in botany, and especially Rouelle in chemistry, had, however, implanted in him a love of science. At first he was most attracted to mathematics and meteorology. He acted for three years as assistant to Guettard in a survey for a geological map of France. In the intervals of the necessary journeys he wrote an essay for the Royal Academy of Sciences, which had offered a prize for a description of the best method of lighting the streets of a large town. Lavoisier's essay did not gain him the prize, but he received a gold medal and the honour of having his essay published.

This early association with applied science was to continue throughout his life, and he later carried out a very large amount of work in the service of the French Government. The latter, during the early part of the seventeenth century, and in association with the Royal Academy of Sciences, had taken a keen interest in the application of science to arts and industries, and the spirit of the organization of knowledge which found its expression in the "Encyclopædia" was also manifested in the publication of several large and richly illustrated volumes dealing with various trades. The idea that it is a matter of political importance to have existing knowledge summarized and rationalized for the public benefit is, therefore, not a new one, and it found extensive and fruitful application in pre-revolutionary France. The six large volumes of the collected works of Lavoisier, published in the period 1864–93, are largely devoted to his many investigations on applied science, such as the manufacture of gunpowder, and he gave a large amount of time and energy to such public services.

The Royal Academy of Sciences, founded by Louis XIV in 1666, elected Lavoisier to membership in 1768, at the early age of twenty-three. In 1764 he had

published a paper on gypsum, but at this time he had done no scientific work of real importance. In 1768 he also entered the *Ferme Générale*, an association which, in return for a sum paid to the Government, fixed periodically, had the right to collect from the taxpayers whatever sum they could be induced to part with. As might be expected, the members of the *Ferme* varied considerably in their methods, and there was some harsh administration, so that the association as a whole laid up for itself a growing store of hatred and contempt which was later to play a large part in the Revolution. Whatever pretext was offered for the execution of Lavoisier, it was actually his association with the *Ferme* which sealed his fate. He carried out his duties honestly and, we may be sure, humanely, but he also made large profits. These enabled him to carry on very expensive researches, and his work is noteworthy in the use of elaborate—often over-elaborate—apparatus, and much of it was outside the means of other scientific men.

In 1771 Lavoisier married Marie Anne Pierrette Paulze, the daughter of a member of the *Ferme*, then in her fourteenth year. Madame Lavoisier, although so young, set herself the task of becoming an assistant and amanuensis in his scientific work, and besides being a capable and affectionate wife she also, with her notable linguistic and artistic ability, gave him very effective help in his researches and publications. The charming illustrations in his famous "Traité élémentaire de Chimie" (1789) are from drawings which she made.

The scientific work of Lavoisier has a marked character. He discovered no new substances, devised no really novel apparatus, and worked out no improved methods of preparation. He was essentially a theorist, but a theorist of a most original, drastic and revolutionary kind. It must not be supposed that scientific chemistry originated with him, although he undoubtedly gave it a new form, which it still carries. From the beginning of the seventeenth century, with the work of such men as Van Helmont, Boyle, Glauber, Lemery and Stahl, a very important body of systematized knowledge had grown up which constituted a true science of chemistry. The underlying theory, when Lavoisier began his work, was the doctrine of phlogiston. This was primarily intended to explain the phenomena of combustion and the calcination of metals. The theory assumed that combustibles and metals contained a common, identical, and transferable entity called phlogiston, which they lost when burnt or calcined; the theory was also widely extended to other chemical phenomena. There had also been good quantitative work, notably that of Black (whose researches served as a model for Lavoisier's) and Bergman. The focusing of attention on combustion phenomena by Lavoisier, and the overwhelming importance which he conferred on oxygen, must not be allowed to obscure the fact that a large part of chemistry lies outside this region, and that much fundamental and important research had already been carried out in this wider field.

Lavoisier's great merit lay in his capacity of taking over experimental work carried out by others (whose claims he, unfortunately, did not always sufficiently recognize or admit in his published memoirs or his books), and by a rigorous logical procedure, based on the results of quantitative experiments which he himself made, of expounding the true explanation of the results. This explanation, that combustion and calcination consist in the union

of the combustible or metal with oxygen, found much opposition among the older and more conservative chemists in all countries, but after the publication of his "Traité" in 1789, it quickly gained acceptance everywhere, no less rapidly in Germany, the home of the phlogiston theory, than elsewhere. This was, however, only a part of the story. The appearance of heat and light, or fire, in combustion also required explanation, and Lavoisier did this by assuming the existence of imponderable elements, caloric (the matter of heat) and light, which in their way bore a strong resemblance to the old phlogiston.

This work began in 1772, and after the discovery of oxygen by Priestley in 1774 it proceeded apace, a large number of memoirs being published by Lavoisier after presentation to the Royal Academy of Sciences. The experiments of Cavendish on the formation of water from hydrogen and oxygen, published in 1784, enabled Lavoisier to complete his so-called Anti-phlogistic Theory, and they played a decisive part in leading to its acceptance. The assumption made by Lavoisier that all acids contain oxygen was an error which was not rooted out until after 1810, but his surmise that the earths are oxides of unknown metals received a brilliant confirmation in Davy's isolation of the alkali and alkaline earth metals in 1807-8. The alkalis themselves were not regarded by Lavoisier as oxides of metals, although he was convinced that they were not true elements.

A great service given to chemistry by Lavoisier was the institution, with his colleagues, at the instigation of Guyton de Morveau, of a scientific nomenclature, published in 1787. The principles laid down are still in use.

The same year, 1789, which saw the publication of Lavoisier's revolutionary "Traité de Chimie" witnessed also the outbreak of the French Revolution. During its earlier stages Lavoisier continued to carry out work for the State, but he was soon singled out for attack. The impulse came from Marat, whose theory of fire had been unfavourably criticized by Lavoisier. The series of pretexts by which he was brought into popular discredit cannot be detailed; in the final phase nothing worse could be brought against him than a charge that he had, as a *fermier*, adulterated tobacco with water. In his trial, in which the president of the court was Coffinhal, the plea that his scientific services had been valuable to the State was rejected in the words: "The Republic has no need of savants; justice must take its course". Although Lavoisier's association with the *Ferme* was the real reason for his downfall, this could not legally be brought against him, since the Tribunal had no power to deal with crimes of the pre-Revolutionary period. With a will, however, a way can be found, and on the petty accusation mentioned the great Frenchman was condemned, and on May 8, 1794, he suffered the penalty of death by the guillotine.

In 1795 his property, previously confiscated, was restored to Madame Lavoisier, who lived until 1836; in 1806 she published some memoirs of her husband. His complete works were, as mentioned, published under the auspices of the Royal Academy of Sciences in the period 1864-93. The general contributions of Lavoisier to chemistry are well known, and he has received an ample and generous recognition and admiration, which are well deserved. It is fitting, however, on the date of the bicentenary of the birth of this distinguished man, once more to pay a tribute to his great and enduring services to science in general, and particularly to chemistry.

ARCHÆOLOGY AND ANTHROPOLOGY IN INDIA

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IT is just about a hundred years since an association began to be formed between archaeology and anthropology which has proved very fruitful to both these branches of human knowledge. So necessary are they one to another that no general course of instruction in one can well afford to ignore the other, and the union of the two in a common tripos in the University of Cambridge, due no doubt in the first instance to the foresight and influence of Haddon and Ridgeway, has proved incontestably satisfactory. But this association between archaeology and anthropology has been generally limited to prehistoric archaeology on one hand, and on the other to the more or less historic schools of anthropological thought; for the more extreme, at any rate, of the so-called functionalist anthropologists profess to repudiate inquiry into the past history of the societies and institutions which they study. In his presidential address to the Section of Anthropology and Archaeology at the thirtieth Indian Science Congress held in Calcutta in January of this year, Dr. N. P. Chakravarti, of the Archaeological Survey of India, seeks to extend this association by turning epigraphy to the service of anthropological inquiry.

The period of Indian history from the third century B.C. to the sixth century A.D. is indeed obscure enough. It was a period of minor immigrations between that of the Rigvedic 'Aryans' in the second millennium B.C., and the influxes of Islamic conquistadors which started about the ninth century A.D. with the Arab incursions into Sind, and continued until the establishment of the Mogul Empire. It was the period of the Yavanas, Pahlavas, Sakas, Kushāns and Huns, and inscriptions can at least throw some light on the areas that these invaders occupied, and, in the case of the Kushāns, at any rate, whence they came. Further, the way in which they adopted the religion of the country they settled in is clearly indicated by their votive inscriptions. Thus a pillar in Gwalior State records the dedication of a shrine to Krishna by Heliodorus son of Dion, ambassador of Antialcidas, the Hellenic king of Taxila, and describes the dedicatory as a 'follower of Vishnu'. In a similar way one of the Kushān rulers is shown by his coins to have been a Shaiva.

Inscriptions of the same period likewise throw light on peoples long settled in India, such as the Andhras, whose rulers can be shown to have intermarried with Saka invaders, and Dr. Chakravarti mentions inscriptions of the Ishvaku family of southern India which show clearly that, although it is prohibited by the strict Hindu law, cross-cousin marriage was practised even in ruling families. Other inscriptions perhaps go to indicate an identity of race between ruling families at this period in Assam and in Gilgit, a point which calls up the reflexion that the game of polo was first known to us in Gilgit and in the distant State of Manipur on the eastern frontier of Assam, whence it was introduced into British athletics, though it is the Balti and not the Manipuri name for it which we use. The sum total of information available to ethnographers from inscriptions may not be great, but such as it is, it is likely to be useful and suggestive.

Dr. Chakravarti also dwells on the subject of