ticles of phosphorus therein. This matter the doctor immediately carried to Mr. Boyle, who set Bilgar, the chymist, to work upon it. But he could obtain very little phosphorus from it till another material was added to it in distillation, and then he procured phosphorus in such plenty that, selling large quantities at six guineas the ounce, he soon became rich, and left England." It should be mentioned that Bilgar was assistant to Boyle before Hanckewitz.

It is probable that, by the end of the seventeenth century, no substance had been so fully and accurately experimented upon, although the explanations of its action and the anticipations of its value were often expressed in almost ludicrous terms. Dr. Frederick Slare (Hooke's "Philosophical Collections," 1681, No. 3, p. 48, and No. 4, p. 84) says that it was then obtained as "transparent as any resin" and melted like wax in warm water. His remarks show that it was even then obtained in a state of great purity, and he finishes his paper by saying "what medical use may be made of this noble concrete time may discover," adding the hope that it may explain "certain phenomena of nature, including the observation of the learned Dr. Croone, who, on rubbing his body with a fresh and well-warmed shift, made both to shine."

An amusing example of the almost religious ceremony with which phosphorus was treated is found in the *Philosophical Transactions* (1733, vol. 38, No. 428, p. 55), where a description and an elaborate drawing of an apparatus employed for burning phosphorus is described by Dr. Frobenius, the companion of Hanckewitz. The phosphorus was ignited in a golden bowl, contained in another golden bowl on a tripod of the same metal, a glass-bell jar being suspended above to receive the "snow" which the combustion produced. The apparatus was described as the "Machina Frobeniana," and each operation was compared with one of the phenomena of nature, the phosphoric anhydride to snow, and its deliquescence to the melting of snow. In this and similar experiments the learned doctor was in the habit of igniting the phosphorus with the heated tip of his sword.

Almost immediately afterwards, Hanckewitz (*loc. cit.*, p. 58) showed that the Machina Frobeniana was unnecessarily elaborate, and repeated the experiment in a "warmed china cup." He mentioned the production of amorphous phosphorus as a "red caput mortuum" and gave a very complete description of his experiments, observing that "this phosphorus is a subject which occupies much the thoughts and fancies of some alcymists who work on microcosmical substances, and out of it they promise themselves golden mountains."

According to him, Kunkel, Krafft, and Brandt were only able to obtain a little "unctuous opaque phosphorus," and not the true hard "glacial" phosphorus. He considered that Kunkel either spoke too much at large or designed to impose upon the world, and stated that, at the time of speaking, he was the only man capable of making real phosphorus. Hanckewitz was undoubtedly the principal maker of phosphorus in his time, and it is interesting to note that he was the founder of the firm of Godfrey & Cooke. A considerable amount of information on the work of Hanckewitz was given in a paper by Mr. Joseph Ince in the *Pharmaceutical Journal* (1859, pp. 126, 157, and 215).

The chemical properties of phosphorus were carefully studied immediately after its isolation, and the discovery that it increased in weight on burning, which is attributed to Marggraf, is said to have been in part responsible for the overthrow of the phlogiston theory, for Lavoisier showed that its increase in weight when burned in oxygen equalled the loss of oxygen. Lavoisier appears also to have been the first to definitely show that phosphorus was an element, and to point out its wide distribution throughout the vegetable kingdom (see Lavoisier's "Elements of Chemistry," translated by Kerr, 1802, vol. i., p. 323).

Priestley also examined its action on burning in air ("Experiments and Observations on Different Kinds of Air," 1790, vol. i., p. 170).

The action of phosphorus on metals was experimented upon by Marggraf, and later by Pelletier, who found that most metals combined with it when heated. Dr. Peter Shaw (James' Medical Dictionary, 1745, article "Phosphorus") says that the "acid of phosphorus proves a menstruum to perhaps all the metals, but when this acid is driven into the pores of the metal by the action of the flame in burning the phosphorus, it seems productive of much greater effects, as is well known to those connected with the sublimer metallurgy."

The production of amorphous phosphorus during the distillation of phosphorus was early known, but it was not recognized as a form of the element, but as an oxide. Aikin ("Dictionary of Chemistry and Mineralogy," 1807) described it as "a brown red powder which diffuses itself in water like clay, and consists chiefly of phosphorus so peroxygenated as to be no longer combustible."

The modern method of preparing phosphorus is beyond the province of this article, but it may be mentioned that Gahn, a Swedish chemist, showed in 1769 that phosphorus was contained in bones (see "Bergmann's Notes," 1796, p. 203), and that the credit of preparing it from them appears to be due to Scheele. In 1775 he obtained it by treating bone-ash with nitric acid, precipitating the lime from the solution by addition of sulphuric acid, evaporating the solution and distilling the residue with charcoal. Nicolas and Pelletier (*Journal de Physique*, vols. 11 and 28) improved upon the process by dispensing with the use of nitric acid, and Fourcroy and Vauquelin (*Journal de Pharmacie*, v. i., p. 9) determined the proportions most suitable for operations on the large scale. Aikin ("Dict. of Chem. and Min.," 1807) mentions, as a good yield, that Pelletier obtained 60 ounces of phosphorus from 576 ounces of bone-ash.

It was also common at the commencement of the present century to prepare phosphorus by precipitating the phosphoric acid from superphosphate of lime with lead nitrate, and distilling the phosphate of lead thus produced, with charcoal (Rees' "Encyclopædia," 1819).—*Pharm. Journal and Transactions.*

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