CHEMISTRY

Nitrogen and Phosphorus

"Classic of Science"

Making Phosphorus Was a Trade Secret Among Alchemists Nitrogen Is Left When Oxygen Is Taken Out of Air

Phosphorus

THE AERIAL NOCTILUCA: Or, some New Phaenomena, and a Process of a factitious self-shining Substance. In the Works of the Honourable Robert Boyle. London: MDCCLXXII (1722). [This paper originally written about 1677].

AFTER the experienced chymist Mr. *Daniel Kraft* had, in a visit that he purposely made me, shewn me and some of my friends, both his liquid and consistent phosphorus, being by the phaenomena I then observed (and whereof the curious have since had publik notice), made certain, that there is really such a factitious body to be made, as would shine in the dark, without having been before illustrated by any lucid substance, and without being hot as to sense: after this, I say, I took into consideration, by what ways it might be most probable, to produce, by art, such a shining substance. To seek for which I was both inclined, and hopeful to be somewhat assisted, because I had lying by me, among my yet unpublished notes of the mechanical origin of divers qualities, a collection of some observations and thoughts concerning light. And I was also the more encouraged to attempt somewhat this way, because having, at Mr. *Kraft's* desire, imparted to him somewhat, that I discovered about uncommon mercuries (which I had then communicated but to one person in the world) he, in requital, confest to me at parting, that at least the principal matter of his phosporuses was somewhat that belonged to the body of man. This intimation, though but very general, was therefore very welcome to me, because, though I have often thought it probable, that a shining substance may, by spagyrical art, be obtained from more kinds of bodies than one: yet designing in the first place, to try, if I could hit upon such a phosphorus as I saw was preparable, the advertisement saved me (for some time) the labour of ranging among various bodies, and directed me to exercise my industry in a narrower compass. But there being divers parts of the human body, that have been taken to task by chymists, and, perhaps, by me as carefully, as by some others, my choice might have been distracted between the blood, the solid excrements, the bones, the urine, and the hair, of the human body; if various former trials and speculations upon more than one of those subjects had not directed me to pitch upon that, which was fittest to be chosen, and of which, as I had formerly set down divers experiments and observations, so I had made provision of a quantity of it, and so far prepared it, that it wanted but little of being fit for my present purpose. But before I had made any great progress in my design, I was by divers removes, indispositions of body, law-suits, and other avocations, so distracted, or at least diverted, that I laid aside the prosecution of the phosphorus for a long time. And when afterwards I resumed it, though I wrought upon the right matter, yet I was diverted from the right way, by a process that I received from beyond sea, as a great arcanum, that would certainly produce the noctiluca aspired to; for partly upon this account, but more, because I saw that the chief ingredient in this process was that, which I, with reason, took to be the best matter, I was induced to pursue the prescribed method for some months, but without success; the true matter being, as I concluded, too much either altered or clogged by the additional ingredients, that were designed to improve it; besides, that the degree of fire, though a circumstance of the greatest moment, was overlooked, or not rightly prescribed. However, adhering to the first choice I had made of a fit matter, I did not desist to work upon it by the ways I judged most hopeful, when a learned and ingenious stranger, (*A.G.* M.D. countryman, if I mistake not, to Mr. *Kraft*) who had newly made an excursion into *England,* to see the country, having, in a visit he was pleased to make me, occasionally discoursed, among other things, about the German noctiluca, whereof he soon perceived I knew the true matter, and had wrought much upon it; he said something about the degree of fire, that made me afterwards think, when I reflected on it, that that was the only thing I wanted to succeed in my endeavors. . . .

And now you have the history of my pursuit of the liquid phosphorus, that has made some noise among the curious: but I freely confess, that the success, though welcome, was not so full as I aimed at, for I obtained no such consistent phosphorus as that, whereof Mr. *Kraft* shewed me, as I formerly told you, a small parcel. But as I was willing to think, that this defect may be imputed to the cracking of the retort, before the operation was quite finished, so I hope another distillation in a more luckily chosen vessel may make me amends for the newly mentioned miscarriage, and thereby enable me to discover other, and perhaps nobler phaenomena of our shining substance, than hitherto I have been able to observe. Especially considering, that the same misfortune, that I hope was the principal cause of my missing the noblest thing I aimed at, the constant noctiluca, left me so little even of liquid matter, fit for my purpose, that I have not dared, for fear of wasting it, to try several

things with it, that I presume may be of good use in an enquiry into the nature of this light, and perhaps also of light in general. And because I fear by what I have observed, that, though the vessel had not cracked, yet the matter distilled would have afforded but a small proportion of lucid substance, I am the more unwilling to fall upon this troublesome work again, till, besides other requisites, I be provided of a competent quantity of a matter which I fear contains but very little of the desired substance. However, I have endeavoured to make that use of our experiment, such it was, that though the noctiluca it produced, be not perhaps so lucid as that of Mr. *Kraft's* yet it may prove as luciferous as his hath hitherto been, since (as you will see hereafter) I have found a substance, that needs the air, and nothing but the air to kindle it, and that in a moment.

In this narrative I have been the more particular, that it may shew you, (what I hope may make you amends for the length of it) that an inquisitive man should not always be deterred by the difficulties, or even disappointments he may meet with, in prosecuting a noble experiment, as long as he judges himself to proceed upon good and rational grounds. . . .

The Process

There was taken a considerable quantity of human urine, (because the liquor yields but a small proportion of luciferous matter,) that had been, (a good part of it at least) for a competent while, digested and putrified, before it was used. This liquor was distilled with a moderate heat, till the spirituous parts were drawn off; after which, the superfluous moisture also was abstracted, (or evaporated away) till the remaining substance was brought to the consistence of a somewhat thick syrup, or a thin extract. This was well incorporated with about thrice its weight of fine white sand, and the mixture was put into a strong retort; to which was joined a large receiver, in good part filled with water. Then, the two vessels being carefully luted together, a naked fire was gradually administered for five or six hours, that all, that was either phlegmatic, or otherwise volatile, might come over first. When this was done, the fire was increased, and at length, for five or six hours made, (N.B. which it should be in this operation) as strong and intense, as the furnace (which was not bad) was capable of giving. By this means, there came over good store of white fumes, almost like those, that appear in the distillation of oil of vitriol; and when those fumes were past, and the receiver grew clear, they were after a while succeeded by another sort, that seemed in the receiver to give a faint bluish light, almost like that of little burning matches dipt in sulphur. And last of all, the fire being very vehement, there passed over another substance, that was judged more ponderous than the former, because (N.B.) much of it fell through the water to the bottom of the receiver: whence being taken out, (and partly even whilst it staid there) it appeared by several effects, and other phaenomena, to be (as we expected) of a luciferous nature.

The ways I employed to make a self-shining substance, out of other matters than that expressed in this process, I must, for certain reasons, forbear to acquaint you with, at this time.

Nitrogen

EXPERIMENTS AND OBSERVATIONS ON DIFFERENT KINDS OF AIR, and other branches of Natural Philosophy, connected with the subject. In three volumes; Being the former Six Volumes abridged and methodized, with many Additions. By Joseph Priestley, Birmingham, Printed by Thomas Pearson; MDCCXC (1790).

Reading in Dr. Hale's account of his experiments, that there was a great diminution of the quantity of air in which had been exposed, a mixture of powdered sulphur and filings of iron, made into a paste with water, I repeated the experiment, and found the diminution greater than I had expected. This diminution of air is made as effectually, and as expeditiously, in quicksilver as in water; and it may be measured with the greatest accuracy, because there is neither any previous expansion, or increase, of the quantity of air, and because it is some time before this process begins to have any sensible effect. This diminution of air is various; but I have generally found it to be between one fifth and one fourth of the whole.

Air thus diminished is not heavier, but rather lighter than common air.

I conclude that the diminution of air by this process is of the same kind with the diminution of it in the other cases, because when this mixture is put into air which has been previously diminished, either by the burning of candles, by respiration, or putrefaction, though it never fails to diminish it something more, it is, however, no farther than this process alone would have done it. If a fresh mixture be introduced into a quantity of air which had been reduced

HE CUTS STEEL WITH WATER

At a speed greater than the velocity of sound and to the accompaniment of a piercing shriek, water cuts steel in research at Westinghouse laboratories; which may result in better airplane propellers and turbine blades. T. F. Hengstenberg, engineer in charge, is pointing to the apparatus that turns 20,000 revolutions per minute, and the insert shows a plug of test metal before and after. Quarter inch plugs of stainless iron and of nickel steel are eroded half way through in two or three minutes. Stellite, famous for its hardness, and iron nitride, almost diamond-hard, hold out 15 to 20 minutes.

by a former mixture, it has little or no farther effect. . . .

Air diminished by this mixture of iron filings and sulphur, is exceedingly noxious to animals, and I have not perceived that it grows any better by keeping in water. The smell of it is at first very pungent and offensive, which must be owing to a quantity of vitriolic acid air generated in the process.

The quantity of this mixture which I made use of in the preceding experiments, was from two to four ounce measures; but I did not perceive, but that the diminution of the quantity of air (which was generally about twenty ounce measures) was as great with the smallest, as with the largest quantity. How small a quantity is necessary to diminish a given quantity of air to a *maximum*, I have made no experiments to ascertain.

Named by Lavoisier

ELEMENTS OF CHEMISTRY, in a New Systematic Order, containing all the Modern Discoveries. By Mr. Lavoisier, translated from the French by Robert Kerr. Edinburgh: William Creech, MDCCXC (1790).

I mentioned before, that we have two ways of determining the constituent parts of atmospheric air, the method of analysis, and that by synthesis. The calcination of mercury has furnished us with an example of each of these methods, since, after having robbed the respirable part of its base, by means of the mercury, we have restored it, so as to recompose an air precisely similar to that of the atmosphere. But we can equally accomplish this synthetic composition of atmospheric air, by borrowing the materials of which it is composed from different kingdoms of nature. We shall see hereafter that, when animal substances are dissolved in the nitric acid, a great quantity of gas is disengaged, which extinguishes light, and is unfit for animal respiration, being exactly similar to the noxious or mephitic part of atmospheric air. And, if we take 73 parts, by weight, of this elastic fluid, and mix it with 27 parts of highly respirable air, procured from calcined mercury, we will form an elastic fluid precisely similar to atmospheric air in all its properties. . . .

The chemical properties of the noxious portion of atmospheric air being hitherto but little known, we have been satisfied to derive the name of its base from its known quality of killing such animals as are forced to breathe it, giving it the name of *azote*, from the Greek privitive particle *a* and *zoe, vita;* hence the name of the noxious part of atmospheric air is *azotic gas;* the weight of which, in the same temperature, and under the same pressure, is 1 *oz.* 2 *gros.* and 48 *grs.* to the cubical foot, or 0.4444 of a grain to the cubical inch. We cannot deny that this name appears somewhat extraordinary; but this must be the case with all new terms, which cannot be expected to become familiar until they have been some time in use. We long endeavoured to find a more proper designation without success; it was at first proposed to call it *alkaligen gas,* as, from the experiments of Mr. Berthollet, it appears to enter into the composition of ammoniac, or volatile alkali; but then, we have as yet no proof of its making one of the constituent elements of the other alkalies; beside, it is proved to compose a part of the nitric acid, which gives as good reason to have called it *nitrigen.* For these reasons, finding it necessary to reject any name upon systematic principles, we have considered that we have run no risk of mistake in adopting the terms of *azote,* and *azotic gas,* which only express a matter of fact, or that property which it possesses, of depriving such animals as breathe it of their lives.

Science News Letter, August 13, 1932

CONSERVATION

European "Decoy Ponds" Cause Slaughter of Wild Ducks

EUROPEAN conservationists and zoologists are watching the development of America's efforts to save its wild ducks with much sympathy and considerable interest. The effort to put down the commercial exploitation of game in America is being followed especially closely, because Europe, with a smaller wild-life population and a much more intense pressure for food by the human population, has permitted a much more extensive killing of wild ducks for market purposes.

A European institution that has no American counterpart is the commercial decoy pond. Decoy ponds are bodies of water to which ducks are attracted, sometimes with the additional lure of food. On their shores are structures of various types which serve as traps. The ducks, lured into them, leave only as carcasses headed for the market. The annual drain of these ponds on the European wild-duck population is a serious one.

In Germany there are at present eleven decoy ponds, with an average annual catch of 40,000 ducks. In Denmark there are two with an annual average of 12,000; in Belgium there are four, but the average is not stated; England has twenty-one such ponds but the average kill is only about 600; the English use the ponds for sport, not for gain.

Holland has the greatest number of ponds, the number of the catch of which has been, until recently, suppressed in the interest of the Dutch canning industry, which takes the catch and has built up a profitable export trade thereon. Now, at last a Dutch ornithological organ has published a statement. There are, according to it, 145 ponds in Holland, most of which are in the provinces of Gelderland, South Holland and North Brabant. The average annual catch is 300,000 ducks.

The open season lasts from July 27 until February 14, sometimes even until March 13. The bands or banded birds have shown that the majority of the ducks caught in Holland come from Scandinavia and Finland. In the long run the supply will unquestionably become diminished at the present rate of destruction.

It is obviously well-nigh impossible at present to expect much remedy, as the Dutch Government is unwilling to interfere with a profitable home industry; yet if the open season were only somewhat shortened some relief would ensue. An effort will therefore be made at the coming International Conference to bring about certain changes in the Paris Bird Protection Convention of 1902, to reduce the open season to a period lasting from September 15 to January 31.

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A museum of Asiatic arts has been established in Amsterdam.

Trading glass beads to the Indians was so important in colonial America that a factory making glass beads was set up at Jamestown, Virginia, in 1608.