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APPARATUS

OWNED AND USED BY

Dr. Joseph Priestley

The Discoverer of Oxygen

NOW IN THE COLLECTION OF

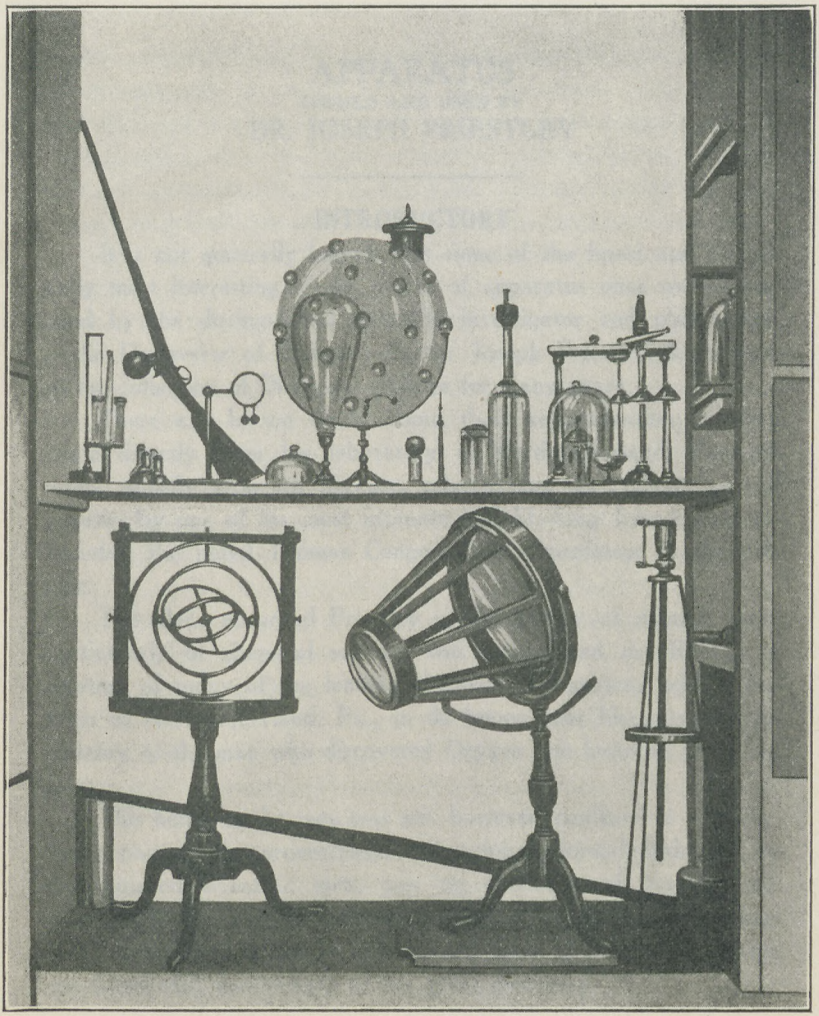
DICKINSON COLLEGE

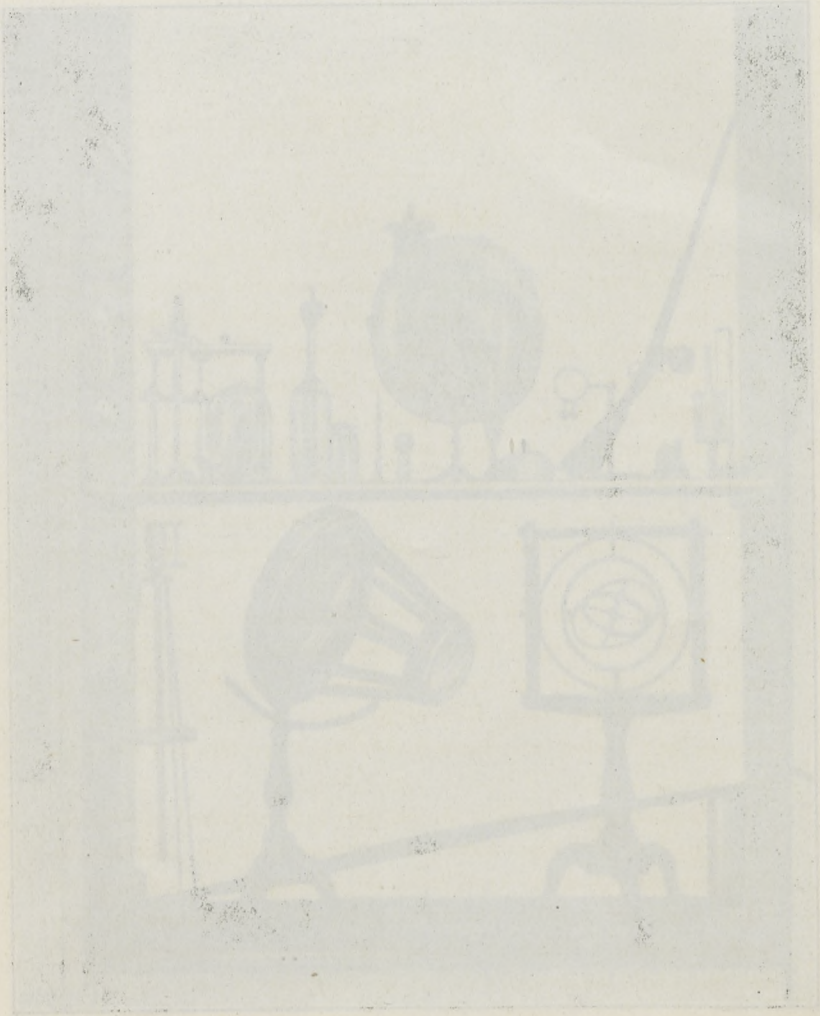
CARLISLE, PA.

BY

Charles F. Himes, Ph.D., LL.D.

Professor in Dickinson College 1865-1896





APPARATUS
OWNED AND USED BY
DR. JOSEPH PRIESTLEY

INTRODUCTORY

It is not generally known that some of the finest and historically most interesting of the pieces of apparatus once owned and used by the distinguished scientific investigator and philosopher, —the Discoverer of Oxygen—Doctor Joseph Priestley, have been in the collection of Dickinson College for many years.

There can be no doubt about their authentication, as they came directly from his laboratory at Northumberland, Pennsylvania, shortly after his decease, selected for the college, as will appear, by one of his most intimate and life-long friends and associates, the noted Thomas Cooper, then a professor in the college.

The place accorded Priestley in the history of science, more particularly of chemical science, was emphasized in 1874 by a meeting of many of the leading chemists of America, held at the town of Northumberland, Pa., to do honor near his grave to the memory of the man who discovered Oxygen one hundred years before.

This honor to the man was not, however, confined to America, for a part of the proceedings, embracing historical addresses by distinguished scientific men, was an exchange of greetings by cable with the English chemists gathered at Birmingham, England, to unveil a statue of him erected there to commemorate the one hundredth anniversary of his great discovery.

More recently, too, the American Chemical Society, the organization of which was one of the results of that meeting at Northumberland, has taken steps "in a lasting way to commemorate his work as an investigator and philosopher, and tireless searcher after truth," by the appointment of a committee of most eminent chemists to secure a portrait bust of Priestley to be deposited in the National Museum at Washington.

THE BURNING-LENS

I. The large compound Burning Lens deserves, perhaps, the first notice. It is composed of two lenses, respectively 16 inches and 7 inches in diameter, set in a wooden frame, with centers 16 inches apart. The frame is arranged on a stand permitting horizontal motion, and with an adjustment for changing and fixing the inclination of the whole to suit the altitude of the sun. This is, however, not simply a unique piece of apparatus, an unusually fine specimen of a class, at one time regarded as of great importance in investigation, now altogether obsolete. It has a much higher historical interest than as a scientific curio, on account of its intimate association with a great discovery; for perhaps no single discovery in science, in any branch, marks more sharply the separation of the new from the old, or was productive of more far reaching results than the discovery of Oxygen in 1774, a discovery that is regarded as the beginning of the new epoch of Modern Chemistry. It was not merely the discovery of a new gas or "air" as Priestley called it, but one that opened up entirely new lines of thought and investigation and in a short time led to new theoretical views. It was not a modification of an old theory, but the subversion of a theory that had been gen-

erally accepted, and had controlled and directed the investigations of scientific men.

Whilst it is plain that any apparatus that had been used by an eminent investigator in his work could not but have a high associated, or sentimental interest, if you please, the old Burning-Lens seems inadequate, trifling, and inconvenient as a source of heat. So it is; although in good sunlight strips of sheet zinc volatilize when drawn through its focus. But to Priestley it was much more than a source of heat. Its employment in some investigations was based on a dominant theoretical conception of that day that may seem almost fanciful to us. All chemical science of the period turned around the explanation of the mysterious phenomenon of combustion, no less mysterious today than it was then, though our explanation may be more in accordance with facts.

Why does charcoal, or wood, or anything burn? What is taking place to produce the light and the heat? The philosophers of that day said: When charcoal burns something is escaping from it and that escape, somehow, occasions the heat and light. That something, by common consent, they called "Phlogiston." The more rapid the escape of Phlogiston, the more vigorous the combustion; the richer a substance was in Phlogiston, the more combustible it was. They recognized, too, some similarity in the change that some metals experienced in the air, especially when heated; and they called what resulted the calx of the metal. So the rusting of iron was due to the escape of Phlogiston, and by restoring the Phlogiston they recovered the iron from the rust. But this Phlogiston was a purely hypothetical something. It had never been isolated. But in all investiga-

tions it had to be reckoned with, and carefully watched. As charcoal, their chief source of heat, was very rich in Phlogiston, they could not tell what part this escaping Phlogiston might play in their experiments and how it might interfere with their results. Not knowing the source of the heat of the sun, they assumed that sunlight was, or at least might be, free from Phlogiston; so they made large burning-lenses, and mirrors-of-force, to avail themselves of the heat of the sun. Thus Priestley, in a letter to Franklin, from Birmingham, England, wrote: "Having at length got sunshine I am busy in prosecuting the experiments about which I wrote you, &c." It was by means of a Burning Lens that Priestley discovered Oxygen. He placed a compound of Mercury in the focus of the lens. He noticed that air, or gas, was released. He was expert in experimenting with airs, and collecting them. He collected some. The first question was: How is it related to combustion? The test, always on hand, a lighted taper, was immersed in it. To his surprise it burned much more vigorously. The next question was: How does it affect life? The test for this was also always on hand. A mouse immersed in it seemed to live faster. His explanation was ready. This new air has less Phlogiston mixed with it than atmospheric air. So it was greedy for Phlogiston and took it more rapidly out of combustibles. He accordingly named it "dephlogisticated air." The discovery was a surprise to him. He said he had no idea that an air having less Phlogiston than air of the atmosphere was possible.

This was the Phlogiston period. No one questioned its existence. It could be made to explain almost anything. But some one with broader curiosity weighed a piece of iron, and then

the rust resulting from it, and found that the rust weighed more than the iron, in spite of the escape of Phlogiston. This was a troublesome fact, but the theory was easily made equal to its explanation. Phlogiston was a purely hypothetical something, not exactly substance, and could have any property imputed to it that might be necessary. So, said the Philosophers, Phlogiston is specifically light, it has no weight; it may be attracted more by the heavenly bodies than by the earth; so when it leaves a body what is left will be heavier. But this explanation became more and more unsatisfactory as the weighings went on; and soon a new school of Chemical Philosophers under lead of Lavoisier explained combustion as combination, not separation; and the Quantitative period of Chemistry was ushered in. The old lens which has no part in the scientific life of today, seemed entitled to this much of a historic setting.

THE REFLECTING TELESCOPE

II. A Reflecting Telescope, of the Gregorian type, is a handsome piece of apparatus, in excellent condition. The main mirror, 5 inches in diameter is mounted in a substantial brass tube of the same diameter, 2½ feet long. It is supplied with all the necessary accessories and adjustments, and the whole is firmly mounted on a brass tripod. The makers' name, "W. & S. Jones, 135 Holborn, London," is conspicuously engraved on it.

THE REFRACTING TELESCOPE

III. An Achromatic Refracting Telescope, bearing conspicuously engraved on it the name "Dollond," is of greater historical interest, for it is probably one of the first achromatic telescopes

made; as John Dollond was the first to achieve that which from the time of Newton, was regarded as the impossible in optics, namely, the production of an achromatic lens. The telescope is 4 feet long.

THE AIR GUN

IV. An Air-Gun, after a fine model of a rifle of that day, is a finely finished, graceful piece of apparatus. It was doubtless designed by Priestley to exhibit in a very practical way the mechanical efficiency of compressed air. The bullet made in an accompanying mold weighs 45 grains.

The following details in regard to the loading and firing may be of interest to some.

The Air Magazine is a wrought iron globe, 3½ inches in external diameter. It is closed by a valve actuated by a spiral spring, assisted by the pressure of the air when charged. This magazine screws over the lock, communicating with the barrel. The valve is opened only for an instant by a small rod actuated by a spring released by the trigger. It closes instantly, reserving the unspent air for about a dozen shots. The magazine is readily charged by screwing it on to the top of a small wrought iron condensing barrel, with two stout handles at the top that can be grasped in the hands. Within the barrel moves a piston on a stout iron rod about the length of the barrel. On the end of the rod is a strong iron cross-bar on which the feet can be placed; and, by grasping the handles at the top, the barrel can be moved up and down on the piston. A hole in the barrel near the bottom admits the air.

At one time the members of the Senior Class of Dickinson College had an annual target-firing with the gun, a practice which was discontinued when the classes became larger.

THE ORRERY

V. There was another piece of apparatus included in the Priestley collection, without which a set could then hardly be considered complete—a mechanical wonder of that day. A description by John Adams on his way to the Congress, 1774, of that at Princeton, may answer for all. He says: "It contained a most beautiful machine, an orrery or planetarium, constructed by Mr. Rittenhouse, exhibiting almost every motion in the astronomical world." But the orrery in Priestley's collection, when obtained by the college, was not in working condition; and with the years has disappeared. The writer, as a student, saw it probably in its last stages in the mathematical department, and tradition of it is lost.

There were flasks with heavy ground necks, and heavy curved glass tubes with ground stoppers on the end to fit into the flasks, such as are figured in Priestley's account of making and collecting gases.

AUTHENTICATION

The question now in regard to the authentication of the preceding statements is a very pertinent one. It is well known that Priestley, owing to persecution in England for his religious and political opinions, came to America with his family and settled on the Susquehanna, at Northumberland, Pennsylvania, in 1794. He brought much of his apparatus and library that had not been destroyed in England. He built a fine mansion and laboratory

there, and continued his literary and scientific work. He died and was buried there in 1804. It may seem strange that he turned aside to this remote, almost uninhabited spot from positions offered him in Philadelphia and its congenial society, where his reputation had preceded him. But whatever may have been his reasons, just enough was known of the region of the upper Susquehanna at that time to impart an almost romantic attraction to it for many, especially of the scholary class, in England. The epidemic delusion of "Pantisocracy" had affected many of his friends, especially those who sympathized with his so-called French views, among them Southey, Coleridge, Wordsworth and others, to whom the name "Susquehanna" "though not classical was poetical." Big schemes for settlements there were also being promoted.

Among those who came with Priestley to America was Thomas Cooper, who had made a previous visit. They had been intimately associated in England. They had both been made Citizens of France by the Constituent Assembly. Cooper with Wordsworth, Watts and others, was associated with the Jacobins; but he was so bold in his denunciation of Robespierre that he barely made his escape from Paris with his life. He wrote in after years, "I went over to France in 1792 an enthusiast, and I left in disgust." He was educated at Oxford; studied law at the Temple; was on a circuit three years; and had given much time to scientific research and the applications of science. As he had shared Priestley's persecutions with him in England, he lived for years under the same roof with him at Northumberland. This, doubtless gave rise to the erroneous statement, frequently made, that he was a son-in-law of Priestley. This remarkable man,

whom Jefferson pronounced "the greatest man in America in the powers of his mind and acquired information and that without a single exception," after he had filled responsible public positions, and had been on the Bench in Pennsylvania seven years, was removed by "Address," in those days of "Judge Breaking." Some of his opinions as Judge were especially endorsed by Madison, Jefferson, Judge Brackenridge and others.

He was then elected, in 1811, professor of Chemistry and Mineralogy in Dickinson College and at once fitted up a laboratory to which students of applied science were attracted by his reputation. According to a very prominent citizen who knew Cooper well, the sons of the Count du Pont de Nemours of Wilmington, Delaware, were among his students. His activity was as varied as his ability. He edited "The Emporium of Arts and Sciences," a bi-monthly, the leading scientific magazine of America. He published a translation of the Institutes of Justinian, with the Latin in parallel columns, and copious original notes, with references to parallel passages in the Civil Law, the Law of England, and American Reports. It is a law classic. Copies of this edition are rare. It was republished in New York in 1848. In addition to these there were many other literary and scientific publications. He was professor of Chemistry and Mineralogy for a time in the University of Pennsylvania, and in 1819 was selected by Jefferson for the professorship in the University of Virginia of "Chemistry, Mineralogy, Natural Philosophy, and also of Law." He was subsequently for many years President of South Carolina University, and was a noted publicist and politician, as well as educator. He died at Columbia, S. C., May 12, 1839.

Whilst professor in Dickinson College he secured the pieces of apparatus just alluded to. Professor Spencer F. Baird, a graduate of the college and for some years professor in it before becoming connected with the Smithsonian Institution, expressed himself as having no doubt in regard to the former ownership of the apparatus by Priestley, but that he was unable to find any evidence to that effect except unverifiable traditions.

Since then, however, a letter to Professor Cooper has turned up, written from Philadelphia by Joseph Priestley, who continued to reside in the mansion at Northumberland after his father's death, but was then contemplating departure from the country. It is dated Dec. 25th, 1811. In it he tells him where the different pieces of apparatus were to be found in the mansion. He also appended an order on the Trustees of the College for $530, the price of the apparatus, and directed him where to forward the money that he might receive it if he carried out his intention of leaving. Of this amount, $250 were for the Lens, and $230 for the Reflecting Telescope.

In the same letter he informs Professor Cooper, who had not yet removed his library to Carlisle, where the key to his room might be found. This fact also appears in Cooper's Preface to his Introductory Lecture on Chemistry, a lecture not only remarkable in itself, but for the equally voluminous notes and references appended. He remarks: "I should have done better if while I composed these notes, I had enjoyed the opportunity of referring to my own library and Dr. Priestley's, for many years and still under the same roof at Northumberland."

AN OLD MANUSCRIPT

The following transcript of a subscription paper bears the names of well known professional men and citizens of Carlisle of that day, 1811-1815:

> We do promise to pay to the Treasurer of Dickinson College for the exclusive purpose of supporting the Professor of Chemistry (Dr. Thomas Cooper) for a course of Lectures to be delivered during the present Summer session of the College, the several sums annexed to our Names:

D. Watts	$50.00
Andw. Carothers	20.00
James Gustine	20.00
Thos. Carothers	20.00
Thos. Davis	30.00
Edward Jos. Stiles	40.00
Robt. Blaine	20.00
Benj. Stiles	30.00
J. B. Parker	20.00
Wm. C. Chambers	20.00
James Hamilton, Jr.	20.00
Geo. A. Lyon	20.00

This paper shows not only the high appreciation of Professor Cooper during his stay in Dickinson College 1811-1815, but, also the interest of leading citizens in the College of their town.