its use, the compass is constructed so as to assure its needle a magnetic moment as great as possible, and a moment of inertia as small as possible. For this purpose, the compass is arranged as shown in Fig. 4. Two steel needles are fixed to a small piece of wood through which passes the vertical axis. Two small springs, *a*, serve to regulate the equilibrium. The two points of the axis move in agate bearings. The bottom and cover of the compass are of glass so as to permit the rider to see through it the meridians previously inscribed upon the paper and to keep them parallel with the needle. This manipulation is effected by means of the arrangement *U T S R* (Fig. 3) already described. The compass is placed about 10 inches above the box in order to protect it against the magnetic effects of the rolling machine.

In order to avoid vibrations, the compass is mounted upon a rectangular frame of strong copper wire (Figs. 1 and 2) fixed by a hinge to the cover of the box, upon which it can be turned down. The compass is capable of revolving upon this frame, and it is held by two independent rods parallel with the surface of the box. The vibrations are thus subdivided and absorbed by eight movable and elastic parts.

In the experiments that were made with the apparatus, the results were such that it was scarcely possible to distinguish the lines thus obtained from those found upon an official map. So before the apparatus was put upon the market, a sample was ordered by the Intelligence Branch of the English government with a view to utilizing it in China, the topography of which country has been but slightly studied, although the country is provided with good roads. In all countries of this kind, the Ferguson cyclograph will certainly be of great value.

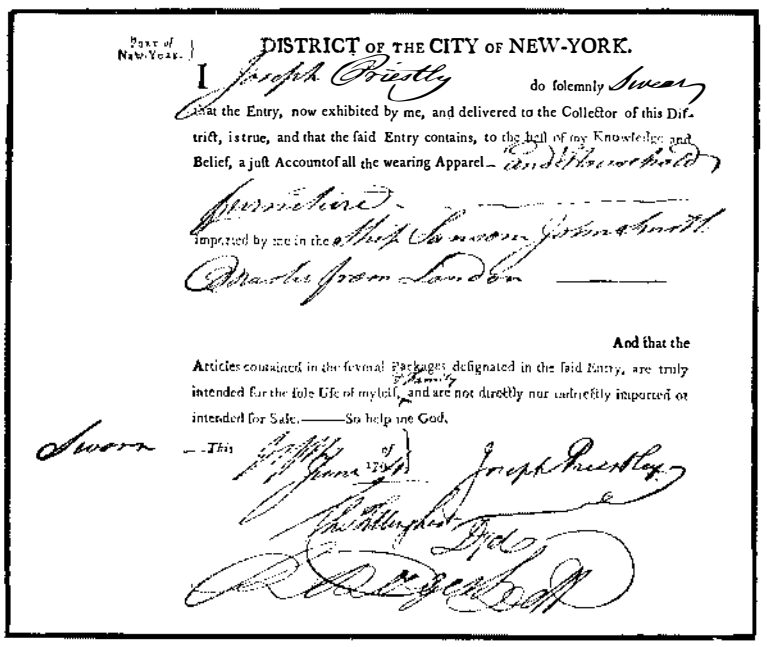
FACSIMILE OF DR. JOSEPH PRIESTLEY'S INVOICE ON COMING TO AMERICA IN 1794.

BY GEORGE F. KUNZ, PH.D.

These valuable documents were recovered from a mass of old papers, many tons in weight, containing thousands of signatures of men noted in local and national history, that was sold for waste paper in connection with the coming removal of the New York Custom House to its new site near the Battery. Their value was suspected, and the New York Scenic and Historic Preservation Society made many efforts to prevent their disposal in such a manner, but without avail.

Dr. Joseph Priestley, whose name is forever associated with the discovery of oxygen, was born near Leeds, England, in 1733. His great discovery was foreshadowed in a paper on the properties of the "different kinds of air," published in the Philosophical Transactions of the Royal Society in 1773. It received the Copley medal, as a communication of great importance, but its full significance was by no means understood. The next year, 1774, is usually given as the date of the actual discovery of oxygen gas, which he termed "vital air," or "dephlogisticated air," but never appreciated its real character. This was recognized and determined some fifteen years later by Lavoisier; but Priestley himself remained all his life a believer in the old theory of "phlogiston."

Dr. Priestley was a dissenting minister, but developed a growing tendency toward Socinian views in theology and liberal doctrines in politics. He was always much interested also in philosophical and scientific studies. After holding several positions, as pastor of churches, tutor in Warrington Academy, and scientific librarian to the Earl of Shelburne, he took charge of a church in Birmingham. When the great agitation connected with the French revolution came on, he was suspected of sympathizing with it, on account of the advanced liberalism of his general views. Public excitement ran very high on that subject; and in 1791, on the occasion of a celebration at Birmingham of the storming of the Bastile, although Dr. Priestley was away, his house was attacked and burned by a mob, and his library and apparatus destroyed. After three years spent at Hackney, largely in scientific pursuits, he decided to come to America, where he had sons living at Northumberland, Penn. He reached New York in June, 1794; and the writer has in his possession the original inventory, from which the illustrations were made, in Priestley's own handwriting, of the goods and furniture which he brought over with him, in the ship "Sansom," Capt. John Smith, as also his affidavit, signed by him and by William Tillinghast,



JOSEPH PRIESTLEY'S CUSTOMS ENTRY, 1794.

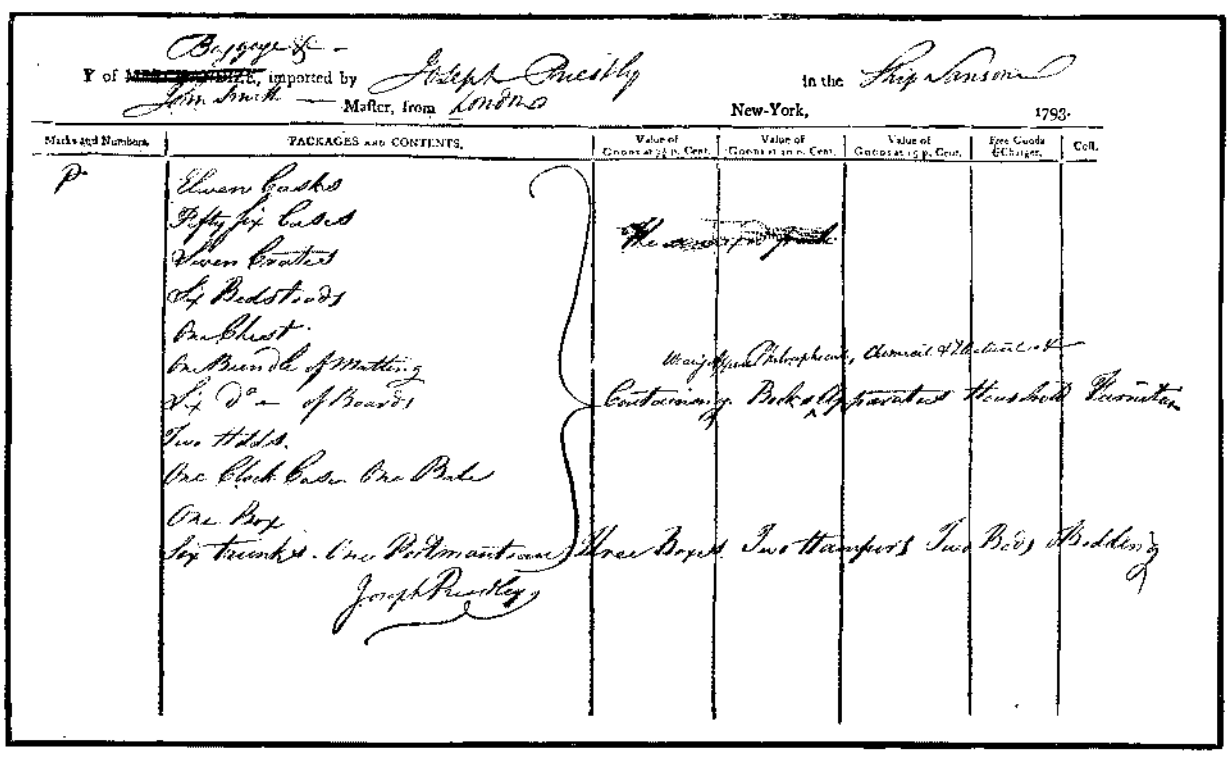
deputy collector of the port, declaring that "the articles contained in the several packages designated in this entry are truly intended for the sole use of myself and family, and are not directly or indirectly imported or intended for sale."

The list, it will be seen, is a pretty extensive one, comprising the furnishings of a large home as well as a laboratory. It is as follows: Eleven casks, fifty-six cases, seven crates, six bedsteads, one chest, one bundle of matting, six dozen of boards, two hogsheads, one clock case, one bale, one box, six trunks, one portmanteau, containing books, wearing apparel, philosophical, chemical, and electrical apparatus, household furniture, three boxes, two hampers, two beds and bedding. [Signed.] Joseph Priestley.

The remaining ten years of his life were passed at Northumberland, Penn., with his sons and family, and were occupied chiefly in his favorite scientific studies. He died in February, 1804, at the age of seventy-one.

In 1874 the chemists of America celebrated the hundredth anniversary of his discovery of oxygen, by a notable gathering at Northumberland, Penn., under the name of the Centennial of Chemistry. Dr. Priestley's descendants are still living there, and greatly revere his memory. Much of his old furniture and apparatus are preserved, the latter very interesting, not only historically, but as showing the simple, and, in many cases, home-made instruments with which a great student and observer did great and pioneer work in chemical research.

In the Kunz collection of scientific portraits and relics of eminent men of science, now in the Field Columbian Museum at Chicago, there is a letter from Dr. Priestley to a friend in England, in which he says that if he had known how cheaply and comfortably he could have lived in France, he would never have come to America. This letter was published, along with a number of others from and relating to Priestley, by Dr. H. Carrington Bolton in a volume a few years since.



MANIFEST OF JOSEPH PRIESTLEY'S GOODS IN SHIP "SANSOM."

The Electric Organ of the Torpedo Fish.

In a paper recently read before the Berlin Academy of Sciences, J. Bernstein and A. Tschermak investigate the thermic phenomena shown by the electric organ of the torpedo or electric ray. Such physiological researches as have so far been made in this direction were intended merely to ascertain the intensity, direction, and duration of the electric shocks. It is safe to say that the electric discharges operative here have been found to consist of individual, short-lasting impulses, which always follow the same direction. The elements constituting the batteries of which the organ is made up, will assume a negative potential on the side where the nerve fiber enters the organ. As regards, however, the causes to which are due the potential differences produced in these elements, the investigations made up to this day were not able to afford any likely explication. Now, according to the recent thermo-dynamic theories of galvanic batteries, exothermic batteries (being heated during operation) should be distinguished from endothermic batteries, which, in the course of working, will undergo a cooling effect. Whereas, the E. M. F. of the former class of batteries is lowered with increasing temperatures, that of the latter class is found to increase. The authors made the following experiments for the most part in the Naples Zoological station. In order to determine the variations of temperature undergone by the electric organ of the fishes, they used Constantan batteries, consisting of ten to twenty elements, made up of plates or wires of iron and of this alloy (Constantan is an alloy of copper and of nickel containing 50 per cent of each), which were dipped in the dissected organ, or else introduced between the two organs of the same fish, while being in connection with an extremely sensitive Rubens galvanometer. The organ was stimulated from the nerve by means of currents from an induction coil, acting in most cases for one second. As it was impossible to evaluate the electric energy of the discharge by means of the electrodynamometer electric method, the authors determined the amount of heat evolved in the external circuit by means of an air thermometer analogous to the Riess thermometer. From these experiments, the remarkable result is inferred that the variations of temperature undergone by the stimulated organ are so small as to be inappreciable. The electric organ, accordingly, shows a thermic behavior essentially different from that of muscles. It cannot therefore be analogous to a battery working exothermically with a considerable evolution of chemical heat. It rather seems likely to constitute an endothermic battery, and, more especially, a concentration battery. With respect to the thermic behavior, it resembles a nervous tissue rather than a muscular tissue. These researches are further confirmed by experiments made with a view of finding the temperature coefficient of the power of the shocks.

Both of the two schemes for an electric high-speed railway between Berlin and Hamburg, lately presented to the Prussian railway department, provide for an electric central station to be installed in Wittenberg, the main station between Berlin and Hamburg. It is anticipated that the journey between the two cities, which at present requires upward of three hours with the fastest trains, will eventually be made in one and one-half hours only. As a matter of course, a new roadbed will be necessary, but the cost of this reconstruction does not seem to be prohibitory. The fact that a third track has been found necessary (which in the case of the electric high-speed railway being installed could evidently be dispensed with) is illustrative of the dense traffic existing between the two largest German cities.