body that produced on silk a beautiful violet, exceedingly resistant to light—being in this respect very different from archil, which was then employed in silk dyeing—it appeared to me that it would be a useful dye if it could be produced in large quantities. But its probable cost of production made this seem almost hopeless, and such would indeed have been the case had it not possessed so strikingly intense a dyeing power. I quietly continued my investigations, sought to determine the formula for the dyestuff, etc., and at the same time I obtained an introduction to Messrs. Pullar, of Perth, who gave a favorable opinion of the specimens of dyed silk submitted to them. When the summer vacation came and I had more time at my disposal, I undertook, with my brother's assistance, technical experiments on a very small scale, in which one or two ounces of the dyestuff were produced. Then, on August 26, 1856, the process was patented. Soon afterward, during a visit to the dyeworks of Messrs. Pullar in Perth, I made experiments, in conjunction with them, in dyeing cotton and other materials. They were also good enough to take me to some print works at Mary Hill near Glasgow, where experiments in printing were begun. As the results, so far, were satisfactory and the opinion of the dye was favorable, it was decided to undertake its manufacture. Consequently, I did not return to the Royal College of Chemistry at the end of the vacation. I must confess that, after taking this step, I experienced considerable apprehension that the undertaking might prove a failure, and I was also worried by the thought that my technical work would put an end to my scientific researches.

As sufficient knowledge concerning the practical operation of the process of manufacture was yet lacking, and as the dye had also not been fully tested on large quantities of material, it was not possible to begin the manufacture on a very large scale. My father had confidence in me and in the invention, found the required capital, and joined with me and my brother in the enterprise, under the firm name of "Perkin and Sons."

After the necessary land had been acquired, the erection of the factory was commenced about the end of May or the beginning of June, 1857. As my father was an architect, the buildings were quickly erected, and by the end of the year a sufficient plant was ready for operation to enable us to begin making the dyestuff and delivering it to silk dyers. This was in December, 1857.

In an article of mine, "On the History of Alizarine," may be found the print of a hasty pencil sketch of the factory, which I made early in 1858, or less than a year after the commencement of building.*

But much yet remains to be told of the difficulties which were connected with the first commercial production of the dye, and which continued for some time longer before they were gradually overcome. At the time when we set the factory going I had no knowledge of chemical factories except what I had learned from a few books, and I had only once been, for a few minutes, inside a chemical factory, and that an alum factory. Had I, however, seen the apparatus then commonly employed in chemical manufactures, this would have been of but little value to me, because the new industry required its own peculiar appliances. As the materials were more costly and the methods more refined than those of other chemical factories, the apparatus also necessarily had to be of a far higher class and more carefully constructed. And not only this, but it had to be newly invented, and practical directions for its manufacture had to be given to the makers, for it was astonishing how little the practical men of those days could help one with suggestions of their own. The waste of valuable time caused by the delays in their work, and their imperfect understanding of the directions given them, were at times very discouraging. Luckily, I had a little practical knowledge of machine construction and mechanics, and this was invaluable to me at that time. Fortunately, also, very little, if any, of the apparatus designed failed of its intended purpose.

In the chemical part, also, many difficulties had to be overcome. The manufacture of aniline, which could then be found in but very few laboratories, was no simple matter. Benzol was not made in large quantities, and when it was obtained it was of very variable composition, so that it had to be purified. Its conversion into nitro-benzol at moderate cost likewise proved difficult. Strong nitric acid was not manufactured except in very small quantities and at exorbitant prices, and as we did not wish to engage in its manufacture, we tried a mixture of soda, saltpeter, and sulphuric acid, and in this way produced large quantities of nitro-benzol, an operation which, however, required great care. The extraction of the dye and its purification also presented many difficulties.

On looking back at all the difficulties of the infant industry, many of them appear, in the light of our present knowledge, so insignificant as scarcely to be worth mentioning. Yet they had a very real existence in their time.

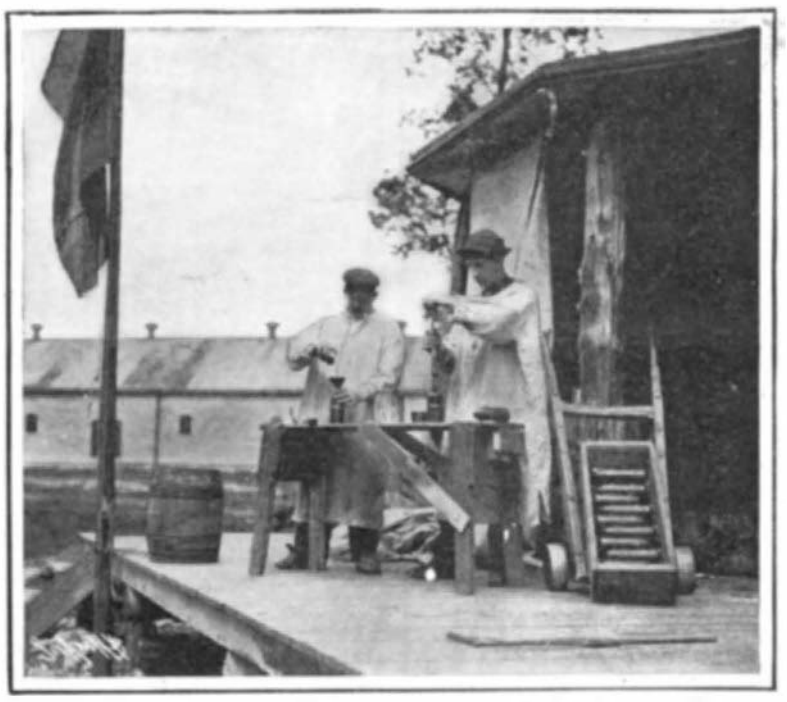
But the production of the dye was not all that there was to do. The methods of using it also had to be developed. In those days dyers were accustomed to the use of vegetable dyes only, and they did not know what to do with basic dyes like "mauve." I had to become, to a certain extent, a dyer and calico printer, and I spent much time, first in London and Macclesfield in silk dyeing, then in Scotland in calico printing, and next in Bradford in finding out how to dye half-woolen mixture with "mauve." I could not well spare this time from my own factory, but it had to be.

Verily, this dye was a pioneer, and it made the way clear for all that came after it! And what a change has come about in dye works and print works! Instead of, as formerly, jealously guarding their own secret processes, the heads of factories now expect that, on the appearance of a new dye, the chemists shall teach them how to use it.

* Journal Society of Arts, 1879.

Utilization of the Entire Cotton Plant.

According to the chemical investigations of Dr. Robert R. Roberts, of Washington, D. C., the entire cotton plant is a fiber that can be utilized. Dr. Roberts has been quietly employed on cotton fiber work for the past five years, and has just reached the stage of his investigations which would justify him in announcing the results of his discovery. He can delint cottonseed in five minutes, handing out a handful of seed that will rattle like shelled corn. This is done without injuring the germinating qualities of the seed, nor does it affect the value of the manufacture of oil. In this delinting process Dr. Roberts claims a saving of 75 per cent of seed waste in planting, eliminating defective seed, which will enable the Southern cotton planter to use the drill machine in planting, obviating, in a manner, the enormous expense of chopping out the surplus cotton stalks. He claims furthermore that his delinting process will effectively destroy the boll weevil, whether the eggs or larvæ are laid in the germinating point of the seed or hibernating in the form of a beetle in the loose cottonseed. The seed can be delinted, he says, for about $6 per ton. Cotton stalks, after the ordinary process of reduction to a pulp, become by the new process in thirty-four hours a fine fiber, not as long as cotton itself, but similar in texture. This fiber, he claims, will make the finest paper in the world.



One of the Powder Filling Houses Charging 3-Inch Shells.

A red flag is flown while this operation is in progress.

THE IONA NAVAL MAGAZINE.—II.

The heart and activities of the Iona naval magazine are centered around the storage and manipulation of smokeless powder into charges for the large and small size guns of the navy, and the black for bursting charges for the shells. Some of the more important places, therefore, are the powder filling houses, four of which are in operation, situated at widely different points. These are all small, one-story, wooden structures, designed to be unpretentious and isolated owing to the possibility of an explosion. One of the accompanying pictures shows the interior of the main filling house, which presents about one of the most animated and interesting sights to be seen on the island. The men are required to wear long white serge suits and moccasins; no metal or other articles are allowed in the pockets which might in any way cause friction. All the tools, funnels, measures, cups, scales, and other appliances used are made of copper. Here the delicate and somewhat dangerous business of weighing out the various smokeless powder charges is done. Even one or two grammes difference in weight is carefully observed. At the Indian Head, Md., proving grounds the naval ordnance experts, by tests, determine the powder charge best adapted for the various guns. Also at the annual target practice similar results as to range and velocities are recorded. With the advent of new guns and the slight chemical change in the powder, the charges are subject to constant revision. This keeps the filling-house men constantly employed. Each morning the day's supply of powder is brought from the magazine in the lead-colored wooden boxes. These are zinc-lined, air-tight, and hold 100 pounds. The government pays seventy cents per pound for powder, and furnishes the alcohol to the manufacturers. The output of the naval powder factory at Indian Head, which is about 2,000 pounds per day, is mainly used for experimental purposes on the proving grounds. Owing to the careful process of manufacture, particularly in the final washing of the pulp, the powder is said to be equal, if not a bit superior, to that obtained from the manufacturers. The boxes of powder are emptied into a long wooden trough, and with a copper scoop it is dipped out, accurately weighed, and tied up in quarter, half, and full charges, in white bags of muslin. These bags have several wide streamers for fastening attached, and each is tagged with the date of filling and the amount of powder it contains. A small ignition charge of quick-burning black powder, to set off the smokeless, is stowed in the bottom of each bag.

They are then placed in large copper cans and returned to the magazines, where they are held in readiness to go aboard the ships. At the time of the writer's visit the big charges, 220 pounds for the 13-inch guns, were being put up. These are arranged in four quarter charges of 55 pounds each. The bags when piled on top of one another reach to the top of a man's head, and present a formidable sight of bottled-up destruction. The heaviest charge used in the navy is for the new 45-caliber, 12-inch, breech-loading rifles installed on the "Connecticut" and "Louisiana," which is 310 to 330 pounds. As the smokeless powder, owing to various atmospheric pressures and different temperatures, absorbs moisture and undergoes a slight chemical change, all the smokeless powder is sent to the naval storage depot at Dover, N. J. Here has been established a redrying house, where the smokeless powder is placed in a series of bins or draws where, at a steady temperature, it is kept for a regular time. Three hundred thousand pounds of smokeless powder were redried here last year. No ammunition is put up at this point, it being reserved entirely for the storage of powder and high explosives. It has an ideal location for this purpose, being seven miles inland and entirely isolated.

Nearly all the powder consumed at Iona Island is sent direct from this depot.

To furnish the great number of bags for the powder charges, an extensive sewing plant is constantly kept going on the second floor of one of the ordnance buildings in the Brooklyn navy yard. Here, with an electric cutter, 50 to 100 thicknesses of muslin are cut up at a time into various sized patterns. A series of steel dies, at a single operation, cut out great quantities of the round bottoms for the bags. Thirty different sizes are made for the bursting and propelling charges, ranging from the 3-pounder to the 13-inch gun. The sewing is all done by skilled men operators, a motor being attached to each machine. The making of the large 12 and 13-inch bags, with a half-dozen wide streamers, requires an extraordinary amount of intricate sewing and manipulation. Each is deftly turned and twisted several hundred times before completion. Besides the regu-

Peary's New Polar Record.

Commander Robert E. Peary has sent a message stating that he succeeded reaching latitude 87 degrees 6 minutes. This is higher than the point reached by the Duke of the Abruzzi, who held the record. Peary suffered terrible privation and hardship, battling incessantly with ice, storms, and headwinds. No deaths or illness, however, occurred in the expedition.

Peary wintered on the north coast of Grant Land and then traveled by sledge northward. Gales broke up the ice, destroyed his caches, and cut off communication with his supporting bodies. Drifting steadily eastward, however, he reached the point mentioned. On the return his party had to eat eight dogs.

lar bottom, each bag has an additional compartment made for the ignition charge, having a perforated center. One man turns out on an average fifteen to twenty 13 and 12-inch bags a day, and about thirty-five of the 6-inch. The longest bag made is for holding the entire 6-inch charge, about a yard long. The completed bags are stamped on the bottom with size and caliber of the gun they are intended for, then sent up to Iona Island, to be filled and stored in the powder cans. Another important operation performed in the filling houses is loading the 13 and 12-inch projectiles with their bursting charge. For the former, 50 pounds of black powder is used, and about 30 pounds for the 12-inch. To hold the shells steady and to get at the base of these huge steel missiles, weighing over 1,000 pounds each, they are roped in a sling and hoisted clear of the floor by a pulley and chain. The point is then lowered a foot or so into a stout wooden frame with an opening a trifle larger than the shell. Then a long narrow bag is inserted in the shell cavity, and the measured amount of black powder is poured through a funnel into the shell. Some fifty of these huge projectiles can be loaded in a day. A new rotating band, to give a truer flight to shells from guns in which the rifling has been considerably worn by erosion, has been devised. At the recent target practice all shells are reported to have had a perfectly true flight. Several of the smaller filling houses are used to assemble the cartridge cases and the bursting charges of the 3-inch rapid-fire shells used to repel torpedo attacks. While in the act of pouring in the black powder charge a red flag is kept flying. The 3-inch rapid-fire cartridge cases, after being filled with the propelling charge of 5 pounds, are placed on a hand power press and the projectile shoved home. The assembled shell and cartridges are then run through a gage having the same dimensions as the actual guns on board the ship. They are afterward packed in wooden boxes up to a weight of 123 pounds, and stored for shipment. With a half-dozen new cruisers and several big battleships soon to go in commission to equip, and the regular routine work of the fleet to look after, the Iona magazine is just now one of the busiest ordnance places of the government. Owing to its superior equipment and possible enlargement, it is destined to become the most important ammunition stronghold and naval base in the country. The writer acknowledges indebtedness to Commander K. Roher, U. S. N., late Inspector Ordnance in the Brooklyn navy yard, now of the San Juan naval station, Porto Rico, for courtesies extended.

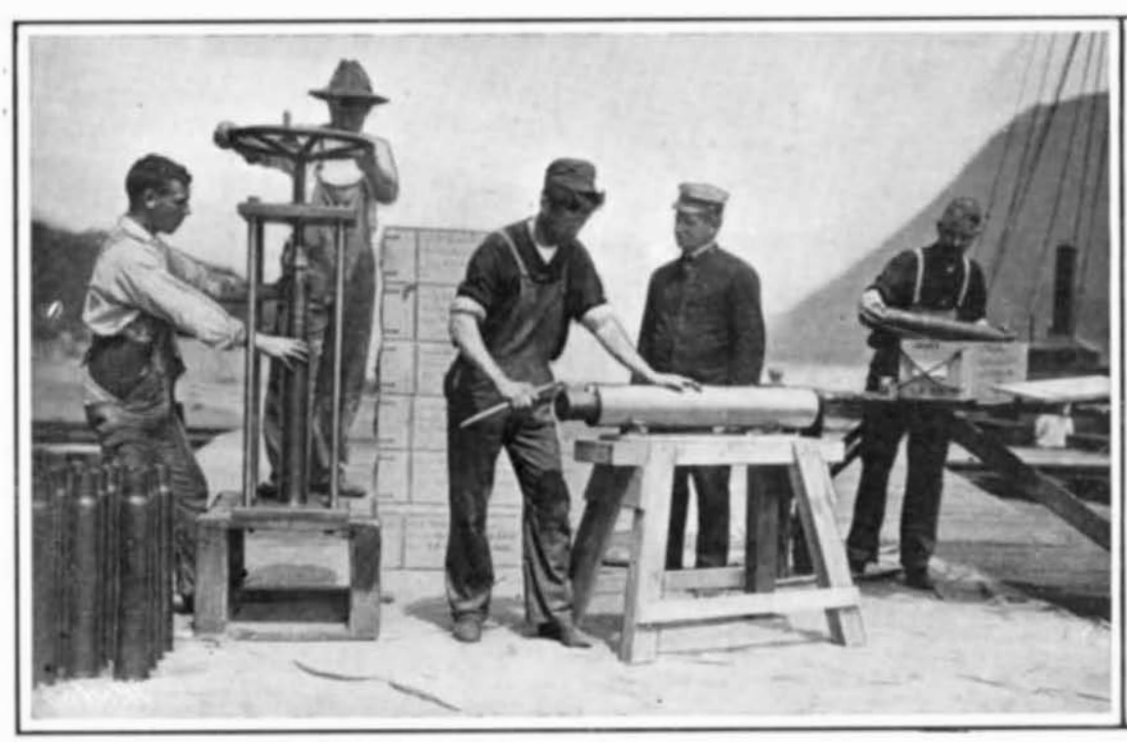
Interior of the Main Powder Filling House, Iona Island, Where the Smokeless Powder is Put Up in Bags Which Constitute the Firing Charges of Naval Ordnance.

A Full Powder Charge for a 13-Inch Gun.

In four bags of 55 pounds each the charge of 220 pounds is stored in two copper cans.

Putting in the Bag to Hold the Bursting Charge of 50 Pounds of Black Powder for a 13-Inch Shell.

The United States ordnance officers are carrying on a series of tests with a new bullet which is expected to supersede the one used at present in the ammunition for the new magazine rifle. The new bullet is jacketed, but is sharper than the earlier form.



Assembling 3-Inch Rapid-Fire Shell and Cartridge.

How Smokeless Powder is Handled Before It Is Bagged.

THE IONA NAVAL MAGAZINE.—II.