in those he opened was completely soaked and worthless. They were designed to have the prongs come up within a few inches of the surface, but as the freshet had raised the river 25 feet above low water, they were far below.

Several submarine infernal machines have also been sunk in the Savannah river, in order to destroy any of the Union gunboats which might be enabled to pass Fort Pulaski. While Commodore Rodgers was sounding this river he discovered several objects floating upon the surface, which appeared at first sight to be empty tin cans, and as such were not regarded by him as worthy of notice. Lieutenant Sprotson, of the gunboat *Seneca*, hailed him and told him that the objects alluded to were buoys attached to infernal machines. These buoys, five in number, were placed several yards apart in the channel leading from Wright river, and they were connected by spiral wires.

An attempt was subsequently made to produce an explosion by pulling the wires, which failed. The wires were then cut, and the outer buoy was brought off in the gunboat *Unadilla*. In consequence of the delicate nature of the exploding apparatus, and the result of the examination of the buoy brought on board, it was deemed more prudent to sink the remaining buoys rather than attempt to remove them, so that the enemy should not have the satisfaction of feeling that a single life had been lost by the diabolical invention. The buoys were sunk by firing rifle shots into them. The torpedo brought on board the *Unadilla* was afterward set upon a bank, and a rifle ball fired through it, when it exploded.

In reviewing the efforts which have been made to render submarine torpedoes effective against war vessels, the conclusion is forced upon us that the results have entirely disappointed all anticipations respecting their infernal character. They have proven to be entirely worthless and abortive in effecting the destruction of a single vessel in actual warfare. They are plausible submarine demons, and if properly constructed and skillfully managed, may be made effective for harbor defense, but hitherto they have not.

THE CHEMISTRY OF COAL.

Number VII.

PARAFFINE.

We cannot dismiss the subject of the chemistry of coal without a few remarks in relation to paraffine. We have a cake of it now lying before us; and to a person having no idea of the immense variety of substances produced by the combination of carbon and hydrogen it would seem incredible that this cake could have been extracted from coal tar. It is white and translucent, very nearly resembling spermaceti, and is extensively used for making candles. It is especially adapted to this purpose from the large quantity of hydrogen which it contains in proportion to the carbon, the heat generated by the burning of the hydrogen securing a perfect combustion of the carbon, and thus preventing the formation of smoke. The proportion of the hydrogen to the carbon is greater than in any other of the products of the distillation of coal; the formula is C_{20} H_{21}.

The word paraffine—from the Latin *parum*, little, and *affinis*, akin—is given to the substance as descriptive of its most marked peculiarity, which is its small affinity for other substances, whether acids or alkalies. This property of resisting the action of acids and alkalies is causing it to come into use for many purposes. If a lump of potash is wrapped up in common paper the paper is soon destroyed; but if the paper is saturated with paraffine, the potash will not act upon it. Acids in bottles with glass stoppers sometimes decompose the glass, and the stopper becomes cemented into the neck; but if the stopper is dipped in paraffine before being inserted it is preserved from the action of the acid.

The power of paraffine to resist the action of acids is very remarkable. Prof. Seely boiled a quantity of it in strong nitric acid, and it was not altered in the least. Neither was it altered when placed in a cold mixture of the two acids, but on heating the mixture it was decomposed and a large number of substances formed. The Professor did not separate these, but the presence of butyric acid in large quantity was indicated by its peculiar odor.

Paraffine, like many other substances derived from coal, is also produced by the destructive distillation of beech wood and other vegetable substances. The diverse properties of benzole and paraffine serve to give us some idea of the great part which the products of the destructive distillation of bituminous coal are destined to play in human affairs.

HISTORY OF TURBINE WATER WHEELS.

Number I.

Up to the year 1829 the only water wheels which had been used in the United States were the overshot breast, pitchback, undershot, Rumsey-re-action, Tyler-re-action and the flutter-wheel. Respecting their construction different millwrights entertained different opinions, each having some peculiar notions of his own which he carried out into practice, and thought it superior to any thing done by others. Works then published on hydraulics and millwrighting were of little or no value, as they only contained information of a general character respecting breast and undershot wheels merely. Excepting the overshot and breast wheels, none of the others gave out more than fifty per cent of the water power, and the art of millwrighting was in a very crude condition. Experiments, however, were then in progress, the issues of which have revolutionized the entire art, so far as it relates to the very general improvement and adoption of re-action wheels—this term being used for those through which the water passes, in contradistinction to those which receive the water and discharge it from the same openings of buckets. These experiments were begun in 1824 by Zebulon and Austin Parker, residing in Muskingum County, Ohio, who made an arrangement with Joseph F. Monroe to erect a dam, lock and mills on a tract of land situated on Hill-creek, about four miles above its junction with the Muskingum river. They put in a common flutter-wheel to drive their first saw after the mill was up, but found it to be a very unprofitable motor on account of its frequent stoppages from back-water. The creek was very sluggish and crooked, and the whole fall was but seven feet; consequently a very small rise of water in the creek caused the mill to stop. This wheel in such a situation, therefore, proved a failure, and the brothers Parker then began to inquire after one that would be more efficient in situations exposed to back-water pressure. The Rumsey-reaction was then extensively known in Ohio as a back-water wheel, and it had been used more or less from the earliest settlement of the territory. It had always been hung horizontally upon a vertical shaft, and was not well suited for driving an up-and-down saw, as it had to be geared in a peculiar manner to get up the proper motion. Messrs. Parker concluded that it was not suitable for their mill and after considerable reflection they devised a new motor consisting of six small re-action wheels set in pairs, hung vertically on a horizontal shaft with the crank attached to the saw pitman in the same manner as with the flutter-wheel. The whole were made, but Messrs. Parker being young and inexperienced, admitted the water to them in the wrong direction—contrary to instead of with, the wheel's motion. The consequence of this arrangement was, that instead of the wheel performing as had been expected by the inventors, they scarcely exercised any power whatever, and ran with the utmost difficulty. The inquiry arose, "What is the cause of the wheel's failure?" They were then unable to discover the error, and finally concluded to give up the saw mill, and they proceeded to erect a grist mill alongside of it intending to use a Rumsey-re-action wheel on a vertical shaft, which was well suited for grinding purposes. For this wheel they adopted improved buckets of thin cast-iron plates bolted between wooden rims, the bottom one being a wooden disk fastened to the shaft and the top rim was made narrower than had been customary in other wheels. This wheel was made to run directly under the forebay, and near the lower end of the forebay the water passed into the wheel through a round opening in the bottom. This orifice corresponded in size with the inner circle of the top rim of the wheel. When finished, this wheel was tried and its makers were satisfied that it was as effective as others of the same class. It happened that the headgates were rather imperfect and leaked sufficient water when shut to make the wheel run constantly, though slowly. In proceeding to erect the gearing and rig the stones for grinding corn, a plank happened to fall into the forebay above the wheel, and the water carried it forward until it lodged against a post in the center of the forebay, when it tilted up on its edge with one end extending down near the wheel, and the other against the side of the forebay. This accidental position of the plank led to the invention which revolutionized the application of turbine wheels. The plank gave a direction to the water in the forebay, which made it assume a vertical motion and enter the wheel case in the same direction of the wheel's rotation. The attention of Zebulon Parker was directed to this by the wheel suddenly doubling its speed. He was surprised; went to see if the gate was not raised, and there found the angled plank, and saw the whirling motion given to the inlet water by the wheel. After a few moments' reflection on the circumstance, he raised the plank and allowed the water to flow as before, when the wheel at once ceased its more rapid motion. The plank was again inserted and the water made to circle with the wheel's motion, when the wheel started as before with a double velocity. The plank was again raised, and placed in a contrary position so as to give the water the direction which it had in the abandoned Rumsey wheel in the saw mill. The result was, the wheel stood stock still and remained thus while the plank was thus held. The plank being removed, the wheel started, and ran as before.

The two brothers then consulted together, and decided to arrange the guide for their wheels, so as to direct the water downward with a vertical motion coinciding with the rotary direction of the wheel. The guides were thus constructed with a box around them and the water was admitted to the wheel which was then started to grind corn. It operated in a very superior manner, doing more work than any wheel of the kind ever had been known to do before. This was the first great step made in the improvement of reaction wheels in America.

Spectrum Analysis in Lecture Rooms.

We take the following from the Paris correspondence of the *Photographic News*:—

The remarkable experiments of Kirchoff and Bunsen upon the spectra of flames colored by metals have been fully described in your pages. M. Debray has conceived the happy idea of projecting these spectra upon a screen by means of a Drummond light. The combustion of coal gas sustained by atmospheric air gives too pale a flame when metallic substances are introduced into it to enable us to see the spectra clearly except with the aid of a telescope; but if we take the exceedingly hot jet of an oxyhydrogen blowpipe, colored by various metals, the splendor it acquires is so brilliant that it becomes very easy to project the spectrum upon a screen, so as to be seen distinctly by an audience. To this end, the flame is introduced into Dubsocq's photographic apparatus, now so generally employed in optical experiments, and proceed precisely as in obtaining the spectrum from an oil lamp or from the voltaic arc. We then obtain upon a screen suitably adjusted the series of brilliant and vari-colored rays which characterize the metal introduced into the flame. These experiments are successful not only with the alkaline and earthy alkaline metals, but also with other metals, such as copper and lead, although these bodies give with a gas flame, and the ordinary apparatus only a very confused phenomenon. As platinum melts instantaneously in the flame of the blow-pipe, the metallic substance is introduced by means of the small piece of retort coke, or by a match strongly impregnated with the matter to be experimented upon, which will be preferably selected from the metallic chlorides; with a little practice we can sustain the phenomenon long enough to study all its details at a very great distance.

By employing the Drummond light, we can also project the development of the brilliant ray of sodium, as first observed by M. Foucault, by the aid of the electric light. The Drummond light, placed in the photogenic apparatus, gives a continuous spectrum, in which a black ray appears in the place occupied by the brilliant ray of sodium in the spectra of the flames containing this metal, upon placing in front of slide of the apparatus the flame of a lamp fed with alcohol containing chloride of sodium.

MR. COBDEN has promised to bring the decimal coinage question before Parliament during the ensuing session.