umns of the SCIENTIFIC AMERICAN. Many of these trials were made under the direction of experienced Government officers, specially appointed for the purpose, and they appeared to establish the fact that the invention was one of a remarkable character. Some of the targets were clad with 6 inches of iron, with a strong wood backing; but the projectiles passed through the mass without the least difficulty. In other instances the projectile has been thrown a distance of 4½ and 5½ miles. Of course no such results could have been obtained had there been any tumbling or other defective operation of the shot. We are constrained to believe that in Commodore Turner's trial there was either some mismanagement in the handling of the shot, or some defect in their construction. We must have further evidence of failure before we give up our faith in what has heretofore been demonstrated to be a good invention.

One of the peculiarities of Stafford's projectile is that it is generally made smaller than the bore of the gun, the intervening space being filled up by wood or other casing, attached to the shot. This casing flies from the shot when the latter leaves the gun, giving the projectile a free flight. It is alleged that by this method a large area of explosive force is made to act effectively upon a projectile of small diameter. Immense velocity and great penetrative power are thus obtained. Engravings of the Stafford projectile will be found in No. 14, Vol. VIII (new series) of the SCIENTIFIC AMERICAN.

DISTILLATION AND EFFECTS OF HEAT.

There are two kinds of distillation, which are entirely distinct in their nature and results, and by which the effects of heat in changing the character of substances are exemplified in a most remarkable manner. These processes are called *common*, and *destructive* distillation. The former consists in applying a moderate degree of heat to a substance, such as water by which it is converted into vapor, and after this it is again converted into water by refrigeration. Or it is perhaps more clearly explained by the treatment of a liquid, such as a mash of malt, which contains ardent spirits combined with water. By the application of a lower temperature than that of boiling water, to the mash in a still, the spirits pass over in the condition of vapor, are condensed in a refrigerator, and thus they are separated or distilled from the mash. This is common distillation, by which no chemical change is effected in the nature of the substances treated. The water is first converted into vapor by heat, then converted into water again by cold; and as the spirits boil at a lower degree of temperature than water, they are separated from the water by distilling at a low temperature, and then are converted into a liquid state again by cooling.

Destructive distillation consists in applying a high degree of heat to substances in retorts, by which products of an entirely different chemical character from the substances treated are obtained. Some of the most astonishing results connected with modern chemistry and the practical arts are due to destructive distillation. For example, when a charge of bituminous coal is placed in a retort raised to red heat, a great portion of this solid is converted into the gas which is used for illumination, and it will flow unchanged for miles through tubes exposed to the lowest atmospheric temperature. Common oil subjected to the same treatment will also produce gas, but it is not converted by refrigeration into oil again. Many liquids and several solids subjected to such a degree of heat, produce similar results; hence as the character of the products is entirely changed by the operation, it has been called destructive distillation.

The wonderful effects of heat in distillation are shown in the variety of products obtained, and the study of these deserves general attention. For example, in the distillation of cannel coal, a different chemical product is obtained with almost every different degree of heat to which the coal is subjected. If the heat is gradually raised, a very clear oil first passes over, at a comparatively low temperature, then darker colored oils, then thick tar. On the other hand, if the coal is subjected at once to a low red heat, most of the matter that would otherwise have passed off as oil and tar is converted into gas, and all these products are different in their chemical characteristics. A full cherry red heat is that at which coal in a retort is treated to obtain the best illuminating gas. If the heat is raised much above this, a greater quantity but an inferior quality of gas results. The manufacture of a heavy oil and tar from distilled coal, was conducted by Lord Dundonald, in Scotland, about 1768, long before gas was made for public illumination. The tar was employed for coating the bottoms of ships, to prevent the attacks of the ship worm, before copper sheathing was generally applied. In the spirit with which the manufacture of tar was pursued, Lord Dundonald narrowly missed producing coal oil for commercial purposes, although he used a retort similar to some that were employed within the last four years for distilling coal in making kerosene.

One of the most remarkable products of distilled coal, peat, &c., is parafine, which was discovered by the German chemist Reichenbach, about 1833, as one of the products of tar. It is a white substance, resembling wax in some of its features. This chemist also obtained oil, which he called eupion, from tar. About the same time that parafine was thus obtained from coal tar, Dr. Christison, of Edinburgh, also produced it from Rangoon petroleum, and called it petroline. From this petroleum he also distilled several oils, such as those which are now in common use for illumination. Prior to 1860, the distillation of coal had been carried on for several years upon a very expensive scale in Europe and America for obtaining illuminating oil; but the great supplies distilled in nature's extensive laboratory, situated in the valley of the Alleghany, have supplanted all the similar products of coal distillation, and the amount exported this year, up to the present time, exceeds fifteen millions of dollars.

A good idea of the varied and remarkable effects of heat upon coal in distillation may be communicated by stating that forty-two different substances have been separated from coal and classified, and the production of some of these engages important branches of industry. Among them are illuminating gas, coke, ammonia, naptha, benzole, heavy oil, parafine, tar, aniline and all those beautiful colors derived from it which are now so common on silk and woolen fabrics. Distillation, and the effects of heat upon various substances, form most interesting and instructive studies to inquirers after scientific knowledge.

BREECH-LOADING RIFLES AT THE NEXT FAIR OF THE AMERICAN INSTITUTE.

We learn from the officers of the American Institute, that a prominent feature at the Fair, this season, will be a general exhibition of breech-loading rifles. An opportunity will be given for a competitive trial of the various kinds manufactured, and a diploma or premium will be awarded to the best gun.

This will doubtless be the most attractive and popular part of the exhibition. We also suggest to the managers to permit a trial, at all ranges, between the best breech-loaders and the best muzzle-loaders, in order to settle the mooted question whether a breech-loading rifle with fixed ammunition carries as accurately as a perfect muzzle-loader. On account of the great convenience of breech-loading rifles, there is no doubt that they will entirely supersede the old-fashioned arm, provided that they carry the bullet with equal precision. But a defect in this particular will more than counterbalance all their other advantages; for, if there is anything that is sure to disgust a sportsman with his rifle, it is to have it send the bullet to a place different from that at which it is aimed. It is also asserted by some that the complication of the breech-loader is fatal to its general introduction in the army. While but few persons are found who object to the employment of this class of weapon as a national arm; there are others who maintain that the delicacy of workmanship unavoidable in a breech-loading rifle, materially detracts from its utility for field or cavalry use. These are disputed points, which we hope to see settled in favor of the breech-loader; and we desire to have the coming tests made thorough and severe. Let us have no holiday decisions; but submit the competing guns to searching scrutiny, at least as thorough as they will undergo in actual service. Let the breech-loader be exposed to a cloud of dust, such as is inevitable in a long day's cavalry ride, and then see whether the closely-fitted joints will work so that the trooper can rely upon his weapon, with perfect confidence that it will not be found unmanageable in the hour of peril. Let moisture have a fair chance at the rifle also, so that the public may know how the parts interchange and play in this condition. Let the gun be thrown rudely to the ground, so that all interested may know to a certainty just how much rough usage a breech-loader can stand;—whether it is a bona-fide weapon, or merely a delicate combination of machinery liable to become deranged at the slightest irregular proceeding. Let us know whether it is, in gunnery, what the spy-glass is in optics; or whether it be like the microscope, which requires previous education to manipulate and understand. These are vital points in the utility of breech-loaders, which we should like to have proved or disproved beyond cavil. The greatest value of a muzzle-loading gun is that it is, under all reasonable circumstances, wholly reliable; and it is of very little importance to a trooper or sharpshooter, when his weapon fails him at a critical time, to know that a number of experts have decided that the arm then in his possession is infallible. We do not propose that unreasonable violence should be offered the weapons; but we are decidedly opposed to the sort of encomiums generally lavished upon arms, which are not at all borne out or justified by their mechanical value, or their subsequent performances.

RECENT AMERICAN PATENTS.

Oil Skimmer.—In boiling fish or other materials for the purpose of extracting the oil, and in heating other substances or liquids for the purpose of evaporation or otherwise, the surface of the liquid is generally covered with scum, and the impurities or dregs precipitate, and occupy the bottom part of the tank or still, the clear good liquid being in the middle. The object of this invention is to draw off the clear liquid from the middle, free from the scum on the top, and from the dregs on the bottom. The invention consists in the employment of a shallow saucer-shaped vessel, provided with one or more floats, and with a pipe leading from its lowest point to the barrel or other vessel which is intended to receive the oil or other liquid; said pipe being sustained by one or more floats in such a manner that the saucer-shaped vessel can be adjusted to float on a level with the surface of the clear liquid, under the scum and above the dregs; the vessel being balanced by the floats attached to it, and the pipe being sustained by the floats which are secured to the same, the clear liquid draining off through said pipe until the saucer-shaped vessel settles down on the dregs at or near the bottom of the still or tank. Address Israel Peck or W. H. H. Glover, the inventors, Southhold, N. Y.

Dredging and Ditching Apparatus.—These improvements are more especially designed to be applied in combination with an apparatus termed a "suction dredging boat," patented May 10, 1863, their object when so applied being to cut, bore, pick, break and tear up all obstructive deposits of mud, sand, clay and other matter from the beds of rivers, harbors docks and other places, or to deepen the same, and to cut and break up turf and earth in swamps and marshes and other places, and reduce all such substances and material to a soft or pulpy or sufficiently diluted condition or get them so mixed with water as to admit of their removal by the pumps of that apparatus; also for cutting ditches and canals, and for forming dikes or embankments and filling up lots and improving swamps and marshes and other low lands, and bringing them to the grade of uplands for cultivation, by depositing upon such swamps, marshes or low lands, the material taken up in cutting the ditches or canals from the adjacent waters. The said improvements may, however, be used in connection with any other kind of boat for the purpose of bringing the matters and substances specified to a condition to be removed by the action of a natural current, or the tide or by any other suitable means; and in some instances the said improvements might be arranged upon a carriage to run upon land, where a stream of water may be obtained to effect or facilitate the carrying away or removal of the material which is loosened by the cutting, boring, packing, breaking, and tearing-up operations. William Atkinson, deceased, late of Brooklyn, N. Y., was the inventor of this improvement; and further informa-