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# SCIENTIFIC AMERICAN SUPPLEMENT

## No. 551.

**For the Week Ending July 24, 1886.**

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## TORPEDO BOATS IN THE GALE.

The report sent hither from Washington to the effect that the recent loss of torpedo boats sustained by the French is creating serious distrust in such vessels, and is likely to affect the torpedo movement here, can scarcely be founded upon anything more substantial than rumor. Surely no sailor or naval constructor would condemn the use of the torpedo boat for harbor and coast defense because it could not outride the gale. The torpedo boat, as designed for use here, is not a cruiser, and not likely, even in active service, to be called upon during storms. In harbors, which she is designed specially to protect, she can always find a lee to run under.

Nor should it be inferred, from the dispatches referred to, that the modern torpedo boat is unseaworthy. On the contrary, she has shown her capability to take to the high seas under the ordinary prevailing conditions of tide and wind. The recent storm in the Mediterranean was of unusual fierceness, and was greatly intensified in its destroying power off Cape Corsica, where the torpedo boats were lost, by the set of the tide, which was athwart the wind; that is to say, at right angles to the direction whence the wind was blowing.

The *Admiralty and Horse Guards Gazette* says:

"A force of eighteen torpedo boats left Bastia for the purpose of assisting in the attack on the squadron at anchor in the Bay of Ajaccio. A stiffish breeze was blowing and the sea was a bit loppy, but the weather was not sufficiently rough to interfere with the regular arrival of the packet boats at Corsica. Of the eighteen torpedoers that accompanied the men-of-war, only six got around Cape Corsica and of these only two were in such a state as to prevent their taking part in the attack before making repairs. One was patched up, so five torpedo boats engaged in the operation upon which so much interest centered. All the second and third class torpedoers had been compelled to put back, those which got round being boats of the first class. It is said that only two men among the crews of the six boats escaped seasickness."

Regardless of such instances of impotency on the part of the torpedo boat, it must continue to be at least a valuable auxiliary in the defense of harbors. Indeed, a torpedo boat which has cost but $100,000 or less may, under favorable conditions, destroy a modern steel monster which has cost three or four millions. Those interested in this matter will remember the brilliant affair in Chinese waters, during the recent Franco-Chinese war, when a well handled torpedo boat sunk the Chinese flagship Yung-Wo without losing a man.

Indeed, it is by no means certain that a fleet of great leviathans, like the English Devastation, the French Imperieuse, and the Italian Dandolo, could, with all their great guns in play, safely pass a fleet of a score of modern torpedo boats. A target moving as fast as the best torpedo boat, viz., 22 nautical miles an hour, is not easily hit, and, when the smoke of battle covers the waters, not readily seen.

More attention is being given to the torpedo boat to-day than to the war ship, and because of its effectiveness and cheapness, it is not strange that this should be the case.

## THE BASIC STEEL PROCESS.

Among the several modifications of the pneumatic, or Bessemer, steel process which have been brought forward during the past few years, none has proved of such large commercial importance as that introduced by Messrs. Gilchrist and Thomas, and known generally as the "dephosphorization," or "basic," process. Though comparatively a recent invention, it has met with a wide application in Europe, both on the Continent and in Great Britain. In America, the plentiful supply of rich hematites and magnetites practically free from phosphorus has somewhat delayed its introduction, since provision for dephosphorization is less a necessity here than abroad. But the higher price of non-phosphoric pig iron, or Bessemer pig as it is denominated in the metal market, together with the perfection to which the basic process has now been brought, makes it a desirable addition to the steel industry of this country as well as to that of less favored districts. As yet the only basic "plant" in America is that just erected at Pottstown, Pa., by the Pottstown Iron Company. The first blow of basic steel was made on July 1, and the product obtained was in every way satisfactory.

Though there are a number of minor differences between the Bessemer and the Gilchrist-Thomas processes as regards the design of the converter and its subsequent manipulations, the essential difference between the two is in the lining. In the typical Bessemer vessel, no provision is made for the removal of phosphorus from the metallic bath, and therefore none but the purest brands of pig iron are available. The lining is entirely acid, being composed of ganister, a silicious rock in which the silica is held together by a small quantity of argillaceous material. The reactions occurring in such a converter are therefore limited to the oxidation of the silicon, carbon, and manganese, while the greater part of the phosphorus contained in the pig iron remains combined with the resulting steel. In the Gilchrist-Thomas process, on the contrary, the lining is composed of oxides of the alkaline earths, and is therefore strongly basic. The converter employed is very similar to that used in the acid process, and in some cases is identical, but in the best practice certain modifications are introduced, on account of the much more rapid destruction of the basic lining. The movable bottoms and interchangeable parts of the vessel are of even greater importance here than in the Bessemer; while the mouth of the converter, instead of being inclined to one side, is preferably wide and straight, in order that the charging and discharging may be on opposite sides, thus equalizing the excessive wear. The success of the basic process is largely dependent upon the proper preparation of the lining of the converter. Besides being strongly basic, it must be sufficiently refractory to resist extremely high temperatures. The material generally chosen for this purpose is dolomite, a magnesian limestone. This is either manufactured into bricks, which are then cemented together by anhydrous tar, or else it is burnt and ground, and then rammed into the vessel, with tar as a cementing material. The bottom of the converter is about two feet thick, and is formed of the same material as the rest of the lining. The blast holes, or tuyeres, are made by allowing rods, half an inch in diameter, and of sufficient length to reach entirely through the finished lining, to project upward from the bottom plate. When the plate and rods are withdrawn, the necessary openings are left for the entrance of the blast. The manipulations of the basic lined converter are quite different from the Bessemer, and the reactions distinctly characteristic. The charge, varying according to the size of the converter from 7 to 15 tons, is composed of highly phosphoric pig iron, low in silicon. At the celebrated iron works at Creusot, France, a pig iron is used containing from 2·5 to 3 per cent of phosphorus and 1·3 per cent of silicon. The most suitable irons for the basic process contain only 0·5 to 1·0 per cent of silicon, merely a trace of sulphur, and from 1 to 3 per cent of phosphorus, the higher proportion of the latter constituent being, however, preferred.

The converter, having been carefully heated, well burnt lime, free from silica, and in amount equal to about one-fifth of the subsequent charge of pig iron, is introduced, and by means of fine coke brought to a bright glow. The phosphoric pig iron is then added. Air under a pressure of 25 pounds is turned on, and the vessel brought to a vertical position. The blow lasts about thirteen minutes, in some localities longer, and is divided into two distinct periods, the Bessemer, or blow proper, and the after-blow. The ordinary blow terminates in a little over eleven minutes at the basic plant in Westphalia, Germany.

The silicon is first oxidized, and then the carbon. In the acid lined vessel it is seldom possible to effect a total elimination of the silicon, except in the Clapp-Griffiths converter, but it is characteristic of the basic process that the resulting steel contains no silicon, or only the merest trace. But very little phosphorus is removed during the blow proper. It is during the so-called after-blow that the reaction takes place upon which the invention of Messrs. Gilchrist and Thomas depends. The temperature rises at the close of this period to about 1,800° C. The phosphorus is rapidly oxidized to phosphoric anhydride, and combines with the lime added to the charge to form a phosphate of calcium, which is not subsequently reduced. In order to remove as much phosphorus as possible, it is necessary to keep the slag very basic; and consequently, when the silicon in the pig iron much exceeds 1 per cent, it is best to treat the metal by the "transfer method," in which the amount of silicon is first reduced in an acid lined converter, and the metal then transferred to one with basic lining for the after-blow. For otherwise the large amount of silicon would increase the slag, and not only more rapidly destroy the basic lining, but prolong the time required for a blow by hindering the basicity necessary for the removal of the phosphorus.

There is, however, a minimum percentage allowable as well, for in the absence of silicon the metal would become chilled, as it is the oxidation of this element which produces a large proportion of the heat of the reaction. The high temperature obtained in the after-blow is due to the combustion of the phosphorus. By oxidation to phosphoric anhydride it affords 5,747 heat units, and performs very much the same function during this part of the process that the silicon does during the blow proper. The slags produced in this process are almost double in quantity those produced in an acid lined vessel. Average specimens contain about 10 per cent of silica, 10 to 15 of phosphoric anhydride, 10 of oxide of iron, 40 to 50 of lime and magnesia, and varying amounts of manganese. It has recently been proposed to utilize these phosphatic slags in the manufacture of fertilizers, and the proposition is now carried out on a commercial scale in both Germany and England.

The elimination of the phosphorus seldom requires more than about two minutes. When it is judged to be complete, the converter is turned on its side, and a sample taken out in a ladle and cast in a small ingot. When cool, the metal is hammered out flat and broken in order to discover its fracture. Large and bright crystals are visible when the process is incomplete. These become smaller when the dephosphorization is ended. Usually, one test sample suffices. The necessary amount of ferro-manganese or spiegeleisen is then added for the recarburization of the molten iron. At some works, the slag is tapped before this addition, and at others afterward. A small amount of cold ferro-manganese is introduced into the ladle. The steel is then poured and cast into ingots in the usual manner.

The basic process has been developed on too extensive a scale in Europe to permit it longer to be called an experiment, except in the broad sense of the word, in which all industrial processes are experimental, since they are constantly subject to improvement; but the introduction of the process into American metallurgy is still very recent, and the newly erected plant at Pottstown will be watched with much interest. There is apparently a large field for the application of the basic process in this country, and particularly in the South, where so many of the limonite ores are highly phosphoric.

The tendency to substitute steel for iron wherever possible was never stronger than at present. Throughout Pennsylvania and the West, a number of Clapp-Griffiths plants have been established during the year, while in Tennessee extensive preparations are now in progress for converting the pure magnetic ores of the North Carolina mountains into Bessemer steel. But a large proportion of the iron deposits of the Appalachian system is not available for either of these processes, by reason of the phosphorus contained. In the great valley of Virginia alone there are almost inexhaustible stores of limonite of this character. It is in such localities, it seems to us, that the basic process will find an inviting field.

### EFFICIENCY OF SMALL WATER MOTORS.

In our issue of July 10, we published an article from the *American Engineer*, on the use and efficiency of small water motors. We find, however, that while our contemporary has done no more than justice to the great convenience of these compact little motors, it has rated their efficiency very much too high.

The natural effect concentrated in a fall of water is equal to the weight of the quantity of water which passes in a second multiplied by the vertical distance through which it falls. Where the aperture and height only are given, the theoretical horse power developed may be calculated from the following formula.:

$$\text{H. P.} = 0{\cdot}573 a h \sqrt{h}$$

in which $a$=the sectional area of the aperture or nozzle, and $h$=the vertical space through which the water falls.

In the motor under consideration, we have a vertical fall of 60 feet and a diameter of nozzle equal to three-sixteenths of an inch. Consequently

$$a=\pi r^2=\pi\left(\tfrac{1}{2}\text{ of }\tfrac{3}{16}\text{ of }\tfrac{1}{12}\right)^2=0{\cdot}00019174+;$$

and substituting these values in the formula,

$$\text{H. P.}=0{\cdot}573\times0{\cdot}00019174\times60\times7{\cdot}745,$$

or H. P. $=0{\cdot}051$.

### A New System of Harbor Improvement.

Scattered along the southern shore of Connecticut there are a number of mills depending for their motive power upon the movements of the tide. The inflowing waters are permitted to pass through the open valves of a suitably constructed dam, while during the ebb the valves close automatically, and the waters have no escape except through the raceway of the mill. This principle of concentration of tidal force has been utilized by Prof. Lewis M. Haupt, of the University of Pennsylvania, in his new system for the automatic improvement of rivers and harbors in sand or alluvium. In place of the permanent dam of the mills, however, he employs a series of adjustable deflecting shields, suspended from buoys or floats in such a manner that they offer little obstruction to the inflow of the tide, but by properly deflecting the outflow they create a channel across the bar, of any required depth consistent with the head of water available.

His device is, in reality, a floating dam anchored by heavy guys to the bottom of the harbor. One or more rows of shields are employed, according to the local conditions, and are arranged in a direction either transverse or oblique to the line of the current. They are made in sections of convenient length, in order to be readily transportable. Being thus built up of separate parts or units, the dam can be extended over any desired distance. As it is simply anchored to the bottom, it can readily be put in place, and its position altered as experience or changing conditions may require.

The action of the floating dam is twofold:

By extending the structure from each shore to the edge of the desired channel, the outfloating waters are concentrated laterally, and pass through the opening left between the two with a largely increased velocity, which scours out a channel whose depth is inversely proportional to its width. But in addition to this lateral concentration of the waters, the inclination of the shields, and their arrangement so that they shall not reach entirely to the bottom of the harbor, cause also a vertical deflection. This lowers the limit of scour, and creates a greater depth of water over the entire bar. The importance of such an increase of velocity will be appreciated when it is remembered that the scouring force of the current is proportional to the square of the velocity, while the transporting capacity varies as the sixth power of the velocity.

By lessening the area of discharge in this manner, it is possible to largely increase the velocity of the current, and consequently both its force and carrying capacity. Such, naturally, is the ultimate result of any system of harbor improvement, but the one under consideration differs from those heretofore proposed in permitting the free inflow of the tide, and, though concentrating the outflowing waters, in interfering in no way with their circulation over the bottom of the entire tidal basin. There is a serious objection to those systems of improvement which depend upon the construction of permanent dikes and jetties, for, however admirable they may be in other respects, the fact remains that they do disturb the regimen of the river and harbor, and that by reason of their unstable foundation they are liable to constant deterioration.

Prof. Haupt has taken much interest in the subject of the improvement of New York harbor, and has advanced a proposition for applying his system in this locality. The need of deeper water over the bar in Gedney's Channel is indisputable, as will be seen by a reference to the illustrated article which appeared in the SCIENTIFIC AMERICAN of July 10. Any plan, therefore, which would secure such a result within reasonable time, and at not too great an expenditure, would certainly be most welcome. The system of floating dams has the advantages of being comparatively inexpensive and also capable of ready application. Its efficiency, we believe, has not yet been practically tested, but it apparently fulfills the conditions which are recognized as essential to success.

### Photo-zincotypy and Other Photographic Printing Methods for the Printing Press.

In place of wood cuts, photo-zincotypes are very often used. The reproduction of line drawings is executed easily and securely by the well known methods of the photographic zinc etching, which offers no difficulties so long as half tones are not to be reproduced. For the production of photo-zincotypes, the transfer process with chrome gelatine or chrome albumen paper takes place, after the well-known method.

Some large houses use the asphaltum method, which gives greater sharpness of the fine lines. In the production of the asphaltum solutions, great improvements have been made lately. Husnik dissolves the asphaltum in rectified oil of turpentine to a thick liquid, requiring several days. With stirring, three to four times the volume of ether is added; a dough-like precipitate separates, which, after twenty-four hours, is washed with ether and then dried. The dry asphaltum is dissolved in pure benzole, free from any water, and mixed with 1·5 per cent of Venice turpentine to make the coating more flexible.

The zinc plates are coated with a thin asphaltum coating, and exposed in the sun under a drawing from 10 to 60 minutes. Oil of turpentine serves as the developer. As soon as the picture is developed, benzole is poured over the same without hesitation, and after draining it is washed with water. The dried zinc plate is etched as usual.

The production of photo-zincotypes in half tones, which can be printed in the printing press, is of the greatest importance for book illustrations. A short description might be appropriate, the many views about the manner of their production not being very clear. The idea of producing photographic reliefs by dividing the picture into lines and dots is an old one. It is the intention to have the dots compose surfaces in the deep shadows, while in the half tones the black dots are separated by white lines. The picture surface consists, so to speak, of a grain, which represents by its more or less close arrangement the half tones, without any actual half tones existing. Meisenbach, of Munich; Angerer and Goschl, of Vienna; and the Military Geographic Institution, deserve particular mention in this direction.

The heliogravure, or the production of copper printing plates by way of photography, is done by etching or the galvanoplastic process. Both processes are based upon the works of Poitevin and Woodbury of more than twenty years ago.

The helio-engraving by etching was brought to a high degree of completion by Klic, of Vienna, in 1883. The process was sold to some persons, and was kept strictly secret, so that it has only become known recently. In Volkmer's "Technik of the Reproduction of Military Maps" (1885), we find communications referring to it which have been obtained by practical observations in the Austrian Military Geographic Institution. The process is as follows: A copper plate is dusted over with asphaltum powder, to produce a grain when afterward etched. After this a glue (gelatin) picture is put on the copper plate by transfer (like the carbon process). This tender glue relief is etched into the copper with chloride of iron solution of 1·3 sp. gr. After this the gelatine film is hardened by the action of the chloride of iron, and is finally gradually penetrated, and etches by the small access of water in it. The picture obtained in the beginning is monotonous. By rolling in with heavy ink the finest tones are covered, the deeper ones remain open and can be etched afterward. Such plates print very delicate, and are durable when steeled, being capable of furnishing over 1,000 copies, as seen by the writer.

In the Imperial Military Geographic Institution of Vienna, the heliographic copper plates (for maps, etc.) are produced by way of the galvanoplastic method, by converting a gelatine relief into copper. The galvanic current is produced with a dynamo machine of Captain Von Huble. The plates to be treated are inserted one behind the other, giving more uniform copper deposits than when placed side by side.

Colored lichtdrucks are at present mostly made with the aid of retouchers and draughtsmen. The process executed by J. Lowy, of Vienna, approaches nearest to that of a genuine photographic picture. From the original or negative, stopped out by retouching, leaving open only those parts which are intended to print yellow for instance, a photo-lithographic plate is taken. In a similar manner a plate is made for blue, etc. The colored picture so obtained (chromolithography) lacks softness. This is obtained by final reprinting of the chromo-lithograph with a lichtdruck plate in half tone, which prints over the picture all those colors which give the picture its finish, the picture thereby gaining in fine half tones.

Troitzsch, of Berlin, prints the picture upon the stone by way of lichtdruck, and this serves as a base for the colorist. Hosch, of Berlin, produces color plates with the aid of photography and painting. He prints the several colored pictures, not from stone, but from lichtdruck plates.

These plates of course will wear off pretty soon, and give less uniformity than the stone; but a smaller number of color plates are sufficient, while in chromolithography seldom less than 20 are used.

*Photo-zincotypes in Colors.*—Angerer and Goschl, of Vienna, produce by a new process colored prints, so-called "photo-chromotypes," which are made in the printing press. The principle which is applied here is similar to the colored lichtdruck. At first, photolithographs are made from the picture to be multiplied, which serve to some extent as copies for the draughtsman. The latter works up only such parts which are to be yellow; upon a second sheet those only which are intended for blue, and so on. Negatives are produced which show only a picture of the blue parts, others for yellow, red, etc. From these negatives zinc printing plates are etched in half tone, and the rest of the manipulation is the same as the fitting of the several color stones in chromo-lithography.

Many newspapers, for instance the *Neue Illustrite Zeitung*, are furnished with these color prints.—*Anthony's Photo. Bulletin.*

### Malignant Pustule.

A patient suffering from this disease died recently in Guy's Hospital, London. He was employed on a wharf, in the handling of foreign hides, and undoubtedly contracted the disease from the hide of an animal which had been affected with the disease known by the French as charbon, by the Germans milzbrand, but by English speaking people as anthrax. The patient noticed a pimple on the back of his neck, which in twenty-four hours became greatly enlarged, and the glands of the neck were swollen. The surgeons removed the enlarged pimple at once, but without avail, the man dying in about four days from the time he first noticed the pimple. This disease may also be contracted by the bite of an insect, a fly for instance, which has been feeding upon the carcass of an infected animal. The microbe of the disease is a bacillus (Bacillus anthracis), and was observed in the blood of cattle as long ago as 1849 by Pollender, although its importance was first recognized by Davaine in 1850.

### Value of the Electric Light.

The passage of the Suez Canal, which until recently occupied from thirty-six to forty-eight hours, can now be made in sixteen hours for vessels fitted with the electric light apparatus. This important advance is the result of a very interesting report by Commander Hector, of the steamer Carthage, belonging to the Peninsular and Oriental company, and addressed to the directors. This report was written after the Carthage made the first continuous passage, under the authorization of the Canal company, given the 1st of December, 1885. The Carthage arrived at Suez after a run from Port Said of eighteen hours. The actual running time was sixteen hours, there having been two delays caused by impediments in the channel; the mean speed made was 5·43 miles per hour.