SCIENTIFIC AMERICAN

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THE MANUFACTURE OF PAPER.

II.—PREPARATION OF WOOD PULP BY THE SODA PROCESS.

In our first article on the manufacture of paper (SCIENTIFIC AMERICAN of March 19, 1898) we described the preparation of chemical fiber by the sulphite process. Sulphite pulp, as the product is commonly called, would not make good book paper if it were used alone, the stock being too hard. These qualities are due partly to the quality of the wood (spruce) from which it is made and partly to the process of manufacture. Paper made entirely from sulphite pulp would not possess the flexibility and softness which are necessary for taking a good impression in the printing office. These defects are avoided by using two entirely different kinds of wood and two distinct processes in preparing the pulp, and mixing the two grades in certain proportions, according to the quality of paper which it is desired to turn out of the mills.

This softer and more flexible pulp is known as soda pulp. It is prepared from poplar wood cut into chips, which is reduced to fiber by cooking it in digesters in a solution containing about 10 per cent of caustic soda. The poplar logs are brought to the Duncan Mills chiefly from the Adirondacks and Canada. They are converted into

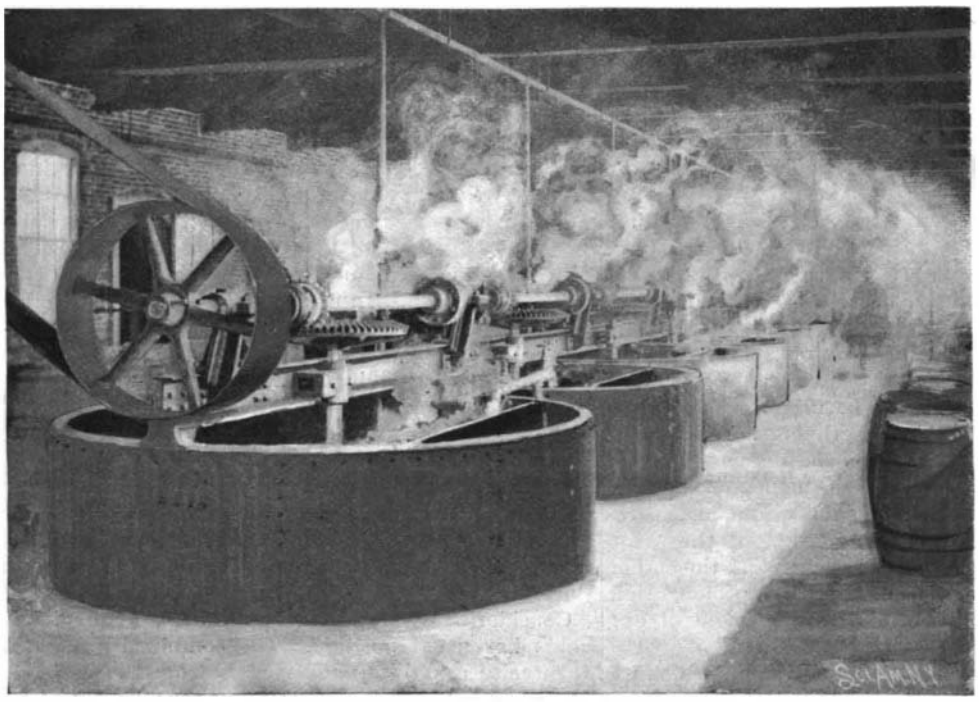

Fig. 2.—THE CAUSTICIZING TANKS FOR TREATING LEACH LIQUOR WITH LIME.

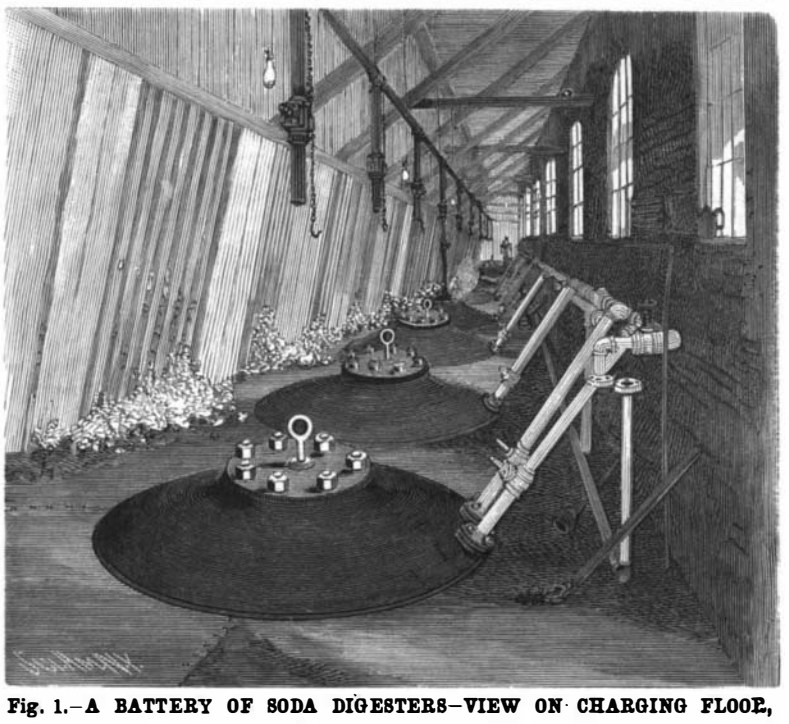

Fig. 1.—A BATTERY OF SODA DIGESTERS—VIEW ON CHARGING FLOOR, SHOWING BINS FOR CHIPS, THE MANHOLES, ETC.

chips in a "chipper," as described in the preceding article, the thickness of the chips in this case being ½ inch, as against a thickness of from ⅝ inch to ¾ inch in the case of the spruce chips. An elevator carries the chips to the second story of the building, from which they pass over an inclined, oscillating screen, where sawdust and foreign matter are taken out, being finally delivered to an elevator which carries them to the long storage bin above the digesters (see Fig. 1).

The digesters are seamless, welded iron cylinders, each of which is 7 feet in diameter and 24 feet long. They stand side by side in a long building, a perspective view of the inside of which is shown in the accompanying illustration. The point of view is at one end of the charging platform, which is located at the top of the digesters. The storage bins for the chips discharge directly onto this platform, from which the charge is run and forked into the mouths of

(Continued on page 277.)

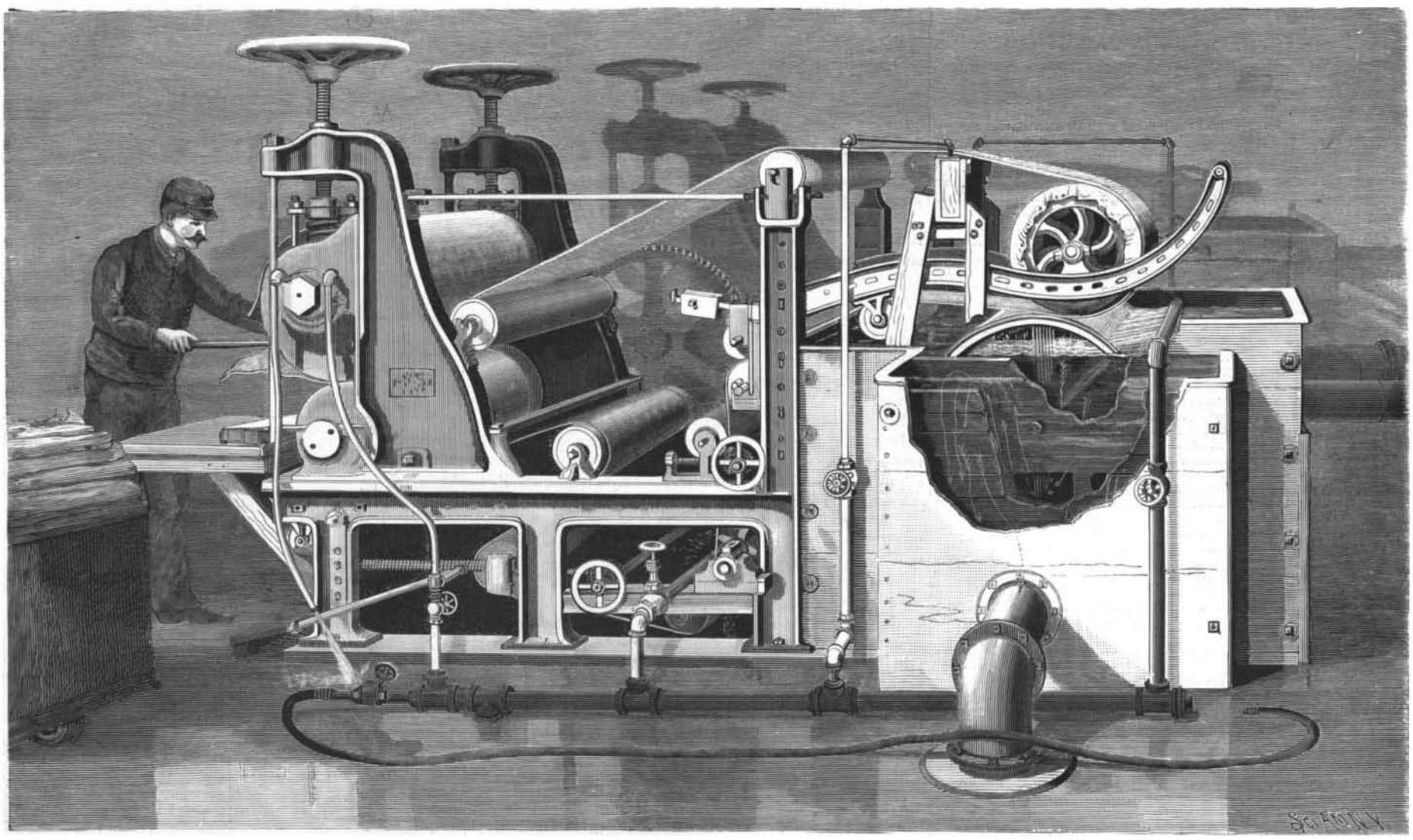

Fig. 3.—WET PRESS, ON WHICH SULPHITE PULP IS FORMED INTO SHEETS FOR THE MARKET.

THE MANUFACTURE OF PAPER.

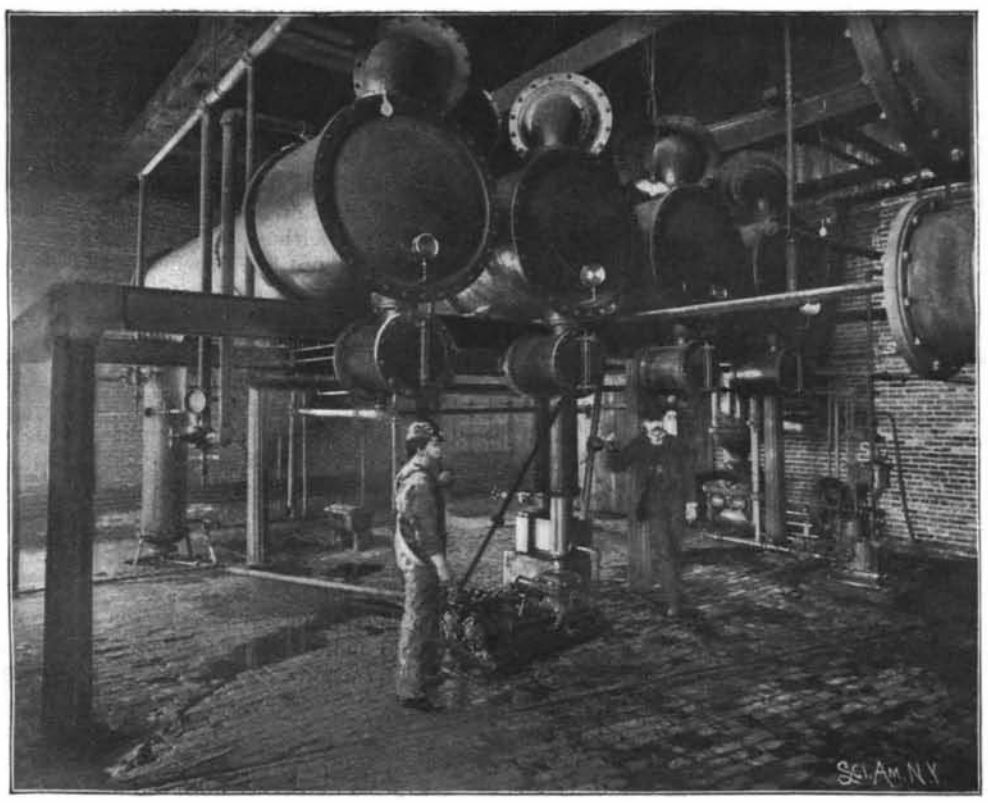

Fig. 4.—TRIPLE EFFECT YARYAN EVAPORATORS FOR CONCENTRATING SPENT ALKALI LIQUOR.

THE MANUFACTURE OF PAPER.

(Continued from first page.)

the digesters, the covers being removed for this purpose.

The cooking liquor is prepared by dissolving soda ash until the requisite strength is secured and then treating the same with lime in what are known as the causticizing tanks, where the liquor is rendered caustic. As soon as the precipitated carbonate of lime has settled to the bottom of the tanks the liquor is pumped out for use in the digesters. In charging a digester, it is first filled with the poplar chips and then the proper amount of liquor is run in. The manhole cover is swung into place and securely bolted down. Steam is then admitted through an injecting device in the bottom of the digester, and, under its action, the temperature rises and a thorough circulation of the liquor through the chips is secured. During the cooking, which lasts for nine hours, the pressure rises to 110 pounds to the square inch, this being accompanied by a corresponding rise in temperature. As soon as the cooking is completed the contents are blown out at 110 pounds pressure into an iron blow-pit through a pipe leading from the bottom of the digester. Blowing off at this pressure serves, first, to thoroughly empty the digester, and, secondly, to blow the fibers apart, rendering the pulp easier to wash, etc., in the subsequent steps of its preparation.

From this blow-pit the pulp goes through a series of washing pits, from which the spent liquor drains off through perforated bottoms and is stored for treatment by the "recovery process," as described later in the present article. The fiber is then subjected to washing in a series of weak, spent, alkali liquors, and finally it is thoroughly washed with hot water. When first discharged from the digesters the pulp was black in color; after its last washing, it is a pale buff.

The pulp is now mixed with sufficient water to render it sufficiently fluid to be piped onto the screens or strainers. These remove any uncooked portions of the wood that may be in the pulp. This latter, in these modern days of the art, is very trifling in amount, as the process completely reduces the poplar, even to the knots. From the screens the pulp is run over a "wet press," where the surplus water is taken out. It is now carried by a conveyor to the bleaching engines, in which it is thoroughly bleached with ordinary chloride of lime. The screening and bleaching are carried out in a similar plant to that used in the preparation of sulphite pulp, an illustrated description of which was given in our paper describing the sulphite process, and to this the reader is referred.

At the present time the pulp mills of the Duncan Company manufacture a larger amount of pulp than their paper mills can take care of, though the latter are soon to be enlarged to the pulp mill capacity. At present the surplus is sold to other paper mills which have no facilities for manufacturing their own fiber. In each twenty-four hours 14 tons of sulphite fiber and 20 tons of soda fiber are placed on the market. The sulphite pulp is shipped wet and unbleached, but the soda pulp is always bleached and dried before shipment.

For convenience of shipment and handling, the sulphite pulp destined for the market is run into sheets in a special machine known as a "wet press," of which we present an illustration on our front page (see Fig. 3). Instead of passing from the screens to the bleaching engines, it is piped into a tank in which is a rotating cylinder, about 2½ feet in diameter and 4 feet long, whose shell is formed of fine wire cloth. The cylinder (see Fig. 3) is immersed in the pulp until only about 2 inches of it appears above the surface. One end of the cylinder is open and turns in close contact with a fixed board (which is broken away in the illustration to show the interior of the cylinder). At the bottom of the closing end board is a square opening through which the waste water flows away from the interior of the cylinder. It will thus be seen that the tank is divided vertically into two compartments, in one of which is the drum, the other forming an outlet chamber for the waste water.

The pulp, which has something of the appearance of thin milk, flows into the tank and surrounds the drum. The wire cloth periphery of the drum allows the pulp water (that is, the water minus the fiber) to flow through the wire and enter the interior of the drum, the fiber being restrained from passing through by the sieve-like action of the wire cloth. As the drum rotates from right to left, the pulp is carried up on the wire surface and the water drains away from it, passing through the wire to the inside of the drum, where it passes away through the side board, as already explained. Above the drum and resting upon it is another drum, over which travels an endless band of rough felt. The layer of pulp is carried round on the wire and pressed against and "picked up" by the felt, to which it adheres, leaving the drum. The drum is cleaned by the action of strong jets of water which wash the wire cloth as it passes down in front of them. The sheet of wet pulp is carried on the felt over the top roller of the machine and passes down between two rolls which are drawn together by screw pressure. The sheet of pulp wraps around the upper and larger of these rolls until there are several thicknesses, the pressure squeezing out the surplus water and serving to "form up" the pulp into a sheet looking something like a piece of rough millboard. As soon as the desired number of layers has been wrapped on the roller they are cut off by the workman, shown in the engraving, and placed on the pile at his elbow ready for shipment.

In our engraving (Fig. 6) the upturned edge of the sheet of pulp shows clearly the various layers of pulp that give the thickness to the sheet. Below the sheet

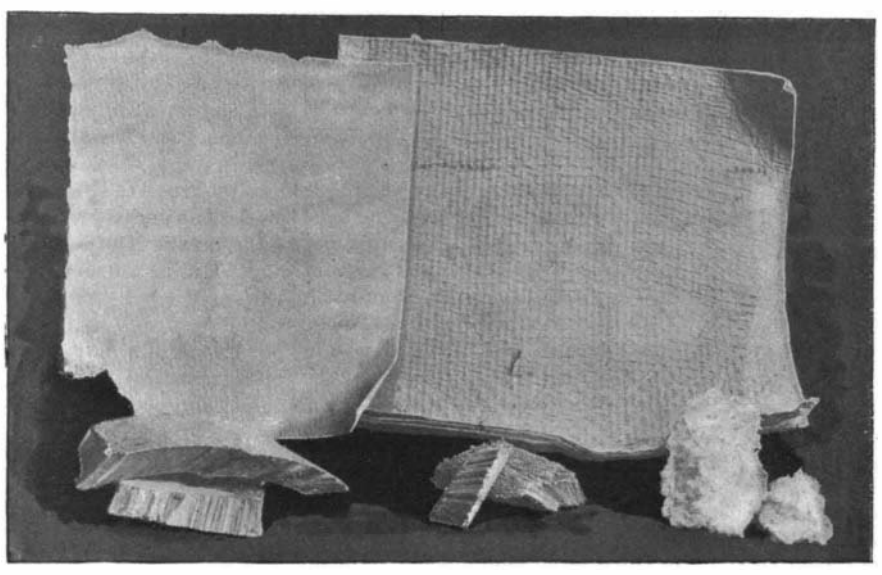

Fig. 6.—POPLAR CHIPS AND A SHEET OF BLEACHED SODA PULP. SPRUCE CHIPS, A LUMP OF PULP, AND A SHEET OF UNBLEACHED SULPHITE PULP.

in the same engraving are shown some spruce chips as they come from the chipper before they are cooked in the digester. The white mass to the right of the chips is a lump of pulp which has been bleached and washed and is ready to go to the paper mill.

The soda pulp for the market is taken from the bleaching engines and run into the sheet form over a drying machine, where it is dried out by passing over a series of large cylinders filled with live steam, being finally wound into large rolls for shipment. A small sheet of this pulp is shown in the engraving with some poplar chips in front of it. The difference in grain between the poplar and spruce and the difference in texture between the two sheets of pulp is clearly discernible.

One of the most interesting features of the soda mill is the recovery process, by which the valuable constituents of the spent alkali liquor are recovered and used in the preparation of the caustic soda. The spent liquor is conveyed to the Yaryan evaporators (Fig. 4), where it passes through a coil of pipes contained in a steam-tight shell. A small amount of steam is introduced within the shell, the heat of which causes the spent liquor within the coil to evaporate. The liquor and the vapor, which has separated from it during the evaporation, now enter the enlarged head (see Fig. 4), where the liquor falls to the bottom and passes to a similar system of coils in the "second effect," while its steam rises and passes into the shell of the second effect. Here the steam condenses on the coils, giving up its heat and causing a further evaporation of the liquor. This is repeated in the third effect, and the final concentrated liquor is drawn off by a pump. The final vapors of evaporation are removed through a condenser by means of a vacuum pump. To show how much work of evaporation is done on the liquor during

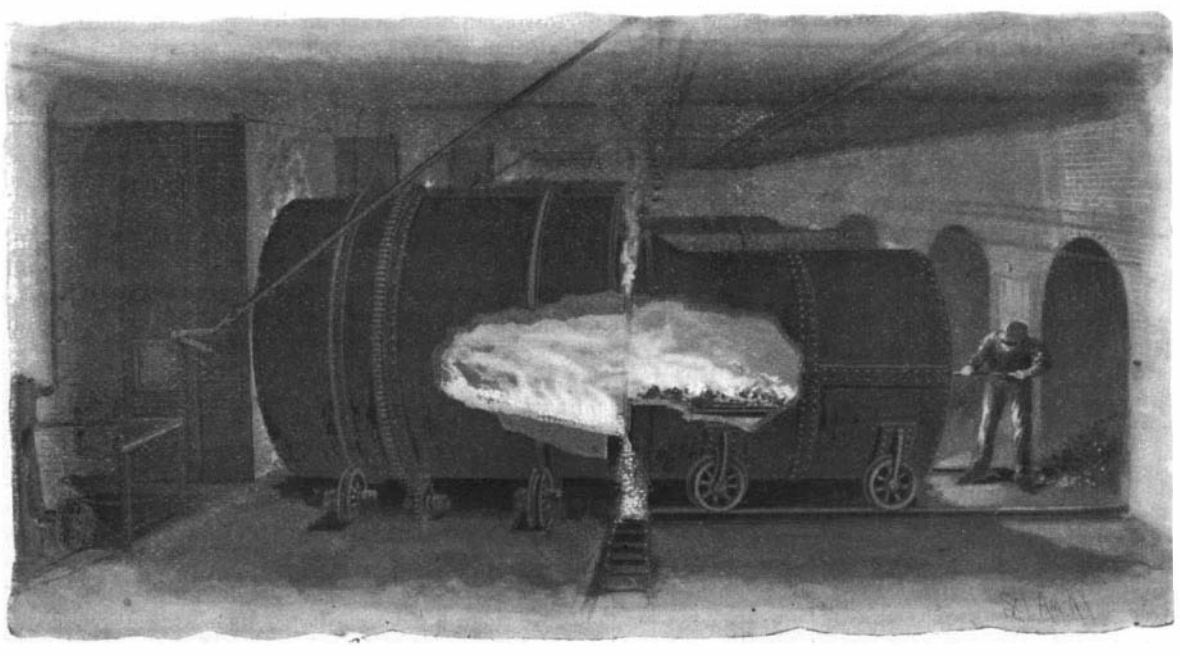

Fig. 5.—ROTARY RECLAIMING FURNACE FOR THE RECOVERY OF BLACK ASH FROM SPENT ALKALI LIQUOR.

its transit through the series, it may be mentioned that fully 90 per cent of the total water in the spent liquor has been removed.

The concentrated liquid now passes to the rotary reclaiming furnaces (Fig. 5). These consist of large steel cylinders, lined with fire brick and open at the ends. At the front and larger end is a movable fire box in which a comparatively small coal fire is kept burning. At the rear the furnace gases serve to heat a set of boilers whose steam supplies the Yaryam evaporators. The remaining moisture in the concentrated liquor is quickly evaporated in the rotary furnace, and the resinous and organic matter takes fire. The interior of the furnace is funnel-shaped and, as it rotates, the black ash rolls forward, and falls continuously into a horizontal conveyor, traveling at the floor level. The recovered black ash, which contains 50 per cent of sodium oxide, 15 per cent of unconsumed carbon and 1 per cent of mineral impurity from the wood, is carried by the conveyor to large leaching pans in which the alkali is leached out. The leach liquor is next conveyed to the causticizing tanks (Fig. 2), where lime is added and thoroughly mixed by means of agitators. The cycle of operations is now complete and the liquor is ready for the digesters.

Up to ten years ago, soda was recovered by a series of open evaporating pans in which, when the spent liquor had evaporated to a certain consistency, it was worked by hand, after the manner of puddling in an iron mill.

In those days, the cost of recovery was from 40 to 50 cents per 100 pounds; to-day it is only 5 or 6 cents per 100 pounds. It is owing largely to this improved process that the present low price of book papers is possible.

Essex County Parks.

Essex County, New Jersey, includes within its territory the city of Newark, the Oranges, Montclair, and other New Jersey towns, and this charming section of the State of New Jersey is to have one of the most beautiful and extensive systems of parks in the country. Certain sections of the county were found to be admirably suited for park reservations, and two such tracts of land, one of 1,600 acres and one of 400 acres, have already been secured in the southwestern and western extremities of the county. These are rare stretches of rocky and wooded hills, fields and valleys with beautiful still and running water. From Eagle Rock on the crest of the hill back of Montclair can be seen the homes and working places of a greater number of the people than can be seen from any other point in the world, the eye ranging for miles over hills and valleys, with here and there a dwelling house. To the westward are the unbroken woods, which make a wonderful contrast to the view from Eagle Rock. In the southeast corner of the county, 200 acres of land including a small pond has been secured. Little work will be done on these reservations except to preserve and protect their natural features and to provide a few roads and paths. In contrast with these three rustic parks will be some 250 acres near the most densely populated sections of the district, which will be developed by landscape gardening. A portion of this park together with three small parks will be designed for the needs of those who cannot go to the distant reservations. Possibly the finest feature of the scheme will be the splendid parkways which are proposed to connect the various parks. These will extend to some of the more rural sections of the county, which are not in need of parks as yet, but which will be directly benefited by the parkways. One of the parkways will pass along the crest of the first range of mountains.

A Historical Celebration in Florence.

Florence is now celebrating the fifth centenary of Paola Toscanelli and Amerigo Vespucci, both of whom were Florentines. The festivities will last from April 17 to 27, and a geographical congress will be held at Florence during the fetes. Many Americans were present in the city, and they presented to the Council an American flag beautifully embroidered to commemorate the occasion. Paolo Toscanelli was a learned man to whom Columbus was greatly indebted for advice and maps of the world. Amerigo Vespucci was the friend and follower of Columbus and our name America is derived from his baptismal name. In the SCIENTIFIC AMERICAN for March 19, 1898, we have described and illustrated the remarkable portrait of Amerigo Vespucci which has recently been discovered in Florence. The festivities include the unveiling of a commemorative monument in the church of Santa Croce, the illumination of the city and surrounding heights, nocturnal fetes on the Arno, lectures and speeches, historical living pictures in the great hall of Palazzo Vecchio, a meet of bicycle clubs, a horse show in the Cascine, reproductions in historical costumes of old Italian games, a masked ball, a grand orchestral concert in the Palazzo Vecchio, and in fact nearly everything which seems calculated to attract foreigners to Florence. Those who were fortunate enough to see the Donatello celebration in 1889 can form some idea of the delightful programme.

Electrical News and Notes.

Trolley Travel in Boston.—Boston travel on the suburban steam lines in the last four years is estimated by the State Railroad Board to have decreased about 10 per cent, while the corresponding trolley travel has increased 25 per cent. It runs this way all through New England.

Electric Installations on the Pacific Slope.—During the past eight years, fifty-two distinct companies in the Rocky Mountain district alone have installed electric power machinery for mining and ore reducing purposes. The plant comprises 62 generators, aggregating 7,988 kilowatts, and 135 motors, aggregating 4,816 horse power, operating every variety of mining and milling machinery.

Long Distance Transmission Plant.—10,000 horse power will be transmitted 110 miles to San Francisco if the plans of a company, of which Prince Poniatowsky is said to be the head, are completed, says Engineering News. It is proposed to utilize the water now running to waste on the western slope of the Sierra Nevada Mountains in Alpine, Amador and Calveras Counties, constructing a system of canals and a power plant. The transmission line at one place will cross San Francisco Bay with a span about 335 feet above the water. The total cost of the plant is estimated at about $1,000,000.

Fires in Shop Windows.—In view of the numerous fires that have recently taken place in shop windows in Germany, the German police have issued a notice containing the following recommendations, says The Electrician: All glow lamps used in shop windows should be provided with globes, shades or wire guards, or so arranged that they cannot come into direct contact with inflammable material. If the lamps are surrounded with silk or other fabrics, the covering must not envelop the lamp completely, so that the air can circulate between the lamps and the covering. Arc lamps should be provided with ash trays of metal instead of the glass ones usually employed. Conducting wires in the windows should be well insulated.

Electric Lighting of the Pyramids.—Lighting the pyramids of Egypt with electricity and the installation of a 25,000 horse power plant, to cost some $400.000, is a plan now under consideration by the British government, and the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., are reported as likely to receive the contract. As outlined, the plan includes the generation of electric power at the Assouan Falls, on the Nile River, and its transmission a distance of 100 miles through the cotton growing districts, where, it is believed, the cheap power will permit the building of cotton factories. It is planned to use the power to illuminate the interior corridors of the pyramids and also operate pumping machinery for irrigating large areas of desert along the Nile.

Magnetic Study of Iron.—It has long been known by physicists that iron alters in length when magnetized. This phenomenon is made the subject of a special study by Prof. Brackett, of Princeton, in The Physical Review, December. The author treats specially of the effects of tension and of the quality of the metal upon such changes in length in iron wires, and he describes researches made by him at the suggestion of Prof. Rowland, of Johns Hopkins University. Prof. Brackett believes that the investigation has established the following laws: "Any increase in the magnetic induction tends to lengthen the iron wire; the magnetizing field tends to shorten the wire, and the shortening due to this cause apparently has no limit; the elasticity changes with the induction; . . . but the law of the change is unknown, further than that elasticity changes only as the induction changes."

Electric Railways of Europe. — L'Industrie Electrique has just published a complete list, with details, of the electric railways now operating on the Continent of Europe and in Great Britain. The summary printed herewith shows that Germany is far ahead of any other European country in both the number of electric railways and in the length of mileage, etc. It is interesting to note also that Germany has four roads using storage batteries and France five such roads. Switzerland also makes a very good comparative showing.

	Total Length, Kilometers.	No. of Motor Cars.	Overhead Lines.	Underground Lines.	Center Rail Lines.	Lines with Accum.	Total No of Lines.
Germany	642·69	1,631	45	2	..	4	51
England	109·42	168	10	1	6	1	18
Austria - Hungary	83 89	194	7	2	..	1	10
Belgium	34·90	78	4	1	..	..	5
Bosnia	5·60	6	1	..	.	..	1
Spain	47·00	40	3	.	..	..	3
France	279·36	432	19	1	1	5	26
Holland	3·20	14	..	..	..	1	1
Ireland	18·00	32	1	..	1	..	2
Italy	115·67	289	9	..	..	..	9
Sweden - Norway	7·50	15	1	..	..	..	1
Portugal	2·80	3	1	..	..	..	1
Roumania	5·50	15	1	..	.	..	1
Russia	14·75	48	2	1	.	..	3
Servia	10·00	11	1	..	..	..	1
Switzerland	78·75	129	17	..	..	..	17
Totals	1,459·03	3,100	122	8	8	12	150

Science Notes.

William Gascoigne is credited with the first use of cross-hairs in telescopes in 1640, or a little earlier, says The Engineer. Gascoigne fell at the battle of Marston Moor in 1644. He speaks of only hair and thread. In 1662 Malvasia employed, besides hair and vegetable fiber, silver wires. In the middle of last century glass and mica plates, with engraved lines, were employed in place of cross-hairs, as described by Brander in 1772, and used by Breithaupt in 1780. Spider webs were not thought of until 1775, when their use was advocated by Fontana. In 1818 Struve employed fine glass threads, and platinum wire has been substituted in recent years.

By tempering steel containing 0·45 per cent of carbon at a temperature of 1050° Cent., a probably homogeneous body consisting of needles is obtained, says Mr. F. Osmond, which when belonging to the same group or bundle run parallel to each other, while the groups often cross each other. All other conditions remaining equal, the needles of the martensite become smaller and less distinct the closer the eutectic alloy is approached; the hardness increasing at the same time until the maximum is reached. Beyond this limit the mass is no more homogeneous. Steel containing 1·5 per cent of carbon and hardened at a temperature of 1050° Cent. separates in two bodies.

A chronograph for recording exceedingly small intervals of time, such as a millionth of a second or less, has been used to record autographically the compression by a blow of a cylindrical piece of copper. In one case a thirty-three pound weight fell fifteen inches and produced a permanent compression of 0·1658 inch in a copper cylinder, the time consumed in producing the compression being 0·0030317 of a second. The machine produces by photography a curve showing the progress of the compression. The chronograph consists of a rotating cylinder, with a surface velocity of 100 feet per second, on which is photographed a pencil of light, which is passed through a hole in the end of a rapidly vibrating tuning fork. The delicacy of this instrument is far greater than that of the ordinary tuning fork chronograph, in which the record is made on a surface blackened by smoke.

A New Solvent for Nitrated Cellulose.—Dr. H. Fleming is employing, as a solvent for nitrated cellulose, epichlorhydrin and dichlorhydrin. The first (CH_2 $OCH + CH_2$ Cl) is insoluble in water, but freely soluble in alcohol and ether, boils at + 117° C., and has a specific gravity of 1·203 at 0° C. The last—really the A— bichlorhydrin (CH_2 Cl CH (HO) CH_2 Cl)—is slightly soluble in water but freely soluble in alcohol and ether, boils at +174° C. and has at 19° C a specific gravity of 1·367. Epichlorhydrin will dissolve any quantity of pyroxylin, but at 20 per cent the solution assumes a very opaque appearance. For these solvents the advantage of a relatively high boiling point and low evaporation is claimed as compared with the more generally used alcohol, ether, acetone and amylacetate, but it is premature to speculate as to its possible uses in the manufacture of smokeless powders.—Arms and Explosives.

M. Camille Matignon, in a paper presented to the Paris Academy of Sciences recently, says that sodium carbide is obtained in the form of a white powder: its density at 15 degrees is 1·575, and it appears to be quite insoluble. Dry air and oxygen have no effect on it at ordinary temperatures, but, on gently heating, combustion takes place, leaving a residue of CO_3Na_2. In the presence of chlorine gas it becomes incandescent, and with bromine the reaction is of almost explosive violence. Iodine has a more moderate action, and C_2I_4, melting at 185 degrees, can be obtained. Hydrogen has no action at all. When thrown into water, carbide of sodium explodes violently, giving a deposit of carbon. It also becomes incandescent when in contact with CO_2 and SO_2. It acts in the cold on a large number of organic substances. The primary and secondary alcohols give off acetylene, giving rise at the same time to the corresponding alcoholate.

The tracing of the pretty curves formed by compounding pendulum vibrations of different periods is a fascinating pastime of which we were beginning to believe the resources were pretty well exhausted. Prof. Charles Schlichter, of Winconsin, has, however, discovered "fresh woods and pastures new" by extending the method to space of three dimensions, and representing, by the aid of the stereoscope, the resultant of harmonic motions of three frequencies in three different directions, mutually at right angles. To do this, says Nature, Prof. Schlichter attaches a miniature electric lamp to the bob of a Blackburn pendulum vibrating in a horizontal plane, and photographs the tiny speck of light by means of a stereoscopic camera attached to a pendulum which swings in a vertical plane about a horizontal axis through the optical centers of the lenses. This last pendulum gives the third vibration component. When the diagrams are viewed through the stereoscope, the curves spring out into relief like bent wires, their forms for many of the higher ratios, such as 5:6:9 or 5:8:9, being very striking.

Miscellaneous Notes and Receipts.

To Raise the Pile of Velvet.—A good method to raise damaged and pinched pile up again is as follows: Cover a hot iron with a wet cloth, lay the velvet or plush over it and beat carefully with a clothes brush. Lay the stuff on a smooth place and do not touch until it is quite dry.—Leipziger Färber Zeitung.

Lime Water for Disinfection.—A very cheap and easily prepared disinfectant is lime water. If wash is laid in saturated lime water, it must be left therein for 48 hours to insure a total extermination of all germs. If one desires to get the wash disinfected after 24 hours, it must be previously rinsed off in supersaturated lime water and left to remain in it for some time; then it is put in fresh lime water and left therein for 24 hours. Wool is very unfavorably changed in color and firmness by treatment with lime water, while linen and cotton are not at all affected as regards color; linen does not lose any of its firmness, cotton very little. Hence, woolen goods should not be disinfected with lime water; of course the lime water must not be very strong.—Staats Zeitung.

Production of Deep Black Writing Ink.—First prepare a clear logwood extract solution, by dissolving 200 parts best French logwood extract in 1,000 parts water, heating in the steam bath. Place the solution aside and allow to settle for about 8 days. Pour off clear from the sediment which has formed. Thin 200 parts logwood solution with 500 water, heat in the steam bath to about 90° C. and add drop by drop the following oxidation mixture prepared from 2·0 potassium bichromate, 50·0 chrome alum and 10·0 oxalic acid dissolved in 150·0 water. Maintain the temperature another half hour at 90° C., thin with water to obtain 1000 total weight, add one per cent carbolic acid and allow to settle two to three days. Express clear and fill in bottles.—Neueste Erfahrungen und Erfindungen.

German Artificial Indigo Alarms the Indian Indigo Planters.—Since the Badish Aniline and Soda Company, at Ludwigshafen on the Rhine, has placed its "pure indigo" on the market at a price which admits of competition with the natural product, the Indian indigo planters are naturally very much alarmed. It is correctly assumed in India that the process to produce artificial indigo will be quickly improved upon and cheapened, and that it will finally be possible to throw the artificial article upon the market at a cheaper price than the natural indigo can be sold at. Considering the exceedingly great value which the indigo trade is to East India, the press of that country discusses freely the new state of affairs. The Capital, a journal highly esteemed in India, admonishes the owners of indigo plantations not to lose courage, but to try their best to minimize the cost of production, it being more than likely that, if experienced chemists are engaged, the extraction of indigo from the plant may be increased, thus cheapening the product and improving its quality. Then a competitive war between the artificial and natural indigoes could well be carried on. From the same journal we learn that the value of indigo exported from Bengal is 4½ to 5¼ crores (1 crore= 10,000,000 rupees). The largest part by far of East Indian indigo goes to England; Germany receives direct 32 lakhs' worth, Austria-Hungary and France about the same each; the United States of America takes 57 lakhs' worth (1 lakh = 100,000 rupees). The average amount of the two dyestuffs of indigo contained in good Kurpah indigo is 50 to 55 percentum, in the Bengal variety 70 to 75 percentum.—Färben Zeitung.

Cotton Spinning Mills in China.—The Chinese are too much imbued with the true business instinct, says the Deutsche Wirker Zeitung, to be unmindful of the advantages derivable from the use of steam power in their factories, but the mandarins prevented such innovations, lest the revolutionary spirit might be introduced into the country at the same time. The unfortunate war with Japan gave a striking proof of the fact that China would be an easy prey of her neighbors if the present system of barricading were continued much longer, and thus the mandarins have given up their resistance in many respects. Among others, several cotton spinning mills were erected in Shanghai in 1896, which will start this year with 275,000 spindles, having been equipped according to the latest systems. If the experiment proves successful, which scarcely admits of any doubt, considering the low wages and the great adroitness of the workmen, many more factories will spring up. It need not be apprehended that they will send their calicoes and other ready goods to Europe, etc., thus becoming competitors; but, nevertheless, their influence will be felt, in that they will claim the Chinese market for themselves and crowd out the English now holding the market. The latter will be compelled to seek substitution somewhere else, which will most likely cause a sharper competition with Germany, etc.; also, as regards the raw material, the new spinning factories will exercise an influence. They will first take the raw cotton from China and then from the neighboring India, and the popular Indian cotton will in consequence become scarcer and dearer. At present the import of cotton goods into China is very considerable, and in 1895 represented a value of 53,000,000, in 1896 79,000,000 Haikwan tael (a tael is about 85 cents), the total value of all imported goods being 171,000,000 and 202,000,000 Haikwan tael respectively.

Transplantation of Muscles in the Treatment of Deformities.

The ingenious method of remedying loss of power and deformity from paralysis of certain muscles by attaching their tendons to those of others is of recent growth. In The Boston Medical and Surgical Journal of November 11, 1897, Dr. Joel E. Goldhurst describes an important advance on this method made by American surgeons in the last few years--the dissection out of the muscles and their direct reattachment to others. In a large number of cases of infantile paralysis the sartorius escapes. Being a flexor of the knee, its action is useless or harmful when extension is lost from paralysis of the quadriceps. To improve the limb and restore extension Dr. Goldhurst transplants the sartorius and attaches it to the quadriceps tendon just above the patella. He has operated on five patients with marked improvement in three and failure in two, which he attributes to imperfect methods of attaching the muscle. He operates as follows. A six-inch longitudinal incision is made on the inner side of the thigh with the middle opposite the top of the patella. The sartorius is dissected out, cut off at its insertion, brought forward and attached to the muscular fascia just above and a little to the inner side of the patella. The attachment must be made firmly by splitting the fascia and drawing the muscle through, so that it becomes adherent to both inner and outer surfaces. Kangaroo tendon is used for sutures, being the best material. The wound is then closed and the whole thigh is bandaged, and finally a plaster of Paris bandage or a long splint is applied. The patient is kept recumbent for two weeks at least, gentle motion is commenced at the end of three weeks, and the plaster is entirely omitted at the end of from five to six weeks. One case was that of a woman, aged twenty-two years, paralyzed from early childhood, who had no power of extension or of bearing weight on the limb unless the knee was fixed artificially, and who had a flail-like leg, flinging gait, and used a crutch constantly. After the operation, though still somewhat lame, chiefly from weakness of the foot and ankle, the mechanical difficulty at the knee and the gait were almost entirely corrected, the leg was extended normally, and she was able to do housework.—Lancet.

The Annual Electrical Exhibition.

The electrical exhibition, which has always been one of the most attractive spring exhibitions, will open this year on Monday, May 2, at the Madison Square Garden, and continue through the month of May. We believe one of its chief promoters is the New York Electrical Society, and arrangements will be made for several interesting experimental lectures.

Mr. Edison will exhibit a model built for him by Mr. Sigmund Bergmann, which illustrates the process he is so successfully using in separating iron from ore. This model will be kept running by a small motor, and the iron will be continuously separated from the crushed rock in full view. Samples of crushed rock in its various stages, as well as samples of the separated ore and of the briquettes which are sent to the furnace, will be exhibited. There will be also some four or five ton masses of rock, which Mr. Edison takes bodily out of the hillside by means of huge excavators, and the magnetic condition of these ponderous masses will be shown and tested by magnets. Photographs of the various parts of the works will be shown, so that the whole will constitute one of the most instructive demonstrations possible. This valuable exhibit will be placed along one side of the concert hall at the Garden, in company with a number of very interesting special features which have already been arranged for.

The Reindeer Expedition a Failure.

The failure of the Alaskan reindeer expedition was announced to the war department on April 18, 1898, in a telegram from Brigadier-General Merriam, commanding the military department of the Columbia. This telegram summarizes the report from Dr. Sheldon Jackson, from Dyea, to the effect that the reindeer are a failure in Alaska for want of proper forage and useless for an exploring expedition there, and many of those sent there are already dead, but enough moss has been found, so that part of the herd may be saved. The time lost will compel reorganization of exploring party No. 1, if it is to go on, but on the advice of Captain Ray and his own judgment, Dr. Jackson recommends the recall of the expedition. Acting on the recommendation of General Merriam, an order was issued at the war department on April 18, relieving Captain Brainerd, who had command of expedition No. 1, from further duty with the expedition in Alaska and directing him to report in person to the Commissary-General of Subsistence at Washington.

Correspondence.

The Classification of Warships.

To the Editor of the SCIENTIFIC AMERICAN:

I suggest that you prepare and print an article showing the utility, efficiency, etc., of the various types of war vessels, viewed from a technical standpoint. I venture to say that a large majority of the readers of the SCIENTIFIC AMERICAN would appreciate some information of this character regarding the general definitions of such words as "first-class battleship," "armored cruisers," "unarmored cruisers," "torpedo boats," "torpedo boat destroyers," etc.

To illustrate the maze which newspaper articles, and even articles in the SCIENTIFIC AMERICAN, have produced, I propound the following problems:

1. If a cruiser carries as heavy guns as a first-class battleship, what advantage is there in building such a ponderously armored vessel as the latter, as our modern rifles pierce any armor used on a battleship?

2. If a battleship carries as many torpedo tubes as a torpedo boat, why build torpedo boats, as the unerring aim of our modern guns makes it just as easy to hit as a battleship, which is armored?

3. If a torpedo boat is a strong vessel, and a torpedo boat destroyer is a stronger one, then why build torpedo boats? etc.

Judging from current information on this subject, the whole science is a huge conglomeration of inconsistencies. This can't be. J. B. BRIGHAM.

Erin, Tenn., April 18, 1898.

[In the SCIENTIFIC AMERICAN SPECIAL NAVY SUPPLEMENT, notice of which has already been announced, will be found a lengthy article of the kind asked for by our correspondent. It is accompanied by four diagrams which show the principal types of warships, and the text answers very completely the questions asked by Mr. Brigham. This article is inserted at the commencement of the number with a view to furnishing the reader with sufficient knowledge of the classification and characteristics of the various types to make the descriptions of the individual ships that fill the forty pages of the issue thoroughly intelligible.

Replying to our correspondent's questions:

1. The efficiency of a warship is determined by the possession of the double qualities of attack and defense. A cruiser does not, except in rare cases, carry as heavy guns as a battleship, and then she only carries one or two of them, as in the case of the Spanish "Viscaya." These guns give her the ability to attack a battleship, but they provide practically no defense. Complete belt and barbette armor alone can do this, and for want of it in a duel the battleship would sink the cruiser long before the cruiser could get in a vital shot through the 18-inch armor of the former.

2. The torpedo boat is built for the sole purpose of carrying and firing torpedoes; in the battleship the torpedo, like the ram, is merely an auxiliary weapon, to be used if the ship should come within close range (500 yards or less) of the enemy. Fifteen hundred to two thousand yards will be the probable fighting range of modern fleets. Theoretically the torpedo boat is not supposed to attack by day. It is supposed to operate by night or in thick weather. Invisibility and swift movement are essential to a successful attack; hence the torpedo boat is made small and swift. It is supposed to creep up as close to a fleet as possible without detection, and then when the searchlight reveals its whereabouts it will make a dash at full speed through a hail of rapid-fire shells and machine-gun bullets. Its small size and high speed render it a difficult object to see and hit.

3. The destroyer is larger than the torpedo boat and more liable to be detected and sunk by shell-fire. Many experts consider that we are going too far in building destroyers of 400 tons, as the valuable quality of invisibility is thereby lost.—ED.]

The New York Public Library.

It is stated in the Bulletin of the New York Public Library that the total number of periodicals and transactions of societies to which the library is subscribing, for the year 1898, is 2,502. Of these 483 are American, 497 British, 595 French, 660 German, 125 Italian, 36 Scandinavian, 27 Belgian, 16 Dutch and 12 Russian. During the calendar year ending December 31, 1897, the total number of volumes received by purchase was 16,098, and by gift 10,128, making a total of 26,226. The total number of volumes catalogued and accessioned during the same period was 29,792. The number of pamphlets actually received during the year, by purchase, was 10,350; by gift, 40,247; and the total number catalogued and accessioned was 15,274. The total number of cards written during the year was 156,925. In addition to this, 15,404 slips from the printer were written, and for each of these slips five printed cards were obtained. The total number of cards in the index catalogue, which was open to readers, on the 31st of December, 1897, at the Astor Branch was about 80,000, at the Lenox Branch it was 27,800. The total number of readers during the year was 103,384, and the number of volumes called for by readers' slips, outside of those taken from the free reference shelves, was 304,466.