feet in diameter. A circular tube of the same size fits down over the edge of the aperture, and prevents the escape of the sand through the opening during the process of pumping. To discharge the load from the twelve tanks these tubes are all simultaneously lifted by the hydraulic cylinders which are located immediately above them and the sand runs out through the bottom. To facilitate its exit, powerful jets of water are thrown into the mass of sand, a powerful pump being carried on the dredge for this purpose.

Between the hoppers is a rectangular well, in which is hinged a length of suction pipe, 4 ft. 6 in. in diameter. This suction pipe which is hinged by a ball-and-socket joint in trunnions, one in each wall of the well, is raised and lowered by means of $1\frac{3}{8}$-inch steel cables, operated by a hydraulic lifting gear. Sand and water are drawn up through the pipe by means of a centrifugal dredging pump of 48-inch suction and delivery. The pump is driven by double, tandem, compound engines, one of which is located on each side of the pump. The engines have 17-inch high-pressure and 30-inch low-pressure cylinders, the common stroke being 36 inches.

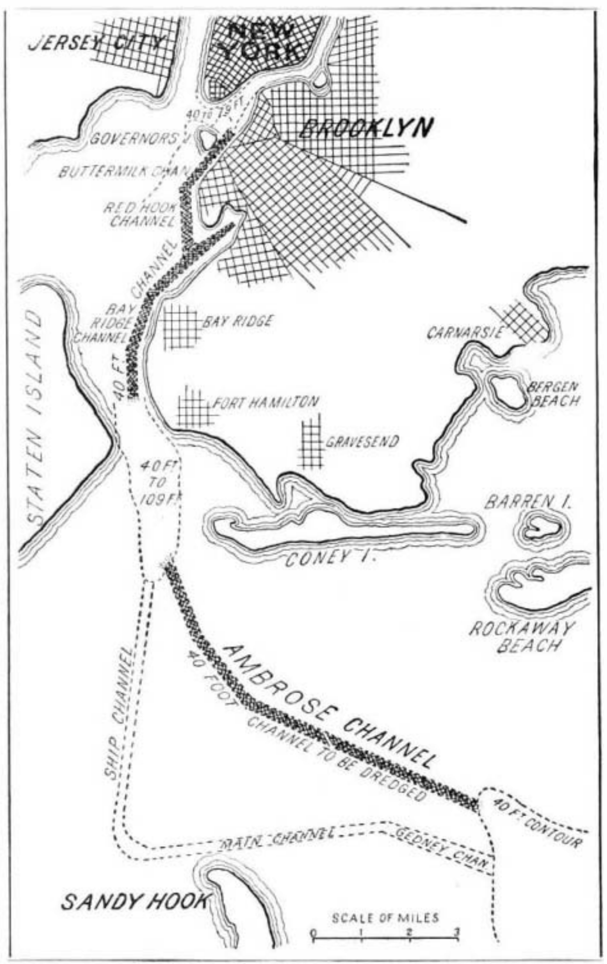
In operating the dredges the sand and water are drawn up through the pump and carried by lines of piping laid along the deck through which it is discharged into the various hoppers, care being taken in loading the hoppers to trim the vessel on an even keel. The sand and mud sink to the bottom of the hopper and the surplus water flows out through the discharge ports in the side of the vessel. When the hoppers are full, the suction pipe is drawn up and the vessel proceeds under her own steam out to sea, where the hydraulic valves are raised allowing the mud, sand, etc., to pass out through the bottom of the hull.

Drainage of Lake Copais.

An interesting piece of engineering work which has been recently carried out in Greece has been the drainage of Lake Copaïs. The lake has practically disappeared, and a large surface of arable land has been thus secured. This sheet of water presented many remarkable features; it was situated near the center of the plain of Bœotia at about 300 feet above the sea level, and was the largest of the lakes of Greece. Toward the north and east it was bordered by high limestone rocks. It received all the waters of Bœotia, the Hereynus, Cephisus and Melas; it was very deep at the foot of the ancient Copæ, but, on the contrary, was partly filled up by alluvium from the slopes of Helicon. At low water it covered a surface of 60 square miles, and its volume reached at times more than 800,000,000 cubic yards, and at some periods its level at the village of Copæ was more than 22 feet above that of the Melas. It had no apparent connection with the sea or with the smaller lakes, the water being carried off by evaporation and by twenty or more subterranean passages which communicated with the canal of Eubœa; these latter were purely natural fissures resulting from earthquakes. The evaporation from the surface was, however, considerable, owing to the high temperature of the region, which in summer reached a mean of 21 deg. to 28 deg. C. and sometimes even 35 deg. When the level of the lake fell at the end of spring a temporary vegetation appeared, which was very abundant, and showed that the soil would be productive if the lake were dried up. Some unsuccessful attempts in this direction were made in ancient times, but it was only in 1880 that the government of Greece made arrangements with a French company, with a capital of $3,000,000, to put into execution the drainage of the lake; for this M. Sauvage had made the projects as far back as 1848. The general plan consisted in making all the waters converge toward the northeast so as to draw them off by a tunnel into the bay of Larymna, but it was also possible to take advantage of the fact that there were two lakes toward the east at a lower level, and it was the latter arrangement which was carried out. It was decided to dig a belt canal around the southern end of the lake which traversed some parts of it and finally ended at the estuary of Karditza; from this point a tunnel took the water to Lake Likeri, the ancient Hylicus, and from there another canal led it to Lake Paralimin, passing by the village of Moriki; a tunnel then brought it to the canal of Eubœa (or Atalanti), near Skroponeri. This work was not, however, finished by the original company; it exhausted its capital, and sold the concession to an English company capitalized at $16,000,000. The company received for the work 16,000 acres of the reclaimed land, and had the use of the rest of the territory, deducting 3,000 acres with which the government indemnified the persons who claimed property rights or possession in certain parts of the lake. The amount of land obtained by the drainage of the lake reaches more than 48,000 acres. The peasants of the surrounding district have already put 15,000 acres in cultivation. The company rents the ground for a payment of 20 per cent of the gross product, at least for certain crops, such as wheat, barley, corn, etc. The cultivator has the right to pasture his stock on the ground reserved for this purpose; he also undergoes a fine if he does not cultivate all the territory he rents. The ground is very fertile, and produces cotton, melons, colza, beet, etc., with success.

Artificial Fossilization of Wood.

M. G. Arth presented to the Académie des Sciences an account of a singular transformation of wood into a substance resembling a fossil combustible. A piece of guaiac wood in a perfectly healthy state had been placed at the bottom of a bronze casting to serve as the pivot of a horizontal turbine of the Jonval type, having a force of 12 horse power and turning at 112 revolutions per minute. The whole of the movable system weighed about 800 pounds; the end of the shaft which rests upon the wood is of steel. Without being immersed in water, the pivot is always damp, as it is placed below the level of the outlet orifices. After six months of running, the apparatus was dismounted. The wood was found perfectly intact in the lower part, but the upper part upon which the steel shaft rested was transformed into a black and brittle substance, breaking easily into small pieces; the brilliant and irregular fractures presented all the appearance of the mineral combustibles. After drying in vacuo, analysis gave 3.9 per cent ash, 4.86 hydrogen, and 69.76 carbon. The organic matter in its original state gave 5.05 hydrogen, 72.59 carbon, and nitrogen and oxygen



MAP OF NEW YORK HARBOR, SHOWING THE NEW 40-FOOT CHANNELS.

22.36 per cent. The relation between the quantity of oxygen and nitrogen and that of hydrogen is 4.42; in woods this relation is about 7; in lignites it is about 5, and in dry coal from 4 to 3. Thus by its composition, as well as by its properties, the black product is to be placed between the lignites proper and coal rich in oxygen; by its calorific power it approaches the latter. It is interesting to remark the short time necessary for this transformation, which was evidently due to the influence of pressure and a moderate elevation of temperature (due to the friction), in presence of moisture; that is to say, under the action of the agents which are commonly made to explain the progressive transformation of wood into ligneous matter and to coal. It is thus shown that under favorable circumstances the time necessary to realize these changes is much less than generally supposed, and the duration of the long geological periods usually considered in such cases is not essential.

Architectural Volumes.

We wish to acquaint our readers with the fact that bound volumes of our BUILDING EDITION for 1900 are now ready for delivery. These volumes are invaluable to those wishing to consult plans of houses of a wide range of cost and architecture; numerous perspectives and floor plans are given in each issue. A feature of this edition during 1900 was the numerous cuts of beautifully furnished and decorated interiors.

Correspondence.

The Parsons Steam Turbine.

To the Editor of the SCIENTIFIC AMERICAN:

In answer to your kind request that I should contribute an article on Steam Turbines in your valued and influential columns, it has given me much pleasure to compile a short statement of the present state of the steam turbine industry so far as it relates to the Parsons steam turbine, manufactured by the following firms: Messrs. C. A. Parsons & Company, Heaton Works, Newcastle-on-Tyne; the Parsons Marine Steam Turbine Company, Limited, Wallsend-on-Tyne; the Westinghouse Machine Company, of Pittsburg, Pa., U. S. A.; Messrs. Brown, Boveri & Company, of Baden, Switzerland, and a German company now in course of amalgamation.

Messrs. C. A. Parsons commenced the manufacture in the year 1884, and have gradually improved and increased the size of the steam turbines manufactured by them. At the present time the aggregate horse power of turbines at work for electrical purposes exceeds 140,000 horse power. The largest size plants yet constructed are two of 1,000 kilowatts output for the municipality of Elberfeld, in Germany. The consumption of steam of these plants when tested by a deputation of experts from Germany, W. H. Lindley, Prof. Schroter, and Prof. Weber, showed the following results:

"At the overload of 1,200 kilowatts, and with a steam pressure of 130 pounds at the engine, and 10 deg. C. of superheat, the engine driving its own air pumps, the consumption of steam was found to be at the rate of 18.8 pounds per kilowatt hour. To compare this figure with those obtained with ordinary piston engines of the highest recorded efficiencies, and assuming the highest record with which I am acquainted of the ratio of electrical output to the power indicated in the steam engine, namely, 85 per cent, the figure of 18.8 pounds per kilowatt in the turbine plant is equivalent to a consumption of 11.9 pounds per indicated horse power, a result surpassing the records of the best steam engines in the production of electricity from steam under the conditions named."

I have also pleasure in sending you an official translation of the report of these gentlemen.

So early as 1892 the steam consumption of the turbine had been lowered to 27 pounds per kilowatt hour, or 16 pounds per indicated horse power, as testified by Prof. Ewing, F.R.S., of Cambridge, England; and in the following year its application to marine propulsion was undertaken by the second named company above, and led first to the construction of the yacht "Turbinia," of 34½ knots speed, completed in 1896, and later to that of H. M. S. "Cobra," of 400 tons displacement and 35 knots speed, and H. M. S. "Viper," of 370 tons displacement and 36.58 knots mean speed on a one-hour trial under English Admiralty conditions of weights and measurements. During the trials these vessels have shown a coal consumption per indicated horse power within the guarantees, they have suffered no breakdown or hitch directly or indirectly connected with the turbines, during their official trials, and the "Viper" has exceeded her contract speed by more than 5 knots.

On November 1, 1896, the United States and Canadian patents for land purposes only were acquired by the Westinghouse Machine Company, of Pittsburg, but up to the present time I am only aware that five plants of 120 to 300 kilowatts capacity have been put to work, and one of 1,500 kilowatts capacity is under construction. This should be contrasted with English output of over 130,000 horse power during the last ten years for electrical purposes only.

Last August Messrs. Brown, Boveri & Company, of Baden, undertook, in conjunction with ourselves, the manufacture of steam turbines for electrical purposes on the Continent, and they have at present an order for a 4,000 horse power turbo-alternator for Frankfort-on-Main besides quite a number of smaller plants.

I have had my attention directed to an article by Rear Admiral George W. Melville, Engineer-in-Chief of the United States navy, in your issue of November 24, and as I have the honor and pleasure of his acquaintance by correspondence, and know his invariable courtesy, I venture to hope that he will pardon me when I say that the "Viper" and the "Cobra" are not "racing machines," but formidable torpedo-boat destroyers, of the usual scantlings of the English 30-knot destroyers, strengthened specially for the higher rates of speed to which they have attained; that they can outstrip by many knots any other destroyers in the world in smooth or heavy weather, and that their complete absence of vibration at all speeds permits of an accurate sighting of guns and torpedoes, impossible with similar vessels fitted with reciprocating engines.

I may perhaps further explain that though the first marine steam turbines have been fitted in very fast vessels for the obvious reason of facilitating the development of a new system, yet steam turbines are quite as readily designed for battleships, cruisers, Atlantic liners, and all fast passenger vessels, and in such vessels will, in my opinion, give results as regards coal consumption at all speeds superior to those at present obtained with reciprocating engines.

As the turbine, when installed on land, as in England and at Elberfeld has surpassed in economy of steam the best triple-expansion reciprocating engines, and the turbine of 4,000 horse power for Frankfort is guaranteed to still further improve the lead; so in marine work the steam turbine is destined to replace the reciprocating engine in all fast vessels from moderate up to the largest tonnage.

CHARLES A. PARSONS.

Turbinia Works, Wallsend-on-Tyne, December 18, 1900.

THREE RECENTLY PATENTED NOVELTIES

One of the most interesting inventions for which letters patent have been granted within the last few weeks is a process of coating one metal with another, devised by Samuel H. Thurston, of Long Branch, N. J. The metal to be coated (usually iron or steel) is first so thoroughly cleaned that all foreign matter is entirely removed. After this thorough cleansing the metal is ready to receive its covering. The coating metal is systematically beaten against the metal to be coated. This beating process is produced by vibratory beating-rods, pivoted to bars secured on a rapidly revolving drum. The drum is located above a bed plate arranged to move beneath or over the radius or action of the beating-rods. On the bed-plate the metal plate to be coated is firmly secured, so that by rapidly rotating the drum the beating-rods strike the surface of the metal. The particles from the beating-rods are hammered into the pores of the plate, and are incorporated with its surface to form an adherent film of metal. So perfect is the cohesion of the two surfaces that the film can not be mechanically removed without removing particles of the plate.

In order to reduce the friction of worm-gearing, Charles M. Jones, of Philadelphia, Pa., has invented the novel device illustrated in the second of our engravings. The driving or pitch faces of the worm are formed with a continuous groove, which receives a series of balls. During the rotation of the worm the balls travel freely along the usual pitch-line and bear against the teeth of the meshing wheel. Thus Mr. Jones substitutes rolling friction for the usual sliding friction.

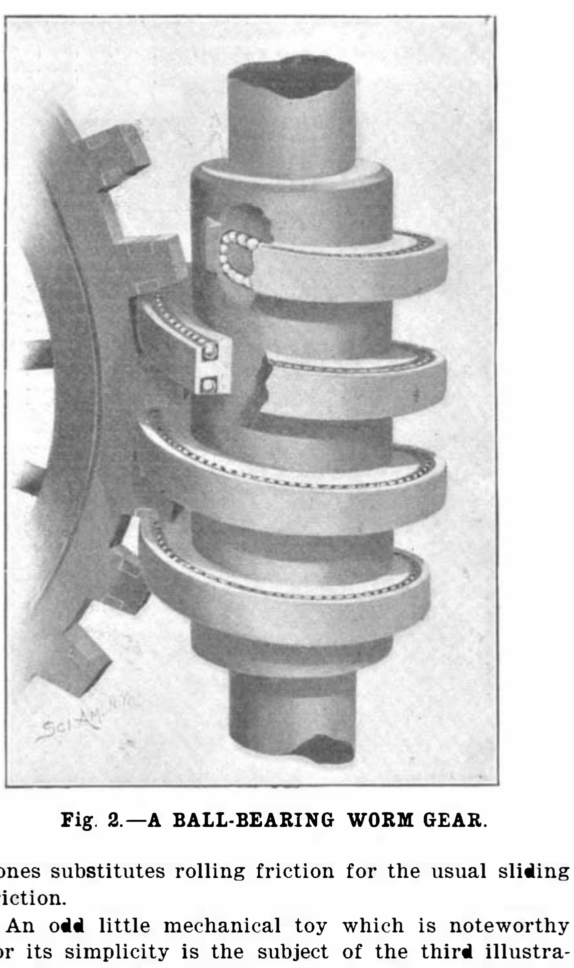


Fig. 2.—A BALL-BEARING WORM GEAR.

An odd little mechanical toy which is noteworthy for its simplicity is the subject of the third illustration. The toy is the invention of John J. Reid, of Lyons, Iowa. Upon an upright having on opposite edges cam-like, staggered fulcrum-bearings a seesaw lever is mounted. The lever is provided with opposite fulcrums in the form of tongues, alternately engaging the bearings. At the ends of the lever figures representing a clown and a negro are pivoted. The seesaw being at the upper end of the standard with the lower fulcrum tongue resting in one of the bearings, the upper end of the longer portion of the seesaw will rock down by reason of its greater weight until its fulcrum tongue engages the next lower bearing and the opposite end of the lever moves downwardly. This alternate rocking motion continues until the seesaw has reached the lower end of the standard. The standard is then reversed, and the seesaw retraces its course.

Internal Water-way Improvements About Pittsburg.

The varied manufacturing interests and vast coal trade of Pittsburg are due to cheap water transportation. In 1836 the Monongahela Navigation Company was organized for the purpose of establishing a slack-water system on the Monongahela between Pittsburg and Virginia (now the West Virginia) State line. The company was chartered with a capital of $300,000, held largely by those interested in the industrial rise of Pittsburg and in the development of the rich coal fields along the Monongahela. The work of establishing dams on the stream was begun in 1838. Instead of the shoaly rippling stream which it was before its improvement, the Monongahela is to-day a noble stream whose traffic amounts to many million tons annually. Until 1897 the slack-water system remained in the hands of the private corporation which had begun the improvement of the stream; but in that year the locks passed into the hands of the United States government, and thus a free system of navigation was begun. In early days both the Allegheny and the Youghiogheny possessed a system of dams, but these were permitted to fall into decay. Of late years several government dams have been constructed on the Ohio, but these are not sufficient to provide the stream with free navigation at all seasons of the year.

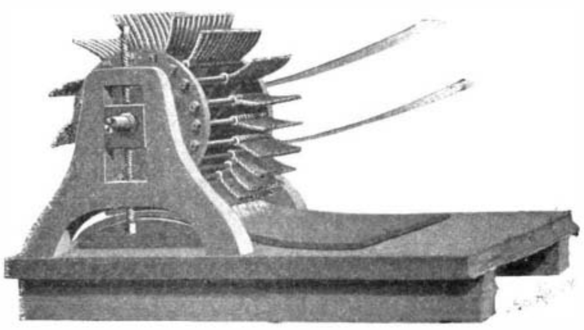


Fig. 1.—THE THURSTON METAL-BEATER.

The time is not far distant when the rivers adjacent to Pittsburg will have an elaborate slack-water system. Congress has passed bills which provide for six dams on the Ohio, including the Davis Island dam, which was completed in 1885. The new dams, like the Davis Island dam, will be of the movable type, so that they can be lowered at any time, leaving a clear channel. They will be located at Glenfield, Osborn, Legionville, Freedom and Merrill, the dam at the latter point being the lowest one on the Ohio which will be erected at the present time. Surveys have already been made for a government dam at Marietta, Ohio, but the work has not yet been begun. It is believed that the series of dams now under construction can be completed within three years.

The work on the Ohio River dams is now well under way, the locks of all the dams being nearly completed. At Merrill the greater part of the dam is finished. The gate at Merrill will, when completed, be the largest one of the movable type in the world. It is 13 feet high and 112 feet wide. It will be moved by hydraulic power, derived from the river, which it will hold back. All of the Ohio River locks will be of the same type.

The Herrs Island dam, on the Allegheny, is already completed, and will be the only Allegheny River dam of the movable type. The other three dams now under construction will render the Allegheny navigable for large river steamers above Tarentum, a distance of 30 miles above Pittsburg. This river improvement will provide a water outlet for the various important industries located in the Allegheny Valley. The Allegheny locks will be 300 feet in the clear, with a width of 60 feet.

Some day a ship canal will connect the Ohio with the Great Lakes. The preliminary survey for this great waterway improvement was made some years ago, when it was proposed to construct a canal which would give vessels of 3,000 tons or more free passage between Lake Erie and Pittsburg at the expense of Pittsburg capital. A detailed description of this great internal improvement will be found in the issue of September 24, 1898, of the SCIENTIFIC AMERICAN. This great canal will solve the problem of cheap transportation of the ore supply for the Pittsburg furnaces, open up an artery for the vast coal-carrying trade, and enable Pittsburg manufacturers to enter foreign markets.

Favoritism to Workmen.

It often happens in factories, says The Superintendent and Foreman, that one workman has a "pull" with other workmen, and by this means is able to make considerable money at the expense of his fellows on the same branch of work, and this all unknown to the foreman. Sometimes man after man will leave the factory, and if asked the reason for quitting, all that can be gotten from them is an indistinct muttering about not getting a square show, and the foreman wonders wherein he did not give the men a square show, and finally sets the men down for cranks.

The men cannot always say positively that it is so; they feel it rather than see it. They see a workman next to them always having the lasts he needs, or always getting the easiest case to set up, buff, or scour, and yet they are not able to see just how it is done. Not seeing, they do not feel like making definite charges or statements, as they do not know how to sustain them; but they are assured in their own minds, for they have encountered the same thing before, that there is a clique running the factory.

Cliques run a great many factories, and generally without the foreman's knowledge. Sometimes a foreman is partner to a clique, and sometimes he believes it is good policy for the firm; and occasionally it is, but very seldom. The best managed factories have systems which make favoritism of one workman to another impossible.

In some factories the firm has a man whose business it is to hunt up all obstacles to good work, including such as this; and it would be a good thing for many manufacturers to use up any spare time they have in asking the more intelligent of their employes—not always the old help, though—what difficulties they meet with. It is not a bad thing to have your factory have the reputation of being a good one to work in, for the time may come when help will be needed, and when not being able to secure the right help at the right time will cause the loss of considerable money.

The Current Supplement.

The current SUPPLEMENT, No. 1306, is of unusual importance, the leading article being entitled "The Steam Turbine: The Steam Engine of Maximum Simplicity and of Highest Thermal Efficiency." This paper is by Dr. Robert H. Thurston, of Cornell University, and may be regarded as one of the most important contributions ever made to the literature of mechanical engineering. It is elaborately illustrated. "The Pollak-Virág Telegraph" is described in detail, showing the ingenious mechanism by which messages can be transmitted and written at high speeds. "The German Colony of New Guinea" is illustrated by many engravings. "The Mechanism of Amphitheaters" is a most interesting article, showing how the cages containing the animals were lifted to the level of the arena by mechanical means and opened automatically, and how the great awnings were warped across the amphitheater in sections. "A New Method of Testing Glass Surfaces" is by Edmund M. Tydeman.

January Building Edition.

The January issue of the BUILDING EDITION worthily begins the new century, and it is one of the handsomest numbers ever issued of this unique periodical. The cover illustrates a half-timbered house at Greenwich, Conn., and is printed in a highly artistic manner. The other houses which are given in this issue are excellent. Among the many interesting features of this edition are the "Spanish National Pavilion at the Paris Exposition," "A Remarkable Wood-Carving," and a "Mediæval German City Gate." The literary contents deal with "Mechanical Triumphs of the Ancient Egyptians," "An Architectural Critic in the Year 2000 A. D.," and "Athens in 1900."

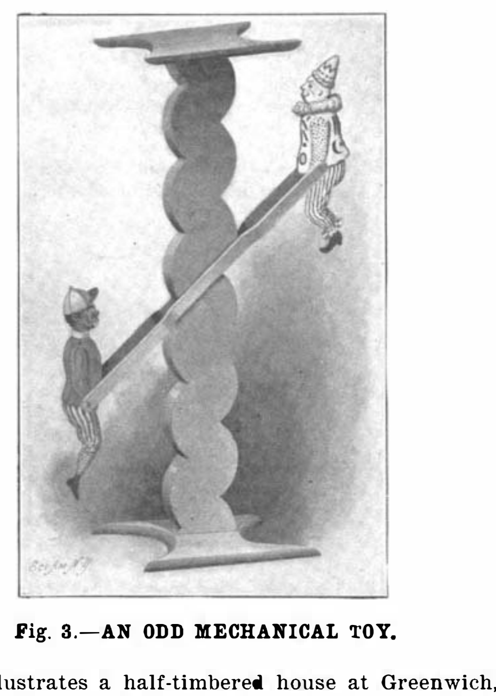


Fig. 3.—AN ODD MECHANICAL TOY.

Contents.

(Illustrated articles are marked with an asterisk.)