the science that showed the least promise of usefulness. The idea that it could ever be serviceable through weather forecasting had not been broached, or, if it had been timidly suggested, was received with derision. The very Scriptures pronounced against it. Wherefore, then, should human life and public treasure be sacrificed to no good purpose?

But once again in the history of science the incredible has come to pass. The seemingly useless has proved to be of the utmost value. Weather prophecy has risen almost to the dignity of a governmental bureau, and affairs of national importance—agriculture and commerce, social and political movements—are largely regulated with reference to the daily report of "probabilities." And as fast as men come to understand that Arctic observations are necessary for the perfection of our already enormously useful weather service, they cease to look upon Polar explorations as something akin to foolhardy venturesomeness or scientific folly. The advancement of meteorological science is now something that appeals to every man's everyday interests; and when the exponents of the science say that the great weather factory of the northern hemisphere may lie around the Pole, and that the causes of many of our most destructive storms may be there at work, the reply is, "Go and see, and good luck go with you. If you want money for the work, you shall have it." It is yet—though it may not always be—impossible to prevent disastrous storms; but the damage they do can be largely prevented through timely warning of their approach. And it is possible that Howgate's colonies may be converted into permanent international meteorological stations, reporting daily by telegraph, and so be enormously beneficial to commerce, agriculture, and other industries, even if they should utterly fail on the score of mere geographical exploration. At any rate the scheme meets the hearty approbation of all thoughtful people, and it is to be hoped that the proposed appropriation for its furtherance will be sufficiently liberal.

THE PHONOGRAPH.

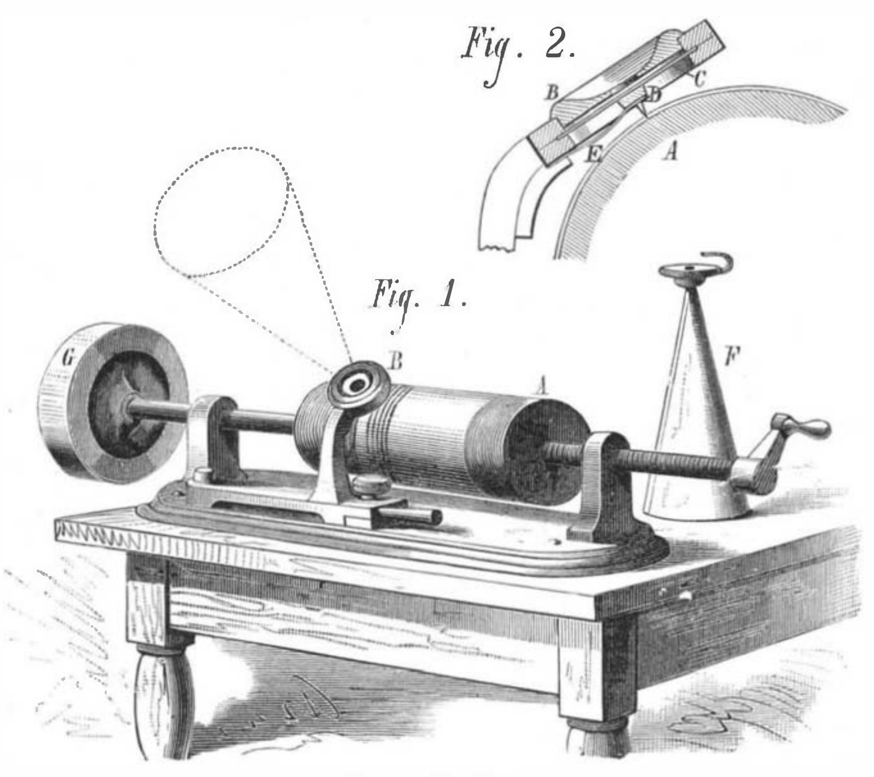
It is a peculiar feature of the Edison phonograph that no mere description can impart any really adequate idea of its performances. Fully familiar as we are and have been with the machine since its inception, it is still impossible for us to listen to it without a feeling of astonishment and a well defined doubt that our senses are not deceiving us. The extreme simplicity of the contrivance enhances this notion. There is nothing in the half articulated monotones of the complicated Faber apparatus to excite surprise, because, although illogically, the hearer half expects that such an assemblage of intricate mechanism will produce more startling results than it does; but here is really nothing but a revolving cylinder covered with a sheet of tinfoil, and a speaking tube; no levers, no springs, no keyboards, no artificial lips or larynx, no bellows. If we lived in 1678 instead of 1878 the life of Mr. Edison would not be worth a moment's purchase; in fact, he would have been resolved into carbonic acid, hydrogen, and his other constituent gases long ago in the flames set apart for earthly communers with his satanic majesty.

If accurate and clearly enunciated repetition of the sounds made in it is the *ultima Thule* of the phonograph's capabilities, then it has already attained that point. Where it is open to improvement, and to this the attention of the inventor is now being devoted, is in augmenting the intensity of the sound. In form it is substantially the same as when it was first described in these columns; that is, it consists, as plainly shown in our illustration, Fig. 1, of a brass spirally grooved cylinder, A, mounted on a long horizontal screw, the cylinder being rotated and at the same time moved laterally by turning a crank on the end of its axis. The chief modification is the abolition of the receiving membrane, one diaphragm, B, serving the double purpose of vibrating in response to the voice, and so indenting by the diamond tipped point, D, attached to the spring, E, the tinfoil wrapped about the cylinder, and also revibrating in response to the movements mechanically imparted to it by the indentations already made passing under the point. It is evident that this change must materially improve the reproductive power of the apparatus, because the size and nature of the membrane materially affect the vibrations it makes, and where two membranes are used a slight dissimilarity between them might result in considerable alteration in the sound emitted. Now, however, the same diaphragm revibrates, and the sound is modified perhaps as little as can be expected, the modification fortunately being in intensity and not materially in quality. The loss is manifestly due, first, to the inability of the rigid plate of metal, C, employed as a diaphragm to register the lateral vibrations which take place in direction parallel to its own plane; and second, in its vibrations being checked in amplitude by the friction met in overcoming the resistance of the foil, its own inertia, and in some degree probably the elasticity of the rubber pads in which it is held, as shown in the section, Fig. 2. Still a rigid plate seems to be a necessity, for it is doubtful whether a thin membrane, such as gold beaters' skin, while responding more fully to the sound waves, would support the point in making its indentations; that is, it is likely that it would yield itself before the tinfoil could be impressed deeply enough. This, therefore may be another subject for further investigation and possible improvement.

As it is, even now, the phonograph will meet the most sanguine anticipations of any one that hears it. The first model that was brought to our notice certainly talked, that is, it produced sounds, the *timbre* of which was unquestionably that of the human voice; but, as we said at the time, it required some previous knowledge to distinguish what was said. The speech was the lispings of infancy. At present previous explanation is wholly needless. The machine repeats the voice with perfect articulation and with every inflection, so that the tones may be recognized as those of the speaker who made them.

Through the courtesy of Mr. W. S. Applebaugh, who has charge of the apparatus now on exhibition in this city, we have been enabled to make as thorough an examination of all its peculiarities as we could desire. At our request the exhibitor sang into the machine an entire verse, and it was repeated as often as the cylinder was readjusted. Sounds of coughing, clearing the throat, knocks, noises of all kinds, were as accurately reproduced. A curious effect is produced by whistling, the apparatus giving forth every note clearly and fully; but more remarkable still is it to hear two voices at once come from the machine. The exhibitor first sang a verse which was registered, and then running the cylinder back talked so that the indentations produced by the speech vibrations came over those made by the song. The instrument repeated both utterances simultaneously, each, however, being clearly distinguishable. Another odd performance is turning the cylinder the wrong way, and making the machine talk the language backward.

The only means now used for magnifying the sound as it is emitted is the funnel-shaped resonator, F, attached to the speaking orifice. Mr. Edison, however, is busily experimenting upon some adaptation of compressed air, by which the sound waves, he thinks, may be intensified. He says that he can in time make the machine talk so loudly that it can be used on vessels to warn off other ships during fogs, and his last astonishing proposal is that he shall construct a huge phonograph to go in the great bronze statue of Liberty which is to be erected in New York Harbor, so that the metal giant can make a speech audible over the entire bay. In view of what Mr. Edison has already accomplished, his success in this respect would not surprise us.



THE PHONOGRAPH.

TREE WASTE AND ITS SEQUENCE.

The matter of forest tree culture and preservation is in rather an anomalous state in this country. At one end of the national domain, people are planting trees and studying every means to turn denuded lands back into forests; at the other, woods are being felled and a small war is in progress against the Government on account of its preventive efforts. In Massachusetts societies are organized to stimulate the preserving and renewing of forests; in Louisiana, Alabama, Florida, and Montana, the authorities are denounced as interfering with the best interests of the people, because an endeavor is made to stop the wholesale denuding of public lands and sale of the timber for private benefit. With the legal aspects of this question of forest destruction in the South and West, it is not our province to deal, but the considerations in favor of protecting woodlands are of importance not merely to every agriculturist, but to every one, and they should be fully realized by all who believe that the only value of forests lies in the amount the wood will fetch per cord.

If any one is disposed to think that our forests are inexhaustible, at least for a long period to come, he has only to cast his eye over the woodland map in General Walker's valuable statistical atlas to perceive his delusion. He will see that the number of heavily wooded tracts having 360 or more acres of timber to the square mile is startlingly small. The area of all such districts is equal only to about that of the Atlantic States, and the remainder of the country, fully four fifths, has no timber, the map showing a uniform blank. Now consider the enormous amount of lumber used yearly in manufactures. Nearly $144,000,000 is invested in the sawn lumber industry alone, that is, the production of laths, shingles, and boards. Add to this the fact stated by Professor Brewer that wood forms the fuel of two thirds of the population, and the partial fuel of nine tenths the remaining third, and some general idea of the enormous drain constantly in progress upon our forests will be reached. This, however, is only the direct draught for purposes of utility. Immense areas of woodland are yearly denuded by forest fires, large tracts are purposely burned as a speedy way of clearing, and thus the wooded regions are rendered more and more sparse. If forest fires were prevented as far as is practicable, if trees were constantly being planted, and if the reckless denudation of woodlands could be stopped by the laws already in existence, but apparently not enforced, there is little doubt but that we possess timber enough to supply indefinitely all our needs either as fuel or for manufacturing purposes; but save in isolated instances trees are not being planted, we have no schools of forestry such as exist in Europe to encourage sylviculture, and as the recent proceedings in Congress have shown, a part of the population claims the right for private ends to denude the woodlands now owned by the whole country, and defenders in the Legislature are not wanting to support them.

We have already taken occasion to point out the dangers which result from tree destruction. The exact relation of forests and rainfall is not definitely settled; but there are very numerous cases on record where the destruction of forests has resulted in the production of desert wastes, and where trees have been replanted humidity has returned. It is laid down, however, by such authorities as Dr. J. Croumbie Brown, of Scotland, and others who have made especial studies of the subject, that "within their own limits and near their own borders forests maintain a more uniform degree of humidity in the atmosphere than is observed in cleared grounds. They tend to promote the frequency of showers, and if they do not augment the amount of precipitation they probably equalize its distribution through the different seasons." "In India," says Mr. B. G. Northrop, in a late address before the Connecticut State Board of Agriculture, "three quarters of a million people have been starved to death since the forests have been cut off, causing the springs to dry up."

It is needless to multiply warnings of this kind. In the thickly settled countries of Europe each generation is bound by law to leave the forests in as good condition as it found them. Forests are protected from fire and they are regarded as public property. Until we adopt some similar course, each succeeding generation will transmit to posterity woodlands more and more depleted. The result is only a question of time. The natives of parts of South Africa tell of giant trees and forests, fertile lands, and abundant floods and showers, all existing or occurring in a region now little more than a dry and arid desert; such will be the traditions of our own descendants. As the soil becomes unfit for agriculture, migrations will follow, favored regions will receive an overplus of population which cannot obtain all its supplies from the soil, and dependence upon other nations for necessaries of life, the first step downward in a country's decadence, is taken. Exhaustion of resources must ultimately succeed, and with it the end of national existence.

ASTRONOMICAL NOTES.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, March 30, 1878.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

	H.M.		H.M.
Mercury sets	7 09 eve.	Saturn rises	5 27 mo.
Venus rises	3 58 mo.	Uranus in meridian	9 20 eve.
Mars sets	11 08 eve.	Uranus sets	4 12 mo.
Jupiter rises	3 01 mo.	Neptune sets	8 28 eve.

FIRST MAGNITUDE STARS.

	H.M.		H.M.
Antares rises	11 28 eve.	Sirius in meridian	6 07 eve.
Regulus in meridian	9 29 eve.	Procyon in meridian	7 00 eve.
Spica rises	7 23 mo.	Aldebaran sets	10 54 eve.
Arcturus in meridian	1 41 mo.	Algol (2d-4th mag. var.) sets	11 36 eve.
Altair rises	0 46 mo.	Capella sets	2 46 mo.
Vega rises	9 06 eve.	7 stars (cluster) sets	10 36 eve.
Deneb rises	10 08 eve.	Betelgeuse sets	11 41 eve.
Alpheratz sets	7 24 eve.	Rigel sets	10 06 eve.

REMARKS.

Venus is upon the boundary between *Aquarius* and *Capricornus*, being about 5° southwest of the λ. Mars is about 7° directly north of Aldebaran in the Hyades being a trifle north of the earth's path. Uranus is 1° 5' north and 9m. west of Regulus.

IT is intended to form in Paris a commercial and industrial museum, where the public will find samples of raw materials from all parts of the world, and samples of articles produced therefrom.

Atlantic Wrecks for Thirty-seven Years.

We have before us a record showing the number of lives lost in crossing the Atlantic during the last thirty-seven years. In this period fifty-six fine steamers have been wrecked, and in twenty-nine instances more or less lives were lost. Nine vessels were never heard from after leaving port. These are the President in 1841, the City of Glasgow in 1854, the Pacific in 1856, the Tempest in 1857, the United Kingdom in 1868, the City of Boston in 1870, the Scanderia in 1872, the Ismailia in 1873, and the Colombo in 1877. The number of lives which were thus blotted out aggregates 1,397. Of the remaining vessels, four were burned, five sunk by collision, two by colliding with icebergs, two foundered at sea, and thirty-four were wrecked on various coasts. This is a suggestive showing, for it at once calls into contrast the relative peril incurred by dependence upon human judgment and human handiwork. Of the entire total of steamers lost, in but two cases can the disaster be attributable to a breakdown of the machinery; namely, the Anchor line steamer Hibernia, which foundered through her propeller shaft having been withdrawn from its place after the propeller had been lost; and the other the Ismailia, of the same line, which was once spoken under sail, her machinery being disabled, and was never heard of afterward. Neither has any boiler explosion occurred on an Atlantic steamer during the period mentioned. So far as the record before us is authority, the inference therefore is that the greatest loss of life is due not to lack of safe vessels, but to failure in judgment or the incompetence of those who handle them.

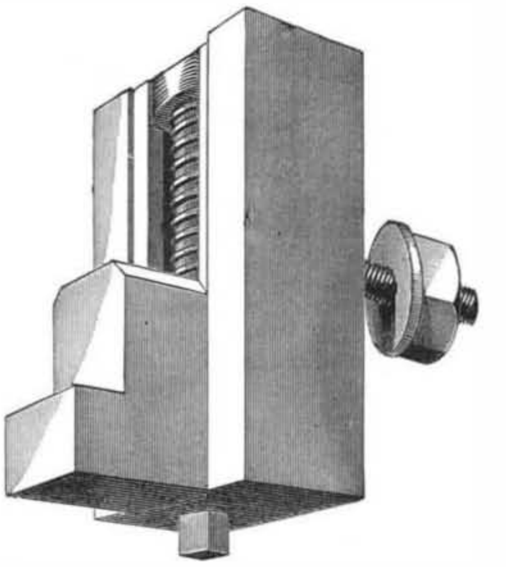
Thirty-four steamers, as above stated, have been wrecked, and an inspection of the localities where the wrecks occurred shows that several have happened in about the same vicinity. For example, the City of New York in 1861 and the Chicago in 1868 were both wrecked on Daunt's Rock, near Queenstown. No less than twelve have been destroyed on the coasts of Nova Scotia and Newfoundland. It may be asked if vessels cannot be built strong enough to withstand driving upon the rocks as in the cases of the Atlantic and the Schiller, at least for a sufficient time to enable the passengers and crew to obtain assistance or make their escape; but here the question of cost obtrudes itself, and the answer of those who have considered the subject is that vessels cannot be so constructed and yet profitably used. Taking this into account with the aggregate number of lives lost, in all 4,780, and it will be evident that the problem of reducing the dangers of the sea becomes, as we have frequently urged, one depending on the efficacy of life saving inventions. Devices which will keep large numbers of people afloat for considerable periods, devices that will keep individuals above water that can be rapidly adjusted to the person with no possibility of mistake, devices for taking lines from wrecked vessels to the shore, devices for indicating the relative positions of ships to each other, new signals for fog and night, and contrivances of that nature, all are subjects for the inventor's skill in devising better modifications and improvements.

A LARGE SUGAR MILL.

The sugar cane mill shown in the accompanying engraving is the largest which has yet been made in this country, and is of a character which leads the London *Engineer* to remark that there is reason to believe that in this class of machinery American makers will soon compete largely with English engineers. It was made by the Farrel Foundry and Machine Company, of Ansonia, Conn. It is driven by a Corliss beam engine (shown at the left of the illustration), with a cylinder 30 inches in diameter and 5 feet stroke. The cane mill rollers are 44 inches in diameter, and 90 inches long on the face. The castings for the entire mill weighed over 300 tons, the nature of the work demanding peculiarly substantial parts. The operation of the machinery may be readily understood without further detailed description.

INDEPENDENT JAW FOR LATHE CHUCKS.

We illustrate herewith an improved jaw for lathe chucks, which can be fixed in any desired position so as to hold pieces of any irregular form. It can be quickly removed from the chuck and attached to the face plates of engine and shafting lathes, drilling and boring machines, or to the platen of planers and milling machines. The manufacturers claim that the device never gets clogged with chips or dirt or the screws out of order, causing it to work with difficulty. It can quickly be removed from one lathe to another, thus saving the use of several chucks, and is further claimed to be the only jaw adapted to chucks of large diameter. It is made of wrought iron or steel and case hardened. The screws are of steel. The large sizes have two or more bolts to fasten them to the chuck. For further information address the American Twist Drill Co., Woonsocket, R. I.



INDEPENDENT JAW FOR LATHE CHUCKS.

Telephone Notes.

Mr. W. H. Preece considers that the telephone may be employed both as a source of a new kind of current and as a detecter of currents which are incapable of influencing the galvanometer.

It shows that the form and duration of Faraday's magneto-electric currents are dependent on the rate and duration of motion of the lines of force producing them, and that the currents caused by the alteration of a magnetic field vary in strength with the rate of alteration of that field; and further, that the infinitely small and possibly only molecular movement of the iron plate is sufficient to occasion the requisite motion of the lines of force. Mr. Preece has also pointed out that the telephone explodes the notion that iron takes time to be magnetized and demagnetized.

The best way to adjust the magnet, that is, as near as possible to the plate without touching, is to sound the vowel sound *ah* or *o* clearly and loudly; a jar is heard when the parts are too near together.

Mr. Preece has found that, if the telephone wire be inclosed in a conducting sheath, which is in connection with the earth, all effects of electric induction are avoided; and further, if the sheath be of iron, magnetic induction also is avoided and the telephone works perfectly.

The leakage on pole lines is fatal to the use of the telephone in wet weather for distances beyond five miles.

Hon. Rollo Russell, says *Nature*, has made some experiments, which go to prove that there is no need to insulate the wires connecting a pair of telephones, at least when used for short distances. No. 18 uncovered copper wire was laid along grass and trees 418 yards, the two lines being kept well apart, and articulation was very well heard. The same wire was buried for three yards in wet clay, when telephones 20 yards apart gave good results, showing that bare wires may be taken under roads, etc., without diminution of the audible effect. Conversation was heard through lines submerged in water about 40 yards and lying on the grass for 28 yards.

M. Demoget, of Nantes, calls attention to the fact that if two telephones be placed in direct communication with the two wires of a Ruhmkorff coil, so as to close the circuits of each by means of these wires, if one or the other of the telephones be spoken into, the second transmits the sounds just as if both were in direct communication with one another. Another fact noted is that two telephones in double circuit may be disposed at the end of a line, and if both be simultaneously spoken into, two voices are heard in a single telephone at the other end of the line. M. Demoget therefore suggests the placing of two or three telephones of different pitch in a chamber forming a resonator, in order to obtain more intense and more distinct sounds.

Modern Marine Engine Economy.

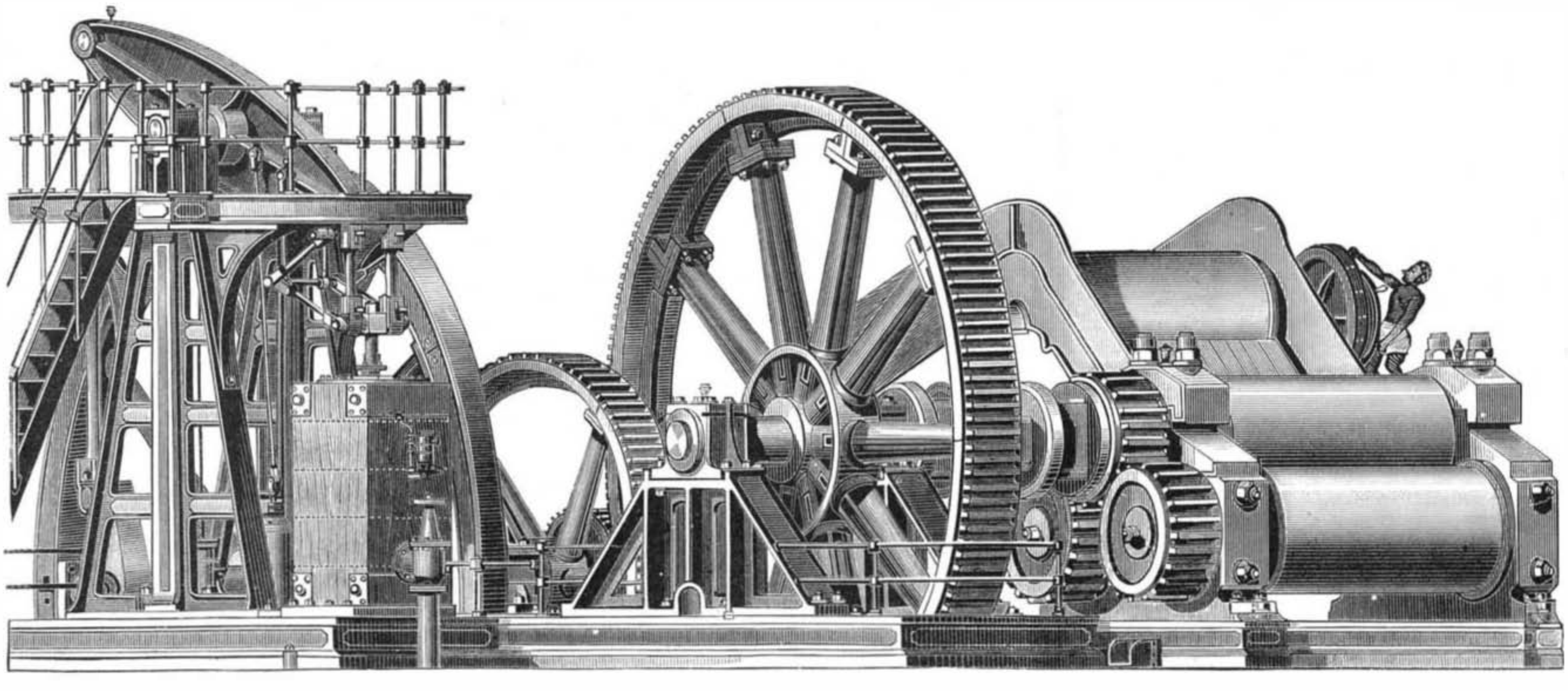
One of the most suggestive illustrations that can be adduced as showing the advances made within the last forty years in marine engine economy is derivable from an examination of data calculated by Mr. Arthur J. Maginnis from recorded averages of Atlantic steamships—and more especially of those of the Cunard paddlewheel steamer "Britannia" in 1840, and the White Star screw steamer "Britannic" in 1877. Of the first vessel the average duration of passage was 14 days and 8 hours, and the consumption of fuel 544 tons, the daily consumption thus being 38 tons.

Assuming the average cargo at 225 tons, this gives 48·35 cwt. of coal per ton of cargo; and the average speed in knots per hour being 8·3, the consumption per knot was 3·8 cwt. The indicated horse power was 740, and consumption per horse power, 4·7 cwt. The Britannia displaced but 2,050 tons, and this must be taken into account in comparing her with the Britannic, whose displacement is more than four times as great, or 8,500 tons. That vessel, in 1877, showed an average passage of 7 days 10 hours and 53 minutes, an average daily consumption of fuel of 100 tons, or total consumption of 745 tons. Her cargo is 3,350 tons; consumption of fuel per ton of cargo, 4·45 cwt.; average speed, 15·6 knots; consumption per knot, 5·3 cwt.; indicated horse power, 4,920; consumption per horse power, 1·9 cwt.

In other words, we are now enabled to transport 15 times as much freight across the ocean in one half the time at an expenditure of less than one and a half times as much coal as in 1840.

Ocean Phenomena.

Mr. J. J. Wild, in his new book on the ocean, based on the data obtained during the Challenger Expedition, states that in the beds of the Atlantic and Pacific there are immense valleys reaching a depth of 17,280 feet below the surface. In the Pacific, south of Asia and around Australia, the depth is 11,500 feet, and near Japan it attains 22,400 feet. The temperature of the sea depends upon the latitude, currents, and the season of the year. If no perturbing cause existed there would be isothermal lines of ocean temperature parallel to the equator. But warm currents travel from the tropics to the poles, and inversely cold currents move from poles to tropics and break up all uniformity. At the equator the average surface temperature is 80·6° Fah.



SUGAR CANE CRUSHING MACHINERY.