system that will shorten the process of extracting the metals and reduce the cost, so as to enable poor ores, which are so abundant, to be worked at a profit. Millions of tons of the material are technically known as "tailings" (that is, ores from which has been taken all the gold and silver that, by present processes, can be profitably extracted, but which still contain an appreciable quantity of the precious metals) exist in all the auriferous districts. For the treatment of these ores various methods have been suggested. The principal difficulty that has been encountered is that of bringing mercury into contact with the gold where the latter exists in only small quantities, or from the flouring of the mercury when vapors of mercury are employed, entailing loss of amalgam and mercury in the subsequent treatment.

Messrs. Forster and Firmin, of Norristown, Pennsylvania, have recently devised a novel method of treating ores with mercury, for which letters patent have been granted them in the United States, Canada, Australia, and other countries. The pulverized ore containing free gold or silver is fed from the hopper, shown in the illustrations, with a horizontal tube, A, Fig. 2. While in the act of falling it is impinged

Fig. 2.

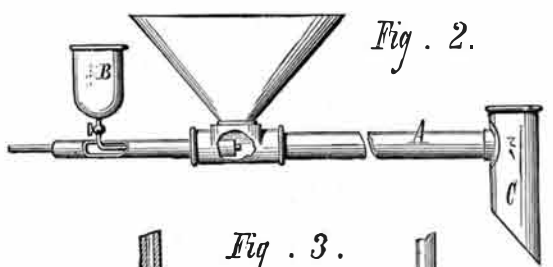
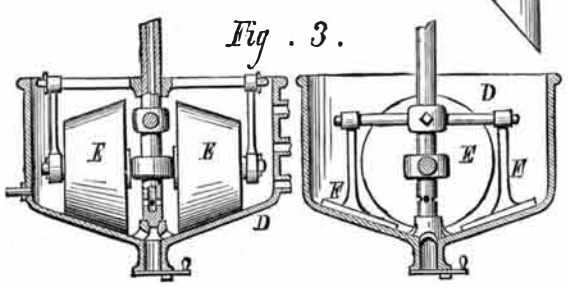


Fig. 3.



upon by a stream of mercury, which escapes from the receptacle, B, through the inner pipe shown. The flow is broken up and carried forward by steam or air pressure, after the manner of the well known principle of the sand blast. The horizontal tube connects with a vertical tube, C, upon which the ore and the atomized mercury are together forcibly projected, grain by grain, in a continuous stream, and fall, by their own gravity, into the washer or receiver, D. It is claimed that an almost unlimited quantity of ore may be treated by this process, as the attendants have only to feed the hoppers and remove the deposit. The inventors state that "with only a three inch tube from three to five tons of ore can be treated per hour."

In connection with this amalgamator an improved washer, shown in detail in Fig. 3, is used. This consists of a vessel, having a conical bottom, in which rollers, E, and also with scrapers or mullers, F, are placed. The feed water is injected through the shaft or near the bottom of the vessel, and the upward current carries off the waste ore, while the amalgam and surplus mercury collect in the dead water space in the conical bottom, whence they are drawn off through the discharge cock.

The advantages claimed for this invention are: 1st. The rapid continuous process of amalgamating, thus treating very large quantities of ore. 2d. The thorough impregnation of the metals with the mercury, giving larger results. 3d. The profitable working of poor ores or tailings, which are now valueless. 4th. The simplicity of the apparatus, having no parts to get out of repair. 5th. The cheapness and portability of the apparatus, and the ease and economy with which it can be operated wherever there is a steam boiler.

In the improved washer the amalgam and mercury are recovered rapidly with a comparatively small flow of water, without the danger of carrying off a portion of either the amalgam or mercury. For further information, address the inventors as above.

CONSTRUCTING ICE HOUSES.

People who do not own ice houses generally find that before the summer is over, they have paid a very high figure for their ice and that the sum so expended would have gone far toward the construction of a suitable storage building. Ice can be gathered near almost any country place, and it can easily be moulded into blocks even if obtained only in the form of a thin layer. The question is how to build a good ice house that will preserve it, and on this point there has been much discussion. Mr. R. G. Hatfield, one of the most prominent architects of this city, points out the best, cheapest and simplest way in SCIENTIFIC AMERICAN SUPPLEMENTS Nos. 55 and 59. There he gives working drawings of an admirable ice house which he has constructed and which has been found to answer its purpose in every particular. If the reader retained an architect to prepare a similar plan the cost would probably be at least fifty dollars; in the SUPPLEMENT, plans, specifications, and descriptions of all the details are given for but twenty cents.

AN OLD SUBSCRIBER.—An esteemed correspondent writes: "I have taken the SCIENTIFIC AMERICAN ever since its first number. I was then under 20 years of age; I am now over 50 years."

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New subscriptions will be entered from the time the order is received; but the back numbers of either the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT will be sent from January when desired. In this case, the subscription will date from the commencement of the volume, and the latter will be complete for preservation or binding.

VOL. XXXVII., No. 25. [NEW SERIES.] *Thirty-second Year.*

NEW YORK, SATURDAY, DECEMBER 22, 1877.

Contents.

(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 108,
For the Week ending December 22, 1877.

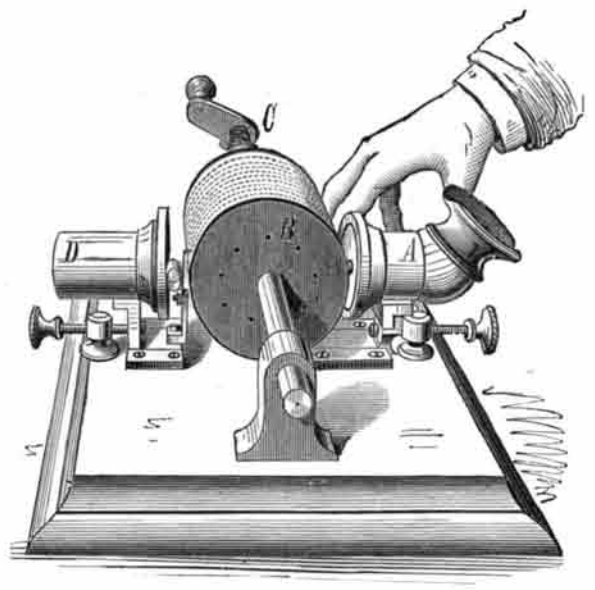
Price 10 cents. To be had at this office and of all newsdealers.

THE TALKING PHONOGRAPH.

Mr. Thomas A. Edison recently came into this office, placed a little machine on our desk, turned a crank, and the machine inquired as to our health, asked how we liked the phonograph, informed us that *it* was very well, and bid us a cordial good night. These remarks were not only perfectly audible to ourselves, but to a dozen or more persons gathered around, and they were produced by the aid of no other mechanism than the simple little contrivance explained and illustrated below.

The principle on which the machine operates we recently explained quite fully in announcing the discovery. There is, first, a mouth piece, A, Fig. 1, across the inner orifice of which is a metal diaphragm, and to the center of this diaphragm is attached a point, also of metal. B is a brass cylinder supported on a shaft which is screw-threaded and turns in a nut for a bearing, so that when the cylinder is caused to revolve by the crank, C, it also has a horizontal travel in front of the mouthpiece, A. It will be clear that the point

Fig. 1.

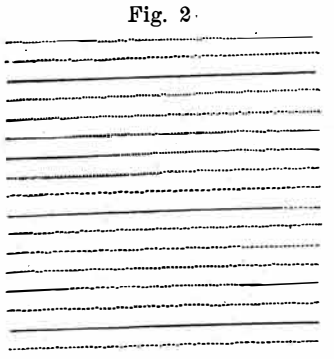


on the metal diaphragm must, therefore, describe a spiral trace over the surface of the cylinder. On the latter is cut a spiral groove of like pitch to that on the shaft, and around the cylinder is attached a strip of tinfoil. When sounds are uttered in the mouthpiece, A, the diaphragm is caused to vibrate and the point thereon is caused to make contacts with the tinfoil at the portion where the latter crosses the spiral groove. Hence, the foil, not being there backed by the solid metal of the cylinder, becomes indented, and these indentations are necessarily an exact record of the sounds which produced them.

It might be said that at this point the machine has already become a complete phonograph or sound writer, but it yet remains to translate the remarks made. It should be remembered that the Marey and Rosapelly, the Scott, or the Barlow apparatus, which we recently described, proceed no further than this. Each has its own system of caligraphy, and after it has inscribed its peculiar sinuous lines it is still necessary to decipher them. Perhaps the best device of this kind ever contrived was the preparation of the human ear made by Dr. Clarence J. Blake, of Boston, for Professor Bell, the inventor of the telephone. This was simply the ear from an actual subject, suitably mounted and having attached to its drum a straw, which made traces on a blackened rotating cylinder. The difference in the traces of the sounds uttered in the ear was very clearly shown. Now there is no doubt that by practice, and the aid of a magnifier, it would be possible to read phonetically Mr. Edison's record of dots and dashes, but he saves us that trouble by literally making it read itself. The distinction is the same as if, instead of perusing a book ourselves, we drop it into a machine, set the latter in motion, and behold! the voice of the author is heard repeating his own composition.

The reading mechanism is nothing but another diaphragm held in the tube, D, on the opposite side of the machine, and a point of metal which is held against the tinfoil on the cylinder by a delicate spring. It makes no difference as to the vibrations produced, whether a nail moves over a file or a file moves over a nail, and in the present instance it is the file or indented foil strip which moves, and the metal point is caused to vibrate as it is affected by the passage of the indentations. The vibrations, however, of this point must be precisely the same as those of the other point which made the indentations, and these vibrations, transmitted to a second membrane, must cause the latter to vibrate similar to the first membrane, and the result is a synthesis of the sounds which, in the beginning, we saw, as it were, analyzed.

Fig. 2.



In order to exhibit to the reader the writing of the ma-

chine which is thus automatically read, we have had a cast of a portion of the indented foil made, and from this the dots and lines in Fig. 2 are printed in of course absolute facsimile, excepting that they are level instead of being raised above or sunk beneath the surface. This is a part of the sentences, "How do you do?" and "How do you like the phonograph?" It is a little curious that the machine pronounces its own name with especial clearness. The crank handle shown in our perspective illustration of the device does not rightly belong to it, and was attached by Mr. Edison in order to facilitate its exhibition to us.

In order that the machine may be able exactly to reproduce given sounds, it is necessary, first, that these sounds should be analyzed into vibrations, and these registered accurately in the manner described; and second, that their reproduction should be accomplished in the same period of time in which they were made, for evidently this element of time is an important factor in the quality and nature of the tones. A sound which is composed of a certain number of vibrations per second is an octave above a sound which registers only half that number of vibrations in the same period. Consequently if the cylinder be rotated at a given speed while registering certain tones, it is necessary that it should be turned at precisely that same speed while reproducing them, else the tones will be expressed in entirely different notes of the scale, higher or lower than the normal note as the cylinder is turned faster or slower. To attain this result there must be a way of driving the cylinder, while delivering the sound or speaking, at exactly the same rate as it ran while the sounds were being recorded, and this is perhaps best done by well regulated clockwork. It should be understood that the machine illustrated is but an experimental form, and combines in itself two separate devices—the phonograph or recording apparatus, which produces the indented slip, and the receiving or talking contrivance which reads it. Thus in use the first machine would produce a slip, and this would for example be sent by mail elsewhere, together in all cases with information of the velocity of rotation of the cylinder. The recipient would then set the cylinder of his reading apparatus to rotate at precisely the same speed, and in this way he would hear the tones as they were uttered. Differences in velocity of rotation within moderate limits would by no means render the machine's talking indistinguishable, but it would have the curious effect of possibly converting the high voice of a child into the deep bass of a man, or *vice versa*.

No matter how familiar a person may be with modern machinery and its wonderful performances, or how clear in his mind the principle underlying this strange device may be, it is impossible to listen to the mechanical speech without his experiencing the idea that his senses are deceiving him. We have heard other talking machines. The Faber apparatus for example is a large affair as big as a parlor organ. It has a key board, rubber larynx and lips, and an immense amount of ingenious mechanism which combines to produce something like articulation in a single monotonous organ note. But here is a little affair of a few pieces of metal, set up roughly on an iron stand about a foot square, that talks in such a way, that, even if in its present imperfect form many words are not clearly distinguishable, there can be no doubt but that the inflections are those of nothing else than the human voice.

We have already pointed out the startling possibility of the voices of the dead being reheard through this device, and there is no doubt but that its capabilities are fully equal to other results just as astonishing. When it becomes possible as it doubtless will, to magnify the sound, the voices of such singers as Parepa and Titiens will not die with them, but will remain as long as the metal in which they may be embodied will last. The witness in court will find his own testimony repeated by machine confronting him on cross-examination—the testator will repeat his last will and testament into the machine so that it will be reproduced in a way that will leave no question as to his devising capacity or sanity. It is already possible by ingenious optical contrivances to throw stereoscopic photographs of people on screens in full view of an audience. Add the talking phonograph to counterfeit their voices, and it would be difficult to carry the illusion of real presence much further.

THE END OF VOLUME XXXVII.

With our next issue the thirty-seventh volume of the SCIENTIFIC AMERICAN closes. At the same time several thousand subscriptions terminate; and as it is our invariable rule never to send the paper after the period subscribed for has elapsed, those of our readers who desire no break in the regular reception of their numbers will favor us by a prompt renewal of their subscriptions. The volumes of the SCIENTIFIC AMERICAN for the coming year will, we believe, excel any of their predecessors. No pains will be spared to render their contents the most complete exhibit of everything that transpires in the world of science, mechanics, or arts, and it will be our endeavor to place this information before our readers at so early a date, and so simplified and digested, as to render it a constant fund of suggestion for those who are ready to exercise their inventive powers to devise new and useful modifications, improvements, or original conceptions. In order to invent it is necessary to know, first, what has been done, second, what is in progress, and third, the general drift of present advancement. The SCIENTIFIC AMERICAN presents the first through carefully prepared articles on prominent industries and lucid illustrated descriptions of the most recent and improved mechanical devices; the second through its correspondence from various parts of the world, its selections from the immense range of current foreign technical periodicals, and from the immediate contact of its managers with the best inventive minds of the country; and lastly, the third is pointed out in elaborate editorial reviews and comments on new ideas as the same are brought out. It may be safely said that more people have obtained from the SCIENTIFIC AMERICAN valuable suggestions which have returned them direct profit than through any other medium extant.

Besides pointing out the road to invention, the SCIENTIFIC AMERICAN during the coming year will give particular attention to the presentation of papers of practical instruction to mechanics of every class. Thoroughly competent mechanical experts will explain the best methods of workshop manipulation, and, both in answer to the questions of correspondents and elsewhere, an immense number of reliable trade recipes, besides valuable advice in special cases which may be submitted to us, will be given. In the department of natural history much that is rare and curious in the animal and vegetable worlds will be illustrated and described, and no engineering structure of importance will be undertaken but that it will be fully elucidated in our pages. The Great French Exposition of 1878 will also be completely described, and whatever is there exhibited of novelty or interest will be found illustrated in these columns.

All this valuable and varied information appears in no other journal, for none other enjoys the facilities for obtaining the same, now possessed by the SCIENTIFIC AMERICAN. The subscription price will remain, as heretofore, $3.20 per year, postage paid.

WINTER SHOP WORK.—BUILDING BOATS.

Many of our readers, especially those who are mechanical amateurs, are just now considering what work they shall undertake in their spare hours during the coming winter. We know several members of professions and other callings who make it a rule to work in their nicely fitted-up shops a few hours daily, and thus they gain health, strength, and relief from brain work, while the result of their labor often proves of value and profit. There are also many regular mechanics who are anxious to find some good paying job to labor at, over hours, so that they can lay up a little extra fund above their wages. Among the suggestions we make to these workmen, amateur and regular, is to build boats. Boats are very expensive to buy. The smallest kind of a 10 foot yawl costs about 50 dollars when purchased from a regular builder, and for a good sail boat from 200 to 600 dollars is charged. Boats can be built indoors. They require nice work, and the amateur mechanic can lavish on them just as much fine manipulation as he chooses as all such shows and enhances the beauty and value of the craft. A boat besides is always useful and frequently necessary to any one who lives near the water.

Most people, whose boat building has not extended beyond the construction of a flat bottomed scow, think that to build a yawl or a yacht is a difficult and expensive undertaking, while it is just the reverse. Any one who can put up a workmanlike chicken house can build an excellent sail boat. All he has to do is to follow instructions, and those he will find in the SCIENTIFIC AMERICAN SUPPLEMENT. In that journal we have published, with elaborate working drawings and directions, full particulars how to construct a scow for three dollars (SUPPLEMENT No. 25), a rowing skiff for five dollars (SUPPLEMENT No. 26), a fine sailing skiff for fourteen dollars (SUPPLEMENT No. 29), a neat ribbed row boat for twelve dollars (SUPPLEMENTS 30 and 32), a large row boat for sixteen dollars (SUPPLEMENT No. 36), a Whitehall boat of fine model, such as is used in New York harbor, for fifteen dollars (SUPPLEMENT No. 37). A sailing and rowing canoe of the type of the famous Rob Roy for fifteen dollars (SUPPLEMENT No. 39), a fast sailing yacht for thirty dollars (SUPPLEMENT No. 42), and finally a large fast and serviceable yacht for three hundred dollars (SUPPLEMENT No. 67). These estimates cover the materials, not the labor, of the amateur builder. The entire series, which embraces about 100 illustrations, mainly accurate drawings to scale, besides full details as to how to rig and manage the vessels, may be obtained for one dollar.

Last summer a great deal of attention was given to catamarans or double boats. Not even professional boat builders as a rule understand the construction of these exceedingly fast craft. In SUPPLEMENTS Nos. 105 and 106 will be found full directions of how to build three different sizes of these remarkable vessels at costs ranging from $50 to $500. Not only can the vessels above referred to be constructed for pleasure purposes, but we have no doubt any mechanic could find in their construction and sale a very profitable source of revenue.

BUILDING ICE BOATS.

In a few weeks the rivers and streams of the Northern States will be frozen over, and therefore the present is the time for those who propose to pursue the exhilarating and health-giving sport of ice yachting to get their vessels in readiness. There is no known mode of locomotion which outrivals the ice yacht in speed. It travels at a mile a minute with ease, outstrips fast railway trains, and, when contrasted with the ordinary sailing vessel, is handled with ease and safety.

Ice yachting has been practiced on the Hudson river for a number of years past. The owners of the boats have exercised great skill and ingenuity in devising improved models, until at present by far the most elegant and swift ice vessel are to be found during the winter on the above stream. The ice yacht Whiff, which, it will be remembered, was exhibited at the Centennial Exposition, proved a revelation to thousands who had practiced ice yachting in comparatively slow and clumsy contrivances. Especially was this true of the people of Northern Europe, whose ice boats were little more than heavy sledges with sails. The result has been a demand for knowledge regarding the best form of ice yachts, a demand not confined to this country, but which comes from every quarter of the world where rivers and lakes freeze over, and where ice yachts can be used either for pleasure or as a source of profit.

Any mechanic of average ability, or any young man of fair mechanical acquirements, who knows how to handle carpenter's tools, can construct an ice boat from the minute directions, accompanied with elaborate working drawings, made to scale, which are to be found in the SCIENTIFIC AMERICAN SUPPLEMENT No. 63. If these are followed, a duplicate vessel in every particular to the famous Whiff is produced. Such information has never before been published and is not attainable elsewhere, and it is now being sent in response to calls to all parts of the world. In SUPPLEMENT No. 1 is given other engravings, showing how to construct ice vessels of different builds, besides full particulars as to management, organization of clubs, etc. For twenty cents, therefore, the mechanic can obtain information whereby he can construct the best class of ice yachts, which he can sell at large profit; or the amateur the directions which will enable him to produce a fine fast vessel at minimum expense and at little labor.

RECEIVING YOUR PAPER.

We shall consider it a favor if subscribers, editors of exchanges, and all others who are entitled to receive the SCIENTIFIC AMERICAN or SUPPLEMENT regularly, and whose numbers fail to reach them in proper season, or who miss numbers, or whose addresses are not printed exactly right on the slip pasted on the wrapper, will notify us promptly of the fact. A line in pencil to this effect is easily written on a postal card, and it may save considerable annoyance during the year. The internal affairs of this establishment, and especially those of the mailing department, are carefully systematized; our subscribers addresses are printed and affixed to the wrappers by machinery; and it is obvious that if anything goes wrong, there is error or neglect somewhere, which is easily traced and remedied. Our readers need have no fear with regard to giving us any trouble in this matter. We ask the information for the mutual advantage of both our readers and ourselves.

BUILD A STEAMBOAT.

Not a big one, but a small craft large enough to run around the river on the pond near your place. To construct the hull will be an excellent winter's work, and the engine can be obtained at a moderate price. There is no better practice for a boy of mechanical tastes than for him to learn to run a small steam vessel. It would be a good idea to buy the engine first, set it up in the shop and make it drive the saw and other tools which can be used in constructing the hull. This will familiarize you with the machine, which may afterwards be put in its place in the boat.

In building a craft of this description, there is every chance for fine work and for some really valuable invention. Shipbuilders everywhere are seeking to discover the best lines for small vessels, through which the highest speed may be obtained, for it is well known that the model of a boat has a great deal to do with her speed. On such a vessel the builder could easily try ideas in this direction of his own, and thus perhaps reach some valuable results. A steam launch is besides a much greater source of pleasure to her owner than any sailing yacht, as she is independent of wind and tide and admirably suited for long trips or even a summer's cruising.

To learn how to build the fastest kind of steam yacht send for SUPPLEMENTS No. 14, 69, 75 and 81, price ten cents each. These explain (with working drawings) how to construct a 15 foot launch like the Black Hawk, a very celebrated boat in this vicinity; how to build a fine 30 foot launch with machinery and everything complete for only $380. How to build a 40 foot steam launch with a three cylinder engine, and finally how to construct a 21 foot launch that will steam 10 knots per hour. An ingenious builder will take all these plans, pick out the best features of each, and produce a boat which probably will excel all.

Wire for the East River Bridge.

Proposals were recently called for the supply of the steel wire for the suspending ropes of the East River Bridge. The specifications require 325,000 pounds of wire rope, making, 70,000 lineal feet in all. There are two sizes required, one measuring 1⅝ inches in diameter, weighing 4½ pounds to the lineal foot, and having a breaking strength of not less than 180,000 pounds; the other measuring 1¼ inches in diameter-weighing 5 pounds to the lineal foot, and having a breaking strength of 200,000 pounds. The attention of the members of the board was called to a gnarled, broken, and twisted suspender rope. This specimen was made at the factory of Roebling's Sons & Co., by the direction of Chief Engineer Roebling. It was 1⅝ inches in diameter, and had been tested by the Keystone Bridge Company, of Pittsburg. It was broken under a strain of 197,500 pounds, the required strength being 180,000 pounds. It was resolved award the contract to J. A. Roebling's Sons & Co., at seven cents a pound, for Bessemer steel wire.