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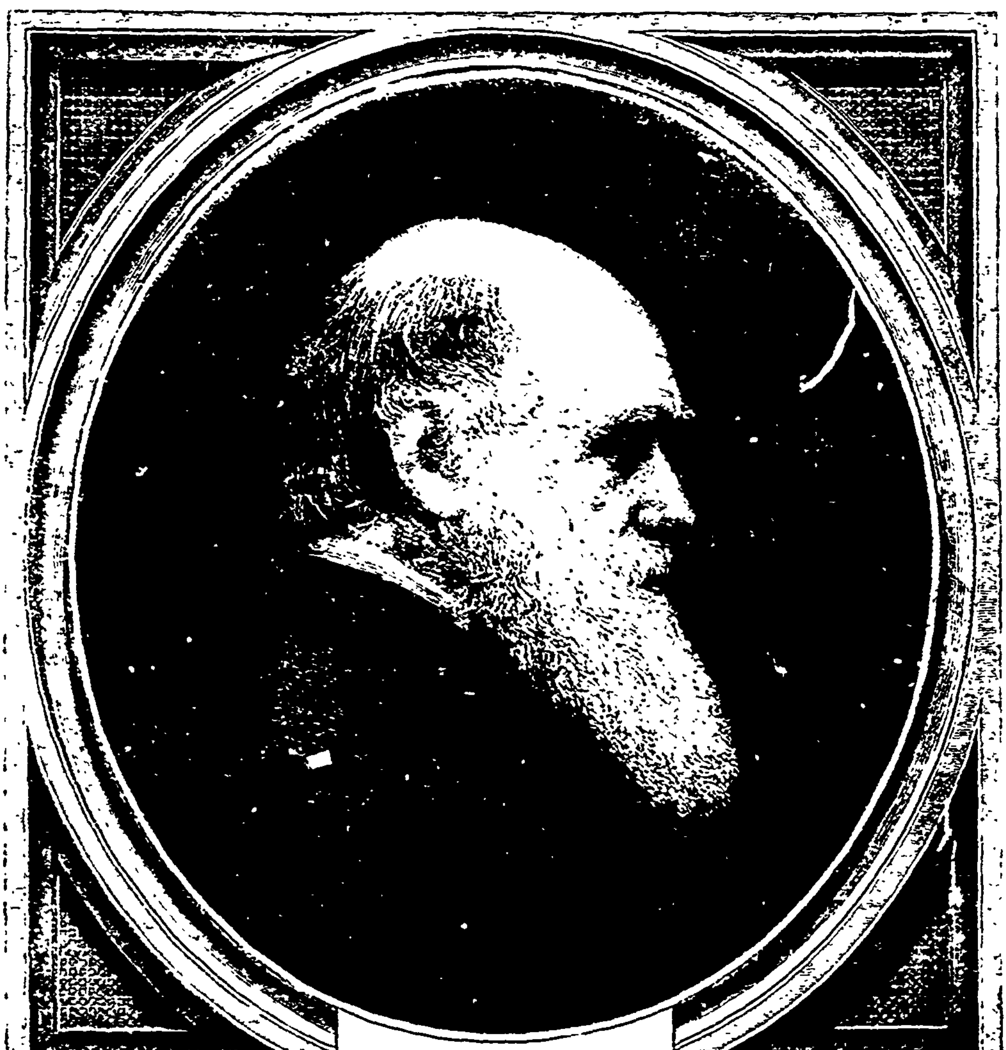
The Canadian Patent Office Record and Mechanics' Magazine

Vol. 3.—No. 5. MAY, 1875. Price in Canada $2.00 per An. United States - $2.50 "



CHARLES R. DARWIN, ESQ., F.R.S.

PROTECTION FOR INVENTIONS.

(Paper read before the Society of Arts.)

By F. J. Bramwell, C.E., F.R.S.

(Concluded from page 107.)

I will ask you to let me give two instances. One occurred about five-and twenty years ago, at a Government victualling yard, when an improvement in grinding wheat was being tried by the Government, at the cost, as I need hardly say, of the patentee. The improvement, if successful, as it was, would have lessened the hard work of the men, but beyond that not would not have interfered with them or their foreman in any way, and yet in this case there was a great amount, not of mere passive but active resistance offered. An inquiry was demanded and was held; it resulted in some of the offenders being discharged, while others were reprimanded. In this instance men in Government employment, where they might have counted on being retained during their working life, and pensioned in their old age, risked and forfeited these advantages, and for no other cause than that their self love was injured

Another instance, much more recently, relates to the introduction of Siemens' furnace into a large works. This was met with covert opposition by the foreman of the department, who used to report adversely of the furnace generally, while admitting that at times it would work well. The principal having privately made his own observations, and satisfied himself that the furnace would work perfectly if it had fair play, called his foreman, and said to him. "You say the Siemen's furnace works well sometimes. Now, the furnace is not varied in construction, therefore when it does not work well it must be because it is not properly managed. The management is under your charge, and if in the course of the next three months you cannot manage it so that it shall work well at all times, I must get another foreman who will see that it does work well" The furnace worked well from that day.

I trust I have given you reasons enough and to spare why a prosperous manufacturer instead of seeking about for changes in his manufacture, looks upon all innovation with dislike, and wishes that, so far as his trade is concerned, "finality" may have been reached. Pardon my using a coarse, but expressive phrase, which is that you want somebody to "thrust improvement down the throats of manufacturers." A patentee is in the position to do this. He has his patent. Very likely he is not a manufacturer; his capital is not embarked in machinery adapted to an old style of things, he has every inducement to devote his time to persuading some one that his invention is valuable, that it will turn out so on trial; he offers to superintend all the experimental work, and thus to relieve the manufacturer from the loss of time and from the distraction of attention from his trade which must ensue if he himself or his staff have to work up an invention to the practicable stage, and then, provided with his patent, he can make an agreement with the person who first tries his invention, to the effect that if successful that person shall be rewarded by a share in the patent, or by being allowed to use the invention free of royalty or at a reduced royalty. By these means a patentee does frequently succeed in getting his invention put to work by the manufacturer, but all these means are needed to obtain this end; and, even, with their assistance, it is commonly a work of years before an invention is taken up. When taken up, and when proved a thorough commercial success, then, indeed, under the pressure of the competition of the improved process, other manufacturers may wish to work the invention, and, finding themselves unable to do so except on the payment of a royalty, may raise the cry, "Patents interfere with the freedom of trade." But is this so? What freedom has been interfered with? The industry as it stood before the invention is as open to them all as it ever was, but the power to exercise the invention itself cannot be had without payment of a toll. How are manufacturers damnified by this? Suppose the inventor choose to carry on his process as a secret manufacture, it cannot I presume be contended that such a course, however undesirable, should be made illegal, and if not, those manufacturers who had not the secret would be unable to pursue the manufacture. Would anybody seriously call this "Interference with freedom of trade?" Assume that a landowner were to go to a number of manufacturers in his district and were to say to them, "There is a large and unfailing supply of water on the other side of that hill. I have had the levels taken. I have consulted geologists, and I am convinced it is practicable to make a tunnel through that hill. If it were made you would bring here a water power which would save each of you a thousand a year in the cost of coals you now use for your steam engines. I should be willing enough to make the tunnel had I the money to spare. I have not, but the water and the hill are mine, and I will contribute the water and give a right of way through the hill as my share towards the realisation of the plan if you will subscribe among yourselves the necessary funds, and when the work is completed I shall expect to participate in the profits." Suppose the majority of the manufacturers turned a deaf ear to this proposition, did not believe in it, looked upon it as hopeless that a tunnel could be made through such a rock, dreaded the great cost of water wheels, and were afraid of finding the value of their steam engines reduced to one of the purely nominal character belonging to discarded machines. Suppose, I say, the bulk of the manufacturers addressed pursued this course, and refused to aid in the work of bringing the water to the district, would it be for then to raise the outcry of "Interference with freedom of trade," or would such an outcry be just, when those of their body who in conjunction with the landowner had succeeded in overcoming every obstacle, and in bringing the water power to their side of the hill, were to refuse to let those participate in the benefits who had not helped in the works. These men might truly say, "Your trade is just as free to you as ever it was. We have taken nothing from you, but we have by our own skill and at our own risk changed the conditions of our manufacture for the better. We can obtain power cheaper than of yore, but our refusal to let you share in it is simply a refusal to give up that which is our property." If such a refusal is to be called: "Interference with the freedom of trade," then every man who carries on a manufacture where he gets water power for nothing, if he refuses to share that power with his competitors in the neighbourhood, interferes with the freedom of trade, and every merchant who has a wharf which gives him better access to a navigable river or to a canal interferes with the freedom of trade, unless he shares his wharf with his rivals. Such propositions one sees at once are absurd, and could only be tolerated in a society of advanced Communists. But I confess I fail to see how the proposition that the use of an invention should be open to all, is not as rank communism as the condition of things I have assumed.

The second of the alleged evils is—That British manufacturers are put at a disadvantage as compared with those of countries where there is not a patent-law.

What is the practical answer to this? Great Britain, the United States, and France, all have efficient patent-laws, and must it not be admitted that in no other countries are manufactures so vigorous, or improvements so rife? Few countries claiming to be civilised are without a patent-law. Switzerland has none. Holland has recently given up her patent-law. Are these countries of progress or countries of invention? What do they do to advance manufactures? I once heard Lord Houghton say, at a discussion on patent-law, when the absence of a patent-law in Switzerland was cited, that he never heard of Switzerland being famous for any manufacture beyond alpenstocks and long hotel bills. So far from the existence of a patent-law putting the country which possesses it to a disadvantage, it is the means of causing ingenious foreigners to bring to that country their various inventions which, did they cease to become property when they reach its shores, they would withhold and would keep in their own land. Not only does a good patent-law bring in foreign inventions, but it attracts good men to come and reside amongst us, and to establish works in our country. A distinguished man, whose inventions I have referred to this evening, said on the occasion of a discussion on patent-law in Section F of the British Association, that he left his own country to settle here, mainly because the patent-law of that country was so defective he could get no adequate protection for his inventions. That gentleman, Dr. Siemens, is a naturalised Englishman; he has vastly improved many of our manufactures, and he is at this time an employer of some thousands of workmen, and is so in manufactures which have to a great extent risen out of his inventions.

The consideration of such facts as these makes it clear to my mind that a good patent-law attracts improvements to a country which possesses it; and that, therefore, the manufactures of that country, instead of being placed at a disadvantage as compared with those of countries which have it not, are much more favourably situated.

The third charge against a patent-law is that "A patent for an invention by barring the road stops further invention."

This I say, unhesitatingly, is contrary to all experience Progress in an industry may be dormant, as it was for years in the steel trade. At last an original mind comes and makes a great improvement. After a longer or a shorter time, dependent on various circumstances, this improvement developes into commercial facts, and excites general attention. The immediate result is that a number of other ingenious men are set thinking of the special manufacture, and there follow forthwith with a large number of inventions in relation to it

It may be said, What good is this, if the invention cannot be used because the first patentee is here barring the road?

The answer is, that this inventor has not got, and the law will not give him, a patent for all modes of obtaining his end, but only for his special mode, and that all inventions of improvement which do not clash with this can be freely used. And further, that if the subsequent inventions be for improvements upon the mode of the first patentee, the practical result in nine cases out of ten is that the first patentee and the subsequent improver come to terms, and work their inventions in common.

The fourth and fifth charges are—That patents are granted for useless things, and also for things which are not new. In some instances this may be so, but who except the foolish patentee suffers? In the first place if the subject of the patent be not new, or be not useful, the patent, if not void, is voidable. In the second place no one wants to use that which is useless, and everybody may use that which is old.

The sixth charge brought against a patent-law is, "That it gives rise to expensive and difficult litigation." This, no doubt, is true, but to what extent? To ascertain the value of the fact, when considering whether or not it forms a sufficient ground for the abrogation of the law of patents, one should examine as to what proportion the litigation bears to the magnitude of the subject. As I have already pointed out, there is hardly an industry in the kingdom which does not employ in several of its branches patented processes and machines The annual value of their products must be enormous, and must form a very large percentage of the value of the total mercantile and commercial transactions of the country. It appears that rather more than 5000 actions and suits are tried and heard each year in the superior courts of common law and equity, while in those courts 18 proceedings only relating to patents are commenced, and that 8½ only out of these 18 are pursued to a primary decision: thus, notwithstanding the magnitude of the interests involved, and the alleged incentive to litigation arising out of the nature of patents, the number of proceedings initiated is only one-third of one per cent. of all other actions that are tried and heard, and the number of patent cases in which a primary decision is given are only 8½, or one sixth of one per cent.

I do not say there may not be instances where persons have been most improperly put to heavy expense in maintaining their rights against patentees by whom they have been unjustly assailed, but is not this true of every other right which is guarded by a law? Yet no one suggests that thereupon the remedy is to do away with law and the right together. Endeavours are made to amend the law, and if this cannot be done, the chance of cases of hardships is submitted to as being the price to be paid for a law which, by its general terms, is for the good, and, as a rule, contributes to that common good.

From my boyhood, until within the last year or two, certain houses at the corner of Stamford-street were shut up, and were allowed to go into decay, and to disfigure the street with their shattered windows and broken shutters, seriously affecting the value of the opposite and adjoining property. Here was a case of individual hardship upon the neighbours, but it was the result of a general law, which gave the control of the condition of houses (so long as that condition was not dangerous) to their owners, and no one suggested that because under such a law this mischief could be wrought, the law must be abolished. The law was a good law but being human, was imperfect, and might be, and in this instance was abused.

Again, we are not, even now, suffered to forget the "Claimant" and his pretensions. Here was an instance where under the operations of laws which enable a person to recover possession of an estate from which he has been displaced, a low adventurer had it in his power to harass the rightful owners of a property by years of litigation, and to put them to an expense said to amount to over a hundred thousand pounds, to say nothing of the nearly equal expense to which he has put the nation, and all this without the slightest foundation for his claims Here was a case of the grossest individual hardship, but no one dreams that because a fraudulent claim was made to an estate, the law under which such a claim could be made should be abolished, or that it would be wise to prevent the repetition of such an attempt at the cost of being without any law by which a rightful owner could recover property that was witheld from him.

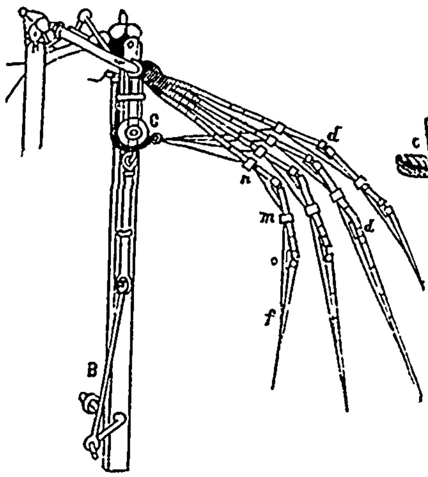
The last statement made as to the ... of patents is, "That patentees are great losers, and that it would be charity to protect them against themselves." That patentees are, taken as a whole, losers by the time and money they expend upon their inventions, is, I think, likely, but we are considering whether the community as a whole is a loser. If we are to make classes, and to divide the population into those who take our patents and those who do not, I say that the community as a whole is largely benefited. The amount received in royalties from successsul patents would, possibly, if thrown into a common fund and distributed over all the patents that are taken out, give but a very poor return to each —a return so poor that it would not be worth while for persons to take out patents if that were to be the utmost measure of their reward But surely the general public ought not to complain of this; they get all the intelligence, the invention, and the labour of patentees as a body for a confessedly inadequate remuneration; and they get it at this cheap rate because the reward is not uniform, but is varied—so varied that the high prizes are worth the efforts of the best men. Sydney Smith has told us, in his letters to Archdeacon Singleton, on the Ecclesiastical Commission, that if you wish to get the best services at the lowest rate of remuneration, you must do so by making that remuneration unequal. He says; "It seems a paradoxical statement, but the fact is that the respectability of the Church, as well as that of the Bar, is almost entirely produced by the unequal divisions of their incomes;" and he goes on to show how men of capital and of education are drawn towards both professions by the hope of the prizes, while if the total gains were evenly distributed there would be no adequate inducement to cause any man of position to enter either profession. So it is as between the great bulk of the public and the inventors; the inventors are tempted by the few prizes, and the public thus get their invention as a whole at the cheapest possible rate.

The public, as I have said, are benefited, the national revenue is benefited, for the State gets as much as 90,000*l*. per annum from patent fees, and the inventors are contented; if they do not get solid gains, they live in hope, and I think it is not too much to ask, that so far as their interests are concerned, it will be time enough to do away with a patent law and their hopes together, when the inventors as a body come forward and demand the destruction of both.

I will say no more in support of my two propositions. The first that in the absence of a patent law there would be no adequate incentive to the continuance of invention. The second, that the patent law is unaccompanied by any evils such as would justify its abrogation.

I may be asked, if these propositions be true, why is it that the question of the withdrawal of protection for inventions is from time to time brought forward, while it is rare to find a paper written to express satisfaction with the existing state of things?

In answer to such questions, I would say, "Contented men don't discuss," "people don't run about proclaiming their content" It is the man desirous of change who makes himself heard; and further, I would ask, who are these men desirous of change? Not the inventors, that is clear, and I will undertake to say not (with very few exceptions) the manufacturers Who are they, then? They are generally men who (with the best possible intentions) occupy their leisure in schemes for the improvement of society. Able men, honest men, and men capable, as a rule, of arriving at just conclusions when reasoning from sound premises. But it behoves such men to be extremely careful The very position and ability that enable them to do much good when they are right, make it inevitable that they do infinite harm when they are wrong,



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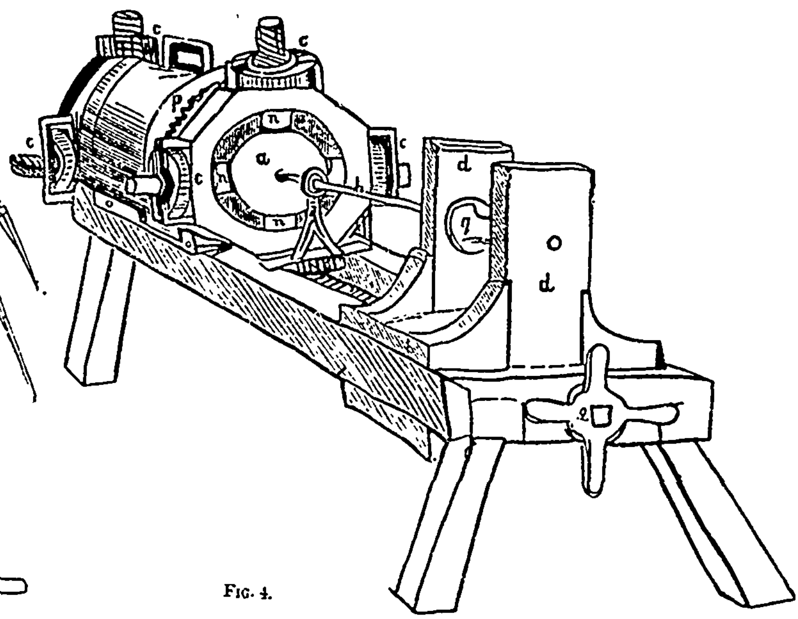

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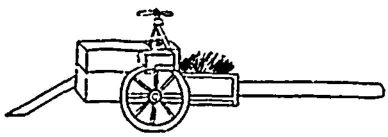

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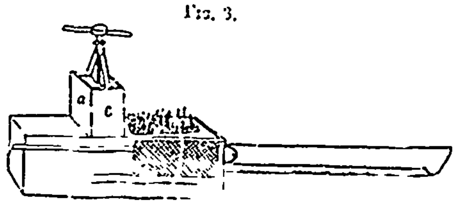

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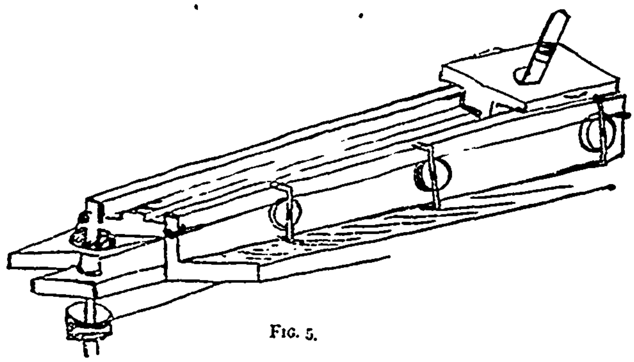

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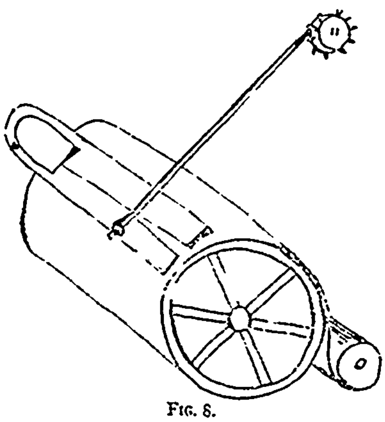

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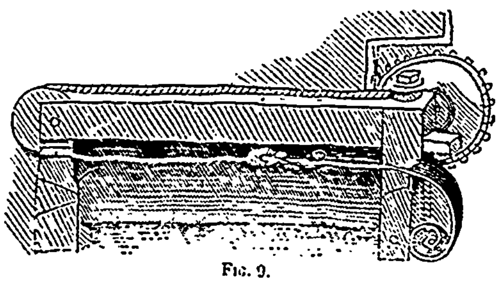

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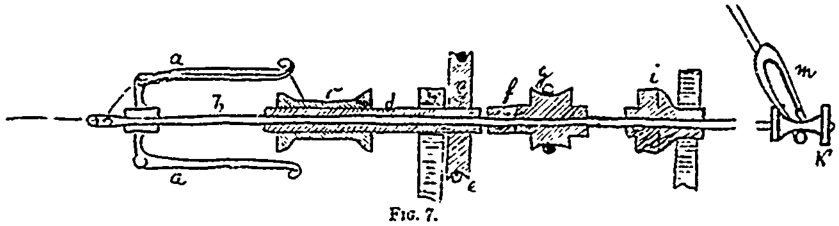
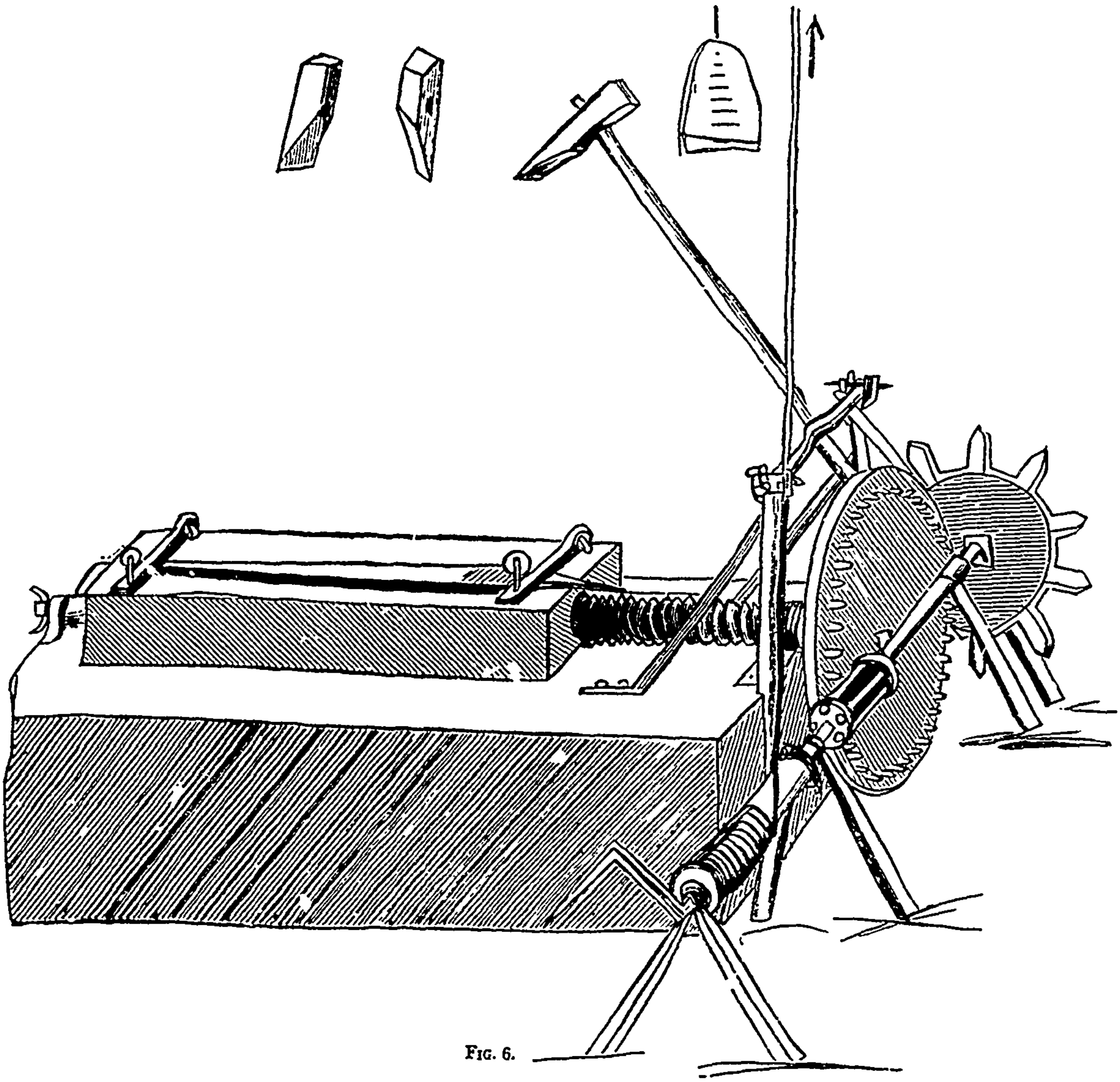


Fig. 7.

LEONARDO DA VINCI AS A MECHANICIAN. (See page 134.)



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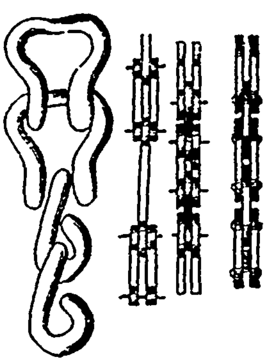

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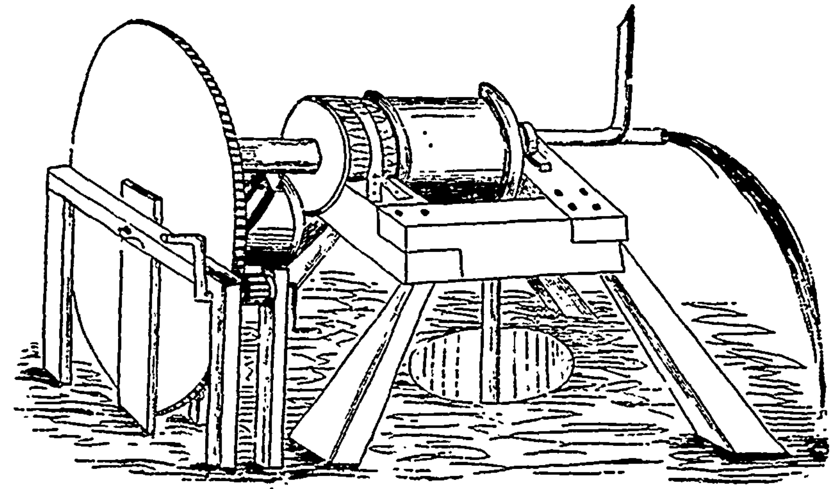


Fig. 11.

LEONARDO DA VINCI AS A MECHANICIAN. (See page 134.)

and they are wrong if they rest their arguments upon inadequate information; and I believe it to be extremely difficult for them to obtain the necessary data, for, as I have said, they are neither inventors nor manufacturers, and therefore have not that thorough acquaintance with the manner in which, in actual practice, inventions are originated and developed, and with the manner in which such inventions are incorporated into commercial pursuits, that should be possessed by those who undertake to be our guides in the subject of protection for invention.

In the absence of this knowledge, the very best reasoning must lead to erroneous results.

I have attended the reading of many papers adverse to the continuance of the patent law, but I never yet heard one of a practical character, and I never yet knew the writer of one of these adverse papers able to answer the arguments which were brought forward, in the discussions that ensued, by speakers possessed of competent knowledge.

The conclusions of such writers as I have described have very great weight with certain sections of the public, who are not at the pains to investigate the hollowness of the foundations upon which these conclusions are based. But I trust that the members of the Legislature upon whom devolves the serious responsibility of determining whether or not protection for invention shall be continued, will examine with the greatest care into the true state of the case, and will not lightly, to satisfy the most unwise desires of the few, determine that there shall no longer be protection for inventions. Should they unhappily take this course, my firm belief is — and I say it with the utmost earnestness — that the result would be, first the stoppage of all substantive improvement in the manufactures of this country, and then year by year, the gradual falling back of its position among the nations, deprived as it would be not only of the foreign inventive talent which now so readily seeks development here, but deprived also of the talent of the most ingenious of our fellow-subjects, who would be driven to foreign shores to find that reward for their skill which they could no longer obtain in their native land.

I believe also the very best of our artisan class would feel that, by the abrogation of the patent law they had lost the most legitimate source of aid which they had for raising themselves in life; and hard, indeed, would be the task to persuade these men that those who withdrew such protection did it for the good of the community.

And, lastly, I will ask, are we prepared to see the abolition of copyright? If not, we must retain a patent law, for depend upon it the natural sense of justice of the inhabitants of this country would never suffer so gross an anomaly as this, that while the inventor of a machine, which he had perfected by anxious thought and large expenditure, was to have no protection, the describer of that machine in a book was to have, gratuitously, a protection not only in his own land, but, by the operation of international law, in nearly all the civilized countries in the world.

A Maryland inventor has patented a grain sampler, which is described as follows: It consists of a metal cylinder, provided on the sides with wings or flanges, closed and pointed at the end, and containing three openings; within it is a hollow spindle or shaft which has a circumferential movement in it, and is furnished with openings of a corresponding size, which when brought into the same relative positions, afford means of communication with the interior of the spindle or shaft. There is also a handle, by means of which the spindle can be turned and the openings easily opened and closed. The condition of grain at various depths and positions in the holds of vessels, elevators and other places where grain is stored in bulk, can be positively determined, and the apparatus produces at each withdrawal a sample which cannot possibly become mixed with other matter through which it is moved as it is brought to the surface.

On page 300 is a view of the colossal memorial of the Mont Cenis Tunnel, to be placed in Turin. It represents the Genius of Modern Science standing on a huge rock, while beneath him are the Titans he has overcome. The Titans are three or four time as large as life size, and the whole is about thirty metres in height.

LEONARDO DA VINCI AS A MECHANICIAN.

The name of Leonardo da Vinci is so inseparably connected with the painting of the Last Supper, that it is difficult to think of him as anything besides a great artist. Not that his labours in the field of science and military engineering are altogether unknown, but his eminence as a painter has thrown them entirely into the shade. With regard to his mechanical efforts they have indeed been the subject of passing reference by his numerous biographers, but never until now have they received anything like justice, and this at the hands of Dr. Hermann Grothe a well-known German writer on mechanical subjects. In the preparation of this article we have made free use of Dr. Grothe's book and of the fac-similes with which it is illustrated The work is based on an examination of Leonardo's manuscripts, but to trace their history in detail would lead us too far from our subject, and it will be sufficient if we give a slight sketch of the extraordinary vicissitudes which they have undergone Leonardo da Vinci died in 1519, bequeathing his papers and drawings to his friend Francesco da Melzo, by a descendant of whom they were given to one J. A. Mazenta This Horace da Melzo, being of a very liberal disposition, was in the habit of yielding to the importunities of his friends and permitting them to make selections from the papers. The most successful and shameless of these friends was P. Aretin, son (or perhaps we had better say nephew) of Cardinal Leoni, and an artist at the Court of Philip II. at the Escurial. Aretin formed a collection of 392 leaves, which in 1637 found its way into the Ambrosian Library, at Milan, where it now is. Howard, Earl of Arundel, made an attempt to purchase this Codex Atlanticus, as it is now called, and offered 60,000 francs on behalf of the king, but Arconati, in whose possession it was at the time, refused the tempting offer. The other portions of Leonardo's papers are scattered about, some being in the British Museum, some at Florence, some in the library of the Institute at Paris, a few at Vienna, and, we think that the Royal Library at Windsor, also possesses some examples. It is, however, with the Codex Atlanticus of the Ambrosian Library, that we have to do; but we may here express the hope that before long steps may be taken to have that extraordinary collection carefully photo-lithographed, and the notes translated. A translation is the more necessary, as the calligraphy of the period is not very easy to read, and Leonardo had a habit of writing backwards, or from right to left. This affectation of secrecy was not at all uncommon, and we find Dr. Hooke, at a very much later period, doing the same thing in his "Cutlerian Lectures," where he hides his discoveries under anagrams, the key to which he only gives later on.

Biographers have done ample justice to Leonardo as an artist, and the family to which he belonged has been the subject of more than one minute and exhaustive book. Although as we have already observed, several scattered notices of his labours in the department of physical and mechanical science are to be found in writers of the 17th and 18th centuries, it was not until Venturi published his *Essai sur les Ouvrages Physico-mathématiques de Leonardo da Vinci* in the year 1797, that formal attention was called to them The book was founded on the manuscripts in the library of the Institute at Paris, whither they were removed from Milan after the taking of that city by the French in 1796. As the title indicates, the book was confined to a discussion of Leonardo's physical and mathematical labours, and it threw an entirely new light on the condition of science in that period. The universality of Leonardo's genius seems to have forcibly impressed the mind of Hallam, who, in his "Introduction to the Literature of Europe," says that his discoveries "are more like revelations of physical truths vouchsafed to a single mind, than the superstructure of its reasoning upon any established basis. The discoveries which made Galileo, and Kepler, and Maestlin, and Maurolicus, and Castelli, and other names illustrious, the system of Copernicus, the very theories of recent geologers, are anticipated by Da Vinci, within the compass of a few pages, not perhaps in the most precise language, or on the most conclusive reasoning, but so as to strike us with something like the awe of preternatural knowledge. In an age of so much dogmatism, he first laid down the grand principle of Bacon, that experiment and observation must be the guides to just theory in the investigation of nature. If any doubt could be harboured, not as to the right of Leonardo da Vinci to stand as the first name of the fifteenth century, which is beyond all doubt, but as to his originality in so many discoveries, which probably no one man, especially in such circumstances has ever made, it must be on an hypothesis, not very unteanble, that some parts of physical science had already attained a height which mere books do not record." These remarks were suggested by Venturi's book already alluded to.

Having premised thus much, we shall take Dr. Grothe for our guide, and endeavour to give an idea of Leonardo's mechanical knowledge. If we confine ourselves to this side of his character it is not for want of material, for separate essays might easily be written upon the great artist as an astronomer, as a mathematician, as a civil and military engineer, and even as a geologist The illustrations are given in the same order as they occur in the original.

Aerial Navigation.—The laws of flight appear to have been a very favourite study with Leonardo and it is related that he was in the habit of purchasing birds in order to restore them to liberty, watching their movements as they flew away His knowledge of the anatomy of the bird was very complete, and the Codex Atlanticus, as well as the collections of sketches in London and Paris, abound with drawings on the subject. Fig. 1, page 132, shows his idea of an artificial hand, in which the various bones and muscles are reproduced. Clothed with feathers, as he suggests, this becomes a species of wing. The invention of the parachute has hitherto been attributed to Le Normand, whose experiments date from November, 1783. The idea was claimed for Montgolfier, but Le Normand makes a *réclamation* in the *Annales de Chimie*, vol. xxxvi., page 94, where the merit of the invention is unreservedly awarded to him. Dr. Grothe shows, however, that Le Normand had been anticipated nearly three centuries previously.

The Steam Gun.—The engravings, Figs. 2 and 3, represent the *Architronito*, as Leonardo calls it, which consists of a chamber heated by a fire into which a portion of water is permitted to flow. The water being suddenly converted into steam discharges the ball from the barrel with great force It appears from the description that the steam gun went beyond mere suggestion and that an apparatus of the kind was actually made.

Boring Mills.—Without going so far as to assert that machines of this kind were unknown before Leonardo da Vinci's time, we may say with safety that his sketch (Fig. 4) gives evidence that the mechanical arts were very considerably advanced at that period The log of wood to be bored (marked *a* in the drawing), is held in a long hollow chuck furnished with four jaws *n* which are moved simultaneously towards the centre by screws. It would seem that this simultaneous action is brought about by the toothed wheel *p* taking into the toothed nuts *c*, and if we rightly interpret the sketch there is a similar arrangement at the further end of the apparatus, so that the log of wood, previously rounded, cannot fail to be chucked in a perfectly central position; *b* is the boring bar carrying the tool, and *q* we assume is a pulley by which it is rotated. The chuck carrying the log is mounted on a saddle and is moved up to the tool along the bed of the machine by means of a screw on the extremity of which is fixed the handle *g*.

Skew Bevel Wheels.—The many interesting examples of gearing of different forms published in the work of Dr Grothe, indubitably prove that skew bevel wheels are more ancient than is generally supposed

Planing Machine.—It must be admitted that the sketch, Fig. 5, has not a very promising appearance, from a practical point of view at all events. It is, however, sufficient to show that the idea of moving a plane by mechanical means was not unknown to Leonardo.

File-cutting Machine.—The machine shown in Fig 6 on page 133, is actuated by a descending weight, the height of fall being regulated according to the length of the file to be cut. The blank is fixed on a bed, which is driven by a screw having at one end a crown wheel actuated by a lantern pinion. The pinion is driven by the falling weight, and the hammer (which apparently falls by its own weight) is raised by a wheel having wipers or teeth arranged round its circumference. The hammer is fixed to a cross bar pivoted at the extremities of two uprights, but the exact mode of raising it is not shown, the mechanism being hidden by the large crown wheel. It will be noticed that the motion of the bed carrying the file blank is continuous, which, in theory, it ought not to be, as the bed should be stationary during the instant that the cut is being made. It is, however, an extremely interesting example of the mechanical genius of the great painter, and is in all probability the earliest machine of the kind Hitherto the credit of the invention has been given to Du Verger, who devised an apparatus for this purpose in 1699 (see *Machines Approuvées par l'Academie des Sciences, tome i., page* 155) It is probable, however, that something had been done in the interval, for Du Verger does not claim the general idea of cutting files by machinery, but describes his invention as a machine for cutting four files simultaneously.

Spinning Machinery.—Italy having been for centuries the home of the silk manufacture, it is not at all surprising that Leonardo's attention should have been directed to machinery of this kind. Accordingly we find an extremely interesting example of the throstle, absolutely perfect in all its details In the sketch, Fig. 7, *a a* represents the flyer, *b* the spindle, *c* the spool, *d* the hollow shaft for driving it, and *e* the pulley by which motion is given to the shaft carrying the spool; *q* represents the pulley for actuating the flyer which is moved up and down by the fork *m*, for the purpose of distributing the yarn evenly on the spool; *i* is a bearing for the flyer shaft It is unfortunately not possible to say whether this was Leonardo's own invention, or whether he simply sketched what he had seen. If the former be the case, most assuredly the name of the great artist must not be omitted from future lists of inventors who have contributed to bring spinning machinery to its present high state of perfection. We have already alluded to the silk manufactures of Italy, and the romantic, yet true story of Thomas Lombe, furnishes abundant evidence of their great importance in the early part of the 17th century The earliest example of the flyer with which we are acquainted, is that given by Branca, in "La Machine," a work published at Rome in 1629. It is there shown attached to a spinning wheel, and is of a very rudimentary nature. But the example shown here is exceedingly perfect, and it will be observed that provision has been made for driving the flyer very much faster than the bobbin, the pulley *q*, which drives the former, being considerably smaller than the one which gives motion to the latter. This of course on the supposition that both pulleys are driven from the same drum.

We may mention in this place that the manuscript contains sketches of rope-making machines, which Dr. Grothe says are of very excellent design, but he unfortunately gives no *facsimiles*. There is also one of a loom which *may* be an anticipation of the Jacquard apparatus.

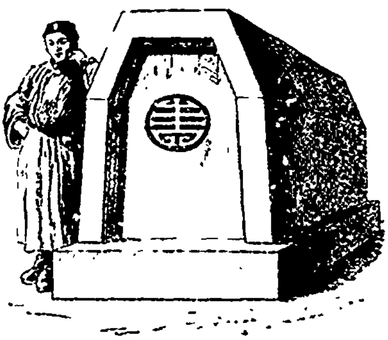
Cloth-shearing Machines.—Several forms of machines for this purpose are suggested by Leonardo, all founded on the same principles, but differing slightly in their details. In one of them the mechanism which actuates the shears is enclosed in a box, as if the inventor were afraid of pirates In the one which we select for illustration (Fig 8), the cloth to be operated upon is passed round a large cylinder underneath a pair of ordinary shears, one blade of which is fixed, the other being moved to and fro by means of a lever actuated by a ratchet wheel. It would appear that the shears in their normal position are closed, but being opened by the ratchet wheel are suddenly released, the shearing operation being effected solely by the elasticity of the spring Considering the importance of the cloth trade in Italy at this period, Dr. Grothe thinks that there is every probability that machines on this principle were absolutely constructed and came into common use.

Washing Machine.—Dr. Grothe also illustrates by a *facsimile* sketch a washing machine with two rolls. The contrivance appears to have had the special approbation of the great artist, for he has written against it the word "Bono."

Drawbench for Metal Strips.—This contrivance was figured by Alcan (" Bulletin de la Société d'Encouragement, 1864, page 284), as a continuous machine for shearing cloth, and, as such, it attracted a good deal of notice at the time. There seems, however, no reason to doubt that it is what we have stated, although it must be confessed that the details are by no means clear. The strip of metal, being seized by the pincers, is drawn through the die by the rope or chain, which passes over a pulley at the opposite end of the machine, and is then led back to another pulley actuated by the toothed wheel. There is no reason to limit this machine, as Dr Grothe does, to the purpose of drawing " springs," but it may be described in general terms as a drawbench. It is quite obvious, we think, that the substance which is being operated upon is not cloth, which no artist would depict as falling in

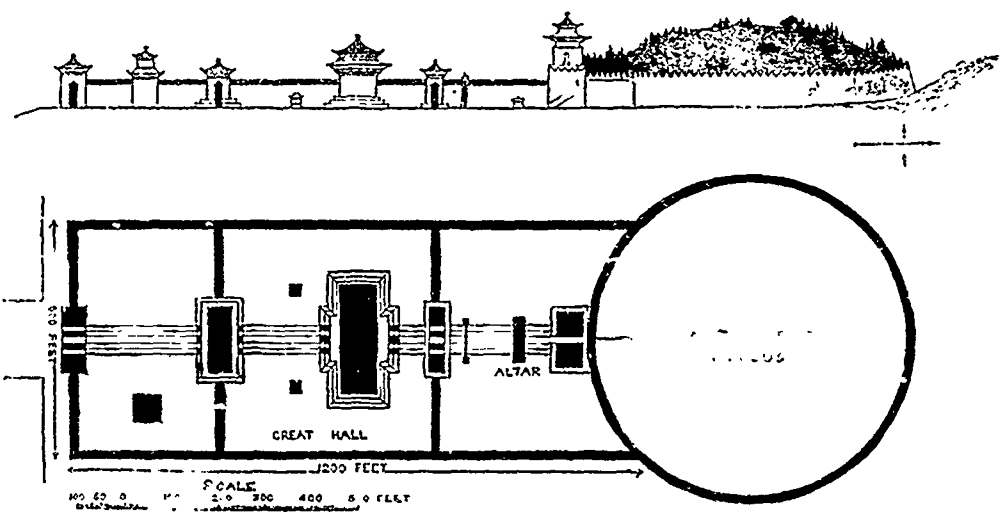
MEMORIAL MONUMENT OF THE MONT CENIS TUNNEL AT TURIN.

GRAVES NEAR SHANGHAI



CHINESE COFFIN

GRAVES ON THE PEIHO



CHINESE FUNERAL CUSTOMS. (See page 138.)

the manner shown in the sketch, Fig. 9. It is obviously elastic, and has had a slight curl imparted to it, presumably by having been passed once or twice through the dies. The art of drawing wire is supposed to date back to the fourteenth century, long anterior to Leonardo's time.

Chains.—The ordinary pitch-chain, Vaucanson's chain, or the *Chaine de Galle* as the French call it, is figured in Leonardo's book, as shown in Fig. 10.

Pumps.—A very interesting form of pump is shown in the sketch, Fig. 11. The cylinder is fixed horizontally on a framework by means of an iron strap, the portion round which the strap passes being apparently scored to prevent slipping. A valve, opening upwards, is shown at the top of the supply pipe, and the piston being solid, we assume that there is another valve in the delivery pipe opening outwards, that is, towards the right-hand side of the cut. On the piston rod is a projection which takes into a spiral groove cut on the surface of a drum. This drum is rotated by means of the wheel and pinion shown, and an alternating motion is thus given to the piston. The delivery pipe may be directed upwards, or may discharge the water horizontally as shown in the sketch

In taking leave of this interesting work we must observe that we have only made a selection of those machines and contrivances which appear to us to be most striking. Some of Leonardo's sketches are obscure, and we are not always able to accept Dr. Grothe's interpretation of them. Some, on the other hand, might well have been omitted as wanting in interest. We refer more particularly to the sketches of gearing of various kinds, which appear to us to have been the production of idle moments, and are not in all cases theoretically correct. Our intentions, however, are not critical, and we are doing Dr. Grothe no more than justice when we say that to him belongs the honour of having contributed an unwritten chapter to the history of the mechanical arts.

CHINESE FUNERAL CUSTOMS.

Among the different modes of marking the resting places of the dead, mound-building seems to have been the most universal. The mounds which still exist in America are all that remain to us of a long departed race, and judging from the size and extent of some these it must have been a numerous and fairly civilized people. Mounds of this description are even now built in that mother country China. An illustration of one of these tombs, that of the Ming dynasty will be found on page 137. The mound, in this case is more than half a mile in circumference and is planted with pine trees. Beside the mound there is an oblong space about 1,200 ft. by 500 ft., enclosed by a high wall. Inside of this enclosure is a series of buildings where the reigning Emperors perform ceremonies in honor of their ancestors One of the most singular facts connected with Chinese burial customs is that cemeteries are not consecrated or enclosed; graves are found scattered over the face of the country, beside the roads and in the fields. The precise form of these mounds when new may be seen by the drawing at the top of page 137. It is formed of a square platform of earth, and a circular cone of the same material is raised upon this. The square and the circle represent the Yin and the Yang, or Earth and Heaven; the whole forming part of the Chinese system of geomancy, and being allied to the mysterious Fung-Shuie. There is no enclosure with halls, temples, or altars at these graves, such as at the Imperial tombs; but on the ground when the sketch was made there were the ashes of some burnt oblation which had been recently made, telling that ceremonies had been performed.

In the twelve years immediately preceding the completion of the drainage and water supply system of Salisbury, England, the yearly mortality amounted to 27 per 1,000. During the twelve years following the mortality fell to 20 per 1,000, and during the last three years it was only 17 per 1,000. During the latter period typhoid fever was almost unknown, and the cholera, which in 1849, or before these changes had been made, was fatal in nearly two hundred cases, was fatal in only fourteen cases in 1854, the time at which the works were under completion In 1866 there was not a single case in the town.

AUTOGENOUS SOLDERING.

The term autogenous in connection with the process of soldering is strictly applicable to those instances only where the pieces to be joined are united by means of the same kind of metal, and more strictly still in those cases only where the joint is made by melting the surfaces or edges of the pieces to be united. In shop parlance this is known as "burning," an operation requiring no little skill, but when satisfactorily accomplished affording a better joint than can be obtained by the use of alloys, and indeed in some cases the only joint that is practically useful The term autogenous is, however, applied to a process of soldering in which metals are united by melting the lead or other alloys along the seams by means of the flame of hydrogen, or of that obtained by the combustion of a mixture of hydrogen and common air. The correct or incorrect application of the term is of little moment, as the use of the expression "burning" has become so general and well understood amongst mechanics, that its use in connection with the operation of joining metals is scarcely likely to be misunderstood.

The first and most important use of burning is in the construction of vessels for holding acid or corrosive liquids, which would attack one of the ingredients of ordinary solders; as for instance the leaden vessels, tanks, and chambers employed at chemical works. In vessels subjected to considerable changes of temperature, alloys are frequently of little use in constructing joints, owing to the difference in the amount of their expansion and that of the metals to which they are attached; and in other cases they set up a galvanic action, which more or less speedily destroys the more oxidizable metal. Autogenous soldering is also employed for the sake of appearance in pewterer's and plumber's work—especially in the former, in which if solder were employed, the joints of angles and the seams would become too apparent to the eye. Burning is also resorted to remedy defects in castings, and in various jobs in which solder is either inapplicable or objectionable.

The simplest method of burning is that adopted in the manufacture of leaden tubs, tanks, and other vessels, the success of the operation depending more upon the quantity and state of the materials than upon the skill of the workman. Thus if a round or square tank is required, a piece of the sheet-lead sufficient in size to form the sides and ends of the tank, or the hoop, if a round one, is bent into shape, the overlapping ends being secured by a few touches of solder or a few nails, driven from the inside, so as to keep the overlapping edges perfectly close. On the outside of the joint a piece of stout brown paper is pasted, so as to cover the whole of the joint. The hoop, or parts to be joined, are then turned downwards on to the casting floor, and moulding sand of good quality packed over the joint to about 5 or 6in. in depth, a piece of wood about ¾in thick being placed over the junction of the edges, while the sand is being rammed together. This wood is to form the runner or channel for the molten metal, and must be slightly longer than the joint to be made, so that it can be drawn out lengthways. The sand being tolerably firm, cut down to the wood, with a trowel, forming a sort of V-shaped groove along nearly the whole length of the intended joint, leaving a few inches of the wood buried at one end, which is also to be completely stopped. When the wood is drawn out, which is the next operation, the other end of the "runner" is to be stopped up to a greater or lesser height, according to the thickness of the metal: about an inch is usually sufficient. It will be understood that we have here, as it were, a broad-mouthed ditch in the sand, stopped at one end, and with a "bar" 1in. deep at the other; and at the bottom are the over lapping edges of the lead that is to be joined. A quantity of lead is then melted in a furnace, and brought to a heat sufficient to melt the two edges in the metal to be joined. Everything being in readiness a small quantity of rosin is dusted along the intended joint at the bottom of the runner, and a bay formed to catch the overflow of metal The latter is then poured in steadily but quickly, giving it as much fall as possible, and keeping up the supply till by means of a trying stick it is known that the cold metal of the edges has been melted. The overflow end is then stopped up, and more metal poured in, the molten lead being kept ready to fill up as shrinkage shows itself. When set, the sand is removed, and the "runner," or the remains of the metal poured on the joint, is cut off with a chisel and mallet, and the surface finished off with a scratch-brush or wire card. The paper that was pasted over the outside will have fallen off, and will be seen to have left a smooth surface, in which no trace of a join is visible It will be seen that the secret of success lies in having a good bed of sand, plenty of hot metal, and careful attention to the shrinkage. The bottom of the tub or tank is put in by a similar process. The hoop or sides, when the tank is not too deep, being completely sunk in a hole in the casting-shop, is filled up with sand inside and out. The sand is then removed from the inside to a depth equal to the thickness required in the bottom of the tank, and smoothed over well with the trowel The sand outside the tank must be rammed hard, and a bay left all round to take the overflow. As before, rosin is sprinkled over the edge of the metal, and the melting-furnace brought close to the work. When the metal is as hot as possible, two or more men take a ladleful and pour along the edge, and when the latter is melted the molten metal is poured in until it is up to and running over the level of the outside sand all round. The dross is then skimmed off and the metal left to cool, as it shrinks equally all over and requires no further attention. It is obvious that instead of making the bottom by pouring on molten metal, a piece of the required size can be cut of thinner sheet lead, and placed on the top of the inside sand, but we believe the majority of experienced workmen prefer the first mentioned method of burning in a bottom. If the article is of considerable size, however, it is necessary to have more than one workman, as the metal must be poured on as quickly as possible.

This method of lead-burning is, it will be seen, considerably troublesome, and is rarely used except when the lead is too thick to be melted conveniently by means of the blowpipe, or the oxy-hydrogen flame. The latter is, however, always used when possible by those who can accomplish the operation, which requires a much greater degree of skill than the process of lead-burning we have described above. The edges to be joined should be scraped clean, and be dusted with rosin. A piece of lead is then laid along the intended joint, and the flame brought to bear upon it. In many cases the skilful lead-burner omits the strip of lead, and obtains a joint by fusing the two edges to be united, but it is only the skilful workman who can accomplish this, as, especially in thin lead, the edges as they approach fusion are apt to run away from one another instead of coalescing. It is always best to use the covering strip of lead, because it is easy to remove superfluous metal from the joint, and failure in the other process involves loss of time. In either case it is only by practice that the amateur or tyro can hope to succeed.

Similar processes are applicable in the case of the other metals. Thus brass may be burned together, by placing the parts to be joined in a sand mould, and pouring a quantity of molten brass on them, afterwards reducing the parts by means of the file, &c., to proper dimensions. The sine quâ non is plenty of molten metal, made a trifle hotter than usual. Pewter is generally "burned" by the blowpipe or a very hot copper-bit. In angles and where it is bent over sharp corners and in seams, one edge is allowed to stand over the surface of the other, and a strip of the same metal is then laid along the intended junction. This joint is then burned, as mentioned, by melting the surfaces and edges by means of a blow-pipe or the hot soldering-iron, and the superfluous metal is filed off, leaving the joint of at an angle, looking as if it had been made out of the solid. The principle of the process is the same whatever be the mode, in which it is performed, and when hot metal is used as the sole agent of heat, it is necessary to have plenty of it, and to see that the parts to be joined are clean It is scarcely necessary to say that the autogenous method is the only proper method of remedying defects in castings, and notwithstanding the trouble attached to it, should always be attempted with all metals for which it is applicable, and all articles in which it is possible. We do not suppose that trifling defects in iron castings will be remedied by this means, though there is no very great difficulty in accomplishing it, as flanges are often burned on to pipes and wheels, but with the more costly or easily worked metals, the practice of this process would be attended with advantage

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The Huntington Copper and Sulphur Mining Company, in Shefford, Quebec, gives some indication of activity in purchasing lately 9,000 cords of firewood for smelting purposes.

GRINDING EDGE-TOOLS.

Perhaps there is no operation which is apparently so simple as this · and yet as it is one on which a great deal of the beauty and exactitude of the work depends, it is really of considerable importance. Supposing the grindstone to run perfectly true (without which no tool can be properly ground), and that its surface be neither round nor hollow, the first difficulty the beginner will encounter will be to maintain the face of the tool against the grindstone in such a manner as to insure the production of a flat or slightly concave face. To produce this effectually, the handle of the tool should be held in the right hand, while the fingers of the left hand should press on the upper surface of the tool, just over the level to be produced Care must also be taken that the edges of the tool should be formed perfectly square to its sides, especially in the case of plane irons, &c To prevent depressions forming in the stone, the tool should be carried with a gradual motion, from one side to the other whi[illegible] grinding. Non-attention to this rule will soon score and ru[illegible] the finest grindstone; so it is better when gouges and other [illegible]rved tools have to be ground, to devote a separate stone entirely to this purpose, as a scored stone, or one with hollows, is useless for the production of a straight edge such as it is required for plane-irons, chisels, &c. All tools which require to be "se[illegible]" after grinding may be ground on a stone the upper part of which revolves *away* from the operator, but care must be taken not to carry on the grinding until it reaches quite to the cutting edge, or else a wire edge is formed, which is removed with considerable difficulty. The fine touches are then given on the oil-stone. Of course this cannot be done if the edge has been notched or requires altering in shape.

In such a case, as also in grinding tools for metal work, in which the edge is formed entirely on the grindstone, this latter must revolve so that the upper part comes towards the operator, and considerable care will now be required to prevent the tool catching and injuring either itself or the face of the stone.

To preven[illegible] the tool becoming heated, and thereby losing its temper it is usual to wet the stone continuously, either by dripping water, or by placing a trough under the lower half of the stone But in this latter case the trough should be movable, and should be removed after each grinding, for if the stone be allowed to stand in water, the immersed portion becomes softened, and consequently the stone wears away unequally. Directly the stone is untruly worn, it should be immediately attended to and ground down with an old three-cornered file. By instant attention to this point "backing" the stone may be long deferred, if not entirely avoided.

All tools having a concave cutting edge, boring tools, &c., should be ground either with a file or on a copper or iron lap, dressed with emery Consolidated emery wheels, such as are now found in commerce, will also be found of great service for grinding this species of tool

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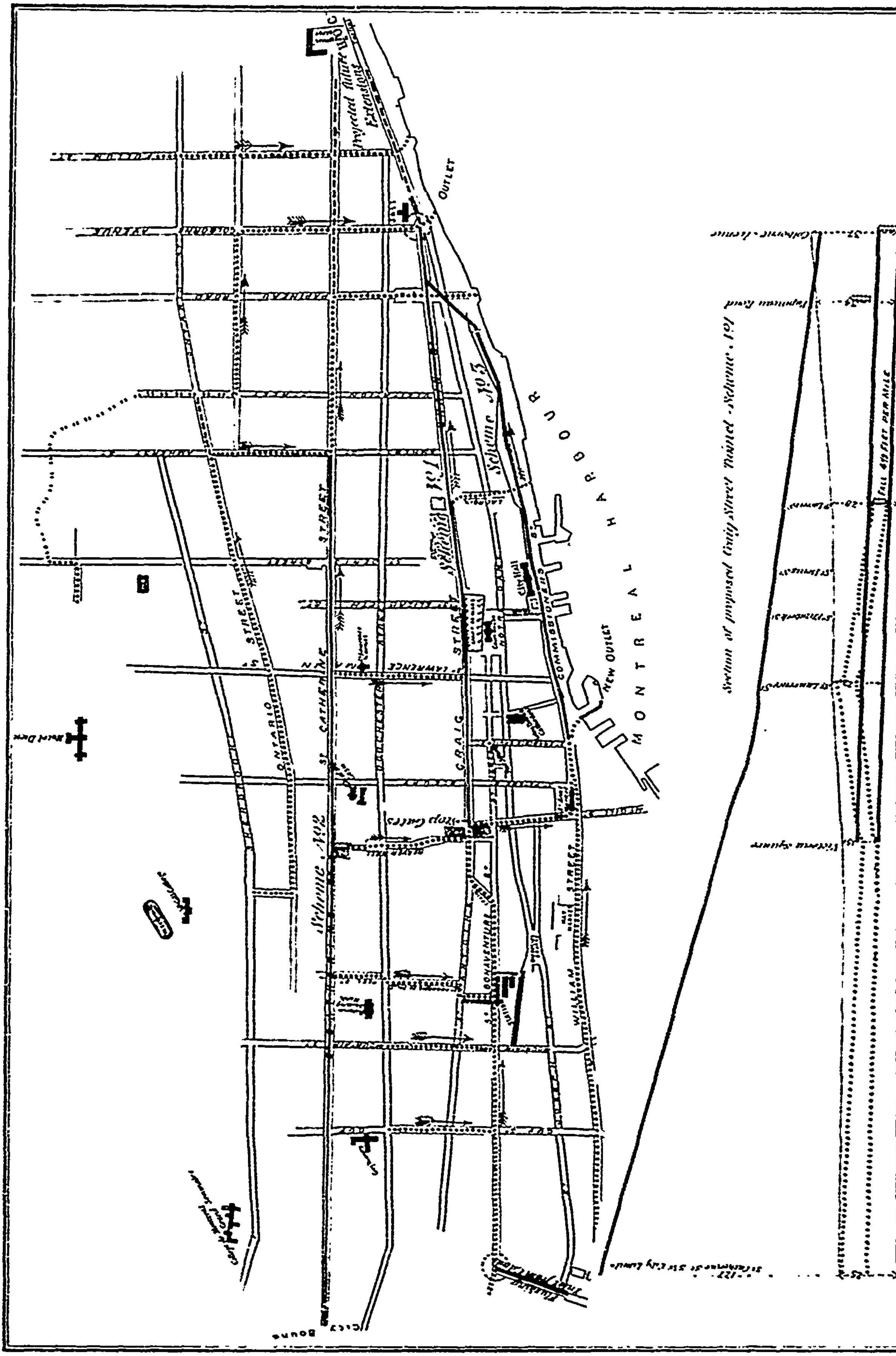
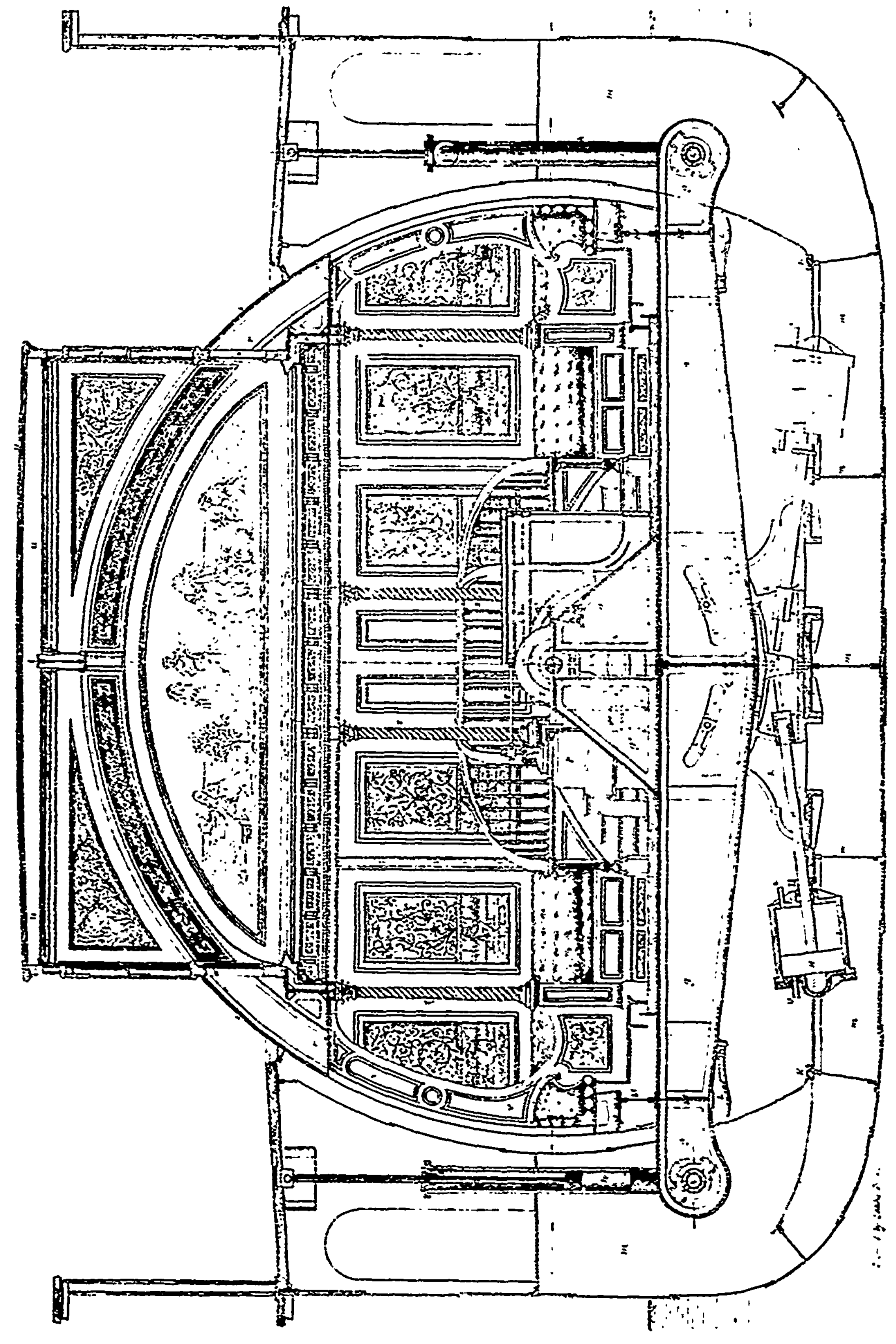
The boats for the Alert and Discovery, the arctic ships, are being rapidly completed. Their construction is somewhat peculiar. The boats are 18 in number, and include two yawls 25ft. long, and two cutters of the length of 20ft. They are built of one diagonal thickness of mahogany planking, which is paid over with a coating of marine glue and a second coating of strong linen cloth. The whole is then ironed over until the glue comes through the linen, and the boats are then said to become impervious to water. The boats are then planked over longitudinally with the best wych elm and Christiana pine. A large semicircular cork belting is placed under the waist strake, and over this strong canvas is stretched, thereby forming a capital fender for the little craft. Six of the boats, each having a length of 25ft, are modelled like whalers, having bows at both ends, and are constructed in other respects like the four already mentioned, with the exception that they have no cork fenders, but rails with hand holes all round. There are also six ice-boats, three being built as gigs, and then having a sheathing of cork over the diagonal planking, which is again covered with a layer of pine and elm. The latter are built on dead-wood, with keelson above, so that should their stems, keels, or even sternposts be destroyed by grating on the ice, the boats would not be seriously injured, but would retain their buoyancy.



SCHEMES FOR DRAINAGE, MONTREAL.



THE CHANNEL STEAMSHIP "BESSEMER," SECTION OF SWINGING SALOON.

Mechanics' Magazine.

MONTREAL, MAY, 1875.

THE WAY TO EUROPE.

The question of the rival routes to Europe is now fairly before the public and bids fair to be settled in some way before very long. The public seems to be fully alive to the importance of the question as affecting the vital interests of the Dominion, and we have just received an interesting report of a committee of the Legislature upon the subject. No one doubts for a moment the necessity of our having at any rate one port of our own readily accessible from all parts of the country, open all the year round. The point to be new settled is, which shall it be? There is no lack of good harbours, Quebec, Halifax, Paspebiac, Louisburg, Sydney—all have their advocates, but we do not yet know sufficiently well the geography of our own coasts and of our interior to be able to speak unhesitatingly of the rival claims of some of these. In the report before alluded to Halifax, Louisbourg and Paspebiac are mainly considered Taking Quebec as the point of departure the distances of these ports is as follows :—

	Water.	Land.	Total.
Via Halifax	2,466 miles.	622 miles	3,088 miles.
Via Louisburg	2,270 "	790 "	3,060 "
Via Paspebiac	2,500 "	400 "	2,900 "

Halifax and Louisburgh are thus seen to require more land carriage than Paspebiac, but then they are upon the real Atlantic coast while Paspebiac is on this side of the Gulf. It is claimed, however, that Paspebiac is easily accessible at all seasons. The Arctic ice which passes into the Gulf by the Strait of Belisle is carried against the north-east of Anticosti at a rate of half a mile an hour. The St. Lawrence ice strikes the south shore of that island with a velocity of two miles per hour, and this latter current forces back the Arctic ice towards the western shore of Newfoundland. Another current which plays an important part in this matter is the tidal current, which, entering the Gulf between Cape Breton and Cape Ray, is divided by the Magdalen islands. This current keeps back the ice from the southern part and thus keeps clear that part of the Gulf south of the islands and north of Cape Breton. If these geographical facts can be relied upon Paspebiac has great advantages over Halifax and Louisbury, the whole passage being shorter, and the land portion of it comparing still more favourably as to distance. It remains to be seen whether a railroad to Paspebiac can be advantageously constructed Those interested believe this to be the case and have obtained a charter and made preliminary surveys over the route. Again it is claimed by some that there is no necessity to go so far; but that in Quebec we have a port which by the use of suitable vessels can be kept open all the year round. The navigation of the St. Lawrence from Quebec to the Gulf is said to as feasible in winter as in summer, there is always an open channel, there are no fogs and what floating ice there is could easily be passed through by a properly equipped vessel. Mr. Sewell, of Quebec, some time since offered, aided to a certain extent by the Government, to equip a vessel and make passages during the approaching winter season. It is very probable that the scheme will have a fair trial as the Dominion Government have given Mr Sewell the contract for carrying the mails across the Strait of Northumberland during the winter months and as there are from six to eight weeks during which no vessel can cross these straits, the vessel employed will then be allowed to ply between Quebec and the Lower Ports. Still, however, one season or two will not suffice to establish a good reputation as a winter port for either Paspebiac or Quebec. Winter storms and masses of floating ice together are ugly thing to contend with and in our opinion Louisburg or Halifax will ultimately be the port decided upon, unless it should be clearly demonstrated that the geographical facts cited as to the condition of the south-western part of the Gulf are invariably to be relied on.

SCIENCE SCHOOL.

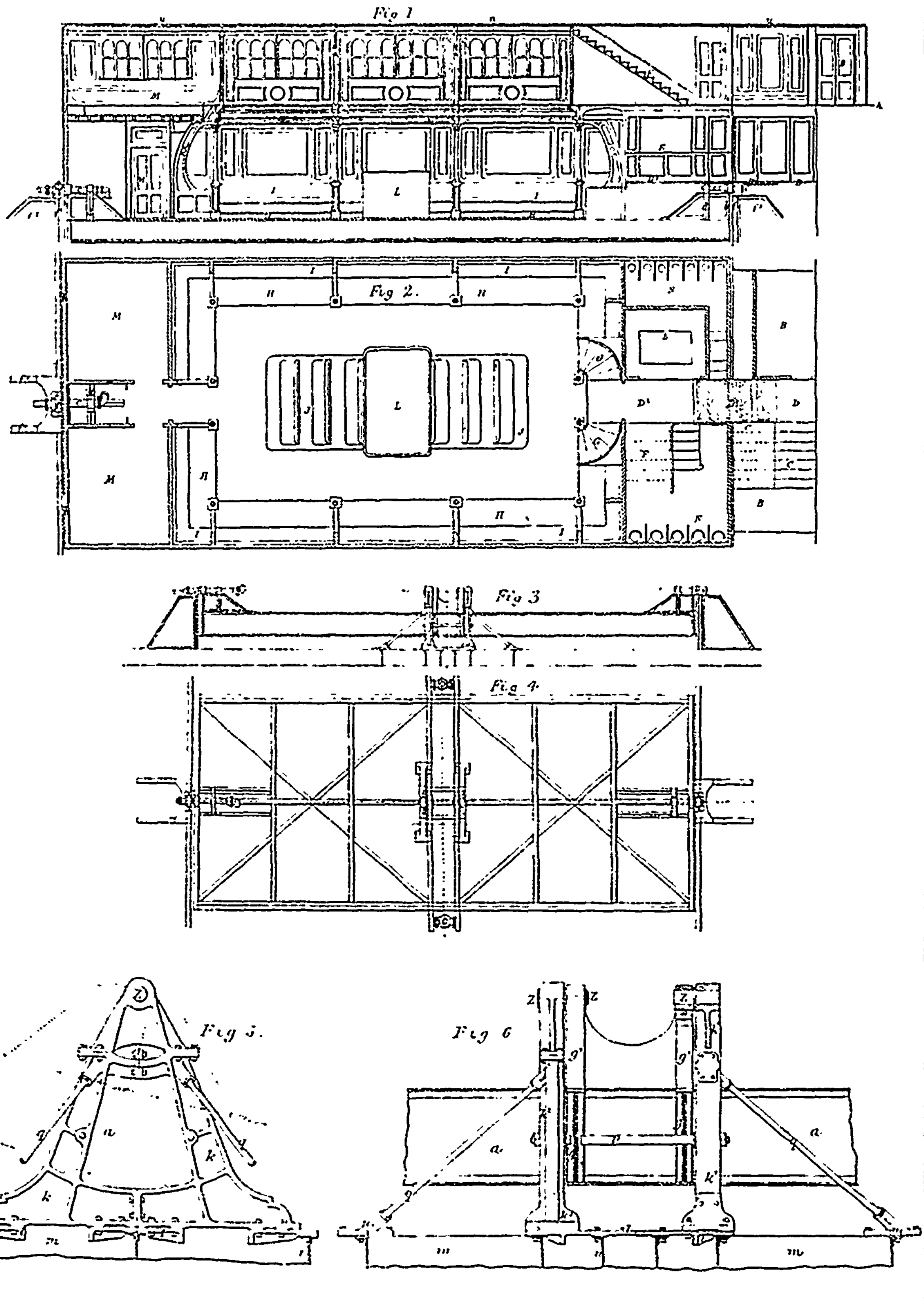
We have had much pleasure in reading the address of Prof. Armstrong at the close of the fourth session of the Department of Practical and Applied Science of McGill University. It is matter of sincere congratulation not only to those specially interested but to the public at large that Canada should possess a school in which the principles of applied science as they bear upon engineering, mining and the manufactory, are systematically taught. This department of our University, organized in the autumn of 1871, has shown steady advancement and counted last session thirty-two students It is, as the Professor says, too soon as yet to expect to see any definite result of the labours of the graduates upon the technical industry of the country. That the effect must, in no long time, be apparent is fairly argued from the condition of the industries of France and Germany. These countries were the first to establish schools of this nature and the effect produced is very clearly shown by a comparison of their products with those of Great Britain at the first Great Exhibition in 1851, and afterwards in 1862, and in 1867. At the first exhibition the British products were manifestly superior, but in the subsequent ones the continent not only had caught up, but in some respects had even surpassed the English, especially in such branches as called for the display of a knowledge of scientific principles in matters of economic arrangement and practical aptitude. It is plainly manifest then that we, in Canada cannot afford to be behind hand in such work when we consider on the one hand the rapid strides our energetic American neighbours are making in the establishment an perfecting of such schools, and on the other hand the need we have of such trained men to bear their part in the progress our country is so happily making in manufactures and in the development of her resources. Men must be had, and trained men too, and if Canadians cannot be found we shall have to go on sending for them to Europe and to the United States. There is no necessity for this, and we firmly believe that, properly supported, we shall soon have, at McGill University, a faculty of applied science as well known in America and Europe as some of its other faculties are now. Thus we shall have men who by birth and education are best fitted to take charge of our growing industries, and, knowing thoroughly the country, understand best the engineering and other problems which will constantly arise.

KING HEZEKIAH AND THE FIG.

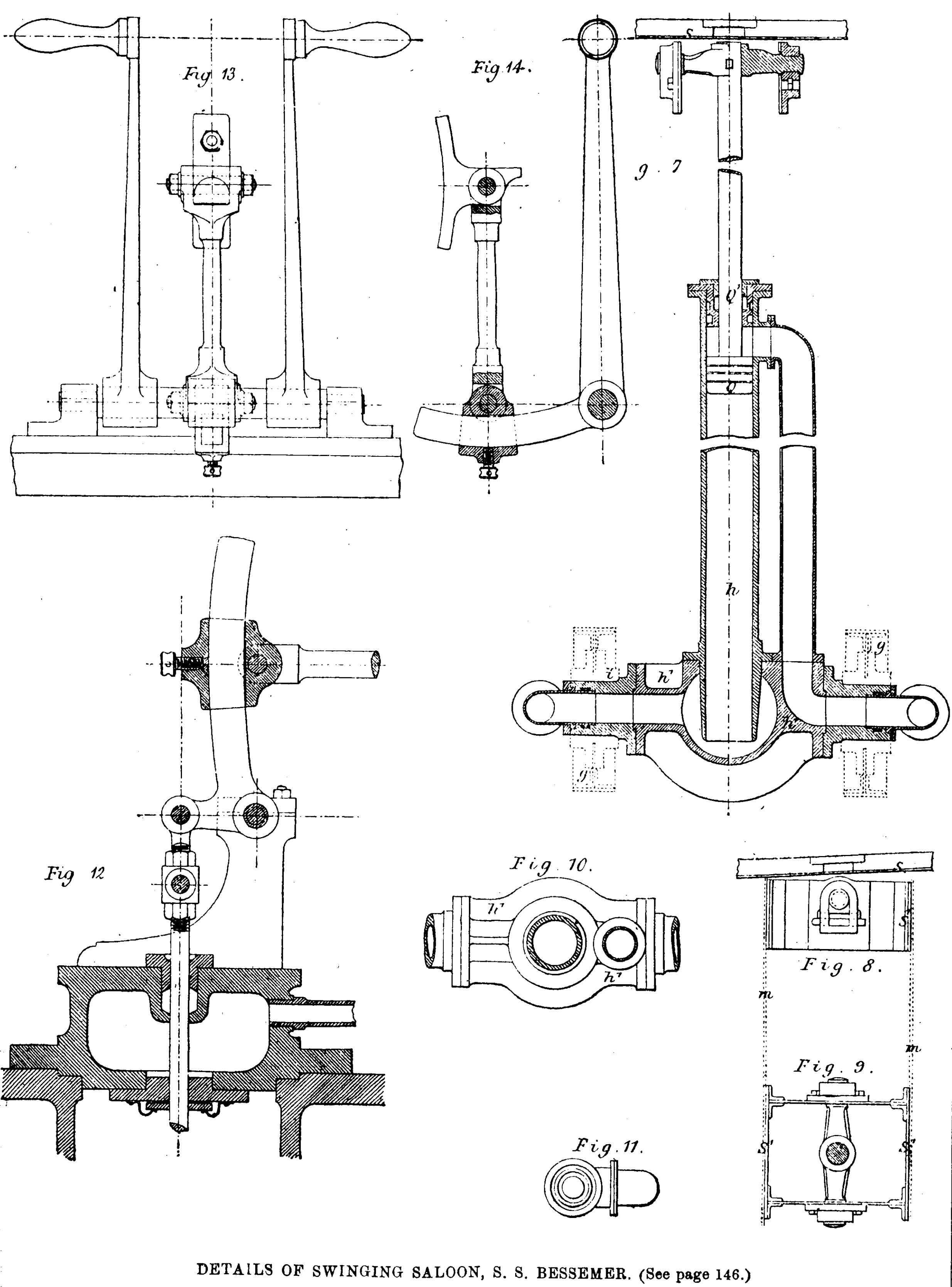
A somewhat favourite subject of discussion for debating societies has been the comparative influence on modern public opinion of the pulpit and the press. We do not intend here to offer any opinion on this subject but to call attention to a topic on which our city press and our preachers have dilated with little or no result. We allude to the unhealthiness of Montreal and to the fact that it is almost universally believed that the city drainage is a preponderating producing cause of the unusually high death-rate. The press has certainly done its duty in this matter so far as it could, and, for the pulpit, a sermon preached not long ago on king Hezekiah and the fig left an impression on our mind at least as deep and enduring as any newspaper article could do. "Fancy," said the preacher, "a beautiful city in a new country, a city situated on an island surrounded by broad and rapidly flowing rivers. The city moreover is built on land for the most part sloping towards one of these grand rivers. Behind the city is a hill which shelters it from the piercing blasts of winter and affords room for health-giving recreation at all seasons of the year. Against these beneficient provisions of nation there are no counterbalancing physical evils—no malarious or terribly scorching winds—in fact nothing that can be at all prejudicial to the bodily health of the inhabitants. And now fancy that such a city is preeminent among the cities of the world for its unhealthiness, that its death-rate is higher far than that of cities by no means so favoured as to surroundings, newness and other advantages. Something analogous there must be to the deadly boil which slowly but surely sapped the life of the Israelite king. The duty of the citizens in such a case must be to find the cause and then to apply the remedy no matter at what cost." Such was the gist of a discourse at once eloquent and practical. The facts cited by the preacher are indisputable. There is disease and there is every opportunity of removing the cause. The question is truly, as a contemporary says, one of life and death. The remedy also is by no means hidden We must have, and at once, a complete scheme of drainage suitable to the requirements of the city as it now is and one capable of adapting itself to the increasing demands which will be made upon its capacity as the city extends itself. Moreover besides the improvement and remodelling of the drainage system there are one or two other smaller evils which militate seriously against the health and prosperity of this community. Montreal is proverbially a dusty city. The very winds which carry off our harmful gases and city effluvia, clog with dust the skin and weaken the lungs of our people to an extent that must be very prejudicial to health. The limestone with which our streets are metalled pulverises readily into a most penetrating dust which abounds entirely beyond the repressive influence of water-carts. Then when the pores are thus clogged, how are the majority of our citizens to remove the obstruction to persporation? Public baths there are none, and the tax on private ones is large enough to hinder the placing of them in any houses but those occupied by people in easy circumstances. With the St. Lawrence rolling but a few hundred yards from the bathless houses, how simple a matter to place on it floating public baths similar to those in use in Europe. The cost would be but small compared with the erection of permanent buildings and the constant supply of fresh water at no cost would be infinitely preferable. So far as the drainage however is concerned we are glad to see that the civic authorities are devoting their attention to the matter in earnest. We publish on page 140 an illustration of three schemes which are now under consideration and which we find described as below in a recent number of the *Canadian Illustrated News*.

"The first and most important scheme is that of remodeling the Craig Street tunnel. At present this sewer has its summit at St. Lawrence Street, whence it flows west, through Craig, McGill, and Commissioners Streets to the Elgin Basin, and east through Craig Street to beyond St. Hubert Street, where it leaves Craig Street, and passes by a tunnel under Dalhousie Square, through Lacroix Street to the river. So that the western part of this drain flows west through Craig Street to McGill, south down McGill to Commissioners, then east to Elgin Basin where it discharges. This course is roundabout, and impeded by the Bonaventure Street drain which meets it from an opposite direction at McGill Street. It is intended to change this course, in fact to continue the Bonaventure Street sewer through Craig, on a continuous, though slight down grade, not only to the present outlet at Lacroix Street, but as far as the Colborne Avenue tunnel. The head of this main sewer will then be above Fullum Street, near the Canal, whence a flushing inlet will be connected with the tunnel. Here we will have a large body of water whereby to wash out this great drain whenever required. In fact a continuous stream can flow through it at most seasons, and keep it clean. The necessity for this provision will be readily seen, when it is remembered that the total fall of sewerage from Fullum Street to summer water level at Colborne outlet is only thirteen feet, the distance being about fifteen thousand feet. It is thus seen that the average grade is less that one in a thousand feet. Flood gates at the intersection of McGill Street, will turn the stream through the latter when desired. This will give Montreal, for the first time, a natural and efficient channel for its principal drains. The next important feature to refer to is the extension of the outlet at Elgin Basin to the outer edge of the Island wharf, where a rapid current will sweep away the refuse coming from the area still left to drain into McGill and Commissioner Streets. This improvement we take to be a prime necessity. It will effectually stop the stench usually afflicting that neighbourhood, and preclude the necessity of periodical dredging hitherto experienced. Scheme No. 2 consists of a proposed intercepting sewer along St. Catharine Street, from the western city limits to Colborne Avenue. This would constitute the main artery of drainage for all the upper part of the city, and would carry off the waste and filth of all the district north of St. Catharine Street. That this improvement should also be carried out at once, can scarcely be discussed. Here, we have fortunately an ample fall, and no necessity for flushing, as no convenient canal is at hand. The elevation of St. Catharine Street at the western city limits is 127 feet above the Colborne outlet. Thence there is a gentle incline towards the east to Bleury Street, where it falls rapidly towards St. Lawrence Main Street, at which point it is still 59 feet above the outlet. Following its course to Colborne Avenue, we there find it with 35 feet of height above the water level. This drain then, properly constructed, will be an invaluable auxiliary to the city drainage, and a great boon to all the wealthy proprietors of the Mountain slopes.

"Scheme No. 3 we do not entertain. It is costly and useless —would necessitate tearing up the water side street, raising the revetment wall, and all to no purpose. Nor do we see any object at present in carrying the main outlet further down than Colborne Avenue. The difference of level of the surface



DETAILS OF SWINGING SALOON, S. S. BESSEMER. (See page 146.)



DETAILS OF SWINGING SALOON, S. S. BESSEMER. (See page 146.)

of the water in the River St. Lawrence between the outlet near the gaol and the foot of the current Ste. Marie below the Longueuil Ferry Wharf is only from three to four inches ; the distance between these points is 2,200 feet; from the latter point to Ruiss au Mig on, the fall is from 8 to 12 inches, and the distance 5,900 feet, these differences of level vary very little at any time The fall is therefore only 2 inches per 1000 feet, and of little avail.

"The total length of sewers at present constructed is estimated at 75 miles, of which ten miles are known to be wooden box drains, which should be replaced by brick or vitrified clay pipes.

The cost of the Craig street Tunnel is estimated at......	$192,200
The cost of the St. Catherine street intercepting sewer at......	136,000
Replacing wooden drains by brick or vitrified pipes.	143.190
Flushing Inlet at Fulford street, and extension at Elgin Basin......	10,000
	$481,390

"The citizens of Montreal must not hesitate These improvements are *vital*. They are a question of Life and Death. If our new Mayor, Dr. Hingston shall succeed in pushing through this gigantic, but truly indispensable drainage scheme (a portion of which has already been resolved upon under his *régime*,) he will deserve to be enshrined as one of the greatest benefactors of Montreal."

THE NEW STRONG GLASS

This improved condition of glass, the invention of M. de la Bastie, which has generally been called "tough glass," seems by no means to deserve the name as it is in reality more brittle than ordinary glass. This seems to be an anomaly for the glass is really much stronger after treatment, as evidenced by the numerous experiments which have been made upon it. It will successfully resist the impact of much heavier blows than would suffice to shatter the ordinary substance, and a thin sheet of it may be thrown from one end of a large room to the other without breaking. When, however, it does break, it goes like "the Deacon's Master-piece" all at once. The whole piece resolves itself into atoms not larger than half the size of a pea and these fragments are so shattered and internally fissured that they may be pulverized between the finger and thumb. Scientific men have here another problem proposed to them, another opportunity of enquiring into what we know so little about, the internal life of matter. The process followed in the Bastie process is simply an annealing one. The glass is heated to a high temperature and placed in a bath of mixed oils and tarry matter, also at a high temperature, and there it is allowed to cool. The process is exactly similar to that of the annealing of steel but the results are very different. The steel is at once strengthened and toughened but the glass while it is on the one hand strengthened, is, on the other hand, rendered much more brittle than before and presents us with the anomaly of a substance being at once and by one process strengthened and weakened. The molecules of glass adhere to each other much more strongly than before, but when they do yield the whole internal arrangement is upset and the mass falls to pieces. The case seems at first glance similar to that of the Prince Rupert drops but it is not really so. The drops are a skin formed on an internal mass and when the skin is scratched it yields and the drop falls to pieces. On the other hand the Bastie glass may be scratched without any such result. The subject is an extremely interesting one, and we are glad to learn that a series of experiments on it are being made which will tend to an elucidation of the apparent mystery.

Human nature seems to require something new and wonderful occasionally and does not always stop to consider whether the new wonder is anything but a wonder. Of this nature is the feat we illustrate on page 148. John Holtum, a Dane, has been astounding the citizens of the principal cities of Europe by the extraordinary feat of catching in his hands a real cannon ball fired from a real cannon. He performed the feat recently in Paris in a public hall and among the press reports of the feat was one which characterized it as a fraudulent deception. Holtum, fired at this, offered to perform the feat in an open field, to give 5,000 francs to the poor if he failed and to give 3,000 francs to any one else who should succeed in catching the ball. Parisian journalists to the number of 300 assembled to witness the performance, which to their unbounded astonishment was successfully accomplished. They saw the ball leave the gun "like a flash of lightning" and remain caught in the powerful hands of Holtum. There seems to be no deception about the thing and it remains—but to admire the ingenuity of the man in gaining such influence over the untractale materials he has to contend with—gunpowder and a heavy iron ball. His cannon was cast for him at Birmingham and cost him £300 sterling and eight months labour to bring to perfection. Complete mastery over it was not then attained until he had a finger shot off in England and his skull nearly fractured at Vienna.

THE CHANNEL STEAMSHIP "BESSEMER," DETAILS OF SWINGING SALOON.

The steamship "Bessemer" is at last completed, and waits only for a few trifling adjustments of her machinery, and the necessary preliminary trips, before she is placed upon her station to run regularly between Dover and Calais.

On the present occasion we propose to confine our attention to the machinery designed by Mr. Bessemer for this purpose, but we may first remind our readers of the general dimensions of the vessel itself. She is 350 ft. in length, and 40 ft. actual beam, although the width over all is increased to 54 ft., by the row of private cabins placed on each side of the ship between the paddle boxes The length of the deck is 270 ft., the remainder being occupied by the low projecting ends, which give the ship so peculiar an appearance. On these low decks the capstans, &c., are placed. Although so large a portion of the ship is taken up by the great swinging saloon and the engines and boilers, ample space has been left for second-class passengers, while the rows of cabins on deck, already mentioned and of which there are twenty-two, including a large smoking saloon and other first-class state rooms, provide sufficient accommodation on the fixed part of the ship, which is propelled by two independent engines and sets of boilers, the former indicating 4000 horse power collectively. These actuate two pairs of paddle wheels 30 ft. in diameter, and placed 106 ft apart. The vessel was built from the designs of Mr. E. J. Reed, but its general features were clearly defined by Mr. Bessemer in his patent of February, 1870.

The swinging saloon, which weighs 180 tons, occupies a central position in the ship, and has a total length of 70 ft., a width of 30 ft., and a height of 20 ft., the sides being curved as shown in our engraving, which is a transverse section through the centre of the saloon. Figs. 1 and 2 on page 144, are a longitudinal section of the saloon and a plan, and from these the general arrangements for the passenger accommodation will be understood. On descending the stairs C the passenger arrives at one end of the passage D. A portion of the floor of this passage is formed of oak bars, through each end of which a steel rod passes, one end of the rods resting on the fixed and the other on the moveable part of the vessel, so that the bars D' will accommodate themselves to the motion of the ship, and form a slightly inclined or spiral surface, on which the motion disappears gradually between the fixed and moving parts. The ends of the swinging saloon are almost in contact with bulkheads in the fixed portion of the ship, there being a space left of 1½ in. In this space is introduced an inflated rubber tube covered with baize, against which the ends of the saloon are in close contact, so that no moisture or draught can penetrate into the saloon. Near the end of the passage D¹ is a landing, on one side of which is a buffet E, and on the opposite side is a staircase to the promenade deck *u* on top of the saloon. The sweeping stairs G G at the end of the passage D² lead down into the saloon, around which is placed a raised dais H, with sofas at I. In the centre is an enclosed space L, within which are the equilibrium valve hand gear, &c., and the man controlling the apparatus, and on each side of this at J are other sofas, also upon a dais Ladies' private cabins are provided at M M, whilst others at N N are reserved for gentlemen, and over these apartments are situated other state rooms and smoking rooms. Throughout the whole of this portion of the vessel, evidences of the utmost care in design are apparent, even in the minutest detail. Arrangements for forcing 3000 cubic feet of air per hour and per passenger, into the saloon are provided, the air entering at the bottom, and passing out through the windows at the top. In winter the air thus introduced may be warmed, by bringing it previously into contact with a series of hot-water pipes. We believe it quite possible, that ample as are the means provided for introducing a sufficient air supply, some alteration in the mode of ventilation may be found advisable. In the retiring-rooms a different process is adopted. Air is not forced as in the saloon, but is constantly exhausted from them, in order that the current may flow from the saloon to the retiring-rooms.

The platform or floor which forms the base of the saloon consists of a framing of plate iron girders (see Figs 3 and 4); the main central girder runs the whole length of the structure, and is united at both ends to cross beams which are of considerable breadth, extending downward at their central part to the lower side of the central girder, and rising upward, as shown in Fig. 3, to the under side of the axes carrying the saloon; these are of steel, and are held firmly in place by the iron framing, while the axes rest in plummer blocks which are supported on a girder or partial bulkhead having strong brackets to resist any end thrust of the saloon. The girders *f* extend across the entire breadth of the ship and add greatly to the strength of it at this part. In addition to the end beams above mentioned there are four other cross beams, as shown in plan Fig. 4, the ends of which are rivetted to the two outer longitudinal beams which are also connected to the end beams so as to form a strong rectangular framework; through the central part of this framework there are two other cross beams *g*, which project beyond the outer longitudinal beams, as shown in Fig. 4, and to a large scale in the transverse section of the saloon shown in the engraving on page 144. These form a pair of working beams between which the trunions of the oscillating hydraulic cylinder *h* work, as shown in Fig. 7, where the trunion h_1 of the hydraulic cylinder *h* is shown fitted into brasses *i*, *i*, bolted to the web of the beam *g*, which is made with a double thickness of plate at this part to give it additional strength, a hole is made in the web, as shown in the transverse section, for the purpose of getting the trunnion h_1 in or out of place. In the middle of the girder *g* are rivetted brackets rising about 3 ft. higher than the floor, and carrying brass bearings to receive the axes on which the girders *g* oscillate, these axes being in a line with the axes *c c* at the end of the saloon (see plan Fig. 2).

The frame of the structure is further stiffened with four diagonal beams, which tend to prevent racking when hydraulic force is applied at the ends of the central beams. Smaller angle beams are employed between the intermediate cross beams, and on these the floor boards are secured, thus completing the level platform or floor of the saloon. By reference to plan Fig. 4 it will be seen that there are four points of support on which the floor moves, and as the lift and thrust of the hydraulic cylinders act on opposite sides of the floor and in the centre of its length, it is desirable that the forces applied at these two central parts should be evenly distributed throughout the floor.

The axes of the girders *g* are supported on massive cast-iron frames *k*, see Figs. 5 and 6 page 144, in which a central opening is made through which the main longitudinal girder *a* can oscillate freely. These frames are bolted to bedplates *l* securely fastened to the main framing *m* of the bottom of the ship. Four wrought-iron raking stays *q* are keyed to bosses formed on the frames *k*, their lower ends being secured in flanged shoes *n* bolted to the frame *m* of the ship. The frames *k* are steadied by means of two horizontal struts *p p* passing through bosses in the frames *k*, the slots in the girder *g* (see the transverse section) allowing the latter freedom of motion.

In Fig. 6, one of the cast-iron frames k^1 is shown in vertical section, and the other k^2 in end elevation. In Fig. 5 the frame *k* is shown in front elevation, by which it will be seen that it is composed of three castings bolted together, so that it can be made to embrace the main girder *a* after the latter has been rivetted up in the rectangular framework for the floor.

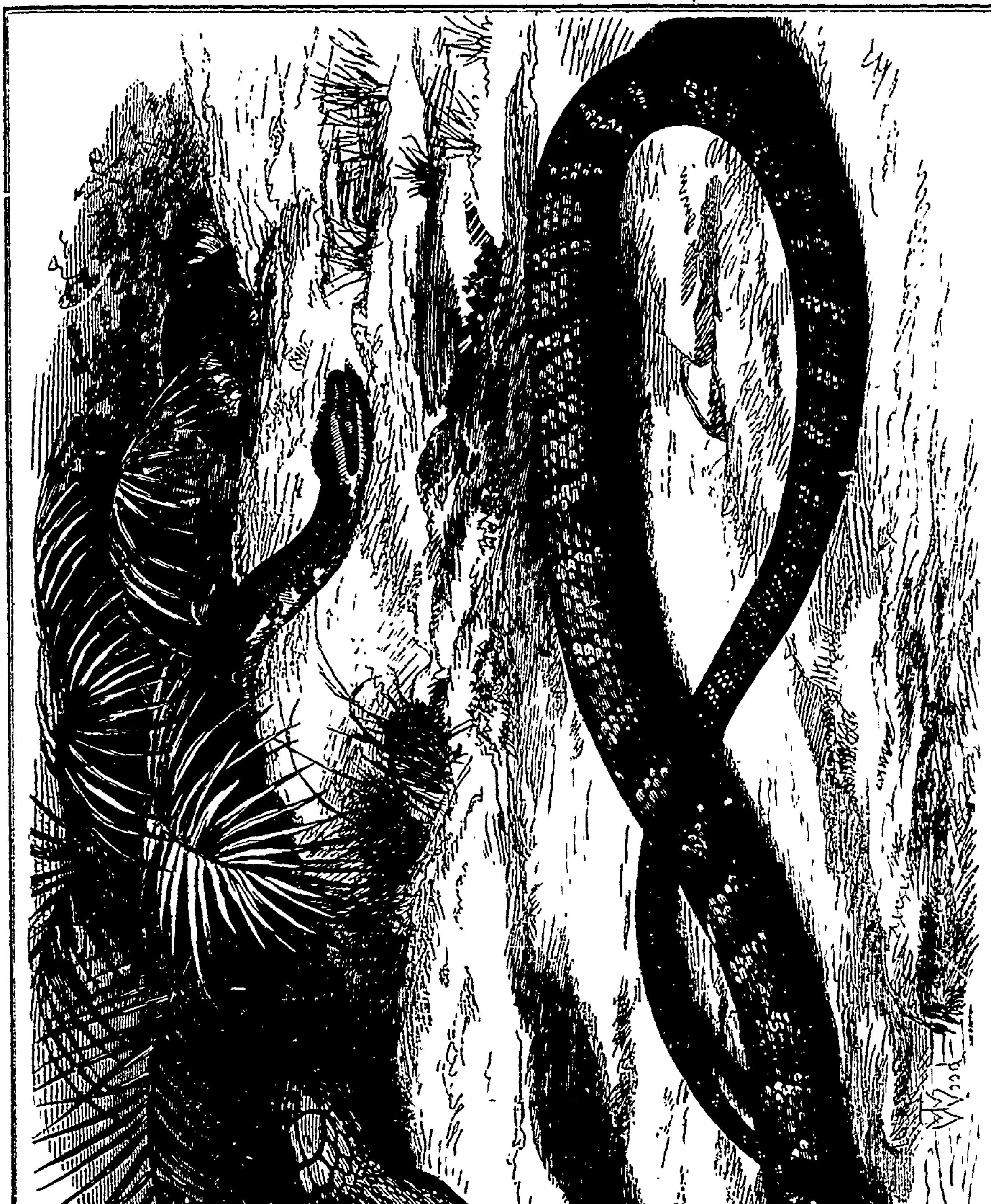
The upper portion of the saloon is formed by a series of light semicircular plate girders, as indicated in Figs. 1 and 2, and in the large transverse section, resting on the outer longitudinal beams, which are of considerable depth and rise above the floor, as shown in the transverse section. The upper flanges of these beams extend horizontally as far as the curved shell of the saloon, and are strengthened by numerous gusset pieces. A plate girder extends around the saloon at a height of about 12 ft. above the floor, connecting the several arched girders, and supported by wrought-iron columns resting on the floor beams, and giving great stiffness to this part of the structure. These columns are concealed in highly decorated casings, as shown in the section. The curved plate girders forming the framework for the sides and roof are also concealed by wooden panels, which form small bulkheads united to the bases of the columns above the girder. The framing is carried vertically upward, as shown, and in it a row of windows is formed. The upper floor or promenade deck *u*, Fig. 1, which is surrounded by a railing, rests at its edges on this vertical framing, and in the centre is supported by the central girder, which unites and stiffens the series of curved girders. Beams or rafters serve to strengthen the upper deck, and the lower sides of these are all laid so as to hide the iron and woodwork. The whole of the curved sides of the saloon are formed of a series of light angle irons curved to correspond to the girders, and a thin iron plating $\frac{3}{16}$ in. thick covers the exterior surface as high as the vertical framework.

The mode of working the equilibrium valve and the distribution of the water under pressure, which operates on the pistons employed to control the motions of the saloon, is seen in the transverse section Here P represents the external casing of the equilibrium piston valve, the casing being provided with pipes which lead from the valve through the trunnions h_1, at the ends of the girders *g*, and for enlarged view of which see Fig. 7, to the opposite sides of the pistons Q, and thence returns the water to a cistern from which a set of pumps actuated by steam power again forces it through the equilibrium valve in quantities regulated in the manner about to be described.

The valve casing P is fixed on the floor of the saloon at a distance of about 3 ft. from a line drawn through the axes of the saloon, and centrally on a line drawn through the cylinders *h*. *h*, at the ends of the girders *g*. Hence whenever the floor of the saloon moves either upward or downward from a true horizontal position, the valve box P will also rise and fall, and if in such case the valve rod R is made to retain its position unaltered, the movement upward and downward of the valve casing will cause the ports in the valve to open and shut. Hence it will be seen that the distance that the piston valve will cover or uncover the ports will always be in proportion to the movement of the floor on which the valve box rests.

The pipes are so arranged, that whenever water under pressure flows to the upper side of one piston Q, it also flows to the under side of the similar piston at the opposite end of the beams *g*, and the reverse sides of both pistons are in like manner brought simultaneously into communication with the exit water pipes, so that while one end of the beams *g* is lifted the other ends are forced downwards. It will be seen that the piston rods Q¹ are jointed to the deck of the vessel at S, as shown in Figs 5, 7, 8, 9, and also in the transverse section. The deck plates are strengthened at this part by a strong rivetted framing S¹, attached at each side to large vertical semi-bulkheads. The lower ends of the cylinders *h* are bolted to a hollow cross head h^1, see Figs. 9 and 10. The ends of these cross heads work in brasses *i*, *i*, bolted to the curved ends of the beams *g*, thus it will be understood that when the ship rolls the friction of the bearings on the axes tends to produce a corresponding motion of the saloon; as soon, however, as this motion commences, the rise or fall of that part of the saloon floor on which the valve case P is fixed will open a communication between the water under pressure and the pistons Q, and counteract as further tendency to movement in that direction, the opening

CANNON BALL FEAT IN PRESENCE OF PARISIAN JOURNALISTS. (See page 146.)



THE SNAKE-EATING SERPENT. (See page 151.)

of the valve taking place exactly in proprotion to the saloon's movement, thus if the ports are half an inch wide and there is no lap in the valve, a movement upward of the valve box of half an inch would open it to its fullest extent, and if the distance of the centre of the valve box is 3 ft. from the axis of the saloon, and the distance of the extreme width of the saloon is 15 ft. from the centre, it follows that a movement of 2½ in. at this part of the saloon will fully open or close the valve, as the case may be. It will also be understood that there being no lap in the valve, the smallest amount of the saloon's movement will commence to check it, and it would rarely be required that the valve should be fully open.

The motion of the saloon requisite for this regulation is controlled in the following manner: In a position central with the axes of the saloon a small heavy disc wheel T (see the transverse section) is supported on a horizontal axis having a radius rod U united to it by a joint at U*. On the top of the valve box P there is a pair of plummer blocks, see Figs. 12, 13, supporting a small way shaft. This shaft carries a curved bell-crank lever X, the lower end of which is united by links to the valve rod R, and on the upper curved part a sliding piece Y is fitted, to which the radius rod U is jointed. A jointed piece 1 is screwed on to the wheel on the opposite side, see the transverse section and Figs. 13, 14, having a short connecting rod 2 attached to it, the lower end of which slides on the curved arm 3; this arm is keyed on to a small way shaft supported by plummer blocks resting on a bar 5, which is secured at boths ends to the standard brackets attached to the beam *g*; a pair of lever handles 6 is also keyed on the same way shaft at a distance apart convenient for the steersman to grasp firmly in his hands. Projecting from the wheel T is a small arm carrying a spirit level 7, the position of which is shown clearly in Figs. 13, 14; it extends forward between the handles 6 and is immediately beneath the eye of the steersman, whose duty is to maintain a true level in this instrument by gently moving the handles 6, as the floor beneath him moves through a small space upward or downward. The desired amount of range of the equilibrium valve with a given motion of the saloon floor being regulated by the sliding piece Y on the curved lever X, and by a similar arrangement by which the connecting rod 2 slides on the curved arm 3, the position of the joints 1 and U* in reference to the axis of the wheel T form a triangle, and serve the purpose of a bell crank, with the advantage that the wheel T by its *vis inertia* serves to correct small inequalities of pressure and motion better than a light bell-cranked lever would do, and thus renders the task of steering more easy. It will be observed that in this arrangement of the valves and levers the man operating has not to exercise any judgement as to how far he will open or shut the valve to check or alter the saloon's motion, but he has merely to keep the wheel T motionless, as indicated by the spirit level, by doing which the slight motion of the saloon floor will of itself turn on or off the water pressure from the pistons in the exact proportion that is necessary to maintain the floor of the saloon in a horizontal position less the small movement requisite to move the slide valve.

When the vessel is not in motion, it is desirable that there should exist means of securing the saloon from movement without the aid of the steersman. It is also very desirable that in case of any accident occurring in the steam pumps or other hydraulic apparatus, the accidental bursting of a water pipe or other cause, that the saloon should be rendered a fixture with the vessel, and with the saloon floor parallel with the ship's deck. For this purpose two water cylinders 8, 8, are employed fixed in an inclined position firmly by flanges formed along their sides and united by angle irons to the lower framing *m* of the ship. (See the transverse section.) Central between them is a strong bed plate 9 fastened to the frames before described. The bed plate 9 has two cheeks a short distance apart with grooves formed in them, in which two short cross heads 10 slide. To these cross heads the piston rods 12, 12, are attached. Beneath the main central beam of the saloon floor a strong forging 14 is securely rivetted by angle irons. The piece 14 projects downwards in the centre, but there is sufficient space between the cross heads 10, 10, for it to oscillate so long as the pistons 13 are retained at the furthest or lower ends of their respective cylinders. A small iron receiver is placed at any convenient point between the steam boilers and the cylinders 8, 8, capable of containing about twice as much water as will fill the cylinder. A communication between the boilers and the upper part of this vessel is made by a pipe and a similar pipe is made to communicate between the lower part of the water vessel and the lower ends of the cylinders 8. This pipe is shown broken off at 15, 15. Similar pipes, 16, 16, communicate with the water pipes charged with the water under high pressure, which works the hydraulic pistons Q. Now the pressure of the water for this purpose may be equal to about 400 lb. per square inch, and, consequently, while the pipes 15 and 16 are open to their respective reservoirs the pistons 13 will, by the superior force of the water entering at the pipe 16 be kept down to the lower end of the cylinders, and thus allow the block 14 to oscillate freely between the crossheads 10, 10, but if the steersman is desirous to fix the saloon rigidly with the ship, he allows the water to escape freely from the upper end of the cylinders 8 by the means of a two-way valve from the pipe 16, when the force of the water acting on the lower side of the pistons will cause them to move forward and act on the piece 14, at whatever part of its path it may be in, and force it to the centre, where both pistons will hold it firmly between them, and thus retain the saloon in its required position. By again allowing the high-pressure water to enter by the pipes 16 the low-pressure water will be forced into its reservoir, and the piece 14 be again at liberty to oscillate with the saloon floor.

It will be understood that the openings by which the water has ingress and egress from the cylinders 8, 8, are sufficiently small to prevent their movement with a speed that would give a sensible blow on their coming in contact with the piece 14. Should at any time a stoppage of the hydraulic power take place by the bursting of a pipe, or otherwise, the failure of the pressure on the upper side of the brake cylinders 8 will allc the pressure always kept up in the vessel in connexion with the boilers,to slowly move the pistons forward, and push the piece 14 until the saloon floor resumes a position parallel with the ship's deck, and there retain it, and at the same time the steersman would pull the handle of the lever shown in dotted lines, which acting on a small bell crank would slide a steel bolt into its socket, and thus further secure the saloon to the ship.—*Engineering*

IMPROVED COFFER DAM.

This invention is a portable coffer dam of a construction which offers improved facilities for the excavation of tunnels, building of bridge supports, piers, sea walls, or other marine structures. It is formed of watertight compartments which, when the apparatus is to be towed from one point to another, are filled with air only; but when it is desired to locate the dam, water is admitted into the sections, causing the entire structure to sink and rest on the bottom. The principal feature of the invention is the system of plate piles which surround the interior sides, and which may be forced down below the bottom of the dam and into the mud for a considerable depth. These, besides, enable the apparatus to conform, in its lower portion, to the irregularities of the bed, and thus tend greatly to prevent the infiltration of water.

The large engraving, Fig. 1, represents the dam in position for the construction of a pier, the dotted lines indicating the depth of the structure. The forward portion is shaped somewhat like the bow of a vessel, by connecting together two hinged gates, formed of metal, and each constituting a compartment similar to those into which the body of the dam is divided. The rear portion of the structure is provided with similar doors, made so as to secure and fit tightly against the sides of the pier end, being secured by screw clamp rods, which embrace the ends of heavy posts.

The manner in which the body is constructed in sections is shown in Figs. 2 and 3. In the latter engraving are represented the rear gates, at A, and at B, in both figures, are the valves which admit water to the compartments to sink the same. At C, Fig. 2, are the plate piles, which are raised or lowered by the screws attached to their upper portions. D are the holding piles, which are guided by, and slide upon, T irons that are secured to inner plating of the body. Extending around and underneath the middle portion of the latter is a keel, E, which serves to take a firm hold in the bottom, thereby giving greater security to the structure.

On top, and secured parallel to the decks and over the open middle portion, a track is laid, to support a dredge and pile drivers which travel thereon. Lastly, clamping bars extend across the inner part at G, Fig. 3, and at other points, serving to bind the sides together and give solidity to the fabric.

In order to prepare the dam for pier or tunnel building, the sheet and square piles are first raised so that their lower edges and ends will be above the bottom of the sections. The latter being empty, the dam is easily floated to the desired point, where it is sunk as already described. The square piles are then forced into the earth to form a solid bearing, the sheet piles being driven in until bed rock, if necessary, is reached The water in the middle space being pumped out, the building operations may be begun at once, and, if a pier, the work carried on until the entire space is filled. To extend the masonry further out into the water, the piles are raised, and the dam floated and towed ahead until its rear gates embrace once more just the extremity of the structure, when the dam is again sunk and the work continued. The advantage of building the dam in two sections will be obvious from the fact that the parts can be adjusted at any desired distance from each other to accommodate varying breadths in masonry, etc, and by, means of the transverse screw clamping rods, F, Fig. 2, solidly held.

The removal of the earth within is effected by simple dredging apparatus, which lifts out the soil and empties it clear of the decks, returning the same on top of the tunnel arch, as shown in Fig. 2, after the mason work is finished.

The invention offers many practical advantages, both in point of economy and convenience, which will doubtless be evident to engineers generally.

The two engravings, Figs. 2 and 3, also show the two methods by which, the inventor suggests, a tunnel by the aid of his apparatus may be constructed. In Fig 2, piles are driven down into the mud, etc; until their lower ends meet hard pan, and above them the masonry of the tunnel is built, as shown, concrete being placed over all. The other plan, in Fig 3, involves digging down directly to bed rock, and building masonry therefrom upward, filling in the lower part with concrete, up to the desired level of the tunnel floor.—*Scientific American.*

THE "BON MARCHÉ" ESTABLISHMENT AT PARIS.

This is nothing more or less than an enormous shop for the sale of linendrapery and whatever else can be classed as "articles de Paris." The establishment, however, is *unique* in point of size and has many very peculiar and interesting peculiarities in the details of its management It is more than a shop, it is a pleasant lounging place, with a superb drawing room in which refreshments are provided gratis for customers. Close to this salon is found a reading room comfortably furnished and provided with French and English journals, reviews, albums, stereoscopes, pens, ink and paper, all at the service of visitors and for which no charge is made. As if all this was not yet sufficient the proprietors have recently added a spacious picture gallery, the ceiling of which has been beautifully decorated by Henry Levy This picture gallery will serve as a place of exhibition for artists and sculptors where they may expose their works and thus it will at once benefit them and the public. A Turkish divan has also just been opened for the sale of goods imported direct from the Levant.

A double staircase unites the different floors of the building, and the whole is lighted by an immense skylight no less than 1,600 metres square. We will now visit the kitchen, where we see a stove which throws into the shade the famous stove of the Hotel des Invalides, giant pots and pans, &c. There is a dining-room for the shopwomen, another for the shopmen, separate dining-rooms for the workwomen, porters coachmen, and grooms. After each repast all repair to the dressing-rooms, where hair-dressers are always in attendance. The shopwomen lodge on the premises, and each has her separate room; they meet together in the evening in a private drawing-room, where there is a good piano. As soon as the shop is closed it is turned into an evening academy, professors of English, German and Italian make their appearance and give lessons to the employees, who are instructed also in vocal and instrumental music.

Some acquire considerable proficiency and take part in the concerts which are given from time to time by the proprietors, and have even carried off prizes at several musical societies—at Troyes, for example.

It is very satisfactory to know that this spirited attempt to make a mere place of business attractive to the public and a pleasant home for hundreds of employees, has been perfectly successful M. Boussicault, the founder, has certainly reaped a rich reward.

That the founder of the establishment of the "Bon Marché," M. Aristide Boussicault, is a man of genius is certainly proved by the result of his commercial operations In the year 1854, when he first began business, the capital of the house amounted to £39,000; during the past year it has reached the sum of £1,006,000. 1,550 hands are employed, of whom 1,250 reside in the house; 22 of these are employed all day long in cutting patterns, and they use a machine even for that; 100 more are employed in expediting letters and parcels to the provinces and to foreign countries. 200 000 parcels are forwarded during the year, and of these one-third leave the country. There are 30 cashiers for Paris receipts only, 30 vehicles and 80 horses convey the articles to their various destinations. One omnibus is for the service of those whose duty it is to complete the assortment of the various articles, another is at the orders of the chief-cook, who has at his command some 50 men and women. The amount of money which changes hands through the medium of this establishment is enormous—it is upwards of £480 000,000.

THE SNAKE-EATING SERPENT.

Among the recent acquisitions of the Zoological Society of London is a serpent from Burmah, of the Genus Hamadryad. The species is the Ophiophagus Elaps. The *Illustrated Sporting and Dramatic News* describes it as follows:

"This poisonous snake, recently purchased by the Zoological Society from Mr Jamrash is the largest and most powerful species at present known This specimen is about eight feet in length, but there are well authenticated instances of its being met with or obtained from twelve to fourteen feet. According to the various authorities this serpent inspires more fear among the natives of the country it inhabits on account of its fierce and active character. It is stated and believed by good judges to be always ready to attack and follow any living object that may come in its way—in fact to be always on the aggressive. As its name implies its food is other serpents; and it is reasonable to suppose that, having to capture others of its own class, it would be gifted with extraordinary powers of overtaking snakes upon which it exists. In proof of the correctness of this portion of its history, we may state that we have witnessed this mode of feeding in the specimen above alluded to, for during the two days it has been deposited in the gardens, it has devoured no less than two good-sized English snakes This, of all the venmous serpents is the most to be dreaded on account of its boldness; and it is a fortunate thing for the inhabitants of the countries in which it is found that it is one of extreme rarity, and, according to the statements of the serpent charmers, they would avoid if possible, rather than risk, the capture of so dangerous a subject."

The following is extracted from Dr. Fayrer's elaborate work on the Thanatophidia of India:—

"The Bengali name is *Sunkerchor*, breaker of shells. It is found in the forest and grass jungle; it is said to live in hollow trees and to climb them readily, being frequently found resting on the branches. As its name implies, it feeds upon other snakes; though probably, when its usual food is not forthcoming, it is contented with birds, mammals, fish, frogs, &c. It resembles the cobra, except that it is longer in proportion to its size, and its hood is relatively smaller; it is, however, more graceful in its movement, and turns more rapidly It is occasionally seen with the snake-charmers, who prize is highly as a show, but they say it is exceedingly dangerous to catch and difficult to handle before its fangs are removed."

AN EXTRAORDINARY SCALE.—The 128-feet railroad-track scale built at Packerton, one mile south of Mauch Chunk, in June, 1872, by Messrs. Fairbanks and Co., for the Lehigh Valley Railroad Company, has done more for the same time than any other scale in the world. Its average weighing per day is over 20,000 tons for every day in the year, an annual tonnage of over 7,000,000 tons. A single day's (24 hours) weighing has often exceeded 60,000 tons. The scale has been subjected monthly to the severe "Goodwin Test," and has always been found correct Although over 18,000,000 tons have been weighed upon the scale it has never yet required repairs.

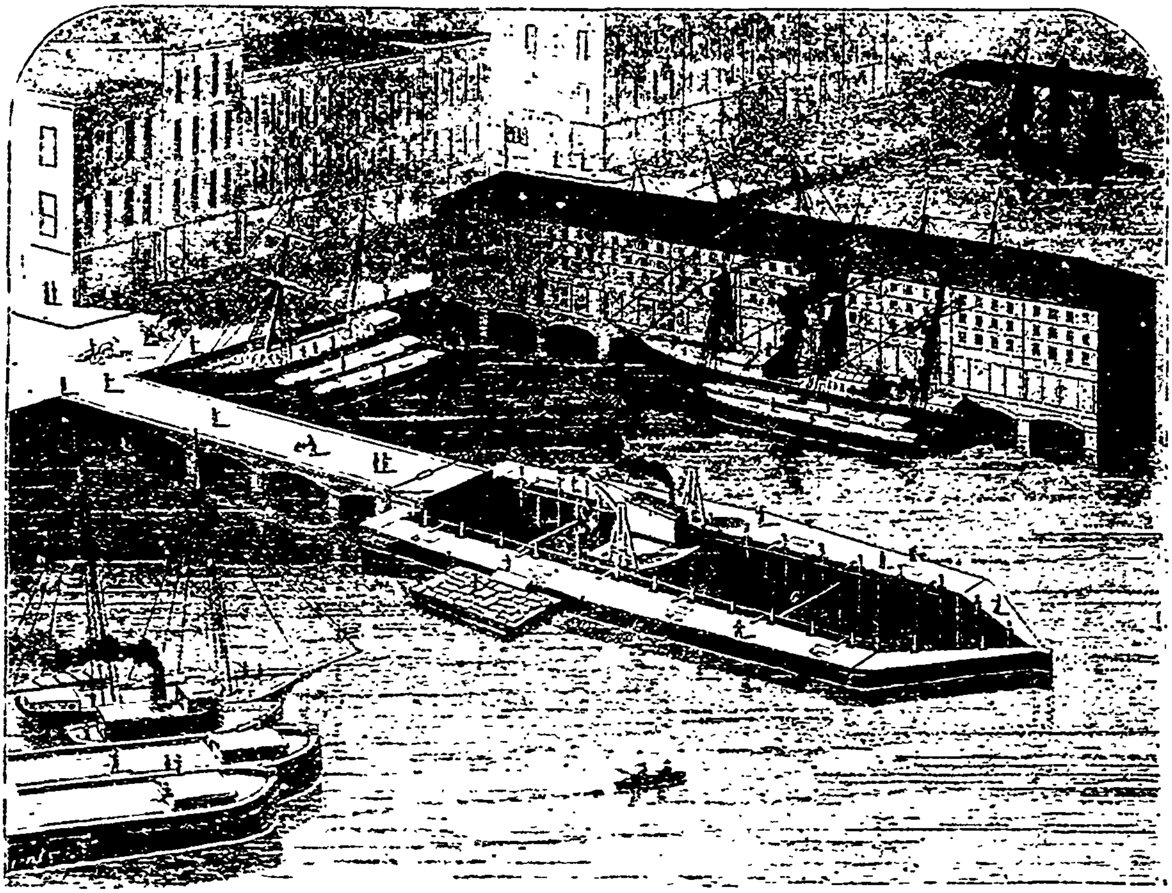


Fig. 3

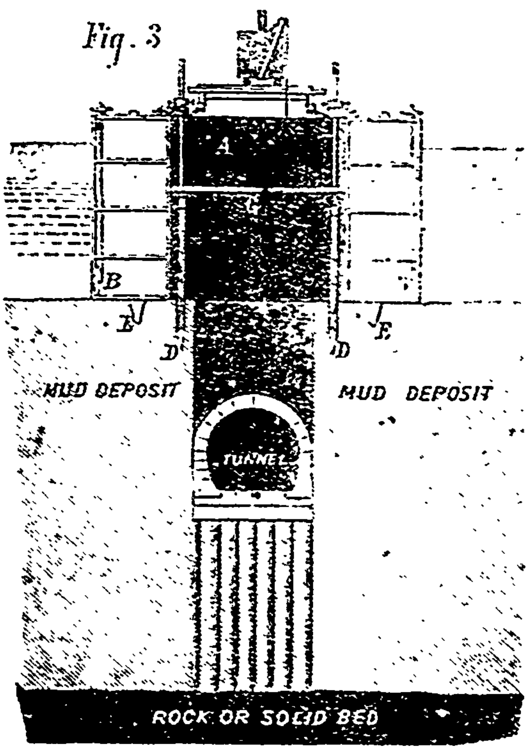
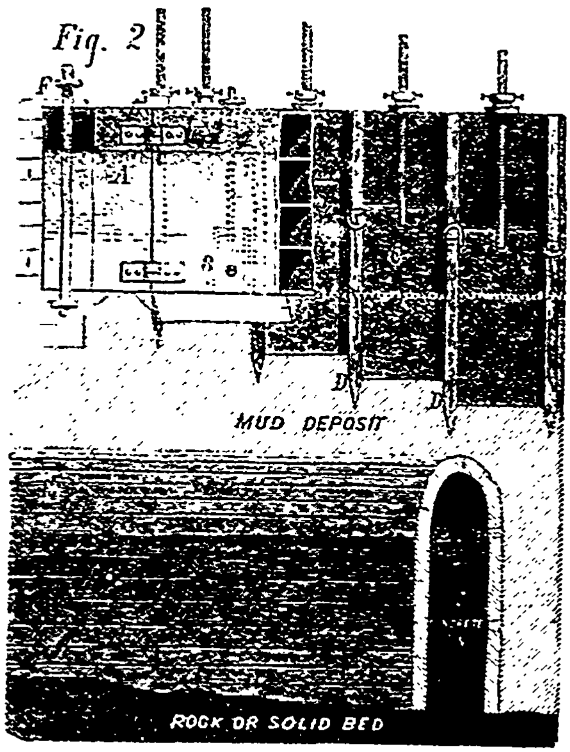


Fig. 2



IMPROVED COFFER-DAM. (See page 150.)

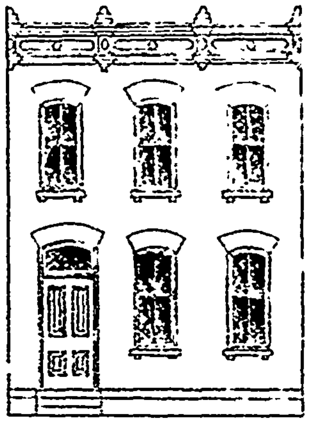


Fig. 1.—FRONT ELEVATION.

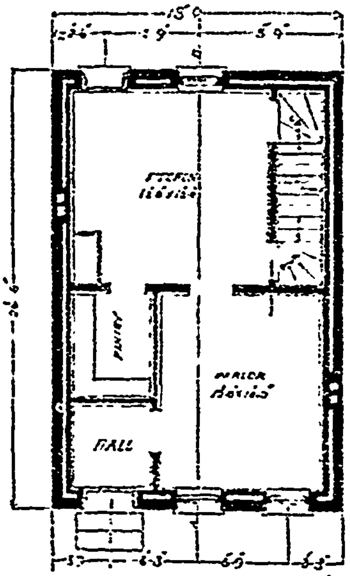


Fig. 2.—PRINCIPAL STORY.

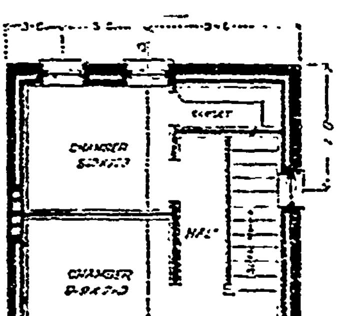


Fig. 3.—SECOND STORY.

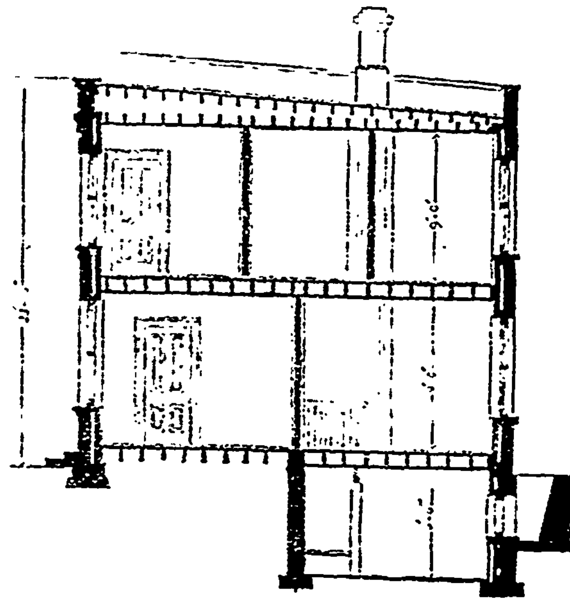


Fig. 4.—SECTION AT A, B, C, D.

PRIZE PLAN FOR A FIREPROOF HOUSE.

Some time ago a prize of $1000 was offered by the Merchants, Farmers and Mechanics Savings Bank of Chicago for the best set of plans and specifications for a fireproof dwelling house, of not less than five rooms, and a total capacity of at least 5,500 feet. Up to the end of the last year, thirty applicants for the prize had put in an appearance, and a committee have since been occupied in investigating the merits of the designs. They recently awarded the prize to Mr A. J. Smith of Clark street, Chicago, whose plans were for a one story house, 20x43; a two story house, 15x26½; and a two story store and dwelling, 22x57. The cost of these buildings, respectively, is to be $1,200, $1,700, and $3,600.

The one story dwelling house is a building 43x20, of five rooms, consisting of parlor 13x10½, and two bed rooms 10x6½ each. The hight of each room will be 10 feet in the clear between floor and ceiling. An important feature in this plan is that, should a fire occur in the front part of the building, the rear portion may be preserved intact, and *vice versa*. The outside walls are hollow from foundation to roof. The floor, beams, and rafters are wood protected from fire by concrete, one and one half inches thick on the ceilings and underneath the floors; and the roof is covered with tin on the top of the concrete. Thorough ventilation is provided by flues adjoining the fire flues, and topped out in the chimney. There is a ventilated air space underneath the ground floor, preventing dampness from arising; and there is also a ventilated air space between the ceilings and roof to prevent the heat of summer from affecting the rooms. The fire flues will be lined with flue pipes eight inches square. There will be a drain pipe, connected with sinks and closets and with main sewer, to carry off all surface water, slops, etc.

The two story dwelling, of which we present a front elevation, Fig. 1, and the ground plans, Figs. 2 and 3, is a building 26½x18, with five rooms, two on the ground or principal floor, and three on the upper floor, the sizes of which are: Parlor 12x10, and kitchen 12x12. The three upper rooms are for bed rooms, the sizes of which are, respectively, 11x8, 8¾x7¾, and 8¾x7¾. This building has a cellar for coal and wood, fitted up with water closet. The size of cellar, within walls, will be 12x20. The upper story and the principal story will be each 9 feet in hight, and the cellar 6 feet 6 inches.

The building with store and dwelling combined is 22x57. The entire principal story is occupied with store room. The upper story is divided into seven rooms, consisting of two parlors, 11x12 each, bed room 11x11½, bed room 13x9½, bed room 10½x9½, kitchen 13x11, dining room 13x11.

The three buildings are similar in construction. The cheapness of the structures is unquestionable, and we trust it will be long ere their fire resisting qualities are put to the test. —*Scientific American.*

FILTH THE CAUSE OF BOILER EXPLOSIONS.

The following interesting facts are taken from the report of Mr. A. T. Hay, to the Secretary of the Treasury of the United States, on the subject of boiler explosions

When we boil pure water the steam rises regularly in spheres from the bottom of the vessel to the surface of the water. The volume of a confined mass of steam is inversely proportional to the pressure to which it is exposed, and directly proportionate to its absolute temperature Steam at a like temperature and pressure has at all times the same number of molecules in a like volume, and the true measure of its energy may be calculated with mathematical precision Water assumes three natural, or allotropic forms—liquid, solid, and vapour, in all these forms its qualities inhere What is true of a molecule of water, ice, or steam, is true of the whole volume of either—these several forms being due entirely to a change of temperature. Water is the most stable compound in nature; neither pressure, cold, nor heat alone being able to reduce it to its original elements. It also has a greater capacity for heat than any other known substance, except hydrogen gas. Water, *per se*, is as true to its peculiar characteristics under the various degrees of temperature and pressures to which it may be subjected, as the magnet is to the Polar star.

Steam is an elastic fluid, and has the true measure of its energy in any given case directly proportional to its temperature and pressure. These two conditions supplement each other. Now, the volume of a confined mass of steam being inverse to the pressure to which it is exposed, a rupture in a steam boiler must instantly reduce the internal pressure and relieve the stress, and, on the other hand, the pressure being directly proportioned to the absolute temperature, the checking in of cold water reduces the temperature and relieves the pressure or tension; which brings us to the logical conclusion that neither a weak place in a boiler nor the supplying of cold water are, in themselves, the least sources of explosion "But, we are told, "it is the discharging of cold water on to red-hot iron that does the mischief." Let us look at that in the light of truth. In the first place, water has nearly ten times the capacity and affinity for heat that iron has, and I will defy any man to heat any part of a boiler or open kettle red-hot with an ordinary blast so long as there is any considerable quantity of water therein; beside, if it were possible to have any portion of a boiler "red hot," it would be above the water line — whereas, the cold water (on river steamers) is supplied either through the mud drum or discharged by feed pipe near the bottom of the boiler Now, it is a fact that boilers blowing up under such supposed conditions generally go at the first or second stroke of the pump. Then, I would ask, how high a few strokes of the pump will raise the hot water over a battery of boilers? Not the thickness of a sheet of brown paper Another fact is that many of our most terrific explosions take place under a reduction of pressure—that is, the boilers become, as it is termed, "fire hard," and sometimes it is with difficulty that a medium gauge of steam is kept up; in fact, I have known instances wherein just before an explosion ensued the steam gauge would recede from 50 lb. to 20 lb. pressure, and no amount of firing would bring up the pressure sufficient to perform the work satisfactorily. If there had been a scarcity of water there would have been a surplus of steam. When boilers fire easily and steam freely there is no danger of any fearful disaster. If a boiler gives way under such conditions, it is at its weakest point, which lets off the excessive pressure and relieves the stress instantly over the whole battery. Such accidents are of frequent occurrence. They are simply ruptures, the effects of over-pressure, and not explosions in any sense of the term.

There can be no violent explosion from steam made from clean water, free from organic matter. At least, after many years' close observation, coupled with direct investigation and research, I have failed to find an instance where pure simple steam made from clean water ever exploded within a range of from 15 lb. up to 500 lb pressure to the square inch. But I do find that explosions in steam boilers (like cholera, typhoid fever, &c.) revel in filth and foul water, and may be traced directly to the same source. Take, for instance, the Mississippi and its tributaries, and it will be found that steamboat boiler explosions have been most frequent in the vicinity of large cities, and as we go down the river. The Lower Mississippi has been termed a graveyard, while in that portion of the river above St. Louis, including the Illinois, where the waters are comparatively pure and free from nitrogenous matter, explosions have been very rare, while the Ohio, from Cincinnati down, is noted for many steamboat disasters The most destructive and terrific explosions have occurred in the spring of the year, when the waters were loaded with organic substances, earthy salts and oleaginous matters.

My researches lead me to a positive conviction that these disasters have their origin in the impurities contained in the water In a paper like this it is impossible to go into detail, or to give reasons and incidents running through many years observations investigation and research, but I think that the following will give a sufficient data to enable all to see the importance of avoiding foul water for steam purposes.—

When we boil foul water we find it tumultuous, accompanied with a low, bumping sound, with fits and starts, so sudden and violent in some instances as to jump bodily out of or even burst an open vessel. This antagonism to the boiling of any compound solution is caused by the attraction of these foreign particles for each other (chemical action and reaction), while in the boiling of pure water there is no chemical action whatever. Great rivers, like those in the Ohio, Mississippi, and Missouri valleys, are great natural sewers, and their waters at certain seasons of the year are loaded with organic remains in every stage of putrefaction, while city wells and those around factories frequently become great sink-holes and receptacles for foreign matter My researches show that such waters hold in solution and carry in suspension from six up to sixty-three grains per gallon of organic substances, to which may be added copious quantities of oleaginous matter in certain localities and the salts of ammonia—NH_4. These substances find their way into steam boilers, where they rapidly undergo chemical change, distillation, concentration, and sometimes violent decomposition—that is, culminate in terrific explosion

These organic skeletons, glycerine salts, albuminous substances and ammoniacal gases found in water consists chiefly of carbon, hydrogen, oxygen and nitrogen, and it is among such nitrogenous combinations and types that we find some of the most remarkable explosive bodies. They are not only aeriform, but they are gases of the most subtle and potent character; gelatinous substances, in which the different elementary atoms are all chemically combined in the same molecule that are liable to sudden and violent decomposition whenever the opposing forces to which they owe their existence become deranged by heat or some external cause. Their affinities are very feeble hence their frequent destruction at high temperature Merely a molecular disturbance of any kind may cause violence Their combustion being internal and instantaneous, they develop a force at least ten times greater and 100 times quicker than that of steam pressure—sudden and violent enough to destroy open vessels.

The instability of all nitrogenous compounds is the striking peculiarity. No amount of pressure or cold is able to reduce their aeriform gases to the liquid or solid condition again. But in clean water we have the most stable substance known, under these distinct forms, either of which may be safely had out of the other by merely a change of temperature. As I said before, heat alone will not decompose water, but electricity readily resolves it into its original elements, and chemical action being the source of electricity, water in the midst of fickle and treacherous company becomes demoralized and loses its virtue and stability, and goes off in a gaseous state in time of chemical reaction This frequently occurs when boilers explode, as neither water nor steam are ejected from them, but an inflammable gas is evolved Under such conditions the engineer, dead or alive, is convicted of murder for allowing the boilers to become dry, when, in reality, a moment before the explosion his boilers contained a full gauge of water

Great power in the hands of ignorant managers implies great dangers, which has been practically illustrated in American steamboating, railroading, &c Science takes things as it finds them, and occupies itself in tracing relations and dependencies among phenomenal effects Any investigation, to have any permanent value, must be based upon the natural order of things. It must be interwoven with matter, force, and truth. Then intelligence becomes a true mirror that reflects things as they are. It is only by well observed and well digested facts, through patient investigation and research along the varied lines of nature that we generate new and recast old ideas and arrive at truth and practical utility.

SCIENTIFIC NEWS.

OXYGEN.—In the establishment of Krebs, Kroll, and Co., Berlin, oxygen is prepared by heating together in a glass flask, in a water bath, ten quarts of water, 10 lb. chloride of lime, and 1 lb. nitrate of copper. It produces 14 cubic feet of oxygen.—*Laboratory.*

The *Moniteur Industriel Belge* states that German manufacturers are purchasing the fish bones gathered along the Norwegian shores which result from the extensive fish curing stations there located. These bones make a fine fertiliser, and, when pulverised by suitable machinery at the point of collection, are readily transported. The same journal suggests the more extended utilisation of the bones from the establishments in Newfoundland, and estimates the product from American fisheries at twenty million pounds a-year.

The *Moniteur Industriel Belge*, in an interesting article on this costly perfume, says that the manufacture is largely carried on in the valley of Kesanlik, Roumelia, the annual production of the rose farms of which amount to 4,400 pounds of the otto per year. As it requires about 130,000 roses, weighing some 57 pounds. to make an ounce of the oil, some idea of the extent of the plantations may be formed from the above given total.

The flowers are gathered in the middle of May, and the harvest continues for three weeks. The blossoms collected each day are at once worked, in order that none of the odor may be lost. The process consists in distilling them in water and then causing the water alone to undergo distillation, when the oil is skimmed from the surface. The labor is principally done by women and children, at wages of about ten cents per day.

The otto is always adulterated, before transmission to market, with one third or one fifth its quantity of geranium oil.

PROFESSOR THURSTON, of Hoboken, speaking of the improvement of iron and steel by age says.—"One of the most striking illustrations of this improvement of the quality of wrought iron with time has recently come to my knowledge. *The first wrought iron T rails ever made were designed by* Robert L. Stevens about 1830, and were soon afterward laid down on the Camden and Amboy Railroad. These were Welsh rails, and, when put down, were considered, and actually were, brittle and poor iron. Many years later these were replaced by new rails, but until quite recently some still remained on sidings When a lot of unusually good iron was wanted, some of these rails were taken up and retrolled into bar iron. The long period of exposure had so changed the character of the metal that the effect was unmistakeable.

WOOD pulp appears not to present much resistance to compression, and the elasticity of its fibres is destroyed at a comparatively moderate pressure, so that glazing tends to diminish rather than increase its tenacity. It was found that paper composed entirely of wood pulp, which before glazing broke at 11·70 kilogs. and 15 kilogs., was capable of sustaining but little more than half the weight after being glazed, and broke at 6·40 kilogs. and 4·20 kilogs Another sample, containing 53 per cent. of wood pulp, and weighing 60 grammes per square metre, broke at 12·35 kilogs. and 7·50 kilogs. before glazing, and at 10·30 and 7·50 afterwards. The influence of kaolin on the strengths of paper is shown by the following experiments :—A sheet of printing paper, weighing 48 grammes to the square metre, giving 10 per cent. of ash, broke with a weight of 8·40 and 6·25; the same quality of paper, but containing 17 per cent. of ash, broke at 7 90 and 5 35.

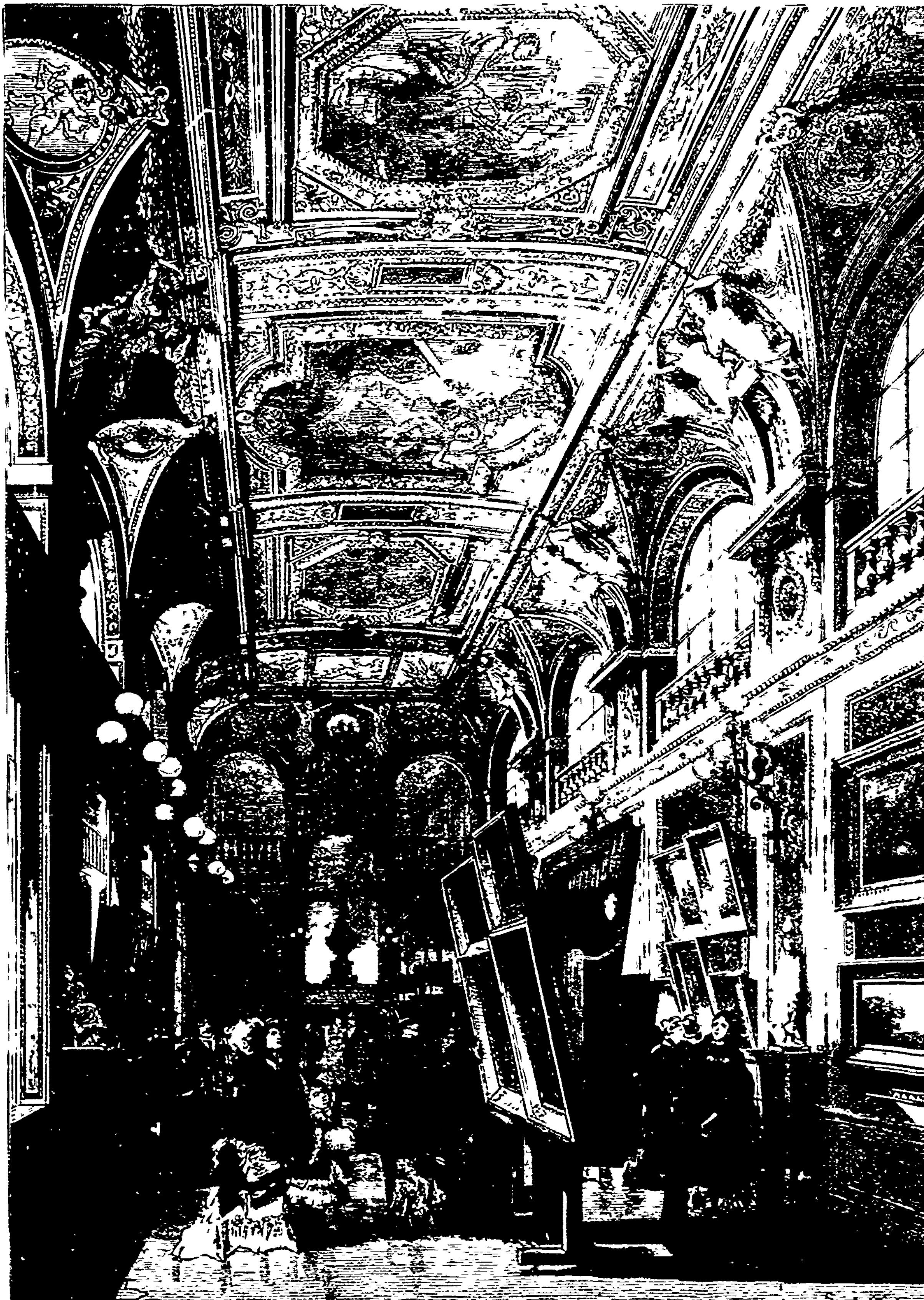
THE *Gazetta della Cartiere Italiane* gives some interesting data respecting the tenacity of paper, which, up to the present time, has received but little attention, and more especially the influence its manufacture by machinery has upon its resistance to tearing. It is very evident that the paper during its passage over the drying cylinders stretches in the direction of its length, and shortens in the direction of its width, it has always been found that paper has a greater tenacity in the former direction than in the latter. The following are the results of a series of experiments :—Of fifteen different qualities of paper, weighing on the average 50 grammes per square metre, the breaking weight of a strip 33 millimetres in width was 9 10 kilos. when taken in the direction of length as manufactured, whilst a strip of similar dimensions cut in the direction of the width from the same paper broke at 6 20 kilos. Paper made from rags containing half wool, and weighing 160 grammes per square metre, broke with a weight of 6 60 kilos. when taken in the direction of its length, and at 4 65 kilos. in the opposite direction. Paper made from wool pulp, and weighing 60 grammes per square metre, broke at 11·70 in the first and at 8 15 in the other direction. From these experiments it will be seen that the strength of paper in its longitudinal and transversal directions stands in the ratio of 3 to 2. The glazing of paper tends to increase its strength, provided that the pressure is not such as to destroy the elasticity of the fibres of which it is composed. A sheet of printing paper made entirely of rags, and weighing 40 grammes to the square metre, gave the following results as to its breaking weight :—Before glazing, longitudinally, 6 80 kilos , transversely, 4 30 kilos ; glazed by passing once through rolls, longitudinally, 6·85 kilos. ; transversely, 4 30 kilos ; and glazed by being passed twice through rolls, longitudinally, 7 35 kilos., transversely, 4·35 kilos.

The origin of the name America is involved in some obscurity. In the current number of the *Atlantic Monthly*, Mr. Marcou propounds a theory on the subject, of which the following is an outline. The names of places in the Indian dialects of Central America often terminate in ic or ique, and *Americ, or Amerique is the name given to* a high mountain range in Nicaragua. No denominations are more surely established than names of localities. Was this region, then known by the name to Columbus on his fourth and last voyage? He makes no mention of it in his description. Remember, however, that the Littera rarissima were written under painful circumstances, when Columbus was a prisoner in Jamaica, old and infirm, and unable to make a very full report. The great object of Columbus and his company was the finding of gold mines. The Americ mountains are auriferous, and the gold of the alluvium has been entirely exhausted, which must necessarily have been by the Indians themselves. The Cariai Indians whom Columbus mentions, were probably the Indians of Carcai of to-day (who are found working in the *gold mines of Libertad and Santo Domingo at the foot of the* Americ chain.) These Indians would very likely, in reply to questions about the gold they wore, speak of Americ as the region where they had got it. The voyagers on their return to Europe would boast of the rich gold mines they had discovered through the Indians of Nicaragua and say they lay in the direction of Americ. Thus the name would become popular and be widely known as a synonym for this golden country. A bookseller and printer at the foot of the Vosges Hylacomylus, knowing no printed account of the voyages but that in Latin by Albericus Vespucius, and having also heard the name Americ, thought the latter (Mr. Marcou further supposes), an altered and corrupted form of Albericus, and in his pamphlet he changed the name into Americus! The error was propagated *in a new edition, and by the appearance at Basle, in* 1522, of the first map on which was seen America Provincia. The map reached Spain, when there was no one there to correct the mistake. The name Americ had been heard as that of an undetermined portion of the New World; and it was accepted without difficulty Thus, according to Mr. Marcou's view, it is owing to a grave mistake of Hylacomylus, that the aboriginal name Americ or Amerique has been Europeanised and connected with the Christian name of Vespucio.

A SAN Francisco inventor has applied for a patent on a horse-brake of his contrivance. It is intended to control a horse in much the same way as a waggon is governed in its movement by a brake. A buckle with a belt is attached to the ring of the breeching on the left side of the horse, and the belt is continued around the latter's breast, where it is fastened to the martingale. Thence it passes to the right-hand side of the buggy seat, where it is caught by a buckle and a loop. When the reins are pulled tight the brake presses on the forelegs of the horse immediately below the breast, stopping him instantly, and preventing him from rearing or kicking Should the reins slip from the hands of the driver or break, the horse can be brought to a stand-still by pulling the strap which is buckled at the righthand side of the seat.

AN artesian well is proposed for Fredericton.

GRAND STAIRCASE OF THE BON MARCHE ESTABLISHMENT. (See page 151.)



PICTURE GALLERY OF THE BON MARCHÉ ESTABLISHMENT.

A "ROLL-WAY," AND WHAT IT IS.

At a recent meeting of the Civil Engineers Club of Chicago, one of their members, Mr. S. A. Clemens, read a very interesting paper on a novel mode of conveyance which he terms a "roll-way." The author is a practical engineer, and therefore deserves to be heard. He begins by claiming for it greater safety and durability and equal speed than the ordinary railway. After the scheme has been tried and found successful, the claims may be admitted, but at present it will be wise to withhold judgment. The following is an outline of the system :—

The track of this newly-invented roadway consists of a series of pairs of small wheels or rollers, each supported by journal boxes, or equivalents, bolted to timbers, like railroad ties, which are placed side by side and set fast in the ground. The way-rollers of each pair are placed parallel—from 3 to 5 feet apart, according to any determined gauge — and the pairs of rollers may be 8 to 16 feet apart on the line. Midway between the rollers—thus ranged in two parallel rows, is a single guide-rail, the top of which is 3 or 4 inches above the level of the rollers, and its connected sections are strongly fastened to the ground-timbers to which the rollers are secured — thus tying the entire superstructure longitudinally together.

The way-rollers, made of chilled iron, or converted steel castings, are about 5 inches diameter, with 3-inch faces, and have on each side journals of 2½ inches in diameter and length, which revolve on small steel, anti-friction rollers, in chilled-iron journal-boxes, so closed as to exclude both dust and rain. Or, preferably, the way-rollers may be steel or wrought iron tubes about 5 inches long by 4 inches outside diameter, and five-eighths of an inch thick, revolving on steel anti-friction rollers of about three-eighths of an inch diameter, which encircle and roll around a short fixed steel shaft 2 inches in diameter, the ends of which are held in supports of hard wood or iron, bolted to the ground-timbers. These tubular way-rollers are designed of three-fold capacity to safely endure the train-weights at highest speed to which they are to be subjected, while combining low resistance from friction and inertia.

For the purpose of securing favourable grades and curves the ground-line is prepared like the ordinary road-bed, with the exception that the grade is not necessarily required to be continuous.

The cars are to be from 30 to 50 feet in length, with timber-runners shod with steel, and elastic rubber cushions to run over the rollers, while a system of guide-rollers provided with flanges run along the central or guide-rail to keep the cars from leaving the track. The outside rollers are placed at intervals, so that the runners of the car overlap at least three of them at the same time, while they may be placed closer together if it is found to be desirable.

The locomotives have an under construction similar to the cars, with steel-shod runners upon the outer lines of rollers, and secured to the central or guide rail by flanged rollers. The driving-wheels of the locomotive are horizontal, in pairs, and bear on opposite sides of the double-headed guide-rail. They may be of about 18 inches diameter, and are fastened on the lower ends of vertical shafts, to the upper ends of which the steam-power is applied by direct attachment. Adjustable pressure, for tractive adhesion of the driving-wheels to the guide-rail, is obtained by a spring-cushioned screw or eccentric rolling pressure, at the control of the engineman. This is similar to apparatus for a like purpose used on the middle-rail railway system, devised and applied in America nearly thirty-five years ago by Mr. G. E. Sellers, and recently in use on the Mont Cenis railway.

The roll-way car-brakes are arranged to act directly on opposite sides of the guide-rail, and they may be made on any operating principle now approved by railway usage. At road crossings of the roll-way a section of the guide-rail is left out, and the crossing space between adjacent pairs of the way-rollers is open and unobstructed by any part of the superstructure. This is made practicable by providing flanges on two or three pairs of the way-rollers on each side of the crossing. The flanged rollers guide the car-runners in straight lines over the crossing, on the further side of which the driving-wheels and guide-rollers again come into position on the opposite sides of the guide-rail In this way obviously the crossing can be made at any desired height above the intersecting road, be it of whatever class, a desideratum which is not practicable with railways, aside from the cost and wear of crossing-rails in the latter.

For switching this new style of cars and locomotives, the inventor has a section of guide-rail on the line, which, being pivoted at one end, is swung outward at the opposite end, to meet in line with an outside section of switch guide-rail which is swung inwardly, both moving simultaneously, by mutual connection to the same switch-lever. Pairs of way-rollers are so placed to form the switch or turn-out line, upon which the car-runners are directed, by the guide-wheels of the train bearing against the switch guide-rail In this way all costly, destructible apparatus like a railway switch-frog is avoided.

The timber-plant for supporting each pair of way-rollers may consist of two common railroad-ties, laid side by side across the line, and resting on three short sleepers of like material, sunk below the surface of the ground. To this the guide-rail and way-rollers are fastened by long, strong lag-screws. Otherwise, three pile-posts of length and size to carry the grade over moderate undulations may be driven deep below frost, and two transverse connecting cap-timbers, on opposite sides of the pile-heads, serve for the attachment of the guide rail and of the journal-boxes of the rollers. The roll way can thus be carried above the general surface, unobstructed by deep snow on the occurrence of inundations in valleys. Furthermore, in this mode of making the roadway, it is unnecessary to move the ground for grading, save in places requiring deep cutting or embankment. The economy of cost can be increased by using steam-power machinery to drive and dress the heads of the pile-posts, for fitting on the cap-pieces, the apparatus being carried on the structure, which is made as it progresses.

Steep grades are to be overcome by having stationary auxiliary steam-power, by connecting on the same shaft a pair of way-rollers, and this is repeated at intervals of three or five hundred feet on the line of ascent. On one extended end of each shaft a simple form of rotary engine is attached, to operate which steam is supplied by a protected steam-pipe underground along the line, connected with stationary boilers suitably located. For this use reversible, reactory engines on the Parker-mill rotary plan, are preferable for their simplicity and cheapness. The weight of the train resting on the rollers affords adhesion to the runners, and the attached rotary engine causes the connected rollers to revolve and propel the train. Arrangements are provided for the automatic admission of steam to each rotary successively on the approach of the train, and also to shut off steam as the rear end of the train passes over. For underground and elevated lines of transit the system is especially urged for its cheapness and security.

The claim is set up in its behalf that the cost of constructing the roll-way is from one-half to two-thirds less than the ordinary railway, while the cost of equipment is proportionately smaller. The following are the inventor's comparative estimates of roll-way superstructures : — 3½ railroad ties, $1 40 c ; 42 feet 4 by 8 inches pine scantling, 67 c.; 14 feet oak, 4 by 5 inches, 42 c ; 160 pounds iron guide-rail, $7 20 c.; 18 pounds bolts and lag-screws at 8 c., $1 34 c.; 4 pounds spikes at 5 c., 20 c.; 1 pair way-rollers, $4 ; 1 day labour. $2 50 c.; cost per mile, $17 83 c. × 330, or $5,883 90 c.

When the superstructure is made on short pile-posts, as previously described, the cost of materials does not exceed that on ties, given in the column above, while the estimated expense for labour on track-work and grading is less. The following is a comparison of cost per mile of superstructure, including ties on roll-ways and railways :—

Railway, standard 4 feet 8½ inch gauge, $11,735 ; Roll-way, 5 feet gauge, $5,883.90c. ; ratio, as 1 to 0·5. Cost of freight trains of 200 tons load capacity :— Railway, 20 box cars, $13,-700 ; engine $12,000.—$35,700 ; roll-way, 13 box cars, $6,500 ; engine, $5,000.—$11,500 ; ratio, as 1 to 0·44 dols. Dead weights of trains of 200 tons load capacity : — Railway, 20 cars, weight 190 tons, 1 engine and tender, 35 tons, 225 tons ; roll-way, 13 cars, weight 91 tons, 1 engine, 15 tons, 106 tons ; ratio, as 1 to 0·47. Resistance of loaded trains at 30 miles an hour, on level : — Railway, 225 + 200 425 tons, 13 lb. coefficient per ton, 5,525 lb.; roll-way, 106 + 200 — 306 tons 7 lb. estimated per ton, 2,149 lb , ratio, as 1 to 0·38. Starting resistance of loaded trains on level way : Railway is 425 tons, 18 lb. coefficient of starting R, 7,650 lb.; roll-way is 306 tons, 6 lb. coefficient of starting R, 1,836 lb., ratio, as 1 to 0·24.

It is claimed for the roll-way that it is safer than the railway, since there is no danger arising from the breakage of wheels, trucks, or axles, while from the nature of the locomotion, friction, and mode of construction, they will be more durable and need less repairing. Ordinary railroads can be converted into roll-roads at a comparatively small outlay.

MORTAR.

The mode in which lime acts, and the changes it undergoes with the lapse of time when worked up with sand to form mortar are, even at the present day, very imperfectly understood, and would well repay investigation. Lime, while giving out superficially the water with which it has been mixed, absorbs also superficially a certain quantity of carbonic acid gas; but this absorption does not reach, in ordinary cases, to any great depth, for the central portions of mortars which have been exposed to the air for many ages are still found to contain an abundance of free lime. Thus Dr. Malcolmson was able to detect a large portion of hydrate of lime even in the mortar taken from the Great Pyramid.

A certain amount of combination between the lime and the silica of the sand does evidently take place, for each grain of sand is found to be externally converted into hydrated calcic silicate, which compound acquires gradually considerable hardness, and therefore contributes largely to the setting of the mortar Miller states that a mixture of carbonate of lime and lime, sets harder than a mortar of pure lime alone; so that it would appear that for many purposes, lime which has been slaked by exposure to air, and therefore contains a considerable proportion of carbonate, is to be preferred to that rapidly slaked by water. All old mortars, treated with an acid, yield a small proportion of gelatinous silica, a fact which proves that combination has taken place between the silicic acid and the lime.

There are, however, certain practical points connected with the production and behaviour of good mortar that have been carefully studied, and are worthy of being more widely known.

Supposing the lime employed be of good quality (fat), and the sand to be of medium sharpness, clean, and free from clay, the best proportion for ordinary purposes are 1 part lime to 6 or 7 of sand. Such a mixture will have but little tendency to crack, will dry slowly, but harden very completely.

Pure lime, worked up without sand, forms a mortar which cracks as it dries. If the quantity of sand above recommended be diminished, the mortar exhibits also this tendency to crack. Mortar made with a larger proportion of sand is short and difficult of application; its hardness also is not so great as with a due quantity of lime. Mortar made up with lime-water instead of common water, is of far superior quality to the ordinary article. The lime after slaking will produce a very much stronger and better mortar, if passed through the meshes of a very fine sieve.

The sand should not consist of rounded grains, but of particles bounded by flat surfaces; it should not be too fine in texture, and should be perfectly free from any saline matter or clay. To obtain it of equable size (and this is of great importance) it should be sifted in the open air to remove the finer grains and dust, and the second sifting, which serves to cleanse it from coarse rubble and clay, should be performed in a running stream of water, which removes at once the clay and finer particles.

The use of blood, skimmed milk, &c., in the hope of producing a mortar of greater hardness, is to be deprecated, unless when very inferior chalky limes are employed. In other cases the mortar does not set with its wonted hardness, and after the lapse of a year or two, the surface becomes covered with a fungoid vegetation, which naturally brings about disintegration of the whole mass.

The North Sydney *Herald* regrets to learn that destitution is still prevalent at the Lorway Mines, and that the pinchings of hunger are severely felt by many. A few have obtainted work, but most of the poorest yet remain unemployed. The people of Sydney Mines have nobly come to the front in contributing to the relief of their brethren.

MISCELLANEOUS.

The Goderich breakwater will be sixteen feet above low-water mark, with a breadth of 100 feet.

Ground gypsum, or plaster imported for agricultural purposes has been transferred to the free list.

Nova Scotia and Cape Breton have 93 lighthouses besides several fog whistles.

If gilt frames are varnished with copal varnish, they can be washed with cold water without injury.

The New York city authorities, who once peremptorily refused to allow the American Telegraph Company to lay its wires underground, are now seeking to compel all the companies to bury their wires.

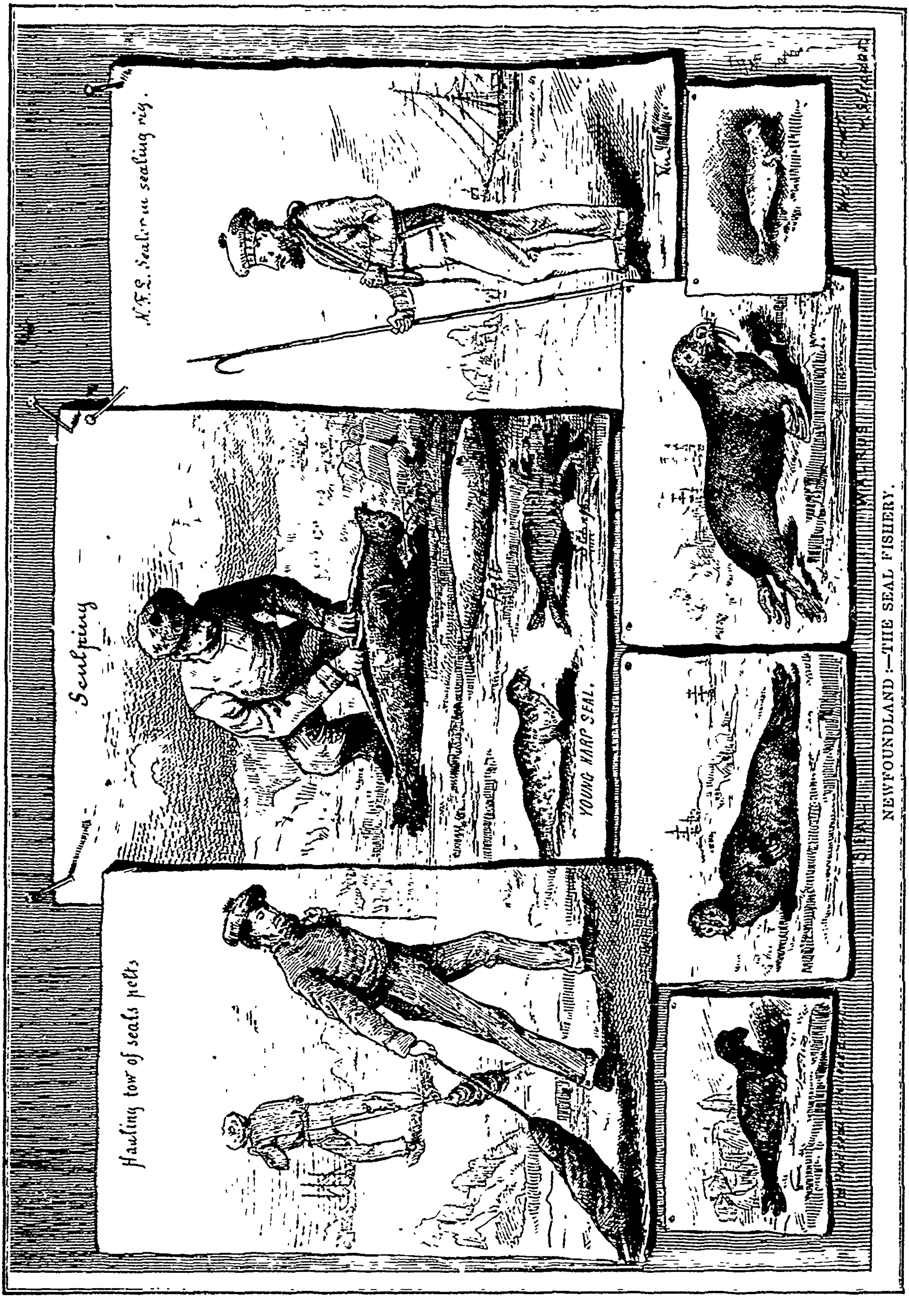
Kangaroo Leather.—In Australia kangaroo skins are becoming an important article of traffic, and experts declare that they make the toughest and most pliable leather in the world. Boot uppers of this material are said to be both comfortable and durable. It also makes the best of morocco whips, gloves, &c. Of these skins some are exported in their raw state, and others after being manufactured. The kangaroo is widely distributed throughout the colonies, and great numbers are slaughtered, yearly, for their skins.

Silver mining news published in the Algoma *Pioneer*, of the 2nd inst, is as follows:—"The Silver Islet mine has stopped paying the men until the 1st of June, with the exception of $5 per month, which is allowed each man. The erection of the stamp works is proceeding very quickly. The Shuniah mine, with only four men at work, continues to take out from a barrel to a barrel and a half of very rich silver, and has done so for weeks. Thunder Bay is expected to start with renewed vigour upon the opening of navigation. 3 A mine is also expected to start again, although nothing very definite is known regarding it as yet.

The hydrographic office at Paris has begun a process of engraving on copper which promises, by its rapidity and the moderation of its price to be very widely useful. It consists in substance, first, in covering a plate of copper with a thin shell of adhering silver, upon which is spread a thin layer of colored varnish; second, in drawing thereon, with a dry point, the lines of topography, and lettering, precisely as one engraves with a diamond upon stone, third, in corroding the traced parts by means of the perchloride of iron.

THE SEAL FISHERY.

The 5th of April was a memorable day in the old port of St. Johns, Newfoundland. Two of the sealing vessels returned from their cruise laden with booty. The steamer "Greenland" had 25,000 seals on board, as many as she could possibly load. She was followed by the "Proteus," with 42,000 seals, the largest number by far ever brought in by one vessel. The seals were fine harps, in excellent condition. The value of the 67,000 seals brought in by those two steamers is $198,000. Our correspondent writes. "The sealers did not leave St. John until the 15th March, and to-day the "Proteus" seals are valued at $100,000. Good work for three weeks." We should think it was. A big Bonanza. These steamers brought good accounts of other vessels. The following were reported by them as fully loaded: Ranger, Walrus, Hawk, Iceland, Nimrod, Commodore and the Mic Mac were seen entering the seal meadows with every chance of filling up These vessels unloaded as quickly as possible and started on their second trips, and may bring many more seals. The young seals are born on the ice about the middle of February; and as they grow rapidly, and yield the finest oil, the object of the hunters is to reach them in their babyhood, while yet fed by their mothers' milk, and while they can make no effort to escape. So quickly do they increase in bulk that by the 22nd of March they are fat and in the most desirable condition to be taken. For six weeks they are fed by their mothers on the ice, and soon after the 1st of April take to the water, and then pursuit is almost useless. The hunters, after that date, turn their attention to the old ones.



NEWFOUNDLAND:—THE SEAL FISHERY.