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The Canadian Patent Office Record and Mechanics' Magazine

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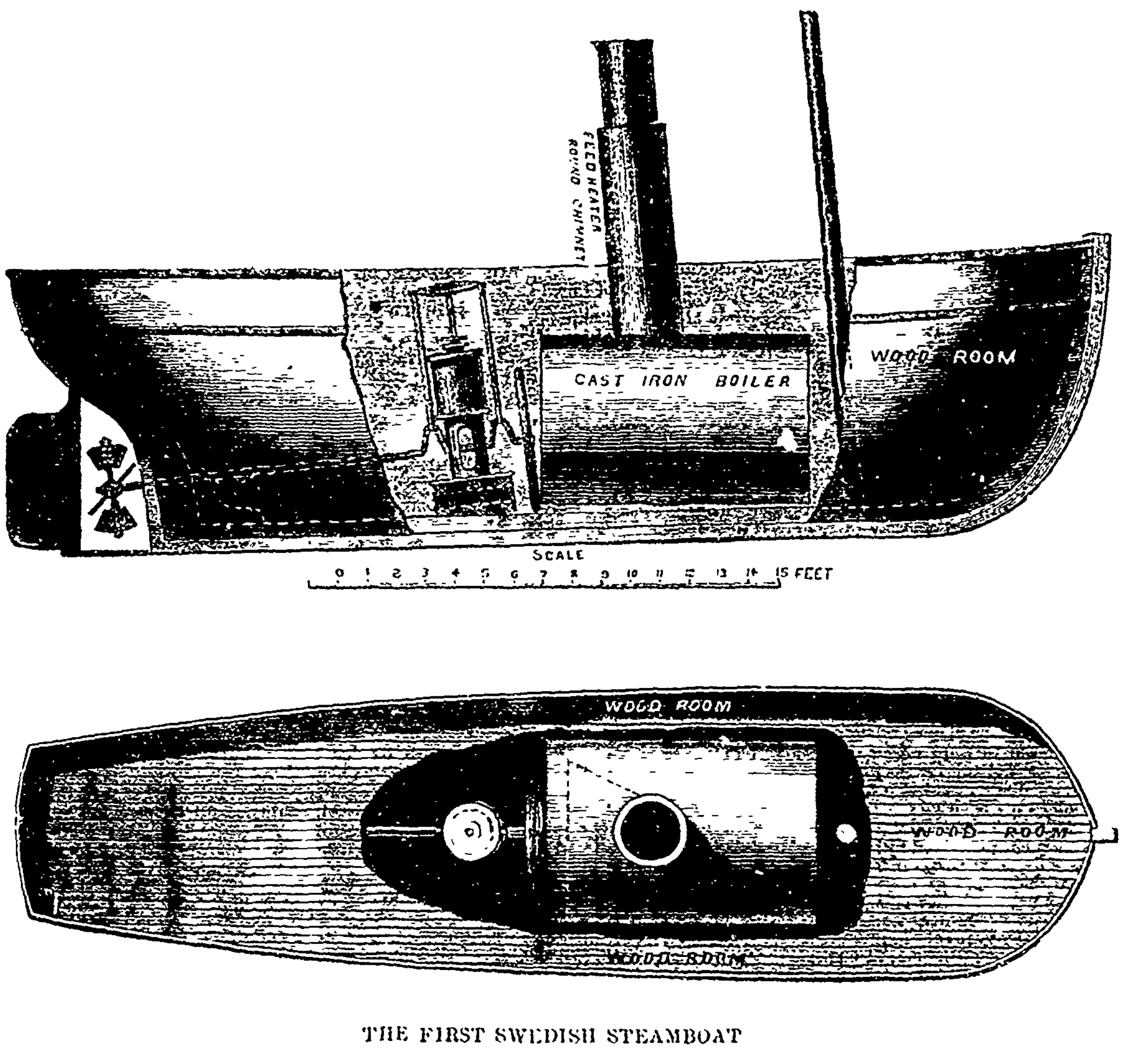


THE FIRST SWEDISH STEAMBOAT

THE FIRST SWEDISH STEAMBOAT.

In 1804, an English engineer, Samuel Owen by name, was sent to Sweden by his employers, Messrs. Fenton and Murray, of Leeds, to erect a steam engine for a person called Edelcrantz, and was employed in various engineering undertakings throughout Sweden until the year 1809, when he established himself as an engineer and ironfounder at Kungsholmen, an island forming part of Stockholm, where he worked more than thirty years producing steamers and steam engines. He was the first to introduce the former into Sweden. His first attempt was made in 1816, by placing on board a craft, which he called the Witch, an 8-horse condensing engine which drove a propeller with four blades.

Our engraving on page 259, which we reproduce from the columns of the *Engineer*, is a copy from Owen's original drawing. With this arrangement the Witch had a speed of four and a-half knots an hour, which was even in those days considered to be too slow. In 1818 this engine was taken out of the Witch and put on board of a steamer called the "Amphitrite." It was connected through gearing with side wheels, and a speed of between five and six knots was obtained. This was the first passenger boat in Sweden. From this it will be seen that Owen was the father, so to speak, of steamers in Sweden, and is acknowledged as such by the Swedes in general who are now erecting a monument to his honour in Stockholm; this monument is to be unveiled on the 12th of May next, the 100th anniversary of Owen's birth, and a scholarship will also be created at the engineering college, which will be called the Samuel Owen's Scholarship. He died in Stockholm in 1854.

SINGLE RAIL RAILWAYS.

Haddan's Pioneer or Single Rail Caravan.

The present system of railway construction is just now the object of many attempts at alteration, or rather of adaptation to the requirements of the different localities in which attempts are being made to extend the great pioneer and improver of civilization. We have already referred to the very narrow gauge roads which have been so successfully carried out in Wales, and more recently we described a locomotive constructed in the United States for use on a single elevated rail. Our illustration on page 262 is of a new cheap railway, the invention of Mr. J. L. Haddan, C. E., engineer in chief to the Imperial Ottoman Government. It is from the columns of *The Engineer*, to which journal we are indebted for the following description of this curious invention.

"Many attempts, (says Mr. Haddan) have been made with the view of substituting one rail or two in the construction of railways and tramways, though hitherto with but indifferent success; for as a rule we find that three rails or running surfaces of different materials have simply been substituted for the usual pair of iron rails.

"The practical experiments hitherto made in this direction have been principally confined to existing roads, where the central rail is supposed to carry the greater part of the weight, the equilibrium being maintained by huge side wheels running on the road itself. In France and Portugal considerable success has attended this system, though theoretically it is far from being perfect, especially for a constantly changing load, such as passengers; moreover, it is open to the objection of requiring a first-rate road."

Mr. Haddan then states that it has been his endeavour for some years past to provide an economical railway suitable for a country like Turkey, where all the conditions are very unfavourable to railway construction proper, and so very different in every respect from England. "Money at 20 per cent., traffic inconsiderable, country very rough, all materials and skilled labour to be imported, no no ion of the value of time, water scarce, enterprise unknown, labour far from plentiful, fuel dear, soil for the most part rocky or marshy, distances enormous, transport often impossible, produce generally agricultural—and therefore bulky—difficult and costly of transport, no cross-roads, few, if any, important manufacturing centres; the only feasible outlets are the river-beds, for the most part far too steep for railway use, and whose valleys moreover are generally far too narrow and precipitous to admit of making detours for so moderating the inclines as to render them practicable for railways. In Asia Minor it has been found impossible to penetrate the country, except with miles upon miles of gradients of 1 in 30, and only then by means of the sharpest of curves, frequent tunnels and viaducts, and the heaviest of earthworks."

Mr. Haddan, after some remarks on the working of ordinary lines, goes on: "To obtain perfect economy in the construction of a railway, all the parts of a train should weigh the same per metre run, else we shall find our rails and bridges too strong for the weight of the carriages, or not strong enough to support the ponderous engine. Seeing that the disparity of weight between our carriages and engines is as much as 4 to 1, it shows us that by simply reducing the weight of the engine to that of the carriages we should obtain off the reel an economy of 75 per cent. in the first cost of rails and girders, and in addition no mean saving of wear and tear. Next, the moment we leave the level and attempt inclines our engine has to be made still heavier, and mighty brakes—worse than useless in ascending—have to be made use of for the descents; whereas, in fact, the steeper the inclines the more we ought to lighten our burdens, but, unfortunately, the very reverse is the case in practice.

"All such objections (says Mr. Haddan) have been carefully met in designing the Pioneer, which the author considers peculiarly suitable for Turkey, the colonies, and even the mountainous portions of our own country. The Pioneer or steam caravan, has its origin in a wooden post and rail railway erected some thirty years since at Posen. It worked for many years drawn by horses, and later on by a stationary engine, but locomotive steam traction could not be made use of owing to the fact that weight was in those days necessary for obtaining power in the locomotive—a burden which the wooden fence could not stand. Many engineers have since attempted to overcome this difficulty, but it seems to me that the Fell horizontal grip, where unlimited adhesive power can be obtained quite irrespective of the weight of the engine, is the only practical means of overcoming the difficulty. The permanent way of the Pioneer consists of a wall of a minimum height of 2ft. 3in. and 14in. thick, surmounted by a single rail and sleeper, which simply consists of a 1½in. plank laid on edge in cement and tipped with thin half round iron strips. The wall rarely exceeds 2ft. 3in. in height, because the gripping powers of the locomotive allow the gradients to be traced nearly coincident with the natural surface of the ground, that is to say, with its grosser features. Of course little dips are not gone into, and ravines are made light of and spanned by sandwich arches in masonry, or with a single iron girder of but a few inches in width. The locomotive and rolling stock are, so to speak, "twin," and mount astride the wall like a man on horseback, or rather like the panniers on a donkey. The carriages are thus double, one-half on either side of the wall, the roof being common to both; there is a space of about 18in. in width between the two halves, forming as it were a passage between them, in the upper part of which are situated the single wheels which are to run on the summit of the wall; the lower part of the passage is open from end to end to allow the carriage, when hung on the wall, to hang down to a depth of 2ft. 3in. on either side. The locomotive is purposely extended as much as possible and is articulated, water in one section, fuel in another, boilers in another; by which means its weight per metre does not exceed that of the carriages or wagons when laden. The weight per metre run is about 8 cwt. The total length is 24ft. 8 metres, and its power is sufficient to take 100 passengers up an incline of 1 in 10 at a speed of fifteen miles an hour. The great economy manifested in the construction of the Pioneer permanent way is owing to nine major points and divers less important ones:—(1) The load is spread out over as great a length as possible, and concentration of weight is carefully eschewed. (2) The load or weight of the train is evenly distributed throughout. (3) No banks or cuttings are required, owing to the special powers of the locomotive enabling the train to follow the natural surface of the soil. (4) No transverse levelling of the soil is required, because the train does not run on the ground, but on the top of the wall. (5) The size of the rolling stock is reduced to the minimum, sufficiently large to accommodate passengers almost singly, and goods piecemeal, whereby the size and cost of tunnels and under-bridges are reduced to a mere trifle. (6) The light weight of the Pioneer permits rapid travelling even over the roughest ground. (7) The time of construction may be measured by months instead of years, an important economical item, where interest on money is so high as in Turkey. (8) When constructed in iron the *whole* is transportable. (9) The Pioneer, owing to its climbing powers, can follow a crow line more nearly, and can open up hitherto inaccessible positions; and, moreover, can follow up the rivers (in their beds, if necessary), which frequently form the only means of communication in most mountainous countries.

"The locomotive is fitted on its underside with two pairs of horizontal wheels covered with leather, which grip the wall on either side with any desired force. Owing to the constant changes of gradient incidental to following the natural surface of the ground, the intensity of the grip should constantly vary, which is effected by a screw and lever arrangement acted upon by the draw-bar, which attaches the engine to the train. Thus, as the inclines are steep or moderate, so does the pull on the draw-bar vary, and by its action on the horizontal driving-wheels open or close their full embrace, moderating the adhesion or grip precisely in the proportion that the gravity of the train varies in its ascents and descents. Thus the whole weight of the train is secured for adhesive purposes.

"The equilibrium of the locomotive is maintained by the grip of its horizontal wheels. The train is composed, firstly, of a locomotive, then of a caravan of articulated carriages, each articulation being about 7 ft. long, the whole concluding with a brake-van, fitted like the engine with four horizontal wheels. The whole mass is attached together by rigid couplings, which, while freely permitting articulation do not allow of the smallest lateral motion; that is to say, that no single carriage can lose its balance, upheld as it is by its two companions fore and aft; and as the whole train is continuous, the horizontal wheels of the engine at one extremity of the train and those of the brake-van at the other, effectually maintain the equilibrium of the whole train and prevent all oscillation whatsoever. A train of twenty-four of our basket carriages, capable of accommodating ninety-six passengers, will measure in length about 50 metres, and will weigh about 20 tons = 8 cwt. per metre run. Each double carriage contains four passengers, two on either side of the wall and facing each other. The seats are composed of slung strips of carpet—like American chairs—the balance of the passengers is consequently always preserved, even on the stiffest inclines. The brake-van is fitted with a stair passage to allow of communication with both sides of the train. I spoke of the permanent way as a brick wall—in some cases I should adopt stone or concrete; and in marshy districts a light wooden or iron viaduct, consisting of a single line of posts or columns In all cases the external dimensions of the wall or fence must be the same, so that though different soils may be differently treated, yet the permanent way will be continuous. That portion of the wall or other structure which the horizontal wheels work against is especially prepared for their grip. In the case of the wall it consists of a string of cement, and where posts and rails are used, of light iron or wood rafters strutted to resist compression. In semi-tropical countries it is very difficult to avoid interference with the water-sheds. The Pioneer leaves innumerable openings in the wall for this purpose, the numbers of these culverts positively diminishing in lieu of increasing the cost. Necessarily posts and rails would be used in the most exposed positions, and in crossing rivers or arms of the sea. In Asia Minor as in many other places where no cross feeder roads exist, it becomes necessary that the main line should accommodate as large an area as possible. Therefore the Pioneer double line is not constructed as at home, side by side, but the up-line takes quite an independent route from the down-line, touching every now and then at the important towns. Where only a single line is used it forms on alternate days an 'up' or 'down' line.

"The cost of the Pioneer may vary between £300 and £1000 per kilometre, a safe rule being to divide an ordinary railway estimate by ten. Most of the railways in Turkey run but one train either way in the twenty-four hours, all the rest of the day the whole of the vast capital is lying idle. The Pioneer will, on the contrary, run its caravans all day long, and compete with its giant opponent like the hare with the tortoise."

Mr. Haddan concludes his paper with a few extracts from his work, "The Proper Gauge for Turkish Railways."

We have only to add that a line on this system is to be constructed from Alexandretta to Aleppo, a distance of ninety-eight miles. The cost is put down at £100,000. The annual outlay for camel and mule transport, according to Mr Consul Skéne's report, averages per annum £50,000 The company therefore, expect a profit of at least 30 per cent. or 40 per cent. The works, Mr. Haddan states, will require twelve months only for their construction The first train on this system is now being constructed for the company in Munich.

PUNCHING COLD IRON.

By Coleman Sellers.

At the meeting of the Franklin Institute, held in December 1873, two cold punched hexagon nuts were exhibited by Messrs. Hoopes and Townsend, bolt, nut, and washer makers of Philadelphia. These specimens are worthy of attention from the fact that one of them had a hole one quarter of an inch in diameter and one inch deep, the other was perforated with a hole half an inch in diameter and one and a half inches deep.

These specimens are remarkable when we take into consideration the oft-made statement "that the maximum thickness of iron that can be punched cold is about the diameter of the punch," as the depth of the smallest nut is four diameters of the punch, and the largest one three diameters of the punch.

In conversation with Mr. Barton Hoopes, who has conducted these experiments, I learn that he has since succeeded in punching a half-inch hole through an inch and three-quarters thickness of wrought iron; the punching which came out of the hole I have examined, and it differs in no respect from ordinary punchings, but it has been compressed to seven-eighths of an inch in length—that is, the punching shows an irregular cylinder half-inch in diameter and seven-eighths of an inch long. The metal forming the punching is not condensed into a smooth cylinder, but shows the usual roughness common to all iron punchings, while the punched holes are very smooth.

The punch and die hole were the same size, and there has evidently been a side flow of the cold metal upon the entrance of the punch, and the operation may in a measure be considered a piercing one, up to a certain depth and finally the punching out of the residuum after it has attained that depth.

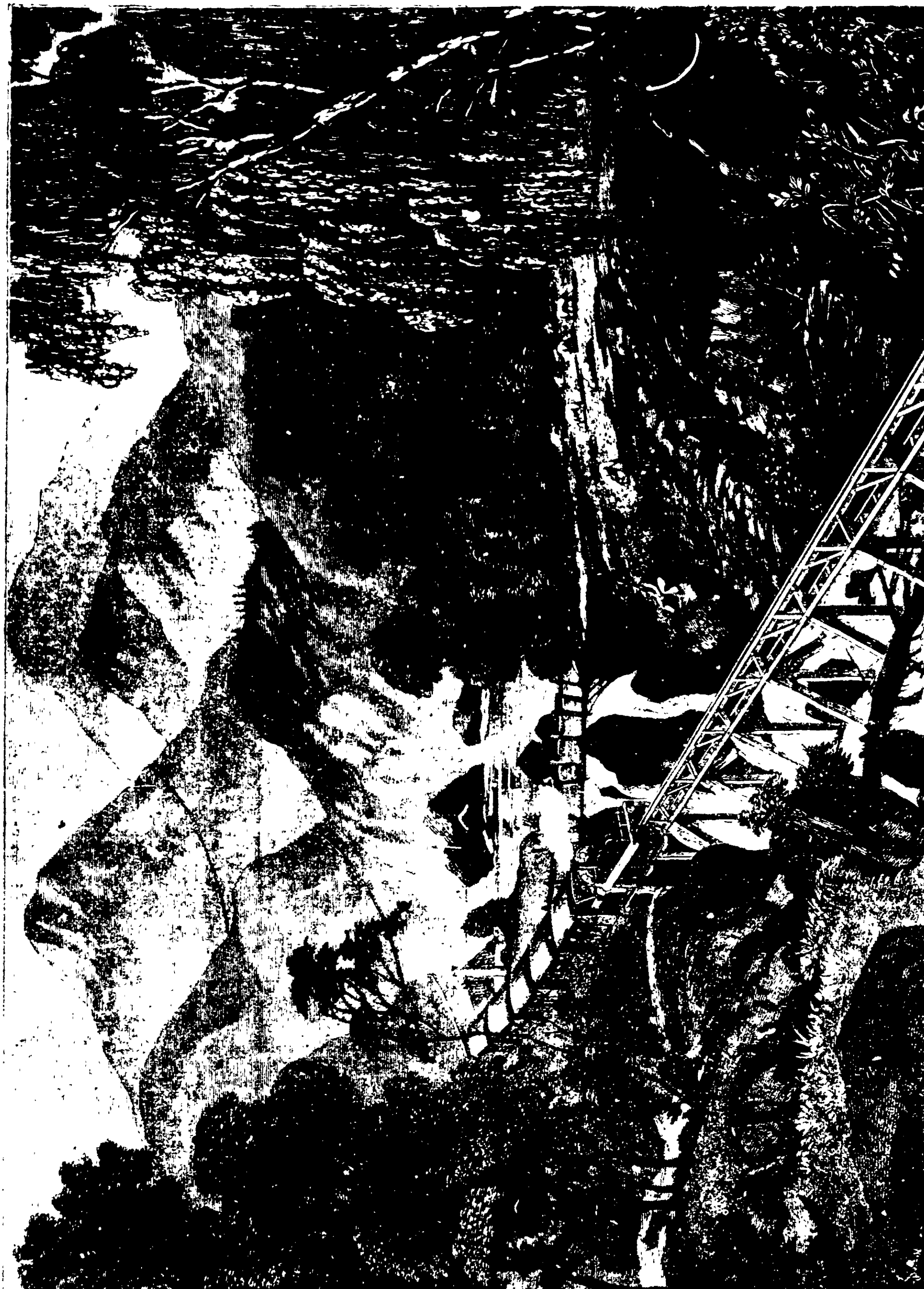
In punching the quarter-inch hole through one-inch iron, the punching showed a very smooth surface, and was only three-eighths of an inch long, seemingly very much compressed.

I have examined the punches used in this curious experiment; they differ in no respect from ordinary punches; they are made of good steel and hardened in some peculiar manner unknown to me.

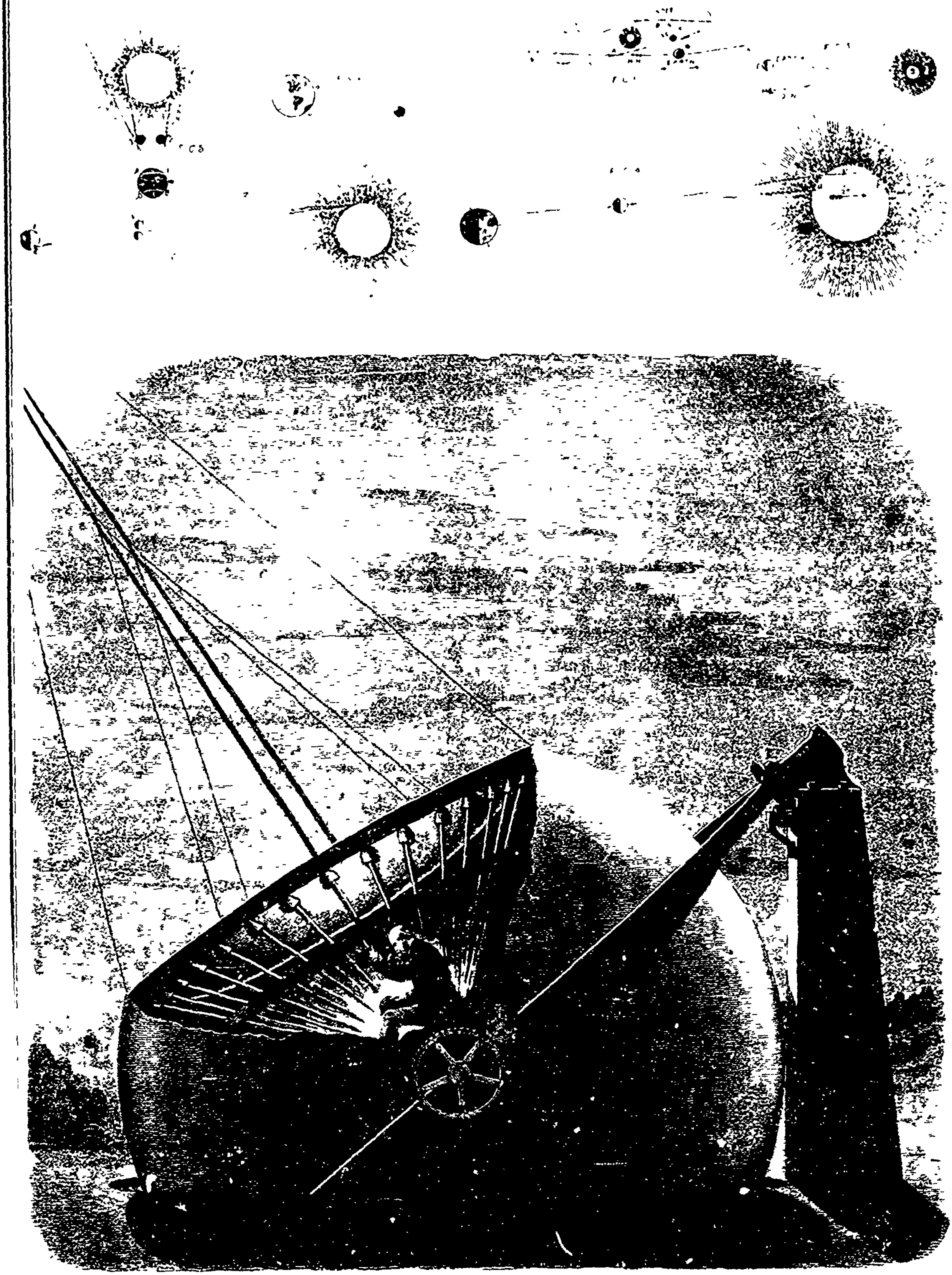
Bars of iron one inch square, punched with a quarter inch punch, show a sensible widening under the action of the punch, and a bar of inch and three quarters square iron, punched with a half-inch punch, is swelled sidewise to an inch and thirteen-sixteenths, showing conclusively that some of the iron has been forced sidewise.

The machines used in driving the punch through this great thickness are said to be of unusual strength and accuracy of construction.

American Patents.—The number of American patents granted since 1836 is about 140,000. The number of applications for patents has steadily increased from year to year, until it now averages from 20 000 to 21,000 per annum, and the number of patents granted annually is from 13,000 to 15,000. To perform the work of examining this large number of applications, the corps of expert examiners has been increased from time to time until it now numbers about 100; twenty-four principal examiners, and the same number of first, second, and third assistant examiners, together with a special examiner of trade marks and also of interferences. The clerical force has been correspondingly increased, so that the officials of all grades now employed in the office may be stated in round numbers as about 500. I should be remembered, when comparing the number of English and American patents, that in the States many designs, &c., are patented which are only registered in England.



HADDAN'S PIONEER. (See page 260.)



NEW AND GIGANTIC TELESCOPE. (See page 269.)

THE TRANSIT OF VENUS.

I.

We need hardly inform our readers that it is intended that 1874 is to witness an astronomical effort of an international character and of a magnitude without precedent. The Governments of Great Britain, France, Germany, Russia, and America, have long made their plans for taking observations in various quarters of the world of the transit of Venus, to be looked for on Dec. 8th, 1874. Probably few who have read the controversial articles in the daily papers on this subject are aware that many of our astronomers have been looking forward to this event for nearly fifty years. It is well to understand before entering on the subject that the organisation of the various expeditions is the result, in at all events most cases of long matured plans. A year ago, on the occasion of the annual Greenwich visitation, a visitor remarked on the completeness and care with which a map had "already" been drawn up showing points connected with the stations for observing the transit, to which the reply was made that that particular map had been executed for considerably over thirty years. It is not our aim to enter into any discussion as to the precise advantage of each detail in the plan that is being carried out, but we may observe that if England, France, Russia, and America — for the charge of error applies to at all events these four, so that they must be included in the designation used by the *Times*, "the Astronomer Royal and his friends" if, we say, England, France, and Russia and America are going to "send expeditions to find an astronomical mare's nest,' the mistake has been made after great deliberation. We have just said, however, that our object is not to take up any controversy; we may further add, that it is not to handle the subject in an abstruse way. We have waited purposely until the preparations were so far advanced as to enable us to deal with them in a practical fashion, which we can now do, noticing any new and peculiar features in the instruments employed.

Looking at the project from an engineer's point of view, we will first consider the nature of the work required, and with the assistance of a few cuts put the problem before our readers, stripped as far as possible of difficulties and technical expressions, although in doing so we must frequently ignore minor processes and corrections.

To enable those who may know nothing of this matter to follow what is said, it must be first explained that a transit of Venus is the passage of Venus directly between the earth, and the sun, so that from the former she is seen to cross the sun's disc, standing out against it as a round black spot. Venus and Mercury are the only inferior planets—that is to say, the only two planets who revolve round the sun inside the orbit of the earth; they are, therefore, the only bodies, the moon excepted, that ever pass between the sun and the earth. Both Mercury and Venus frequently pass the earth, as their periods of revolution are much less than hers, but as their orbits are in planes inclined at considerable angles to hers, an actual transit only occurs when either of them overtakes and passes her, as it were, very near a point of intersection of the orbits (*vide* Fig. 1), when the planet is seen against the sun in the manner we describe. Thus, if A be one intersection of the orbits of Venus and the earth, it is evident that Venus will only be seen against the sun when she passes the earth at a point very near A—in other words, near the node of her orbit. At other times she would appear to pass above or below the sun if she could be seen, which as a matter of fact, is impossible, both because her dark side is then towards us, and also because if it were not so, the brightness of the sun would make her light imperceptible. A transit of Venus, in fact, corresponds to an eclipse of the sun, only that Venus is too far away from us to hide the entire disc as the moon does, she only covers a very small spot of the sun as she crosses it. Venus passes the earth at intervals occurring rather more frequently than every eighteen months. It is not necessary to give the exact intervals, but, as they occur rather more frequently than would form any exact division of any complete number of years, the points at which they take place come earlier and earlier on the earth's orbit. Thus, in Fig. 1, the arrow showing the direction of the earth's motion, we may suppose Venus to pass her consecutively at A, B, and C. After passing at A, a year and a half, (or more strictly speaking nearly a year and two-fifths) will elapse, and passage B will take place, and so on C, D, &c., the sixth conjunction, F, after an interval of nearly eight years, occurring very near the same spot as A. Thus, as the writer in the *Times* puts it, the conjunctions or passages may be supposed to form a five-spoked wheel, whose spokes move slowly backwards, and whenever one occurs close to a node a "transit" takes place. This happens, however, only about every 112 years, when it may occur either once or twice. For example, if the conjunction indicated by I happened very close to a node, then both N and D would be too far from the node for Venus to be seen in line with the sun; but if the node was nearly half way between N and I, then both those two would be visible as transits, in one case Venus being seen near the northern limb of the sun, and in the other near the southern. In this way it happens that a transit will occur in 1874, and again in 1882. Both will be, of course, at the same part of the earth's orbit, viz., in December, so that the southern pole of the earth will in each case be towards the sun, but Venus will be seen from the northern hemisphere to cross the sun, as it were, high up and low down respectively.

In these practical times, however, it may be asked, why is all this a matter to interest anyone except astronomers; that is to say, to interest them so keenly as to cause large sums of money to be expended by civilized nations in observing the phenomena referred to? The answer to which is that a well-observed transit of Venus enables us to measure the distance to the sun, and, indeed, to all the worlds which constitute the solar system. The labours of astronomers have furnished us with a map of our system on which the *relative* distances have been determined, but there is some doubt as to the *scale* they have supplied to the map in question. Nay, what had been laid down as the sun's distance, namely, 95½ millions, of miles is now believed to be incorrect by perhaps as much as 4½ millions. We look to the coming transits to decide this question. Further, since the masses of the heavenly bodies have been calculated on the supposition of their distances being correct, it follows that with a decrease of distance must be made one of bulk, so that the mass of our entire system (the earth and moon excepted) awaits its fresh estimate after the coming transit.

Some sordid objector, however, may not see the necessity for wanting to know all these matters, just as Mr. Peter Magnus told Mr Pickwick he did not see the necessity for anything original; and to this there is no answer, except the admission that there *is* no necessity for it. We have gone on very well, it may be said, thinking that the sun was 95 millions of miles away, why disturb him and bring him nearer and make him smaller? Nay, we got on very fairly once, and were well satisfied in thinking that the earth was flat, and the sun, moon, and stars pretty little twinkling things moving round us. There is clearly no necessity for knowing the sun's distance, but, it may be added, there is no necessity for railroads, submarine telegraphs, or mail—an observation that has some point, inasmuch as the discovery of America itself was due to astronomy. Two opportunities are now afforded us of measuring the vast dimensions of the solar system which will not again occur for 112 years; it is clearly the duty of civilized nations to avail themselves of them. It is hardly right to call upon astronomers to predict all the uses that may be made of the information in an age when new sciences spring up so rapidly round us. It may be sufficient, perhaps, here to indicate one. Almost the only method of determining longitude is by observations of the moon's apparent place among the stars. The accuracy of the result depends on our knowledge of the moon's motion and path in the heavens, and this depends directly on the action of the sun. As Professor Forbes, in his able paper read at Glasgow last winter, says, "In the lunar theory an equation appears connecting the relative masses of the earth and sun with the solar parallax, so that if we know the one we can find the other." Thus, by means of the moon we may in time form an estimate of the sun's distance; but surely it is very important to have the value of the sun's distance directly, and to check or improve our lunar tables, on which so much depends, to the fullest possible extent. Few people are aware of the magnitude of the errors in the existing maps of the world and globes. Thus, in facilitating observations of longitude, we perform a most practical work. Concisely, then, the distance to the sun or to Venus—for the relation between them is known—does this: it furnishes a *scale* to our map of the solar system, and it facilitates the accurate measurement of the world.

To come, however, to how the sun's distance is measured by means of the transit of Venus. It may be well to consider what means would naturally suggest themselves for measuring the sun's distance generally, and why they fail in the accomplishment of the object. The Astronomer Royal has made this matter so clear in his Ipswich lectures on popular astronomy that we cannot do better than refer any reader to them for a more full description of the subject.

The distance to a heavenly body is ascertained on the same principle as that of an earthly one. A base line is measured, from the extremities of which angles are observed to the distant body, and its distance becomes known. To do this, however, the base must be carefully determined and there must be some fixed line to measure the angles from. In terrestrial surveys, one end of the base is generally visible from the other end, so that at each may be measured the angle between the direction of the base line and the line pointing to the distant object. In celestial work this is impossible; the direction of the axis of the earth, however, within certain limits furnishes the necessary line of reference, on a similar principle to the use of the prismatic compass in surveying. Thus, in Fig. 2, suppose at station *a* the angle *a* to be measured between the moon and the celestial north pole, or, in other words, the moon's north polar distance, and again, at the station *b* the angle *b* or *b'*, which will be the moon's north polar or south polar distance, it is clear that the distance *a*, *b* being known, the moon's distance ought to follow. This actually may serve to represent processes which are carried on at the Greenwich and the Cape of Good Hope Observatories; but the distance even to the moon cannot be accurately obtained in this way, owing to the disturbing influence of the refraction. It may, however, serve our purpose as an illustration, and the angle *a*, M, *b*, which would follow from subtracting *b* from *a*, is theoretically the moon's parallax, that is to say, the angle subtended at the moon by the two points on the earth. Strictly speaking, the angle should be referred to points at the circumference and centre of the earth. As a matter of fact in this process the angles are measured from the vertical at each section, and corrected for the want of sphericity of the earth, which prevents the vertical from pointing to the earth's true centre, but, as we have said, we do not want to get entangled in corrections and details. It is sufficient here to observe that refraction takes away from the accuracy of the calculation, however performed, in the case of the moon, and if this be so, its influence on the measurement of the sun with a hot atmosphere in a state of vibration, is much greater and this delicate operation becomes impossible. With the moon the difficulty is diminished by measuring her distance from a near star, but, in the case of the sun, this again is out of the question, stars becoming invisible anywhere near it.

Fig 3 exhibits another proposed method of measuring the sun's distance. When the moon is half illuminated, or "dichotomised," the angle E M S being a right angle, the measurement of the angle M E S, combined with the known distance of the moon M E, gives a determination of the sun's distance, but the roughness of the moon's surface is such, and the angle M E S is also so near to a right angle, that the method is practically valueless. The velocity of light and the variation in the apparent time of phenomena, such as the eclipse of Jupiter's satellites, when the earth was at various distances from that planet, have been brought to bear on the solution of the question of the sun's distance with some success. But we will now pass on to show the manner in which it is obtained from a transit of Venus when well observed, which as yet can hardly be said to have been done.

There are two methods of dealing with the question, known as Halley's and Delisle's methods—the former is based on the fact that the relation between the distances of Venus and the sun are known, though, as we have said, not the actual distances. Speaking roughly, if the distance between Venus and the earth is called 2, that between Venus and the sun is 5

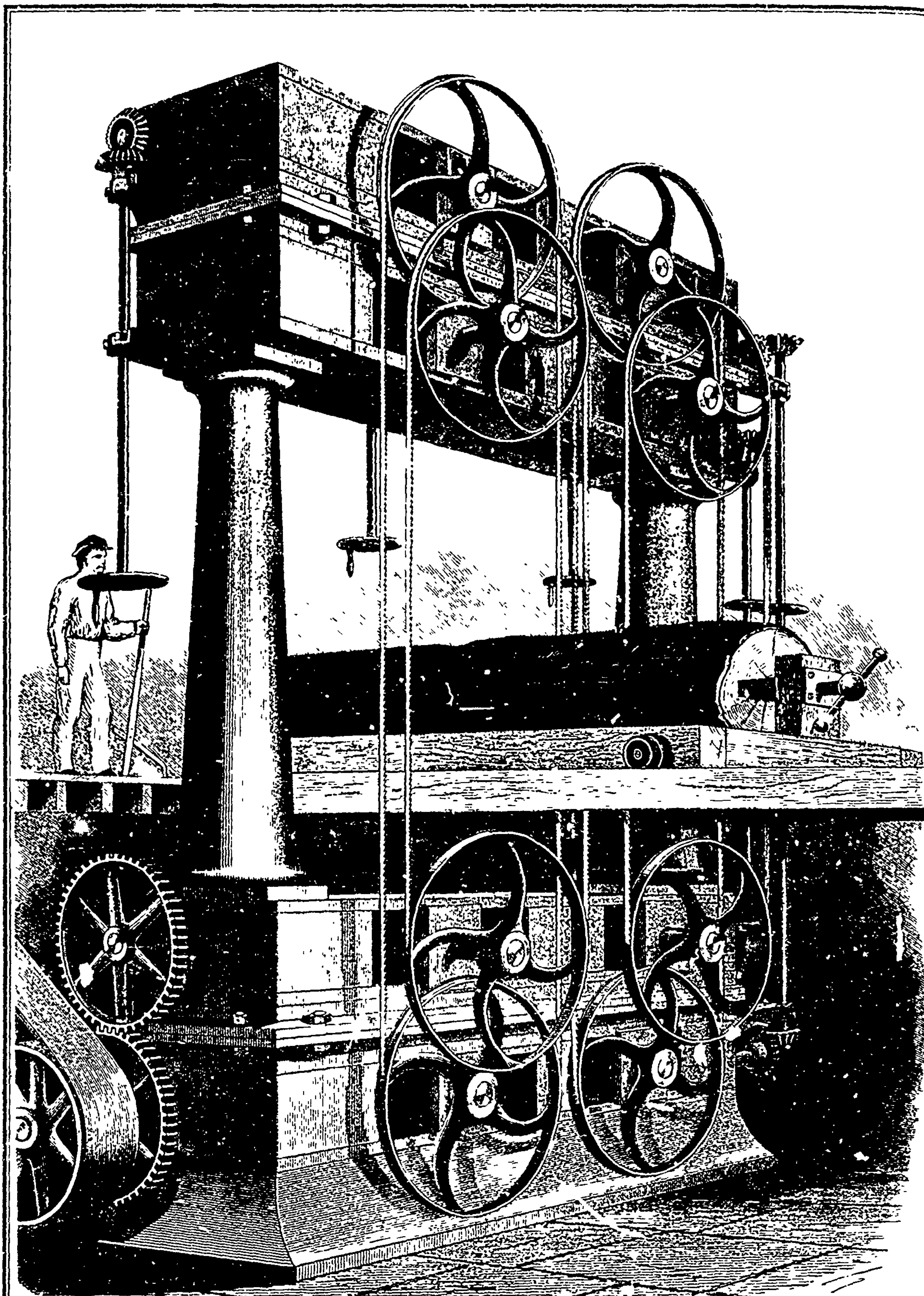
Let us suppose the transit observed from two places situated as shown in Fig. 4, which may serve to represent the actual stations in Rodriguez and Northern India, in the coming transit of 1874, at the commencement of the phenomenon, the direction of the rotation of the earth and apparent path of Venus across the sun being shown by the arrows. It is quite clear that at R Venus, will be seen to cross the sun's disc on the line *a b*, while at I she will be seen to move along *a' b'*. Supposing the entire phenomenon to be seen from each station, which is necessary for the success of Halley's method, we obtain the duration in time, which is the same thing as a certain angle for the passage or line *a b*, as observed at Kerguelen's Land, while we have the length of *a' b'* observed from India Now the distance of the base, I R, being known, and the angles at Venus equal and opposite, we have in the similar triangles the distance *v v'*, or the distance between *a b* and *a' b'*. Hence we get four points on the circumference of a circle whose dimensions become determined

For the full application of Halley's method, another physical feature of the occurrence must be turned to account For the explanation of this we must refer to Fig 5, borrowing it and our explanation again mainly from Sir G Airy's Ipswich lectures.

Let S *s*, and A B be the sun and earth respectively, our view being taken from a point on the side of the earth remote from the sun, say from Mars, so as to get an oblique downward view of the phenomenon. We will suppose the earth, as in the case of the transit of 1769, to have its north pole inclined towards the sun, or in other words, we suppose a June transit when it is summer in the northern hemisphere Venus passing along from V to *v*. When at V, an observer at A will see her just in contact with the sun's limb at S, but at a station on any other meridian, as for example, near *c* (shown in a dotted line because it is on the side of the earth next the sun, and concealed from us), Venus will be in the line *c* V, produced, that is, she will not yet be seen on the sun's disc. In short, A, whose position nearly corresponds to the apparent point of contact of Venus on the sun's limb, sees the phenomenon commence first. Now suppose A to be a point so chosen that its night terminates in time for it to arrive at *a* before the transit is ended, then we can see in the same way as before that Venus, now at *v*, will be seen on the sun's limb at *s*, from our station *a*, after it would appear to have left it, as seen from a station on any other meridian—for instance, the one that is at this moment at *c*. Thus, an observer at A sees the transit commence early, and having come round to *a*, he sees it terminate late, so that to him the time of transit has been greatly lengthened That it is possible, in the abstract, to select a station with a night short enough to occur during the interval of transit is obvious, seeing that we have only to go near enough to the pole to get a night as short as we like, or indeed, no night at all. On the same principle, we may select another station B, in the southern hemisphere, where transit is seen to commence in the morning and terminate before B, at evening, gets to *b*. On the principle we have just explained, Venus will be seen to come late on the sun's disc from B, and to leave it early from *b*. so that at this station, the time of transit will be reduced to a minimum. Thus, in 1769, at Wardhoe, in Lapland, the duration of the transit of Venus was 5h. 54min., while at Otaheite it was 5h. and 32min. Of the 22 min difference in duration about 12 min. was due to Wardhoe being towards the north, so that Venus appeared to cross a lower and broader part of the sun's disc than as seen at Otaheite, and 10min. was due to the position of the meridians at A and *a* and B and *b* as just now explained. It is obvious that in a large difference of duration a small error of observation will tell but little; for example, 5 seconds is only $\frac{1}{264}$ part of 22min., and thus if the whole of the 22 min. is dependent on the distance of Venus, or if it is, as it is termed, a function of it, which is the case, it is clear that we have very favourable observations for the solution of our problem.

It is necessary, however, to add that such favourable circumstances can seldom be expected to offer themselves. For instance the coming transit is a December one, when the south pole is towards the sun, and there is no station available for securing the observation of ingress in the evening, and the egress on the following morning, as just described. Again, it is often found that uncertain weather prevents the double observation of both ingress and egress, especially at stations selected from the equator; thus it happens that the second method we have referred to, that of Delisle, comes into use.

In Fig. 6, which we suppose to be a plan showing the position of the sun, earth, and Venus at a transit, an observer at E would see Venus on the limb at S, when to one at *e* she would be in the line V L, and be still invisible. Now, supposing Venus to remain stationary at V, an observer at *e*, whenever the earth moved him round to E's present position would see the same phenomenon as was seen at E, and at the same local time, that is, with stars and sun in nearly the same relative positions as they were to the first station at E; if, however, Venus moves, we can select a station which will be at *e* about



GANG BAND SAW-MILL. (See page 268.)

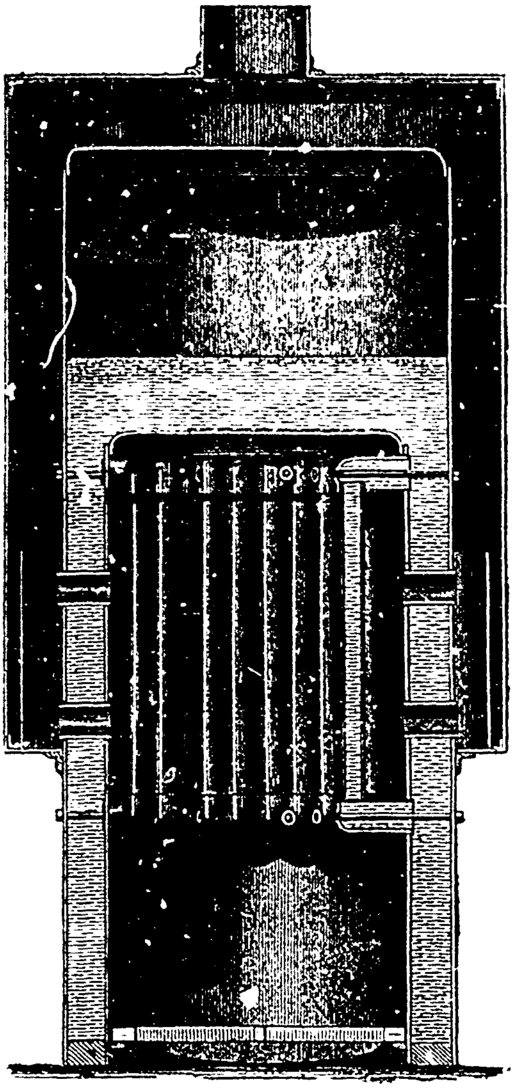


FIG. 1

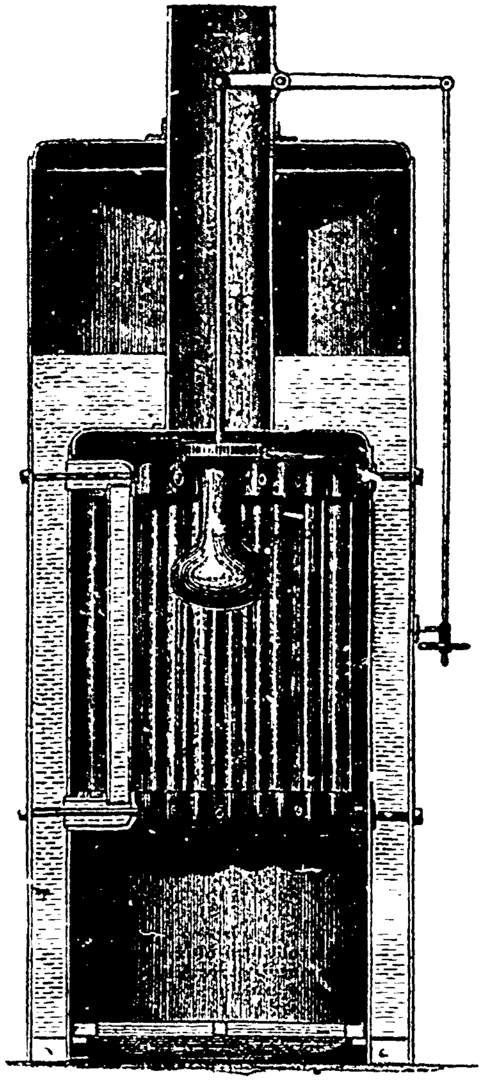
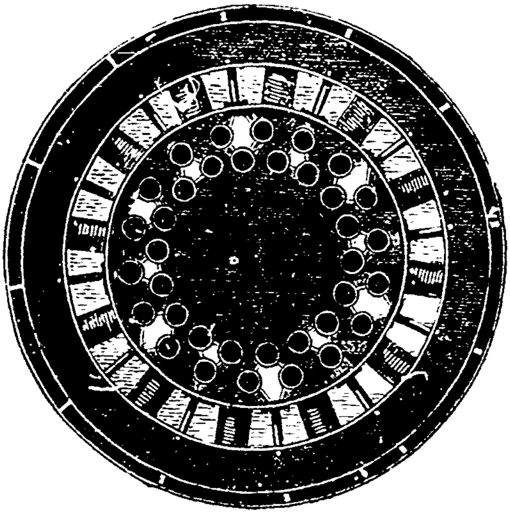
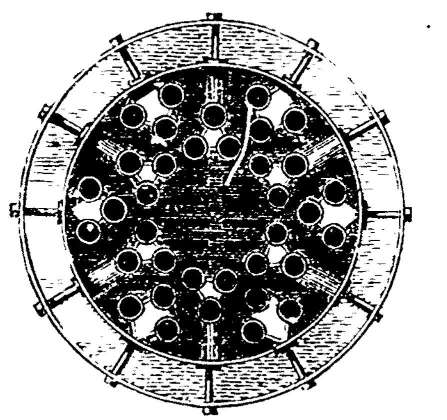


FIG. 2



SECTIONAL PLAN OF FIG. 1



SECTIONAL PLAN OF FIG. 2

HILL'S PATENT VERTICAL BOILER. (See page 268.)

the time when Venus reaches v, and thus an observer sees the contact long after the observer at E, although he sees it at early morn instead of evening, as he would if Venus remained at V and he had to come round to E to see her against the sun.

In short, the phenomena which would be seen in the regular arrival of the same local time to the successive stations are seen earlier at the more westerly station, owing to Venus' motion on her path causing her to meet the second station, and thus, as it were, arrive earlier and earlier in local time.

We come, then, to this—the transit is seen to commence some time earlier at a more westerly station, owing to the motion of Venus from V to v. Now the time that Venus takes in performing an entire revolution—or 360 deg. arc—round the sun is known; therefore the arc she describes in any given number of minutes is known, or, what is the same thing, the time being observed, the angle V S v becomes known—that is E S e, and since in this last triangle, the base E e is known, we have the necessary elements for the solution of the triangle, the angle at the base e E S being obviously consequent on the position of E and e. Hence it follows that the distance E S—the sun's distance—may be obtained. For this method it is clear that a single observation—that is, the ingress or egress alone—is valuable, and consequently there is a much better selection of stations open As compared with Halley's method however, Delisle's has the disadvantage of being dependent on longitude, while Halley's only requires latitude, which is more easily determined. Delisle's, however, so much better suits the circumstances of the 1874 transit, that the English, French, Russians and Americans have all selected certain stations favourable for the observation of the phenomena — that is, either the ingress or egress.

The selection of the individual stations, with the question of instruments, we reserve, however, for another article

GANG BAND SAW-MILL.

We illustrate on page 266, what we regard as a valuable improvement, and one at the present moment of great importance to the American lumber trade. Notwithstanding the fact, that the timber of this country is being consumed at such a fearfully rapid rate, as to threaten to exhaust the supply within a few years, it is well known, that an enormous waste in sawing is constantly going on. The great rapidity with which lumber can be cut with circular saws has caused the extensive adoption of circular saw-mills; and although the necessary thickness of these saws consumes in kerf, very much more than gangs of reciprocating saws, still, the speed with which the logs can be converted into lumber and marketed, by the use of circular saws, has rendered the latter very popular with lumber manufacturers, thus enabling them to increase the capacity of their mills and turn their money quicker.

The inventor of the gang band saw-mill, Mr. M. Sillman, of Brooklyn, N. Y., has supplied means, whereby equally as rapid conversion of logs into lumber is possible as with circular saw-mills, while, at the same time, very thin saws may be employed. With circular saws, cutting two-inch planks, not less than twelve per cent. of timber is wasted in the kerf. With Mr Sillman's invention, this waste can be reduced at least one-half, a very much larger percentage of saving being effected with thinner lumber. The advantages of reciprocating saws in gangs are thus secured, while, at the same time, rapidity of cutting, is attained equal to that of a circular saw-mill. The engraving will illustrates the construction of the mill. Upon examination, it well be seen that simplicity is a characteristic of the invention. It consists in the arrangement in juxtaposition with each other, of sets or series of band saws, and in the combination of shafts with the upper and lower journal-boxes of the pair of pulleys or wheels of opposite saws to each shaft, having a right-hand thread on one half, and a left-hand thread on the other half, intermediate shafts connecting each pair of screw shafts by suitable beveled gears, whereby the saws of the several pairs may be uniformly adjusted laterally, either towards or from each other.

Journal boxes composed of two parts, are used, one capable of sliding vertically within the other. A screw passes through the vertically sliding part, and impinging against the bottom of the other part, is [illegible]ated by a worm gear. This mechanism is controlled, and the tension of the saw adjusted from the sides of the machine, by means of a hand-wheel, shown at the left of the engraving. The adjustment for thickness of lumber is effected by horizontal shafts above and below, previously referred to, which have right and left screws cut upon them, and which are simultaneously operated by means of two vertical shafts, shown at the right of the engraving. The right and left hand screws respectively pass through sliding blocks which carry the bearings of the saw pulleys. Their operation, therefore, is to separate or bring nearer together the band saws, while at the same time, the blades are kept parallel with each other.

As we have given special attention to the invention, it having been patented through the "American Artisan Patent Agency," we give it as our opinion that this method of employing band saws is attended with no practical difficulties not met with in the use of single band saws. The practicability of cutting lumber with band saws has already been fully demonstrated. The only draw-back has been, that the band saw-mill could not turn out the same amount of work in a given time as the circular saw-mill or gangs of reciprocating saws. With band saws used in gangs, as herein described, this objection will be removed; and when the great saving of lumber effected by the invention is taken into consideration, we regard its ultimate success as certain.—*American Artisan.*

HILL'S PATENT VERTICAL BOILER.

The boiler which we illustrate on page 267 possesses several novel and useful features, which deserve the attention of those who may examine it at Manchester The details of construction will be obvious at a glance. Fig. 1 and plan show an ordinary boiler, Fig 3, and plan show a boiler in which the whole outer shell is enveloped in a smoke box which can be lifted off in a moment. Internally the boilers are nearly alike. Vertical water tubes are fixed in the fire-box. This has been done before repeatedly, but not as in this case. The tubes instead of being bent and fitted directly into the tube plate, are fitted into malleable castings, as shown, in groups These castings are tapered and ground at the outer ends or legs, and these tapered ends are drawn into slightly conical holes in the fire-box, by the bolts and nuts passing through the outer shell as shown. Any tube, or rather any group of tubes, can be taken out by removing the nuts on the outside of the boiler, and on withdrawing the bolts allowing the group of tubes to descend into the fire-box, whence it can be taken for repairs or renewal of tubes.

It will be seen that the arrangement is cheap and simple, and we understand that several of these boilers which are at work have given very satisfactory results. The malleable castings appear to stand very well, and give no trouble of any kind. The facilities for manufacture are obviously great, and the boiler deserves extended adoption.—*The Engineer.*

AMERICAN LIGHTHOUSES

We publish this week, on page 270, two more examples of American lighthouses, both designed for the sea coast of California, but neither of which are yet completed. The first of these is for Piedras Blancas, a point about midway between the lighthouses on Points Conception and Pinos, and is distant about 150 miles from each. An appropriation of $75,000 was made for this work, which is to have a first order light and fog signal. The site belongs to the United States.

The second illustration shows the lighthouse for the Straits of Karquines, California. An appropriation of $[illegible] was made for this work, to mark the entrance to the Straits of Karquines. A location on the southern shore, opposite Mare Island, was recommended, but as none suitable was found, the final selection of site was made on the southern end of Mare Island.

The two tallest chimneys in the world are at Townsend's Chemical Works, Glasgow, and St. Rollox, Glasgow the former 454 feet high, and the latter 432 feet.

NEW AND GIGANTIC TELESCOPE.

(From the *Scientific American*.)

Among the many ideas which have been elicited by the discussion in these columns regarding a gigantic or "million dollar" telescope, we have recently had submitted to our examination one which seems to us quite novel, ingenious, and, although untried, not unpractical. It is a scheme for a huge instrument, to be built on either the Gregorian or Cassegrainian system, in which the image is first received on a large parabolic mirror located in a position diametrically opposite to the objective in a refracting telescope, thence reflected back to a secondary mirror, which, in accordance with the respective systems, is either concave or convex, and by the last re-reflected to the eyepiece, the tube of which passes through an orifice in the centre of the large glass. It is hardly requisite to explain the immense labor and, in fact, almost insuperable difficulties which would be encountered in constructing a reflector of the proposed size—ten or fifteen feet in diameter—of metal, and mounting the same. The great mirror in the telescope in Melbourne, Australia, though but 3 8 feet in diameter and weighing 3,498 pounds, required 1 270 hours of continuous labor to bring it into the last polishing stage, while its adjustment and mounting exacted the nicest engineering skill. In brief, it may be safely asserted that a metallic mirror, of the large size above noted, supposing it could be successfully constructed, would, from its great weight but far more on account of its consequent flexure, be practically useless

Mr. Daniel C. Chapman, of this city, who is the originator of the plan we are about to describe, suggests both a mode of making a mirror of light weight, and also a method of supporting the same. The reflector, he says, may be constructed of glass. A mould of clay, metal, or cement, of the required shape, is carefully formed and placed in a suitable furnace, cavity upward. Over the latter a huge plate of glass is disposed, and the heat applied. At a certain temperature, the glass begins to soften, and in such state may be bent, fitted into the mould, and subsequently annealed. The whole is then removed and placed on a plane. The glass is taken from its bed, disposed convex side up, and a backing of cement or plaster, the composition of which is previously determined by experiment so that it shall have the same coefficient of expansion as the glass, is applied, to several inches in thickness. The mirror is next inverted, placed on a turning table, and carefully ground or finished within, into the exact form necessary. But little labour, comparatively speaking, will here be required, as an approximate or nearly true curve, will, it is believed, be taken by the glass in fitting itself to the mould. The reflecting face is, lastly, silvered by Dr. Draper's process, a solution of Rochelle salts and nitrate of silver being applied, which very quickly deposits a fine uniform metallic surface. It will be noted that the inventor thus obtains a reflector of light plaster and glass, the weight of which is necessarily quite small.

Next, for its suspension, and this will be rendered clear by the engraving on page 263. On the rear of the plaster backing are made a number of projections, arranged with sockets to receive the ends of any number of braces. The latter are of wood, strong and well seasoned, and covered with some preserving material. These, extending from various points on the back, meet at the centre of a huge copper sphere, which encloses the entire apparatus except the mirror, and then intersecting, spread again to abut against the interior periphery of the globe. The mode of arranging these stages is, of course, a matter of engineering detail, and will depend greatly on local circumstances. The shell of the sphere comes, as shown in the engraving, just to the edge of the mirror, but has nothing to do with its support, the braces being solely for this purpose. The secondary mirror is held by two stays, which extend from the circumference of the reflector and meet at a calculated distance from the same. It is not necessary that the reflector be placed at the surface of the globe, but it may be placed at or near the centre, leaving an opening of the same size in the globe, with perpendicular sides, thus requiring little or no counterpoise. The standards and stays holding the small mirror may be attached to the extreme external surface of the globe, thus giving a large base and greater steadiness. The stays toward the poles are so arranged that the lower one is detached when nearing the horizon, in case it should be desirable. By this method there is nothing, so far as we can now see, to prevent the successful constructing and using of a telescope of very large size.

Through the centre of the large glass is made an opening, and in this is a telescope tube, suitably jointed and terminating in an eyepiece within the globe at the observer's seat. The situation of the latter is clearly shown in the illustration, and it is suitably supported so as to be always vertical. By this arrangement the observer is constantly located in the right position; and by placing a partition of some non-conducting material between him and the backing of the reflector so as to leave an intermediate space of four or five inches, a warm room to work in may be gained, and a means of keeping the braces dry provided.

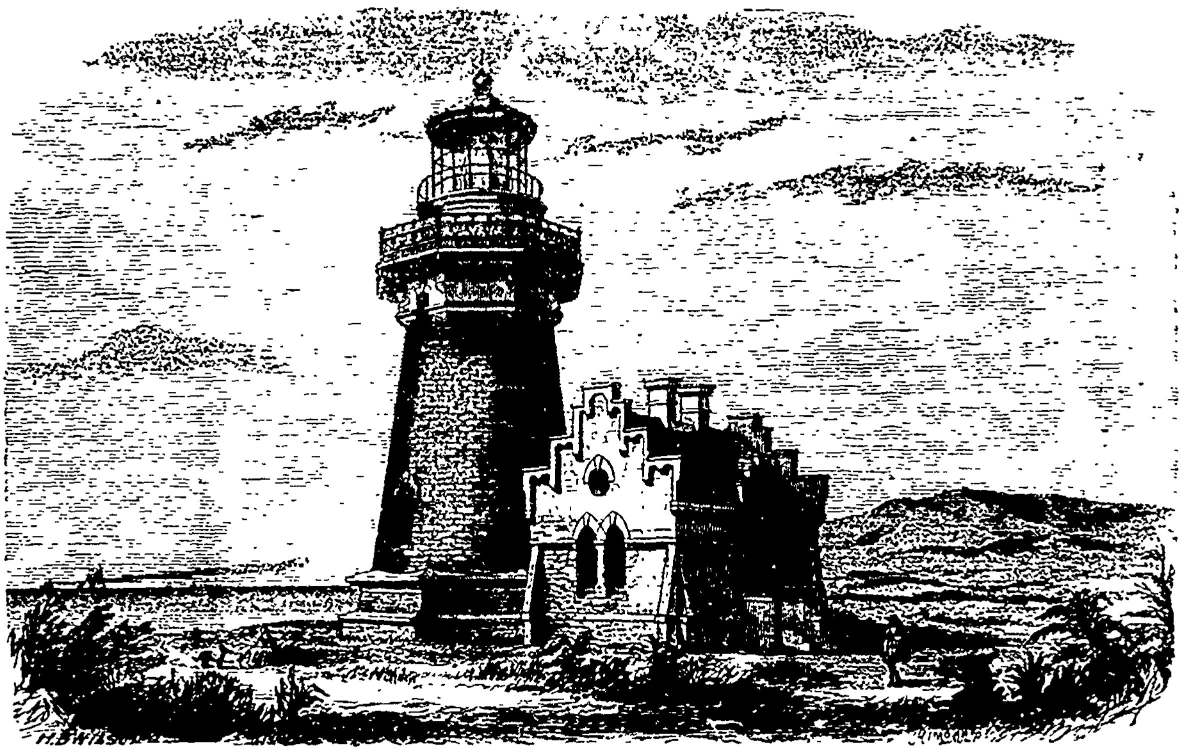
The great sphere pivots in a ring, the axis of which is inclined to point to the pole, and is pivoted at one side in the cap of a single heavy pier. Below the globe is a vault filled with water or other liquid, in which it floats and from which it receives it principal support. It is evident that the motion of the apparatus will thus be susceptible of easy regulation, and may be effected by simple mechanical appliances arranged with counterpoises and governed by the observer. As our object is not to enter into the minor details of this plan, but rather to exhibit the idea upon which it is based, further explanation is deemed unnecessary. The inventor thinks that a mirror of fifteen feet diameter may be constructed and mounted as we have described. As compared with a refracting telescope with an objective of corresponding size, and a focal length of 200 feet, the refractor would give a sun picture 20 inches in diameter; the reflector, having 100 feet focal length, would shew an image 10 inches in similar dimension. In point of quantity of light, compared with Herschel's reflector, which was nearly five feet in diameter, the focal distance being still 100 feet, a 15 foot mirror would gather nearly 14 times as much. For photography a great reflecting telescope could not be aevantageously employed, as it would fail to give sufficiently fine definition of the object; but for spectroscopic work, it would be very useful and especially valuable for heat investigations with the thermopile. As a searcher for faint comets and double stars, from the large amount of light received, it would lead to results of great importance, and enable us to examine and resolve nebulæ before which the highest magnifying power now existing fails.

The completion of the Hoosac Tunnel and the rapid progress of the Sutro have caused the miners both in the East and in the West of America to look with interest upon what has been and is projected in connection with tunnel driving. It is in Germany, says the *Mining Journal*, that the great tunnels have been constructed, and these have been made exclusively for mining. There is the great tunnel at Freiberg, twenty-four miles long; the Ernst-August and the Georg at Clausthal, thirteen and a-half and ten and three-quarter miles respectively; the Joseph II. at Schemnitz, nine and a-quarter miles; the Rothschonberg at Freiberg, eight miles; the Mont Cenis, seven and a-half miles, which about completes the European list. In the United States we have the Hoosac, in Massachusetts, five miles long, the Sutro, in Nevada, for opening up the celebrated Comstock lode, this tunnel, although only four miles long, will, with its ramifications to the various mines of the district, prove one of the most important in America; the Sierra Madre tunnel at Black Hawk, commenced during the present year, and which will be twelve miles long, as well as San Carlos and Union Pacific tunnels which are under two and a-half miles. The Ernst-August tunnel was driven at the rate of a mile per annum, and it will be interesting to notice how long it will take the Americans, with all the approved appliances at present to command, to complete the nearly similar Sierra Madre Tunnel.

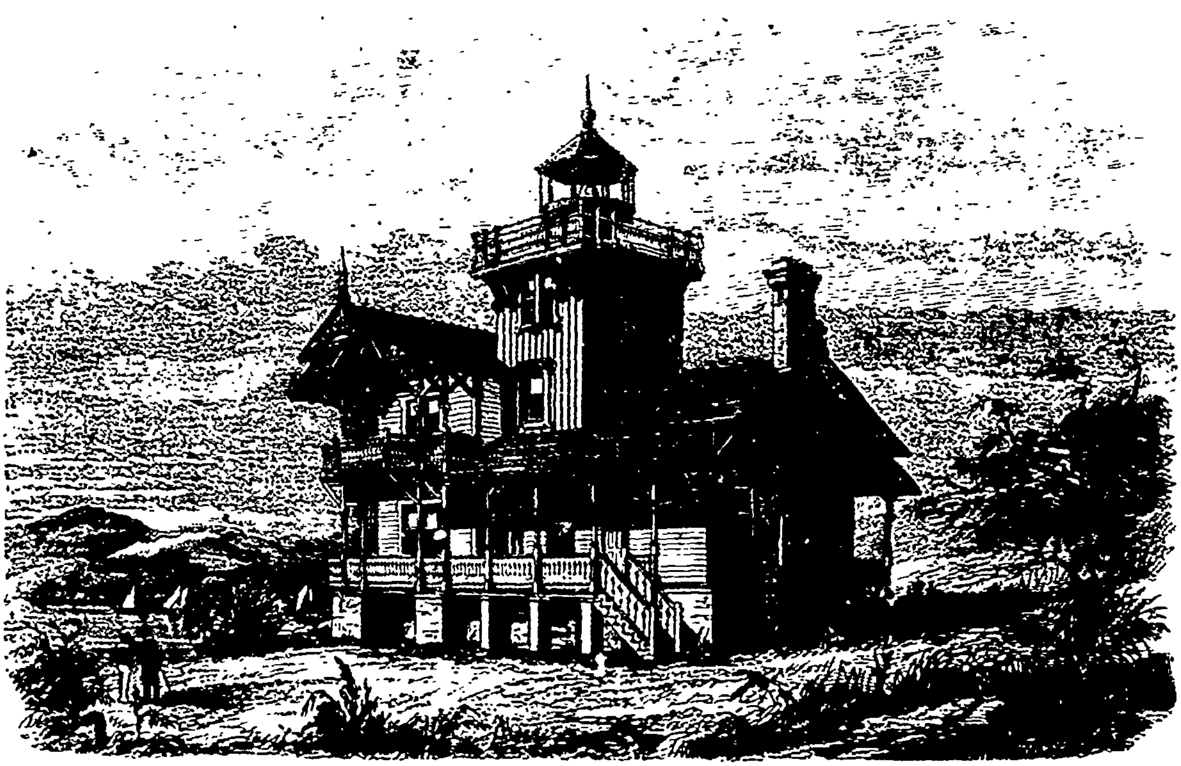
State Assayer Bartlett of Maine asserts that several factories are in operation in that commonwealth producing cheap sugar and syrup from saw-dust and other substances. The sugars and syrups are corrected by sulphuric acid, lime, and other ingredients. Maine, with its vasts forests, may yet rival Louisiana as a sugar and syrup-producing district.

AMERICAN LIGHTHOUSES.

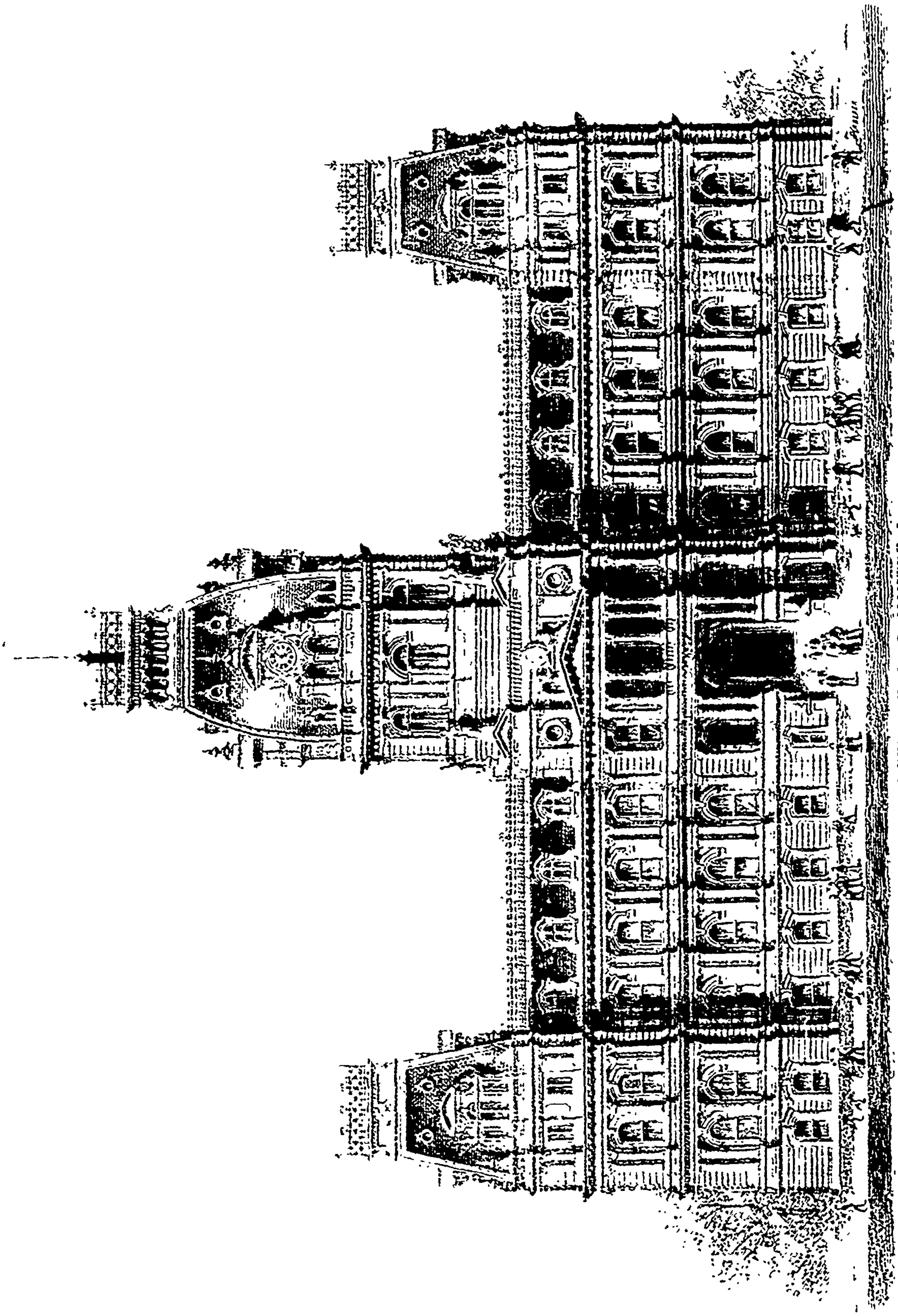
(*For Notice, see page 268.*)



LIGHTHOUSE AT PIEDRAS BLANCAS, COAST OF CALIFORNIA.



LIGHTHOUSE AT THE ENTRANCE TO THE STRAITS OF KARQUINES, CALIFORNIA.



NEW CITY HALL, MONTREAL.

MECHANICS' MAGAZINE.

MONTREAL, DECEMBER, 1873.

ILLUSTRATIONS:

CONTENTS:

LOADING OF VESSELS.

It will be remembered by many of our readers that complaints were made last autumn by captains of vessels loading with grain at the Port of Montreal that they were subject to unnecessarily severe restrictions and oversight in the matter of loading. It was even said, we believe, that such a course, if persisted in would be of great damage to the port inasmuch as these severe regulations would have the effect of leading ship owners to seek some other port for such freight. The subject is an extremely important one in itself and in its relation to Canadian commerce. The vast products of the Western States and of our own Dominion in the West are every year seeking more and more the St. Lawrence as the shortest and most natural outlet to the Great European Market; and this branch of trade in itself promises at no distant period to become of gigantic proportions Under these circumstances it is plainly evident that all restrictions which can be removed from the development of this industry should be removed as soon and as completely as possible. But on the other hand there is very much to be said. It is a well-known fact that vessels are now to a very great extent overladen and badly laden. Then again grain is known to be a treacherous cargo, especially when, as is the general case now, it is stowed in bulk. This danger arises from the fact that the cargo poured in quickly by elevators has not time to settle at all, and even if it does settle somewhat it soon settles more during the voyage and thus leaves an empty space under the deck. The grain thus is at liberty to move from side to side with the motion of the vessel, or to shift over to one side and give the vessel a permanent list. This is avoided, to a certain extent, by the use of shifting boards fitted vertically along the middle line of the vessel from end to end of the hold and also by transverse bulkheads dividing the hold, so as to enable the grain to be trimmed closer up under the beams. In the case of steamships, however, these precautions have not been deemed so necessary, since they are not so liable to be heeled over by canvass as sailing ships, and it is stated that many steamships have been sent to sea without provisions of this nature As a consequence of the nature of the cargo and, also, of a certain amount of carelessness in handling it there have been so many losses during the past year or two that the subject has received scientific investigation. The Committee of Lloyd's has recently published a very interesting pamphlet on the stowage of grain cargoes, containing "Reports upon the Theory of Rolling and Stability as affecting the Seaworthiness of Vessels, and on the Stowage of Grain Cargo," by Mr. Simon Fraser Mackie, of Lloyds' Agency, New York, and by the Surveyors of Lloyd's Register of British and Foreign Shipping. Mr. Mackie says that grain in bulk may be classed as a semifluid having an angle of repose of 30 degrees at rest, but that when accompanied by motion, as in the case of a ship at sea, it should be taken at about one-half of what it is when ashore, or say 15 degrees. He says also that loose grain in the hold of a vessel will evidently commence to move as soon as the list of the vessel exceeds the angle of repose; and as it is almost certain that a vessel will roll through a greater angle than 15 degrees, it is almost certain that bulk grain will move more or less on every voyage. But the mere movement or working of a grain cargo is not what is meant by a shift of cargo; and the great danger of a grain cargo lies in its liability to move.

The practical application of all the statement and theory and its peculiar interest to us will appear on glancing at the following list of steamers lost at sea between the 1st January 1872, and the 31st March, 1873:

Ship's name.	Gross Tonnage.	Voyage. From	To
Carolina	1174	Baltimore,	Queensland.
Churruca	905	New York,	Waterford.
Gravina	950	Montreal,	Dublin.
James Marychurch	905	"	Queenstown
Alexander Tod	913	Rostock,	Leith.
Cresswell	1147	Berdianski,	Falmouth.
Devon	1254	Montreal,	United Kingdom.
Mary	614	Danube,	Falmouth
Scanderia	1983	New York,	Queenstown.
Annie Broughton	1229	Nicolaieff,	Leith.
Commander	1160	Montreal,	United Kingdom
Counseller	809	Nicolaieff,	Falmouth.
E. S. Judkins	889	Sulina,	"
George Cairns	1146	Montreal,	Limerick.
Marcus	644	Ibrail,	Yarmouth.
Reindeer	1025	Nicolaieff,	United States.
Retriever	726	Salonica,	"
Shannon	1210	Montreal,	London.
Sphinx	849	Kustendje,	"
Malta	945	Cronstadt	"

Total 20 steamers 20,477

We are indebted for the above list to the columns of *Engineering*, which remarks as follows: "Of 62 (or n steamers lost during the above mentioned dates) no less than 20 were laden with grain on the homeward voyage and they represented a tonnage of over 20,000 tons gross, and a money value of nearly half a million sterling. Of the twenty steamers laden with grain that never reached port, six are known to have capsized in consequence of the cargo having shifted, and as in most of the others all hands were lost and the vessels were principally news ones, it is fair to assume that a large proportion of them foundered by capsizing, owing to the bad stowing of a treacherous cargo" In the above list Montreal certainly occupies no enviable position, and in view of the facts and theories advanced we are of opinion that the harbour authorities exercised no more than a very necessary amount of supervision and restriction in the matter of loading grain. There is at stake in this matter not only the vessels and the crews, but also a large amount of human food, the former of course, the human life is of paramount importance, but the last has probably a greater effect than any on the price of flour and the rates of freight and insurance. In view of this condition of affairs there are few interested or uninterested persons, we imagine, who would not favour even more severe regulations than those existing rather than a removing of such as are now in force, and it appears but reasonable that the reputation of the port is more at take among underwriters and such others as may trust to the list we have printed than among ship captains and others interested in getting a ship to sea as quickly as possible

OUR IRON INDUSTRIES.

The question of duties is one which just at present occupies very prominently the attention of all our merchants and capitalists We take advantage of this to bring before our readers' notice the substance of a circular received by us some time since on the subject of protection to our iron industry. The circular starts with the unquestionable statement that the importance of the iron industry can hardly be over-estimated, that it employs vast capital and gives employment to great number of skilled hands. It then goes on to state some facts in connection with the iron trade of Canada as follows:

"The importance of the iron trade of Canada will be apparent from the following figures, showing the imports for the past five years, distinguishing the amounts paying the different rates of duty and that entered free.

For the five years ending June 30, 1873:

	Paying 15 p. c.	Paying 5 p. c.	Free.
1869.—	$2,132,021	$1,817,800	$2,223,889
1870.—	2,366,265	1,793,876	2,487,496
1871 —	3.110,161	2,449,369	3 401,796
1872 —	3 840 859	3,247,172	6,163,969
1873.—	4,642,299	4,842.148	11,510,443

Total, 15 per cent,	$16,091,605
" 5 "	14,150,365
" free	25,790,593
	$56,032,563.

"The increase from year to year is remarkable, and is owing to the great developement of our railway system, and the ever increasing demand for machinery in every branch of industry. The very remarkable increase for 1872-73, over the previous year, is not so much due to the larger quantity imported, as to its enhanced value. The relative ratio of increase of quantity was about the same. With the augmentation of our population, trade and wealth, this increase must continue for years to come

"It does seem, therefore as if the time had arrived for some step to be taken, tending to the establishment of iron works in different parts of the country, where the ore exists in such quantity and [illegible]y, and with such facilities for bringing it and the necessary fuel together, as to justify the investment of capital

"It will be remarked that the greater portion of iron imports enter free, and a small portion only pays 5 per cent. That entered free is looked on, to a certain extent, and under present circumstances, properly so, as raw material, seeing that is not yet manufactured in this country; but once works are established for the conversion of the true raw material, the ore into merchantable shape, the imported article ceases to be such, and comes into competition with a home manufacture.

"It is a fact, that, within the last three months iron has been imported into Canada from the United States, manufactured from ore taken out of the Hull Mines, near Ottawa.

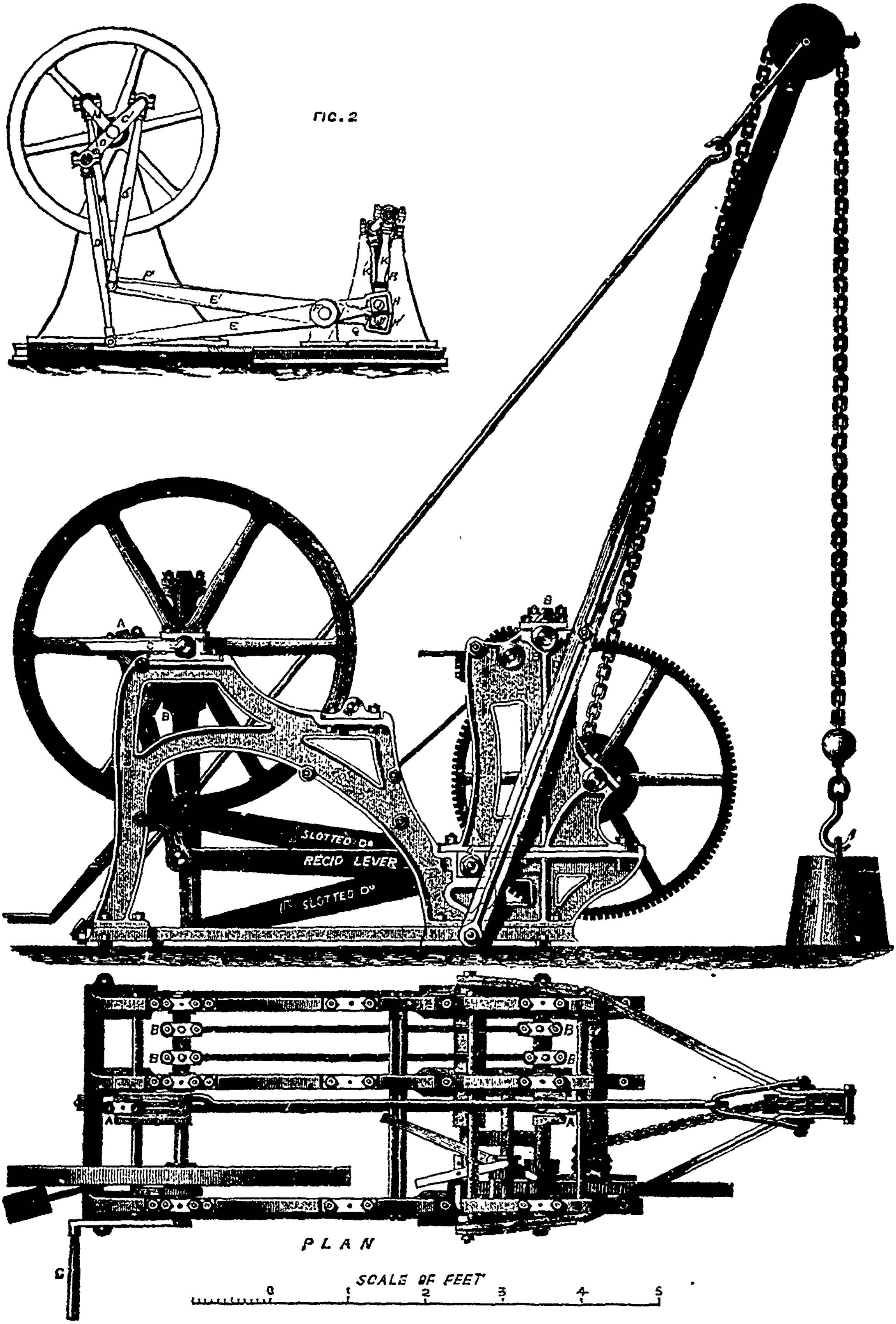
"Now what is the result we see here? Our own raw material sent out of the country to the United States, to which it pays a 20 per cent. duty ad valorem, yielding a comparatively small profit to the Canadian seller, returning to the country as so-called raw material, yielding a large profit to the manufacturer in the States and paying no duty to our exchequer. The wages and profit involved in its manufacture are all lost to Canada.

"At the present moment negotiations are going on with capitalists in Great Britain, having in view the investing of large amounts of capital in the erection of works for the manufacture of pig, bar, railroad, and other forms of iron, in the Province of Ontario, Quebec, and Nova Scotia, and it appears that the efforts would be successful, could those willing to invest, be guaranteed a certain security over and above the ordinary commercial aspects of the investment.

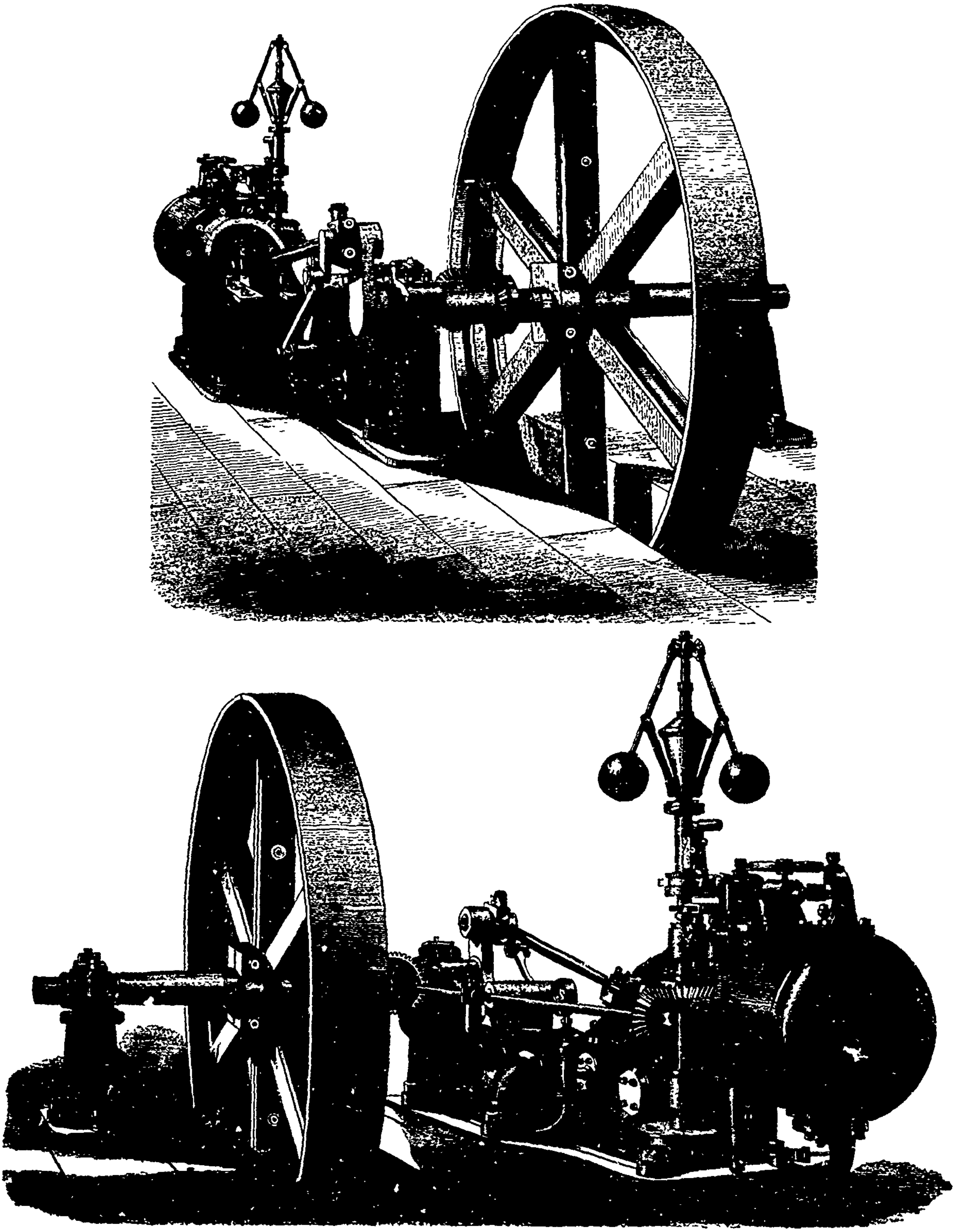
"It appears that to afford this it would be sufficient to increase the duty on iron, now paying 5 p. c. to 7½ p. c ,or 10 p.c , and to place a duty of 5 p c. on all such articles now on the free list as would be manufactured in the proposed establishments. This increased duty, while affording a tangible protection to the manufacturer, would not sensibly be felt in the country."

With reference to the iron ore, there is no question but that we are abundantly supplied with that. The main question is as to the fuel and this difficulty is by no means easy to be surmounted. It is a difficulty the solution of which, however, becomes more easy every year as our means of intercommunication extend. As our railroads are extended the bringing together of the ore and fuel becomes a matter of less and less difficulty and the day is not far distant, we believe, when this industry will have taken firm root among us. That it will ever become a great one, at any rate in these central provinces without coal measures is, to say the least, very problematical. Smelting operations are, we believe, to be undertaken before long, on a somewhat extensive scale in Ontario, and data will thus soon be afforded on which to come to some definite conclusion on the subject. In this connection we would remind our readers of some remarks of ours on the utilization of our vast deposits of peat. In the course of those remarks we alluded to the advantage such action would have in retaining, in this Province, the useful labour of the numerous body which fluctuates between the valley of the St. Lawrence and the brick-fields and other industries of the Northern United States. This result, if it could be attained would be of immense benefit to the country at at large; and if in connection with it the additional industry of smelting our iron ore with peat charcoal could be taken up there would be a much greater result attained. The iron produced by this means would be of importance not so much from its quantity as from its quality. For certain purposes iron produced by this process would command always a price that should ensure success to its producers. With respect to the subject of tariff we are not prepared to go into it at any length but are certainly of opinion that in certain cases the cheapest market is not by any means the best. At all events there is a good opportunity in this Province to create a very useful industry which would in itself be valuable and would further have a beneficial influence by affording to many of our inhabitants that labour which they now seek elsewhere. If this end could be secured by reasonably taxation we think the attempt should be made as soon as possible.

The *Guardian* advocates the construction of a railway from Nanaimo to Esquimalt, by which the mineral wealth of the island would be developed, and the location of the terminus of the Canadian Pacific Railway rendered a matter of indifference to Victorians.



DE LORIERES PATENT CRANE. (See page 281.)



HORIZONTAL ENGINE AT VIENNA. (See page 287.)

TRANSIT OF VENUS.

We reproduce on page 263, for the benefit of our readers, the first of one or two articles on the approaching transit of Venus which have just appeared in the *Engineer*. The phenomenon is occupying the attention of all scientific men just now to a great extent and the results of the expeditions now being fitted out by England, France, Russia and America are looked forward to with intense interest. The question, as the writer states is, not merely a theoretical astronomical problem, but is one with practical application to the very geography of our earth. The importance with which it is regarded by men of science may be gathered from the fact that preparations have been making for the coming observations during the past half century. That the results may be expected to be as correct as possible may be argued from the friendly scientific co-operation and rivalry of the leading astronomers of the leading nations of the earth.

We are compelled, from want of space, to defer our descriptions of the New City Hall at Montreal and of the Birmingham Aquarium until next month.

REVIEWS.

THE AMERICAN ARTISAN. Brown and Allen, New York.

We have been compelled by force of circumstances, which have somewhat delayed our publication, to postpone noticing the recent change in this very interesting and ably conducted journal. The present volume appears in monthly numbers instead of weekly as before. We cannot say we are altogether pleased with the change since the oftener we see such a journal the better. The monthly, however, is much larger and shews, if possible, more care than ever, especially in the matter of the engravings which are of a very high degree of excellence. The cover is ornamented by a spirited engraving o prominent feature in which is a view of the celebrated East River Bridge as it will appear when completed. The *Artisan* constitutes now a monthly magazine of undoubted scientific ability and is at the same time a journal which few, if any people, can read, in these days of universal education without intense interest.

We congratulate the publishers on the typographical beauty of their publication and wish the *Artisan* every success in its new form.

HOW TO MAKE MONEY BY PATENTS: by Charles Barlow. London, E. Marlborough & Co.

We have just received the third edition, recently published, of this work. It is not very long since we referred to the former edition as a work of great practical value to inventors and patentees, and the fact that a new edition has been called for proves that its usefulness is being realized. The work is replete with useful hints and suggestions, and contains moreover some very sound advice to inventors on subjects on which they are apt to go somewhat astray. As a guide in securing patents it will be of greater service to English patentees than to Canadian ones, but even to the latter it cannot fail to be of service sometimes, and the general truths as to the disposal of patents, &c., are of universal application and are put forth in the clearest and most forcible manner by one who is an authority on the subject.

GOLD MINING ON LAKE SUPERIOR.

We condense the following from a report, in the Toronto *Globe*, of a paper read before the Canadian Institute by Mr Peter McKellar.

The general characteristics of the Huronian slates of Lake Superior resembled those of the most gold bearing formations of the world so much that I invariably looked for gold whenever I came across veins in them, but always failed until the summer above mentioned. The excitement caused by the Silver Mines of Thunder Bay spread amongst the Indians, who also began to look for metalliferous veins, by bringing specimens from every white rock that they could come across. Two of these, J. Baptist and M. Putchat, who were in the employ of the H. B Co, under Mr. Neil Whyte, of the Beau Blanc Post, one of which showed the ores of lead, copper, and iron, which are very common in the veins near the coast, but not in the old rocks back. Mr. Whyte sent the specimen to Fort William in the winter of 1870 71 to show them to me to see if they were of any value. Mr. John McIntyre, of Fort William, got the Indians to bring in more specimens, and some of the wall rock which was talcose slate. From the appearance of the vein-stone and slate I felt confident that the vein did carry gold, although the specimens did not show any; so Mr. McIntyre sent two of the Indians along with me to show it. We started in July, 1872, following the Dawson Road a distance of 45 miles, to Lake Shebandowan, where we procured a canoe and provisions for the rest of the journey, which was 30 miles by water, to bring us to the next end of the lake; then, according to the Indians' calculations, 25 miles to the vein, by portages, small lakes, and streams, which afterwards proved to be only 12½ miles when the road was cut out and measured.

On reaching the place I commenced my examination, and was soon rewarded by finding the free gold in the form of thin leaves coating the bitter spar. At the point of exposure the lode is running along in the face of a steep hill, and large blocks of the vein rock had fallen down, making it appear to the Indians to be running at right angles to its real course, therefore they were unable to trace it up or find it in any other place. Before leaving for Thunder Bay I traced the vein by its outcrops for about three-quarters of a mile, finding it of similar character throughout.

The rock formation consists of the usually fine textured, greenish slates of the Huronian series—such as dioritic, chloritic, talcose, silicious, and fine grain micaceous slate, interstratified with beds of ferruginous quartz and magnetic iron ore. There magnetic beds are from 20 to 150 feet in width and show a ribbon-like structure, being interlaminated with layers of quartz, and can be traced for miles along their strike, no doubt the time will come when some of them can be worked with profit. The rock on either side of the lode for some distance is composed of the greenish slates, talcose, chloritic, and dioritic, with the massive dioritic and iron ore beds, while to the north-west of the lode, about a mile, lies a great thickness of the above-mentioned micaceous slates, which are dark in colour, and in places pass into clay slate, showing a transverse cleavage. These are cut in every direction by masses or irregular veins of quartz, which appear to belong to the gash-vein system. Again, to the south-east, some two miles beyond the vein, are developed great thicknesses of greenish-white, silicious, slate conglomerates. The whole of these slates seem to lie conformably on one another, dipping to the N. W., at an angle of 50° to 80°. About three-fourths of a mile to the N. E. of the vein lies the Jack-fish Lake, which is over a mile and a half in length. Its bed is worn out of massive reddish granite which must have been forced up through the above mentioned slaty strata, as we find it displaced and altered in appearance next the granite. In coming from the S. W., we find that the slates within half a mile of the Lake change in their strike from E. N. E., around to the N., and then to the N. N. W., the angle of dip increasing with the change of strike from 50° until it has reached the vertical, then after passing the broadest part of the granite, west of the Lake it again changes and gradually gains its original dip and strike. To the south-east side of the granite and Lake, the change in the strike of the slates is light, but their dip is nearly vertical, besides they are changed into a sort of gneiss for some distance from the granite. The general width of this igneous belt of rock is one half to three-fourths of a mile. It extends northeastward for many miles, intersecting the strike of the slates at a small angle. On Jackfish Lake, where it terminates abruptly in its westward course, with the exception of the small branches it sends forth, it spreads out to a mile and one-half in width. These branches cut the slates in all directions near the Lake, but the most of them at no great distance seem to fall in and follow the cleavage planes of the slates. Some of them are seen to continue for several miles from their nucleus, as it were.

The vein may be said to consist of 2 ribs or bands of quartz, each averaging from 1 to 3 feet in thickness, with a parting of talcose slate of 2 to 4 feet in thickness, making in all a width of 7 or 8 feet. The slaty parting is filled with crystals of iron pyrites, and carry some gold, but whether in paying quantities or not I could not say. The quartz make an aggregate thickness of 2½ to 4 feet, it is charged with galena, and copper, and iron pyrites, with some zinc blende, gold, and the sulphuret of silver. The latter occurs through the quartz in bunches, consisting of an aborescent nucleus of the malleable ore, around which, from one to several inches, the quartz is rendered very dark from the presence of thin leaves and minutes particles of the silver ore. Nuggets and leaves of gold are almost invariably found in these branches. The gold is also found in leaves coating the bitter spar, and in small nuggets penetrating the quartz, galena, zinc blende, copper and iron pyrites. It seems to be present in more or less quantities throughout the whole lode as shown by many trials both by the fire assay and the simple way, crushing, roasting, and washing. It may give you a better idea of the value of this lode when I tell you that Captain W. B Frue, of Silver Islet, and associates, paid $20,000 for less than a half interest, on the strength of the specimens and the description I had given of it.

The result of the 126 lbs. of ore sent to the Wyandotte Smelting Works, was an average of $505 to the ton, about $40 of silver, the rest of gold—the button of gold produced, which weighs some two ounces or more, is in the possession of Mrs. J. McIntyre, of Fort William, to whom it was presented by Captain Wm. B. Frue. We do not expect that the average of the ore will equal the above result, unless the mine improves much in depth. We could scarcely expect such a large average when the ore is there in such large quantities. Take the mines on the great Comstock lode, Nevada, which have paid millions of dollars in dividends, and the average yield of them was from $20 to $46. It may seem strange to those unacquainted with mining how those low grade ore mines can be worked with profit, when mines yielding from $1,000 to $2,000 per ton are only ordinary mines. The simple reason is this—that whenever ore yields an amount greater than the expense of mining and reducing, as long as there is plenty of it, the mine can be worked with profit, which will increase in proportion to the amount annually worked, and the percentage of the ore over and above the cost of working. The expense of working a ton of ore in different mines varies from three dollars to thousands, this great difference being due, principally, to the amount of waste ground that is required to be removed in procuring the ton of ore

Having thoroughly examined the out-crops of the lode in question for about three-quarters of a mile along its strike, and having been there when it was being cross-cut in several places from one of which about 100 tons of ore were taken, and judging from the character of the lode throughout, I am satisfied that there will be no lack of ore, as the whole of the quartz seems to be more or less auriferous, and therefore can be cheaply worked, or in other words, at a low rate per ton; so that it could be worked with profit at a small fraction of the yield of the sample sent to Wyandotte, say, $50, or $20, or even less per ton when we know that ore can be mined at a much lower figure, where labour and supplies are much more expensive, than with us. Take, for example, the above mentioned mines on the Comstock lode, Nevada. According to Mr. J. Ross Browne's official report to the United States, the total expense per ton of working the ore in several of these mines was from $7 to $9, that, too, six to eight years ago. Again, take the Black Hill Mine in Australia, the ore of which, could not have cost $3 per ton for mining and reducing as shown by Mr. A. R. C. Selwyn, Director of the Geological Survey (see page 281 of the Geological Report of Progress for 1870-71). He states that the average yield of the ore from this mine was only 2dwts. 21 21-100grs. of gold per ton, yet it paid the proprietors 10 per cent. on the capital invested.

Besides the precious metals in the Jackfish Lake lode, the ore consists largely of galena, with considerable copper pyrites. The galena especially could be saved, and I have no doubt it would pay the total expense of working the ore. In the first place, I believe it to be a true fissure vien. Although it seems, from an examination of one point only, to conform in dip and strike with the formation, it does not, for I find that one of the large magnetic beds lies about 600 feet to the south-east of the north-easterly exposure of the vien, while the two come within 100 feet of each other at the south-westerly exposure, where the vein is lost in low land; in the next place, it and the bedded lodes, which are numerous, are distinctly different in character as well as in the ores they bear, the latter being finely granular schistose, and holding iron pyrites and magnetic ore. It differs also from those of what appear to be the gash-vein system which prevails in the above-mentioned fine, micaceous strata, in being persistent in its course for a long way, in being rare in the locality and also in the ore it carries, and its quartz being less transparent and vitreous Again, the vein-stone is identical in character as well as in the ores it contains, with that of the Heron Bay lodes, one of which runs with the stratification and the other across it at right-angles of which I will give a brief description further on. For a vein to run with the cleavage or stratification is no proof against its occupying a true fissure, as is generally believed, for the direction of fissure depends on the way the forces that caused it were applied, which would be more likely to be exerted along the line of bedding, the way it had previously been when folding or tilting the strata in the way we find it. But allowing that it did not occupy a true fissure, the surface characteristics of the lode and of the enclosing formation show clearly that it is sufficiently extensive in depth for all practical mining purposes I have been more particular in describing this vein by reason of its being further developed than any of its kind in the section. Besides, if we can show, as I believe we have, that there is one good gold-bearing lode in this locality, we can safely calculate on the existence of others where there is such a large tract of unexplored country lying on the same formation.

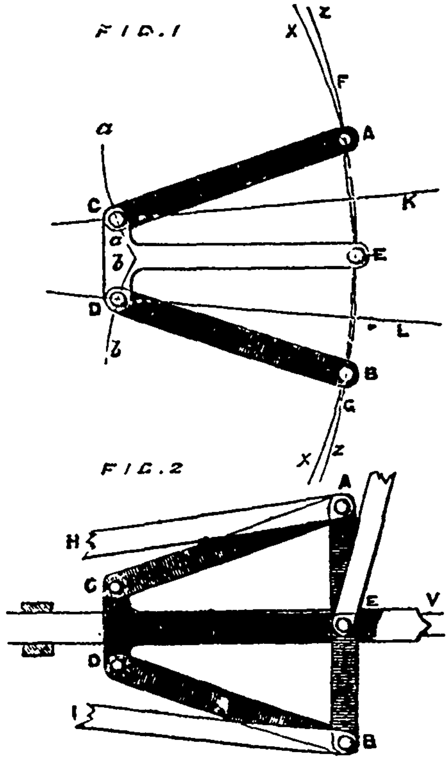
Another vein near Partridge Lake, 25 miles from Mille Lac, on the Dawson Road was traced by the outcrops for a mile along its strike, without any apparent diminution of size. It disappeared in a lake at the one end and in low land at the other.

It seems to run along in a broad band (half a mile or more in width), of fine textured dark and greenish-gray slates, which seem to consist of talcose, chloritic, siliceous and porphyritic slates, which are cut occasionally by small granite veins. These strata dip at a high angle to the north-west, and are enclosed on the one side by reddish granite, and on the other by a peculiar semi-crystalline porphyritic rock. The relation of these rocks to one another has not been traced out. The vein seems to be very large, averaging from 6 to 14 feet in width, composed of vitreous quartz with an occasional thin parting of soft talcose slate. The quartz is partly stained red by the oxide of iron, and blue and green by the carbonate of copper. It seems to be sprinkled, as it were, all over with copper and iron pyrites and small particles of gold. The latter seems to be so evenly distributed through the veinstone that there is little room for choosing in selecting specimens. A fragment of the vein, weighing from 80 to 90 lbs, was sent to Montreal, along with other specimens from another part of the vein three quarters of a mile off. The assays by Dr. Girdwood, of Montreal, yielded from $27 to $30 to the ton, there being but a dollar or so difference in the yield of the two places. The gold is very easily extracted as it seems to be free through the quartz.

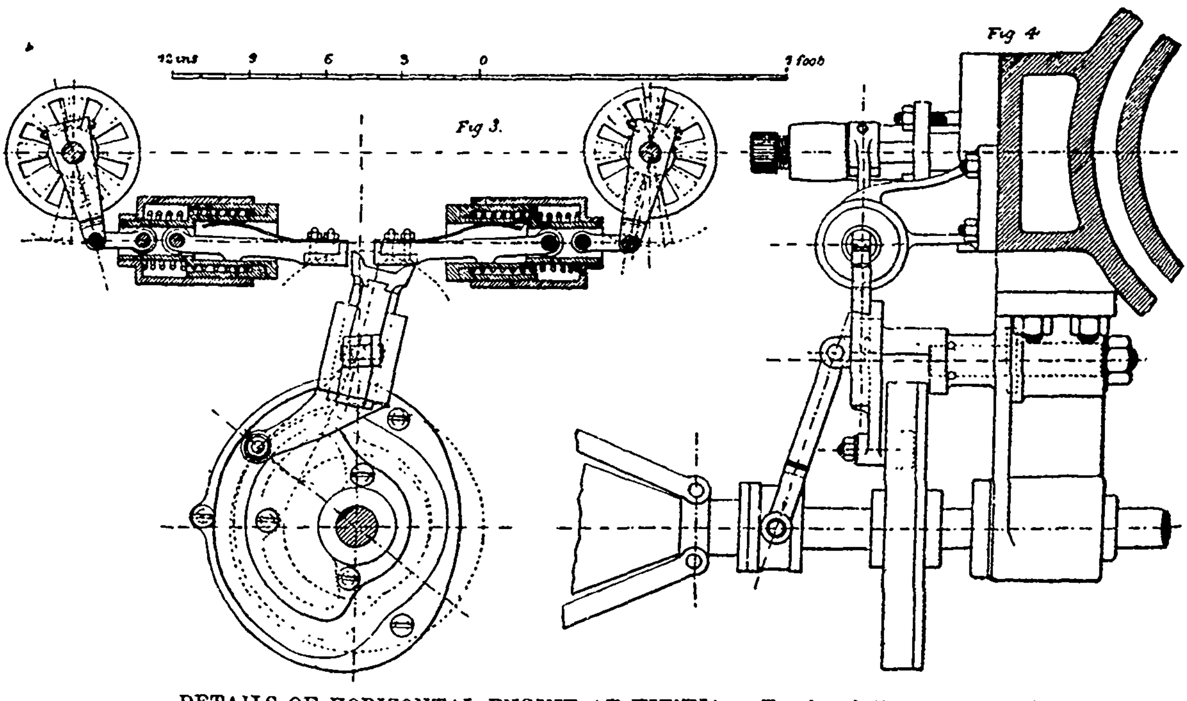
The fact of the gold being so evenly distributed through the quartz, and the quartz being in such large quantities, are, I believe sufficient evidence, although only $27 to $30 per ton, to show that this is a valuable mine. The above description of the lode, formations, &c, are given as received from the discoverer of the gold, who had taken specimens and geological notes when there, and can be depended upon. I may state that this vein is distinctly different in character from the Jackfish Lake gold lode. Being on Indian territory, no work has been done on it since.

Some time during the summer of 1872, Messrs. W. Pritchard, J. McLauren, and A. or P. Syrette, explorers, and all of Fort William, were prospecting near the Pic River, which lies over 150 miles to the N. E. of Fort William, and discovered two

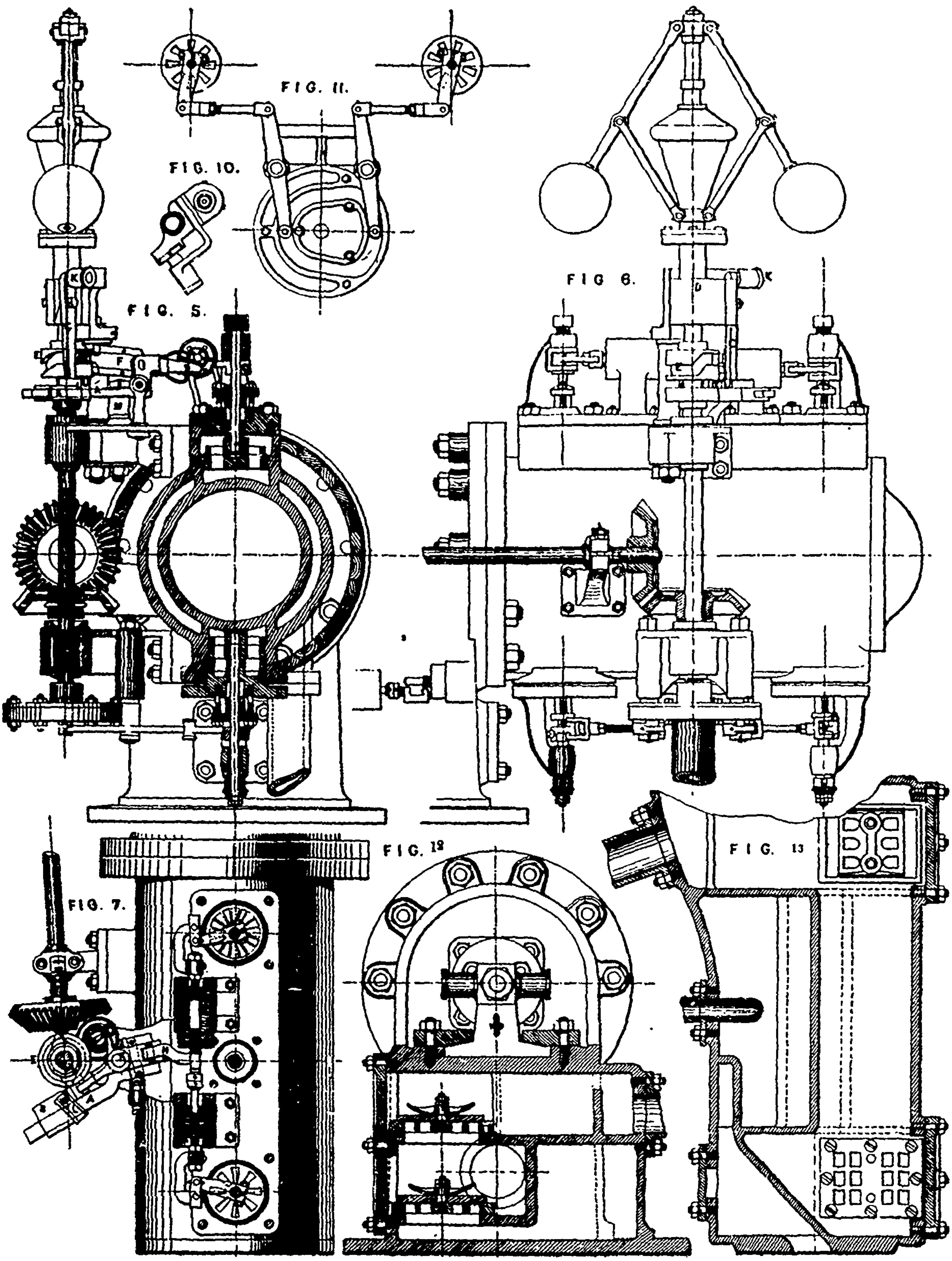
THE AUSTRALIAN FEVER TREE. (See page 284.)



A SUBSTITUTE FOR LINK MOTIONS. (See page 239.)



DETAILS OF HORIZONTAL ENGINE AT VIENNA. (For description, see page 287.)



DETAILS OF HORIZONTAL ENGINE AT VIENNA (For description, see page 287.)

veins of quartz near Heron Bay, carrying considerable galena, zinc blende, iron and copper pyrites, also gold and silver, as proven by the assays made by Mr. McDermid, of Silver Islet. It lies in the talcose and chloritic slates of the Huronian series which occupy the coast of Lake Superior for ten or twelve miles, and runs back towards White Lake some 60 miles or more. I have not seen the veins myself, but I will give their character, &c, as near as I could gather from those who have.

The veins lie within a mile or so of the Bay; at the surface their widths vary from 1 to 4 feet, composed of vitreous quartz with some bitter spar; all the specimens I saw from them were charged with the above mentioned ores. One of these veins seems to conform in dip and strike with the slates, which strike about E. N. E, with a dip nearly vertical.

The other bears nearly N. and S, intersecting the slates, upon this a shaft was sunk some 40 feet last winter. The lode is said to be much wider in the bottom (5 to 6 feet), and richer in ore than at the surface.

I noticed, in going up the Pic River some years ago, a large patch of granite, similar in appearance to that above mentioned as occurring on Jackfish Lake near the gold mine. It is enclosed within the slates, and lies within about a mile or of the Heron Bay lodes. It must have terminated between the river and the lake shore near Heron Bay, as I examined the coast and could not find it pass on. Not having seen its line of contact, I am unable to say what relations it bears to the slates. Having seen it in about the same position in regard to each of these gold-bearing lodes, which lie about 150 miles apart, I thought it worthy of mention, as it may or may not have something to do with the presence of the precious metals in these veins.

Since the discovery of gold at Jackfish Lake, there have been many lodes of quartz found on this side of the Height of Land in the vicinity of Kashaboie and Shebandowan Lakes, which are said to yield by fire assay from a few dollars up to $100 or more per ton, but as far as I am aware, none of them show the free gold, and, with one or two exceptions, the galena, zinc blende, and silver ore are wanting. These, as yet, are totally undeveloped, but in all probability some of them will be good.

Now we know that these metalliferous slates occupy a large portion of the country from Thunder Bay westward, between the American boundary and the Dawson Route, extending in a few places to the north of the latter in broad belts. From the results of the partial explorations already made—of which I have given a short account in this paper—we must conclude that the metalliferous wealth locked up in this extensive tract must be very great between gold, silver, lead, and iron. On the American side of the line, in Minnesota, in this same formation, near where it crosses, have been discovered large deposits of iron, which will soon be made available, as they commenced last summer to build a railway from Lake Superior to tap them. In order to explore and work it to advantage it would be necessary to have a railway connection between Lake Superior and the chain of water courses on the Height of Land which penetrates the above mentioned tract in all directions in the form of lakes and streams, otherwise none but rich mines of the precious metals could be worked, iron mines being out of the question, there being 45 miles over a rough road from Lake Superior to the nearest body of this chain of waters. This railway connection we expect to have in a few years, as the Government is going to build the link between Lake Superior and Fort Garry as soon as the surveys are finished.

Behaviour of Chloride of Silver with Concentrated Sulphuric Acid and with Solution of Chloride of Iron.—It is generally maintained that chloride of silver is not at all, or only imperceptibly, attacked by sulphuric acid. This is decidedly erroneous. If chloride of silver, either precipitated and washed, or crystallised, or even fused, is heated with concentrated sulphuric acid for some time in a covered porcelain capsule, the chloride of silver is completely decomposed and dissolved, with escape of hydrochloric acid. The precipitated chloride decomposes most readily. Chloride of silver is also soluble in chloride of iron, a fact which must not be overlooked in determinations of silver.

DOMINION.

Two one thousand gallon tanks are being put down in London for fire purposes.

The Cariboo gold claims are all washing up over wages.

Mr. Alex McNab has been appointed Provincial Engineer of Nova Scotia.

— The St. John's, P. Q, Woollen Mills are getting in some iron machinery. The profits for the past year have been very good.

— The first cup and saucer were made in the St. John's, P. Q., Stone China Ware factory on the 4th inst.

The Teeswater salt works are suspended for the present. In a short time the directors will hold a meeting for consultation as to future working.

A new and finely finished passengar car for the Riviere du Loup Railway has just been completed at the New Brunswick Railway workshop, the first turned out by the Company.

The clearing of the wood off the Louisburg Railway Line commenced on Saturday the 21st ult., at Louisburg, the ancient capital of Cape Breton.

Several of the Goderich salt works have commenced operations. They are now in full blast, working night and day. The prospects are favourable for the season's business.

The plaster trade of Windsor, N. S., and vicinity is opening. Since the 23rd of March, 17 vessels, carrying 3,940 tons, have cleared at Windsor for the United States ports. During March, seven vessels, carrying 1,400 tons, left Cheverie for the States.

The Bothwell *Advance* understands that the G. W. R. Co., have signified their willingness to assist in furthering the proposed scheme for "tapping" the Thames. It is probable that definite action towards accomplishing the work will be taken during the ensuing summer.

The Coaticook Knitting Company have received an order from a house in Ontario for the manufacture of 1,000 dozen shirts and drawers. The Company have given orders for the erection of a warehouse near the factory, 24 x 60 feet, which the local paper affirms is to be built in nine days. Mr. Charles Merrill has the contract.

Manganese in Nova Scotia.—Manganese has been found on the Six-mile road, near Wallace, Nova Scotia. As a ditch was being dug, large quantities of the mineral were discovered, and samples were sent to Halifax and pronounced pure and valuable.

The Government surveyors have entered upon their work on the mainland. Mr. Turner, with Mr. Bonson, takes the survey on the Yale road. Mr. Ralph will push forward the township surveys, and Mr. Pinder will complete some surveys at Port Moody, left unfinished by the Royal Engineers.

The Almonte *Gazette* says: — A liner named Sabourin, in one of Mr. McLachlin Bros. shanties, made on the 26th inst., a stick of square white pine measuring 69 feet in length, with a girth of 29 inches by 30 in., free from rot, knot or shake, and straight on four lines. Notwithstanding its immense size, it and another stick containing 164 cubic feet were drawn to the river, a distance of 2½ miles, by one team, making a load of 520 cubic feet.

Detroit is to have a self-propelling steam fire engine. Its preliminary trial in Manchester, N. H., resulted satisfactorily, as it climbed the various grades it had occasion to ascend very easily, and turned corners with little, if any, loss of power.

Canadian Ironstone.—The discovery of large deposits of rich iron ore in the provinces of Quebec and Ontario, is rousing attention to the subject of the manufacture of iron in Canada. The large importation of iron from England into all parts of the Dominion and its marked increase during the past year, when prices ruled unusually high, are facts which have not escaped attention.—*Engineering.*

RAILWAY MATTERS.

Baron Reuter is making some progress with his Persian concession. One-third of the railway from Restit to Teheran has been surveyed, and a commencement has been made with the earth-works, ballasting, and laying of sleepers. Very opportunely Dr. Titze, the Baron's Austrian geologist, has discovered extensive coal mines near Kasbin, directly on the line of the railway.

While the new iron bridge over the Winooski River, near Waterbury, Vt., was being tested Saturday afternoon by Governor Smith, and the railroad officials, the western span fell into the river, a distance of thirty feet, carrying with it four cars loaded with iron, weighing 213 tons. Two labourers went down, but were not seriously hurt. The accident was due to the breaking of the lower chord of the span, supposed from a defect in the iron. The loss, which is heavy, falls upon the contractor.

During the great storm of December 5th, (says the *American Railroad Gazette*) some of the Michigan roads experienced much trouble from fallen trees. A train on the Grand Rapids and Indiana was obliged to cut through 100 trees between Traverse City and Clam Lake, forty-seven miles. On the Jackson, Lansing and Saginaw a train was twelve hours running from Otsego Lake to Wenona, 112 miles, having cut through 200 trees, one of which fell just in front of the locomotive, smashing the head light and pilot. On the Detroit and Bay City a train cut through three hundred trees in the run of 110 miles, eighty of them in fifteen miles.

M. de Lesseps has modified his original plan with respect to the Central Asian Railway. According to his modified proposals the line will commence at Kezon, instead of at Orenburg, and it will run to Jekaterinburg. At this point M. de Lesseps proposes that the line should bifurcate. If M. de Lesseps' ideas prevail one fork will direct itself to the north, so as to traverse Siberia, and the other fork will run to Troick, Turkestan, Taschkend, and Samarcand. The Pacific, the Indian, and the Atlantic Oceans would be united by this means. M. de Lesseps has sent his son, who is accompanied by Mr. Stuart, to India, in order to ascertain the best route for a line from Peshawur to Samarcand.

The Chesapeake and Ohio Railroad Company have, for two years, been trying to tunnel through Church Hill, in the eastern part of Richmond, but the work has been attended with unexpected impediments. It was supposed it could be completed for 300,000 dols., as there were no rocks, and the contract was let at that price. The tunnel runs 80ft or 90ft. below the surface, through a slippery blue clay, which has the habit of caving in at the most unseasonable times in the most disagreeable manner. The contractors long ago gave up and the railroad company was compelled to take the work. Six or seven men have been killed, while the repeated cavings have undermined many houses over the line, which is about three-quarters of a mile long, and is not yet open.

The *Titusville* (Pennsylvania) *Herald* says:—"With the present low prices the question of employing petroleum as fuel is again agitated. The latest intelligence upon the subject comes from Canada, where a man named Relighine has been trying an experiment on a locomotive belonging to the Canada Southern Railway, with an average consumption of four gallons per mile. The engine steamed quite freely and made good time with a train of thirty cars. This would be about a barrel for every ten miles. The most simple contrivance for burning petroleum is either by means of a jet of steam or compressed air passed at right angles over the orifice of a pipe in such a manner that the oil will be sucked up and thrown into the furnace in the form of a fine spray, where, if properly adjusted, it will undergo perfect combustion. The cost of the apparatus is trifling. The whole point, it seems to us, turns upon cheapness, and as the market might go up rapidly with any marked increase of demand, there seems to be an indisposition to try the experiment. There can be little doubt that oil will be found in many parts of the country where at present it is not thought of, in which case a new and unlimited market for its utilisation as fuel would naturally follow." A Californian paper states that oil has been found on the bank of the Pajaro river.

THE BELLS AND CARILLON MACHINE, WORCESTER CATHEDRAL.

So much interest has been recently expressed concerning the bells and bell-chiming arrangements in Worcester Cathedral, that we are led to give a view and plan of the bells and bell-chamber, together with a view of the carillon machine recently completed there. The proposal to raise funds by subscription, to provide the cathedral with a clock and peal of bells, was originated by the Rev. Richard Cattley, minor canon of Worcester, and by his perseverance and devotedness to the object it has been successfully carried out. In his appeal Mr. Cattley said, "I have felt anxious for some time past that the noble tower of our cathedral, which rears itself with so much grandeur, not only over the city but also over the rich valley of the Severn that environs it, should, with the sanction of the Dean and Chapter, be furnished with a clock, in which all the resources of modern art (including, if practicable, daily telegraphic communication with Greenwich Observatory), together with the most finished workmanship, should be combined. And not only so; but, in order to complete a scheme worthy of Worcester, which from its rising importance now takes no mean place amongst the cities of England, I propose that we provide a peal of twelve bells, in the key of D flat, on the heavier of which the noted Westminster quarter-chimes would be sounded; and a bell of great power and magnitude, much after the model of the Leeds Town-hall bell, the note of which would be B flat, weighing nearly 5 tons, on which to strike the hours. The carrying out of this latter part of my plan is the hinge on which the whole practical utility of the scheme would turn, because by such a grand measure only would the time be distinctly indicated in every part; thus all other clocks could be regulated with perfect truthfulness; and I also make bold to say, without fear of contradiction, that the changes at the quarters, corresponding with the celebrated chimes to which I have just alluded, and answering to the deep-toned hour-bell, will present a combination which has not as yet been equalled, and will, moreover, only be surpassed when the unfortunate 'Big Ben' passes succesfully through the founder's hands."

The sum named at first as the probable cost was about 4,000l. The greater part of the money was speedily raised, and the work was put in hand.

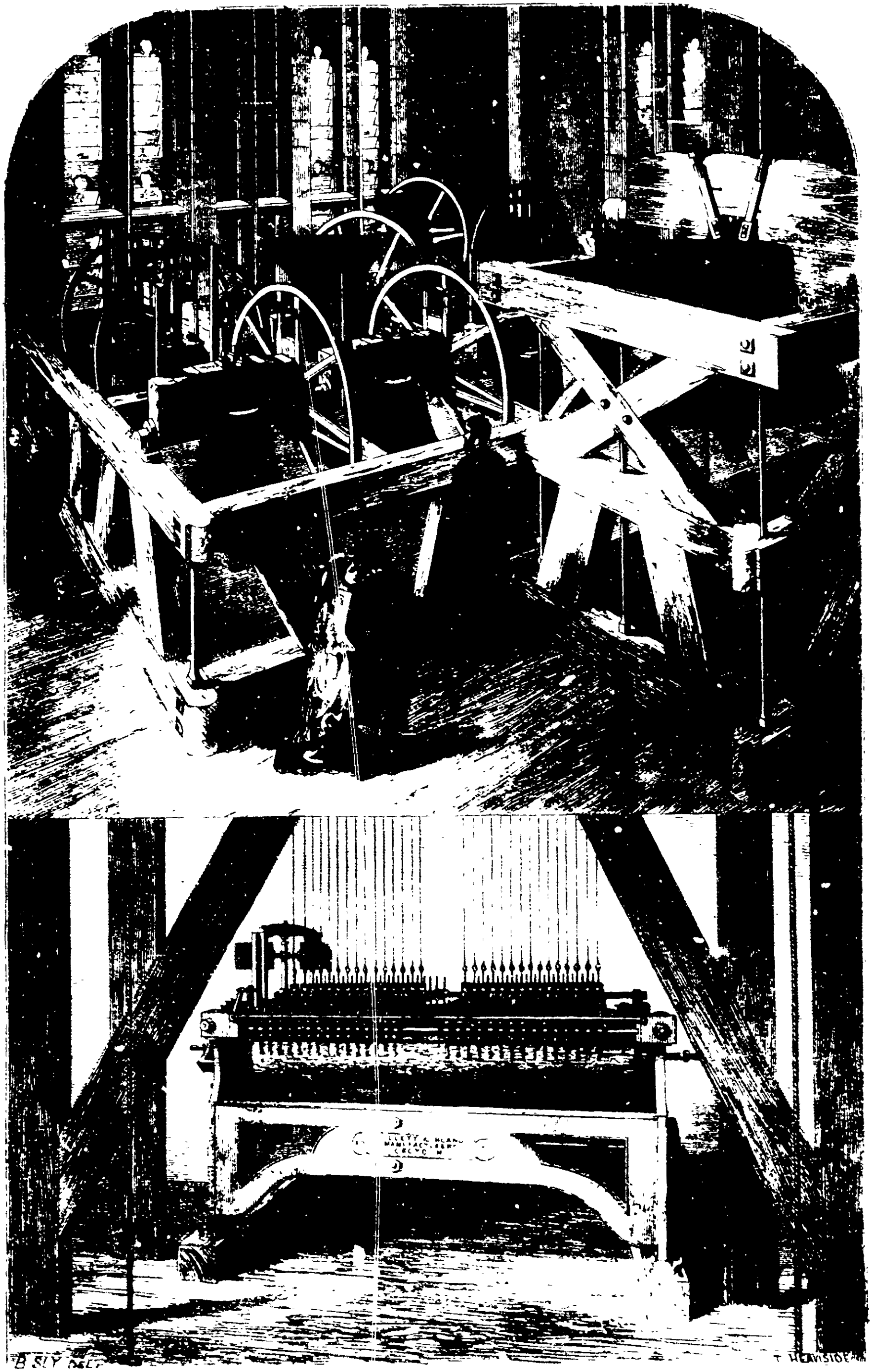
The casting of the bells was successfully completed by Messrs. John Taylor & Co., of Loughborough, and the tone is pronounced exceedingly fine.

The ringing peal consists of twelve, the weight of the tenor being 50 cwt.; note D, flat. They are dedicated to the Twelve Apostles, and the name of the Apostolic Patron is cast in beautiful 15th-century letters on the waist of each bell. The Cambridge Quarter Clock Chimes necessitate an extra bell sounding D natural. This is dedicated to St. Paul.

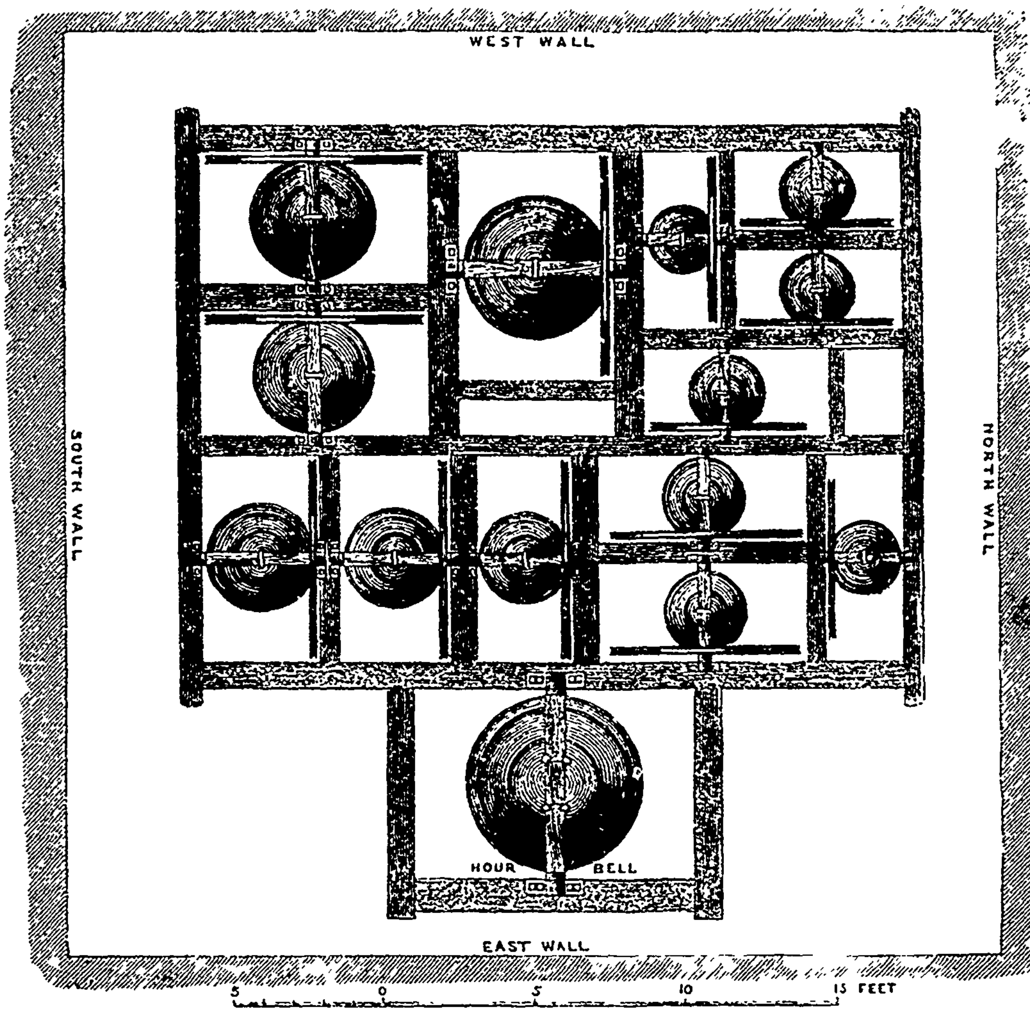
The weight of each bell, with the title and note, is as follows:—

No.			cwt.	qrs.	lb.
1.	S. Matthias	A flat	6	3	19
2.	S. Judas Jacobi	G flat	7	0	22
3.	S. Simon Zelotes	F	7	2	10
4.	S. Jacobus Alphæi	E flat	8	3	0
5.	S. Matthæus	D flat	10	1	21
6.	S. Bartholomæus	C	11	0	24
7.	S. Thomas	B flat	12	0	0
8.	S. Philippus	A flat	15	2	11
9.	S. Andreas	G flat	21	2	11
10.	S. Joannes	F	26	1	8
11.	S. Jacobus	E flat	34	2	12
12.	S. Petrus	D flat	50	0	0
	Extra Quarter Bell S. Paulus	D	0	2	4
	Total		221	3	12

There is also the great bell, on which the hours will be sounded by a new and powerful clock, constructed by Messrs. Joyce, of Whitchurch, Salop, (from the designs of Mr E. B. Denison, Q.C.), weighing 4 tons, 10 cwt.; making a total weight of metal of 15 tons, 11 cwt., 3 qrs., 22 lbs. This bell is a fine casting, and the note B flat is a remarkably true and full one. The ornamentation is of the same character as the peal bells. There are also four coats of arms on the waist—(1) England; (2) See of Worcester; (3) Dean and Chapter of Worcester; (4) City of Worcester. Round the crown is a text of Scripture,



THE BELLS AND THE CARILLON MACHINE, WORCESTER CATHEDRAL.



PLAN OF THE BELLS AND BELL CHAMBER, WORCESTER CATHEDRAL.

Eph. v. 14—"Surge qui dormis et exurge a mortuis, et illuminabit te Christus." (See Durandus de Campanis.) Also, on the lower part of the bell, in addition to the founder's name, is the following:—"In usum Ecclesiæ Cathedralis Christi et beatæ Mariæ Virginis in Civitate et Comitatu Vigorniensi. Anno Domini MDCCCLXVIII."

The following is the estimated expenditure :—

Bells, oak frame, and all necessary fittings complete...	£2,677
Clock, about	500
Timber trussing, floors, &c., about	1,200
Architect's commission, about	70
Gas fittings	12
Chiming apparatus (Ellacombe's)	20
Wire for tower windows, about	35
Incidental expenses, including taking down old bells, printing, advertising, &c., about	200
	£4,714

The large bell was tolled for service for the first time by Mr. Denison and the Rev. H. T. Ellacombe, on Sunday, the 17th of January, 1869, in the company of Mr. Cattley and others.

A desire having been expressed for the restauration of the ancient musical chimes, which had fallen into decay many years ago, Messrs. Gillett & Bland, of Whitehorse-road, Croydon, who have brought the machinery for such chimes to great perfection, were called in, and have constructed a machine on a new and patented principle, a great improvement upon the orignal patent which was first applied to a set of Belgian bells in Boston Church. Since then the firm have effected many improvements, all of which have been introduced in the piece of mechanism under notice. It may be well to state that the chimes are the quarter-chimes of the clock. Mr. Ellacombe's chiming-hammers strike the bells inside with round hammers pulled by ropes, so that the success of the tunes or chimes depends entirely upon the skill of the performer; but the carillon machine is an automatic musician, the tunes being played entirely by machinery, and let off by the clock at the proper times. The carillon machine is constructed to play twenty-eight tunes on fifteen bells but at present it will play seven tunes only on the ringing peal of twelve bells, occasionally introducing the great bell of 4½ tons, which has a grand effect. The tunes are original, composed for the purpose. This we are disposed to regard as a mistake. Known tunes would have given more general satisfaction. When two extra bells are provided (which are essential in order to render the music of the Worcester carillons the finest in England), the other three barrels will be pricked with seven tunes on each. There are thirty-four keys to the machine, only twenty-four of which are now used. The machine is wound up every morning, and plays eight times in the course of twenty-four hours, a period of three hours elapsing between each performance. The same tune is repeated three times on each occasion, and it continues in action four minutes and a half. At the expiration of twenty-four hours the tune changes involuntarily, and in like manner the seven tunes of the barrel are consecutively played. Its connexion with the clock is by means of a lever, which, by a mechanical arrangement, is gently drawn when the time approaches, dislodging a pin, and thus setting the machine in motion. The motive power is obtained by weights, and the speed, as in clocks, is regulated by revolving vanes, capable of easy and instantaneous adjustment. The barrel, which is exactly on the same principle as that of a musical box, and is constructed to play seven tunes, is studded with brass pins, and in its revolution releases the detents and lets the hammer descend upon the bell; a cam-wheel of peculiar construction, continuously revolving, immediately draws the hammer back into a striking position, and forces the detents back into their proper place. When the bells are required for ringing, by a simple arrangement a bar is turned down on the keys, which prevents the machine being set in motion, so that the ringing may continue for any length of time without fear of interruption. The works of the machine are enclosed in a massive cast-iron frame bolted together with iron nuts and bolts, and 7 ft. long, 4 ft. wide, and 4 ft. high, and weighing over 1½ ton. The motive power is given by weights, weighing 14 cwt., which are suspended by a steel line (280 ft. in length) from the iron barrel which drives the main wheel, and thus sets the whole machine in motion. The four musical barrels have seven tunes on each and are 5 ft long, 12 in in diameter, and are made of mahogany, each being pricked with 1,100 brass pins, one-eighth of an inch square. There are twenty-six hammers for striking the bells, some of which weigh 2 cwt., 1½ cwt., and 70 lb. each, altogether weighing 1,202 lb. The weight of the whole machine, including hammers, cranks, lines, &c., is nearly 4 tons of metal.

The great advantages claimed for the new system of carillon machinery are, that instead of the hammers being lifted up by the pins on the musical barrel (in the way common to all chiming machines on the old system), the two actions of lifting the hammers and letting them off to strike the bells are separated, so that the moment the hammers are released by the small pins on the musical barrel, they are again instantly raised into the striking position, their actions being perfectly simultaneous

To show the facility with which the carillon machine acts upon the bells, it is stated that, notwithstanding the great weight of the hammers, an ivory key-board could be attached, the same as in a pianoforte, so that the tunes could be played upon the bells by the fingers as easily as playing a church organ, and any number of tunes could be played by having a series of musical barrels with seven tunes on each.

THE AUSTRALIAN FEVER TREE.

A question of considerable general interest was recently discussed at a meeting of the French Academy of Sciences. The subject was the remarkable sanitary influence of the *eucalyptus globulus*, when planted in marshy grounds; and the tree, in brief, it seems, has the curious and valuable power of destroying the malarious element in any atmosphere where it grows.

The species is indigenous to Tasmania, and is known among the colonists by the name of the Tasmanian blue gum tree, on account of its dark bluish tinged leaves. Growing in the valleys and on thickly wooded mountain slopes, it often attains a height of from 180 to 220 feet, with a circumference of trunk of from 32 to 64 feet. The foliage is thin and oddly twisted, surmounting, with a thin crown, the top of the pillar-like stem. The wood exhales an aromatic odor, and, after seasoning, is said to be incorruptible. For this reason, it is largely used in the building of piers, vessels, and other structures exposed to the ravages of the weather. It is largely exported, to the aggregate value, an authority states, of $4,000,000 per year.

To the peculiar camphor-like odor of the leaves and the large absorption of water by the roots is doubtless owing the fact of the beneficial influence of the tree. Where it is thickly planted in marshy tracts, the sub-soil is said to be drained, as it by extensive piping.

Miasma ceases, we are told, wherever the eucalyptus flourishes. It has been tried, for this purpose, at the Cape; and, within two or three years, completely changed the climatic condition of the unhealthy parts of that colony. Somewhat later, its plantation was undertaken, on a large scale, in various parts of Algiers, situated on the banks of a river, and noted for its extremely pestilential air; about 13,000 eucalypti were planted. In the same year, at the time when the fever season used to set in, not a single case occurred, yet the trees were not more than nine feet high Since then, complete immunity from fever has been maintained. In the neighbourhood of Constantina, it is also stated, was another noted fever spot, covered with marsh water both in winter and summer; in five years, the whole ground was dried up by 14,000 of these trees, and farmers and children enjoy excellent health. Throughout Cuba, marsh diseases are fast disappearing from all the unhealthy districts where this tree has been introduced. A station house, again, at one end of a railway viaduct in the Department of the Var, was so pestilential that the officials could not be kept there longer than a year; forty of the trees were planted, and it is now as healthy as any other place on the line.

La Nature, to which journal we are indebted for the engraving on page 278 of the peculiar leaves and flowers of the tree appears, adds that careful experiments have proved that, in a medicinal preparation, it cures the worst cases of intermittent fever, against which quinine proves powerless. It is also valuable as a disinfectant, and as a dressing for wounds while more recent investigations point to the fact that it may be rendered of great service in catarrhal affections.

DE LORIERE'S PATENT CRANE EXHIBITED AT VIENNA.

In the illustration on page 274 we illustrate a crane exhibited at Vienna last year by Messrs C. E. De Loriere & Co, Victoria street, Westminster. We cannot better describe it that in the inventor's own words. The object of the apparatus combined with the gearing is, says M. De Loriere, "to more effectually utilise the accumulated power, in a fly-wheel in motion by applying it at the point of greatest efficiency through the medium of a compound motion, thus overcoming the difficulty of the dead points and making effective power heretofore lost."

The apparatus is a combination of cranks and levers connected together, and described as follows: First, the arrangement of cranks and levers that are coupled by connecting-rods having no lost motion, the arms of the lever from the fulcrum being of the same relative length as the cranks Second, the arrangement of levers that have lost motion, which is produced by travelling bearings working in the slots shown in Figs. 1 and 2. The working of the apparatus is as follows:—The hand crank marked Cl, is placed at right angles to the cranks A. The force exerted upon the crank during that portion of its revolution which is most effective is transmitted directly through the system of rigid cranks and lever A, being then at their point of greatest efficiency, the cranks and levers marked M, not transmitting any of it until the moveable bearings working in the slots of the levers marked M, have taken up the lost motion and become effective. But at this point the cranks and lever marked A, are at dead point, or nearly so, and not effective. Beyond this portion of the revolution of the hand crank Cl, the power is applied through one or the other of the systems marked B, alternately at their points of greatest efficiency until they are at dead points, when the force is again transmitted through until it has nearly reached its dead point again, and so on alternately. By this combination the power accumulated in the fly-wheel is constantly being discharged upon the cranks at their most effective leverage, and the power is discharged suddenly as by concussion, thus making the momentum of the fly-wheel far more effective than in any apparatus heretofore in use —*Engineer*.

Rolled Screws.—Messrs. Charles Fairbairn and Co Tyne Patent Nut and Bolt Works, Gateshead, are now making screws of all sizes by a very curious and successful process Briefly described, the process consists in rolling bars of heated iron between two peculiarly grooved plates. The result is quite satisfactory; specimens of the work now lying before us leave nothing to be desired. By planing away one side of the screws and treating the surface with acid, it becomes evident that the fibre of the metal follows all the threads of the screws, which are therefore superior in strength to cut screws from which the metal is removed.

SCIENTIFIC NEWS.

[We should be glad to receive scientific news, suitable to this part of our paper, from any of our correspondents.]

ACTUAL experiments show that water which remains overnight in lead pipes in New York contains 1·10 of a grain of lead to the gallon.

ACCORDING to M. Malenfant, by placing flowers in boiling water and collecting the distillate at once, a product much superior to that afforded by placing the flowers in cold water and raising the heat is obtained.

THE influence exercised by the moon on meteorological phenomena has been the subject of a communication to the Académie des Sciences of Paris, by M. Marchaud. From examining the distribution of storms between the years 1785 and 1872 he supposes that he detects some relation between the appearance of storms and the age of the moon, and he attempts to show by tables that the moon has an appreciable influence on the temperature and pressure of the air, on the state of the sky, and the distribution of rain.

WIND-INDICATORS.—In a communication to the Académie des Sciences, M. Tany objects to vanes as indicators of the wind, since they indicate a direction when there is no wind, and they do not indicate the force or velocity of the wind. He would substitute a little flag suspended by a cord from a metallic ring pulleyed on a vertical rod.

SURVEYS have been made by the Tuscarora of the bed of Pacific Ocean over 1000 miles from Cape Flattery. A submarine mountain has been discovered 2400ft. in height, to which the grade of the eastern slope is 123ft. to the lineal mile. The greatest depth detected was 15,240ft.; the bottom of the Pacific Ocean being a blue, black, and brown mud, with ooze and occasional mixture of gravel and shale.

IN a letter to the French Society of Horticulture, a chemist, M. Frémont, mentions that a good way of preserving cut flowers in a state of freshness is to dissolve sal-ammoniac, or Chlorhydrate of ammonia with the water in which the stems are put, in the proportion of five grammes per litre of water. They will thus often be kept fresh for a fortnight. The experiment is one which can be easily made.

SOLDER FOR UNITING BRASS AND STEEL. — The difficulty of finding a material suitable for permanently joining brass with steel or iron, on account of the unequal expansion of the two metals, is well known, on which account it may be of service to note that Dr. Dingler recommends the following alloy possessing the properties necessary to insure a permanent adhesion tin, 3 parts; copper, 39½ parts; and zinc, 7½ parts.

THE Romans used the large stone specus, or aqueducts, instead of ordinary pipes, because they could not depend either upon their leaden pipes or their terra cotta pipes to resist the force of such streams of water as they had to deal with. Nothing but the concrete stone was strong enough. At the present time we understand that cast iron pipes are frequently bursting in the streets of Rome. This seems to show that the old Romans knew what they were about.

THE manner in which liqueur bon-bons are made is extremely simple. The sugar preparation, reduced to a fine powder, is spread over a tray, and upon this single drops of the liqueur are allowed to fall; the tray is then shaken, and the pulverised sugar forms a coating round the several drops of fluid, which can be increased at will to any thickness. The manufacture of bon-bons is carried on all over France, and in Paris alone there are nearly 200 shops devoted to it, employing over a thousand hands. The men get from a franc and a half to eight francs a day, and the women from one to four francs; while the amount of indirect industry, such as making boxes, packets, crackers, and fancy goods, is enormous. The last published statistics show that the sweetmeat trade of France exceeds twelve million francs. Perhaps the greatest marvel is to find that the country itself expends ten millions of this sum.

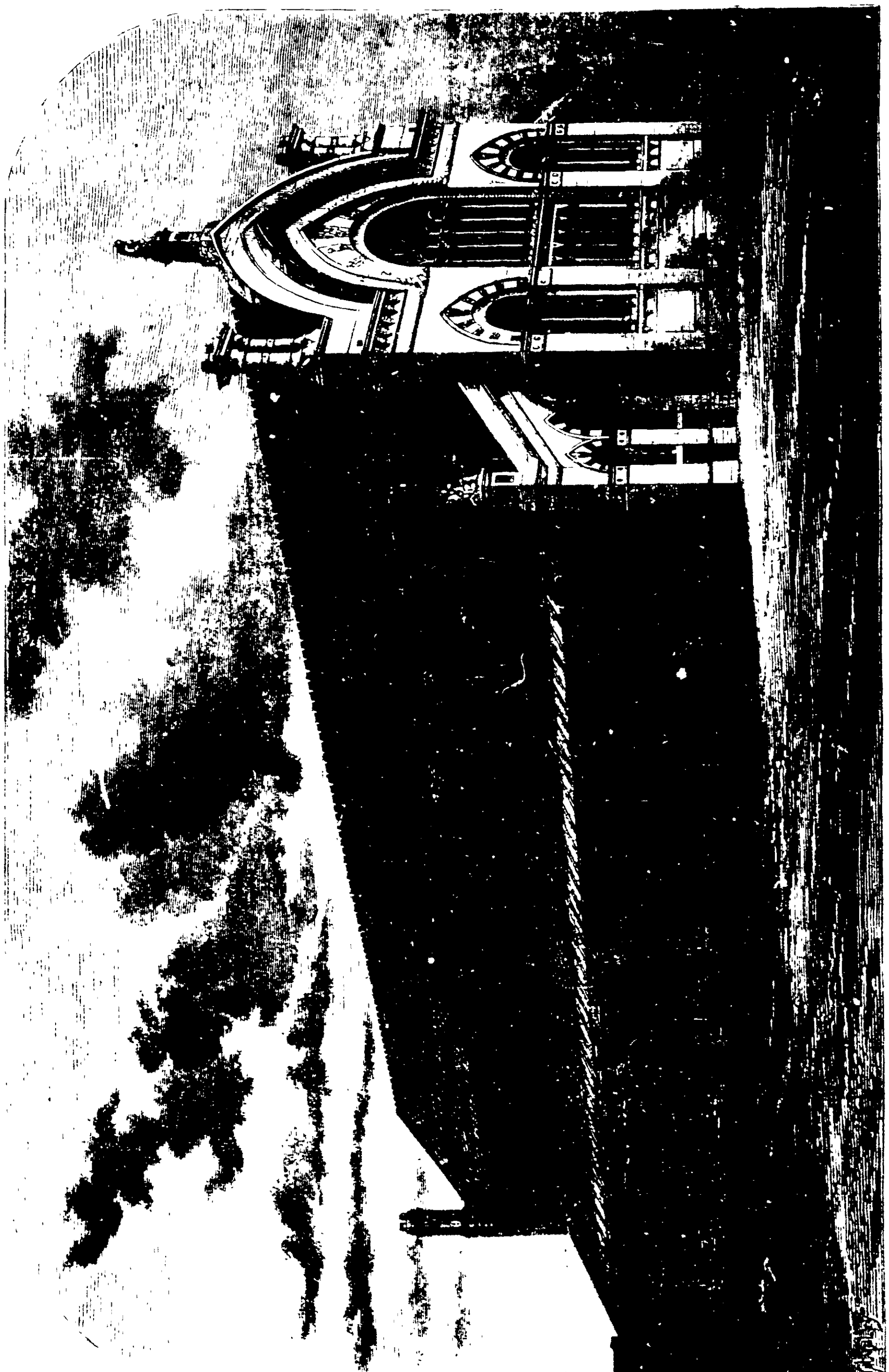
COMMERCIAL benzole often contains quite a large proportion of petroleum, which leaves a disagreeable odour when the benzole is employed for the removal of grease. As a test for its presence a small piece of pitch is placed in a test tube and the suspected liquid poured upon it. Pure benzole will readily dissolve the pitch, forming a tarry mass, while adulterated benzole will be less and less coloured in proportion to the amount of petroleum contained in it. Coal tar will dissolve easily in pure benzole, but forms distinct layers when impure material is employed for the solution.

PLANS BY TELEGRAPH.—At the Paris Academy of Sciences, M. Dupuy de Lome has recently exhibited an invention for sending a plan or topographical sketch by telegraph. Over the plan or map is placed a semi-circular plate of glass graduated. On the centre is a radial arm, also graduated, which carries on a slide a piece of mica with a blade-point. A fixed eye-piece is adjusted; and, looking through this, the micapoint is carried successively over all the points of the plan to be reproduced, and the polar co-ordinates of each noted. The numbers thus obtained are transmitted by telegraph, and they are laid down by the receiver, who uses a similar arrangement to that described.

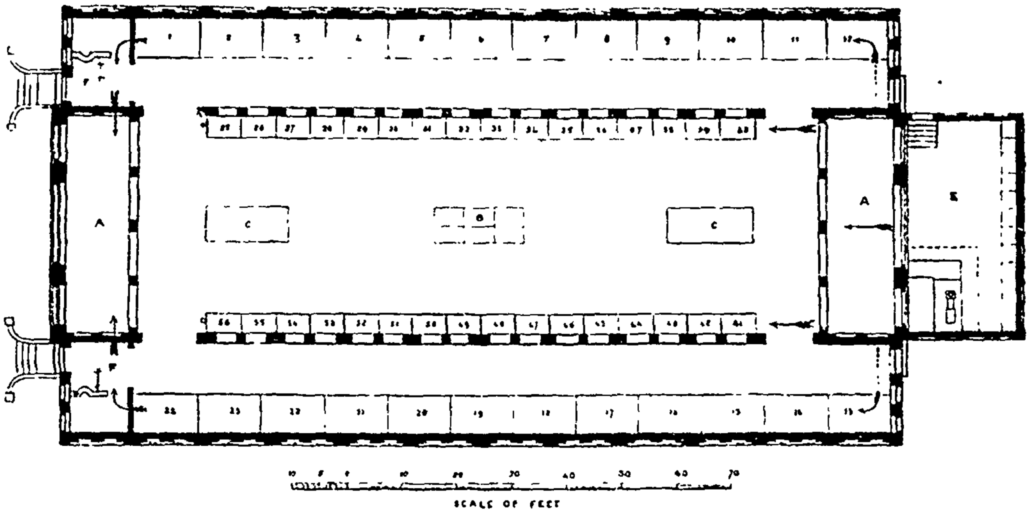
IN extracting the saccharine juice from the beets, the Germans use centrifugals, cold maceration, and diffusion, the latter most largely, while in France few of these improved processes are employed. Various other points may be noticed in which the Germans use better methods, the result being a larger yield of sugar of first run. The three per cent. of superiority of the German sugar manufacturers over the French is summed up as follows:—Superior quality of German beets, 1.57 per cent.; preservation of beets, 0·40, extraction of juice, 0 25; washing the scums, 0 10; black washwaters, care on various points, 0.25; inferiority of German sugar in quality, 0.50; total 3·00.

ANDERSEN discovered that pulverised charcoal applied to sheepskins produces depilation. Charcoal takes up oxygen from the air, or the fatty substance present in the neighbourhood of the glands of the hair. An oxidation takes place in the pores of the skin, which destroys the glands and loosens the hair. Finely powdered charcoal is mixed with sufficient water to make a thin paste, and the hides immersed for four or five days and well turned over in the meantime. After this the hair can be taken off at once. Hides treated with charcoal do not require further treatment, as is the case now with the lime process, and after being washed with water they are ready for tanning. The charcoal can be used over again. Animal or vegetable coal can be used in any quantity, having no deleterious property whatsoever; and for each hide six or ten pounds, with the necessary quantity of water, are sufficient. The temperature should be 61 deg. or 70 deg. Fah., and can easily be maintained by introducing steam into the vats. The tanning process is facilitated, as no lime is left behind to neutralize the tannic acid.

In the *Journal of the Franklin Institute*, Professor E A. Dolbeur communicates notices of an instrument of great ingenuity for showing optico-accoustic effects. The following is Professor Dolbeur's description of it: — "Take a tube of any material, from one to two inches in diameter, and anywhere from two inches to a foot or more in length. Over one end paste a piece of tissue paper or a thin piece of rubber, or goldbeaters' skin, either will do. In the centre of the membrane with a drop of mucilage fasten a bit of looking-glass not more than an eighth of an inch square, with the reflecting side outward of course. When dry, take it to the sunshine, and with the open end of the tube at the mouth, hold the other end so that the beam of reflected light will fall upon the white wall or a sheet of paper held in the hand. Now speak, or sing, or toot in it. The regular movement of the beam of light with the persistence of vision presents very beautiful and regular patterns, that differ for each different pitch and intensity, but are quite uniform for given conditions. If a tune like "Auld Lang Syne" is tooted slowly in it, care being taken to give the sounds the same intensity, a series of curves will appear, one for each sound and alike for a given sound, whether reached by ascension or descension, so that it would be possible to indicate the tune by the curves; in other words it is a true phonautograph.



THE MANCHESTER AQUARIUM.



Nos. 1 to 24, Deep-sea Tanks ; and Nos. 25 to 56, Tidal Tanks. Reserve Cisterns under.
A. A. Ocean Tanks. B. Table Aquaria. C. C. Fresh-water Tanks. E. Engine-house and Reserve Tanks. F. F. Office and Entrance.

THE MANCHESTER AQUARIUM.—(Ground Plan.)

BERCHTOLD'S STEAM ENGINE.

Messrs. Scheller and Berchtold, of Thalweil, Zurich, exhibited at the Vienna exhibition a small steam engine, which we illustrate this week bg a double page engraving, besides perspective views and a number of details on pages 278 and 279. This engine is constructed on Berchtold's patent, which covers the general arrangement of parts, as well as the very unique valve gear.

The general arrangement of the machine, which is exceedingly compact, will be clearly seen from the engravings. Its principal feature is that the bedplate is made it contain both air pump, hot well, and condenser, which are placed underneath the crosshead guides The air pump, as illustrated, is double-acting, 125 millimetres (4.92 in.) diameter by 400 millimetres (15 75) in stroke ; in the engine at Vienna, however, these dimensions were respectively 160 millimetres and 300 millimetres. The pump is worked by a somewhat complicated arrangement of levers. Convenient access can be had to the air pump valves by the two doors in the casing, the valves themselves being rectangular in shape. The arrangement of passages by which the condensers, pump chamber and hot well are all got into a very limited space is certainly ingenious, and will be easily understood from an inspection of Figs. 12 and 13, page 279. The cylinder is bolted on to a strong flange on the end of the bedplate, and overhangs without other support. It is 300 millimetres (11.8 in.) diameter by 600 millimetres (23.62 in) stroke, and is steam jacketted, the steam passing through the jacket on its way to the valves. The jacket and back cylinder cover are properly cleaded. The piston-rod head worksi n a slipper guide of large surface, and the crankshaft has its main bearing brasses adjustable both ways, the plummer block itself forming part of the bedplate. The section used in the arms of the flywheel, which will be seen in the perspective views, deserves a word of praise.

The valve gear is somewhat complicated, but we shall endeavour to make it clear by the aid of Figs 5 to 9. It is one in which the valves are actuated from the governor spindle, and the cutoff entirely under the control of the governor itself. The governor runs at the same number of revolutions as the crankshaft, and is driven by bevel gearing ; it is of the ordinary type, but weighted. The valves are four in number, two steam and two exhaust. They are flat perforated dics (Figs. 5 and 7), working in a horizontal plane, and are kept tight both by the steam pressure, and by small springs. The exhaust valves (under the cylinder) are worked from a grooved disc revolving on the lower end of the governor spindle by means of the arrangement shown in Fig. 11. The levers on the steam valve spindles are connected with dashpots and springs, of much the same kind as are used with Corliss valves ; the way in which the difficulty of want of room for the connecting rods is got ove, (see Fig. 7), is very neat. All the levers are made straight-sided throughout their length, slotted behind the spindled, and the two sides nipped together by a tightening screw, Figs. 7 and 11, so that no keyways have to be cut in the spindles. The centre lines of the two dashpots are not in the same plane, but one lies about an inch higher than the other.

In the figures A, is a horizontal lever working on a pin at M, and embraced by a brass slide B, on the upper surface of which are cast a couple of parallel webs enclosing a small channel L. A cam with very sharp corners (almost lozenge-shaped in fact) revolving always with the governor spindle, and shown dotted in Fig. 7, works against the side of B, and so communicates a continual rocking motion to A, in a horizontal plane. Upon the lever A, itself is the fulcrum of another lever F, which can move in a vertical plane, and which has at the end farthest from the governor, a steel striker H, which, by pressing the piston rods of the dashpots, can open the valves. The opening motion of this striker is in the same direction (towards the crankshaft) for both the valves ; in the one case it presses directly on the end of the rod, and in the other it presses on the inner side of a steel hook, the arrange ient being as shown in Fig. 9. E, is a block fixed to, ana revolving with, the governor spindle, and having a groove in it, of which one half is at one level, and one half at another, the two being joined by steep curved which are seen in Figs. 5 and 6. A pin in the end of the lever F, works in this groove, and this lever therefore receives (in addition to the horizontal vibration given to it by A), quick motions up and down, alternating with periods of rest in each position. The limits of the up-and-down motions are so adjusted that the two corresponding positions of the striker H are exactly oppo-ite the two centre lines of the dashpots, which, as before explain d. are at different levelsi D is the moveable slide of the governor, and has upon one of its faces (the one furthest from the crankshaft) an oblique straight groove, in which works a pin in the lever C. This lever can move upon a fixed pin)in a bracket K) at its upper end, but only changes its position when the upward or downward motion of the gover ior slide compels it to do so by giving a side motion, by means of the groove, to the pin above mentioned. The lower end of C, works in the channel L, on the top of ihe block B, previously mentioned, this channel being sufficiently long to allow C, to remain in gear, whatever may be the position of the lever A, The lever F is compound, the end nearest E, being separately jointed upon a vertical pin, and prevented from sharing the sideway motion given to F by A so that it always remains in the slot in E.

The action of the gear is as follows: suppose the striking end of H to be the level of the lower rod, as the piston to be at the commencement of its stroke. The cam on the governor spindle, pressing against the slide B, moves the lever A, and consequently also F and H, and in this way opens the valve. Directly the point or the cam leaves the slide B (as shown in Fig 7), the spring (we mentioned before that the gear includes spring boxes and dashpots) closes the valve, and therefore presses back F, and so keeps B in contact with the cam. The shape of the cam renders this closing motion practically instantaneous. During all this time the pin in the end of the lever F, has been stationary in the higher half of the groove in E, as is seen in Fig. 5. On approaching the end of the stroke, however, its position is rapidly changed, and the striker is brought opposite the centre of the higher dashpot, so that when the second lobe of the cam comes in contact with B, and moves A and F' again, the valve belonging to the other end of the cylinder is opened, and so the process goes on. It will be seen that the position of B upon the lever A is determined altogether by C, and the position of B itself is determined entirely by the governor (through the slot in D), the position of B is also controlled by the governor As the cam on the governor spindle works against B, a little consideration will make it clear that upon the position of B upon A, depends the duration of contact of the lobe of the cam, which in its turn determines the period during which the valve remains open, and by this means the cut-off is brought entirely under the control of the governor.

Figs 3 and 4 (page 278) show a modification of the gear we have just described, which has also been introduced by Herr Berchtold. In this case a grooved disc revolving continuously with the governor spindle, imparts to a striking lever an oscillatory motion, alternating with periods of complete rest. The striker itself is separate from the lever, and slides in V-guides upon it. It is connected by a link with the governor sliding bush This connexion is so arranged that the upward and downward motion of the latter moves the striker away from or towards the valve rods; its position in this direction obviously determines the time during which the striker is allowed to press against the rods; in other words, controls the cut off. The dashpots in this case are in the same plane, but the shape of the striker head is so arranged that, while it gears with one valve rod, it simply pushes the other side. The lead is of course constant, as in all such gears, no matter what position in reference to the spindle the governor may give to the striker. An engine with this gear is working at Messrs. Scheller and Berchtold's shops.—*Engineering*.

WATER SUPPLY—PREVENTION OF WASTE.

In our last issue we intimated our intention of explaining to our readers a system of inspection of water supply recently adopted with great success by the municipal authorities of Liverpool, England. The originator of the system is Mr. Deacon, water engineer of Liverpool, and we cannot do better than give extracts from a paper read by him before the Association of Municipal and Sanitary Engineers. The explanatory diagrams are from *The Engineer*.

" In the following paper I propose to state, first, what appear to me to be the inducements to undertake systematically the prevention of waste, next my experience as to the working of the district waste water meter system; and I will begin by submitting to you the three following propositions, which have failed in gaining universal acceptance, owing principally, as I believe, to the superficial manner in which the subject has been considered:—

" Proposition 1.—The prevention of waste of water, or, in other words, the conservation of all water not actually required for domestic or manufacturing purposes is, or may be accompanied by vast sanitary benefits arising from the more efficient action of existing drains, as well as from the dryness of the subsoil of dwellings.

"Proposition 2.—The prevention of waste by the system hereafter described is practicable, and, apart from all sanitary considerations, it is by far the most economical mode that can be resorted to for increasing the available water supply, while it will always diminish the working expenses in cases of supply by pumping from wells.

" Corollary.—Towns and districts at present supplied on the intermittent system, when the total supply is more than sufficient to meet the necessities of the people, which is the case when more than ten to fifteen gallons per head per day are taken for domestic purposes, may obtain constant supply, accompanied by a surplus of water or by a corresponding reduction in the working expenses of the supply."

With respect to the first proposition, that the prevention of waste is or may be accompanied by vast sanitary benefits arising from the more efficient action of existing drains, as well as from the dryness of the subsoil of dwellings, I would call attention to the very prevalent notion that a town cannot have too much water, and that all the water which can be passed into the mains should, if possible, be given to it, as it is conducive to cleanliness, and as the sewers require it The prevention of waste is assumed to be equivalent to stinting the supply, when in reality it may have the contrary effect Take the common case of a town demanding twenty-five gallons per head per day for domestic purposes. Now ten gallons per head per day is probably the maximum quantity actually used for such purposes. Of the remaining fifteen gallons a large proportion is lost by defective fittings and misuse, and flows down a few isolated drains to the sewers. But the maximum waste due to this cause considerably exceeds the average, and it exists where the pressure on the mains is greatest, viz., in the lower parts of the town—so that the greater part of such waste water enters the sewers near their outfalls, where it is useless: while at their upper ends, where water is most required, the supply to the sewers from this cause is trifling. Among the sewers of a town many are or ought to be permanently self-cleansing, and without entering upon the consideration of the various circumstances which conduce to so desirable a condition, I may say that all sewers which are not self-cleansing, with the reasons why they are not self-cleansing, should be systematically tabulated, and if want of water is the cause — which is certainly not always, and, I think, not usually so—the cure is very simple when you have a surplus of water, formerly wasted, to use for this most beneficial purpose.

Imagine the influence on a single system of sewer, if only a quarter of a gallon per head per day of the population whose drains fall into it were used for flushing that system. I will give, as an example, a single existing case, and in most towns there are many cases more striking. The sewer system to which I refer carries away the refuse of 52,000 persons. There are in it about 250 dead ends of branch sewers, of which probably 100 require artificial flushing to keep them absolutely free from deposit. A quarter of a gallon per head per day will give 4000 gallons for each of those sewer ends every month, a quantity which, whether flushing direct from the mains or the tank system, which is by far the best, be adopted, is more than ought ever to be used. It would, in short, fill a 4ft. by 1ft. 10in. sewer to the crown for 145ft. of its length

But the private drains also require flushing. It is certain that the dribble of waste water will never flush them, the small pipes of ordinary water-closets kept running all night will never do it; but the regulating system delivering its two gallons through a 1¼in. pipe will do it most effectually, and that cistern will help you greatly in your work. Of course there are other private drains, but the dribble of waste water, if it exists, is no advantage to them.

I have spoken of the proportion of the lost fifteen gallons due to defective fittings and misuse, and I now come to the remainder of that quantity which leaks from innumerable defects in public and private service pipes. This water sinks into the subsoil; it renders healthy soils unhealthy; it makes the houses damp, and certainly militates against the cleanliness of the lower orders. But its influence for harm does not end here. Part of it reaches the sewers, and even though it may get into them, it can only do so by damaging the brickwork and water. The second proposition and its corollary is to the effect that the prevention of waste by the system hereafter described is practicable, and that it is, apart from all sanitary considerations, by far the most economical mode that can be resorted to for increasing available water supply while it will always diminish the working expenses in cases of supply by pumping from wells; while towns and districts at present supplied on the intermittent system, when the total supply is more than sufficient to meet the necessities of the people, which is the case when more than ten to fifteen gallons per head per day is taken for domestic purposes, may obtain constant supply, accompanied by a surplus of water, or by a corresponding reduction in the working expenses of the supply. I think I may satisfy you as to the truth of this statement by giving an example of the cost of the work in a district of Liverpool where the consumption was 20 per cent. below the average before the prevention of waste under the new system was commenced, and the pipes in which, being very old, required in a great number of instances to be entirely renewed Add to this the fact that the corporation relaid at their own cost all defective private service pipes not within the dwellings, and you can understand that I have good grounds for saying that while the saving was a minimum the cost was a maximum. The district in question contains 31,000 persons; the saving of water between former constant and present constant supply was 21.38 gallons per head per day, and between former intermittent and present constant 7.42 gallons per head per day; and the saving of water between former and present constant service was obtained at a cost to the corporation of less than a farthing per 1000 gallons In districts containing a better class of property the saving is often greater, while the work to be performed in obtaining that saving is far less. When we consider this in connection with the fact that water obtained from new works usually costs 5d. to 6d. p 1000 gallons, we must admit the last proposition as an established fact.

The inducements to undertake systematically the prevention of waste have been laid before you in what appear to me their most striking aspects. But to those who have taken up the subject in practice many other important features, which I am unable to consider in a short paper, suggest themselves. I will, therefore, at once describe to you the method by which the the prevention of waste and restoration of constant service is being rapidly carried on in Liverpool.

To be continued.

A Dangerous Paper Weight.—A writer in the Boston *Transcript* says.—"A young lady in a house on Louisburg Square the other day in passing through an entry perceived a suggestion of fire, a smell of something burning, sufficiently out of the common course to arrest her attention. Finding the furnace fire and soft-coal sitting-room fire with nothing unusual to account for this smell of fire, she continued to the front drawing-room. Now the forenoon was bright, the curtain and shades withdrawn, so that the rays of the sun were hotly streaming in at the windows in full blaze upon the centre-table, where rested a round-top glass paper-weight, under which a mass of papers lay. Here was the fire. The papers were burning smartly. She disposed of them in the grate, and taking up the glass found it burning hot; acting as a burning glass, it had concentrated the rays of the sun sufficiently to cause combustion. It should be told that the paper bottom of this glass was for some reason gone — either worn off or torn off."

A large cuttle-fish (according to Mr. Harvey, of St. John's, Newfoundland), was recently observed by two fishermen off the Newfoundland coast. At first sight it appeared like a large sail or the débris of a wreck. On reaching it, one of the men struck it with his gaff, when it immediately showed signs of life, and reared a parrot-like beak, which, they said, was as big as a 6-gallon keg, with which it struck the bottom of the boat violently It then shot out from about its head two huge arms and began to twine them round the boat. One of the men seized a small axe and cut off both arms as they lay over the gunwale; whereupon the fish backed off to a considerable distance, and ejected an immense quantity of inky fluid, that darkened the water for a great distance round. The men estimated the body to have been 60 ft. in length and 5 ft. in diameter One of the arms, which the men brought ashore, was unfortunately destroyed, but a clergyman who saw it assured Mr Harvey that it was 10 in. in diameter and 6 ft. in length The other arm had 6 ft. of its length cut off before leaving St John's; the remainder which measured 19 ft. in length, is about 3 in. in circumference, except at the extremity where it broadens like an oar to 6 in. in circumference. The largest of the sucking discs was an inch and a quarter in diameter. The men estimated that they left about 10 ft. of the arm attached to the body of the fish, which would make it about 35 ft. long.

A SUBSTITUTE FOR LINK MOTIONS.

The following method of working steam expansively is suggested by Mr Hugo Bilgram in the Journal of the Franklin Institute, as a substitute for links and link motions :—

By the arrangement of levers represented in Fig. 1, the end E, of the T-shaped middle piece is guided in a curve X, X, which between F, and G, so nearly coincides with the arc of a circle Z, Z, that practically it cannot be distinguished from the latter. The rods A C and B D form the guides of two points of the middle piece, and have their respective fulcrums in A and B, as the engraving shows. For it's remarkable property this combination may be utilised to substitute the links of reversible engines that are exposed to destructive influences; for instance, of crane engines in foundries, where the sand suspended in the surrounding air causes a considerable wear of the sliding parts of the engines, and necessitates frequent repairs. It may also be applied on cheap reversible engines, especially if their manufacturers are not provided with suitable facilities to give the link its proper curvature.

In Fig 2, H and I represent the eccentric rods of a Stephenson's link motion, in which the link is substituted in this manner. A plain connecting piece A, B. takes the place of the link, and may be suspended in the usual way. To the ends of the eccentric rods are also attached the two guiding rods A C and B D, to which the T shaped middle piece is fastened by the pins C and D, the end of which E, moves directly the valve-stem V, or the rocker. The point E being guided in relation to A B, as though it was moving in a slot conform to Z Z, this arrangement produces the same motion as the ordinary link. By the way of suspension, the corrections of the irregularities between fore and back stroke can be accomplished in the modified link motion as well as in the original one.

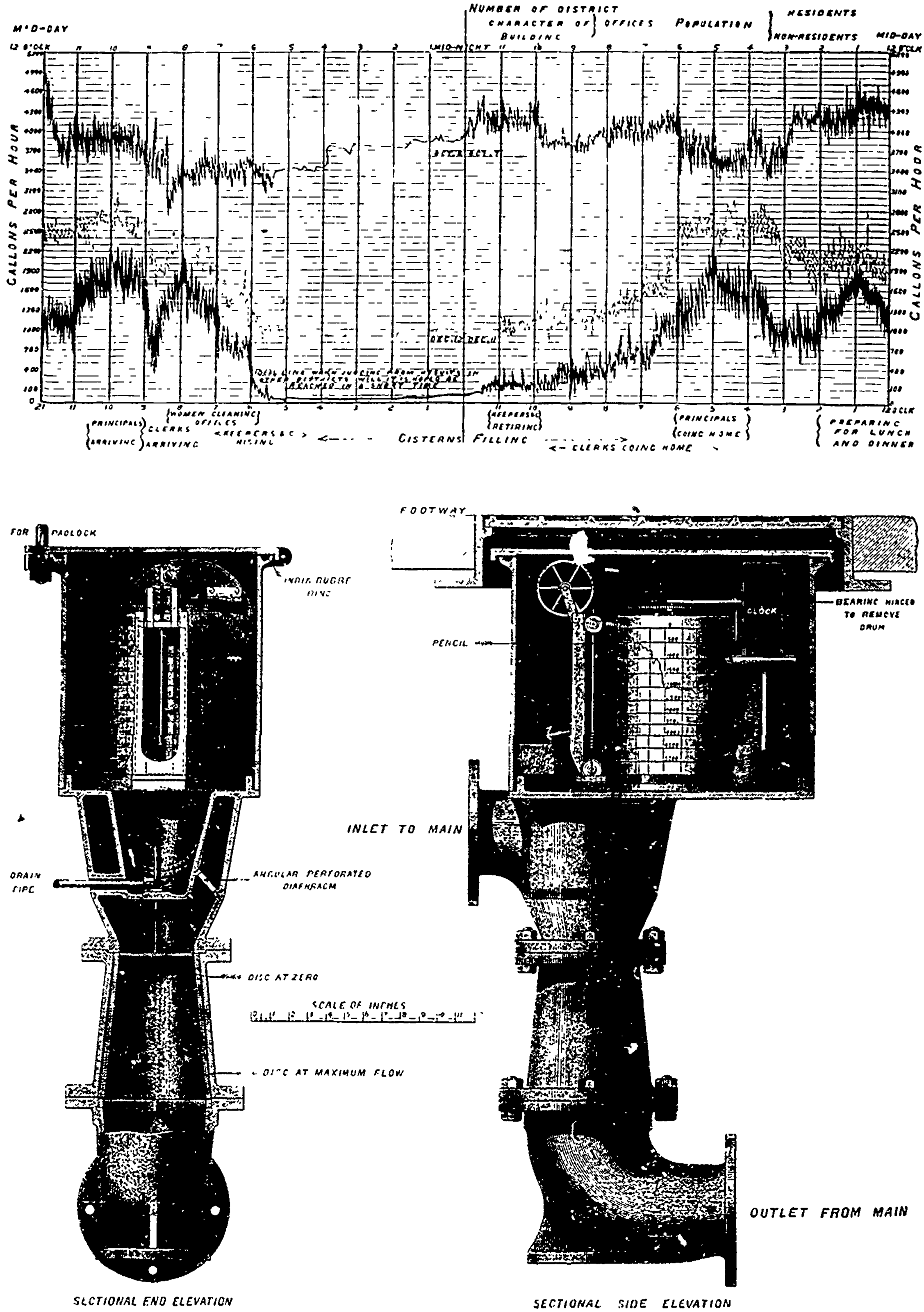
A rule for the choice of proper dimensions can be only empirical. A good result may be obtained if the rods A C and B D are made equal to, or at least not much shorter than, the link A B. The dimensions of the T-shaped lever are easily found by first sweeping the circle Z Z of the proper radius, then drawing the chord A B of a length equal to that of the link, and sweeping two arcs, *a a* and *b b*, from A and B, with radii equal to the length of the guiding rods. If, now, the chords A E and B E (E being the vertex of arc Z Z) are perpendicularly divided in two equal parts by the lines C K and D L, then the respective points of intersection C and D, with the arcs *a a* and *b b*, together with the vertex E, represent the three characteristic joint centres of the middle piece. The application of this arrangement is not restricted to Stephenson's link motion only, as it may be applied to any other expansion gearing in which a link is used.—*See page* 278.

TO INVENTORS.

C. E. G., in the *Scientific American*, lays down the following maxims for the guidance of inventors :—

1. Know definitely what you want to accomplish, stick to it, and let other matters go, for the time.
2. Post yourself thoroughly as to the laws governing the action of each part of your machine.
3. Always bear in mind that whatever is gained in time is lost in power, and *vice versa*.
4. Think over every machine, of a nature similar to yours, which you have seen, and when your idea is clear in your head, compare it with those of inventors who have preceded you in the same line.
5. Be sure that the cost of your device will not prevent its use.
6. Avoid all complicated arrangements; make every machine of as few parts as possible.
7. Imagination, judgment, and memory are the faculties to employ. Imagination will bring forth new forms and actions, judgment will compare them with other devices and determine their relative value, and memory will store up the results for future use.

A large English Company is about to open an iron mine near Lyndhurst, Ont. Operations will be carried on which will involve the outlay of large sums of money and the employment of a considerable number of hands.



WASTE WATER METER. (See page 288.)