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The Canadian Patent Office Record and Mechanics' Magazine

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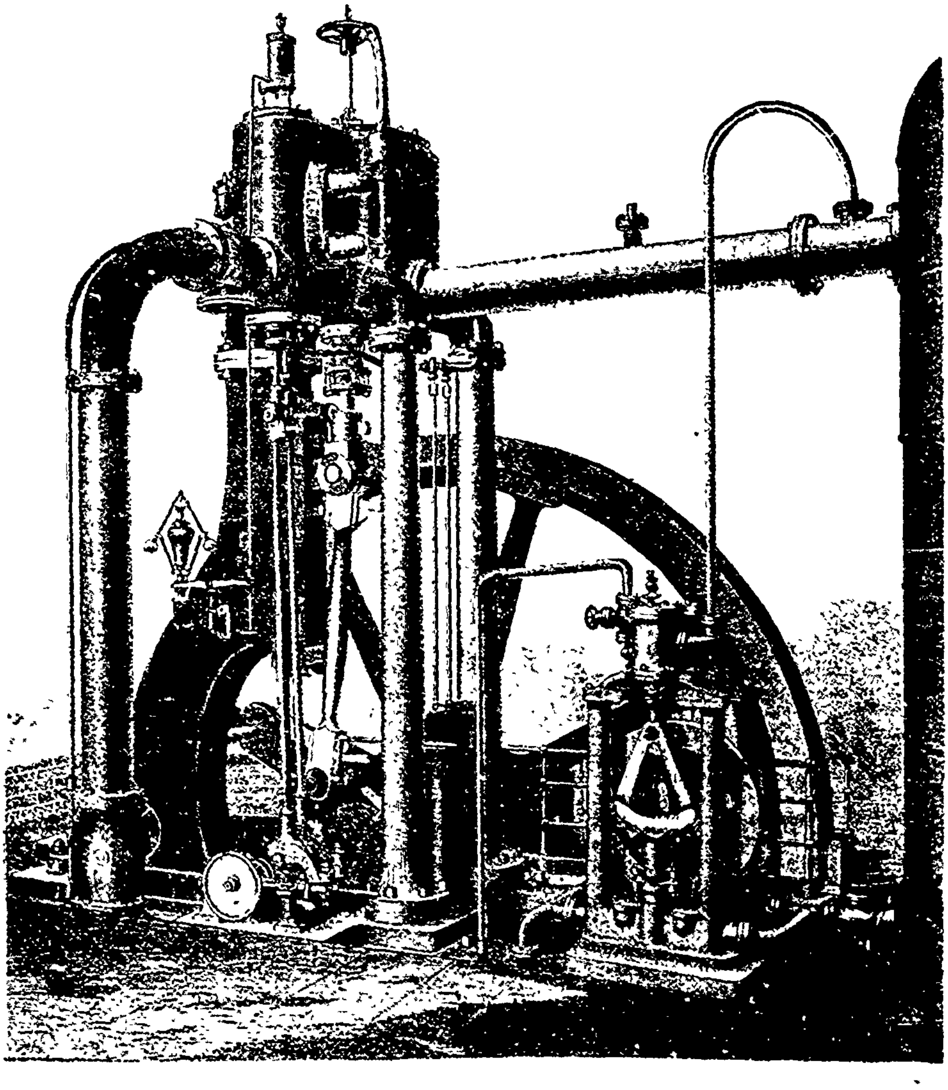


ENGINE OF DARLINGTON IRON-WORKS.

ENGINE OF DARLINGTON IRON-WORKS.

The engine which we illustrate on page 1, is employed to drive a 20-inch rail mill at the Darlington iron-works, the largest railway-rail manufactory in England. These works are built in accordance with the principles enumerated in the "Principles of Shop Manipulation for Engineering Apprentices"—that is to say, the machinery is classed and fixed in the order of the different processes so that the product of one machine is at once passed on to the next. This general arrangement is carried out with admirable skill and a proper discrimination of economical subserviency. From these works the puddled bars are carried by locomotives, owned by the company, to the Albert Hill Works close at hand, where they are manufactured into rails. The company do not produce anything else on a large scale except iron rails, but of this commodity they probably manufacture more than any other company or firm in England. Previous to the transfer of the works from Mr. William Barningham, their founder, to the company by whom they are now owned, their annual turn-out of iron rails was about 70,000 tons, and as much as 865,000*l*., have been turned over in a single year. But even with this enormous yield the productive resources of the works were not taxed to their full extent, for they were estimated by competent men two years ago to be capable of producing over 100,000 tons of rails per annum, although this figure has never yet been reached in any one year.

EFFECTIVE POPULATIONS.

An American medical writer has compiled some very suggestive statistics showing the relative rank of different countries according to their effective population. By effective population he means the portion of the population between 20 and 70 years of age. In those 50 years, as he remarks, each generation not only provides for its own present wants and the need of its old age, but also saves enough to maintain its children up to 20. Of course this is not accurately true. Many are productively employed before 20 and some continue to produce after 70. But the exceptions are not numerous enough to disturb his comparisons, and, besides, they are almost equally frequent in all countries. Another circumstance which diminishes the value of the statistics is that they make no allowance for the different proportions of the effective population non-productively employed in different countries. For example, they take no account of the enormous standing army of France, nor of the still more enormous pauper horde of England. The tables represent, therefore, the potential rather than the actual effective populations. Understanding them so, then, it appears that in population France possesses the largest effective population of any country, and Switzerland next, Belgium being third; Prussia is eighth, England ninth, and Ireland, last. France stands highest, no doubt, because her population is stationary, while Ireland stands lowest because of the drain of emigration, and probably, too, of the early marriages and large families common there. The proportion of the effective class in France exceeds that in Ireland by 30 per cent, and even in England the proportion is higher than in Ireland by 12.9 per cent.; while the effect of immigration is shown in the United States by the fact that the proportion in Massachusetts, exceeds that of the whites in the Carolinas and in Georgia by 38 per cent—that is, by more than the excess of France over Ireland. "Comparing the substaining power with the burden laid upon it, the demand was 94 per cent. greater in Ireland than in France. On the whites, it was in the Carolinas 50 per cent., and in Georgia 60 per cent., greater than on the people of Massachusetts."

More interesting as well as more practically instructive is a second table, which exhibits the relative vitality of different populations. Judged by this test, France falls from the first place, which we have just now seen her occupy, to the second lowest, while England rises from the ninth to the third. The United States also rise, coming, so far as men are concerned, next after England. But Ireland still remains at the bottom of the list. Out of 10,000 children born, it is found from official statistics that in Norway as many as 7,415, or roughly speaking, three out of every four, live to be 20 years of age. In England only 6,627 so live or 788 fewer than in Norway. In the United States boys have nearly as good a chance of life as in England, while girls have not. But in France only 5,022, or scarcely more than one out of two, reaches 20; while in Ireland no more than 4,855, or actually less th[an] one out of two, attains that age. More surprising still are the statistics regarding old age. Out of the same 10,000 for example, we learn that in Norway 3,187, more than one out of three, reachs 70; in England almost one out of four; in the United States, still men only, one out of four—a trifle higher than England; in France, 1,776, or about one out of 8½; and in Ireland only 861, or one out of 11½. If this table is to be depended upon, we thus learn that of all countries in the world Norway offers the new-born child the best chance of long life, whilst Ireland offers the worst. And France, universally admitted to be, so far as soil and climate are concerned, one of the most favoured regions of the earth, offers but little better chance than Ireland. As regards Ireland, it is obvious that the statistics, if collected since the famine, are totally misleading. In the first place, the mortality which attended the famine and the pestilence which followed it was altogether abnormal; and in the second place, there must have emigrated from Ireland since the beginning of the famine in the winter of 1845 at least 3,000,000 people. If, then, we should know the real mortality of the Irish, we must not confine our researches to Ireland, but must follow the emigrants to Great Britain, the United States, and the British Colonies. None of these remarks, however, apply to France; and the bad chance of life which she offers is certainly most surprising. But, in whatever way accounted for, the cost of these unproductive lives to the countries upon which it has fallen is the same.

"In the production of dead machinery, the cost of all that are broken in the making is charged to the cost of those which are completed. Thus, if two fail when half-finished for every one that is completed, the cost of the finished one is doubled and this increase of cost is in proportion to the expenditure which has been made or lost on those that broke down in the process. So, in estimating the cost of raising children to manhood, it is necessary to include the number of years that have been lived by those that fall by the way, with the years of those that pass successfully through the period of development.... The loss in Ireland was 120 per cent. greater in the first year, 75 per cent. in the first four years, and 120 per cent. greater in the period of growth than in Norway."

We have quoted this passage at length, as setting in a new light the pecuniary value of sanitary precautions resulting in an improvement of the public health.

One other important point illustrated by these statistics is the relative length of life of the portion of the population over 20 in the different countries which afford data for making the calculation. In this respect, again, Norway stands first; Sweden, as before, ranking second. The United States, still only in respect to men, now takes the third place, Hanover the fourth, while England is only fifth And France and Ireland are once more at the bottom of the list, Ireland being lowest The average length of life of the effective population in Norway is 39.61 years; in England, 35.55; in France, 32.84; and in Ireland only 28.88 years. Thus it will be seen that, while in Norway the proportion of the population that reaches 20 survives nearly 40 years, or four-fifths of the effective period, to contribute to the wealth of the community; in Ireland the same proportion survives less than 29 years, or considerably under three-fifths of the effective period. The Irish effective population has, therefore, 11 years less than the Norwegian in which to replace the cost of its own maintenance and accumulate a capital for its successors. The last point illustrated by these curious statistics is "the cost, in years, of creating and maturing human power, and the return which it makes in labour in compensation." This is done by showing the number of labouring and productive years secured in each country for every 1,000 years expended in the developing period upon all who, are born whether they die prematurily or live to old age. It appears that in Norway 1,881 years are secured, in England, 1,688, in France, 1,398, and in Ireland only 1,[illegible]8. These results are arrived at from life tables, but the dates of the tables are given only in the case of France and Ireland. As regards France the date is 1806; and as this was the very middle of the great war she was waging against all Europe, and as, besides, nearly three quarters of a century have since elapsed, it can hardly be but that the chances of life have since greatly improved. On the other hand, the Irish date is 1841—that is, before the famine—and consequently our previous objections do not apply to the present calculations. It will be seen that Norway heads the list. In Norway a larger proportion of infants survive than in any other country, and when grown up these infants display the greatest power of endurance that statistics acquaint us with. A thousand years spent in the growing period produce 63 per cent more of working life among the Norwegians than among the Irish, and 13 per cent. more than among American men, while the same expenditure among American men produces a return of 14 per cent higher than in Ireland. But it will be noticed that, in the case of the United States throughout, only men are referred to, while in every other case both sexes are included, mortality in America being higher among women than men.

LIFE IN OTHER WORLDS.

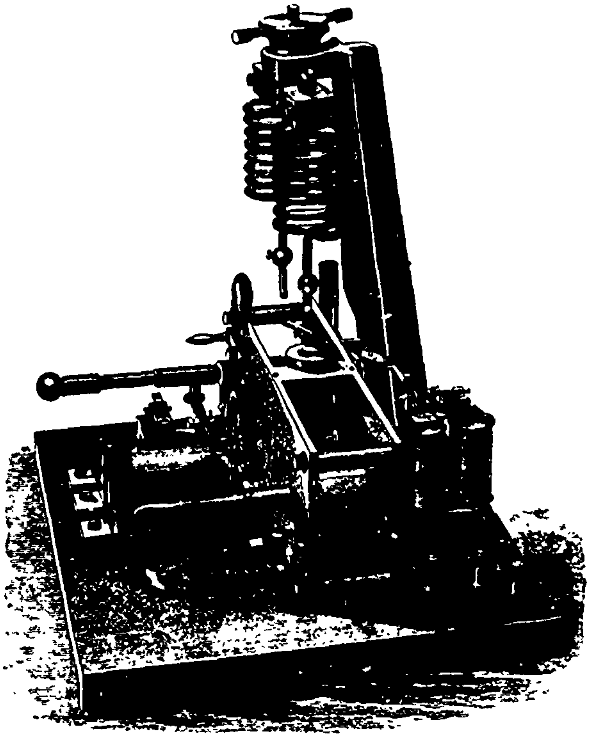
(By Mr. R. A. Proctor, in the *Day of Rest*)

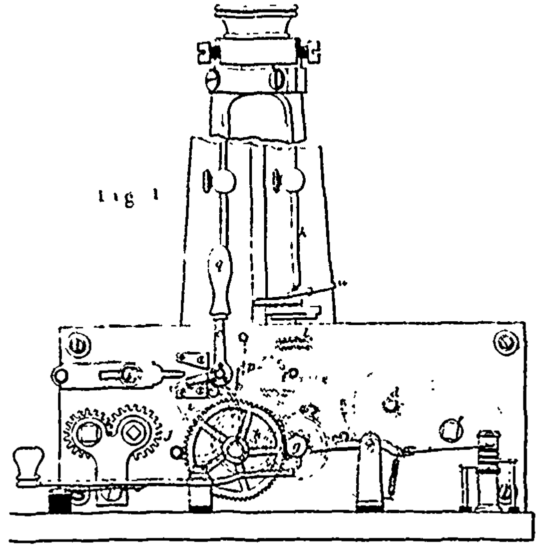
But let us next consider what is the probability that there is life on some member or other of a scheme of worlds circling round any given sun, Here, again, the argument is from analogy,,being derived from what we have learned or consider probable in the case of our own system. And I think we may adopt as probable some such view as I shall now present. Each planet, according to its dimensions, has a certain length of planetary life, the youth and age of which include the following eras—a sunlike state; a state like that ot Jupiter or Saturn, when much heat, but little light is evolved, a condition like that of our earth; and lastly the stage through which our moon is passing, which may be regarded as planetary decrepitude. In each case of world-existences the various stages may be longer or shorter, so that speaking generally the period of habitability bears the same proportions in each world to the whole period of its existence; or perhaps there is no such uniform proportion, while, nevertheless there exists in all cases that enormous excess of the period when no life is possible over the period of habitability. In either case, it is manifest that regarding the system as a whole, now one, now another planet (or more generally, now one, now another member of the system) would be the abode of life, the smaller and short-lived having their turn first, then larger and larger members, until life has existed on the mightiest of the planets, and even at length upon the central sun himself. We need not concern ourselves specially with the peculiarities affecting the succession of life in the case of subordinate systems, or of the members of the asteroidal family, or in other cases when we have little real knowledge to guide us, the conclusion remains the same, that life would appear successively in planet after planet, step by step from the smaller to the larger, until the approach of the last scene of all, when life would have passed from all the planets, and our sun would alone remain to be in due time inhabited, and then in turn to pass (by time-intervals to us practically infinite) to decrepitude and death. During all this progression, the intervals without life would in all probability be far longer than those when one or another or other planet was inhabited In fact, the enormous excess of the lifeless periods for our earth over the period of habitability, renders the conclusion all but certain that the lifeless gaps in the history of the solar systems must last very much longer than the periods of life (in this or that planet) with which they would alternate. If we apply this conclusion to the case of any given star or sun with its scheme of dependent worlds, we see that even for a solar system so selected at random the probability of the existence of life is small. It is, of course, greater than for a single world taken at random—just as if I had ten friends who were to be at home each for six minutes between noon and ten, the chance would be greater that some one of the number would be at home at a given moment of that interval than would be the chance that a given one of the number would be then at home; while yet even taking all the ten it would still be more likely than not that at that moment not one would be at home Thus when we look at any star, we may without improbability infer that at the moment that star is not supporting life in any one of those worlds which probably circle around it. Have we them been led to the Whewellite theory that our earth is the sole abode of life? Far from it. For not only have we adopted a method of reasoning which teaches us to regard every planet in existence, every moon, every sun, every orb in fact in space, as having its period as the abode of life, but the very argument from probability which leads us to regard any given sun as not the centre of a scheme in which at this moment there is life, forces upon us the conclusion that among the millions upon millions, nay, the millions of millions of suns which people space, millions have orbs circling round them which are at this present time the abode of living creatures. If the chance is one in a thousand in the case of each particular star, then in the whole number (practically infinite) of stars, one in a thousand has life in the system which it rules over; and what is this but saying that millions of stars are life-supporting orbs? There is then an infinity of life around us, although we recognise infinity of time as well as infinity of space as an attribute of the existence of life in the universe. And remembering that as life in each individual is finite, in each planet finite, and in each solar system finite, in each system of stars finite, so (to speak of no higher orders) the infinity of life itself demonstrates the infinity of barrenness the infinity of habitable worlds implies the infinity of worlds not as yet habitable, or which have long since passed their period of inhabitability. Yet is there no waste, whether of time, of space, of matter, or of force; for waste implies a tending towards a limit, so that of the illimitable there can be no waste.

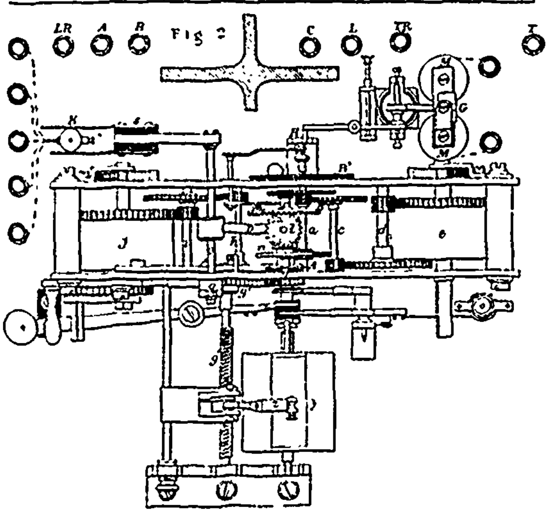
There is now upon exhibition at Brady's docks, says the *Detroit Post*, a mammoth mass of native copper, brought down by the Pacific from Lake Superior, which possesses no little interest to scientific people and the public generally, from the fact that it bears unmistakeable evidence of having been worked hundreds of years ago by the ancient miners, those primitive men who are supposed by many scientists to have been identical with the mound-builders. This huge mass of copper, which is 1½ ft. long, 3 ft. thick, and irregular in shape, weighs over 6,300 lb., and was discovered in October last by Mr. A. C Davis, of this city, a gentleman well known in mining interests and long engaged in developing the mineral resources of the Upper Peninsular. It was found in township 66, north of range 35 west, section 27, being on Isle Royale, in Keweenaw county, and was at the bottom of an ancient mining pit 16½ ft. deep. This excavation contained large quantities of charcoal and several cart-loads of the ponderous stone-hammers or mauls, weighing from 10 lb. to 30 lb. each, which were the chief tools with which the labour was performed. The marks made by their mauls in clipping off the wings or rough edges are distinctly visible upon the lump of copper found by Mr Davis. At McCargoe's Cove, a deep inlet on the northern side of Isle Royale, there is a belt of rock carrying a rich vein of copper about three miles long, and from 25 ft to 40 ft. in width, which was worked by the ancient miners, in some instances their pits being as close together as would allow. The relic of ancient mining found by Mr. Davis was upon valuable property owned by well-known Detroiters, among the number C. M. Garrison, S. G Wight, Hiram Walker Jacob Beason, A. W. Copland, and others. A stock company will be organised at once for the purpose of fully developing the mineral resources of the property The specimen would be a rich acquisition to the cabinet of a scientific society, but its cash value is $1,300, and it will probably be melted up. For the present it will remain on exhibition at Brady's dock.

UTILIZATION OF SILK RAGS.

According to *Les Mondes*, one of the wealthiest English velvet manufacturers, Mr. Lister, worked his way to success by years of patient labor in search of a way to utilize silk rags. He began by buying up all such waste at less than a cent a pound; and up to the year 186-, he had expended the immense sum of $1,312,500 in fruitless efforts to find a process. Nothing daunted, Mr. Lister continued his experiments; and within the past ten years, he has discovered a way of making the refuse into fine velvet. He carries on this industry at Manningham, Eng., in an establishment which employs not merely 4,000 workmen, but 283 travellers in all parts of the globe, whose sole business is to buy the silk waste. The factory is said to have cost nearly $3,000,000.







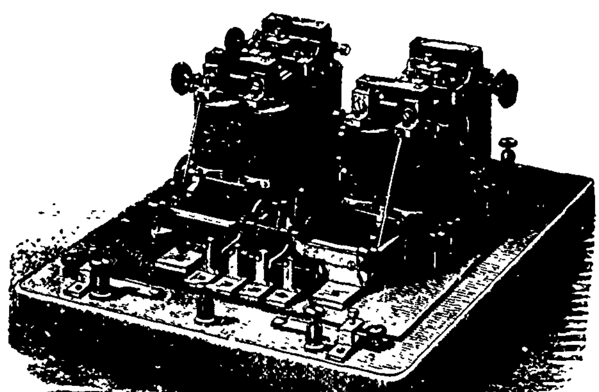
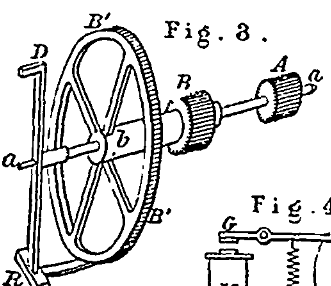
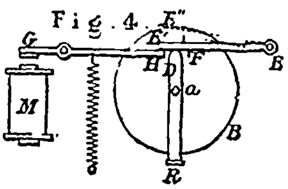


Fig. 5.



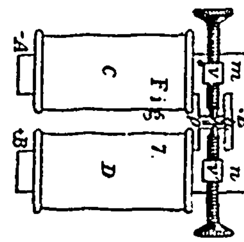


D'ARLINCOURT'S AUTOGRAPHIC TELEGRAPH.

Among the most interesting of the science exhibits at Vienna was the autographic telegraphic apparatus exhibited by M. L. d'Arlincourt, the following description of which we extract from *Engineering*. It consists of two cylinders revolving synchronously, and covered respectively with sheets of chemically-prepared paper and tin-foil. On the latter the despatch to be sent is written with insulating ink; the passage of the current determines on the former an electro-chemical tracing, which is an exact reproduction of the message.

This instrument is shown in the accompanying perspective view, and also in Fig. 1. These two differ from each other only in some details relating to the synchronous mechanism, especially the substitution of a coiled spring for the metallic rod or diapason.

The method by which the isochronous movement of the transmitting and receiving portions of the apparatus is secured, is novel and ingenious. Instead of the conical pendulum of Meyer's apparatus, M. d'Arlincourt regularises his trains of wheelwork by metallic rods; not, however, in using their rectilineal but their circular vibrations; and the synchronism of the rods being once established, it is maintained by the instrument itself. The error which may glide in cannot in any case be considerable, as the corrective action takes place at every revolution of the cylinders. One of these—the transmitter—is automatically brought to rest, in which state it must remain until a current from the receiver releases a little



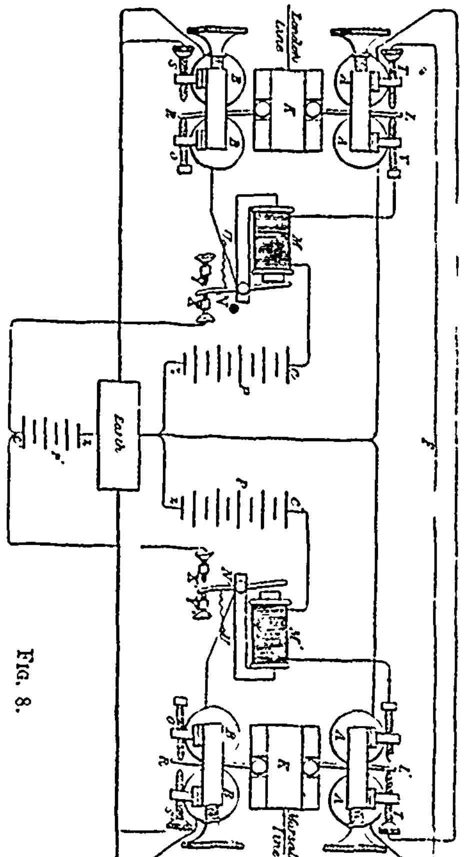
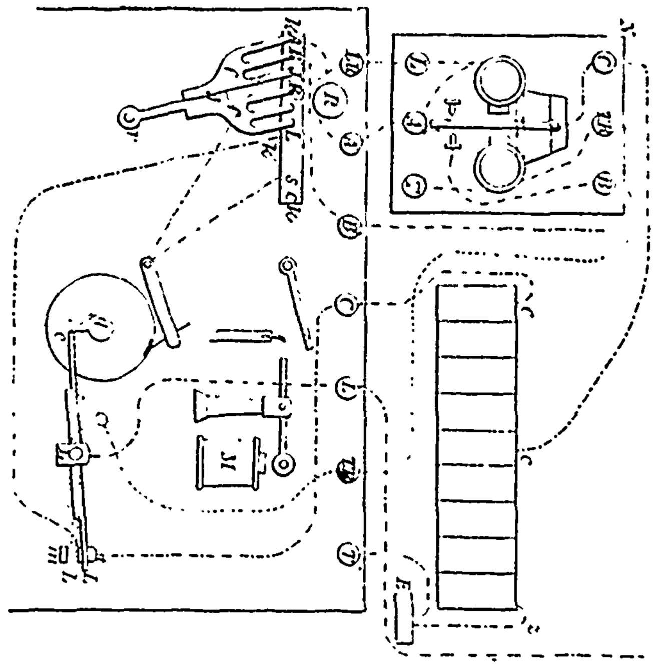


Fig. 8.

D'ARLINCOURT'S AUTOGRAPHIC TELEGRAPH.



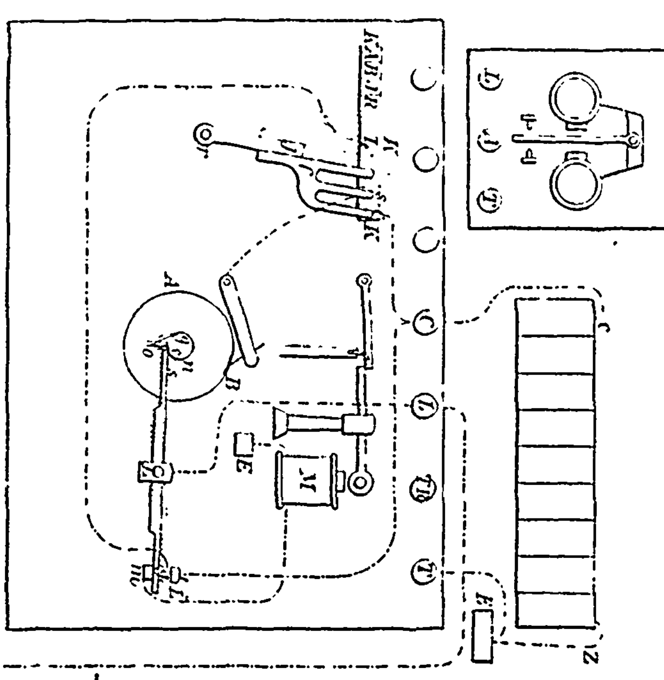


Fig. 6.

catch, and sets it rotating again. In the mechanical arrangements necessary to insure this immediate rotation, lies a considerable part of the originality of the apparatus. Two trains of wheelwork, shown in Figs. 1 and 2, are so disposed, that they may act either separately or together. The train *a c d e f*, which is used solely to maintain the synchronism, is connected with the rod K, while the other *a g h i j* drives both the cylinder *g* which carries either the chemical paper or the tin-foil, and also the micrometric screw *g'*, along which the tracing-point or style slides as it successively comes into contact with every point on the surface of the paper or foil. As the two trains do not necessarily work in conjunction, one of them —the autographic for instance—may be stopped without in the least disturbing the synchronous train, and *vice versâ.* This is readily effected by the axle *a*, which is common to both systems, and which, as it plays an essential part in the proper working of this apparatus, we give on an enlarged scale in Fig. 3; *a* A *a'* is the axle, carrying at one extremity the pinion A, which gears into *g h i j*, Fig. 2, and at the other *a'*, the piece D R, whose *rôle* we shall presently see. B B' *b* moves freely on *a* A *a'*; it consists of the pinion B gearing into the wheelwork *c d e*, and of the wheel B' R B' is a ratchet or spring which secures the joint movement of the axle and B B'. The teeth of the ratchet wheel are so made that when *a* A *a'* is brought to rest by D R, the wheel B' B', and the pinion B—that is to say, the synchronal regulator—still continue to rotate. When D R is released, the axle, *a* A *a'* is set free, and with it the train *g h i j* of the autographical section. The ratchet R at the same time abuts against one of the teeth of B' B', and immediately begins to revolve with the velocity of that wheel. The mechanism by which D R is stopped, and afterwards released, will be understood from Fig 4. E E' is a lever carrying a cam F, which is effectual in arresting D R. The end of the lever rests on the extremity of G H, which arm carries the keeper of the electro-magnet M. As soon, then, as the transmitter stops, and a current is sent from the receiving station, the keeper G is attracted, and E E' assumes the dotted position E E"; D R being realised, begins to revolve together with its axis, and the train of wheelwork that drives the cylinders. As this current is sent by the receiving station just at the moment when the two apparatus are in exactly similar conditions, it follows that the practical synchronism of both instruments is maintained.

We shall now examine the electrical connexions. The current that releases the transmitter is quite distinct from that which is sent to the cylinders, and its duration is only a small fraction of one of their revolutions. It is by means of L L' Figs. 5 and 6, that the same battery current is commutated, and made to fulfil this two-fold purpose. This lever oscillates freely on its fulcrum L, and may assume the three positions s L m, s L g, and s L t, according as it comes into communication with the various points on the circumference of n g o. In the first of these positions, viz., s L m, the line-current, arriving at L, will be sent to the electro-magnet M, and will thus free the transmitting instrument, as explained above. In the superior position, viz., s L t (better shown in Fig. 6), the current from the battery c c z, passing through the binding-screw C, traverses t L, and reaches the line-wire at L. In this case the apparatus ceases to be receiving, and becomes transmitting. It is while the lever is in these extreme positions that the synchronous movement of the cylinders is regulated. In the intermediate position s L g of the lever the current from the sending station is directed to the cylinders by the contrivance r K K. It must be born in mind that the cylinders are in permanent connexion with the earth. When the apparatus is a receiver the lever is in the dotted position s L g, Fig. 5. The line current then passes from g to L on the horizontal plate K K, as indicated. This plate contains several divisions, all of which are carefully insulated from one another. That marked L communicates, as we have said, with the line, S with the style, and c with the positive pole of the battery. The three prongs of the commutator r K are electrically connected with one another, but are insulated from the arm r p. In the present case, the line current arriving at L, the fulcrum of the lever, will pass from g through the first two prongs of the commutator, and thence through the metallic sector s and the style to the cylinder A B and to earth. On reaching the paper, it will decompose the preparation, leaving as a record of its passage a fine precipitate. The breadth of this line will depend upon that of the corresponding letter in the original message; or in other words, upon the duration of the current. When the style of the transmitter again meets the insulating ink of the written message, the current is sent into the line, and a part either of the same or of another letter is traced. The *ensemble* of these minute lines or tracings forms a message which is a perfect fac-simile of the original.

The system represented in Fig. 5 is practicable only for short lines. If used for considerable distances, it becomes necessary to introduce a relay, which appendage requires the various modifications shown in Fig. 6. The commutator is thrown into the position indicated by means of the handle c q, Fig. 1. The line-current is led as in the former case, from g to the central division on the plate K' K'.

As the first three prongs connect the segments marked L R, the current will pass from L to R, and thence through the binding screw L R to the relay, which sends the current from the local battery through B B' B to the commutator, and thence from the segment j to the style.

As all autographical instruments require a very rapid succession of currents, M. d'Arlincourt was obliged to devise an improved form of relay which would meet this condition, the ordinary relay being too much affected by return currents and by variations in the residual magnetism of the cores. In M. d'Arlincourt's relay, Fig. 7, the magnetic action of the coils of the electro-magnet is used to attract the thin metallic pallet or tongue, destined to complete the electric circuit, whilst the remanent magnetism, which has hitherto been an impediment to the proper working of relays, is used as a substitute for the ordinary antagonistic spring. When a current traverses the coils, A and B become respectively the negative and positive poles. The intensity of magnetisation is greatest at the free ends A and B, and it diminishes as we approach the neutral line E, at which it is obviously a minimum.

Here at p is pivotted a small strip of steel previously magnetised. When the current passes, the south pole a is attracted by the opposite polarity of m, and at the same time repelled by n. Under the action of these forces, the free end of a p would move towards v'. But the coils C and D exert a magnetic influence on the same movable tongue, which is opposite in direction to the former, and also of greater intensity. The tongue a p will thus obey the latter force, and move from its position of rest over to v, with which it will remain in contact as long as the current is passing. During this time the local battery is brought into action. When the current ceases, the influence of the coils instantaneously disappears; but it is otherwise with the soft-iron cores, their residual magnetism being considerably increased by the extra current, which is developed at the moment of opening the circuit. The little magnet a p will thus yield to the force repelling it from n, and soliciting it to m. In this new position it will remain until the circuit is again closed when it will move from v' back to v. The oscillators of a q are regulated by the two screws v and v'.

To suppress the return currents it is only necessary to regulate the relative positions of the points of v and v', so that a p may remain stationary when the circuit is closed, and make a complete oscillation when the circuit is opened.

This relay has the advantage of requiring little or no adjustment, as every current must necessarily displace the movable magnetic strip in the proper direction for sending messages. It possesses a considerable sensitiveness, and works with rapidity

By the introduction of this relay the autographic apparatus which we have just described has successfully transmitted messages to distances of 560, and even of 740 miles.

M. d'Arlincourt also uses his relay for the purposes of translation, and the manner in which the correspondence between two distant stations is established, is shown in Fig. 9. A A is the translating relay, and is so arranged that the tongue or pallet L will make only half an oscillation in one direction when the circuit is closed, and a complete oscillation when the circuit is broken. The pallets L and R are pivoted upon the two poles of a permanent magnet K, and, therefore, possess opposite polarities. As long as no current passes, the residual magnetism of the cores retains L in contact with the screw T, while the inherent magnetism of R maintains it in contact with B. M is a sounder connected with the screw V and the local battery P. When at rest, the armature N, drawn to the insulated screw Y by the spring U; a thin wire connects N with the coils of B B, which, on account of the sharp clicking sound of the pallet N, is called the "whip" relay. The second part of the apparatus, marked in the figure as receiving the Marseilles line, is identical with that which we have just described. The sets of relays communicate with each other by the wires F and F'. The first, F, puts the screw T in permanent connexion with the coils A' A'; the second connects T' with A A. Let us now suppose that the employé at Marseilles opens correspondence with the operator at London. The current will arrive at the magnet K', whence it will pass through the tongue L', the screw T', the connecting wire F' to the coils A A, and thence to earth. As soon as the electro-magnet is made, L passes from its position of rest into contact with V, thus closing the circuit P, and transmitting the current from M through V and L to the London line wire. By the action of the same current, N moves from Y to X, and closes the circuit of the local battery p, the effect of which is to keep R in contact with the screw O. When the electrical signal has been sent, L returns to T, and N to Y. By thus breaking the circuit of the local battery, the pallet R is thrown over to S, and the London line is put to earth. After discharging the line R returns to O, as explained above.

PROTECTION FOR INVENTIONS.

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

(Paper read before the Society of Arts.)

I shall make no apology for bringing this subject before you to-night; its great importance is a sufficient reason for adding one more to the number of papers that within the last few years have been written upon it.

There is a difficulty in dealing with "Protection for Inventions," or, in other words, the recognition by the State of property in inventions, which it is believed does not affect any other subject on the law of which papers are written.

In other cases when discussion is excited, the extreme scope of the contested questions does not go beyond the modification of the law under consideration. All parties agree that there must be a law of some kind, but with respect to the subject of patents this is not so, for there are certain persons who insist there should be no patent law at all; they hold it to be wrong in principle, and they endeavour, not to improve the existing law, but to make an end of it once and for all. Therefore, in a paper on the expediency of protection for inventions, written by one who believes that some kind of patent law is desirable, two things may well be treated of, the one, "Ay or no, shall there be any patent law at all?" other, "Assuming a patent law, what are the best provisions to embody in it?"

To properly consider, even in the merest outline, both these questions, would occupy far longer time than accords with the fair limits of a paper to be read before this society; therefore, on the principle that it is no use dealing with details when you are in doubt about the very essence of a matter, or to borrow the language of parliamentary committees, that it is idle to go into "clauses" before you have proved your "preamble," I propose in this paper to consider, and to consider only, the broad question, "Is it expedient that there should be a patent law for the protection of invention?" And as I refrain from discussing the alterations of any clauses in the existing law, I must be prepared, and I am prepared, to deal with the question on the following issue: assume that the existing law with all belonging to it is to remain unaltered and unimproved, is it expedient that there should still be protection for inventions?

I will not urge before you the "right" of property in invention. I am aware that advanced political economists can demonstrate there is no such thing as "right," and thus they admit (when they are discussing questions of political economy but probably not at other times), that the houses they live in, the clothes they wear, and the money in their pockets, are not theirs because they are "rightfully" theirs, but because it is "expedient" for the benefit of the whole community that the possession of property should be secured to individuals.

I will deal with the consideration of the patent question upon this hard and wholly unsentimental ground, and I will abstain from appeals to those feelings of natural justice which are outraged by the suggestion that although a man who goes and dredges up an oyster, and finds within it a pearl, is to be the legal possessor of that pearl, and may call upon the laws of his country, and not call in vain, to secure it to him against all comers, another man, a Cartwright, a Watt, a Crompton, a Neilson, a Bessemer, a Siemens, is to have no property in his inventions inventions which are pearls of great price, and are destined, not to the private enjoyment of the finder, but to the benefit of mankind. More especially does it seem unfair to inventors, when we consider that their pearls have been obtained, not by a few hours of mere toil of the body but by the employment of years in anxious thought and weary experiment.

Having made these preliminary remarks, I will now consider the question, "it is expedient, in the interest of the community as a whole, that there should be protection for invention?"

I will take it as conceded that it is expedient there should be improvement in manufacture. Clearly all must be interested in obtaining better, stronger, more elegant, more numerous, and cheaper articles, the product of manufacture, and of patentable invention. In this age (as I have recently had occasion to remark in my address to the Institution of Mechanical Engineers, as President) it should always be remembered there is not an article of food, there is not a garment, there is not a portion of the house we inhabit, there is not a book that we read, nor a ton of the fuel, that warms us, that does not come to us on easier terms, better in every way, and cheaper in consequence of mechanical improvement and, under our present law, nearly all such improvements constitute new manufactures, which that law recognizes as subjects of patentable invention.

Take our home-grown food; it is, under the blessing of the Almighty, the product of the skill of the intelligent farmer, and of the labour of hard-working men, but of those backed by what? Not capital alone, as capital, but capital invested in steam ploughs, in machines for sowing, in reaping machines, in steam-engine power, in traction engines, and in the vast number of other implements, which, year by year make the shows of the Royal Agricultural Society one of the most interesting of all exhibitions, to a thoughtful man who has the welfare of the great agricultural industry of England at heart. It is by the aid of such inventions that the English farmer, though weighed down by the heavy rental, by taxes, by dear labour, and by uncertain seasons, is enabled to hold his own in the face of free trade, admitting (in fact, welcoming) the unlimited introduction of food from all parts of the world.

And with regard to that food, whether it be grain, flour, cattle, Australian preserved meat, or tea, coffee, or sugar, most of this has been prepared by machinery and machinery propels the vessels by which these products are brought to our shores.

Again, in our towns, water is laid on through every street, circulates there to supply the wants of all, and does it by the aid of mechanical inventions. And in most of our towns also, light, in the form of gas, circulates and owes its origin to a happy combination of chemical and mechanical invention.

As for clothing it would be a waste of time to enlarge upon the extent to which mechanical invention comes into play. The cotton manufactures of Lancashire, the woollen and linen manufactures of Yorkshire, the lace and hosiery of Nottingham and Leicester, all are the results of mechanical invention. Again our movement from place to place (unless the journey be a very short one) is due to some of the highest developments of mechanical skill, in the locomotive, and in the iron steam vessel.

So much for the conveyance of our thoughts, whether this be done in the form of letters, carried by the post, or of books, printed and circulated all over the world; or, whether, when more urgent need arises, it be done by the instantaneous telegraphic message, once more invention has to be acknowledged with gratitude. The paper, the steel pen, the type, and now-a-days, even the very setting-up of the type, the electro-type plate, the steam printing-press, all matters in the domain of letter writing and book producing, are the offspring of mechanical and chemical invention, while the electric telegraph, from the comparatively coarse covering of the deep sea cable, to the delicate instrument by which signals are transmitted and received, involves a combination of some of the most excellent inventions that have ever emanated from the human intellect.

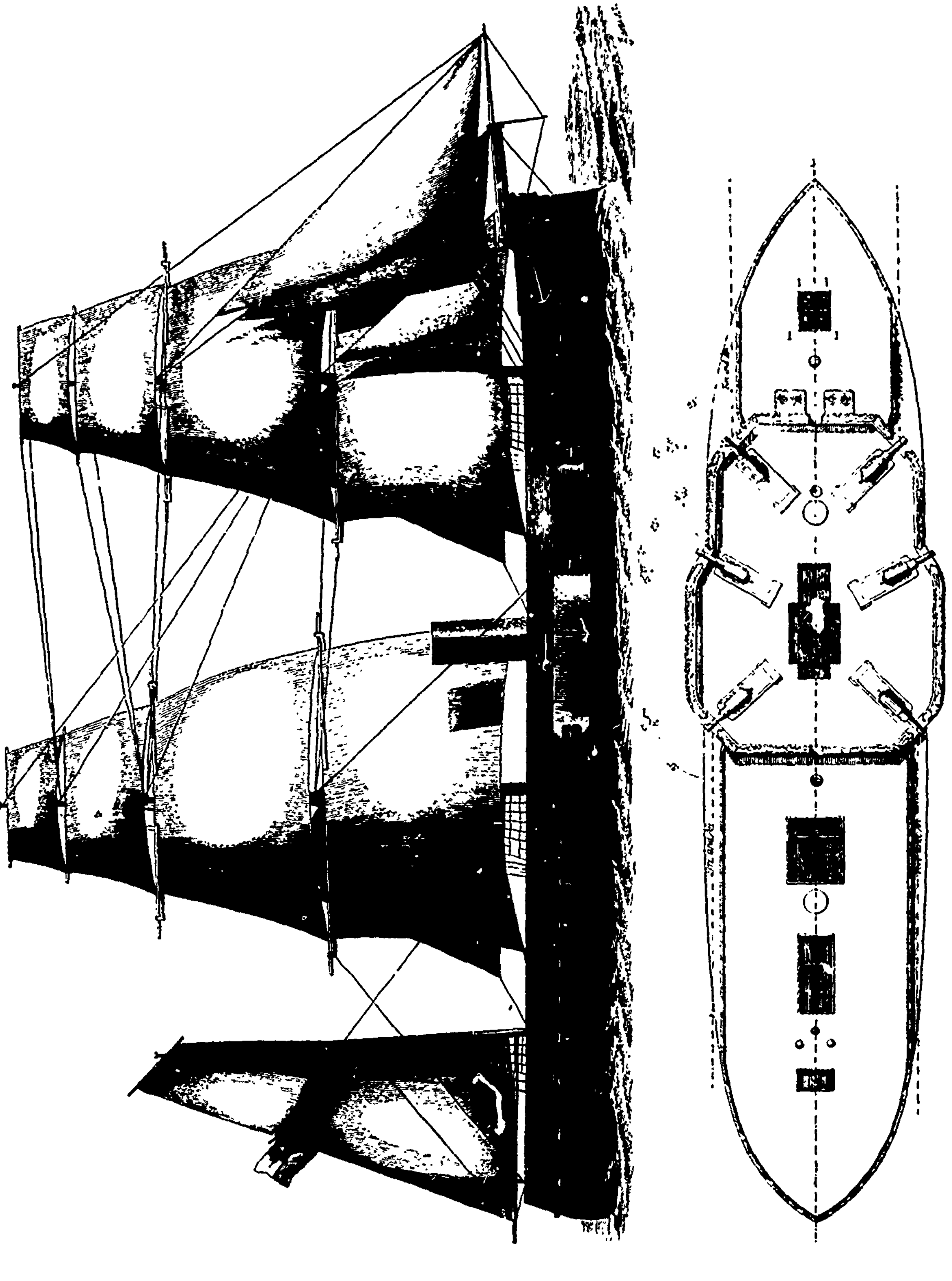
The foregoing matters may be called the necessaries of life, but the luxuries and adornments are equally under obligation to mechanical and chemical invention. Furniture for instance; the woodwork has been prepared by the strong and the simple sawing machinery, afterwards it owes its form to modelling machines capable of producing the most exquisite carving. The covering of chairs and couches, the materials for curtains, and carpets for our rooms, are the produce of the chemical art of the dyer, and of the engineering skill of the spinning-machine manufacturer and of the loom maker. Our windows and looking-glasses are the result of scientific chemical combinations, producing in the first instance a material translucent, but not transparent, until it is subjected to a succession of ingenious mechanical operations, in which large invention is displayed.

Passing from these peaceful and happy uses of inventions, and dwelling for a moment on warlike considerations, one finds, that within the last twenty years (that is to say since the period when the mechanical engineer took up the subject), the art of the gunner and of the artilleryman has become converted into a science, and thus even in the profession of arms acknowledgment is due to mechanical invention.

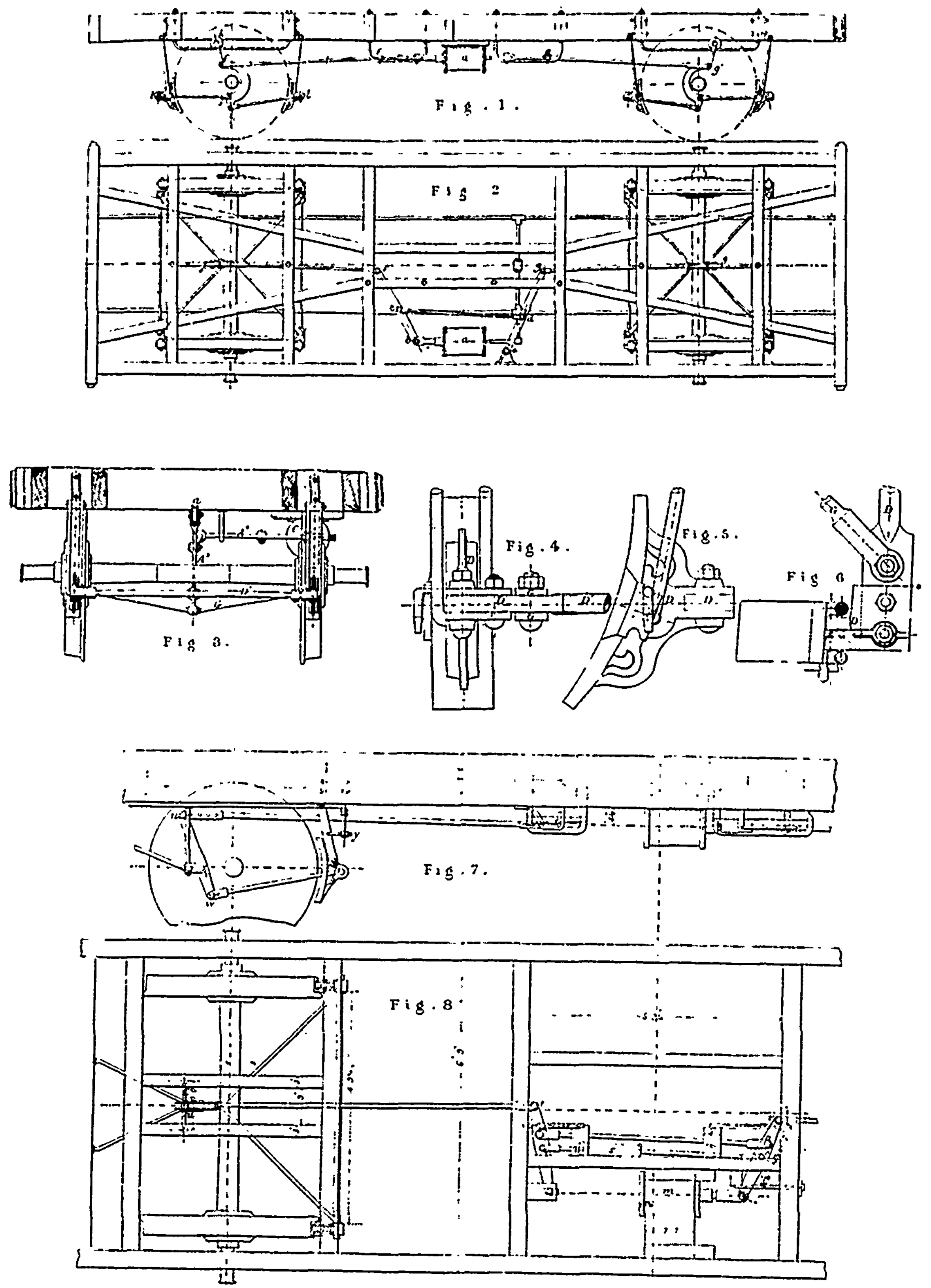
Not an unnatural sequence to the consideration of the public calamity,—"war," is the train of ideas which proceeds from the more private disaster of "fire." In this instance it is by mechanical engineering a supply of water is brought within a few yards of the conflagration, and it is to mechanical engineering that we are indebted for the steam fire-engine, that wonderful concentration of great force, within the minimum of space and weight, by the aid of which tons of water are poured forth above the highest buildings.

Having thus endeavoured to call to your minds how absolutely dependent we are for every necessary and for every comfort upon invention and improvement, I trust you are prepared to agree with me, that although there may be persons who oppose protection for inventions, there cannot be any who will not admit that we have largely profited by inventions up to the present time, and that it is most desirable inventions and improvements should continue This being so, let us see whether improvement is more likely to be made with or without a patent law.

The opponents of a patent law say (among other things) that



CHILIAN ARMOUR-CLAD.—(See page 10.)



THE WESTINGHOUSE AIR-BRAKE.—(See page 11.)

an ingenious man can no more withold himself from inventing, than a musician can abstain from composing, and that whether the invention is to result in profit or not, the genius must invent, and he will do so, not only in the absence of all pecuniary reward; but even in the absence of the glory which it is supposed might arise from the publication of this invention. I think this is a very unfair estimate of the nature of a really ingenious mind, and also an unfair illustration. The musician composes, perhaps, to gratify his artistic taste, but having composed—which really means having committed his idea to paper—he has done all that any musician could do; for him there is no further step to be taken. A real inventor, however, cannot rest contented with this committing of his ideas to paper, he must see them practically carried out, and above all he must do so if he be of the useful class of inventors; that is to say, a man distrustful even of his very ingenuity, acquainted with the difficulties that arise in practice, and knowing therefore how necessary it is that the thought of the mind should be developed into practice, such a man must see his improved locomotive drawing an express train, his improved hot blast at work reducing refractory iron ore. A real sound inventor, who had no hope of thus perfecting his invention would, in despair, cease to invent, and the inventors who remained would be either the impracticable, visionary men, whose so-called inventions are useless, or they would be persons engaged in manufacture, who would make inventions of detail in their special trade, and if these inventions were of any real value, would strain every nerve to keep them secret.

The opponents of a patent law further say that in its absence inventions would continue, because an inventor would reap his due reward by embarking in the manufacture of his own invention, and they say he would do so on favourable terms, for not only would he have the start of all other persons, and a more intimate knowledge of his own invention than any one else could have, but his would be the best trained workmen, and from these causes he would be in an excellent position as a manufacturer, and his products would have credit with the public.

Those who put forward such a mode of reward appear to forget that commercial success, which must be attained to get the reward, demands, not merely skill of invention, but demands capital, business habits, the art of organising and controlling a staff of workmen, and the equally great, if not greater, art of finding a market and selling to a profit; and also that if the inventor is not living in a suitable locality for the manufacture, he must be prepared to break up his connexion with the place where he may have been for years, involving the surrender of any occupation he might have held there, and must recommence life elsewhere.

And just one word as to his retaining the skilled workmen, trained in the exercise of this invention. Would not the very first step in rivalry of manufacturers, be the procuring the services of the workmen who had been taught by the inventor? A few extra shillings a week would be a sufficient inducement to secure them and all the knowledge they could impart, and thus the inventor would have the mortification of seeing his workmen taken from him, one by one, as they became competent, and would find himself in the position of constantly teaching beginners, with the certainty that they were to go to his rivals, as soon as they had learned enough to be of any service to them.

This is no mere imaginary state of things, it happened in the case of Crompton, the inventor of the spinning mule. I shall have to refer to him on more than one occasion, but I will say here that when his unpatented invention became public, and he was left to the product of his manufacture for his reward, the spinners in the neighbourhood, not content with tempting away his workmen as soon as they became competent, so that, to use Crompton's own phrase, "he was always teaching green hands," actually bought over his own sons, to become the teachers and assistants of the rivals of their father.

Reverting to the suggestion that inventors can be rewarded by becoming manufacturers, I will consider, first, the case that appears to me most favourable to the success of such a system of reward, that is, where an invention has been made by a manufacturer in some branch of his trade, where he has all the appliances of an established business, so that he can readily make his preliminary experiments, carry his invention into practice if these experiments succeed, and, also find a market among his connexion. I will assume, moreover, the invention to be of such a nature that the inventor may have reasonable hopes of carrying it out as a secret manufacture.

I do not know whether those who say it is inexpedient to protect invention have considered the question of secret manufacture, nor whether they are of opinion that the increase of such manufacture is, or is not, to be deplored. To my mind, nothing could be more lamentable in a moral point of view. The proprietor of a secret manufacture lives in constant fear of discovery; he hardly dares to increase his product, because in doing so, he has to add to the number of persons whom he must trust; he is obliged to pay these persons large sums, not really for wages, but as hush money, and these payments have to be charged upon the article manufactured, which thus must be unnecessarily high-priced. The limitation of manufacture and the high prices are obviously injurious to the public—the consumers. We have seen that it was worth the while of manufacturers to buy away Crompton's workmen, even when his process was no longer a secret, and when all that his men could impart would be some detail of skill in manipulation; how much more would it be worth the while of manufacturers to buy away workmen who could disclose the actual secret of an improved process? The inevitable result must be a constant tempting of the fidelity of the workmen, temptation which must be counterbalanced by heavy payments on the part of the employer, and thus the workman is put in a false position, which renders it almost impossible for him to preserve his uprightness, and to do his duty.

Sooner or later the secret is all but sure to leak out, and I think I have shown that in most cases it cannot be preserved for any length of time. Thus, those who are of opinion that an inventor may derive his reward from the profits of a secret manufacture, are, it appears to me, in this dilemma, either the secret is not kept, in which case the profits it might bring are not made, and the inventor is not rewarded, or, if it be kept, workmen are demoralized, production is limited, cost is increased, and the public are injured.

Crompton commenced by a secret manufacture at his house called the "Hall in the Woods," but he was compelled to give up the secrecy, being unable to support the systematic siege he suffered there. In spite of barricades to doors and windows, his house was literally broken open, by men who were truly burglars, for they came there to commit a robbery, the robbery of his invention.

(To be continued.)

CHILIAN ARMOUR-CLADS ALMIRANTE COCHRANE AND VALPARAISO.

A short time since there sailed from the port of Hull for Chili, an armour-clad vessel, named the Almirante Cochrane, recently completed from the designs of Mr. E. G. Reed, C. B., M.P., under whose inspection she has been built by Earle's Shipbuilding and Engineering Company, Hull. The sister ship, the Valparaiso, will be ready for launching from the same establishment in a short time hence.

The Chilian Government, two years ago, requested Mr. Reed to prepare a design for an armour-clad vessel whose tonnage should not be more than 2000 tons builders' measurement; to have 9-in. armour at the water-line, to have several $11\frac{1}{2}$-ton guns with great command of fire on bow, broadside, and stern; and to have a measured mile speed of from $12\frac{1}{2}$ to 13 knots with twin screws. To fulfil all these conditions, which were quite unprecedented in a rigged seagoing ironclad, Mr. Reed prepared a design of a vessel of which the following are the leading features. The length between the perpendiculars is 210 ft.. the extreme breadth is 45 ft. 9 in., the depth in hold 21 ft. 8 in., the tonnage being $2032\frac{86}{94}$ tons (builders' measurement). The draught of water forward is 18 ft. 8 in., aft 19 ft. 8 in., and the mean draught 19 ft. 2 in. The height of the port sill from the load water-line is 7 ft. 6 in. The armour is 9 in. thick at the water-line, protecting the engines and boilers 8 in. in wake of the gun slides, and of varying thicknesses elsewhere on the sides and on the athwartship battery bulkheads. The usual amount of taper is given to the thickness of the armour on the belt forward and aft. Behind the armour the teak backing is from 8 in. to 11 in. in thickness; with the ordinary arrangement of longitudinal girders worked on the two thicknesses of plates behind armour, the latter being supported by 10 in. frames placed vertically on the inside of the plates behind armour.

The armament consists of six 12½-ton guns, manufactured by Sir W. Armstrong and Co. These guns are placed in a central armour-plated battery, arranged as shown on the deck plan on page 492. The peculiar recessing of the sides of this battery makes it possible for the two fore guns to command a range of 93 deg., namely from right ahead to 3 deg. abaft the beam—the two after guns to command a similar range of 93 deg. from right aft to 3 deg. before the beam—while the two middle guns command a range of 85 deg. extending between 20 deg. from a right-ahead fire to 15 deg. abaft the beam. It can also be easily seen from the sketch referred to that the three guns on either side can be readily combined in a broadside fire, while the four foremost guns can be worked so as to form a powerful combination for firing ahead. Altogether, then, every point in the horizon is commanded by these six guns in a small and compact battery.

The speed of the Almirante Cochrane at the steam trial was very nearly 13 knots, and this was easily sustained continuously when a strong breeze was blowing and the sea rough. Under favourable circumstances it is fully expected that the speed would be a little over 13 knots. The engines of the most modern compound type of 500 nominal horse power, with horizontal cylinders, are manufactured by Messrs. J. Penn and Son, for both ironclads. The weight of the coal carried in the bunkers is 240 tons, and provision for additional coal is made.

These vessels are also supplied with a good spread of canvas which is distributed, as shown in the sketch. This will allow them to be independent to a certain extent of their coals and machinery in going long distances, and they will have all the advantages that nautical men claim for sails to keep vessels out of the trough of the sea in case both engines get disabled. The chances of such an event happening are, however, remote. The chief project in providing the sails in these vessels is no doubt the saving that they effect in coal, and as the rigging in no way interferes with the range of fire, as it inevitably must with turrets, there were several reasons in favour of their adoption.—*Engineering.*

THE WESTINGHOUSE BRAKE.

This brake, which is almost universally used in the U. S., seems to be rapidly growing into favour in England. Successful trials of it were recently made on the Midland Railway in England and, we find in *Engineering* the following description of two of the arrangements tried. Before describing these it may be remarked that in all cases the brakes may be worked from either of the two lines of air pipes which extend through the train, and that damage to one of these lines of piping in no way affects the efficiency of the other. Under normal conditions the air is admitted to both these lines of pipes, and is led off to the brake cylinder of each carriage from a T-piece placed upon a short piece of pipe which connects the two lines of piping under the vehicle. This T-piece is a brass casting and it contains a light valve, so arranged that in the event of one line of pipes being damaged. the rush of air towards the leakage throws this valve over and shuts off the communication with the damaged line of piping. This, of course, takes place simultaneously with these valves on all the carriages, so that the result of one line of piping being damaged is simply to place it automatically out of use.

We will now describe the arrangements of brake gear we illustrate. In that shown by Figs. 1 to 6, on page 9, the brake blocks are of cast iron, and are, as will be seen, applied to both sides of all the wheels. The arrangement by which an equal strain is placed upon each block is very ingenious. When the air is admitted to the cylinder *a*, Figs. 1 and 2, it drives out the piston and thus operates the horizontal lever *b*, *c*, *f*. This lever has no fixed fulcrum, but is connected at the point *c*, and by the link *c*, *d*, to an intermediate point on the lever *g*, *d*, *e*, which turns on a fulcrum at *e*. Inasmuch as the arm *b*, *c*, bears the same proportion to the total length of the lever *b*, *c*, *f*, that *e*, *d*, does to *e*, *g*, the effect of this arrangement is to cause an equal pull to be exerted at the points *f*, and *g*, upon the links *f*, f_1, and *g*, g^1, respectively.

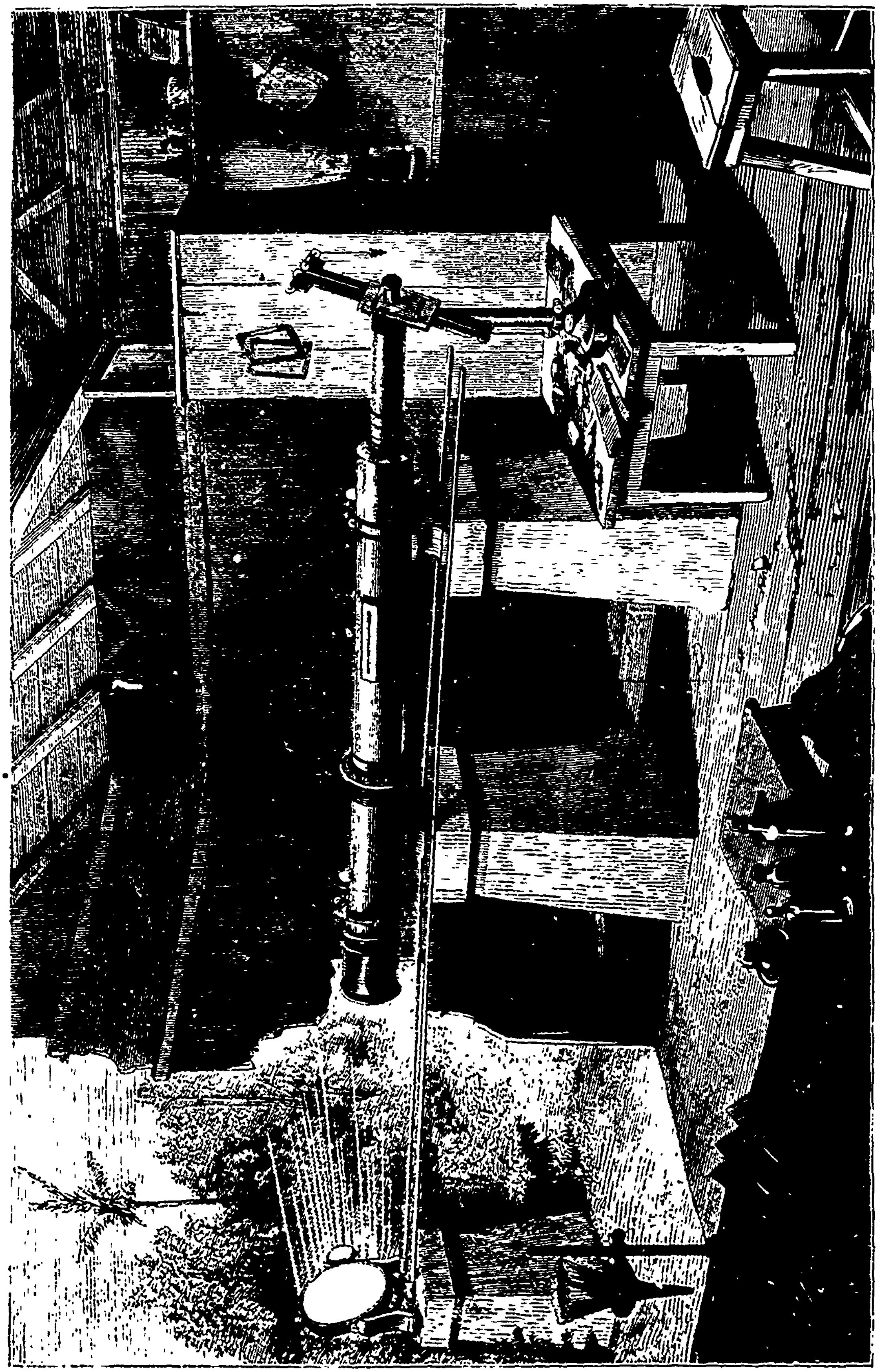
Considering now one end of the carriage only, it will be seen that the rod *f*, f_1, is connected at f_1, to an intermediate point on a bent lever *k*, *f*, *j*, *i*, this lever being hung from a pulley *k*, which runs on the rod provided for it, as shown in Fig. 1. At *j*, and *i*, rods are led off diagonally from the bent lever to the brake blocks, and it is thus evident that as the upper end of the lever is pulled over by the strain applied to the rod *f*, f_1, nearly equal pressures are exerted on the brake blocks on the two sides of the wheels. Referring to the plan Fig. 2, and to the views 3 to 6, on page 9, it will be seen that the brake blocks are tied together across the carriage as shown. In Fig. 3, the bent lever is marked A1, and the pulley which supports it *a*, while in this and the detail views, Figs. 4, 5 and 6, the diagonal links from the lever to the brake blocks are lettered G, and the transverse tie rods between the brake blocks D1. The brake blocks used in this instance are of cast iron, and of a simple form, the wearing part being loose, and being fixed in a kind of holder, on which are cast the jaws for the attachment of the tie rods, &c. The mode of fixing is very simple, and will be understood from the views given. In describing the above arrangement of brake gear we have spoken of the fittings for one pair of wheels only; but, as will be seen from the engravings, the arrangements for the two ends of the carriage are symmetrical.

We have now to speak of the other arrangement illustrated by Figs. 7 and 8, on page 9. In this case the arrangements for the two pairs of wheels are also symmetrical, and we have therefore illustrated one only. Referring to Fig. 8, it will be seen that when air is admitted to the cylinder *m*, and the piston forced outwards, the lever *n*, *o*, *p*, *t'*, is actuated, and a tensile strain exerted on the rod attached to that lever at *t'*, and also to the link *p*, *r*, attached at *p*. This last mentioned link is attached at *r*, to another lever, turning on a fixed fulcrum at one end, and having its other end *t*, connected to the rod which actuates the brakes of one pair of wheels. The effect of the arrangement is that the rods led off at *t*, and *t'*, have equal strains applied to them. The rod *t*, *u*, led off from the point *t*, is attached at *u*, to the upper end of a lever *u*, *v*, *w*, which turns on a fixed fulcrum at *v*, and has its lower end *w*, connected by diagonal rods to the two brake blocks *z*, to be operated. A spring at *y*, serves to withdraw these brake block from the wheels when the brake is taken off, while there is also a spiral spring on the box *s*, this spring and its box being connected to the horizontal levers first mentioned at *o*, and *q*, the tendency of the spring being to force these levers apart, thus causing them to turn on the points *p*, and *r*, as fulcra.

Both the arrangements we have described are well worked out; but of the two we prefer that shown by Figs. 1 and 2. It is true that the application of the brake blocks to both sides of each wheel increases the first cost of the application, but on the other hand, only half the pressure is required on each brake block, and the wear of the latter is thus proportionately reduced, while all tendency to produce uneven wear of the axle-box bearings by exerting a side thrust on the wheels is avoided.

MODE OF ASCERTAINING THE VARIOUS KINDS OF MATERIALS IN MIXED FABRICS.

A German industrial journal gives, after M. Vupp, the following treatment for fabrics containing silk and wool, with vegetable fibres. All vegetable fibres resist caustic alkaline solutions, even when boiling, and are dissolved by sulphuric, nitric, hydrochloric acids, even when diluted, with odor. Vegetable fibres when burnt do not give forth any characteristic odor. Wool, insoluble in the above acids, is readily attacked by caustic alkalis, especially when hot; the sulphur which it contains combines with the alkali, and the solution becomes black when acetate of lead is added to it. In burning, wool produces the same smell as horn. Silk is dissolved both in the acids and the caustic alkalis, and produces an odor similar to that of wool; but it contains no sulphur, and consequently, its solution in alkalis is not blackened by acetate of lead. In order to distinguish these materials in a tissue, it is treated first with concentrated hydrochloric acid, cold; the residue is then washed in a filter, and if necessary bleached, by means of water containing chlorine, and then washed again in pure water and boiled with caustic soda, which dissolves the wool, leaving the vegetable fibre intact. The wool is distinguished from silk by adding acetate of lead to the liquid, as already mentioned.



COLONEL LAUSSEDAT'S APPARATUS FOR PHOTOGRAPHING THE TRANSIT OF VENUS.

TRANSIT OF VENUS.—CAPTAIN ORDE BROWN'S PARTY ASCENDING THE HEIGHTS NEAR CAIRO

MECHANICS' MAGAZINE

MONTREAL, JANUARY, 1875.

ILLUSTRATIONS:

CONTENTS:

Our subscribers will notice that the present number of the MECHANICS' MAGAZINE has been made the first of the third volume, the second volume thus consisting of but nine numbers. This has been necessitated in consequence of the action of the Government who decided to begin a new volume of the PATENT OFFICE RECORD with the new year. The two parts being so intimately connected, it became necessary to make the change also in the MAGAZINE. Subscribers will not, however, be suffered to lose by this as each will receive his full supply of twelve numbers for a year's subscription. The present is thus a good opportunity for new subscribers and we trust that our present ones will do what they can towards increasing our list.

TRANSIT OF VENUS.

The New York *World*, has received the following special from London. On enquiry I have learned from Greenwich that the first tentative computations of the data obtained from the observations of the recent transit of Venus have yielded results somewhat different from what was looked forward for. Four calculations, made independently, give the sun's parallax as being 906 seconds, 945 seconds, 925 seconds and 920 seconds, the mean being 924 seconds. The computations were made by Prof. W. G Adams, Lecturer on Physics in King's College; Prof. O. Henrier, of University College; Frederick Guthrie, Royal School of Mines and Arts, and Messrs. Dunkin and Ellis, assistants at the Royal Observatory, Greenwich. No calculations have yet been furnished at Kew Observatory. The computations as given were made only on the basis of the moment of external and internal contacts, as reported from different stations of observation, and may be considerably modified when the photographic and micrometric measurements are taken into account. The above despatch was, according to a lengthy supplement statement, submitted by the editor of the *World* yesterday to a learned astronomer, who states that, according to these calculations, the distance of the sun from the earth is about 32,323 semi-diameters of the earth or 88,443,726 miles. This is nearly 7,000,000 miles less than the distance made out by Encke from observations of the last transit, and 3,000,000 or 4,000,000 less than the results obtained by more recent measurement. Comparing the calculations made in 1769, and these made in 1874, the distance from the earth to the sun in course of the 105 years that have elapsed has been reduced 6,926,274 miles. The astronomer concludes therefore that if this ratio were constant it would require just 1,440 years to overcome the entire distance, and the earth would be then swallowed up or consumed by the sun. He considers the figures given as hardly truthworthy, however, as scarcely sufficient time has elapsed to make the calculations accurately. The observations to be made in 1882, will, it is thought, settle the question as to whether the possibility of the earth falling into the sun exists.

DR LIVINGSTONE.

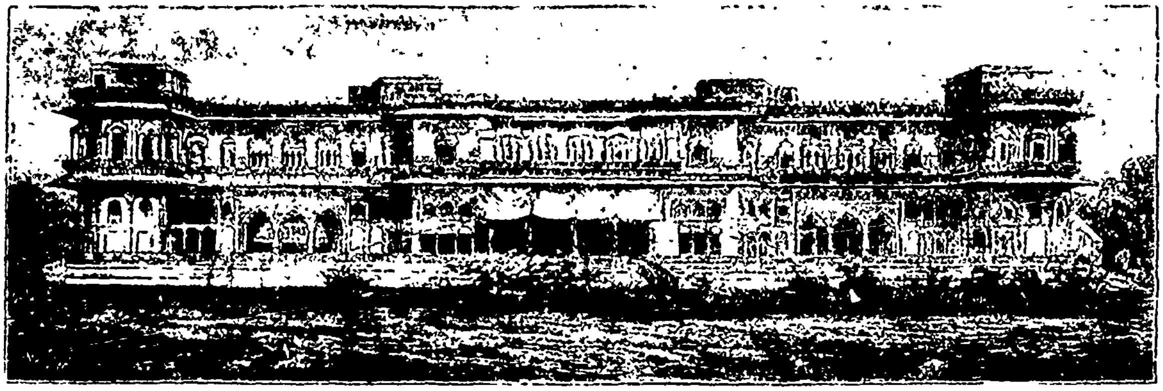
The last journals of David Livingstone have just been published by John Murray. The work is commented on as follows by the *Graphic*, to which journal we are indebted for the illustration on page 25.

"The most artistic narrative would do far less to enhance the fame of Livingstone as an explorer and a man than these rude and simple diaries. Extending over more than seven years from his arrival at Zanzibar, in January, 1866, to his death in the fen-country of Bangweolo on the 1st of May, 1873, they tell in plainest, sometimes in broken, words, the hopes, disappointments, and results of his last efforts to fulfil the mission of his life. Their very preservation in complete form — in part from the large Letts' Diary brought home by Mr. Stanley, in part from the "battered tin-case" saved for the Foreign Office by the faithful Susi and Chumah — is itself a wonder. With a writer, indeed, less methodical, the restoration, without a break, of the connected narrative, would have been impossible, for note-books, ink, and pencils failed Livingstone at last, till every blank space had to be utilised, and entries made in coloured juice across the pages of old newspapers, so that but for the precision which attached month and year to every entry, the most careful editing would not have availed to place each note in proper sequence. In a more finished work, too, we might have missed those heart-wrung expressions of devotion. al thought, or of a weariness well-nigh unto death, which make the journal at times so unspeakably touching, while no elaboration could have better reproduced its brighter side of vivid enjoyment of African scenery and character, the delight of the observant naturalist, or the bold, but never presumptuous theorising of the geographer. Disaster followed Livingstone from the start. The worthlessness of his Johanna boys and Sepoy escort was but a passing cloud. The plunder of his medicine-chest in the first week of '67 by his treacherous Waiyau guides fell on him, in his own words, as the sentence of death. From that time the seeds of fever sown in previous wanderings ripened apace. The iron constitution, though often seeming to recover, month by month continued to give way. It is hard to repress a sense of disappointment on reflecting how much more, if properly supported, a man so versed in African travel, and so rarely gifted with the art of gaining the goodwill of savage tribes, might possibly have achieved. Yet painfully evident as are the difficulties which henceforth hamper every step and impart a certain air of indecision to his movements, even from the explorer's point of view this latest work of Livingstone's stands on an eminence apart. Almost for the first time the veil is rent which hides that central heart of Africa where types of life from the Eastern Coast merge gradually into those of the West, where great apes and varieties of animal life little known to the zoologist share the sub-tropical forest and marsh with the dense tribes of primitive Negro land, and the humid south-east winds feed the sources of the unexplored rivers that flow from thence south, west, and north to join, as Livingstone held, the Zambesi and the Nile. Thus the rough diaries, with their occasional [illegible] of past researches, are full of the deepest and most varied interest, whether we trace in them Livingstone himself still struggling onward to the goal, though worn with fever and weak from loss of blood, his great walking powers deserting him at last, or hear the death-songs of the captured slaves and the cry of the women in the massacre of Nyangwe, or follow the keen eye of the practised naturalist from the great tropical ape to the little fly-catching ant, or map out with the explorer the ever-widening chain of newly-discovered lakes and rivers. The last fragments of the journey through the flooded marshes towards the Hill of the Four Fountains, whence Livingstone believed the Nile to spring, are painful in the extreme. But there are trusty followers with him now, and their journey down to the coast with their master's body is hardly less interesting than the Diary itself. On one question likely soon to come into greater prominence—whether Africa is to be civilised with the rifle or the mission?—Livingstone, who judges no one, not even those who betray him in his need, gives no uncertain sound, and lovers of Missionary work will find few manlier or more encouraging sentences anywhere than those penned by him in '72, while waiting for the supplies which Stanley was to send up from the coast. The Journals, we should add, have been admirably edited by Mr. Horace Waller, and are enriched with a perfectly new map of the Forest Plateau of Africa, carefully compiled by Mr. Bolton from Livingstone's own notes and sketches."

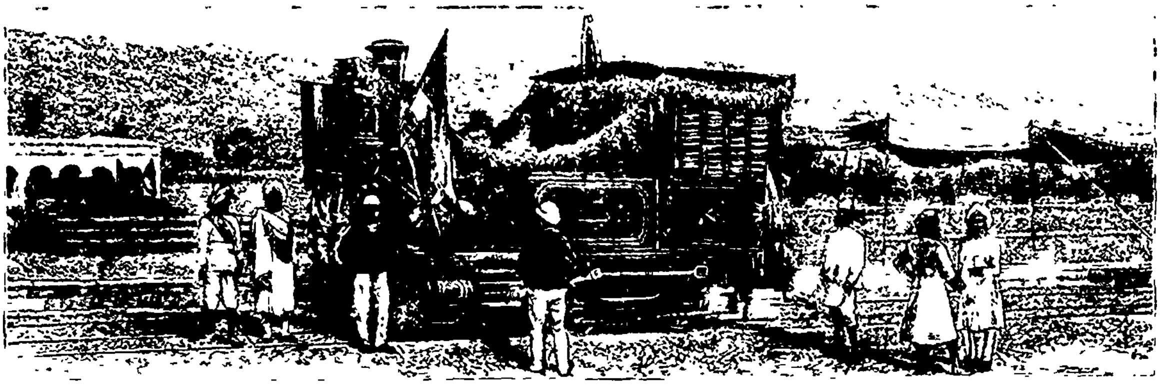
There seems to be for some men a strange allurement in Arctic travel. But for these restless and energetic spirits we question much whether expeditions would start so frequently to face privation and often death amid those dreary scenes. The love of science and the desire to complete our maps and furnish new facts and theories for geographical science we believe all, in themselves, would fail to send forth one half the number of expeditions which this strange love of Arctic life excites to action. The British Government are rapidly pushing forward their preparations for the new English Expedition. Thousands of pounds of beef are being prepared and a steam whaler has been purchased and is being fitted. We stated, previously that probably the partial success of the recent Austrian expedition had caused the British Government to yield at last to the advocates of a new attempt on England's part to reach the pole. The following short account of their trip will hardly seem, to most persons, very provocative of rivalry.

The second North German expedition to the Arctic Seas was sent out from Bremen in June, 1869, and arrived there, on its return, in September, 1870. It was equipped by the contributions of merchants and men of science, under the patronage of the King of Prussia and of the Berlin Geographical Society, at the suggestion of Dr. A. Petermann, of Gotha. An interesting narrative, by Captain Karl Koldewey, who commanded both this expedition and that of 1868, has been translated into English by the Rev. L. Mercier. It forms a volume, edited by Mr. H. W. Bates, assistant secretary of the Royal Geographical Society, and recently published by Messrs. Sampson, Low & Co., which is very well worth reading. The vessels employed were the steamer "Germania," 90 ft. long, 22½ ft. broad, and 11 ft. deep, of 143 tons burden, stoutly built, and fortified by an iron sheath; and the schooner "Hansa," of 76 tons burden. The scientific members of the expedition were Dr. Borgen and Dr. R. Copeland (an Englishman) for astronomical and physical science, Lieutenant Julius Payer, of the Austrian army, for geography; and Dr. A. Pansch, for zoology, ethnology, and botany, on board the "Germania"; Dr. Buchholtz and Dr. Gustavus Laube, on board the "Hansa." The latter vessel was under the command of Captain F. Hegemann. The east coast of Greenland was to be explored as far northward as possible, in the hope of reaching the North Pole, and perhaps even getting across the polar circle to Behring's Strait. The expedition, however, did not get beyond the 77th degree of latitude, where a point of land, at the end of Dove Bay, was named "Cape Bismarck;" the adjacent mainland is "King William's Land," and in front of it lies "Koldewey's Island." During the winter months, the shores of Greenland are bordered by a vast field of ice, over which they had to travel hundreds of miles in sledges, but this mode of conveyance was sometimes exchanged for boat journeys in the creeks and openings through the ice. The "Hansa" was wrecked or crushed among the icebergs, in October; but her officers and crew, saving the needful stores, and building a house of snow with the aid of timbers and sailcloth, contrived to live on the ice through the winter. It is interesting to read the account of how they kept Christmas in this cheerless situation, which we have endeavoured to illustrate by one of our engravings. These brave Germans, according to their national custom, erected a Christmas Tree, which was adorned with wax candles and paper garlands; they plucked off and distributed the usual toys, crackers, and gingerbread nuts, as children do at home; and they were comforted, each man of them, with a glass of port wine, followed by a cup of chocolate. But their position was one of extreme danger, and they suffered terribly, in the dreary months that followed, before they could reach the shore of Greenland, where, at the Moravian mission, at Friedrichsthal, they found a kind and hospitable welcome.

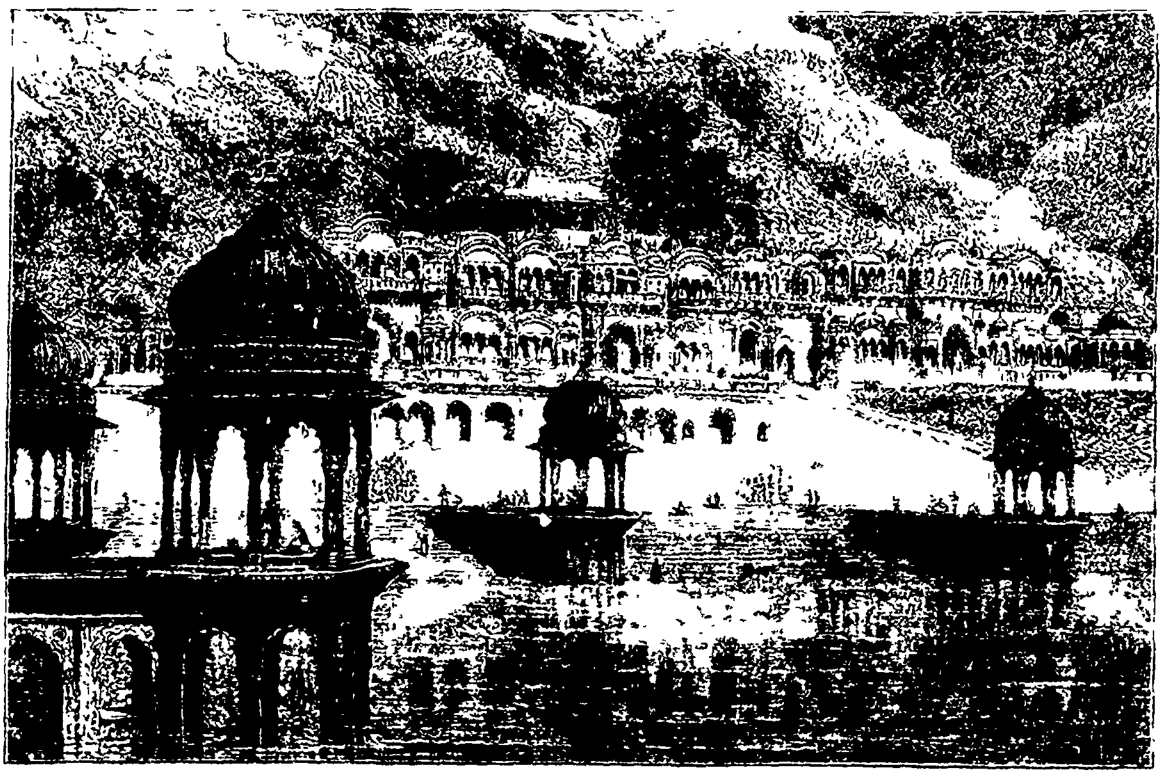
The march of empire is rapidly extending not "westward" only but "eastward." India under the wise rule of England is developing its internal resources and becoming acquainted with the most complete and finished examples of modern science in engineering. Russia too is changing the face of Siberia and these two great nations by means of industry and energy hitherto almost unexample are reversing the seemingly natural direction of the march of progress. To illustrate the truth of what we have just stated, we publish on pages 16 and 17, illustrations of two new marks of advancement in India. One of these is the opening of the Rajpootana State railway, and the other the iron works for the King of Burmah. The Rajpootana railway is at present one hundred miles long extending from Delhi to Ulmar, the capital of a State of the same name with a population of about 800,000.



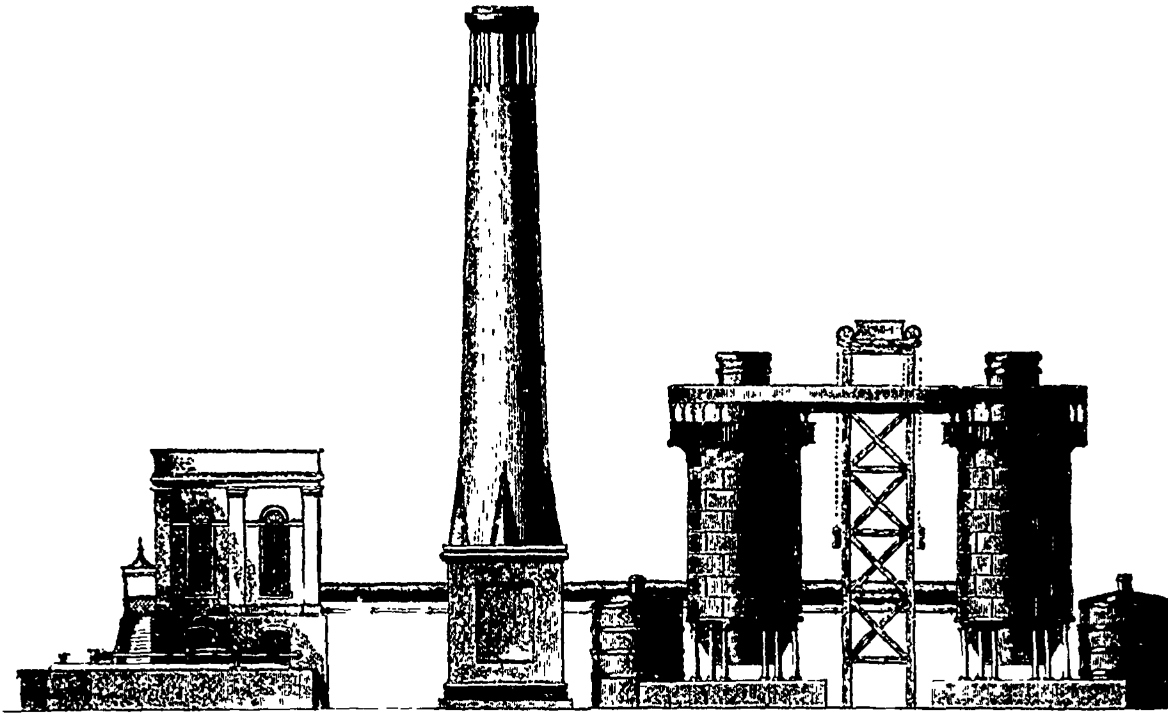
THE BANNI BHA'S PALACE.



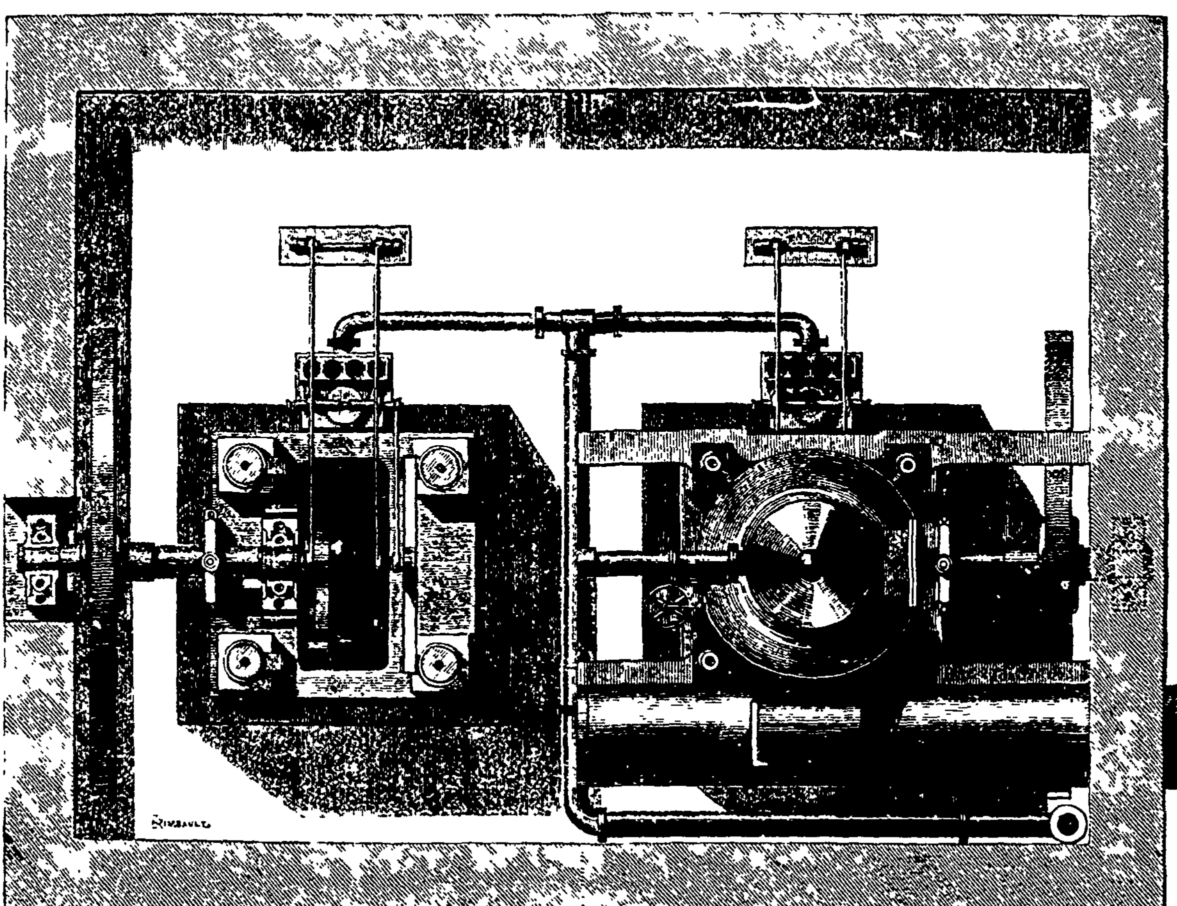
THE FIRST ENGINE THAT ENTERED ULWAR.



ROW OF HINDOO TEMPLES AT THE OPENING OF RAJPOOTANA STATE RAILWAY.



ELEVATION OF BLAST FURNACES AND ENGINE HOUSE.



PLAN OF BLOWING ENGINE.

IRON WORKS FOR THE KING OF BURMAH.

One of our engravings depicts the engine, another represents the palace of Banni Singh, a former chief of Ulwar, who died soon after the great mutiny of 1857. From a native point of view he was a good governor. He formed lakes for pleasure and irrigation, and beautified the suburbs of the city with fine gardens and buildings. His palace is a structure of much beauty, and is surrounded by one of the most magnificent gardens in North India. Our last picture shows a grand rocky hill, on which, a thousand feet above the cenotaph of Baktawar Singh, stands the nobly situated fort of Ulwar. At the base of the hill, close to the cenotaph, are a fine row of Hindoo temples, excellent specimens of the graceful segmental arched style, very common in Rajpootana. The tank in the foreground is surrounded by elegant kiosks, and a very pretty scene is presented when, on a festive day, the chief sits under the upper arcade of his ancestor's tomb at one end of the tank, while a gay procession passes along the other, conveying an idol to the temples in the rear, every step and terrace and kiosk being covered by a multitude, each individual of which wears clothing set off by a turban and girdle of brilliant colour.

The other new undertaking, the iron works for the King of Burmah, are a greater proof of advancement, showing the force of the example set by the two European nations. The following short account of these works is from *Engineering*.

Upper Burmah is especially rich in mineral wealth, and amongst its deposits it includes considerable quantities of iron ores, consisting partly of brown and black hematites, partly of magnetic oxide, and partly of beds of red hematite, stated to approach in quality to that of our well-known Cumberland ores. Both coal and charcoal, too, are available for fuel, while there is an abundance of pure calx-spar for flux. The ironstones, are, we believe, for the most part found near the surface, and are readily obtainable; the coal, however, has to be brought from inland districts, and it is not improbable that the difficulties attendant upon its transport may — at first, at all events—lead to the use of charcoal in the iron works.

The project for the iron works was decided upon during a recent visit of the Burmese Ambassadors to England, the development of the undertaking being entrusted to Dr. Clement Williams, formerly the representative of England at Burmah, and a gentleman who has had an extensive eastern experience. A staff of engineers and managers left England some months ago under the charge of Mr. R. H. Holgate, an engineer of much experience in iron works.

The site chosen for the works is on the right bank of the Irrawaddy, about twelve miles below Mandaly, the present capital of Burmah. The blast furnace plant, which has been constructed according to the designs of the chief engineer, Mr. Holgate, consists of two iron-cased furnaces, 56 feet in height, supported on cast iron pillars, the casing being of sufficient size to admit of having boshes up to 12 feet in diameter. As we have already stated, it is possible that it may be decided to work the furnaces with charcoal, in which case the height would be reduced, and provision has been made for effecting this change. Each furnace will be blown by three tuyeres, and there will be complete arrangements for taking off the gases for their use at the ovens and boilers.

A neighbouring level tract, about a dozen miles across, will supply the ore, while the river will afford the means of transit for the coal from the inland districts, and also for the finished products of the works. The latter will, of course, be connected by lines of railway, with suitable landing places. The general arrangement of the works will at once be seen from the plan which we give on page 20.

ENGINEERING IN EGYPT

Instructions have been sent by His Highness the Khedive to the consulting engineer of Egypt, Mr. John Fowler, to take immediate steps to commence the works of the Soudan Railway, the route and method of construction being those which were recommended by him in his report of December 1873 This line of railway commences at the southern end at Shendy, the most convenient centre or collecting point for all traffic arriving by the Nile, which is navigable from the south to this point, or by the coverging camel routes from Abyssinia, Keda '', Gellabat Taka, Barka, Sennaar, and the other neighbouring fertile Provinces, and thence traversing the so-called desert of Bahiuda, a tract well provided with water and small timber, it reaches the Nile again near Dubbe, which is a convenient centre of commerce for Darfour, Kordofan, Wady, and the Western Provinces. Passing the seat of Government, Dongoba, it then runs near the Nile along the whole of that portion of its course (about 220 miles) where the rapids known as the Second and Third Cataracts render navigation almost impossible, and reaches Wady Halfa, a point whence the river is navigable at all times of the year to Philœ, at the head of the First Cataract. Thence to Assouan, a short line of railway has already been constructed to avoid the difficulties of navigation through the First Cataract, and from that point water communication is open to Sivut, the southern terminus of the Upper Egyptian Railway, to Cairo and to Alexandria Simultaneously with the construction of the Soudan Railway the short Railway at Assouan will be extended northward and the upper Egyptian line southward until they meet near Esnó, so that eventually one continuous line of railway will extend from Alexandria to Shendy.

Mr. Fowler will complete the necessary contracts before he leaves for Egypt, in December, and he will then proceed with Mr Kilgour, who will have chief charge of the works, to commence the works of the railway at Wady Halfa.

The Soudan Railway is not the only great work of internal improvement occupying attention at the present time. The Government of the Khedive has given instructions to Mr. Fowler to lay before it without delay a complete scheme of improved irrigation for the whole of the Delta and Lower Egypt, on the principle of almost entirely dispensing with pumping, and of providing that the necessary quantity of water be supplied with certainty for each crop at the period of the year most required. This great work, if successful, will have the effect of largely increasing the revenues of Egypt and diminishing the risk of inundations from an exceptionally high Nile.

STEAM ON CANALS.

The report of Canal Auditor Thayer, of New York State, contains some interesting remarks on the use of steam on canals. He considers that the reward offered by that State for a practical solution of the difficulty has resulted in the production of a successful system viz., that in use by the Baxter Steam Canal Boat Company. This Company is working seven boats with considerable financial success. The speed of the boats is greater than that before obtained and the cost of propulsion is less than by animal power. This success, however, is but a very partial one, as may be gathered from the fact that but seven boats out of the five or six thousand on the canal are thus worked. The Auditor thinks that the Legislature did wrong in limiting the competition to appliances which could be fitted to the existing canal boats, that they thus prevented mechanical engineers from engaging in the contest, since these latter knew that a boat to be propelled by its own machinery must be of a different form and model from one that was simply towed. The Auditor is of opinion that had this restriction been removed and the time for competition extended the results would have been more favourable. Another system, which seems to have been more successful on the New York canals is that of towing by means of a submerged cable. This system is commented upon as follows. "The New York Steam Cable Towing Company was organized for the purpose of introducing upon our canals the cable system of towing. That company, during the season of 1872, laid a single cable between Buffalo and Lockport, and with two steamers especially constructed for the purpose, has been operating the system, experimentally, during the past two seasons. It is claimed by the projectors of the enterprise that during their experimental operations 1,400 tons of freight, with boats containing it, have been hauled in one train by a single cable steamer, against the strong current between Tonawanda and Buffalo at the rate of three miles per hour, at as low a cost for steam-power as any known steam canal boat carrying two hundred tons ; that is to say, doing seven times the work at the same cost for steam. The cable system ought not to be considered as an experiment. It has been in successfull operation on European canals and rivers for several years, and found to be the cheapest adaptation of steam for towing purposes yet divised. There is no reason why it should not be equally successful on our own canals, and certainly no more profitable field for the operation of the system can be found.

THE PROTECTION OF IRON SURFACES.

The increasing utilization of iron as a material of architectural and engineering construction, and the necessity for protecting it from surface deterioration by means of some kind of paint which is at once economical and durable, have given the subject to be considered in this article a very great practical importance to painters. Until within a short time, our painters have not seemed to realize that iron required special treatment, very different from that which would answer with wood or brick; and during the first ten or fifteen years of the history of iron architecture in this country, the best effects of design and ornamentation were spoiled by heavy coats of white paint, which were sure to become streaked with reddish stains very soon after they were put on. There has been a very decided progress—towards a style of painting at once tasteful, durable, and adapted to iron as a material of construction—since white iron fronts were general, and many of the iron buildings in New York are models of beauty as well as strength; but we may consider the painting of iron an art yet to be learned by a majority of painters, if we may judge by the many conspicuous examples of ugliness and bad taste which disfigure our finest business streets.

In mixing paints for iron surfaces, it is of the first importance that the best materials only be used. Linseed oil is the best medium, when free from admixture with turpentine. A volatile oil, like turpentine, cannot be used with advantage on a non-absorbent surface like that of iron, for the reason that it leaves the paint a dry scale on the outside, which, having no cohesion, can be readily crumbled or washed away. Linseed oil, on the other hand, is peculiarly well adapted for this purpose. It does not evaporate in any perceptible degree but the large percentage of linolein which it contains combines with the oxygen of the air, and forms a solid, translucent substance, of resinous appearance, which possesses much toughness and elasticity, and will not crack or blister by reason of the expansion and contraction of the iron with variations of temperature. It is, moreover, remarkably adhesive, is impervious to water, and is very difficult of solution in essential oils, spirits, or naphtha, and even in bisulphide of carbon. Another important advantage of linolein is that it expands in drying, which peculiarly adapts it to iron surfaces; since cracks, however minute, resulting from shrinkage, expose enough of the metal to afford a chance for corrosion, which will spread in all directions, undermining the paint and causing it to scale off, besides discoloring it.

With all its advantages, however, the best linseed oil paint is but poorly adapted to long service as a protection to iron surfaces exposed to extreme variation of temperature and to all kinds of weather. Even the continuous film of linolein, notwithstanding its compactness and the additional substance afforded by the body of the paints, gradually loses its toughness, curls up, and peels off. If chipped off by accident before it had lost its hold on the iron, we find, if we carefully examine the exposed spot, that a thin film of oxide has formed under it. This fact accounts for its diminished adhesion. Iron, in uniting with oxygen to form a rust, increases its bulk in proportion to the amount of oxygen it has taken up, and necessarily occupies increased space. In a word, it swells, and in so doing pushes off the paint film, which, sooner or later, drops away from it. This undermining action of the rust is the chief difficulty to be contended with in effectually preserving iron surfaces by means of paints or varnishes. It is not improbable that the linolein, itself an oxide, may impart oxygen to the iron, and thus promote its rusting. This idea has been suggested by Professor Williams in a recent treatise on the subject; and while it is purely speculative, it may account for the oxidation of iron surfaces, when to all appearance effectually protected by a film of paint thick enough and continuous enough to exclude both air and dampness.

In selecting a paint for iron, mechanical adhesion is a consideration of the first importance. In this respect, paints differ widely, but it must be remembered that, in painting or varnishing a metallic surface, mechanical adhesion is all we have to depend upon. With absorbent surfaces it is different. Professor Williams gives it as his opinion, based on observation and experiment, that pitchy or bituminous films are especially effective as regards their adhesion to iron: for example, solutions of asphalt or pitch in petrolum or turpentine. These are also very effective as regards continuity, owing to the fact that, in drying, they form plastic films, which yield with the expansion and contraction of the iron, and manifest no tendency to crack. If the surface is rusty, they penetrate the oxide scale, and envelope the particles very effectually, making them a portion of the paint. The solubility of such a film in water may be counteracted by mixing it with linseed oil. The experiment may easily be tried by mixing about two parts of Brunswick black with one of white, red, or stone colored paint, the body of which is composed of red or white lead or litharge. Red lead is the best for many reasons, if finely ground and thoroughly mixed with linseed oil. Any one of several kinds of bitumen may be used, either natural mineral asphalt, pine, pitch, or artificial asphalt, such as gas tar or the residuum of petroleum distillation in cases where the crude oil has been distilled before being treated with acid. This gives a very hard, bright pitch, which is soluble in "once run" paraffin spirit, and which makes the base of an excellent, cheap, and durable paint for ironwork in exposed positions.

During the past few years the writer has heard many accounts of the preservative influence of paraffin when applied to iron surfaces, and can recommend it for all classes of ironwork which can be treated hot. The most effective method of applying it is to heat the iron in vacuo, in order to expand it and open its pores, when paraffin, raised to the proper temperature, is run upon it. By this means the iron is penetrated to a sufficient depth to afford a very effectual protection against oxidation, especially when a suitable paint is subsequently applied. Any non-oxidizable substance would probably answer, but paraffin is as cheap as any, and quite as good if not better, the only exception as to quality being made in favor of some kind of vitreous enamel, which while costing more, would certainly be more permanent in its benefits. Brushed upon the outside merely, it is doubtful if paraffin would have much effect in preserving the iron, while it would certainly tend to lessen, if not destroy, the mechanical adhesion of a surface paint. There is no reason, however, why bridge work, iron fronts, etc., should not be treated with paraffin before they leave the shops where they are made, which would greatly simplify the problem of their easy and economical preservation from oxidation. In the absence of such treatment, a careful coating with the paint above described will probably prove the most effectual means of protecting iron surfaces.—*Painters' Magazine.*

A NEW PREVENTATIVE FOR THE EFFECTS OF BEE-STINGS.

Mr. G. Walker has made some interesting (but unpleasant) experiments lately, whereby he has proved that immunity from the pain and other effects of the stings of bees can be obtained by inoculation. The following description of his manner of experimentalising on himself is taken from the *Lancet*:—

He went to one of his hives, caught a bee, placed it on his wrist, and allowed it to sting him taking care that he received the largest amount of poison by preventing it from going away at once. The first few stings he got during this experiment had the usual effect; the whole of his forearm was affected with a cutaneous erysipelas, and there was disorder of the nerves, accompanied with heat, redness, swelling and pain. This attack lasted till Tuesday, and on Wednesday, October 7, he was so far recovered that, following the same plan, he stung himself three times more, also on the wrist. The attack of erysipelas this time was not nearly so severe, but, as before, he felt a stinging sensation as far up as his shoulder, and he noticed that a lymphatic gland behind his ear had increased considerably in size, the poison being taken up by the lymphatic system. On Saturday, October 10, he again treated himself to three stings, and the pain was considerably less, though the swelling was still extensive. At the end of the next week (October 17) he had eighteen stings; then he stung himself seven times more during the next week and reached the number of thirty-two on October 31, the course of the experiment having lasted very nearly four weeks. After the twentieth sting there was very little swelling or pain, only a slight itching sensation, with a small amount of inflammation in the immediate neighbourhood of the part stung, which did not spread further.

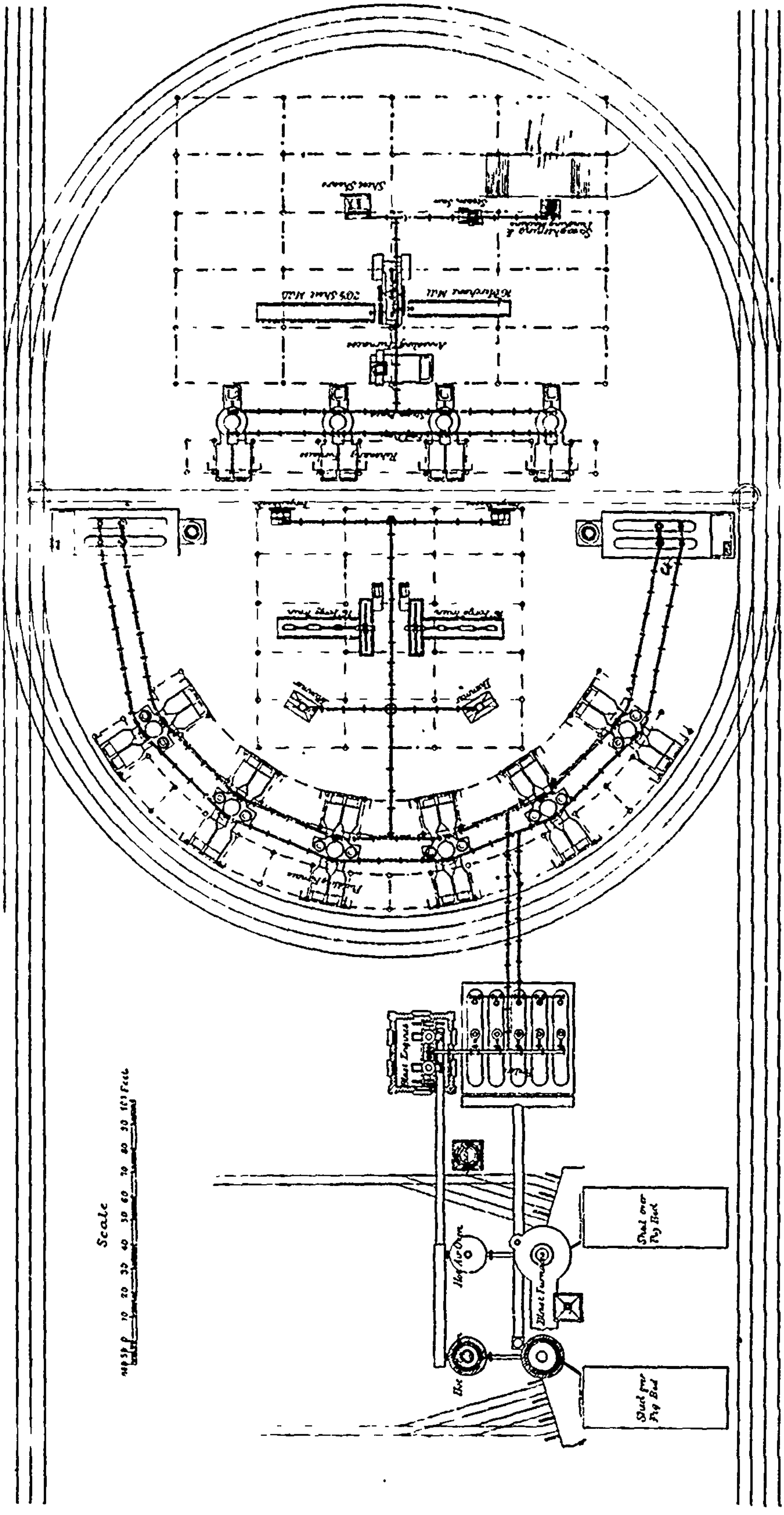
THE BOY ASTRONOMER.

(From the St. Nicholas Magazine.)

The first transit of Venus ever noted by a human eye was predicted by a boy, and was observed by that boy just as he reached the age of manhood. His name was Jeremiah Horrox. We have a somewhat wonderful story to tell you about this boy.

He lived in an obscure village near Liverpool, England. He was a lover of books and of science, and before he reached the age of eighteen he had mastered the astronomical knowledge of the day. He studied the problems of Kepler and he made the discovery that the tables of Kepler indicated the near approach of the transit of Venus across the sun's centre. This was about the year 1635.

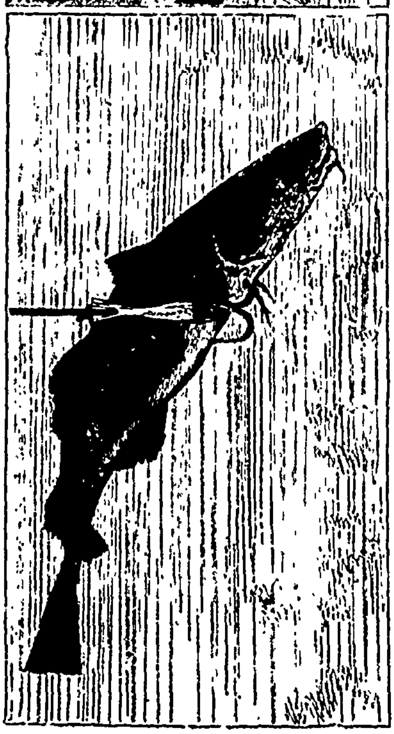
Often on midsummer nights the boy Horrox might have



IRON WORKS FOR THE KING OF BURMAH, NEAR MANDALAY, BURMAH.

FISHING BOATS OFF THE COAST

FISH STAGE AND FISHERMEN'S DWELLINGS



COD CAUGHT BY A "JIGGER"

THE CURING HOUSE

THE NEWFOUNDLAND COD-FISHERY.

been seen in the fields watching the planet Venus. The desire sprung up within him to see the transit of the beautiful planet across the disc of the sun, for it was a sight that no eye had ever seen, and one that would tend to solve some of the greatest problems ever presented to the mind of an astronomer. So the boy began to examine the astronomical tables of Kepler, and by their aid endeavoured to demonstrate at what time the next transit would occur. He found an error in the tables, and then, he being the first of all astronomers to make the precise calculation, discovered the exact date when the next transit would take place.

He told his secret to an intimate friend, a boy, who like himself, loved science. The young astronomer then awaited the event which he had predicted for a number of years, never seeing the loved planet in the shaded evening sky without dreaming of the day when the transit should fulfil the beautiful vision he carried in his mind.

The memorable year came at least—1639. The predicted day of the transit came, too, at the end of the year. It was Sunday. It found Horrox, the boy astronomer, now just passed twenty years of age, intently watching a sheet of paper in a private room, on which lay the sun's reflected image. Over this reflection of the sun's disc on the paper he expected moment by moment to see the planet like a moving spot or a shadow.

Suddenly the church bells rang. He was a very religious youth, and accustomed to heed the church bells as a call from heaven. The paper still was spotless, no shadow broke the outer edge of the sun's luminous circle.

Still the church bells rang. Should he go? A cloud might hide the sun before his return and the expected disclosure be lost for a century.

But Horrox said to himself; "I must not neglect the worship of the Creator, to see the wonderful things the Creator has made."

So he left the reflected image of the sun on the paper and went to the sanctuary.

When he returned from the service he hurried to the room. The sun was still shining, and there, like a shadow on the bright circle on the paper, was the image of the planet Venus. It crept slowly along the bright centre, like the finger of the invisible. Then the boy astronomer knew that the great problems of astronomy were correct, and the thought filled his pure heart with religious joy.

Horrox died at the age of twenty-two. Nearly one hundred and thirty years afterward Venus was seen crossing the sun. The whole astronomical world was then interested in the event, and expeditions of observations were fitted out by the principal European Governments. It was observed in this country by David Rittenhouse, who fainted when he saw the great vision.

POLYCHROME PRINTING.

A remarkable innovation upon the ordinary process of colour printing has just been introduced to public notice at the International Exhibition by Messrs J. M. Johnson & Sons, who are well known as the printers of official catalogues, &c The new process is perfectly distinct in every respect from any of this class by which it has been preceded, and, although embodying some very striking features, is in itself a very simple matter So simple is it, in fact, that the first idea which suggests itself on examining into its details is—"Why was it never thought of before?" Briefly, it consists in printing any number of colours at a single impression; it is colour printing without blocks or stones, and with colours which are not ink, the colours forming at once the block and the pigment. To follow out the process we will first take the colours, which are moulded into blocks measuring about 6 in. x 4 in. x 2 in. thick. These blocks have to be cut up into slabs about half an inch in thickness, to do which a block is taken to a band-sawing machine, having in place of the band saw a steel wire. The block of colour is fixed against a vertical plate, the plate having been previously warmed and thus causing the block to adhere. The plate is carried on a travelling table, and, the feed motion being started, the block is carried forwards against the wire, and the first slab is cut off. This operation is repeated until the block has been cut up into slabs, when another block takes its place.

The next step is to cut pieces out of the slabs of the pattern required for printing from. For this purpose a template made of brass is caused to adhere to the slab of colour, and by means of another band-saw machine, having an exceedingly fine steel wire, a piece of colour of the exact shape required is cut out of the slab. When the various pieces of colour forming the subject to be produced have all been cut out, they are carefully joined and fitted into each other inside an iron sliding frame, just as a dissecting puzzle is put together. By the application of a gentle warmth the various pieces of colour are made to cohere, and a solid block is produced. The upper face is then brought to a true surface by being ground upon a stone, and the block is then ready for taking impressions from. It is placed on a printing press of special construction, and the impressions are produced upon paper moistened with turpentine, or any other solvent of colour. As the block wears it is automatically raised within its frame, and when worn nearly away, what remains of it on the base plate is scraped off. When sufficient scrap ings have accumulated the whole is melted down, stirred up, moulded in large slabs, and is used for printing marbled paper, which is thus produced in bright and striking patterns. It will thus be seen that the process involves no waste whatever, all the scrapings, chips, and fragments being ultimately utilised. We should mention that before the half-inch slab has been used up in its original form it will have given about 8,000 printings.

The advantages of the new system over that ordinarily practised are very maked; any number of colours or flat shades can be printed at a single impression instead of requiring a separate block or stone for each colour. Then again the prints become perfectly dry in a few minutes, thus avoiding loss of time in that resp ct. The polychrome process has been so recently developed, that many modifications, of which it is plainly susceptible have not yet been worked out in practice Thus, for instance, the process at present is only applied to ground colours. If a very clearly defined outline, or high degree of finish is required, the ordinary methods of lithography or block printing are used in combination with new process. The same means must also be used as at present to produce the effects of shading, although it is believed that the new process will in course of time be made to subserve all these varied purposes and will form of itself a perfect and independent system of colour printing. The samples of we have seen testify to the efficiency of the process in the present stage of its development, whilst an examination into its working gives us reason to expect that the anticipated perfection will ultimately be realised.

We have observed that the printing press used in the polychrome process is of very special construction; it, in fact, differs from all others in several important respects. It has been designed and manufactured by Mr. Arthur Rigg, of London, who also designed and made the two band-saw machines which have likewise their specialities. We purpose shortly to illustrate and describe in detail the printing press, but in the meantime we may point out its peculiarities. Motion is given to the table by a worm and wheel and crank; the crank moving the table backwards and forwards, and also actuating the tympan, which is in the form of a segment of a large circle, and is suspended from a centre over the table. There is a very neat arrangement for keeping the same point of the tympan precisely over a corresponding point in the table so as to preserve the register. In order to allow for the varying thickness of the blocks of colour which arises from the gradual denudation of their surfaces by use, the tympan is lowered by an hydraulic arrangement which allows it to exactly follow up the wear of the blocks. The hydraulic presses — for there are two — are charged by a small pump which can be set to work at the speed required. Such, then, are the particulars of a process which promises to aid in and to cheapen the production of chromatic printing of all kinds, and to mark an era in the history of that art.—*Engineering.*

COMPOUNDS FOR POLISHING.

It is not often, nowadays, that a new compound for cleaning and polishing metals and other substances is discovered or invented, and when such a thing is deemed sufficiently valuable to secure by letters patent, it is likely to obtain a little notice whatever may be its real value. Whether or not there may be any novelty in the compound invented by Mr. Wilkinson we cannot say; but certainly there is no novelty in the use of slate-dust for polishing purposes. The compound consists of slate-powder mixed with a small quantity of suphuric acid, ammonia, and whiting, pipeclay, rouge, crocus, or the like, and it may be used either dry or wet, preferably in the latter state. In manufacturing the compound the patentee places a quantity of the slate-dust in a tank containing sufficient—ammonia, he says, but we presume he means—ammonia-water, to make a paste, which is then removed to another tank containing sufficient sulphuric acid (dilute?) to bring the paste to the consistency of cream, when a quantity of whiting, pipeclay, rouge, or other substance is thrown in and the whole thoroughly mixed until it becomes nearly dry, in which state it may be compressed into cakes or moulds, or desiccated until it becomes a powder. Instead of sulphuric acid, spirits of wine(?) may be used. Another part of Mr. Wilkinson's invention consists in amalgamating slate-dust, prepared with ammonia and sulphuric acid, with caoutchouc or guttapercha, and moulding the compound thus obtained into any desired or suitable shape for polishing, e.g., knives and forks Buffing-sticks of all sizes and forms can be moulded from the plastic material, and for certain purposes it will be advisable to add a small quantity of emery-powder to the compound. The prepared slate-powder may also be mixed with glue, oil, litharge, and other adhesive materials, and spread upon paper or cloth, or it may be treated in the usual manner for manufacturing glass and emery-paper, and used for similar purposes.

The slate-dust prepared as above may be fixed with fat, potash, silica, or other substances, for forming into soap-tablets, tooth-paste, powder, &c. The slate-dust may also be utilised as a paint for ships' bottoms and metalwork generally.

Mr. Wilkinson claims as his invention the use of slate-dust, mixed with other substances to fit it for a commercial compound for cleaning and polishing metals, and he also claims the use of the dust in the modified combinations above described. In short he claims the exclusive use of slate-dust for polishing purpose when it is prepared in the manner described. We presume that the patentee by slate dust means the powder obtained by crushing ordinary roofing slate, although as the only definition he gives is "mineral slate," his patent will cover all descriptions, viz., mica slate, whet slate, drawing slate, adhesive slate, that which is known by the specific name of polishing slate, and the common and better known roofing slate. We suppose that Mr. Wilkinson has tested the capabilities of his compound in cleaning and polishing metallic surfaces, and having found the result satisfactory has paid the fees and secured his invention. There is not such a plentiful supply of cheap and good polishing materials that mechanics will refuse to try his compound, even if it be but slate-dust.

[TH]E POISONOUS NATURE OF RED WALL PAPERS.

(British Medical Journal.)

The dangers to be feared from wall-papers, stuffs, laces, and flowers, dyed green by the agency of arsenite of copper, have long been patent to the world. The particles of arsenic which become detached from articles so coloured have given rise to undoubted cases of poisoning, as well as to much unaccountable ill health. This danger is particularly great in ball-rooms, where the particles detached from the dresses and flowers worn by the ladies are in constant agitation in a condensed and heated atmosphere. To these dangers appertaining to articles dyed green must now be added, according to an article in the *Gaz tte des Hôpitaux*, a fresh series, which have been traced to wall-papers and materials dyed with coralline dye. It was believed for some time, some years since, that this material, which was used to dye stockings, socks, and other woollen goods, a magnificent red, was poisonous. A young man who wore red socks, having been attacked by a very acute and painful vesicular eruption on both feet, M. Tardieu attributed this affection to the red colour of the coralline dye. The substance in question having been separated by M. Roussin, the chemist, and injected under the skin of a dog, a rabbit, and a frog, which died from its effects, it was concluded to be a violent poison, and subsequently fell out of use as a dyeing agent. Contradictions of this statement, however, were soon forthcoming; M. Landrin, a veterinary surgeon, asserted that he had administered coralline to dogs and cats without observing any subsequent ill effect. He had had positive proof of the absorption of the coralline, and of its purity, since he had been able to collect it in the lungs of the animals, and to dye silk with it. Dr Guyot confirmed these experiments, and came to the conclusion that coralline was not poisonous, even in large doses, and that it may be safely used in dyeing, provided that it be not mixed with poisonous substances.

In presence of these contradictions between men of equal education and veracity, doubt was permissible, and things remained in this state. M. Bouchardat had often had an idea that signs of poisoning by local applications of Scheele's green or arsenite of copper were present in some cases from the nature of the symptoms recorded, but this was an *à priori* explanation which was far from convincing. This question was still environed in mystery, when it was declared by a most singular incident. Dr. Bijon, a physician of Quimperlé had an apartment hung with *feutre l'avy*, a wall-paper with a red pattern on a hazel-brown (*noisette*) ground. Whenever he inhabited this room, he was annoyed by prickings of the eyelids, with itching and burning sensations; he was even attacked by purulent conjunctivitis after having slept for several nights in this room. He had the paper analysed, and, from a piece of [illegible] square *centimètres* (0.12 square yard), MM. Mayer and Lebaigue obtained, with Marsh's apparatus, enough arsenical patches to cover a saucer. They were also able to extract from a larger quantity of this paper enough coralline to submit it to reagents, to dye silk and wool with it, and to obtain sufficient arsenical patches to enable them to affirm that the red substance employed to colour the paper was undoubtedly coralline, and that, in its use as a dye for paper, it was an arsenical substance as M. Bouchardat had foreseen, though M. Roussin had not been able to recognise it as such. M. Mayer could not obtain any patches of arsenic by submitting the brown portions of the paper to the action of Marsh's apparatus; and therefore came to the decision that the arsenic was only mixed with the red colour of the paper, that is, with the coralline dye.

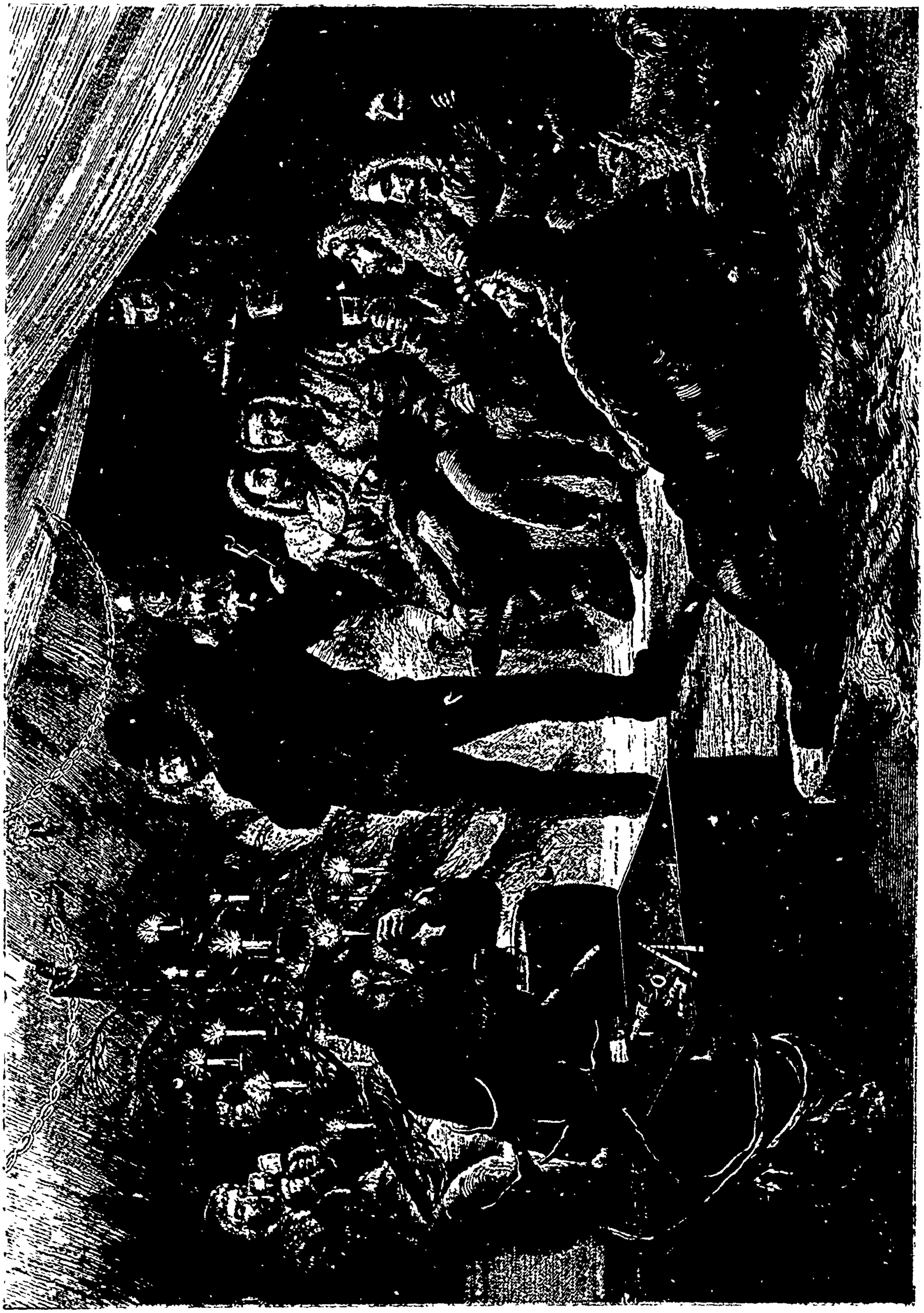
An apparent contradiction is thus solved. It results that pure coralline is not poisonous, and may be employed as a dye; but, in materials as well as in wall papers, an arsenical mordant is often used to fix it. This mordant, then, acts as a poison, whether acting topically on the skin, where it is directly deposited, through the medium of red shirts, drawers, and stockings, or by the dust and vapours which disengage themselves from the papers or stuffs dyed with it.

AMERICAN TINWARE STAMPING.

The manufacture of seamless goods from tin plates, by machinery, was introduced into the United States about the year 1860. A few years previous to that date tinned goods, such as plates, pans, jelly moulds, &c., had been made from one piece of metal in France and elsewhere in Europe, but it was not until about fourteen years ago that the process was in successful operation in America. About that time machinery was brought from France, and this branch of mechanical industry, which has since grown to be of such large proportions, was fairly inaugurated. Pending the introduction of the French machines, an American writer tells us, the process of stamping metals has been elaborated and got into successful working order by C Hodgetts and W. Taylor, of New York. The two methods—the French and what is called the American — both attain the same result, and the principles governing them are alike; they differ only in minor details and in the construction of the machinery used.

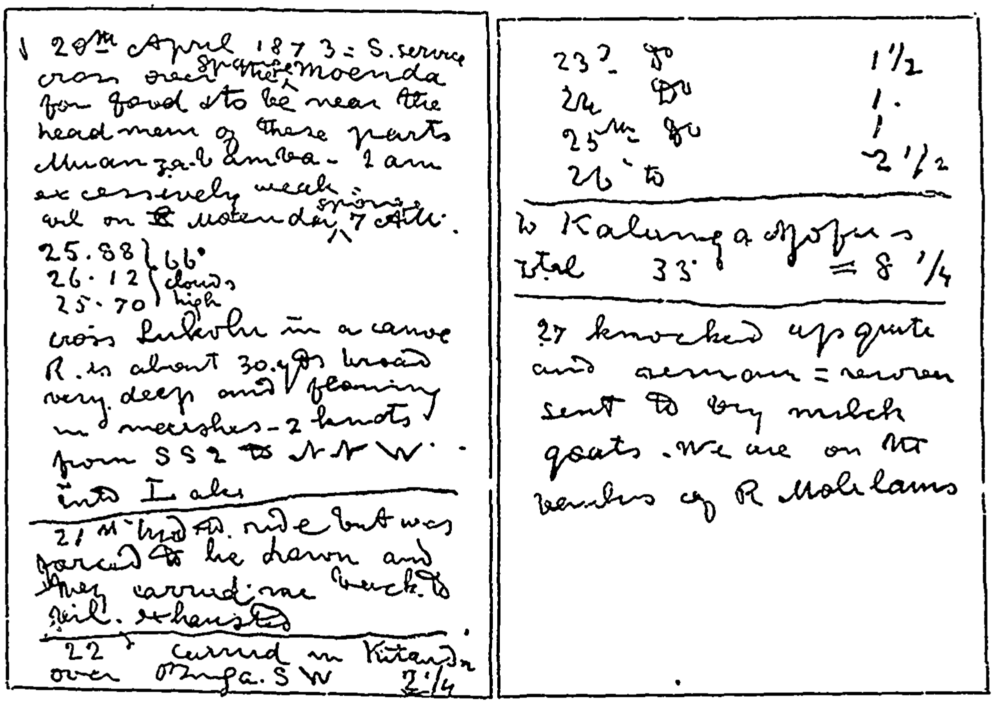
Stamped goods were made at first by means of a drop press, but this method was open to objection, principally on account of the liability of tin plates, unless of exceptionally good quality, to crack in stamping, thereby causing considerable loss of material. The process now in use was adopted about ten years ago. By its operation the pressure brought to bear upon the metal in the successive stages of manufacture is more gradual; there is no sharp impingement—such as would be caused by the falling of a drop hammer; fractures are of rare occurrence, and a great saving in material is effected.

In stamping tin plates into such forms as may be desired, the first operation is that of cutting the blank of the requisite size and shape from the tin plate This is done, generally, by means of an ordinary drop press. The blank is then transferred to the stamping machine, where the flange is so held during the pressure of the descending die as to keep it perfectly flat, and free from the force brought to bear upon the rest of the plate. The flange by this means retains the same thickness as the original plate, while, at the same time, its shape is preserved, the corrugation being confined to the sides of the basin. The descending weight containing the die is governed by the machinery throughout, and does its work by gradual and steady pressure. Successive dies are used, each one smaller in circumference than its predecessor, until the required depth is obtained. The nature of the plate is such that it has been found necessary to use dies of moderate depth, and to prefer a succession of strokes to endeavouring to make articles of much depth at one operation The metal forming the sides of the basin is necessarily stretched in the operation to some extent, and the tin plating is made to cover a larger space than when in the blank, while on the flange and bottom it retains its original condition. It consequently becomes necessary, for the purpose of securing uniformity in the plating, to have many of the manufactured articles retinned. The corrugations on the sides of the basin are smoothed out with a burnishing iron on a lathe,



AUSTRIAN ARCTIC EXPEDITION.—CHRISTMAS ON AN ICE FLOE.

"THE MAIN STREAM CAME UP TO SUSI'S MOUTH"



20th April 1873 = S. service
cross over the Spring Moenda
for food & to be near the
head men of these parts
Muanzabamba - I am
excessively weak - sponges
vil on R Molenda 7 Alt.
25.88 } 66°
26.12 } clouds
25.70 } high
cross Lukolu in a canoe
R. is about 30 yds broad
very deep and flowing
in marshes - 2 knots
from SS2 to NNW.
into Lake

21st tried to ride but was
forced to lie down and
they carried me back to
vil. exhausted

22 carried in Kitanda
over Buga S.W 2 1/4

23 do 1 1/2
24 do 1.
25th do 1
26 to 2 1/2

to Kalunga Mofu's
total 33 = 8 1/4

27 knocked up quite
and remain = recover
sent to buy milch
goats. We are on the
banks of R Molilamo

AUTOGRAPH FAC-SIMILE OF THE LAST ENTRY IN LIVINGSTONE'S NOTE-BOOK

THE LAST MILE OF LIVINGSTONE'S TRAVELS

THE LAST JOURNALS OF DAVID LIVINGSTONE IN CENTRAL AFRICA.

as in the manufacture of spun goods. The presses used are of great strength, and can be adapted to the production of any size of article that may be required. One man is required to attend each press, and he is kept busily employed.

When the article has been stamped into the required shape, it is removed to another machine, where the flange is turned over and wired It is then rea'y for the spinner, who smooths out the corrugations and gives it an even, regular surface. Some kinds of goods, such as dust pans, &c, are frequently put on the market without the corrugations being removed, but the great majority of stamped wares, when they are of any considerable depth, are spun before being retinned. The tendency of iron to crack under such pressure as is brought to bear upon it in the stamping process has made it necessary for the manufacturers to use only the best charcoal plates, as it has been found that it is more profitable in the long run to do so than to employ inferior metal.

The advantages claimed for stamped goods over those made by the old methods are many and important. The absence of seams rendering the use of solder unnecessary, and affording no place for water to lodge and cause rust, is one of the most important of their claims to superiority. For such articles as milk pans, &c., that require, when not in use, to be thoroughly clean, dry, and free from sour "milk, crust," the absence of any place where liquids could possibly lodge, is a matter of considerable moment.

The same method of stamping is also applied to other metals beside tin-plate. Copper and brass basins, &c, are made by the same or similar machines.

THE POSITION OF WINDOWS IN HORSE STABLES.

We find in a German exchange some curious observations on the manner in which the position of the windows in the stable affects the eyes of a horse. In one instance the horses of a farmer—fine animals, celebrated for their excellent condition — were kept in a stable lighted only by a small window at one side. When light was needed for work the door was temporarily left open; the result was that nearly all of these animals had eyes of unequal strength, and in time a number of them became blind on the side toward the window. A strong light directly in the horses' faces has been found to weaken the sight. The worst position of all for a stable window is in front of the horses and much higher than their heads. An officer had bought a perfectly sound mare from a gentleman whose stable was lighted by windows at the rear of the stalls. The animal was sound and perfectly satisfactory. After three months she became suddenly "ground-shy"; on examining her eyes they were found directed upward, and this was explained by the fact that the windows of the officer's stable were situated above the head of the stalls, the eyes being generally drawn in that direction She was removed to another stable where the light was admitted from all sides, and in three months the difficulty had disappeared Another officer reports that during the campaign of 1870, in France, he rode a horse that was a capital jumper On his return from the war he placed this animal in his stable, the windows of which were above the front of the stall, and in a short time the horse became so shy of the ground that he had to sell it He had had a similar experience with other saddle-horses, all of which became gound-shy in his stall. One animal in particular a thorough-bred mare, renowned for her jumping qualities, refused in a short time to cross the smallest obstacle, and, when forced to cross a foot-wide gully, made a leap that would have cleared a ditch fourteen feet wide Owners of horses who find that their animals shy at objects on the ground or at their side would do well to look to the windows of their stables for an explanation of the evil.

A NEW plan is about to be adopted as an experiment, on the line between Brussels and Antwerp, with regard to the issue of railway tickets, and substituting for them coupons available for any date, these coupons will be sold in books containing twenty, and will be issued for either single or return journey for every class. This will be without doubt of great convenience to the public, and we may safely predict that this new system will soon become general.

DOMINION.

THE tonnage of the new vessels built or registered at Halifax during 1874, was 18,359, the number of craft being 75.

WE understand that last week a very rich vein was struck in the north-east shaft of the Lyndhurst lead mine. The prospects of the company are considered very favourable, work being pushed forward regardless of the unfavourable state of the weather.

SAYS the *Free Press*, — Grashoppers are now hatching out in great numbers in the Greenwood settlement. This remark may possibly be regarded with suspicion, but the thing is a fact. You see, a settler built himself a house, and didn't put any floor in it. Consequently when things got warmed up the grasshoppers commenced to hatch out and things are now pretty lively in that house.

THE *Colonist* of the 25th ult, says:—It is estimated that there are at least 100 miners returning from Cassiar, at Fort Wranger unable to reach Victoria because of want of conveyances It is known that supplies of food and clothing were very short at Wrangel when the last steamer left, and some Cassiarans go so far as to say that there is danger of the men now there starving to death, or, at least, suffering from the severity of the season.

AT the last meeting of the Board of the port Dover and Lake Huron Railway, the contract for track laying from Port Dover to Woodstock was let. The contract is also let for 2,620 tons of rails, at $43 per ton, to be delivered at the Company's wharves here in June next. The iron was bought from an English firm on very advantageous terms, and is now lying part at Buffalo and part at New York.

THE annual statement of the New Brunswick shipping shows that the total tonnage of vessels built in that Province during 1874, was 46,655, comprised in 104 vessels. Estimating this tonnage at $40, it would give the value of the vessels built as $1,868,200. There are now building 43 vessels of 34,470 tons. The indications are, however, that the coming year will not be a very busy one in shipping. From St. John papers we learn that at the present time there is not the same activity apparent in ship-building that was noticeable last year. About St. John there are several yards idle that have seldom of late years been without a vessel or two on the stock—particularly the ship-yard of Messrs. Nevins Fraser & Co, these builders having retired from business here. The yards in Portland, where in previous years times were very full, are now tolerably active. It is also noticeable that there are comparatively few small vessels building, the bulk of the tonnage being ships and barques, many of very large size. A considerable number of the vessels are for our own people.

TRIAL TRIP OF THE HOPPER DREDGE ST. LAWRENCE.—On Tuesday, during the storm, this new type of dredger had a very satisfactory trial on the Clyde off Greenock, in a heavy sea, and in presence of Mr. Ackerman, of the Admiralty: Mr Turner, representative of the Canadian Government; Mr Dempsey, their engineer, Mr. Kinniple, engineer of the Corporation of Greenock; Mr. Morton, chairman of the Clyde Light Trust; Mr Wilson, Marine Superintendent of the Caledonian Railway; Captain Callender, and others. After dredging for some time into its own hopper cavity, by a change of steam gearing the dredging girder and apparatus were raised on board, the propeller put in motion, the fastenings loosened, and the vessel instantly converted into a loaded screw-steamer; when, as such, her sea-going qualities were severely tested in a run of 20 miles through a heavy sea, and in the teeth of the gale and blinding snow-storm. The party on board repeatedly expressed their satisfaction with the behaviour of the vessel, and this new system of dredging, and their conviction of the great economical advantages it has over the present mode of dredging on the Clyde. The St Lawrence dredges to 30 ft. depth of water, carries 600 tons of its own spoil, and is the second patent hopper dredger Messrs Simons & Co., Renfrew, have constructed for the Canadian Government. The previous one steamed across the Atlantic in 18 days.—*Glasgow News*

RAILWAY MATTERS.

On the United States railways 81 accidents occurred in the month of October, and 16 persons were killed and 60 injured. The averages per day for October are 2.61 accidents, 0.51 killed and 1 94 injured; for the year they are 2.69 accidents, 0.56 killed and 2 06 injured. The averages for the month are all slightly below those for the year.

The Northern Railway Company, of New-Brunswick propose, under the general Act of Assembly, to run a line from the town of Richibucto to the nearest point on the Intercolonial.

M. N. C. Ry.—We understand that at a meeting of the Directors of the Northern Colonization Railway Company, held at Montreal, recently, it was decided to push on the construction of the road through Pontiac as rapidly as possible. The scheme for amalgamating the Northern Colonization and Canada Central Railways has been abandoned for the present.

The Belgian canal-boats are propelled for short distances by small locomotives, running on a single rail laid upon the bank of the "tow-path." The system is to be established on the Bourgogne canal, over a distance of 150 miles. Relay engines will be provided at suitable distances, and when two engines meet on the track they will exchange boats and retrace their paths. The locomotives will be run at the rate of three and one-tenth miles in an hour, and will pull one boat, carrying a cargo of 150 tons each.

The building of the New-Brunswick and Canada Railroad is leading to some new things under the sun in the way of trade. We learn that eight millions of shingles will be manufactured during the winter in Presqu'ile and forwarded by rail to Boston at special rates The course which the shingles will take will be somewhat circuitous. They are to be hauled from Presqu'ile to a distance of about eight miles below Tobique, where the railroad is reached. Thence they are to be sent by rail to St. Mary's station, hauled across the river by teams, and forwarded to Boston via Frederickton Branch and Consolidated European and North American Railroad. Shingles are usually shipped by water at very low rates of freight, but by the present plan a good deal of money will be drawn during the winter by a Presqu'ile district. Were the railroad extended to that locality travel and business would be greatly extended.

A Duluth paper proposes a railroad on the ice from Duluth to the Sault—the whole length of Lake Superior. It would simply spike the rails to the ice, without grading, filling, excavating, ballasting, or ties The track, it says, could be taken up every spring and stowed away. The road would be about 400 miles long, and a dead level. It suggests further that "if the rails could be spiked to the ice, or they could be fastened in a frame and laid on the ice without spikes, which would do just as well." "Just as well? A great deal better!" says the Detroit *Tribune*. "For, laid on a frame, the track could float when the ice melted from beneath it, and thus the great thoroughfare would be available summer and winter. Give us the railroad on frames, and let the Legislature look to it that they give it a subsidy both sides of the track"

The Government Railway in Prince Edward Island has experienced sad luck at the outset of its career. Tremendous snow storms have blocked up the line ever since the 28th of December. Every possible effort has been made to clear the track of ice and snow, but all in vain, owing to the severity of the weather and a succession of heavy winds and snow storms blocking up the cuttings from eight to fifteen feet Strong gangs of men and seven engines have been constantly employed to make communication between Charlottetown and Sunnyside, to little purpose. Some engines are frozen up, and snow ploughs have proved practically useless. Several times the engines and ploughs got off the track, and were replaced with great labour. This is the third week the line has been blocked, the cuttings all being too narrow and no snow fences The Superintendent has had to announce the postponement of the opening of the road for the present.

SCIENTIFIC NEWS

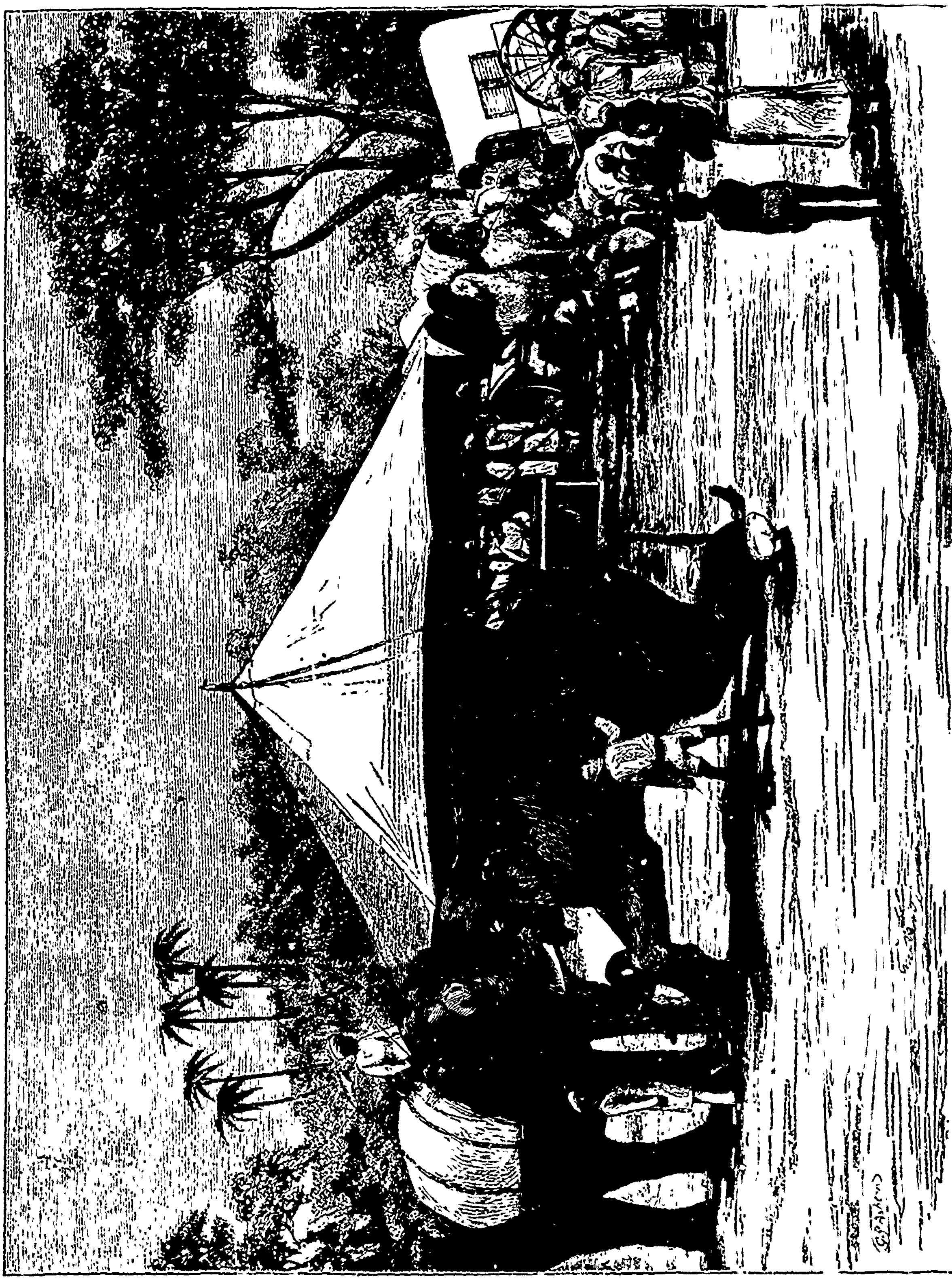
Mr. Hind of Nova Scotia, calls attention to the fact that the equatorial bulge of the earth's surface may have been much larger in earlier geological epochs than at the present day, and that Captain Clarke's and General Schubert's investigations, according to which the earth's equator is an ellipse and not a circle, favor the idea that in these earlier epochs this ellipticity must have assumed the nature of a gradual change in the figure of the earth, in virtue of which a vast equatorial undulation has progressed with extreme slowness in an easterly and westerly direction.

A request has been made by the Foreign Office that the Danish Government will permit their agents at Disco Proven, and Uponivik to collect hunters, dogs, and dog drivers for the Arctic Expedition. It is announced that the vessel chosen to be the consort of the steam-whaler "Bloodhound" in the forthcoming Arctic Expedition is her Majesty's ship "Alert." She is a 5-gun steam-sloop of 751 tons old measurement, and 100-horse power nominal. Active preparations for the equipment of the ships will soon commence, but the start will not be made until the latter part of June of next year, as it is considered merely waste of labour and time to push across the North Water until the ice has had time to melt and drift out from Smith's sound.

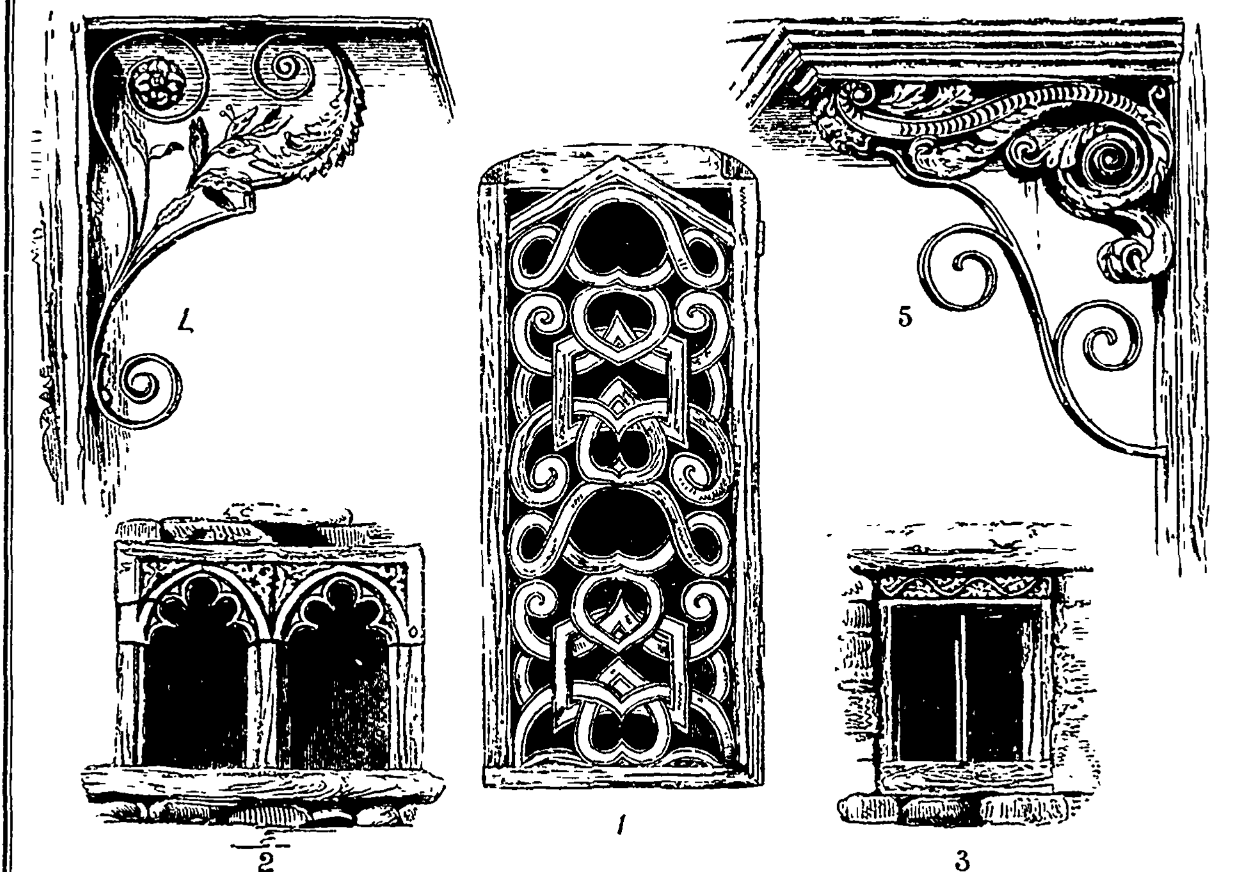
M. Nordenskjold has recently found, in the ice and snow of the Arctic polar sea, a black dust. This he had melted, and subsequently submitted to chemical analysis, which has proved that it is composed of nickel and cobalt, and is similar in constitution to the meteorites. It seems probable, therefore that the powder is actually due to the disintegration of these aerial bodies at a short distance from the earth. The regions which this intrepid traveller has lately explored are the most inhospitable on the globe. He has traversed ice seas, the level of which rises to over 3000 ft. above that of the ocean, and which are rent with huge crevasses often entirely concealed by snow and fog, rendering their exploration an enterprise of the greatest danger. M. Nordenskjold is now organising a new expedition to start in the spring of 1875.

M. Faivre has recently performed a series of experiments on the mulberry, hazel nut, and cherry laurel, which he considers goes far to prove the fact that the substances which supply the food of plants have an ascending motion in the bark. For this purpose he made perfect or imperfect annular incisions through the bark, or detached pieces of the bark, to which buds were attached, or removed entire cylinders of bark from the trunk. The result of the experiments was that the buds always continued to develope when the communication remained uninterrupted with the lower portion of the trunk; while when this communication was completely destroyed, the buds invariably withered away. If the bud was separated by a perfect annular incision, it withered the more slowly the greater its distance from the incision; and in these cases the starch disappeared entirely from the portions of the wood above the incision between it and the bud. When entire cylinders of bark with buds on them were removed, the buds continued to develope, and even produced branches bearing leaves.

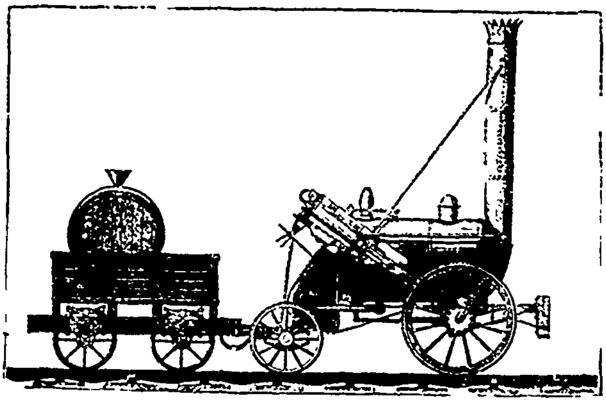
M. Victor de Lesseps and Mr. Stewart have printed their report upon the journey they recently undertook for the purpose of tracing out a railway line between Tarkestan and India. It appears from the report that, baffled by the Hindoo Koosh, they turned east, and found Kashgar to be connected by open and very gradually ascending valleys and plateaus both with Khokand and Cashmere. That this is undoubtedly so was repeatedly stated two years ago in the Russian intelligence of the *Times*. M. de Lesseps thinks that the most practicable road starts from Lahore, and reaching Serinagapur by the Valley of the Jhelum, proceeds through the Sotchil and Karakorum Passes to Yarkand, Kashgar, Khokand, Tashkend, Orenburg, Ekaterinburg, and Moscow. We may add that the Russian Government are in no hurry to act upon this advice. They will for the present content themselves with constructing a line from Orenburg to Southern Siberia. From this trunk line another may eventually be branched off in the direction of Tashkend. At the same time, the project of a canal between the Caspian and Aral is still under discussion.



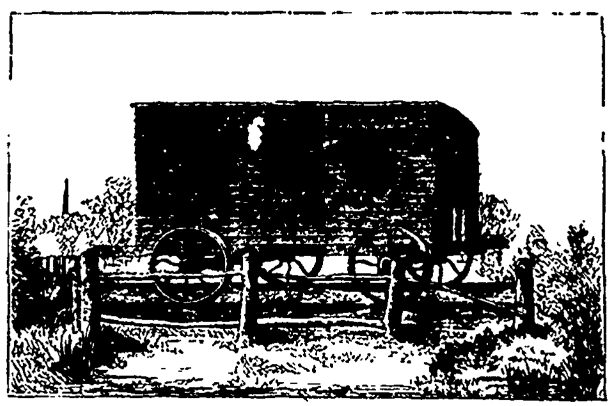
ELEPHANT AUCTION AT MYSORE, INDIA. ARCHITECTURAL SCRAPS.



ARCHITECTURAL SCRAPS.



GEORGE STEPHENSON'S LOCOMOTIVE, "ROCKET," 1829



THE FIRST RAILWAY PASSENGER CARRIAGE, "EXPERIMENT," 1825

ARCHITECTURAL SCRAPS.

The jottings represented above are not without suggestiveness.

No. 1, shows a wooden door, of pierced work, *temp.* Queen Elizabeth, from the hermitage at Pontefract, Yorkshire, in which, tradition says, Peter, the hermit, of Pomfret, lived in the time of King John.

Nos. 2 and 3, Two windows from an old building at Minehead, Somersetshire, now used as a tannery. The woodwork is of great solidity, fastened with pegs. The arched windows are in the upper story, whilst the square-headed one is on the ground-floor.

Nos. 4 and 5, Door-hoods or canopies from Woodstock, Oxfordshire. In No. 5, the truss or bracket is of wood, boldly carved, with secondary support of iron. No. 4, is entirely of wrought-iron; the foliage and scroll-work being worked with great freedom of handling.—*The Builder.*

BUNT IN WHEAT.

The fungus diseases of the cereals are a sore trouble to farmers. Their fields are carefully ploughed, the seed as carefully sown, and the growth of the plant appears as strong and healthy as could be desired; but a little later the farmer finds that the yield from his field will fall far short of an average, because many of the grains or seeds of the ear contain nothing but a number of bunt-spores. *Tilletia caries*, as this parasitic fungus is named, is a most subtle and destructive disease; for, owing to the toughness of the coat of the seed, the bunt-spores are kept together, and are taken to the threshing-machine with the sound grain, where they are dispersed, and, adhering to the other seeds, are too often sown to grow as the wheat grows, and to destroy it when grown. Bunt and smut are almost synonymous terms to farmers, although they are distinguished by mycologists. Bunt rarely attacks barley, but smut [*Ustilago segetum*] appears to attack wheat, barley, oats, millet, maize, &c., indiscriminately. Of the two, *segetum* is probably worse than *caries*; for while the latter destroys the ovule, its spores are kept together by the pericarp; but with the former the pericarp is attacked as well as the floral envelopes and even the spikelets, the spores being thus wafted all over the soil by the wind, and resting there are ready to attack the young plant almost as soon as it is through the ground. The *segetum* however, attacks oats and barley much more frequently than wheat, so that, as far as the latter is concerned, it is principally against bunt that the farmer has to take precautions; and accordingly seed-wheat is, as a rule, pickled, dressed, or steeped. It will be understood by what we have said above that while pickling the seed-wheat in some solution calculated to destroy the fungus spores adhering to it may be effectual in the case of *Tilletia caries*, it can effect nothing towards preventing the ravages of *Ustilago segetum*, the spores of which are contained in the soil, save on the supposition that pickling destroys the germinating power of the weak grains, leaving only those which are strong and healthy to grow and reach maturity untouched by the destructive parasites. Various preparations for dressing wheat have been tried with what appears to be a fair amount of success, and several nostrums are sold for the purpose, which may or may not be as effective as the generally used and comparatively cheap sulphate of copper. Although it is undeniable that bluestone has given good results on the lands of some farmers in preventing bunt, it is, and must be, all but useless in preventing smut; and a similar verdict must be pronounced in the case of the other dressings, such as lime, salt, corrosive sublimate, arsenic, &c. There have not been wanting amongst the more intelligent agriculturists, however, many who have persistently avoided dressing their seed with any solution whatever, and they have not been left unsupported in their arguments by the professors of agricultural chemistry—notably Prof. Buckman, who for many years has concluded than the beneficial effects of steeping are due to the destruction of the weak and diseased grain. The Rev. Mr. Wix, too, has waged unceasing war against the practice of steeping or dressing seed wheat, and challenged all the agriculturists in the kingdom to inspect his crops, relying for the successful results he invariably obtains, on the selection of sound seed and thin sowing. Twenty years ago Professor Buckman recorded in the *Royal Agricultural Society's Journal*, the result of some experiments he had made in dressing wheat, and comparing the produce with that from undressed seed. Thus, from the same sample he picked out sound seeds, and also some of those much diseased. The two qualities were then divided into two parcels, each one of which was dressed with the sulphate of copper solution. The four parcels of seed were then sown in separate plots, with the result that there was scarcely a perfect ear amongst the undressed diseased wheat, which nearly all germinated and grew. The other parcel of diseased seed produced only a few plants, and the grain carried by these was free from bunt. The sound picked seed, both dressed and undressed, yielded a good and clean crop thus showing that the sulphate of copper destroys the germinating power of diseased seed. There may, of course be circumstances or conditions when it may be advisable to do everything calculated to disinfect the wheat, and it is notorious that sulphate of copper does not afford protection always, though possibly this may be due to the fact that the disease is really *Ustilago segetum*, the resting spores of which were in the soil. To destroy these it is obvious that the dressing must be applied to the land; but where it is desired to destroy fungus spores attached to the seed, or where diseased seed is suspected to exist in any appreciable quantity amongst the bulk, it might be advisable to try the pneumatic process of pickling, using strong cylindrical vessels for the purpose. The grain being placed in these, and the lids closed air tight, a vacuum would be created inside, and the effects of such vapours as those of carbolic acid, carbon disulphide, or sulphurous acid gas itself, might be tried. We suspect, however, that the results would be the same — that the germinating power of the diseased grain would be destroyed, and consequently, those seeds which would produce a plant, would have more room to develop and so acquire a robust growth, enabling them to resist the attacks of their fungus parasites. Rust, bunt, smut, and mildew afford some interesting objects to the microscopist, and agriculturists would find it to their advantage to make a good microscope a recognised implement of husbandry.—*English Mechanic.*

PLAIN COOKS.

Wanted, an industrious, thrifty, sensible woman, who has some idea of cookery, who will do a little housework, clean her knives, and be content with the wages of a governess. The servants who now apply for such situations in middle-class households are for the most part wholly unfit for them. Sometimes they are kitchen-maids who have been under good cooks, but have been too lazy or too stupid to learn from them. Sometimes, again, they belong to a class of which the young or inexperienced housekeeper must beware. Its representative is usually an elderly woman of many places who is destined to be in many more; indeed, she adds to their number almost every month, for drink, or laziness, or both will account for any frequency in her migrations. A third and more numerous class is that of the young woman who has been a maid of all-work. She has been ignorantly brought up, and her home training has been worse than none. She has seen waste when money and provisions were plenty, alternating with starvation, begging, and dishonesty when scarcity of work and drunkenness have made times hard. She has inhabited a crowded room where tidiness was impossible; her dress has consisted chiefly of rags, garnished with artificial flowers, her highest ideal of amusement has been a fair or a music hall; and her only preparation for entering domestic service a few months at nominal wages in a lodging-house. There she has learnt little but speculation, and has been accustomed often to lie down at night in her clothes too weary to undress, and to rise in the morning and go about her work unwashed and uncombed. When the maid-of-all-work obtains a place as plain cook she assumes the office with perfect self satisfaction. She proceeds without any hesitation to waste and destroy the material intrusted to her for conversion into food. It need hardly be observed that her success is complete. She keeps her milk and cream in the hot kitchen, and wonders that they turn sour. She puts the butter into the same small cupboard with the cheese, and is surprised that the sauce which she sends to the dinner table has an unpleasant taste. She will not be at the trouble of cleaning out the oven flues, and cannot imagine why the paste will not rise. She leaves the fish upon the kitchen table from the time it is brought until she is ready to cook it, and stands by with a look of innocence while the fishmonger is scolded for sending stale fish. When she lays a fire she crams it with bundles of wood so that it will not light and supplements her bad architecture with whole boxes of matches and very long candle-ends. She stirs the kitchen fire every time she passes it, and keeps it blazing even when there is no cooking to be done, and when the family is dining out. If the heat makes her ill, she blames the poor accommodation of the house, and talks as if she had come from a palace to enter service. If she has a gas-stove the taps are constantly turned on, and as to lowering the lights in the passages or scullery, such an idea never crosses her mind even in dreams. She will send up the eggs either raw or hard boiled rather than use your sand-glass. She will give you bread and milk with roast chicken rather than beat and flavor the mixture into bread sauce. She will make tea with tepid water, will send up spinach that looks like cabbage rather than put it through a sieve, and will peel the potatoes an inch thick to save the trouble of picking out their eyes.

Now, really refined cooking is the result of practice and teaching. But, short of this, the genius which consists of "an infinite capacity for taking trouble," will do much for the production of food which shall be wholesome and palatable as well. This is exactly the quality deficient in an ordinary cook. Flavoring, frying and making puffpaste are not to be learnt in a day, though common sense and the will to use it are enough for the preparation of an ordinary dinner. But the contemporary cook has only one recipe for every dish—namely, quantity and waste. She asks for a dozen of eggs and a pint of cream for the smallest cabinet pudding, and prefers isinglass to gelatine only because it is more expensive. A whole pot of jam must be consumed to make a single tartlet. A joint in the kitchen and another in the parlor is the allowance she prescribes for each day. She never keeps gravy; it is mean to boil down bones and scraps. If gravy is wanted, gravy beef should be ordered. The rind should be cut off the bacon at least an inch thick, and a crock of broken bread must always be kept to get mouldy for the honor of the house. Frying can only be done in lard in any respectable kitchen, and what number of oysters are required for a single patty we do not venture to estimate. Untidiness, too, the constant companion of wastefulness, she has reduced to a science. Her cupboards are an alarming mixture of scraps, sauces, forgotten white of eggs, and pots of dripping, together with raisins and corn flour, furniture polish and blacklead.

Her destruction of articles of food is well matched by her treatment of the crockery and kitchen utensils in her charge. She warms the best china dinner plates to a white heat. The dishes she puts into the oven until their surface resembles that of the crackle porcelain admired by the collectors. If they are adorned with arms or monograms in color or gilding, she early discovers the efficiency of strong soda and soft soap in the removal of such vanities. A few dexterous movements will chip the edges on a stone sink, and she thinks it well to remove such excrescences as the handles of dishes or the tops of their covers; her reasons for these measures may be sanitary, as handles only form recesses for grease and dirt, and it is impossible to clean them without trouble. Pudding basins she consumes in large numbers, and uses butter-boats to feed the cat. The dishes she sends to the table invariably soil the cloth, and are so full of gravy that they very often spill on the way upstairs. The covers are smeared with greasy finger-marks, and it is well if the outside only is dirty. The kitchen is her fortress; from it drawing-room company is carefully and jealously excluded. In all families the children look upon the kitchen as a paradise of dainty devices. In some they are never allowed to enter; but in others the little missy is sometimes privileged to make a bit of paste into ducks and drakes, or to knead some dough into a cake for the doll's birthday. Such frivolities a modern cook sternly represses. She supposes the young ladies will want to make puddings next or to come down and try recipes out of "them rubbishing books." She has no notion of encouraging such pranks. A favour has to be made of leave to use her bowls and spoons, and the young officer just home from his regiment dare not venture into the sacred precinct to concoct a real Indian curry or a Mulligatawny pillaw unless he has first ascertained that cook is in a good humor. Even the lady of the house is informed very plainly that after her morning visit she is not expected to disturb the quiet of the lower regions. The trap is always missing from the kitchen sink, and things run into the drain which should never go there; the valve itself disappears among the ashes, and is carried away by the dust-cart, together with the stoppers and sauce bottles, the heads of pepper castors, jam pots, and half-burnt coals. Indeed, one might think that the cook had a personal interest in the dustman, and wished to bestow as many useful articles upon him as possible; or perhaps her benevolent feelings are stirred by some tale of the poor sorters in the cinder yards, to whom these things are perquisites, and she would be charitable by proxy. She has a kind heart for all sorts of tramps, and frequently has her fortune told. The woman whose babies seem endowed with a perpetual youth, the man who sells pencils, the various folk who eke out a precarious livelihood by hawking mittens, combs, and pen-wipers, find in her a sympathetic patron, and draw from her large supplies of her master's bread and meat. A carrier, whose pony was more sleek and well-fed than carriers' ponies often are, confessed on one occasion that he obtained from the tramps in the neighborhood their stores of crusts at 1s. a peck. "Sometimes I am almost inclined to pick out the pieces of cheese and meat, but Jack here eats it all up as sweet as can be, and his coat's like satin."—*English Paper.*

THE EYES OF DEEP-SEA ANIMALS.

It is known that, in many nocturnal animals, the eyes are comparatively large—*e.g.*, the owl, the cat, the dormouse; such are properly twilight animals, their greatest activity is not in the dark night, but in the evening or morning twilight, or in moonlight, and the size of their organs of vision compensates to some extent the weakness of the light in which they move.

It is otherwise with animals who really live without light, under the earth, or in dark cavities, in these the eyes are dispensed with, as useless organs—being, it may be, present in position, but not developed, wanting essential parts, and so not acting. The best-known example is the mole, in which the eyes are mostly (or in Southern European and the Japanese species wholly) covered by the hardened outer skin; as occurs also in the blind rat of South Eastern Europe (*Spalax typhlus*). The blind animals of caverns are also known, such as the Proteus, of the Adelsberg, and various beetles, grasshoppers, spiders, woodlice, and snakes, in which the eyes are defective, wanting especially the black pigment.

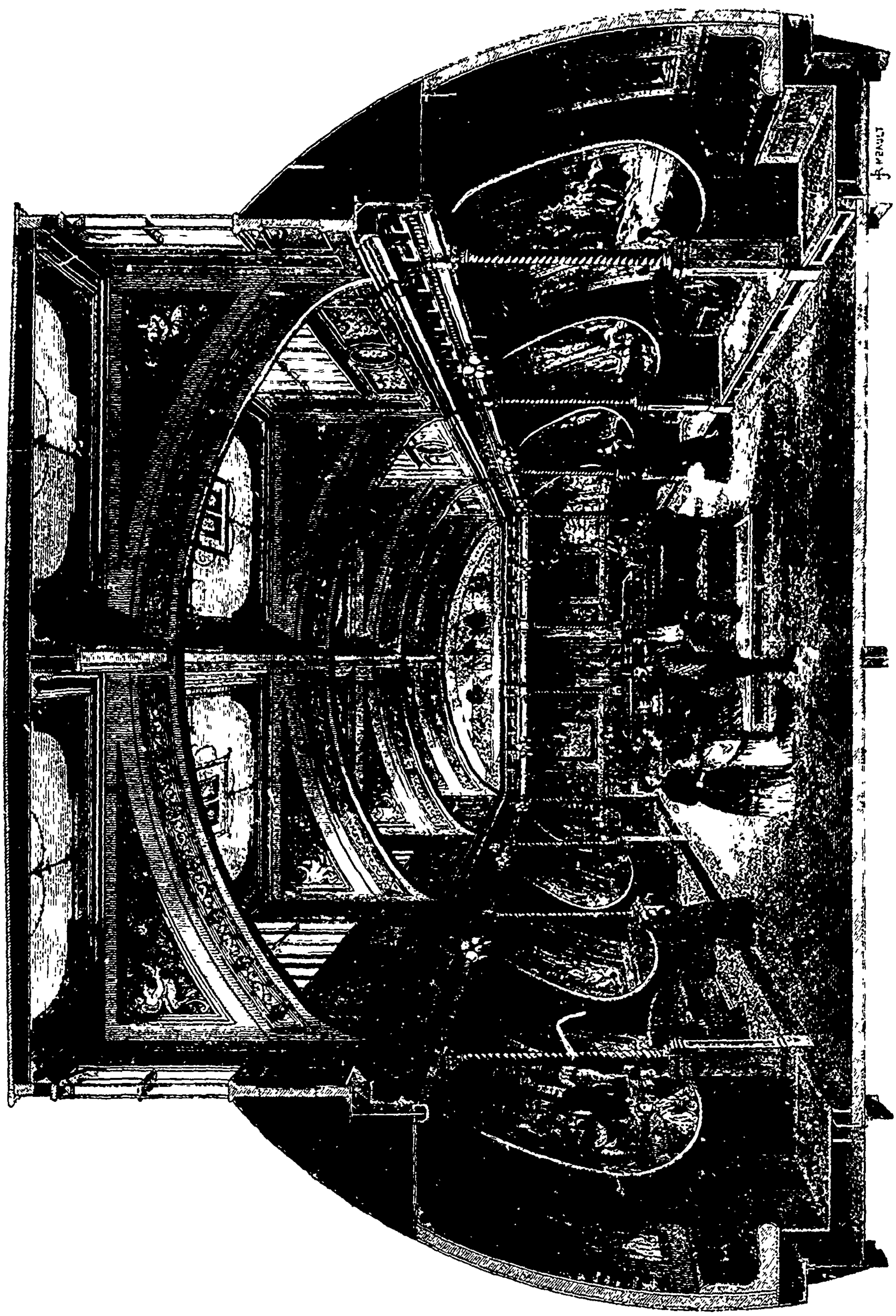
Recent investigations have shown that animals live at great depths in the sea, where the light must be very weak, or may not penetrate at all; and it is interesting to know what features are here presented in the eyes. We have long known of marine animals, especially fishes, in these parts which are like the twilight animals. Risso, the eminent naturalist of Nizza, fixed upon large eyes as one of the characteristic features of fish species from great depth, and he instanced the species Lomatemus, Alepocephalus, Polyprion, Tetragonurus, Mora, and Lepidolepru-, all of which have uncommonly large eyes. Delaroche, in Iviza, confirmed these observations for the most part. Among crustaceans, too, we meet with such large-eyed inhabitants of the deep. A very notable example is the *Thaumops pellucida*, a transparent animal of the order of Amphipoda, about 84mm. in length, while the eyes occupy 20mm. It was recently discovered by M. Willemoes-Suhm, of the *Challenger* expedition, in the Atlantic. Even there, at depths of 1,000 to 2,200 fathoms, was found also a new species of crustacean, Enathophausia, belonging to the order of Stomapoda, distinguished by multiplication of the eyes, having a second pair in addition to the normal.

But crustaceans with eyes defective or absent, corresponding to the subterranean and cavern animals, are also to be found in the depths of the sea. A species (Nephropsis) was taken by Mr. James Mason, in the Indian Ocean, at a depth of 200 to 300 fathoms, somewhat like the *Nephrops Norvegicus*, and which had no eyes; and now, again, Prof. Thompson, of the *Challenger* expedition, has met with other crustacea, allied to lobsters, but without eyes—*Astacus Zaleucus* and *Willemasia crucifera*—in the West Indies, at a depth of only 450 fathoms (in the latter the eye-stalks also wanting), and a second variety of the same species, also in the Atlantic Ocean, at a depth of 1,900 fathoms.

There appear to be present at the same depth both large-eyed and eyeless animals, just as in many caverns we may find together animals with and animals without eyes—*e.g.*, in a brook in the Falkenstein cavern in the Swabian Alps, are to be found an eyeless Hydropia and an Ancylus furnished with eyes, where it is not easy to see the meaning of the absence of eyes.

Mr. Barnum is having an air-ship built of papier-mache. It is divided into two compartments—the upper being light and capable of expansion; the lower heavy and strong. It is intended to utilise compressed air by way of ballast, a portion being allowed to expand when the aeronaut wishes to ascend. An engine is to be carried which will work an air-compressing pump, and also rotate a shaft carrying a propeller.

A car is now in use on one of the French railroads to which the Bessemer steamer system has been applied. The car is hung on elastic springs, and the motion while travelling is said to be almost imperceptible.



THE CHANNEL STEAMSHIP "BESSEMER."—SECTION OF SUSPENDED SALOON.