steam is one of the principal advantages of the invention, in addition to the saving effected in repair and care.

In Fig. 3, our artist has depicted the application of the pulsometer on shipboard, showing a double arrangement whereby it may be used for freeing the ship from bilge, or for drawing sea water, in case of fire or to wash decks. A shows the bottom of the suction pipe near the keelson, fitted with a suitable rose nozzle. This, provided with proper valves, connects with the pump and thence overboard at C. At B water is drawn in through suitable adjustment of the valves and carried to the coil of hose represented. The arrangement is simple and, doubtless, very convenient and effective.

Another application is to the locomotive: the small space required by the machine rendering it easily located and thus convenient for filling the tender from roadside streams, in cases of necessity. In addition to these instances, the pulsometer, it is claimed, may be employed for pumping deep wells, being suspended by a chain or rope, and lowered as the work progresses; for removing water from foundations, as we are informed that it will raise fluid containing fifty per cent of sand or mud; as a working meter, as, by knowing the exact capacity of the working chamber and counting the pulsations, the quantity of liquid moved at any time may be determined; and in fine, through its absence of complicated parts, freedom from requirements of oiling, packing, and constant supervision, for a multiplicity of other uses which circumstances will suggest.

The device, which is covered by some thirty patents, is the invention of Mr. C. Henry Hall. It may be seen, and other information obtained, at No. 20 Cortlandt street, in this city, or at the manufactory of C. H. Hall & Co., corner Hudson and Sussex streets, Jersey City, N. J.

Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year	$3 00
One copy, six months	1 50
CLUB RATES { Ten copies, one year, each $2 50	25 00
Over ten copies, same rate, each	2 50

VOL. XXIX., No. 9 . . [NEW SERIES.] *Twenty-eighth Year.*

NEW YORK, SATURDAY, AUGUST 30, 1873.

Contents:

(Illustrated articles are marked with an asterisk.)

THE "GRANGES" AND THEIR OBJECT.

The agriculturist is, from the nature of his pursuit, necessarily isolated; and the greater the scale upon which his operations are conducted, the wider is he separated from the communities in which his market must be found. While thus compelled not only to raise but transport his produce to the consumer, at an expense which materially diminishes his profits, he, on the other hand, also labors under the additional disadvantage of being far removed from his immediate sources of supply; hence he is obliged either to purchase his necessaries of life at an augmented cost of importation, or else submit to the often extortionate exactions of agents and middle men.

It was a fact, evident to every thinking observer, that the state of affairs which existed in the agricultural districts of the west during last fall, resulting in the burning of corn as fuel rather than pay the high rates demanded for its transportation to eastern markets, was such as to necessitate speedy means of relief; while it lead many to the thought that, if reform could not be effected through individual effort, it might be gained by aggregation. To these causes may be attributed the very rapid spread of an organization, the object of which is—setting aside all political construction, w ich is beyond our province—to bring the farmer into direct relations with the manufacturer and capitalist; and at the same time, by the agency of association, to improve his intellectual and social, as well as financial, condition. The system of granges, as they are termed, originated in 1867; but on being broached to farmers, it was regarded at the time with suspicion and virtually discountenanced. Up to the beginning of 1871, but 125 societies had been formed; but from the autumn of 1872, the plan has grown in popularity to such an extent that there are now over five thousand granges, aggregating 300,000 members; while it is estimated that fully 8,000 will have been organized before the close of the present year. The order of so-called Patrons of Husbandry is modeled something on the Masonic principle, so far as secrecy and the observance of a ritual is concerned, the object of ceremonial restriction being principally, however, to excite an interest and engender a more fraternal feeling among individuals. The National Grange in Washington grants dispensations to form other lodges, and the masters of the latter, when a certain number are organized in a State, constitute a State Grange. The last body elects its own master, who is a member of the National Grange or governing authority. Both sexes are eligible to membership, and a certain amount of internal discipline is maintained.

These societies deal directly with producers, buying their supplies in quantities and paying cash. Contracts are made by agents with manufacturers to furnish various articles at the lowest price attainable. A list of parties thus agreeing is sent to every grange. If a farmer requires, for example, a reaper, a sewing machine, or a piano, instead of buying it from a middleman, he notifies the master of his grange, to whom he pays a stipulated price. An order from the official to the maker procures the desired article, and the same process is gone through with for anything else that a member may need. Necessarily, manufacturers are willing to sell to the granges; and in some cases, we learn, are satisfied to do an exclusive business with them. On their part, they save agents' commissions and send their wares direct from factory to depot for a certain cash profit. There are no vexatious delays, time sales, nor bad debts to distribute, perhaps, among the bills of other customers.

The cost of buying being lessened, the organization has yet to reduce that of selling. At present, and indeed for some period past, the attitude of many of the Western railway corporations and the farmers has been open hostility. The former refuse to reduce their freight charges, and the latter, except where compelled by circumstances, decline to pay them. Of course, politics are brought in, which add to the asperity of the war. The farmers point to the goods of the manufacturer traveling from terminus to terminus at charges far below those demanded for the transportation of the crops, and ask an equalization of expense, decrying the carrying of the wares of one man at rates less than that required for the produce of another. The railroads, on the contrary, assert that it is cheaper for them to transport goods in unbroken bulk from one end of their main lines to the other, shipping and unloading at points where facilities exist for the purpose, than to gather single individual crops from sparsely scattered intermediate stations.

Although no particular compromise has been suggested, the policy of the granges is toward negotiation and diplomacy rather than a continuation of the difficulty, toward securing as advantageous terms as possible from opposing capital rather than undergoing the losses of open rupture. The system, so far as its fundamental principles are concerned, is of material benefit to the farmer; but how far it will stand the test to which time will subject it, it is hardly possible to predict. It is not coöperation, nor are its supplies derived from establishments in the nature of coöperative stores. Briefly summed up, its object is to break away the barriers encompassing the farmer, which are the natural consequence of his isolation, and to bring him at least to a level, so far as the advantages of trade and social intercourse are concerned, with men of other callings.

THE FLOWING OIL WELLS OF PENNSYLVANIA—GREAT DECLINE IN THE PRICE OF OIL.

Within the past few weeks, a new section of the Pennsylvania oil region has been tapped by enterprising well drillers, and their labors have been rewarded by the opening of flowing fountains of the unctuous commodity. So prodigious has been the flow of oil that the proprietors, so it is reported, have scarcely been able to provide barrels and tanks fast enough to catch the liquid as it spurts from the pipes, and considerable quantities have run to waste.

The result of these new petroleum supplies is the overstocking of the market and the decline in price to the insignificant sum of 75 cents per barrel, delivered on the cars near the wells. At this figure the oil is almost given away. This is a condition that, probably, cannot long continue, and the price will undoubtedly soon rise again. But the depression is likely to prove very disastrous to large numbers of honest and industrious oil pumpers, who, from their wells furnishing ten or twenty barrels of oil per day (working night and day, Sundays included), were just able to make a living, and give employment to their hardworking assistants. Hundreds of these oil dealers will, we fear, be made bankrupt, their pipes and engines sold for old iron, and their families brought to suffering.

The new flowing wells are in Butler county, Pa., a considerable distance south of Oil City. The new oil region is supposed to be quite extensive. The opening of every new section is the signal for the formation of a new city. The Starr farm, near Grease City, is at this moment the most highly favored by the caprices of petroleum fortune. One well, here located, has been flowing over a thousand barrels of oil *per diem* for more than a fortnight, and several others in the immediate vicinity are regularly delivering five and six hundred barrels daily. Large numbers of new wells are being bored. Already a new town is in existence on this farm, having its hotels, boarding houses, livery stables and rum shops. Seventeen of the latter were in full blast within ten days after the oil began to flow.

The principal use of petroleum at the present time is in the form of illuminating oil. Various attempts have been made to employ it as a substitute for bituminous coal in the manufacture of illuminating gas; and if this could be accomplished with economic advantage, the demand for crude petroleum would soon be equal to the supply, and steady, remunerative prices might always be expected. Some of the difficulties connected with the conversion of petroleum into illuminating gas are suggested on another page. The subject is well worthy of study, and we hope that some one will be able to solve the problem.

The discovery of new uses to which this abundant article can be put likewise presents itself as an excellent subject for research.

The employment of petroleum as a fuel, in lieu of coal, especially for use on steam vessels, has been repeatedly attempted, but without economical success. Weight for weight, petroleum yields fifty per cent more heat than coal. In markets where coal is worth $6 a tun, petroleum must be supplied at 3½ cents a gallon or $1 a barrel in order to compete, as a fuel, with coal.

THE STUDY OF MATHEMATICS.

We have frequently advised our readers who are deficient in a mathematical education to devote some time to the study of this science. It is scarcely necessary for us to advance any arguments in support of this advice. The statement that "knowledge is power" is always true, with certain limitations, and especially true with regard to the power which it puts into the mechanic's hands.

We have seen men who, in spite of strong efforts, had labored in vain from a lack of favoring circumstances. Not knowing how to study, and having no one to show them, all their time has been thrown away. Nothing can be equal in value to the efforts of a good teacher, in smoothing the path of the pupil; but perhaps a few general hints on how to study may do some good.

We suppose that our reader is thoroughly acquainted with arithmetic or the science of numbers, and that he is ready to commence the study of algebra, which may be called the generalization of arithmetic, operations being performed on general quantities, producing results that are general in their nature. If the student will fairly master this idea at the outset, it will be of great value to him in his future studies. Many a young man has gone entirely through a treatise on algebra without really understanding the purpose of his pursuit.

We say that the product of 4 multiplied by 6 is 24. Here we have two factors and a product. Now let us see if we can form a perfectly general expression of this nature. In this case, we would say that the product of two quantities is equal to a third quantity, and the next thing to do will be to represent this statement by an algebraic expression. To do this, let us represent the first quantity by a, the second by b, and the product by c. Then the algebraic expression of the statement given above will be $a \times b = c$, and the statement is called the translation of the algebraic expression. Simple as this may appear, we have seen many students who professed to be well acquainted with algebra, who were unable to translate the most elementary expressions. The reader will doubtless see at once the value of this kind of practice. Since algebra is a process of generalization, or, in other words, since the results obtained are perfectly general in their nature, it is necessary to be able to translate these expressions and interpret the results. How unmeaning an algebraic expression appears to those who are not familiar with the subject! But, on the contrary, how much is conveyed by a few symbols to those who hold the key to the translation! Let the young student, then, make himself expert in the translation of algebraic expressions at the commencement of his course of study.

A teacher of great experience once told us that a very common answer to his question to a student: "Why is this so?" is: "The book says so, in such a place." An answer of this kind shows an utter want of appreciation of the nature of the study. Algebra is eminently a rational science, and the reason why can be given for any one of its propositions. The student should exercise himself in finding out the reason why, in any particular case, and should receive no statement in the book on trust. To say that there is such a rule without being able to give the reason for the rule is evidence of learning merely by rote, a method applicable to some branches of study but wholly out of place in this pursuit. A rule is merely the translation of a general formula, which formula has been established by exact reasoning. All the arguments must rest on some basis; so the principles of mathematical science are based on a few simple propositions, or axioms, which cannot be demonstrated and can scarcely be denied. These axioms being admitted, various propositions are established, the axioms being used as a starting point. The student can then have a sure test, as to the truth or falsity of any statement made by the book, by tracing it back to its original source.

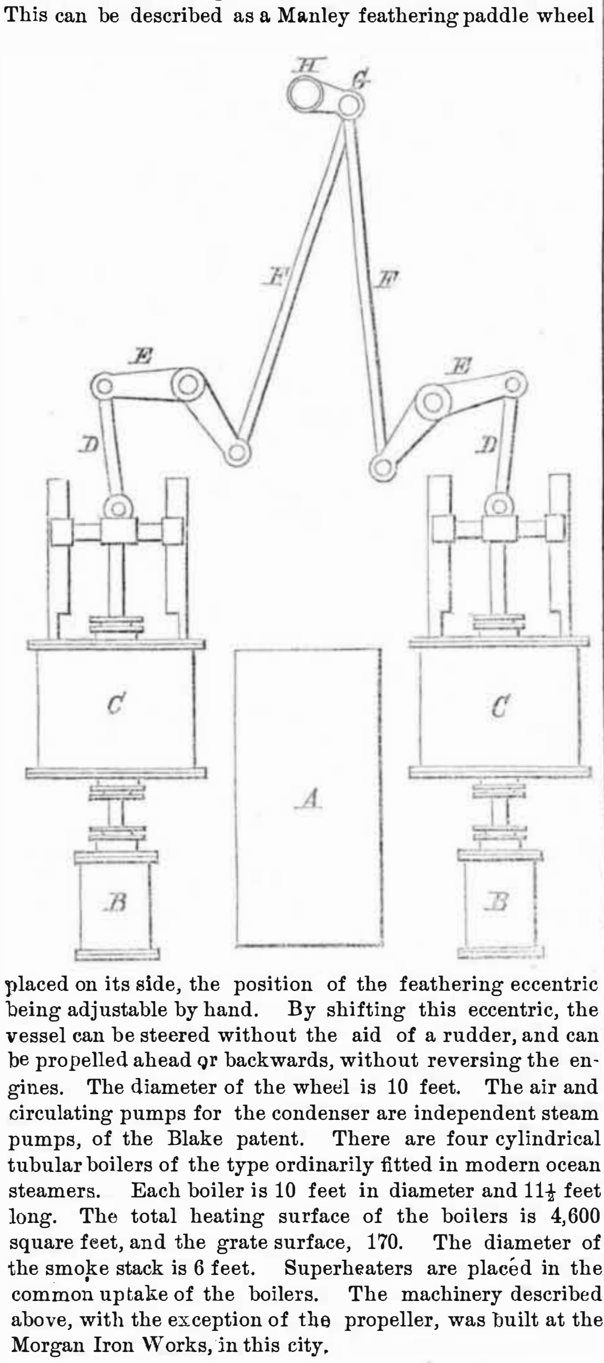
We frequently receive questions from correspondents who ask for rules that can be worked out by arithmetic, as they do not understand algebra. Frequently, as no data are sent, the question could not be answered without the use of algebra. But as the correspondent does not understand how to use a formula, the translation is sent, and he has only to apply the data. So, after all, we are using an algebraic formula in answering his question, merely putting it into a shape in which he can use it. This is quite sufficient to show the general nature of the science. We feel convinced, from the many communications we have received on the subject of a mathematical education, that our present remarks are timely, and we shall be amply repaid if they prove of any assistance to the young student. We do not mean for him to rest satisfied when he has finished the study of algebra; but our hints on this subject will apply with equal force to any other branch of mathematics.

It does not matter so much what text book the student uses as how he uses it; and as most mathematical works are written with the expectation that they will be interpreted by teachers, our remarks may not come amiss to those who are obliged to study without assistance from an instructor.

We shall be happy at all times to aid the young student in his difficulties, and hope that those who are in need of assistance will apply to us freely. We shall, from time to time, give the solution of simple problems, illustrating the value and use of a right understanding of mathematics and mechanical principles.

ENGINES OF ADMIRAL PORTER'S TORPEDO BOAT.

In a recent number of the SCIENTIFIC AMERICAN, we gave an illustration of this vessel, and we now present a sketch, showing the general arrangement of the engines, which are quite novel in design. The engines are of the compound variety, with four cylinders, the condenser, A, being placed between them. There are two high pressure cylinders, B, diameter 20 inches, stroke 30 inches, and two low pressure cylinders, C, with a diameter of 38 inches and a stroke of 30 inches. The low pressure cylinders are jacketed. Short connecting rods, D, from the crossheads are attached to two bell crank levers, E, which have a throw of 27 inches. The crank connecting rods, F, are attached to the other ends of these bell crank levers, and to a common pin in the driving crank, G, which latter crank has a throw of 15 inches. The valves (not shown in the sketch) are on top of the cylinders, and are operated by eccentrics working on an intermediate shaft which is actuated by levers from the crossheads. No links are fitted to the valve gear of these engines, as the revolution always takes place in one direction, whether the ship is going ahead or backward. It will be observed that the propeller shaft, H, is vertical, the wheel employed being what is known as the Fowler patent. This can be described as a Manley feathering paddle wheel



placed on its side, the position of the feathering eccentric being adjustable by hand. By shifting this eccentric, the vessel can be steered without the aid of a rudder, and can be propelled ahead or backwards, without reversing the engines. The diameter of the wheel is 10 feet. The air and circulating pumps for the condenser are independent steam pumps, of the Blake patent. There are four cylindrical tubular boilers of the type ordinarily fitted in modern ocean steamers. Each boiler is 10 feet in diameter and 11½ feet long. The total heating surface of the boilers is 4,600 square feet, and the grate surface, 170. The diameter of the smoke stack is 6 feet. Superheaters are placed in the common uptake of the boilers. The machinery described above, with the exception of the propeller, was built at the Morgan Iron Works, in this city.

THE SUN'S DISTANCE AND HOW IT IS MEASURED.

One of the simplest problems in applied trigonometry is to find the hight of an inaccessible object. The solution involves the measurement of a baseline and the angles formed on it by two lines connecting its extremities with the object whose elevation is to be found. For example, suppose the object to be a balloon. If at the same moment two persons, in line with the balloon and a considerable distance apart, make a note of its angle of elevation, the angles thus obtained, with the distance between the observers, are all the data required for calculating the hight of the balloon above the earth. In like manner, if two observers, say, one at Washington and the other at Lima, or one at Paris and the other at the Cape of Good Hope, observe the position of the moon's center at the same moment, they will have two angles of a triangle, which, with the included side—the distance between the observers,—will enable them to determine the length of the remaining sides of the triangle, that is, the distance between either station and the moon. In this case, the triangle is extremely long and narrow, the longer base line mentioned giving an angle at the moon of only about a degree and a half.

It is obvious that an object much farther off than the moon would give, with any base line obtainable on the earth, an angle too small for direct measurement. In the case of sun, for instance, the distance is so great that the nicest observation fails to show any measurable difference in his position, whether he is viewed from one or another part of the earth's surface. The determination of his distance must therefore be by other means than by direct triangulation.

Several ingenious attempts were made by ancient astronomers to solve this problem of the sun's distance indirectly, but the limits of error by their method were so wide that the results obtained by them had no value even as approximations. Indeed it was not until Kepler discovered the proportions of the solar system that it became possible to attack the problem with any hope of success. As soon, however, as Kepler's third law made all the distances of all the system calculable as soon as one was exactly known, it was clear that, if the distance from the earth to one of the nearer planets, say Mars or Venus, could be found, then a simple proportion would give the distance of the sun.

Mars was the first planet to be studied for this purpose. Venus approaches nearer to the earth; but as her orbit lies within that of the earth, her position during her periods of conjunction is unfavorable for observation, save at remote intervals when she happens to be exactly in line with the the sun's disk, that is, during her transits. Of these more hereafter. Since Mars, when nearest the earth, is still too far away to be reached by direct triangulation—that is, so far that two lines connecting the extremities of the longest base line to be had on the earth with the planet's center would be so nearly parallel that the angle of their convergence could not be directly measured—it is obviously necessary to devise some other means of discovering the value of that important angle. Omitting all but the fundamental elements of the problem, the plan adopted may be roughly illustrated as follows: Hold a small object, say a pencil, steadily at arm's length and note the spot on the wall which the pencil point covers when looked at with the right eye, the left being closed. Now close the right eye and look at the pencil point with the left eye. Its position is shifted to the right, more or less according to the distance of the pencil from the eye and from the wall. The amount of this shifting, in angular measurement, may be called the pencil's parallax.

Suppose that, instead of being held between the eye and a wall, the pencil is placed before the moon at such a distance from the face that, when looked at with the right eye, its point covers the left horn of the moon, and, when seen with the left eye, the right horn. We may now imagine two similar triangles: one having for its base the distance between the eyes, and for its sides two lines proceeding from the eyes and meeting at the pencil point, the other formed by the prolongation of the same lines to the opposite sides of the moon's disk. The measure of the vertical angle of the triangle standing on the moon's diameter is the portion of the great circle of the heavens covered by the moon, that is about half a degree. The vertical angle of the triangle having for its base the distance between the eyes is the same; hence the remaining sides of the triangle—that is, the distance of the pencil from either eye—can be determined by a simple process of calculation.

Precisely the same principles are involved in the determination of the distance of a heavenly body like Mars, the displacement of the planet, as seen from two distant observatories, being measured with reference to some star lying as nearly as possible in the same direction. (Since the distance of a star is so extremely great that its position is not appreciably altered by any difference in points of view possible on the surface of the earth—in other words, since the star has no parallax—it answers perfectly as a fixed point of comparison.) As soon as the distance of the planet has been calculated, the distance of the sun can be determined by an application of Kepler's third law. Kepler made the calculation on the basis of Tycho Brahe's observations of Mars; but owing to the rudeness of those observations, he could only say that the sun's parallax could not be greater than one sixtieth of a degree (1′) which would make his distance not *less* than thirteen and a half million miles.

Subsequent observations of greater exactness enabled Cassini to calculate that the sun's parallax could not exceed ten seconds of arc (10″) and he was confident that it was not greater than 9·5″, corresponding with a distance not less than 85,500,000 miles. The establishment of more widely separated points of observation, and the immense improvement made of late years in the construction of astronomical instruments, have enabled modern observers to make great improvements on these figures, which will be noticed directly. In the meantime, however, the transits of Venus in 1761 and 1769 furnished data for another and entirely different set of calculations.

The importance of the transits of Venus hinges on the fact that at such times the planet appears as a black spot on the sun's disk, so that her position can be observed with great exactness. The conditions which serve to complicate the problem are too numerous and complex to be taken into account here. The apparent position of the planet on the sun's face at any given moment of her transit necessarily depends on the position of the observer. The amount of such displacement is the essential term for calculating the distance of the planet, and from that the distance of the sun.

The observations made during the transit of 1761 were interpreted as giving a solar parallax of 8·65″, corresponding to a mean distance of about 94,500,000 miles. More elaborate preparations were made for the observation of the transit of 1769; but the conditions were less favorable, the observers were unprepared to meet a grave difficulty which arose, and the results were exceedingly discordant. Some made the sun's distance nearly 109,000,000 miles, others less than 88,000,000. About fifty years ago, Encke re-examined the observations made on both transits and, combining results, deduced the distance 95,174,000 miles—an estimate which was accepted as the best that could be hoped for until the transit of 1874 should furnish data for a new determination. It could not hold its ground, however, in the light of modern science.

From a study of the perturbations of the moon depending on the position of the sun, Laplace had deduced a solar parallax closely corresponding with that subsequently obtained by Encke from the transits of Venus. But in 1854 Hausen applied the same method to a larger number of more exact observations, and obtained 91,650,000 miles for the sun's distance.

By another method, depending on the apparent motions of the sun, Leverrier calculated a solar distance of 91,330,000 miles. Mr. Stone, of Cambridge, Eng., discovered a numerical error in Leverrier's work, and, on correcting it, made the sun's distance 91,739,000 miles. By the same method, our own Professor Newcomb obtains 92,500,000 miles. Foucault, by an experimental study of light, obtained results which would make the sun's distance 91,400,000 miles. Applying improved methods to the study of Mars, several astronomers, including Newcomb, Stone, and Winnecke, obtained, between 1860 and 1864, slightly varying figures approximating 92,000,000. It was clear that Encke's estimate was too great. Thereupon the observations of 1769 were subjected to another scrutiny with results so clearly confirming the later and smaller estimates that the distance, 92,000,000 miles—with a margin of possible error of 500,000 miles—was provisionally adopted. The finer instrumental and other appliances, which will be brought to bear on the transits of 1874 and 1882, will no doubt establish an exacter estimate, which it may take centuries to improve upon.

SCIENTIFIC AND PRACTICAL INFORMATION.

NEW ROUTE FROM NEW YORK TO LONDON.

A quicker route from New York to London is suggested, to wit: By rail to Shippegan, on the Gulf of St. Lawrence, thence across the Gulf by steamer to St. George's Harbor, Newfoundland, thence by rail to St. John's, thence by steamer to Valencia, Ireland, thence by rail to St. George's Channel and by steamer to England. The time of this route can be reduced to seven days three hours, the longest water steaming being 4 days, to wit, St. John's to Valencia, 1,600 miles. At the present time, from 10 to 12 days is occupied by the fastest steamers in sailing from New York to Liverpool.

POISONOUS COBALT COMPOUNDS.

According to some experiments of Siegen, the compounds of cobalt are to be reckoned among poisons. This savant experimented with the nitrate and chloride of cobalt, and found that one sixth of a grain of either substance would kill a frog in half an hour, and five grains killed a strong rabbit weighing over 3 lbs. in three hours. The poison seems to act directly upon the muscles of the heart. A frog was poisoned whose heart had been previously exposed, and its contractions became from 50 to 25 per cent less frequent; and after five minutes it stopped, and mechanical scratching failed to produce any farther contractions. With rabbits 1·66 grains produced a strong dyspnœa, and the pulse fell from 178 to 128 per minute.

POWER OF EXPLOSIVES.

Some experiments have been made recently in a German iron mine at Hamm, to ascertain the relative efficiency of powder and some of the nitro-glycerin compounds for blasting purposes. The following were the results obtained:

Ordinary saltpeter gunpowder, 1 unit of force; extra best powder, with excess of saltpeter and cherry tree charcoal, made by L. Ritter at Hamm, 3 units; dualin, obtained from Herr Dittmar, lieutenant of artillery, Charlottenburg, 5 units; lithofracteur, from Krebs & Co., Deutz, 5 units; colonia powder (a sort of powder saturated with 30 to 35 per cent nitro-glycerin) 5 to 6 units; dynamite, 6 to 7 units. It will be seen that dynamite far exceeds the others in power, and its use is displacing theirs in German mines.

THE TRANSATLANTIC CABLE AND PLANET NO. 131.

An example of the free transmission of telegraphic dispatches relating to astronomical discoveries was presented on the occasion of the last new planet (No. 131), discovered at Washington on May 26 and observed at Marseilles on May 27 of the present year. The news was received by Atlantic cable and telegraphed from Paris to Marseilles in the following cabalistic terms: "Planet, sixteen, fourteen, south, twenty-one, eighteen, movement, right, west, eleventh." This, being interpreted, means: "A planet has been discovered, of which the right ascension is 16 h. 14 m., and the declination, southerly, 21° 18′: its movement is directly toward the west, and it is of about the eleventh magnitude."

It is an odd coincidence that the first planet discovered in America (during the year 1854) was No. 31, so that this last new comer, No. 131, also first noted in this country, is the hundredth found since.

TO REMOVE PAINT.—Chloroform will remove paint from a garment or elsewhere, when benzol or bisulphide of carbon fails.