fit into a recess, so that the contact between the abutment and cylinder is always maintained. The reversing gear, by which steam is admitted to either port by means of a common D valve, is operated by the hand lever shown.

The most important points in the rotary engine are no clearance and tight joints which, while avoiding friction, are slow to wear. An English contemporary, speaking of the sliding abutment plan, and allowing the abutment to have the same velocity as the piston, says that, in an engine 9 feet 8 inches in diameter, having 86 square inches of piston surface and making 60 revolutions, such an abutment could not completely close until the piston had moved four inches away from it. This four inches represents clearance, which is waste, for in rotaries there is no compression.

In the Myers mechanism, there is no clearance. The abutment is always closed; the instant the piston clears the port, steam enters and immediately exerts its useful effect, and there are no springs, cams, valves, or other devices, save the simple three working parts, to produce this highly important result.

The packing difficulty is a stumbling block for an immense number of rotary engines. In the present machine, the broad bearing surfaces are of metal, face to face. There is no packing at all inside the cylinder, and it only exists in the stuffing boxes about the shaft. So far as the development of friction in the engine is concerned, it might be supposed that the steam, pressing against the broad flukes of the piston, would force the same into too close contact with the cylinder, bending the shaft. Such is evidently not the case, for the steam must enter between the piston and cylinder, so balancing the former at every point, except during the instant it passes the exhaust port, exactly, in fact, as the ordinary slide valve is balanced. Friction and wear are thus prevented. Finally the aggregate friction of the various parts of this machine, as compared with that of the parts of a reciprocating engine (the piston, the rod, the gibs, the crank pin, etc.), is, as is apparent from the very fewness of the working portions, the less.

The operation of the Myers engine is perfectly noiseless; there is no pound or clack whatever, and the 50 horse power machine at the Fair runs and reverses instantly under half a pound pressure of compressed air or steam. The arrangement of pistons, as shown in Fig. 2, forms really a double engine, the pistons being 180° apart, thus ensuring even motion, while it suggests the possibility of any number of engines and pistons being thus combined.

The particular form of engine represented in our engravings, through its prompt reversing and capability of holding the load, is especially adapted as a hoister for mines, elevators, and like uses. It is besides well suited for the working of steering gear, or the driving of propellers in vessels. As it is remarkably compact, occupying a minimum of floor space, it will doubtless prove valuable in establishments where economy of room is an object; and in instances in which, for example, it is desirable to attach a circular saw directly to the shaft.

A word may be added with reference to economy of steam, to point out that the tendency of the pressure within the cylinder is to force the abutment up and so obviate leakage. If the other leakage about the piston edges is prevented, there seems no valid reason why the engine should not be as economical as a reciprocating machine at full stroke. All that is necessary to provide for expansion is to arrange a cut-off at the reversing valve. Of this, however, more hereafter. For the present, we dismiss the subject with the opinion that the engine is of unquestionable merit; and if future tests prove this probable economy of steam, we can predict for it a well deserved success. The inventor is Mr. Edward Myers, and further information regarding the machine may be obtained by addressing the Myers Engine Company, No. 6 Cortlandt street, New York city.

Breathing through the Mouth.

A fact which cannot be too frequently impressed on the mind, says the *Science of Health*, is "that the pernicious habit of breathing through the mouth while sleeping or waking is very hurtful. There are many persons who sleep with the mouth open, and do not know it. They may go to sleep with it closed, and awake with it closed; but if the mouth is dry and parched on waking, it is a sign that it has been open during sleep. Snoring is another sure sign. This habit should be overcome. At all times, except when eating, drinking, or speaking, keep the mouth firmly closed, and breathe through the nostrils, and retire with a firm determination to conquer. The nostrils are the proper breathing apparatus—not the mouth. A man may inhale poisonous gases through the mouth without being aware of it, but not through the nose."

The editor should, in this connection, have directed the attention of his readers to the patent anti-snoring device illustrated in these columns some time ago. By its use, the above troubles are all obviated.

Crystalization of Tin.

A fine crystalization of tin is obtained as follows: A platinum capsule is covered with an outer coating of paraffin or wax, leaving the bottom only uncovered. This capsule is set upon a plate of amalgamated zinc in a porcelain capsule. The platinum is then filled completely full of a dilute and not too acid solution of chloride of tin, while the porcelain is filled with water acidulated with $\frac{1}{20}$ of hydrochloric acid, so that its surface comes in contact with the surface of the liquid in the platinum. A feeble electric current is set up, which reduces the salt of tin. The crystals formed after a few days are well developed. They are washed with water and dried quickly.

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RAPID TRANSIT IN THE CITY OF NEW YORK.

We recently called attention to the appointment of a special committee of the American Society of Civil Engineers, to receive, consider, and report upon the best plans for providing rapid transit in this city. The Committee have held several meetings, and examined a variety of plans; but only a few new ones have been presented.

Mr. Davis proposes a cheap elevated single track railway, of narrow gage, like that used in some of the mining districts of England. Mr. Nolan has a two story iron bridge railway. Mr. De Puy's plan is an iron framework placed over the street, with sidewalk for passengers and railway in the middle. Mr. McGonegal would have an arch of iron over the street, with tracks within the arch. Peter Cooper suggests an elevated railway with endless propelling rope and cars. Mr. Speer presented his chain of flat cars, with little houses and chairs set thereon, forming what he terms a traveling sidewalk. Mr. Schuyler exhibited his canal railway, through private property, estimating the cost at eight to ten millions of dollars from City Hall to Harlem, eight miles. Mr. Church advocated an arcade railway, four tracks, to cost a million and a half per mile. Mr. Gardner urged his elevated railway along the rivers, with warehouses. Our readers are familiar with most of these plans, as they have heretofore been illustrated and described in the SCIENTIFIC AMERICAN.

The Committee, we understand, are not pledged to any particular plan, but are so convinced of the paramount necessity of having some sort of rapid transit road immediately built, that they will recommend a hard times railway, one of the economical plans, believing that the cheaper it is in first cost the more quickly it will be erected.

In the meantime, while the many inventors are planning and the Committee considering, it is gratifying to know that rapid transit in this great city is making real progress. The magnificent line of solid and substantial underground railways on Fourth avenue, between the Grand Central Depot, 42nd street, and Harlem river, 4¼ miles, authorized by the State Legislature of 1872, is now almost completed, and will open for traffic in January next. The continuation of these tracks down town to the southern limit of the city, at the Battery, 4½ miles, by the Broadway Underground Railway Company, was finally authorized by the Legislature, May 10, 1874; and although but a brief time has elapsed, it is believed that the construction will soon begin. These great works, having a total of 8¾ miles in length, built in the strongest manner, under the direct supervision of the most eminent engineers, will form a rapid transit railway of which the citizens of New York may well be proud. Our engineers will do well to lend all possible influence in favor of their early completion. Over these tracks, passengers may be safely conveyed, at high velocity and for low fares. Nothing about these roads will be experimental or uncertain. Their capacity for traffic will be enormous; they will in all respects be adequate, convenient, and satisfactory to the public.

We commence on another page a series of articles descriptive in detail of the Harlem section of the Underground Railway, from which our readers will gain some idea of the magnitude and importance of the work. As the most recent specimen of American railway engineering, the plans are worthy of study, and will undoubtedly command the attention of civil engineers everywhere. Our articles will not only embrace sectional views and dimensions of the tunnels, viaducts, open cuts, and bridges, but will also exhibit the construction of the underground passenger stations and other peculiar features. These papers will possess special interest and value, owing to the many different forms of construction that are involved along the line of the work.

HINTS TO INVENTORS AND CAPITALISTS.

As a general rule, the man who makes an important invention has not the necessary capital to manufacture and place it in the market; hence he is obliged to seek assistance from others, giving up some part of his invention in return for the means of development which was furnished to him. Indeed, many valuable inventions are abandoned before being fully perfected, on account of the poverty of the inventors. It is eminently fitting that capital should lend its aid to intelligence, in cases of this kind, since the original outlay will be more than returned when the public appreciate the value of the new idea. It is not true, however, that every new idea is a good one, and a useless or imperfect invention forms one of the best devourers of money that can well be imagined. There are many capitalists who are ready and anxious to furnish means for the advancement of new projects, if assured they will be useful and profitable; but they have been deceived so often by schemes that promised well, that it is difficult to induce them to listen favorably to anything that is presented. It would seem, then, that there should be some middle ground upon which inventors and capitalists could meet, making and receiving propositions by means of a third party who is well versed in business matters and also fully acquainted with technical details. The capitalist, for instance, although a good business man, generally has not the experience and the technical knowledge necessary to enable him to form a thorough opinion in regard to the value of a mechanical device or process. The inventor, even allowing that he is fully acquainted with all the matters to which his invention relates, can hardly be considered the most suitable person to expatiate upon its merits. There is a trait in human nature that causes most men to have a pretty good opinion of their own ideas, and our readers must have noticed that the inventor of the most worthless article is apt to consider it of as much value to the world as anything that can be desired. In listening to the enthusiastic talk of the inventor, one is apt to be carried away by his remarks, unless he is thoroughly acquainted with the subject. Many inventors, however, before approaching a capitalist, carry their designs to experts and obtain opinions from them. But even with a score of such recommendations, the capitalist will not be safe in investing money to develope a design. Many experts are not as careful as they should be in giving opinions on inventions, and no one, however honest and capable he may be, can assert positively, without a trial, that a new machine will be successful. He can frequently discover fatal defects by simple inspection, but he cannot safely assert that none exist. A little incident, which lately occurred, will illustrate these points more fully. A mechanic had invented a new cut-off, which he asserted would save at least 25 per cent of the fuel, on being attached to any engine that had a plain slide valve. Like many other inventors, he had exhausted his means in obtaining his patent and building one machine; but it had been examined by several engineers, who thought very favorably of it, and expressed these favorable opinions in writing, so he considered that it would not be difficult to obtain what money he needed. After interviewing a few capitalists, he met one who seemed quite favorably impressed. The latter, however, rather distrusting his own judgment in a matter with which he was so little acquainted, sent the inventor to an expert, promising to accept his report as final. The expert was a man who was accustomed to dealing with such matters, and was moreover rather cautious in expressing an opinion in cases in which he could readily discover facts. So he addressed the inventor, somewhat after this manner: "My friend, you say that you have a cut-off which will save 25 per cent of the fuel, and you have also letters from a number of well known engineers, in which they state that they believe the invention will effect this saving. If it really does, it is a valuable device, and I shall not hesitate to recommend the gentleman, who sent you to me, to invest his money. I will propose a plan to you, by which the matter can be definitely settled. There is a plain slide valve engine, near here, that has been running for nearly twelve months, and a careful record has been kept of the coal consumed and the power developed each day. Attach your cut-off to this engine, and let the record be taken for a month."

The attachment was made; and for several days, as the coal account did not seem to diminish, the inventor kept making slight alterations when the machinery was stopped, but without any apparent benefit. After two weeks his fa

miliar face was no longer seen around the premises; and when the month had elapsed, the apparatus was removed and is still on storage, waiting for a claimant.

Many more such examples could be cited, and there are few consulting engineers who have not met with a number of such cases in their experience. But the trial to which this cut-off was subjected was made in the interest of no one, being intended simply to determine the truth in regard to its value.

CHLOROFORM DANGERS.

The death of another patient in the dental chair, while under the influence of chloroform, again attracts public attention to the dangers attending the use of that anæsthetic. This latest accident occurred in Boston, and the opinion of the physicians points to the fact that the lungs of the deceased were affected by consumption, and hence unable to throw off the influence of the volatile spirit. However, the jury impaneled at the coroner's inquest ignore in their verdict the previous condition of the patient, and, while asserting that the death was due directly to the inhalation of the chloroform, add that, owing to our present lack of knowledge regarding the same, its use as an anæsthetic is utterly unjustifiable. They also recommend legislative enactments to prevent its administration.

The distressing effects of sulphuric ether upon a large class of patients, more especially those of extreme nervous temperament, have been the cause of the preference given to chloroform by many physicians. It is argued that the latter anæsthetic is not dangerous so long as the inhaler's heart is not affected, and that its more speedy action in producing insensibility is eminently advantageous in many surgical operations. But these claims in its favor, it must be conceded, are greatly outweighed by the consideration that, while there are repeated instances of death being the direct sequel of the administration of chloroform, there is no record of ether ever having produced fatal results.

It does not appear needed, however, that legislation should interfere to check the use of chloroform, since the growing tendency of the medical profession is in favor of pure ether as a substitute, or else a mixture of chloroform, ether, and alcohol, which, we understand, produces good results without causing the dangerous depressing effect of the chloroform or the nausea of ether. The employment of nitrous oxide in dental surgery is also greatly extending; and since it is both a harmless as well as an agreeable anæsthetic, it possesses peculiar advantages in connection with the rapid operation of removing teeth, or, in fact, with almost any case in which a minute or two of time is ample for the purpose.

As regards the proper treatment of patients who fall into a dangerous syncope while under the influence of chloroform, there is some difference of opinion among physicians. The most recent mode of procedure (which the eminent French surgeon, Dr. Nélaton, not long since deceased, as well as Dr. Sims, of this city, both state to be very efficacious, having in six different instances saved the patient's life) is as follows (we extract it from the *Tribune*). These surgeons had come to the conclusion that death from the inhalation of chloroform was immediately caused by a want of proper determination of blood to the brain. "The want of this stimulant to the brain's action rapidly led to the suspension of other vital organs of the economy. When, therefore, M. Nélaton's patient, upon whom he was operating, suddenly ceased to breathe, he caused his legs and body to be elevated, the head hanging downward. The blood, by specific gravity, tended to the brain. Artificial respiration was kept up, and after a time the patient again began to breathe of his own volition. He was laid back upon the table, and the operation was about to be continued, when it was noticed that he had again ceased to breathe. The same process was gone through with, and again the patient was resuscitated. A third, and even fourth, time he relapsed into the state that would have been death, and each time his breathing was restored by this process. The fifth time he relapsed, the effects of the anæsthetic had almost passed off; and, while the patient was suspended in the air, head downward, and when artificial respiration had just ceased, with the returning regular breathing he asked M Nélaton why they were holding him in that extraordinary position. The operation was finished without further administration of the anæsthetic, and it resulted successfully. In the other cases the patients were resuscitated, the medical men having charge of them testify, by the same process. These cases are considered enough to demonstrate, with a reasonable degree of certainty, the proper treatment to be followed in cases of syncope and approaching death, from the inhalation of chloroform."

MASTERS AND MEN.

Great captains have not always been those best able to plan brilliant campaigns or best able to make the most of the varying vicissitudes of war. But whether great in strategy or not, they have always been men who could get the best work out of their followers: captains whose presence was inspiration, whose commands were prophetic of victory because certain to be carried out.

"Who ever saw such tactics?" grumbled the veterans of Italy, when the young Corsican knocked their enemies right and left with his handful of men, winning victories not so much because of his audacity and military genius, as because his soldiers could be depended on to do what they were sent to do. Then, as afterward, the great secret of his success lay in the unbounded personal devotion he inspired in those by whom his victories were won, a devotion which he took great pains to justify, by honoring faithful service to the utmost.

The great captains of industry have ever been of like disposition. They have succeeded, not because they excelled their rivals as marketmen or financiers, but because they could get more and better work, and trustier service in every way, from the men they employed. The best work wins, other things being equal. This is one of the great lessons so strikingly enforced in Parton's lecture on "Kings of Business," a lecture crammed with illustrations of successful enterprise, drawn very largely from direct study of the operations of American business kings.

At the Cambria Iron Works, where 7,000 men are employed making iron and rails, the President of the company was asked the secret of such a great development of business. The reply was: "We have no secret. *We always try to beat our last batch of rails.*" This persistent endeavor to excel, not others only but themselves, is the master key to the success of many.

Another lesson is that the surest way to turn out uniformly good work is to employ good men and treat them well. Said the manager above quoted, the other day: "We find that the more we do for our men, the better they do for us." In this Saxon sentence, the experience of hundreds of business kings is crystalized. Justice wins justice. The rudest workman will do more honest work gladly for the man who does the fair thing for him and his family, than the hardest driver can get by other means. The wisest selfishness is just if not generous: a lesson which small men never learn.

The country is full of illustrations. We have in mind two establishments of the same sort, within cannon shot of each other, which may stand as types of the extremes of management in this respect.

Half a century or so ago, a sterling business king became controller of a new establishment for mining and manufacturing purposes. The country was new, rough, and unattractive; yet a thriving village soon sprang up, with stores, churches, schools, and all the other accompaniments of a well-to-do and self-respecting community. The men employed were carefully selected, well paid, and fairly treated. The works were eminently successful; their various products soon won an honorable name, not only throughout this country, but abroad; and the brand of the establishment was a guaranty that every article was what it should be.

The king died. The heirs were of the meanly selfish sort, caring only for their immediate income, and taking no interest in the works save to get out of them all that they could with the least trouble to themselves. They lived at a distance, and regarded their employees merely as parts of a great machinery. What they were or how they lived, they did not care. The management of the works was committed to agents, subject to the minutest control from headquarters. Naturally, meanness could command only mean tools, and the character of the directors was soon stamped upon everything connected with the works. Merit ceased to be regarded. The good men whose honest work had contributed to the success of the father soon drifted away, to be replaced by men of lower grade, themselves to be displaced by those yet lower. The strongest claim for service was irretrievable indebtedness to the company, or pliability at the polls, in gratifying the petty political ambition of the managers. Irregular working, strikes, breakdowns, and other business drawbacks became common; and after some years of decadence, the once thriving business collapsed in utter failure. Meantime, the exodus of the honest and saving had depleted the village of all that had made it worth living in. The school degenerated, the church became the playhouse of window-breaking boys, the stores were closed or turned to groggeries, and a low-lived rabble made life miserable in the place of a once respectable community. As this town went down, the adjoining village rose. The owners of the works, round which the village clustered, lived among those they employed, and sought to surround themselves with the best men they could get. Still more: they sought to make their workmen better for being in their employment. Thrift was encouraged, and the unthrifty systematically weeded out. The men were made to understand that they were expected to be better off at the end of each year than at the beginning. Not to be so, accidents excepted, was to hazard their continued employment. Yet the unfortunate, the sick, and the bereaved were looked after with a kindliness that could not be misinterpreted. The wives of the partners—genuine ladies—made it their business to know and visit the women folk of all the employees, winning their confidence and esteem by sisterly service in times of trouble, and aiding them at all times by judicious counsel, or, if need be, with more substantial help.

It is needless to describe the development of a village where the ruling influence bears steadily toward good government, good schools, good society, sobriety, and universal thrift. Floods destroyed and fires laid waste now and again, but help was always ready for the deserving; and though surrounded by colonies of rude miners, colliers, and the like, and largely composed of men of rough employments, the village became and remains a worthy representative of our best manufacturing towns.

It is needless, also, to describe the prosperity of the business by which and for which the town exists. In employments of such a nature that the indifferent or evil-disposed can destroy or waste in five minutes more than he can earn in a day, the advantage of careful, honest, trustworthy, and interested help is enormous. By dealing justly with their men, the rising company gained while their meaner rivals lost, and won a handsome fortune and the lasting esteem of their men whom they had helped to competence and comfortable homes; while the others were hated for the poverty they engendered in their descent from wealth to merited bankruptcy.

That men have been mean, hard, grasping, and ungenerous to their help, and yet have amassed wealth is undeniable, just as generals have won victories with mutinous soldiers; but these cases are relatively rare, and the success so won is not only precarious, but liable to most unexpected reverses. Our great manufacturing establishments have not been built up by such management. As Parton tersely puts it:

"Traverse the world over, search the history of our race in all times; and wherever you find a man truly superior to his fellows, a natural king of men, born to command, you will find him attentive to the interests, and to the feelings, and to the dignity of those who execute his will. If he is not man enough to be so from good feeling, he is man of business enough to do it from policy. If there is any one here who snubs persons dependent upon him, begrudges them their just compensation, cares nothing for their interests or their honor, that man is not naturally a master; he is one by accident only: he belongs, by birth or breeding, or both, to the class of the defeated and the servile. He is merely a beggar on horseback, and perhaps stole the horse."

THE DEVELOPMENT OF SUBTERRANEAN HEAT.

A gentleman engaged in the mining of lead, a Mr. Ewing, of Joplin City, Mo., has written for an explanation of some curious phenomena which have recently occurred in his vicinity. They took place in sinking the shaft of a lead mine. The shaft had been sunk 96 feet, and a drift, located about 16 feet above the bottom of the shaft, had been driven about 40 feet. At the time the work was going on, nothing unusual was experienced; but a short while after, the temperature of that portion of the drift situated about two thirds the distance from its opening into the shaft, along a space of 15 feet, began to augment. It finally rose to 102° Fah., while the temperature at the mouth of the drift and in the body of the mine remained at 60°. The miners, on attempting to cut another drift through that portion of the earth which thus increased in temperature, at right angles to the former, were compelled to stop work on account of the oppressive heat. "In one minute's time after entering the warm space, a person will sweat freely. No bad effects are felt, the lamps burning as freely as on top, and the air being good. In the heated portion of the drift, its walls are covered in spots with a substance in appearance like mold from dampness. It proves, on closer examination, to be a greasy or waxy substance, which at a lower temperature becomes as solid as clay, and resembles tallow and beeswax mixed together. It dissolves readily in water, and dyes cloth yellow."

At the time of receiving the specimens which accompanied the letter, they were quite hard, though friable, and appeared like a hardened, unctuous, greenish-yellow clay. It was evident, from the fact that a change had taken place after the earth in the drift had been exposed to the atmosphere, that we ought to find the results of this change by an analysis of the substance, and thence be able to infer the original bodies out of which it had been formed. It proved to consist of: Silica and clay, 9·499; sesquioxide of iron, 25·170; protoxide of iron, 0 438; sulphuric acid, 31 640; water, 33 030. Total, 99,777, which were probably combined as: Silica and clay, 9·499; protosulphate of iron, 0 918; hydrated persulphate of iron, 72 960; hydrated sesquioxide of iron, 5·880; water, 10 520. Total, 99 777.

These analyses reveal, in a very striking manner, the cause of the remarkable liberation of heat. A large amount of pyrites has existed finely disseminated throughout the earth. On exposure to air and moisture, it has absorbed both with great rapidity. We have no determination at hand, giving the number of thermal units equivalent to the oxidation of one pound of iron pyrites, and the subsequent conversion of the protoxide and sesquioxide of iron into hydrated sulphates; but it must be a large number, as shown by the great elevation of temperature. Although we are not aware of such a phenomenon as this having occurred in sinking a shaft in lead mining, yet similar occurrences are common in coal mines, and have produced many serious accidents. In the great piles of "slack" heaped up around the mouths of the pits of the Lehigh & Wilkesbarre Coal Company, many small pieces of sulphur can be found, produced by sublimation from the decomposing pyrites. It is said that on sinking a pail of water into one of these slack heaps, the water may be made to boil, and cook an egg. The heat thus developed, operating upon the finely divided carbon of pyritous bituminous shales, may at times reach to the hight of rapid combustion.

The subject is one full of interest, and of high importance, as affording one explanation of volcanic action, and of the occurrence of sulphur deposits in connection with these phenomena. It is stated by Lyell that, when moistened iron filings and sulphur are buried in the ground, in the course of a few hours the temperature rises, the ground is swollen by expansion, and finally flames arise, or there is an explosion. By the hypothesis of similar chemical actions on a great scale, certain geologists have endeavored to account for all earthquake and volcanic disturbances. A. R. L.

WE are gratified by receiving a large number of letters, from subscribers to the SCIENTIFIC AMERICAN, approving of the folding, cutting, and pasting of the paper. These features add to the expense of publication; but we believe that our old patrons will influence enough new subscribers to compensate for the extra cost.

THE consumption of coal per train mile on the London and South Western Railway shows an average of only 28·0 pounds, against fully 45 pounds on the eight other principal British lines.