Scientific American,

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

O. D. MUNN. S. H. WALES. A. E. BEACH.

☞ "The American News Co.," Agents, 121 Nassau street, New York.
☞ "The New York News Co.," 8 Spruce street, New York.

☞ Messrs. Sampson, Low, Son & Marston, Crown Building, 185 Fleet street, Trubner & Co., 60 Paternoster Row, and Gordon & Gotch, 121 Holborn Hill, London, are the Agents to receive European subscriptions. Orders sent to them will be promptly attended to.

☞ A. Asher & Co., 20 Unter den Linden, Berlin, Prussia, are Agents for the German States.

VOL. XXIV., NO. 2 . . . [NEW SERIES.] *Twenty-sixth Year.*

NEW YORK, SATURDAY, JANUARY 7, 1871.

Contents:

(Illustrated articles are marked with an asterisk.)

WHERE IS THE LIMIT OF INVENTION?

Let one take up the Patent Office Reports, beginning with the first volume, and pass cursorily through them to the very latest, and he will, if not familiar with the number of inventions which are there recorded, probably be struck with astonishment, and rise with a feeling that after all this struggle for the complete mastery of the physical forces, there must remain very little to be done; that the field must have been worked nearly or quite entirely over, and that scarcely anything, in comparison, can remain for inventive talent to grapple with.

A closer and more rigid examination would, however, correct this mistake. Scrutinizing the character of each invention separately, he would find that by far the greater portion of even those entitled to be called useful, at the date of their devising, can, from the very nature of things, only remain useful till some advance in other departments renders them obsolete, and creates a want for other and entirely different appliances.

Besides this, each important invention is the parent of a large family of minor ones. See how numerous are the inventions which have been born of the application of steam as a motor. Governors, cut-offs, boilers, boiler feeders, high and low-water detectors, low-water alarms, steam whistles, valves, cocks, steam-engine indicators, apparatus for testing the strength of boilers, etc., etc., have been invented, each one of the classes specified or omitted including, we had well-nigh said, countless inventions of greater or less utility.

A discovery of means whereby electricity could be so cheaply employed as to exceed, or even to compete on equal terms with steam, as a motive power, would be inevitably followed by generation after generation of inventions, till the whole civilized world would teem with them. It would take a long time to cull out and count the inventions born of the Morse system of electro-magnetic telegraphy, yet this system is scarcely more than a quarter of a century old. The introduction of insulating cables for submarine telegraphy, and the extension of the system to very long distances, created a demand for more delicate recording apparatus, which, notwithstanding the large number of exquisitely ingenious devices created to supply it, is still unfilled.

"The eye is never satisfied with seeing, nor the ears with hearing." The human mind constantly feels a craving for something more than it possesses. Any creation of inventive genius which appeals to this craving is sure to be received with favor, be it nothing more than a sixpenny toy.

Looking at the progress of invention in this light, it will be seen that instead of approaching its ultimate limit, the field enlarges as we advance. In short, it has no limits. It is infinite as is the capacity of mankind to desire. We are all of us to-day longing for swifter means of travel and communication; for cheaper books; for more extended educational facilities; for more powerful instruments of scientific investigation; for fuller gratification of our tastes in the arts; and we are willing to employ, and keep employed, the creative genius which devotes itself to the supply of these wants.

Every announcement of a new discovery in chemistry or physics, heralds to the world the fact that a new "placer" has been opened, wherein rich veins of ore may perchance be found by the skilled inventor. When "oil was struck" in Pennsylvania, a few years since, who would have dared to predict the extent of the field it opened to inventive genius? No doubt the mechanical devices and chemical processes to which it has given birth may be numbered by thousands, and the improvement in the general welfare of the race resulting therefrom, is simply incalculable.

No, the end is not yet; and it will never come so long as man remains constituted as at present. There are as many chances to win now in invention as there ever were, but it requires now higher qualifications for eminent success. The more inventions multiply the greater the necessity for higher standards of technical education, and the more general diffusion of theoretical as well as practical knowledge.

THE PROFESSION OF THE MECHANICAL OR DYNAMICAL ENGINEER.*

The term "Mechanical Engineer" is a very unsatisfactory one, and its meaning is very indefinite. To some it conveys the idea of practical engineer; another will confine it to the profession of steam engineering, while the courses of study designed to fit young men for the profession of mechanical engineering are variously styled as "Mechanics and Engineering," "Applied Mechanics," "Industrial Mechanics," and "Applied Mathematics."

The necessity for a more accurate defining of the limits of the two great branches of engineering which in the terms "Civil Engineering" and "Mechanical Engineering" have had a very imperfect line of demarkation, has impelled the Sheffield Scientific School of Yale College to apply a new and more definite term, *"Dynamical Engineering,"* to the chair of "Mechanical Engineering," in that institution.

In the inaugural address of Prof. Trowbridge, the reasons for the adoption of this term are given by him as including those we have already stated, and he adds that its indefinite character

arises from the fact that the term *"Mechanical"* is not employed in the sense which it would derive from the word *Mechanics*, as descriptive of a science of mathematically applied principles; but from the more restricted sense in which it is used to designate the work of construction of a machine, and the labors of the artisan or mechanic. It originated in the large machinery establishments, and at first referred especially to the manipulations necessary to produce and combine the material parts of a machine, rather than to the intelligent application of the laws of statics and dynamics, in designing and adapting machinery for the performance of specific work. In the sense derived from the word mechanics as a science, civil engineering is also a mechanical science; the only difference between this and mechanical engineering being that one is based on the principles of *statics*, and the other upon *dynamics*. These considerations would have little importance if the questions involved were merely those of words; but, as before remarked, they involve confusion of ideas, especially in the popular understanding of the subject. It has not always been deemed essential, for instance, that a mechanical engineer should be thoroughly acquainted with the *science* of mechanics, and his calling has been regarded as a trade or an art, rather than as a learned profession; as depending more on knowledge and experience in manipulations, or the labor of the hands and the use of tools, than on the exertions of the intellect.

We are glad that the new term "Dynamical Engineering" has been adopted, and think with Prof. Trowbridge that its singular appropriateness will be generally recognized.

In the address under review Prof. Trowbridge also makes some able remarks upon practical and theoretical instruction:

The practical course ignores books, and the study of the natural sciences. A boy on entering a machine shop is placed at some simple mechanical work, the use of the file, or chipping hammer, or lathe. In two or three years he may acquire experience in finishing the finer parts of machinery.

* * * * * * * * *

If he obtains a position in the drawing or designing room of such an establishment, he may acquire a knowledge of drawing, but his time is absorbed in making tracings and working drawings under the direction of superiors who have no time to impart general instruction in the fundamental principles of the work on which he is engaged. A shop, or machinery establishment is a business establishment, not a school of instruction, and it is rather a favor to young men, to allow them the limited privileges of such information as they may acquire through their own observations and experience.

Such a course may lead to a high degree of skill and excellence in the specialties of one establishment, but even in such a case the knowledge is gained by imitation. New problems even in that specialty—which involve new forms and dimensions—are apt to be discussed and solved by reference to the nearest example or precedent.

The instances of men who have reached an enviable degree of excellence by passing the first years of their training in the workshop are regarded as exceptional, and as resulting from peculiar qualifications of industry and application.

Theoretical knowledge as well as practical is necessary in order to avoid fatal errors. The only resource of practical men who are deficient in such knowledge, in solving new problems, is an actual trial involving expense and risk. On the contrary the young man who begins by a thorough course of theoretical study takes with him into his practice written experiences, deductions, and classifications, with a knowledge of an accumulation of facts which he could not acquire in a lifetime of practice.

The questions connected with the dynamical theories of heat employed as a source of power;—the propulsion of ships by steam, the movement of heavy railway trains, the raising of water, the construction of heavy steam and water-wheel machinery for rolling mills, forges and factories—all involving the movements of heavy masses, and the overcoming of corresponding resistances—are subjects which can be successfully treated only by the most rigid applications of the principles of mechanics.

This is a branch of the profession which no amount of practice alone, can reach. Sooner or later, every one who aspires to become a consulting engineer must devote himself to the study of the laws, theories, rules, and formulæ, which constitute this science.

Strength of materials and the proportions of parts to endure the strains to which they must be subjected are also subjects for the most rigid application of theoretical knowledge.

In the course of study which a young man desiring to enter the profession of Dynamical Engineering should pursue, the art of drawing is considered as of primary importance, though not by any means the most difficult accomplishment to acquire. Next in order is a sound knowledge of pure mathematics; next the science of mechanics, both independent of and in connection with its practical applications; and lastly a thorough knowledge of chemistry, physics, and metallurgy.

The fields of usefulness open to men possessing these qualifications are extensive and increasing, and the indirect benefits to be derived from the training of men in this way to take charge of the industries of the country will be felt in the increased economy of production, and the consequent reduction of cost in all that the necessities, tastes, and luxuries of modern civilization demand.

* Inaugural Address before the Sheffield Scientific School of Yale College, delivered Oct. 5, 1870. By William P. Trowbridge, Professor of Dynamical Engineering. New Haven: Printed by Tuttle, Morehouse & Taylor.

THE MONT CENIS TUNNEL COMPLETED.

The readers of the SCIENTIFIC AMERICAN have been made familiar with the history and progress of this enterprise, which for thirteen years has been looked upon as one of the greatest of modern engineering feats; yet, at this time, a brief recapitulation will not be out of place, as telegraphic dispatches have announced the completion of the work.

It was, we believe, about the year 1830 when the tunnel was first talked of. In 1842, the king of Sardinia agitated the subject, and subsequently, under the encouragement of Count Cavour, its projectors appointed a committee of engineers to make preliminary surveys. In 1857 the work was commenced. At first, only the ordinary excavating tools—the pick, spade, and hand drill—were employed, and the work proceeded very slowly.

In 1861 a perforating machine was set to work on the Italian side, and in 1863, a similar machine was put in operation on the French side. No vertical shafts have been sunk; the work proceeded continuously from both sides till the two cuttings met. The cutting has been somewhat more rapid on the French side than on the Italian side.

The machines used were driven by compressed air, conveyed to them through tubes, and ventilation was also maintained by the aid of machinery. Gunpowder was at first used for blasting; afterwards gun-cotton was employed, and, finally, nitro-glycerin.

In 1862 the French Government agreed to defray half the estimated expense of the cutting (65,000,000 f.), in annual subsidies, provided it should be completed in twenty-five years, at the end of which time, should the tunnel remain unfinished, the French should cease to pay anything further. On the contrary, it was stipulated that if the tunnel was completed in ten years from June 30, 1863, the French should pay the full half of the estimated expenses. As the latter condition has been fulfilled, with two and one half years to spare, the French Government will now be held for its moiety.

The Mont Cenis Tunnel, which is eight miles in length, is the greatest work of its kind ever undertaken, and the success and rapidity with which it has been brought to its early termination is a triumph of engineering second to no other on record.

PAVEMENTS.

Want begets supply. When the public become dissatisfied with what they have, and are fully decided as to what is really needed, nothing is surer, in these days of scientific and mechanical progress, than that somehow, by somebody, the need will be met. The public want better pavements. The public will certainly have them. The old cobble-stone pavements, "the car rattling over the stony street," are soon to be things of the past. What is to be *the* pavement? There is no more promising or more difficult field for inventors than this. The man, or the company, who can answer the question satisfactorily, not only does the world a great service, but opens a mine of wealth. Inventors know this, and rush into the field with almost the same eagerness of competition as wealth-seekers thronged to the gold diggings of California, or to the diamond regions of South Africa. New pavements multiply upon us. "Their name is legion." Each claims to be the pavement *par excellence*, but none has yet impressed the public as just the thing. It is not our purpose to discuss the merits of the different kinds of pavements, nor the claims which the inventors of each may put forth, but to call attention to the requisites of a perfect pavement. We have before alluded to this subject, and we return to it for the reason that those who are working in this direction seem almost invariably to lose sight of some feature indispensable to permanent success. And here a remark or two upon the word success may not be out of place. Success in making large profits through corrupt "jobbists" is one thing; a success in a mechanical, scientific, utilitarian point of view is quite another. In the former sense we have had many successes; in the latter sense, as yet, none. We do not mean to say that we have not pavements possessing some of the essentials, but we do mean to say that there has been no pavement extensively laid for which any close student of the subject will venture to predict universal use, or anything like it, say fifteen or twenty years to come.

Let us seek to enumerate the essentials, and let each inventor consider for himself whether his particular device or combination provides for or meets them.

1st. Durability. Not merely sufficient to withstand a few years' wear in some fashionable avenue, frequented for the most part only by carriages, but sufficient to justify adoption in our most thronged and roughly-used business thoroughfares. It may be claimed, with show of reason, that we may have different varieties of pavement for different localities, but it will certainly be conceded that a pavement for which streets adapted to its endurance must be selected cannot claim to be perfect.

2d. Cheapness. We mean cheapness in the true sense of the term. That is not always the cheapest which costs the least. If there is any matter in which a city may be "penny wise and pound foolish," it is just this matter of pavements. That is truly the cheapest where the purchaser gets the greatest possible return for the expenditure. Viewed with reference to durability alone, other things being considered as equal, that pavement is the cheapest with which it costs the least, interest and repairs included, to keep a street paved, and which exacts the least from teams and vehicles compelled to use it. To illustrate by an extreme: A pavement that would last forever—supposing such a thing possible—would be dear at sixteen dollars per square yard, as compared with an equally agreeable pavement, lasting eight years, at five dollars per square yard; for the interest on the difference of cost would more than renew the pavement every eight years. The pavement, no matter how good, should not exceed in cost our present improved pavements, say five or six, or at most, for the severest streets, like our Broadway, seven or eight dollars per square yard. This, of course, does not include bonuses to jobbing city officials, for a pavement possessing all the requisites would fight its own battles, and ultimately compel its own adoption, and not be under the necessity of buying its way into public favor.

3d. Permanent abundance of material. We say *permanent* abundance, for, no matter how good a pavement may be, constructed of a material the supply of which is limited, or must in a few years become so, such an one cannot be the pavement of the future.

4th. Evenness of surface. This essential hardly needs remark. The jolting, rattling, and rumbling, and wear and tear on horses and vehicles, of our present stone pavements, are nuisances no longer to be borne, and it is marvellous that they have been tolerated so long.

5th. Sure foot-hold for horses. Neither those who own horses nor those who have any sensitiveness to the sufferings of these much-abused and useful animals, will favor a pavement upon which horses are constantly slipping, straining, or falling.

6th. Noiselessness. This follows, of course, from evenness of surface, which must be combined with a certain degree of uniform roughness to meet the 5th requisite—sure foot-hold.

7th. Rapidity of construction, so that the street may be impeded for the shortest possible time. The pavement should be completed at the rate of a block, or nearly so, per day, and each block be thrown open to the public on the day following its construction.

8th. Facility of repairs. For the sake of an illustration, we have supposed a pavement lasting forever; but pavements do *not* last forever. It would seem that a pavement which could be laid with facility ought naturally to be repaired with facility; but this does not follow. Some of our improved pavements cannot be repaired without keeping the block, upon which the repairs are made, closed for days for the repaired portion to harden, and some cannot be *perfectly* repaired at all.

9th. Freedom from dust. That is, freedom from dust arising from the pavement itself, which follows naturally from durability; for dust of the pavement proper is caused by pulverization under attrition of hoofs and wheels, and if a pavement wears slowly it makes but little dust. Freedom from dust arising from droppings of animals, etc., is only attained by sweeping, and the surface should have such a kind of roughness as to be easily swept, possessing no deep crevices, or places for the permanent lodgment of filth.

10th. Dryness. There should be nothing of an absorbent nature in or about a pavement, because moisture absorbed into the pavement renders it subject to the action of frost, and, in a sanitary point of view, certain to become impregnated with impurities, making it both offensive and unhealthy.

We have purposely left out of our enumeration of requisites one frequently mentioned, and by some considered indispensable, viz: facility of taking up for the purpose of repairing or constructing sewers, gas pipes, water pipes, etc. Such facility at the present time is desirable, but for the future it is not indispensable. The subterranean work for cities will ere long conform to the pavements, and be so constructed as to be reached without disturbing them.

It would not be deemed wise to build houses with reference to digging and repairing cellars under them afterwards, and it is but a little better policy to construct streets with reference to tearing them up. We do not pretend to say what material, or combination of materials, or what device, or contrivance for using them, are to meet all the conditions which we have enumerated. The material most abundant, and thus far most extensively used, has been stone. Yet no form of stone pavement has, up to the present time, proved satisfactory. All have been either uneven and noisy, or, if smooth, so slippery as to be at times inconvenient. The most agreeable form of stone roadway extensively used is the form commonly known as the McAdam, or broken stone road. And yet a street paved with broken stone alone would not answer the purpose, for the reason that it is not impervious to water. Yet we venture to suggest—and inventors may take the suggestion for what it is worth—that if broken stone could be held together by some kind of cement of sufficient tenacity and durability to hold the stones in their places till worn out, and render the wood impervious to water, and if a pavement thus composed could be made to meet the requisites of cheapness and rapidity of construction, it would, perhaps, approach very nearly to the requirements of the coming pavement.

A VEIN of block coal, forty-seven feet in thickness, was recently discovered near Alamo, Ind. A company of Pennsylvania capitalists have, it is said, offered one million dollars for it, but have been refused.

AIR LIGHT.

What has become of the air light about which so much was said a few years ago? This light belonged to the class where an oxide is rendered incandescent, and hence powerfully luminous by the heat of a burning jet of mixed gases. Instead of using oxygen and hydrogen, it was proposed to compress illuminating gas into cylinders and to employ atmospheric air also under pressure, but previously superheated. The air contains one part, or 20 per cent, of oxygen, and four parts, or 80 per cent. of nitrogen; hence it would require four or five parts of air to give the requisite quantity of oxygen; that is, to obtain one foot of oxygen, five feet of air would be needed, as four of them would be nitrogen.

It has been proposed to remedy this difficulty by passing the air through water under pressure, and freeing it of a large part of its nitrogen, as that gas is not so soluble in water as oxygen. But this would involve expensive apparatus. If the nitrogen could be prevented from carrying away the heat from the jet at the point of ignition, the air would give us all the heat and light required when burnt in combination with illuminating gas. To prevent the nitrogen from conducting away the heat the air must be previously superheated in furnaces and fed hot to the burner. Some of the locomotives on the New York Central Railroad were at one time supplied with head-lights composed of four compound jets, encircling a small pencil of lime. A current of air and of gas was conveyed to each jet, and by a simple device the air was heated before reaching the jet. The flow of gas was controled by simple regulators and stop-cocks within the lamp. Two gas holders, placed under the engine, communicating with the lamp by a small pipe for each, were constructed to carry two or three times the requirements of a trip. The air was superheated by being passed through the fire-boxes under the boilers without additional cost. The engineer who explained it to us pronounced it a perfect success, but that was several years ago; since then we have heard nothing of it, and so repeat the question: What has become of the air light?

WASTE LIQUORS OF PAPER MILLS.

The American Wood Paper Company at Manayunk, Penn., have introduced an important feature into their works in saving the waste alkali solutions. It is said that eighty-five per cent of the original alkali employed is recovered. The spent liquor is conducted from the pulp boiler into a suitable reservoir, where it is pumped up into evaporating furnaces. These furnaces are constructed according to a patent granted to Messrs. Keen & Burgess in 1865. They are of great length and radiate from the center of a building resembling a locomotive shed, and all communicate with one central chimney. A powerful draft carries the hot gases of combustion over and under the evaporating pans, and the water is thus rapidly carried off. The alkali is finally transferred to the calcining furnaces, where it is brought to a condition suitable for mixing with a fresh portion, preparatory to being used again. In the manufacture of paper from straw the stock is also boiled in caustic soda lye under pressure, and in most establishments the impure black liquor is thrown away. The soda extracts silica and gluten from the straw, and thus forms a very weak and impure soluble glass. It has been proposed by some manufacturers to evaporate the solution and economize the soluble glass and the extra alkali, but the expense of the evaporation has deterred most of the larger establishments from attempting to make the saving. It would be well for such paper manufacturers as deal in large quantities of alkali, to try the Manayunk process described above. If soda were a substance that could be thrown down from a solution by precipitation, it would be an easy matter to save it, but unfortunately there is no reagent with which it can be combined for this purpose, and we are compelled to have recourse to evaporation. The use of the spent alkali for agricultural purposes has been tried, and if potash had been employed instead of soda the results would be favorable where the expense of transportation did not destroy all the profit, but as soda is now considered by many authorities as actually deleterious to the growth of plants, this application of the spent alkali of the paper mills cannot be recommended. The soluble silica would be of great value in agriculture if it could be separated from the alkali, but this separation is not feasible. There is no reason why the lime used in the vats to render the soda ash caustic should not be put upon land, and such a disposition of it is made at many country mills.

If any of our readers can give us additional information on this subject we shall be glad to make room for their communications.

SPIRITUALISM AND SCIENCE.

Two of our correspondents exhibit a commendable desire for information in reference to the movements of tables by invisible spirits, and as one of them appears to have been severely handled by some of the evil kind, we do not wonder that he seeks for an explanation of the phenomenon.

If there is anything established in nature, it is the invariableness of her laws. The laws which regulate the material world are beyond all reach, and the Creator never permits the management of the universe to pass out of his own hands, or to be interfered with by any of his creatures. The moment we deny this, that moment science becomes impossible. For ages the belief obtained that angels and demons were able to control or influence physical laws. As long as such superstition prevailed, scientific progress was impossible. It was only when it was discovered that the laws of the physical universe were fixed and sure that men were encouraged to carry on scientific research, for they then knew for the first time that if they asked for bread they would not receive a stone.

The physicist now knows that to move a table without the aid of muscular or mechanical force requires a suspension of the law of gravitation, and he also knows that the momentary suspension of this law would reduce the whole universe to chaos and destroy the equilibrium of matter. To suppose that any spirits have such power as this is impious and irreverent in the extreme. None but the Divine Spirit can act on matter except through the medium of matter, and to ascribe such power to any of God's creatures, whether in the flesh or out of the flesh, overthrows all that religion and science have taught us. Hence the scientific man never believes in any apparent infraction of the laws of the universe. He knows that the phenomenon observed is due to natural causes, and goes to work to search out the mystery. There are plenty of known causes which have always been in operation, that are quite sufficient to produce all of the genuine results of spiritual manifestation without the necessity of appealing to the supernatural for an explanation, and Dr. Hammond has shown us that there are other causes which explain why honest people may conscientiously believe in the genuineness of all these manifestations.

We have recently given a series of articles on the history of attempts to invent a perpetual motion. The physicist is absolutely certain that a perpetual motion *accomplishing work* is an impossibility according to the known laws of mechanics, yet the attempt to construct such a machine has been made for centuries, and no doubt will continue to be made as long as the world stands.

If a party of true believers in spiritualistic manifestations could seat themselves by the side of a stream of water and make it run up hill, they would accomplish a much more clever trick than to chase a table up stairs or out of the window, as your genuine spiritualist will not hesitate to do for you at any time; but as it is difficult to take hold of the particles of a liquid, this particular form of exhibition is never attempted, and making water run up hill is chiefly confined to a vulgar force pump.

Many of our readers have no doubt witnessed the performances of necromancers, and have gone home greatly puzzled and wholly unable to explain what they had seen. We recollect to have seen a cane set upright on a floor and a lad balanced horizontally upon it. There was nothing particularly wonderful about this, but when the cane was taken away, without the lad's falling, and it was passed over, and under, and all about him, so as to show that he was not supported by wires from the ceiling or by rods from the floor, we had no ready way for accounting for it, but were absolutely certain, from our knowledge of the fixity of all physical laws, that there was some trick by which it was done, not visible to the senses. Aristotle believed that the heavenly bodies were suspended by invisible cords, otherwise they would fall upon the earth and crush it. He was evidently no spiritualist, but a believer in the necessity of something tangible to hold up the stars.

Some of our correspondents complain that scientific men will not examine into the phenomena of table-turning and give us an explanation upon a physical basis. They forget that this has been done by the highest authorities in this country and Europe.

In 1859, in the city of Boston, a reward of five hundred dollars was offered, through the columns of the *Courier*, for a satisfactory exhibition of some of the ordinary manifestations which mediums of every degree were constantly pretending to produce and which were fully believed in by the faithful as of spiritual origin. The challenge was accepted by a spiritual corps consisting of Dr. H. F. Gardner, Mr. Allen Putnam, Mr. Alvin Adams, Major Raines, Miss Kate Fox, and others, and Professors Peirce, Agassiz, Horsford, and Dr. B. A. Gould, were appointed a committee to give them a fair trial. It is hardly necessary to say that the whole thing was an utter and complete failure, although the distinguished professors displayed the utmost candor and patience in their search for the truth, just as they would have done in any other scientific investigation.

In England the late lamented Professor Faraday subjected the phenomena of table-turning to a most searching investigation. The report of his experiments has been extensively published and ought to be regarded as conclusive by the most skeptical inquirer. Our readers will find it in *The Athenæum*, page 801, for the year 1853.

Professor Faraday by an ingenious device found a way of measuring the direction of the force by which the table was moved and showed that the movement of the muscles was involuntary. Whenever an index was attached to the table which made the least motion visible to all, there was no effect, because the involuntary feature was destroyed and the parties to the transaction could not exert the force required for lifting it excepting in the ordinary way, and such table lifting would be like moving furniture about the room in the most humdrum style. The experiments were a perfect demonstration of the muscular origin of the table moving, and must be admitted as such by any one possessed of sufficient capacity to understand them.

There is no doubt that rappings and tippings were known to the Romans, and they were re-discovered, so far as this country was concerned, at Rochester, in 1846. Since that date we have had a surfeit of them, and it has now become a regular business, as much so as selling groceries or giving exhibitions with the magic lantern. The tricks of the trade have been exposed over and over again, but the world will be deceived by them in spite of all the warnings that we or the daily papers can give. We must look to our schools to correct the evil by the dissemination of accurate scientific information among the people.