Scientific American,

MUNN & COMPANY, Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

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

VOL. XXI., No. 26...[NEW SERIES.]... *Twenty-fourth Year.*

NEW YORK, SATURDAY, DECEMBER 25, 1869.

Contents:

(Illustrated articles are marked with an asterisk.)

TO OUR READERS.

The day of publication falling one day earlier in the calendar each year, has gradually antedated the issue of our journal, causing thereby a serious inconvenience to ourselves, and one that has been noticed by many of our readers. We prefer in this matter not to be so far in advance of the actual time, and in order to correct the discrepancy between the date of the paper and the day of actual issue, we seize the opportunity now offered at the beginning of the new volume, to defer the issue of the first number one week. By this arrangement none of our subscribers will lose anything, as we have already published two complete volumes, of twenty-six numbers each, for 1869, and before the 1st of January the first number for the year 1870 will be published and mailed to all our subscribers. With the present number we send out a supplement of the SCIENTIFIC AMERICAN to all our readers, which contains a large and fine engraving of the Railway Bridge over the Susquehanna river at Havre de Grace, also a calendar for 1870. This supplement has been printed at considerable expense, and is sent free to all our subscribers. We would regard it as a special favor if they would post it up conspicuously where it may be seen, as it contains our annual prospectus.

Subscriptions are coming in very rapidly, and present indications encourage us to believe that our circulation will be very much increased on the new volume.

ANNOUNCEMENTS FOR THE NEW VOLUME.

The premiums in cash offered by us are as follows: Whoever sends in the largest list of subscribers, according to published terms, on or before the tenth of February, will receive $300; for the second list, $250; third list, $200; fourth list, $150; fifth list, $100; sixth list, $90; seventh list, $80; eighth list, $70; ninth list, $60; tenth list, $50; eleventh list, $40; twelfth list, $35; thirteenth list, $30; fourteenth list, $25; fifteenth list, $20.

Surely these prizes are worth striving for, as either of the sums specified will be handy to have in the pocket. To those who do not compete for the cash prizes we offer the splendid large steel engraving, "Men of Progress—American Inventors," as follows: Any one sending 10 names and $30 will receive one picture; 20 names and $50, one picture; 30 names and $75, two pictures; 40 names and $100, three pictures; 50 names and $125, four pictures. This picture is worthy of the subject, and will grace the drawing-room of any citizen of the land. We are aiming at a large subscription list and we frankly acknowledge that we can only accomplish it by the coöperation of our present patrons, who have always generously responded to our appeals. We urge them now to speak a good word for the SCIENTIFIC AMERICAN. By so doing they can induce some of their neighbors to join in making up a club. If ten or more names are sent, the subscription is $2·50 a year.

STEAM PLOWING IN AMERICA.

The time is coming when in many portions of the United States the steam plow will be permanently adopted. If, in a country of small farms like England, it can be made so useful as to render profitable lands, which, without it, can only be worked at a loss, how much wider is its scope on our broad plantations, wide prairies, and river bottoms which are devoted to grain production.

The period is ripe for the introduction of a Yankee steam plow. Some inventors in this field have had the misfortune to live some years too early. But the inventive genius of the country is now fairly turned to the solution of the problem, and the steam plow of the time to come is now imperatively demanded.

In aiming at the production of a good steam plow, we think inventors have confined their efforts too closely to the imitation of the work of the common plow. Is it not quite possible that some other method of loosening the earth may be found to answer all the purposes of the furrow, without rendering large tractive power necessary.

The early, and still favorite method with gardeners, is forking or spading up the ground, and there can be no doubt that in this way the soil is better prepared for the reception of seed than by the use of the plow.

No mowing machine inventor has ever succeeded in applying other than human strength to the working of swinging blades or scythes, though many have sought to do so. It was not till the shearing principle as used in the common cutter bar was adopted that mowing machines found an abiding place.

But it may be objected that in plowing green sward it is essential to not break the earth to pieces but to turn it over neatly, grass side down, so that the vitality of the grass roots may be destroyed and the turf may rot. We do not think the continuous furrow the only means whereby this may be accomplished, and we believe the plowing machine of the future will demonstrate the truth of our views.

A new locomotive plowing machine, capable of drawing a gang of plows through a stiff soil was recently tried at Rochester, it is said, with highly satisfactory results. The locomotive weighs scarcely more than two tuns, but its tractive power is gained by a series of out-thrusting flukes in the traction wheels, which penetrate the earth, and are withdrawn by machinery inside as the wheels revolve. By this means the flukes only project from the wheels as they approach the earth on the under side of the wheel. There are springs attached to the flukes to relieve them when they come into contact with stones or other impenetrable substances. The plows are attached to this traction engine by chains, and at the trial, three plows, each held in the usual manner by an attendant, were drawn in this way through a stubborn soil.

So much for the Rochester machine.

From New Albany, Ind., we learn of a new steam plow, the invention of a citizen of that place, and which is described at length in the *Daily Ledger*: "The framework, in fact the entire machine, is of pipes. The driving wheels are geared positively, and are driven by vertical cylinders, the pistons of which are attached by an irregular eccentric motion, direct from the engine. In addition to this motion eight toggle joints joining levers, which simulate the motion of a horse's leg, assist the driving wheels when they fail in their traction."

The description given in the *Daily Ledger* is not so clear as to give a very distinct idea of this plow; but we gather that the plows proper are attached to beams, which are raised or lowered at will, and move along with the traction engine.

A California inventor has also recently taken out a patent for a steam plow, the general principle of which, like those described, is the drawing of plows by a traction engine. We are not aware that the English method of drawing gangs of plows across fields by a wire rope and drum finds much favor with American mechanics; but if plows must be drawn through the earth after the old fashion, it seems a more economical plan than the use of traction engines for that purpose.

THE USES OF SNOW.

As we write, a few straggling snow-flakes flutter timidly past our window and quickly melt into oblivion on the flags below. They will soon cease to melt and will gradually fill our streets with the characteristic New York slush, to the utter weariness of overdone horses, and the almost total extinction of good temper on the part of drivers, who will swear that snow is a nuisance, and wish that it were in a place where it would not be long in melting.

Now it is to be admitted that so far as New York city is concerned, the benefits of a "good heavy fall of snow" are rather indirect than otherwise, yet we shall see that even the poorest, who shiver in cellars along dark and gloomy alleys, are interested to have the snow fall, although they, in their ignorance, think it "poverty's curse."

Coal is dear this winter, and for the poor, hard to get, but food costs more than coal, and food must be had at any cost. The supply of fuel may be eked out and supplemented by many a makeshift, imperfect though it be, but hunger cannot be appeased by a subterfuge.

The snow which falls upon the earth is a tender mantle to infant food-plants which would otherwise perish of frost. In what is called an "open winter," you may see whole fields of young rye and wheat and clover, all pulled up by the frost and laid on the top of the ground to wither and die in the spring sunshine. The frost heaves up the earth, and with it the plants; slight thaws permit the earth to settle and renew its hold, and so successive freezings and thawings gradually uproot entire crops. "Winter killed," is the sad verdict of the farmer, as he contemplates the loss of his labor and seed in the spring; and "winter killed," might be appropriately spoken of the suffering and dying victims of starvation prices which follow the destruction of crops.

True, Nature sometimes in her zeal to protect, covers too deep and smothers the young plants; tucks in the coverlid so tight that the unseasonable warmth of the earth stimulates their vitality into an attempt at growth, which fails for want of air and light. But such disasters are comparatively rare, and open winters are the most deadly to grain crops. It is also true that in the large territories devoted to grain growing in the United States, when a crop fails in one section it succeeds in another, and so the food-supply keeps pretty steady pace with the demand, but it is none the less true that in many sections of the country winter wheat or rye could not be successfully grown without snow to protect these crops from frost.

But snow has another important office to perform. It is a fertilizer. Ask the experienced farmer, and he will tell you that the late snows of spring falling upon the springing crops makes them look green and vigorous, and really nourishes them. It is the bearer of ammonia, an important element of the food of plants, which it collects from the air. We have known thrifty farmers to rise early to plow in a light snow before it melted, being aware of its value, though perhaps not realizing in what its virtue consisted. It is also without doubt true that open winters are more favorable to the spread of disease than the contrary. It is an old proverb that "green Christmases fill churchyards."

So we see that snow has other uses than to make sleighing, though we get so little of this in New York, and the snow so interferes with travel in our crowded thoroughfares that one may well be pardoned for wishing that in the annual distribution our metropolis might be over-looked.

WHAT REMAINS FOR INVENTORS.

A great deal has been done in mechanical invention and chemical discovery. In these respects the world has moved immensely since the beginning of the present century. It is the habit of some short-sighted people to predict that we have, as a race, arrived at the pinnacle of our greatness, so far as relates to the subjugation of the brute forces of nature We have, say they, now harnessed the forces of gravity, heat, electricity, light, and affinity, we have learned how far it is possible to make them work for man, and henceforth, whatever improvement is to be made, must be only in the form of the harness.

It is the habit of this class of men to not only regard the steam engine as capable of improvement only in trivial details, in variations in the form of cut-off, or other subordinate particulars, but to look upon electricity as a necessarily more expensive force to generate than heat, and as consequently, forever debarred from economic use as a generator of motive power for machinery. They consider the application of light as limited to the various kinds of photography now known, and which may hereafter be developed.

They discern no remote possibility in the enormous force of chemical affinity, although it is through one of the commonest manifestations of that force—combustion—that we get the heat for our engines, dwellings, dyehouses, furnaces, and forges.

Although the present era in science has given to the world the great doctrine of the mutual convertibility of these forces, and the cognate and equally important doctrine of the conservation of force, the possibilities which a consideration of these doctrines open to the mind, do not seem to force themselves upon their understandings.

To give a glimpse of some of these possibilities is the object of the present article.

When we, divesting our minds of all preconceptions, examine our relations to the things which surround us, we find all these relations resolving themselves into motion. It is primarily through motion that we get any knowledge of anything, and practically it is motion which feeds, clothes, and warms us. Growth is motion. The changes which take place in the substances which we take as food, is a movement of their molecules and their rearrangement in the tissues of our bodies, where they rest not day nor night until finally eliminated and thrown out as effete matter. Nor even then do they rest. There is no rest in nature. Motion is life: nay, more; it and matter together constitute the whole category of physical existence.

It follows that whatever force can contribute to the physical and mental welfare or the pleasures of mankind—and it is in this only that invention finds a profitable field—must be capable of being converted into mass motion; for the human control of molecular motion depends upon mass motion.

To illustrate this let us consider the growth and preparation of any article of food, as wheat. It is by the mass motion of the plow and the harrow the ground is prepared to receive the seed; in this way the molecular motions concerned in its growth are aided, and the full ear and plump berry obtained. It is by mass motion that it is harvested, thrashed, ground, and kneaded, preparatory to the molecular changes which take place in its conversion into bread. It is by mass motion that it is masticated and mixed with the saliva in the mouth, to facilitate the molecular change it must undergo in the process of digestion.

As in this, so in all chemical processes, mass motion is employed to control the molecular motion, and this mass motion is, to a very great extent, in the present age of the world, communicated through the agency of machinery. But we also find that the mass motion of machines is obtained by the aggregation of molecular motions, so that in a ceaseless cycle these forms of motion flow one into the other

The chief field for inventors must, then, continue to be in the future as it has been in the past, in the employment of machines as intermediate links between molecular motion and other molecular or mass motion, which it is desired to make minister to the wants of mankind.

If we now accept the modern view that light, electricity, and gravity are, as well as heat, but modes of molecular motion, who shall dare to say that machinery may not be made the connecting link between them and other modes of molecular motion, in the future, as successfully as it is now between heat and work.

It sounds odd to speak of a light engine, or a gravity engine, although we are familiar enough with caloric engines, steam engines, and electric engines; and a water wheel is but a gravity engine, although we know that previous to the action of gravity it was, so to speak, "wound up" by the action of heat upon the water of the sea.

There is yet an almost unlimited field for lesser lights in the invention of improvements on present forms and devices, but the geniuses of the future have more glorious work before them. When the vast coal-fields upon which the world at present relies shall have been consumed, there will be just as much carbon as before, only it will exist in another form. The mass motion which it will have produced in assuming that form, will in its turn have been converted into molecular motions of some kind, which will be capable of re-conversion without loss into mass motion again, and the world's great workshop will keep running—no fear about it.

Where, then, shall invention stop? When man ceases to want anything to minister to body or mind, then will invention cease. What is there left to do? So much, which is possible, that the ages to come will never see it all accomplished.

THE CONSTRUCTIVE FACULTY OF THE MIND.

Perhaps no one of the powers of the human mind is more widely and uniformly distributed among mankind than the power to control and guide the muscles in the shaping of crude materials into objects of utility and beauty.

Phrenologists have classed constructiveness as a distinct faculty, and have given its supposed external indication a location upon the skull. It is evident, however, that it is not the simple control of muscle by the will that phrenologists mean by the term constructiveness. As illustrations of the prominent development of this faculty their books contain principally heads of such men as have distinguished themselves by great feats of mechanical skill and genius in invention.

Now we maintain that if what is meant by constructiveness in phrenology be anything more than mere power to guide the muscles in making imitations of existing things (and of course more is meant), it can no more be justly considered a single faculty of the mind than the power to become scientific in the most general sense of the latter term. To be scientific a man must have not one but many "bumps" well developed. To become a skilled constructor in anything but the imitative sense of the term, he must have not merely the bump of constructiveness, deemed necessary by phrenologists, but the rest of his skull must contain some brains, as well. Take away his causality, his calculation, his ideality, his sense of color, form, and weight, and he will never make even a horseshoe, not to mention a steam engine. And though he may possess all the faculties which go to make a skilled constructor, he will never become such without knowledge.

To construct, one must have mental as well as physical materials. To become skilled in the working of any material and fashioning it into that which better fits it for the use of man, it is necessary to know in some measure the properties of that material, and the means by which it may be so fashioned.

Savages perform marvels of imitative skill, when the rude character of their implements are considered, but they invent little. Much invention and a savage state are incompatibles. When man begins to invent he has progressed, and it would not be hard to show that the progress of civilization has gone hand in hand with invention.

We see then that mechanical skill may be reduced to three subjective elements; namely, good natural powers of mind and body, cultivation of those powers, and knowledge.

Brutes have not the first of these elements, they can therefore not have the others, and hence it is absurd to speak of their being skillful in their works. The beaver's dam, the honey-comb of the bee, and the tailor-bird's nest, are often spoken of as works of skill, but they are only so by comparison with the feeble mental and physical faculties of the beaver, the bird, and the bee. To form wax into much more complex forms than a honey-comb, would not be a surprising feat if done by a boy six years old. To build a dam as substantial as it is done by the beaver, or to stitch leaves together like the tailor-bird, is far within the power of the lowest and most ignorant savages on the face of the earth. Savages do even more remarkable things than these, but they are not feats of constructive skill in a broad sense of the term; a watch or a steam engine is, because all the requisites above enumerated are necessary to its construction. True, an ignorant man may imitate, but he could not devise, or improve it. An educated man might invent improvements, but lack the power to construct his improvement, but neither of these could be called skillful.

How absurd, then to consider constructive skill as a peculiar aculty of the mind, like the phrenologist, or mere deftness f the hand like the workman, who will none of books because he esteems most the judgment of practical men, and lely thinks himself a practical man.

Of all absurd terms, this "practical" is most misunderstood. What does it mean? Clearly, it means pertaining to practice, and practice signifies the practice of something, the application of knowledge or theory. Hence, theory precedes practice. A theoretical man may not be practical, but a practical man must be theoretical in spite of himself, and just as he is deficient in theory, in just so much he must be deficient in practice. There is a lesson to be drawn from this, but it must form the subject of a future article.

MEN OF PROGRESS---GREAT INVENTORS.

We continue this week our biographical sketches of the lives of the great inventors whose portraits are offered (see another column) as one of our subscription prizes.

At the extreme left of the picture stands the dignified Dr.

WILLIAM THOMAS GREEN MORTON,

who was born in Charlton, Mass., August 19, 1819. His youth was passed on a farm. At the age of seventeen he spent some time in a publishing house in Boston. In 1840 he commenced the study of dentistry in Baltimore, and eighteen months after established himself as a dentist in Boston. Among other improvements introduced by him was a new kind of solder by which false teeth are fastened to gold plates, preventing galvanic action. In order to render his work complete, it was desirable that the roots of old teeth should be removed. This was a tedious and painful operation, and there seemed little prospect of the success of the invention, unless he could devise means to lessen the pain. He tried by stimulants, intoxication, and magnetism, but in vain; yet still he clung to the idea that there must be something to produce the desired effect. He entered his name as a medical student in Boston in 1844. About this time the idea was suggested to him, in a lecture at the college, that sulphuric ether might be used to alleviate pain in his operations. He studied chemistry, and experimented on animals. Learning from books and lectures that the ether could be inhaled in small quantities, but that in large amount it was dangerous, he experimented on himself, and, satisfied of its safety, he administered it to a man, on September 30, 1846, producing unconsciousness, during which a firmly-rooted bicuspid tooth was painlessly extracted. At the request of Dr. Warren he administered the ether to a man at the Massachusetts General Hospital, from whose jaw was removed a vascular tumor, October 16, 1846, with perfect success. Dr. Morton obtained a patent under the name of letheon, November, 1846, in the United States, and the following month in England. The Paris academicians awarded 5,000 francs to be equally divided between Drs. Jackson and Morton; the latter declined receiving this joint award, but in 1852 received the large gold medal, the Monthyon prize.

From this time Dr. Morton labored incessantly for years to induce surgeons to adopt the ether, and, when its anæsthetic qualities were demonstrated, chloroform in their practice. His efforts secured him small profits, but brought upon him bitter persecution. His claim to the discovery of anæsthesia was disputed, and even the value of his efforts in behalf of its introduction was denied. In 1867, after witnessing a very successful, though severe surgical operation, in which Dr. Morton administered with his own hands the anæsthetic, we listened to an able and eloquent statement of his claims to the discovery of anæsthesia, as applied to surgery, which had the effect to establish in our mind the entire justice of that claim, and which, whether allowed by posterity or not, in our opinion entitles him to head the list of the world's benefactors. The full value of this discovery can only be appreciated by those who know how much suffering is saved by its now general application, and this value cannot be expressed in language, or estimated in dollars and cents. After many fruitless applications to Congress for some pecuniary recognition of his services to the world, some of them made at a time when the agony of thousands of wounded and maimed soldiers on the battle field, was being mitigated by his discovery, to the eternal shame of an ungrateful country be it said, he died July 15th, 1868, a poor man.

Immediately in front of Dr. Morton, stands

COL. SAMUEL COLT,

who was born at Hartford, Conn., July 19, 1814, and educated in his own native city. When a child, he preferred the workroom to the school-room. He remained in his father's factory from the age of ten to fourteen, when he was sent to school at Amherst, Mass., but ran away from the school, and, in July, 1829, shipped as a boy before the mast on as East India voyage. On his return, he served a short apprenticeship in a factory at Ware, Mass., in the dyeing and bleaching department, where he learned something; after which, under the assumed name of Dr. Coult, he traversed every State and most of the towns in the Union and British North America, lecturing on chemistry. In this way he earned considerable money, which he devoted to the prosecution of the invention of his revolver, the germ of which he had already devised while on his voyage to Calcutta. The first model of his pistol, made in wood, in 1829, while a sailor boy, is still in existence. At the age of twenty-one, he took out his first patent for revolving firearms. Before obtaining his patent here, he visited France and England and secured patents there. He returned to the United States and succeeded in inducing some New York capitalists to take an interest in the invention, and a company was formed in Paterson, N. J., in 1835, with a capital of $300,000, under the name of the Patent Arms Company. The revolvers were first introduced into use in the Florida War of 1837. In 1842 the Patent Arms Company were forced to suspend. The Mexican War commencing in 1847, General Taylor sent Captain Walker of the Texan Rangers to procure a supply; there were no arms to be had, not even could he obtain one to serve as a model, so that he was compelled to make a new model, which he did with several improvements. The first thousand were made at Whitneyville, Conn. Other orders immediately following, Mr. Colt procured more commodious workshops at Hartford, and commenced business on his own account. The demand for revolvers greatly increasing, and more room and greater facilities being required, he purchased a tract of meadow land south of Mill River, within the limits of the city of Hartford, surrounded it with a dyke or embankment about two miles in length, one hundred and fifty feet at the base, from thirty to sixty at the top, and from ten to twenty five feet in hight. He erected within this his armory, consisting of two main buildings, with others for offices, warerooms, etc., in which armory he could manufacture one thousand firearms per day. He also manufactured the machinery for making these firearms elsewhere, and supplied a large portion of the machinery for the armory of the British Government at Enfield, England, and the whole of that for the Russian Government at Tula. The entire expenditure upon his grounds and buildings amounted to more than $1,000,000. He did not forget the comfort of his workmen, having good dwellings provided for them, besides a public hall, a library, courses of lectures, concerts, etc. Mr. Colt subsequently invented a submarine battery of great power, and was one of the first to lay a submarine cable. He amassed an immense fortune in his manufacture of arms; and died in 1861.

By his side stands

CYRUS HALL M'CORMICK,

of Scotch descent, though born in this country, in the State of Virginia. The constant employment of his active mind in pursuit of mechanical improvements, has resulted in one of the most important inventions of agricultural machinery. His automatic mowing and reaping machine, was exhibited in the World's Fair, held in Hyde Park, London, in 1851, and like many other pioneers in the van-guard of progress, was greeted with ridicule. The *Times* called it "a cross between an Astley chariot and a flying machine." Its first trial, however, at Tiptree farm, changed the current of public opinion, and even the *Times* recanted. A still more satisfactory acknowledgment of its merits was the award to it of the Grand Prize medal of the year by the jury of the Exhibition. In the New York Exhibition of 1853, it also won a gold medal. Mr. M'Cormick, not content with this great success, continued his investigations and experiments, until he achieved another important improvement in this same machine, the automatic "raker." This machine, called by its inventor the "M'Cormick," attracted a great deal of attention at the last Great Exhibition in London, in 1861; even crowned heads and the highest nobility considered it worthy of their examination. At every trial in all parts of Great Britain and the Continent, it elicited applause by its admirable performance of the operations for which it was constructed. At the Lancashire Agricultural Meeting, at Preston, it triumphed over nine competitors. Mr. M'Cormick has a large factory in Chicago, Illinois, where, as an inseparable result of such indomitable perseverance and inventive genius, his success is firmly established.

In front of Mr. M'Cormick sits, with vulcanite cane in hand, and large vulcanite pin on his shirt-front,

CHARLES GOODYEAR,

who was born in New Haven, Conn., Decmber 29, 1800. He there attended public school. When not studying he assisted his father Amasa Goodyear, who was the pioneer in the manufacture of hardware. He subsequently joined his father in the hardware business in Philadelphia, and made many improvements in agricultural tools. The firm being overwhelmed by the commercial disaster of 1830, Goodyear selected a new business, the improvement in india-rubber. His early experiments were made in New Haven, Conn., Roxbury, Lynn, Boston, and Woburn, Mass., and the city of New York. The first important improvement made by him was at New York, 1836, being a method of treating the surface of native india-rubber by dipping it into a preparation of nitric acid. This discovery enabled the manufacturer to expose an india-rubber surface in his goods, which, on account of adhesiveness, was before impracticable. The nitric acid gas process, as it was called, was introduced into public use and met with great favor, especially in the manufacture of shoes. Sulphur had been noticed as producing remarkable drying effects on rubber, and in 1838 and '39 Goodyear made at Woburn, Mass., many experiments with compounds of india-rubber and sulphur. In the course of these experiments, about January, 1839, he observed that a piece of rubber mixed with ingredients, among which was sulphur, upon being accidentally brought in contact with a red-hot stove, was not melted, but that in certain portions it was charred, and in other portions it remained elastic though deprived of adhesiveness. From 1839 to the day of his death vulcanization occupied Mr. Goodyear's whole attention. More than sixty patents were taken out by him. The first publication to the world of the process of vulcanization was Goodyear's patent for France, dated April 16th, 1844. He was unfortunate both in France and in England, in being robbed of both patents at the Paris Exhibition of 1855. He obtained the grand gold medal and the ribbon of the Legion of Honor, presented by Napoleon III. His whole time night and day appeared to be taken up with improvements in india-rubber. For years he suffered from poor health. He died in the city of Washington 1861.

ELIPHALET NOTT, D.D., LL.D.,

is represented as seated by the right of Professor Morse in the middle foreground. Although for more than half a century President of Union College, he was to a great extent self-educated, having never received a collegiate training. He was born in Ashford, Connecticut, June 25, 1773. He studied divinity in his native county, and at the age of twenty-one was sent out as a domestic missionary to the central