improved so much during the last fifty years that even we who live in the days of the telegraph, ocean steamers, railroads, and steam power presses, do not at all realize the magnitude of the change. Fifty years ago such a business as is transacted by more than one firm in New York could not have been created even by the greatest business capacity. In creating these immense concerns, the proprietors have had the aid of cheap printing to advertise them, of railroads to bring them customers from distances that fifty years ago would have occupied months to traverse, of the telegraph to transmit orders, and of a hundred of other improvements. The steam elevators, that raise their numerous customers to the acres of floors in the upper parts of their buildings, are patented machines. The bills and forms, which enable them to transact their business without confusion, are executed cheaply by patented machinery. The paraphernalia of their counting rooms include numerous patented helps to business. The very goods they sell are mostly manufactured by patented looms, driven by patented water wheels or steam engines.

Even the currency is so improved that the counterfeiter finds his deception more difficult and more easily detected.

But there is a still more indirect way in which general business is benefitted by the patent system. In this Yankee land, where the masses are constantly enlightened by the agency of the common schools and newspapers, every lad before he is fourteen knows something of the nature of patents, and has heard of money made and to be made in the invention or in the business manipulation of some patented improvement. The most ambitious often see, or think they see, that this way lies fortune. Many are thus induced to interest themselves in machinery, and to acquire some knowledge of mechanism. We thus have become a nation of mechanics, ready at the moment any exigency of agriculture, manufactures, commerce, or war, suggests a want, to act upon the suggestion, and the needed improvement shall be forthcoming. The farmer's boy invents his churn, his dog power, his washing machine, before he is twenty, and, by the time he reaches middle life, understands enough about machinery to run a saw mill, or even something more complicated, if necessary.

It is this universal, although partial, knowledge of mechanics that has rendered the introduction of agricultural machinery so successful in this country, and has so increased the production of the soil, that every commercial artery is now plethoric with the teeming harvests of our inland domain. Who, fifty years ago, would have thought of cultivating a thousand acres of wheat? The chances of harvesting without serious loss this amount, by any help attainable at that time by a single farmer, would not have been one in a hundred. The modern harvester, the threshing machine, has changed all that, and no one now thinks of impossibility in connection with harvesting a thousand acres.

What has caused the unprecedented growth of this great commercial center, New York? New York, as it now is, would have been an impossibility without the improvements we have named. Not a bushel of wheat from Illinois or Minnesota could ever have found its way to this port; not a tithe of the large business houses which now crowd the lower part of the city would have been heard of; the busy manufacturing towns that fill their establishments with wares would have been nothing but hamlets, and the vast prosperity, that has made America the wonder of the old world, would never have been one of the most brilliant chapters in history.

AGRICULTURAL CHEMISTRY AND CHEMICAL MANURES.

The researches of that veteran chemist, Baron Liebig, and others in the analysis of soils and the use of artificial manures did not result in such extensive progress in agriculture as was anticipated. As the effort to apply the knowledge gained by these researches was made throughout the world by intelligent agriculturists, it became evident that there was still some lack in agricultural chemistry, some mysterious circumstance, relation or element, that defeated this endeavor. As a consequence, the idea of chemical farming became a thing to be ridiculed, and fell into an ill repute which still attends it. The prejudice thus created will for a long time impede progress; but there cannot be a doubt that the missing link, which, if found in Liebig's researches, would have resulted in success instead of failure, has at last been discovered.

In the light of this revelation, the cause of the failure to apply chemical principles to agriculture is plain. We find it fully explained in the lectures of M. Ville, a translation of which, as delivered at the experimental farm of Vincennes, France, now lies before us.* These lectures are, we believe, the most important contribution to agricultural science that has appeared during the last half century. In our review of them, which we shall not attempt to make exhaustive, we shall extract some passages which will give a glimpse of their character to such as have not yet read them. In the third lecture, M. Ville remarks:

A priori, one would think that a chemical analysis which has been pushed so far in our day, and whose methods have acquired at the same time so much delicacy and certainty, ought at least to give us a means of estimating with certainty the richness of the soil, and so guiding us in the choice of the manure best suited to its nature. There is none, however, and I defy the most skillful chemist to say in advance what will be the return from earth submitted to him, and what manures are most appropriate.

A few words will explain the reason why chemistry is powerless to furnish us with these indications: you must recall the distinctions we have drawn between the different elements of which the soil is composed.

*Chemical Manures. Agricultural Lectures, delivered at the Experimental Farm at Vincennes, by George Ville. Translated by Miss E. L. Howard. Third Edition. Atlanta, Ga.: Plantation Publishing Co.

Let us suppose a soil containing both quartz sand and felspar sand among its mechanical elements. For vegetation these two sands are equivalent, although the first is from silica and nothing but silica, while the second is a silicate based upon lime, potash and soda, besides containing phosphate of lime in very feeble but appreciable quantities.

Here, then, are two bodies whose composition, in spite of similitude of exterior, have no analogy; and which, however, are equivalent in an agricultural point of view, because, the felspar being insoluble in water, its *rôle* in regard to vegetation descends to that of the quartz sand, that is to say, to a simple mechanical element. But for the chemist, there are no insoluble bodies, so he confounds in one whole the potash, lime and phosphate of lime that the felspar sand contains, though they are of no use in vegetation, with the products of the same nature which we have ranged under the class of active assimilable elements. Thus is explained the insufficiency of the signs with which chemistry can furnish us.

In order to understand fully the meaning of this quotation, it is necessary to say that M. Ville includes all the essential constituents, of soils in which plants can grow, in the category of fertilizers; but he divides them into two classes, the first of which is azotic or nitrogenous matter, and the second of which includes ten mineral substances, only three of which, phosphate of lime, potash, and lime, are so directly connected with the growth of plants that they need occupy the attention of the agriculturist in his attempt to restore to soils what has been drawn from them by the growth of crops. The other minerals act mechanically and are hence called mechanical fertilizers; but M. Ville maintains that they exist naturally in sufficient quantities, and that it is not necessary to provide them. So far as the mere growth of plants is concerned, this is probably correct, but there are doubtless many cases in which it is desirable to add some material not directly concerned in plant growth, for the purpose of modifying stiff soils, or tempering light ones.

The most favorable conditions of soil for plant growth being the presence of azotic matter, phosphate of lime, potash, and lime, M. Ville calls a mixture of t ese substances "th complete fertilizer." The non-assimilable elements are considered as purely mechanical in their effects.

The following experiments are given to illustrate these facts:

In burnt sand, free from all additions but moistened with distilled water, wheat acquires but a rudimentary development—the straw hardly attains the dimensions of a knitting needle. In this condition, however, vegetation follows its usual course; the plant blooms, bears grain, but in each head there are but one or two dwarfed, badly formed grains. Thus, without soil, the wheat finds in the water it receives and the carbonic acid of air, aided by the substance of its grain, resources sufficient—sorrowfully, it is true, but at last—to run through the entire cycle of its evolution.

From 22 grains of seed, weighing nearly 18 grains, we obtain 108 grains of harvest. Add the ten minerals (phosphorus, sulphur, chlorine, silicium, calcium, magnesium, potassium, sodium, iron and manganese) to the sand, excluding the azotic matter, and the result is but little more.

Under these new conditions, the wheat is a little more developed than in the preceding case, but the harvest is still more feeble; it reaches 144 grains. Suppress the minerals and add only azotic matter to the sand; the growth will still be mean and stunted, but the harvest will slightly increase, as it reaches 162 grains. Let us follow the changes. In pure burnt sand, 108 grains; with minerals without azotic matter, 144 grains; with azotic matter alone, 162 grains.

In this last case, a new system is shown. As long as we operate only with minerals the plants are diseased, the leaves show a yellowish-green color. As soon as we add azotic matter to the sand the leaves change their color, becoming ing a dark green. It seems as if vegetation would take its usual course, but the appearances are deceitful; the harvest is still feeble.

Let us attempt a third experiment, which will, in a measure, be a synthesis of the three preceding. Unite azotic matter and the minerals in the burnt sand. This time you will be tempted to believe in the intervention of a magician, the phenomenon so far surpasses those preceding it. Just now the growth was languishing, doubtful, diseased; now the plants shoot up as soon as they break the ground; the leaves are a beautiful green; the straight, firm stalk ends in a head filled with good grain; the harvest reaches from 396 to 450 grains.

You see, gentlemen, relying upon experience, which is our guide by choice, we have succeeded in artificially producing vegetation to the exclusion of manures and all unknown substances.

You will acknowledge that this is an important and fundamental point. No more mystery, no undetermined power; some chemical products of a known purity, distilled water perfectly pure in itself, one seed as a starting point, and the result, a harvest comparable in all points to the best obtained in good earth.

We are, therefore, justified in saying that the problem of vegetation here receives its solution, for we have not only defined the conditions necessary to the production of vegetation, but the degree of importance of each of the concurring agents.

Azotic matter in its decomposition furnishes ammonia, and nitrates; and the clay constitutes a receptacle which holds and gives out gradually as may be required these important ingredients. M. Ville divides plants into two classes, according as they draw their nitrogen from the air or the soil. Thus wheat is a type of plants which prefer their nitrogen in the form of salts of ammonia, and take it from the soil. Beets prefer it in the form of nitrate and take it from the soil. Peas and the other leguminous plants prefer to take it as a gas from the air. The consequence of this distinction is that plants which take nitrogen from the air will flourish in a soil containing only the other elements of the complete fertilizer, namely, phosphate of lime, potash and lime. Therefore, by planting in a soil one of each of the two classes of plants, it is possible to tell whether the soil contains the azotic and mineral matters or not. Thus, if peas and wheat be planted in the same soil, and the peas yield well while wheat yields little, the land has the mineral elements but lacks the azotic or nitrogenous matters.

At Vincennes, previous to the fertilization of the soil, the land produced nothing, and hence was proved deficient in all the elements of the complete fertilizer, by the addition of which it has been made extremely productive.

As chemical analysis of soils fails for reasons above stated the richness of the soil is determined as follows:

Suppose you institute seven cultures of the same plant—it may be of the beet or wheat, as you will.

To the first give the complete fertilizer; to the second, the same fertilizer excluding azotic matter; to the third, the complete fertilizer deprived of phosphate of lime; to the fourth, the complete fertilizer less the potash; to the fifth, less the lime; to the sixth, less all the minerals—that is to say, reduced to the azotic matter; the seventh not having received any manure.

It is very evident that if, in the complete fertilizer, the effect proper to each component is manifest but as it is associated with three others, the comparison of the returns obtained from the seven strips of the little field ought to indicate what the soil contains and in what it is wanting.

In this system of investigation, the culture with the complete fertilizer becomes, in a measure, the invariable standard of comparison to which are referred the returns of the other strips of ground; and, according as they approach or recede, we conclude that the earth contains or does not contain the element which has been voluntarily excluded from the fertilizer.

To put the value of this method beyond doubt, M. Ville reports the results given under three different conditions.

At the experimental farm at Vincennes were obtained, in 1864, the following proportional returns from wheat:

With the complete fertilizer	5644
" " " without lime	4333
" " " " potash	4044
" " " " phosphate	3466
" " " " azotic matter	1888
Without any fertilizer	1588

The conclusion is evident. At Vincennes, the complete fertilizer was necessary; the azotic matter was most deficient.

An eminent agriculturist of the department of the Somme furnished a second example, which is upon the beet:

With the complete fertilizer	4504
" " " without lime	4103
" " " potash	3703
" " " phosphate	3208
" " " azotic matter	3200
Without any fertilizer	2202

You see here, also, the earth is wanting in azotic matter, and, to put it under high culture, we must have recourse to the complete fertilizer.

The third example is from a culture of sugar cane, instituted by the Hon. M. de Zebrun, of Guadaloupe, a former delegate from that colony:

With the complete fertilizer	50666
" " " without lime	44444
" " " potash	32111
" " " phosphate	13333
" " " azote	49777
Without any fertilizer	2666

If I add that sugar cane particularly draws its azote from the air, you will conclude that the soil is particularly wanting in potash and phosphate of lime.

Here are, then, two methods of knowing the richness of the land. The first is founded on the culture of two different plants without any fertilizer, and the second, on the culture of the same plant with five different fertilizers. These two applications of the same principle lead to the same results, and verify and complete each other.

I need not add, that for each of these trials to have its full signification, the earth must not be used until the effect of each fertilizer has been spent.

By the aid of our experiments in burnt sand, and with only chemical products, we have realized a theoretic scale of culture whose progressive returns have shown us the laws which regulate vegetable productions. By the light of the collection of ideas, we were enabled to conceive and to realize practical processes of analysis accessible to all, whose testimony is of almost absolute certainty, and by means of which we can always say what a land contains, what it needs, and can consequently determine the nature of the agents to which we must have recourse to fertilize it.

In subsequent lectures, M. Ville gives tabulated statements of results from the use of what are ordinarily called chemical fertilizers, that is, such as are not directly of organic origin. These statements indicate that the chemistry of plant growth is destined to pass from under the odium of previous failures, and take its place in the sciences as a splendid collection of established facts, which will inaugurate a new era in agriculture.

We cannot extend our remarks and quotations further, but we will say that we have rarely examined a work more replete with interest, or perused a record of experiments in which the true scientific method has been more closely followed.

SHORT EXTRACTS FROM A FEW LETTERS.

An esteemed correspondent from Fort Concho, a remote spot in western Texas, forwards us a long list of subscribers, and states as follows: "This post is far west of any organized county, cultivated land, or signs of civilization of any kind. The citizens, if such they can be called, are mostly refugees from Mexico or outlaws from the States. Every one goes around armed to the teeth, homicides are common, and horrid shooting affrays are more so. Military law is the only law we have, and that has no control over these outside 'citizens.' When we reflect on the kind of men who recruit the army in time of peace, and what reckless men are willing to drive the mails, by stage, through these wild regions among hostile Indians and more dangerous 'citizens' (though the stage is always escorted by a soldier), we cannot wonder that there is no safety for money in the mails."

Another says: "I live in a small village, where there is more taste for whiskey than for science. It is hard to form a club of ten without cutting a club to break my own head. I have received five names by advancing the money for three, the fourth being a present to my brother in Nebraska; for the balance of the club, I am "going it alone. I hope

I won't lose more than my trouble. I will try to circulate them and get my money back if possible."

The following is gratifying to any who feel interested in the education and mental improvement of the young: "I cannot express to you what amusement your paper gives to my boys, nor what interest it awakens and fosters in them. The subscription is from their purses, and they prefer your weekly to any other they have received."

A Chicago friend writes as follows: "I have been burned out in the great fire (October 9, 1871), to the tune of ten thousand five hundred dollars, besides suffering many consequent inconveniences resulting from my losses, but I can go hungry a whole day and be merry; yet if I fail to get the SCIENTIFIC AMERICAN at its proper time, my equanimity is disturbed and I become a piece of broken machinery, "out of gear." I hope you will see to it that my paper is sent from your office as early as possible after it is printed."

SCIENTIFIC AND PRACTICAL INFORMATION.

THE RECENT ECLIPSE.

One section of the English expeditionary party in India chose Bekul, on the western coast of the Madras Presidency, as the point of observation. The chief results are published, and the existence of radial lines, well marked and distinct, in the corona is now established. These seem to demand our acknowledgdment of the existence of forces extending outwards from the center of the sun. Their exact position and narrowness, says Mr. Proctor, force this conclusion upon us.

PYROLIGNEOUS ACID.

Professor Cox, State geologist of Indiana, has recently experimented with pyroligneous acid, and claims that his results give us some new light on its nature and constituents. The acetic acid of the drug stores is usually derived from crude pyroligneous acid, and the latter has thus been erroneously spoken of as an impure acetic acid; but in the experiments of Professor Cox, acetic acid burned, steadily but not raipdly, with a reddish purple flame full of scintillations, while the pyroligneous acid of commerce boiled away without sparkling. In another experiment, the Professor found that the vapor of pyroligneous acid extinguished the flame of burning paper, while that of acetic acid left it undisturbed, but did not itself ignite.

These facts do not appear to us to show that the two acids are different in their natures, as it is well known that acetic acid will burn, and that when diluted with water, as in pyroligneous acid according to the usual theory, it will not.

A RESISTING MEDIUM IN SPACE.

The retardation of Encke's comet, amounting to about two and a half hours in its period of three and a half years, has been frequently cited as a proof of the existence of a medium in space, of sufficient weight to resist a body of such extreme tenuity as a comet. This explanation of the mystery of space has been objected to by Professor Asaph Hall, who gives his reasons in the following words: "So far as the motions of comets have been determined, the evidence is against the theory of a resisting medium in space. Thus far, the observations of the planets lead to the conclusion that their motions are in strict accord with the law of gravitation; and in the disputes about the acceleration of the mean motion of the moon, no one has thought to seek its cause in a resisting medium, but much more probable causes are at hand. Encke's comet, therefore, stands alone in the strange anomaly in its motion which the calculations have shown. If it be proved that the diminution of the periodic time actually exists, this anomaly must be considered as a peculiarity of Encke's comet, and its cause must be sought for in something which distinguishes this comet from all others. It was early pointed out, by Olbers, I think, that this comet moves through those regions where the zodiacal light is seen. Possibly, also, the numerous meteoric streams which are moving around the sun, and which are closely connected with the orbits of some of the comets, may exert an influence on their motions."

BALANCING SLIDE VALVES.

A correspondent states that it is the common practice, with western engineers, to calculate only the areas of ports, in estimating the pressure upon slide valves with a view to balance them. We can scarcely credit this statement, and think our correspondent must be mistaken. If the faces of valve and seat are fitted steam tight, the entire pressure will be the product of the entire area of bearing surface and ports, in inches, multiplied into the pressure per square inch maintained in the steam chest. This, multiplied into the coefficient of friction existing between the surfaces, will give the force required to move the valve under such pressure when unbalanced. Practically, there are few valves that are perfectly fitted, or that remain so if properly fitted at first. Any sure method of balancing slide valves for general use should therefore provide for experimental adjustment.

THE SUN'S EFFECT ON THE MAGNETIC NEEDLE.

It was observed by D. Müller that the variation of the magnetic needle pursued its regular course till the commencement of the recent eclipse. It then began to retrace its steps until it reached its minimum declination at 1 h. 58 m., which was the instant of totality. After that moment, the ascending motion towards the west recommenced, and continued until the needle regained the exact position it had occupied when the eclipse began.

LE GÉNIE INDUSTRIEL.

We regret to learn that the journal of the brothers Armengaud, published under the above title, is discontinued. Forty volumes have been issued during the twenty years of its existence, and it had till lately an extended circulation and a justly acquired celebrity; but the recent disastrous war on French soil has paralyzed so many industries and impoverished so many mechanics and manufacturers that its publication became no longer a source of profit to its esteemed proprietors and editors, who look hopefully for the resuscitation of mechanical and industrial science in France at no very distant date.

WILL YOU FAVOR US?

Will subscribers to the SCIENTIFIC AMERICAN, who have duplicate copies of No. 1, 2, or 3, of this volume, or others who do not preserve their numbers for binding, re-mail back to this office what they are willing to spare?

At the commencement of the year, we printed several thousand more copies of each number than we had subscribers for, and as many as we anticipated a demand for; but subscriptions have come in so much faster than we expected that the first three numbers are nearly exhausted. The publishers will be obliged to any of their patrons if they return all or either of the above numbers. Address SCIENTIFIC AMERICAN, New York.

A GOOD MONTH'S WORK.

Since the first of last January up to February 5th inst.—a little over one month—201 United States patents have been issued to inventors whose specifications and drawings were prepared at the office of the SCIENTIFIC AMERICAN. This number, as large as it is, does not include a considerable number obtained through this office in foreign countries.

Death of Mr. Joseph B. Lyman.

Mr. Joseph B. Lyman, lately deceased, was for the last four years of his life agricultural editor of the New York *Tribune*, having previously filled a similar position on the New York *World*, and having edited at one time *Hearth and Home*. He had traveled much in many parts of the United States, and was thoroughly acquainted with agriculture in all the localities he had visited. Among the many friends who mourn his untimely death are most of the eminent men in journalism and agriculture on this continent.

THE submarine telegraph cable from Florida to Cuba, as we noted some time ago, was supposed to have been injured either by the bites of the sea turtles, or of some kinds of fish; and we now learn that in China a similar difficulty has been experienced in consequence of the attacks of a minute crustacean. This is so small as scarcely to be perceptible to the naked eye, but can be readily defined under the microscope. Various breaks have been satisfactorily referred to the agency of these animals, which had embedded themselves in the gutta percha. It has become necessary, therefore, to envelop the cables in certain localities with an external supplementary layer of metallic wire, in order to prevent injury in this manner.

PATENT INFRINGEMENT SUITS.—Francis and Loutrel *versus* Mellor and Rittenhouse, and the same *versus* Godfrey & Co., for infringement of plaintiffs' patents for making printing rollers of glue, glycerin and sugar. Judge McKennan, in the United States Circuit Court at Philadelphia, has rendered a decision adverse to the claims set up by Francis and Loutrel, and holds that they are not entitled to any broad claim as the first users of these ingredients, but are limited to the proportions substantially as described in their specifications.

MR. THADDEUS HYATT, formerly of this city, and the inventor of the glass covered gratings now so commonly used, has patented some new improvements connected with buildings, having for their object to render them fireproof. As a substitute for iron beams and brick arches for floors, he proposes wrought iron tubes, placed side by side. Other improvements consist of hollow bricks filled with plaster of Paris or alum, or other mixtures, which, like them, hold considerable water. Wire laths covered with similar compounds are also suggested, together with plasterings of the same materials.

THE experiments on beet root sugar made at the Amherst (Mass.) Agricultural college, during the past year, have been so successful that it is intended to ask the Legislature now in session to grant a charter to a company contemplating the manufacture on an extensive scale. They ask ten years immunity from taxation on account of the experimental nature and public importance of their enterprise. We hope the Legislature will grant the charter as asked for, and thus encourage a new industry in the old Bay State.

THE business address for the American Road Steam, George W. Fitts, inventor, illustrated in No. 6, is: American Road Steamer Company, 24 South Front street, Philadelphia, Pa.

Examples for the Ladies.

Mrs. Amelia Coutant, Brooklyn, N. Y., has had her Wheeler & Wilson Machine since June, 1869; has, besides other sewing, made 836 pairs of pantaloons, making as high as seven pairs a day, besides doing her own housework. She was self-taught, and has broken but two needles of the original dozen.

Miss Adelaide Perry, Bloomington, Ill., says: We have had our Wheeler & Wilson Machine in use eleven years without repairs, and it runs as well as the day it was bought. Last year I earned with it $485.85, besides doing the sewing for a family of eight persons, and considerable other work.

Business and Personal.

The Charge for Insertion under this head is One Dollar a Line. If the Notices exceed Four Lines, One Dollar and a Half per Line will be charged