ART. IV. — 1. *Official Catalogue of the Great Exhibition of the Works of Industry of all Nations.* By Authority of the Royal Commission. London: Spicer Brothers. 1851.

2. *Lectures on the Results of the Great Exhibition of* 1851, *delivered before the Society of Arts, Manufactures, and Commerce.* London. 1852.

3. *The Year-Book of Facts in the Great Exhibition of* 1851. By JOHN TIMBS. London. 1851.

THESE works give a connected view of the Exhibition, of which every one has heard so much. In the Catalogue, we have a full history of the way in which the scheme originated, and the mode of carrying it out, and then a description of every article exhibited, written in each case by the exhibitor himself, with notes and explanations by persons familiar with the processes involved. In the Year-Book, we find comments on all the most noteworthy objects; and in the Lectures, an interesting *résumé* of the whole, by the highest scientific authorities in Great Britain. The accounts published from day to day in the newspapers, the wood-cuts in the Illustrated Papers, the pictures and panoramas, and the endless list of articles on the subject in the Magazines, have made most people familiar even to weariness with all the details. Still, it may be interesting, now that it is over, to compare the plan itself with its execution, and with its results. It was undeniably successful. The building was erected, and the articles all received and arranged, by the time appointed. They were exhibited to 50,000 people a day, without confusion or difficulty, or loss from fire or thieves, or riots, or rain; and the result was a clear profit of more than a million and a half of dollars.

It is difficult to understand now, why people should ever have doubted that such would be the result; why they should have feared riots in the building, when much larger crowds, and of a much lower class, behave perfectly well at a review or a fair;—or why they should have supposed a thief would go into an edifice guarded by an army of police officers, when it would be so much easier to step into a jeweller's shop. As to the million and a half of profit, it must be allowed that the Royal Commissioners showed great mercantile talent. The French exhibition of 1849, which suggested the English one, was opened to the public gratuitously five days in the week; but the English Commissioners not only compelled every one who entered to pay his shilling at the door, but they absolutely "cleared" $4,000 "by taking charge of umbrellas," $16,000 by the Catalogue, and $27,000 by the ice-cream saloons; and, meanwhile, the large money prizes first promised had dwindled down into cheap bronze medals. The point least insisted on, the Exhibition being ready for opening on the 1st of May, the very day originally appointed, seems to us the real wonder.

But though it was, in its way, so singularly successful, it does not appear that the success was of the kind anticipated, or that the Exhibition itself was the thing expected; in fact, it was quite the reverse. It was expected that a million, or more probably, two millions, of foreigners would be collected from all parts of the world to study it. But the Commissioners' Report shows that only a very few thousands came, — hardly a larger number than the foreign exhibitors themselves, with their friends, assistants, and servants, would account for.

It was expected that novelties of every kind, — new substances, new machines and processes, — would be sent and exhibited, compared, tested, and, if good, introduced. Now we believe the very first thing that would strike any workman or manufacturer who should look over the Catalogue, would be, that scarcely any novelty whatever was exhibited. There were many that might have been sent. There are, at least, a thousand new patents taken out every year, in this country alone, and perhaps as many new processes discovered not of a kind to be patented. There is an almost countless number of processes in the arts, never yet described in any book, that would have been entire novelties to every one not engaged in the particular trade or "mystery" to which they belong. But they were not sent to the Exhibition. The writer in the Year-Book has to dwell on such things as "chain cables," exactly as they were made in 1810; "Bramah's lock," that had been twenty years in his shop window; "Pattinson's process for desilvering lead," in use for more than ten years; the "Thames Tunnel Shield," that has been a prominent object in every exhibition these fifteen years; and "Hobbs's lock," and "McCormick's Reaper," both of which, it seems, had been already exhibited, of all places in the world, in Austria. One of the most eager panegyrists of the Exhibition in the Reviews can find but three real novelties in the whole of the immense list. The first is Claussen's mode of treating flax, to fit it for spinning by common cotton-spinning machines. But that, one of the lecturers tells us, is no novelty. It was introduced eighty years ago, and given up after some trial; and the reinvention by Claussen seems likely to share the same fate. The second is Mercer's mode of treating cotton cloth, by dipping it in strong alkali, to make the fibre shorten and swell, so that the cloth shall become finer and closer, and, if printed, the colors brighter. This invention, as far as the lecturers know, has not yet had its value tested by the manufacturers. The third is neither more nor less than a new kind of Lucifer match.

It is easy to see why new inventions were not sent to the Exhibition. An inventor naturally desires to benefit himself by his invention, and he generally finds the safest way is to say as little as possible about it; — that is, if it is a good one. The inventor of the printing press made his first books look as much like manuscripts as he could, and sold them as manuscripts, and would never have been found out, if he had not offered them at too low a price. If he had lived in our day, the only difference would have been that he would have patented his invention; but he would have called as little attention as possible to the profits of the business, and certainly, would never have sent the types and presses to an Exhibition.

The same spirit, very naturally, actuates whole classes and nations. In the first speech, by the Chairman of the Commission, at the London city dinner, we are told, that the blessings bestowed upon us "can only be realized in proportion to the help which we are prepared to render each other;" the necessity of "peace, love, and ready assistance, not only between individuals, but between the nations of the earth," is insisted upon; and, in a later speech at York, he says the invitation "has been received by all nations, with whom communication was possible, in that spirit of liberality and friendship in which it was tendered."

Now this liberal and friendly invitation was, in fact, a request to the foreign manufacturer to send to England every peculiar machine, process, or contrivance he had, and teach the English workmen how to use it, — the foreigner paying all the expense himself. The iron manufacturers in this country are suffering from the competition with the cheaper labor of Great Britain, and necessity has forced them to learn to economize in a variety of ways, which, as yet, in Great Britain, they know very little about. This doctrine of peace, love, and ready assistance would require our iron masters to send out men, at their own expense, to teach the English workmen these improvements. And the doctrine does not apply to the other side. As soon as the Englishman is taught, he is at perfect liberty to use his knowledge, and it is certain he will use it, immediately, to undersell his teachers and ruin their business. It is curious, in this connection, to read the motto on one of the designs for the prize-medals: — "*Britannia orbis terrarum industriam fovit.*" Our manufacturers did not seem to appreciate properly this cherishing process.

Colt's repeating pistols were exhibited there by the manufacturer, very naturally, as it was his business to sell them in London, or anywhere. But it was at once remarked by the Times, that it was very fortunate they had been sent, or else, in the next war, the American sailors would have boarded their vessels, each man armed with a pair of these revolvers, and have cleared the decks as certainly as if they had brought Paixhan guns with them. Why should not our men clear their enemy's decks in a sea-fight, if they can? What possible object can we have, as a nation, in assisting to arm British seamen?

The foreign manufacturers seem generally to have taken this sort of view of the friendly invitation. Any English iron master would give thousands of pounds to learn the secret of the Russia sheet iron. The Russians sent them many samples of the iron, but they did not send them the secret. There was plenty of Sevres and Dresden porcelain and Bohemian glass sent, but not the least hint at the mode of making and coloring the porcelain and glass. The English glass-makers, too, sent their wares, but they sent no receipts. Bramah and Chubb sent their locks; but the interesting part of the matter, the mystery of lock-picking, would never have been brought to light, but for the accident of Mr. Hobbs having a lock there, so expensive that he saw he could not introduce it, unless he could first destroy all confidence in the cheaper, old-fashioned ones which he found in the shops.

But while there were so many objections to sending any thing really new and interesting, there was the strongest inducement to send every thing that was second-rate and unimportant, — every thing that needed advertising to sell it. The inducement was strong enough to bring together the greatest number and variety of objects ever put under one roof; all sorts of things good to eat, or to drink, or to wear, or to live in, or to be carried about by, or to look at,—from a group of statuary to a string of beads; and, however else they differed, they were all alike in one respect,—they were all things which people wanted to sell. The Exhibition, instead of being, as it was intended, a collection, scientifically arranged, of all the materials and machinery and products of the useful arts, was more like an immense shop-window, in which people put exactly those goods which they found could not be got rid of without vigorous advertising. The lecturers praise the disinterestedness of some parties, who sent samples of coal ore and other things, the sale of which the Exhibition could not benefit; but they admit the number of such disinterested people was very small. One lecturer calls it a great bazaar, where "the whole world of manufacturers" offered their wares "to the whole world of customers;"—a statement which suggests a reason for our manufacturers not going to the expense of sending their wares thither,—our customers being all on this side of the water. It is pleasant to find that the assignment of so absurdly large a space as was assigned for specimens from the United States, was their own blunder, not ours. It was not asked for.

The prize-medals, too, spoken of with great respect at first, got to have no other value than that of advertising cards. One lecturer admits, that, in his opinion, as rewards of merit, they were a fallacy. There were 2,918 of them given out; and the mode in which they were distributed does not seem exactly adapted to encourage the highest industrial efforts. Prince Albert got two medals; the Pacha of Egypt, the Government of Spain, the Bey of Tunis, and the Government of Turkey, one each. The prize for life-boats was given, not to any inventor or builder of life-boats, but to the Duke of Northumberland, for a collection of other people's models. W. Bond & Son's invention for a new mode of observing astronomical phenomena received the same council medal as Count Dunin's infinitely absurd automaton figure for tailors to try coats on. The same prize-medal was given for " Bailey's statue of a nymph," and " Simms's equatorials;" and for a " ham," " pickles," "a shirt," " tallow," a " towel," and a " broom."

It was expected that the Exhibition would be a great school for workmen, where each man would study out all the machines and processes that could be of use in his own trade. One of the lecturers says, " for the first time, has been placed within their grasp" — the humbler and working classes — " a knowledge of what has been done, what is doing, and by whom." It is possible the working classes understood this matter pretty well before; but if not, the Exhibition was no place to learn in. No Manchester workman would think of stopping to look at the imitation cotton-mill they got up in the Exhibition. No machinist would care to see the collection of lathes and planing machines, when he could see whole acres of just such machines in any manufacturing town. Workmen went to the Exhibition, certainly; but it is not necessary to suppose they went there to study. The diamonds, and the crystal fountain, the stuffed animals, and the Queen, might have attracted them. It is certain, that workmen and all utterly refused to attend the lectures given while the Exhibition was going on, to explain the objects they were supposed to have come there to study; and out of the 50,000 daily visitors, it was impossible to get decent audiences.

The real use of the Exhibition, it seems to us, was exactly the one never hinted at as a possibility by the originators of the scheme. It did not bring out novelties, it did not establish the doctrine of peace and love; there seems no probability that it will act, as expected, " as an antidote to war," and it has not improved the arts of peace, or taught the workmen any thing, so far as yet appears; but it evidently did teach the scientific men a great deal. In these lectures, by men of science, on the results, we think there is observable an uneasy consciousness of the extent of the workman's knowledge, — almost a doubt whether it was not for the workman to teach them, rather than for them to teach the workman, — very different from the lofty tone generally assumed by scientific lecturers, when they undertake to teach practical men about common affairs.

There is an irreconcilable difference of opinion on these points between the learned and unlearned classes. In our own country, the best authorities as far as learning can go, have said, "our arts have been the arts of science, built up from an acquaintance with principles;" "the application of philosophy to the arts has made the world what it is at the present day;" "the first great step in modern science was to enter the workshop, and superintend its operations." The Chairman of the Commission for the Exhibition says, "science discovers these laws, and industry applies them," the precedence being always given to science; and in Dr. Playfair's lecture, given after he had studied the Exhibition, we still find "science has been a prime cause of creating for us the inexhaustible wealth of manufactures."

These are not the opinions of the workman, perhaps from his ignorance and prejudice; but it is worth considering also, that they are, notoriously, not the opinions of the manufacturer, and he is not prejudiced. The manufacturer is just as ready to be taught how to make money by the scientific man, as by the workman. But while he gives merely a respectful assent to the assertions of the former, he is ready to risk his reputation and his fortune on the accuracy of the other's observations. He believes that the arts are in advance of the sciences, that science cannot superintend the workshop; and, if he has attended to the subject at all, he is apt to believe that, as a general rule, it is industry, and not science, that has discovered these laws "of power, motion, and transformation." His opinions imply no disrespect to science. Science is good for its own sake; and the old philosophers, when they insisted that it ought to be studied only for its own sake, were certainly nearer the truth, than these modern ones, who dwell exclusively on its petty applications in every-day life.

There cannot be a fairer way of examining this question between the workman and the scientific man, than to study this Catalogue, to see what the workman can do, and then the Lectures, to see what the other class have to say. The classification is so admirable that it makes even the Catalogue easy and instructive reading; and it is perfectly English in its character. The French had tried to classify "chemical, mechanical, economical," and, other arts; and at another time, "alimentary, sanitary, and vestiary," which sound something like the new names they once gave the months, — "nippy," "slippy," "dippy," &c., according to the English translation. The English took four classes, — Raw Materials, Processes, Manufactured Products, and Works in the Fine Arts; and then subdivided them again and again, into such groups as commercial experience had proved to be convenient.

Now, when we try to trace the good effects of science on the arts, we have to begin by giving up the whole of the fourth section, or the Fine Arts. Neither science nor industry has added any thing to the resources of the artist for these thousands of years. The ancients cut marble and cast bronze as well as the moderns, and sculptured granite and porphyry much better. The Hindoos, the lecturer on India says, have always understood the use of diamond-powder, in cutting hard stones, better than the Europeans do yet. There has been an enormous advance, certainly, in the facility of multiplying works of art by engraving, stamping metals, pressing clay, daguerreotyping, and electrotyping. But it is unpleasant to have to believe, that art itself is injured and deadened by these very facilities. For all our masterpieces, we have now to go back to a time when modes of copying were unknown, or difficult and little used. And these facilities have not even diffused the knowledge and enjoyment of the Fine Arts through a wider circle than formerly; in spite of the endless cheap engravings, woodcuts, and statuettes, most persons would doubt whether, of the fifty thousand people collected any day at this Exhibition, there were as many able to appreciate a fine statue, as would be found in a similar crowd in old Rome or Athens.

In the Useful Arts, there are many processes which might better be ranked among the Fine Arts, as their sole object is to please the eye; calico-printing and figure-weaving, for example; and it is admitted by the lecturers, that, as to these processes, whether or not they have been directed by science, they have not been advancing. The lecturers and newspaper writers, the School of Designs Committee, the public generally, all agree, that the European manufactures were utterly inferior, in point of taste, to the silks, and shawls, and carpets, the embroidery and jewelry, of Persia and India, where the arts have been stationary for thousands of years. And the point of taste is the only one for comparison. Infinite labor and ingenuity have been spent in contriving cheap processes of putting eight or nine colors at once on a piece of cloth; all to no purpose. The cloth is no better, and the eye is not pleased half as much as by the work of the Hindoos or Turks, with only two colors.

In another way, these arts, by their progress, often destroy the very pleasure they were intended to produce. There are many of the products of the arts, the principal merit of which is their costliness; to contrive a way for making them cheaply is contriving to destroy their value. The singular interest everybody took in the precious stones in the Exhibition was much commented on. It was not merely the money value of these objects, else a bundle of bank notes would have done as well. It was not their brilliancy; the Kohinoor itself was not as brilliant as its glass model at another table. Perhaps it was the uniqueness of the specimens, — the feeling of the difficulty or the impossibility of obtaining similar ones, — the same feeling that gives interest to a pencil-sketch as compared with an engraving, or carved stone-work as compared with iron castings. But the feeling exists in every one. If the border of a cashmere shawl could be made in a loom as cheaply as a piece of blanketing, nobody would be the better for it. It would degrade cashmere shawls to the level of blankets, and nobody but an Indian would wear one.

Of course, whenever an industrial process or product is found to be no better now, in Europe, than it was thousands of years ago, in Greece or Egypt, or than it is now in India or China, we are sure that science has had nothing to do with it, or at least, need not have had any thing to do with it. Accordingly, in the third section, "Manufactured Products," — we may throw out "Jewelry, and similar articles of luxury," and "Tapestry, lace, and embroidery." Then, "Decorative furniture" must also be put aside; for, from Wilkinson's book, it would seem probable, that we are as yet little in advance of the old

Egyptians in this respect. In "Cotton," it is certain we are behind the Hindoos. They sent a piece of cloth to the Exhibition, a yard wide and ten yards long, that weighed about three ounces. And they understand, too, the niceties of dressing the cloth, and making up the weight, when they please, with starch, as well as any European manufacturer. The lecturer says that, 2,600 years ago, a law was passed in India, forbidding their putting in more than ten per cent. of "Devil's dust."

In "Silk," the Chinese are not surpassed. In "Shawls," the Hindoos were not equalled. In "Leather," the lecturer says, "if Simon, the tanner of Joppa, had been able to send leather to the Exhibition, no doubt he would have carried off a medal." "Paper," it seems, came from China, by the way of the Moors in Spain. As to "Cutlery" and "Hardware," all that can be said is, that iron has taken the place of bronze. In "Glass," the Europeans cannot boast of progress till some one has equalled the Barberini vase and the glass mosaics from Egypt. The modern improvement of casting plate glass was the invention of a workman in a glasshouse. The improvements in making glass for optical purposes, it is well known, were not made by an optician or an astronomer, but by a Mr. Guinand, who got his living by making little bells for repeating watches. In "Porcelain," we are not beyond the Chinese for the material; and as to coloring, Mr. Brogniart said, in 1801, that every single invention had been the work of the artisans.

It is obvious that the remark of the lecturer about Simon of Joppa might be very much extended. He might have said that a similar Exhibition, if got up some thousands of years ago, would have been very nearly equal to this one of the nineteenth century, and very much like it, as far as the products only are concerned.

With the processes, it is just the reverse. It is as difficult to find a process that has not been improved, as a product that has been. Nearly every thing is made more cheaply, or with less labor, than formerly. Every modern improvement, from a printing-press to the electrotype, is an improvement to save labor; and in old time, there was little demand for these labor-saving improvements. India, and Egypt, and Europe too, to a late date, were slave countries; and labor-saving machinery is never invented in slave countries. Whatever, as philanthropists, we might wish to believe, slave labor is undeniably cheap labor, as the experience of Cuba and Jamaica shows pretty fully.

To go back from the last section in the list to the first thing described in the Catalogue, — the best thing, perhaps, in the Exhibition, — the Building itself. Was that a triumph of science? The official account says, it was projected by Mr. Paxton, who began life as a gardener's apprentice, and was afterwards a head gardener, — and carried out by Mr. Fox, who had been a working mechanic, and Mr. Henderson, a plain business man; and that the people who opposed it, and who proved by their science that it could not stand, and nearly frightened the public from venturing into it, were, according to Mr. Fox's account, men of high scientific attainments, the Astronomer Royal being the most prominent among them. It is often said, in such a case, that the inventors really were, and must have been, men of science, whatever had been their past history. But this is only quibbling on the words science and knowledge. Dr. Black and Mr. Watt both discovered the facts with regard to the latent heat of steam, and at about the same time. But the first was a philosopher in search of new scientific truths; the other was a half-taught mechanic, thinking of nothing but making a fortune by patenting new contrivances for using steam. To use Prince Albert's classification, in the first case, it was a discovery of "science," in the second, of "industry."

Take the first division of the first section, "Mining and quarrying," "Metallurgy and mineral products;" the lecturer, Dr. Playfair, asserts that "science is essential to progress in this department." But we think he fails to show that the progress hitherto made has been due to science, or that, in fact, science has had much to do with the matter. He begins with what is to us the most important mineral of all, — coal. Nobody knows how soft coal was first brought into notice; but as to anthracite, the facts are well ascertained. It was not the geologists, or chemists, who first called attention to its good qualities. In Bakewell's Introduction to Geology, (1828,) the writer laments that the coal of South Wales is anthracite, and therefore cannot be used. Anthracite was then in common use in Pennsylvania; and the Welchmen have since found out pretty well how to use it at home.

In connection with coal, the lecturer, of course, has to mention the safety lamp. This, certainly, was the invention of a philosopher, and the pertinacity with which it is always brought forward, intimates that such inventions are not very numerous. As to its utility to the miner, it certainly has not prevented colliery explosions; scarcely a week passes without one. In consequence of having these lamps, the men are induced to work in places that no one would think of entering with a naked light; and when there, if a single miner uncovers his light, or lights his pipe by sucking the flame through the wire cover, or if he drops his lamp, and a single mesh of wire is broken, or if a current of gas blows against it, or a particle of coal is inflamed by resting on it, the mine is blown up.

When the lecturer comes to the metals, he lays great stress on a new mode, invented by Professor Plattner, for working poor gold ores; but it is not pretended that it will supersede the regular processes of washing and amalgamation, — processes that are at least 2,000 years old. He then calls attention to Pattinson's patent method of desilvering lead, simply by melting the lead, and allowing it to cool slowly; nearly all the silver is found in the little portion of lead that cools last. It is easy to explain the reason, now the fact is discovered; but he does not show that the process was an application of science. It might be questioned, whether, a dozen or twenty years ago, before Mr. Pattinson tried the experiment, a chemist would have felt sure whether the lead that cooled first, or that which cooled last, would have contained the most silver.

The art of making iron is one above all others in which to look for the application of science; because it is carried to the fullest development only in highly civilized countries; and accordingly, the lecturer selects it as an example "of the teachings of chemistry." It was well represented in the Exhibition, as far as the products of the manufacturer are concerned, though, to be sure, there was scarcely any thing there that could not have been as well seen in the iron stores. The locomotive tires, and the rails, with the wearing part made of hard crystalline iron, and the rest of tough fibrous iron, which the lecturer mentions as novelties, according to the Patent Office Reports, are by no means new. Dr. Playfair does not explain, and it is certain, that, as a scientific man, he cannot explain, how it is that a manufacturer can make a bar of iron crystalline or fibrous at pleasure. The iron paper from Bohemia was the only real novelty, and one of no very obvious value.

But as to the teachings of science; the first thing is, to find the ore bed, and science is not needed for that, for the beds in Europe were discovered long before there was any such science as Geology, and the important ones in this country were all known and worked before Geological Surveys were thought of. The next thing is, to determine the value of the ore when mined. Chemistry has tried her hand here; innumerable analyses of ores have been made; the manufacturer has been perfectly ready to be taught, if the chemist could teach him. But we believe the result is, that he finds it safer to rely, and in fact, does rely, most on the opinion of the workman, who judges merely by his eye. It is said that, in Cornwall, the same practice prevails in buying and selling copper ores. It is not so surprising, either, that the manufacturer should thus judge; for his object is to know the value of a pile of ore weighing a thousand, or ten thousand, tons. An analysis of a piece as big as a pea is worth nothing, unless one is sure that the little piece selected was an average sample of the whole heap; and there is no other way of judging of this but by the eye; so that the two processes come to about the same thing.

Besides, science itself is at fault. The French chemists confess they can find no difference between the ores from which the Dannemora iron, the best iron in the world, is made, and the ores alongside, that are of so poor a quality as not to be worth raising. Then, in smelting the ores after they are mined, the chemists have done their best to assist, by analyzing the pig iron and the slag produced by the furnaces; but to no purpose whatever. The only rule to be found in the books is, that the workman should put into the furnace as much ore "as she will bear," and then as much limestone "as she needs," judging of both by his eye.

Dr. Playfair says of the smelting furnace, "The cold air blown in at the blast lowers the temperature and compels the addition of fuel." "Science pointed to this loss, and now the air is heated before being introduced to the furnace." "Could science do more?" We believe the fact is, science had nothing whatever to do with the matter. Instead of pointing to the loss, it certainly was always laid down in the books, that the colder and denser the air, the better; and the advantage of heating it was discovered entirely by accident, by a Mr. Neilson, engineer for a gas company, at a smith's forge. It might be doubted, from the sentences quoted, whether Dr. Playfair himself understands the subject as yet; for he does not seem to have considered, that it must take just as much coal to heat the air before it goes into the furnace, as was formerly required to heat it after it got in.

In answer to his question, "Could science do more?" he says, "Prof. Bunsen, in an inquiry in which I was glad to afford him aid, has shown that she can;" and he gives an account of their analyzing the gases escaping from a blast furnace, and proving that they could be used for heating the steam boilers. These investigations were not begun until years after nearly every furnace in this country that used steam power, from Maine to the Missouri Iron Mountain, had introduced this very process. There can be no mistake about the dates, for they were proved in court, in a late patent case in Philadelphia, the patent being for this very invention of heating steam boilers by the waste gases.

After all, the natural metals are of very little use in the world compared with the artificial ones,—the alloys. We do not use pure copper, zinc, tin, or even iron; but brass and bronze, pewter, type-metal, cast iron, and steel. The best bar iron, even, is always an alloy. The great and indispensable use of the metals is for cutting tools; and pure iron, or copper, or tin is not as good for this purpose as a sharp stone. Now, these alloys are not scientific discoveries; science cannot even explain their composition. No European understands very well how the ancients made their bronze chisels, if they were of bronze, or how the Chinese make their gongs and mirrors. Dr. Playfair, apparently, did not discover Mr. Estivant's secret for making brass, which received the great medal. From what he says of it, it is evident that it is not enough to know the ingredients; there is a further mystery in the compounding, as there is in making a bowl of punch.

A few years since, the best chemical knowledge in Great Britain was brought to bear on the subject of making steel; a costly and elaborate series of experiments was made, and the results all published in the Philosophical Transactions; and the only effect was, to give currency for a time to "silver steel," and "platinum steel," which the manufacturers have since found to be mere follies.

In the next division, "Chemical and Pharmaceutical processes and products," there was not much exhibited that had any general interest. The lecturer, curiously enough, considers the Exhibition may be of great value to the manufacturer by calling attention to the beauty of the crystals of prussiate of potash, sulphate of copper, &c., and by inducing ladies to use them as drawing-room ornaments. He says, "if the tide of fashion should set in that direction, an additional impetus will be given to industry among the manufacturing chemists." He must have a strange idea of the extent of the chemical manufactures in Great Britain. As to the drugs, it is commonly understood that the important medicines were not discovered by the learned, but either got into use nobody knows how, or were adopted from the example of savage or half-civilized nations. In fact, as far as unprofessional people can see, science does not show to advantage in the history of medicine and surgery. Inoculation and vaccination were opposed by the doctors, in solid column; and there are curious stories told, also, of the drummer-boys in the armies knowing how to cure flesh wounds by "sucking" them, hundreds of years before the army surgeons found out the right mode of treatment.

Among the chemical processes exhibited, the great novelty to the public was the artificial essences of pears, pine apples, and other fruits. The pine apple ice-cream in the saloons, it seems, was flavored, not with pine apples, but with something prepared from a mixture of sugar and putrid cheese; the flavors of the Jargonelle pear, apricot, greengage, and other fruits, were imitated by processes equally extraordinary; and the Lecturer says, "All these are direct modern applications of science to an industrial purpose, and imply an acquaintance with the highest investigations of organic chemistry." His account, though, leaves it in doubt whether it was the confectioner or the chemist who first discovered that the pineapple flavor could be obtained from putrid cheese. We do not know which is the true story.

As to the next two classes, "Vegetable and animal substances used as food, or in manufactures," — certainly we do not owe the knowledge of the utility of these substances to science. Dr. Whewell says, "Tea, coffee, tobacco, sugar, cotton, have made man's life, and the arts which sustain it, very different from what they were in ancient times;" — thanks to commerce, not science. Men did not wait for naturalists to teach them what animals could be domesticated, and how the breeds could be improved. They knew how to graft and bud a tree, and when to tap it, before the philosophers knew any thing about the motion of the sap. Preparing the substances for food, or the great art of cookery, is not the work of scientific men. The art of preserving them, in the modern style, in air-tight canisters, may be an application of science, but certainly would not be a very difficult or far-fetched invention for a skilful cook to make. The new meat-biscuit, that attracted so much attention, made of fresh beef boiled down, kneaded with flour, and baked, was invented not in a European laboratory, but at Galveston, in Texas. In the list of processes for preparing these substances for use in manufactures, the great modern invention, every one would agree, is that of vulcanizing India rubber. By merely rubbing together India rubber and sulphur, and heating them with certain precautions, a totally new substance is produced, — something that will neither melt nor freeze, nor be attacked by acid, or oils, — nearly as hard as metal, and yet more elastic than the India rubber it was made from. It is a chemical discovery, certainly; but the mere statement of the process shows it could never have been discovered by a chemist; he would not have tried the experiment, it would have appeared so silly and hopeless.

In the second grand section, "Mechanical Inventions," we should have a right to look, if anywhere, for the applications of science. The different divisions were represented very unequally, as might have been expected. There was an abundance of musical, surgical, and philosophical instruments, and contrivances for domestic use, — all sorts of things that were small, and pretty, and such as it was desirable to advertise. On the other hand, wind-mills and water-wheels, of course, could be sent only in the shape of models. Steam-engines are generally too bulky and costly to be sent to an exhibition; and the leading manufacturers are also too few, and too well known, to care for the advertising. There were several engines there, but by no means enough to give a fair representation of the different kinds now in use, even in England alone.

As it was the business of the Lecturers to report on the objects exhibited, they were led to say scarcely any thing on the most important point of all in this department, — the modes of obtaining power from wind, water, and steam. No doubt, they would have claimed all these modes as applications of science, for they commonly are so claimed, — the steam-engine, in particular. It may be worth while to look, for a moment, at the admitted facts in the history of these inventions, to see whether they sustain the claim.

Wind-mills, it is admitted, were invented by the millers, and left to them to manage, until at last the mathematicians happened to take up the subject, and investigate scientifically the proper shape and angle of the sails. But Smeaton says he found the mill the mathematicians produced would grind only eight bushels of corn, while a common unscientific Dutch mill, of the same size, would grind sixteen.

As to water-wheels, in England and this country, the millwrights were left pretty much to themselves. They introduced most of the different kinds of wheels now used, so long ago that their history is forgotten; and they knew how to select, in each case, the best wheel for the purpose. If a cheap, light wheel, running fast, was wanted, in a place where workmanship was expensive, and water power abundant, they used an under-shot wheel, or a tub wheel. But if it was an object to economize water power, they always used an upright wheel, and put on the water, with as little shock as possible, at about "half past ten,"—that is, at that point in the circumference corresponding to half past ten on a clock-face. These facts are all admitted in the books, and it is also admitted, now, that the makers were right in their selection. But in scientific works, attention is not often called to a striking instance, in France, of the effect of applying science to this subject. The mathematicians there demonstrated, to their own satisfaction, that an under-shot wheel, where the water acted by the "shock," always was, and, in the nature of things, always must be, more efficient than one of these "gravity" wheels, where it acted only by its weight; and, it is said, they succeeded in inducing the millers to take out their "gravity" wheels, that would give practically sixty per cent. of the total possible effect of the water, and put in these "impulse" wheels, which would give but thirty per cent., and that the effect of their "teachings" can be seen in some parts of France even to this day.

Again, to see the effect of applying science, take the history of Barker's recoil mill, in England. After various contradictory conclusions had been arrived at by the scientific men who discussed the subject, we find Davies Gilbert, Esq., President of the Royal Society, undertaking to give it the *coup de grâce.* He demonstrated, by mathematical reasoning, that "the recoil engine cannot, in any case, be employed to advantage." It is employed, though, and very extensively, in Scotland and this country, and is found to be about as efficient a wheel as can be made.

In the modern *Turbine*, science certainly has been applied to advantage; but science was not necessary to its invention, for, in some of its forms, it is but a slight modification of the old *Danaïde* of the French millers; or to enable a millwright to understand and use it, for, we believe, he would soon learn by experience how to draw the curves, and regulate the speed, so as to produce the best effect.

The history of the steam-engine has been written a thousand times; and yet attention is seldom called to the glaring fact that its progress was, all of it, due to unscientific men, and was constantly in advance of the science of the day. Taking the English account of the invention, we have, first, the Marquis of Worcester. His "Century of Inventions" shows him to have been eminently unscientific, passionately fond of mechanical contrivances, but with no love of abstract truth, and not the least desire to follow out and explain the *rationale* of the extraordinary ingenious processes he hit upon. Then came Captain Savery, not an educated gentleman in the army or navy, but called "Captain" because he was a head miner; — then Newcomen, a blacksmith, Cawley, a glazier, and Humphrey Potter, a little idle boy; and then Watt, a half-taught instrument-maker, who earned his living, at first, by mending fiddles and fishing-poles. It is usual to claim much of the merit of his inventions as due to Dr. Black, in spite of Mr. Watt's own assertion that he discovered every thing about steam, that he needed to know, entirely by his own experiments; and yet, Mr. Watt's assertions might be relied on, for he had the highest possible character for fairness and candor. And as to the progress of the invention being in advance of the science of the day, it is sufficient to refer to almost any English or American work on the subject, from Mr. Watt's time down to ten or a dozen years ago, to find it laid down, that the most efficient engine was a low-pressure, condensing engine, in which, of course, there was but little chance to gain power by expanding the steam, and that the speed of the piston should bear a certain strange relation to the square root of the length of the stroke. Meanwhile, the practical men in this country insisted, as everybody knows, on using high-pressure, "expansive" engines, and running them at a speed utterly in defiance of the mathematical rule. And all this while, it seems that the practical men were right. In 1845, we find William Pole, "F. R. A. S. &c., Lecturer on Astronomy and Steam Machinery to the Indian Navy," telling his countrymen that they had been all wrong in this matter from the beginning. He says, "it must startle English engineers not a little to be told, that the high-pressure engine is both safer and more economical in its use than the low-pressure condensing one." Still, he does, in effect, tell them so, and the number of high-pressure engines, sent by English makers to the Exhibition, shows they have begun to think so too. And as to the speed of the piston, the lecturer on machinery admits, that engine-drivers often run their engines four or five times as fast as the rule would allow, and that it must be given up as mere nonsense.

Following the classification of the Catalogue, we come now to "Machines for direct action, including carriages, and railway and naval mechanism." The steamboat, it is understood, was invented either by Fulton or Jonathan Hulls, neither of whom was supposed to be a particularly learned man. Railways were introduced by the coal-miners; and as to the locomotive, the story is well known, that Stevenson, the practical mechanic, asserted to a committee of gentlemen from the House of Commons, that he expected to see engines run more than ten miles an hour, and some of the committee afterwards inquired of his friends if he were not subject to fits of derangement.

In hydraulic machinery, there was one modern improvement, Appold's centrifugal pump, that received a council medal. It looks, though, very much like the other rotary pumps, that have been so often invented, and so uniformly abandoned after trial. The good old cylinder pump, that nothing apparently can ever supersede, was in every-day use 3,000 or 4,000 years ago; and yet, in all the books is to be found the incredible story, that, 200 years ago, a pump-maker made a sucking pump fifty feet long, expecting it would work, and had to go to Galileo to know why it did not. A pump-maker must have known how long to make his pumps, though he might not know any thing about the pressure of the air;—an Indian hunter may know nothing about the resistance of the air, but he knows perfectly how far his gun will carry. Ewbank, in his Hydraulics, suggests that the pump-maker made a fifty-feet pump, simply because it was ordered and paid for.

In the same division came the modern power-presses, well represented in the Exhibition, and much commented on by the Lecturers. Presses were exhibited there, almost as much superior to the hand-press, as this was to the old mode of transcribing; and, fairly considered, they are as great an invention as the printing-press itself. The invention of separate types enabled a man to make 200 copies, instead of one or two, in an hour; and the invention of the glue-and-molasses inking roller enables a machine to throw off 10,000 in an hour, and very likely the number will soon be 50,000. It all depends upon the glue-and-molasses roller, — a most particularly unscientific-looking invention; for the moment this was introduced, it was the most obvious thing in the world to put the paper on another roller to be printed.

In this same division are the "Machinery and tools for working in wood and metal," of the utmost importance in modern industry, and invented, every one of them, according to the Lecturer's account, by the workmen. In fact, science has had little to do with the whole class of automatic machinery. Contrivances to make iron arms and fingers perform some process that was before done by hand, we should expect, would be made by the men who were most familiar with the process, had been employed at it themselves, and knew exactly the movements required. But after the contrivance had been invented by the workman, the scientific men might be expected to examine and discuss it, explain the theory correctly, and show the workman exactly what it was he had invented.

Now, take one of the last instances, one of the finest modern machines in the Exhibition, — Nasmyth's direct-action steam-hammer and steam pile-driver. Mr. Nasmyth takes an upright inverted steam cylinder, and attaches the hammer, a heavy mass of iron, to the end of the piston rod; the admission of the steam raises the hammer, and the escape of the steam lets it fall. So far there was nothing new; the plan had been suggested by Mr. Watt. The whole novelty was in the peculiar and beautiful contrivance for making the jar of the blow open the valves for the next stroke. This machine, patented in 1842, was brought to the notice of the British Association in 1845, and the theory explained in a way that must have astonished Mr. Nasmyth. The Lecturer considers this "brilliant invention," as he calls it, to consist in using a heavy weight raised a small distance, instead of a light weight raised a great distance, as in the old pile-driver.

He says that it requires as much steam to raise one ton four feet, as four tons one foot, — to which a mechanic would be ready to assent; and then, that four tons falling one foot produce twice the effect that one ton does falling four feet, — a proposition that no mechanic in the world will agree to. He makes the old philosophical mistake of confounding "laboring force" with "moving force," — a mistake that no mechanic could ever make. His calculations are omitted, for some reason, in the Official Report of the British Association; but a *verbatim* report of the lecture is to be found in the July number, 1845, of the Glasgow Mechanics Magazine.

With the next division, of "Civil engineering, architectural and building contrivances," it is not so clear that the arts are essentially in advance of what they were thousands of years ago. Roads and bridges, canals and aqueducts, and even syphons under the bed of a river, are very old affairs. It was a "severe strain" to the science and art of France, to erect one obelisk in Paris, while the Egyptians used to plant whole avenues of them. And in building contrivances, there is nothing more elegant in a modern house than the manner, seen at Pompeii, of warming bath-rooms by hot air in the hollow floor and walls.

Gas-lighting is undeniably modern. It is always seized upon as a grand example in the books. "Chemistry lights our houses with her gas," we are told. Now, a work in the hands of every gas engineer, "Clegg on the Manufacture of Coal Gas," gives a full history of its introduction, and a most instructive one. According to this account, it was first used by a Mr. Murdock, who was employed at a mine in Cornwall, and then taken up by Mr. Clegg, a working engineer, and introduced into cotton-mills. Mr. Clegg then came to London, to introduce it, and science was brought to bear on the subject for the first time. Sir Humphrey Davy sneered at Mr. Clegg's plans; Sir Joseph Banks, and other members of the Royal Society, reported against them. Parliament passed laws interfering with the manufacture. Still Mr. Clegg persevered. He laid down the pipes on Westminster Bridge, and lighted the lamps every night himself; and he forced the thing through at last, in spite of Sir Humphrey Davy and the Royal Society.

In the next division, comes "Naval Architecture." There is no pretence that science is the basis of this art. It is not supposed that the lines of the yacht America were calculated by mathematicians, seeking for the "solid of least resistance." The Lecturer on India finds that the lines of this yacht correspond with those of the Sampan of the Malayan Seas. She had already been proved to be a copy of a Deal fishing-boat, and to be nothing but Mr. Scott Russell's wave-line boat. It is to be hoped it will not be denied, that, somehow or other, she was really built in New York. In the lecture on Naval Architecture, there is a fine instance of the assumptions sometimes made by learned men in behalf of their class. The Lecturer dwells earnestly on the importance of lifeboats on the coast of such a country as England. He gives a full history of their invention and improvement, and shows that, from the beginning to the end, it was the work of boat-builders and shipwrights, — Beeching of Yarmouth, Hinks of Appledore, Bromley of Sheerness, and so on; and concludes by saying, — "it affords additional evidence that many of the working classes are thinking men, and it evinces a desire to improve, that is highly creditable to them." Really, there is a sort of intelligence sometimes manifested among the working classes, highly gratifying for a gentleman to observe.

The other part of this same division, "Ordnance, armor, and accoutrements," was exceedingly well represented; every thing was there, from the Hindoo chain-mail to Colt's repeating pistols. The Lecturer doubts whether they had any right there at all; but we believe some one suggested, that, as the Kohinoor and other trophies of war were exhibited among the products of industry, it was but reasonable to exhibit the implements of the particular kind of industry by which they had been procured. Other writers, in discussing the question whether they ought to have been exhibited, dwell on the stereotyped assertion that the invention of gunpowder was a great gain to the cause of humanity. It is difficult to see how. Gunpowder, unluckily, is just as efficient on the wrong side as the right, as Punch intimates in his picture of a burglar carefully studying the mysteries of Colt's revolver.

The history of the successive inventions in firearms affords excellent instances of the way in which the same thing is often invented, and reinvented, again and again, until at last it stands, no particular reason appearing why it did not succeed the first time. In the Museum of Artillery in Paris, all sorts of revolving barrels and many-chambered guns are to be seen, introduced when the old wheel-lock was used, again invented with the flint, and again with the percussion lock. There is one old contrivance there, that has never been repeated, some practical difficulty being in the way; but it has a charming simplicity. Several charges are put at once into the same barrel, one on the top of the other, and then fired in succession by a sliding lock.

In the division of "Manufacturing Tools," an American would naturally look at the cotton machinery, exhibited in detail there, in all the processes. It has been said, by a high authority, that "not a little of the spinning machinery is constructed on principles drawn from the demonstrations of transcendental mathematics." And yet it is well known that the inventors were Wyatt, a Birmingham mechanic, Hargreaves, a common laborer, Arkwright, a barber's apprentice, assisted by Kay, a watchmaker, and followed by Crompton, a weaver. They left nothing for the mathematicians to invent but the double speeder; and that, it was proved in a patent case, was invented simultaneously by Paul Moody, a mechanic here, and by some other man, said to be a workman, in Great Britain. The double speeder is the only one of the machines to which it is conceivable that transcendental mathematics could be applied; and it is not very easy to see there, why the four rules of arithmetic would not do as well. The yarn is spun, and delivered to the bobbin, at a regular rate, and the bobbin must turn just enough faster than the flyer to wind it up. Every schoolboy that ever wound a ball of twine can see, that, as the bobbin gets full of yarn, it winds up more at each turn. Accordingly, the fuller it gets, the slower it must turn; and it would seem as if, by measuring a full bobbin and an empty one, and counting the number of layers of yarn, a workman could find out how much the speed should be slackened for each layer.

The power-loom was the only thing wanting; — that, it seems, was invented by a clergyman, Dr. Cartwright, not because he was acquainted with the hand-loom, for he says he had never seen one, but because he had seen the automaton chess-player, — and as he told his Manchester friends, he was sure it must be easier to make an automaton weaving-machine than an automaton chess-player. His illustration was a bad one, for it has been pretty well proved since, that the chess-player was not an automaton at all, but was moved by a man concealed in the chest. Still, the argument was unanswerable, though how any one could suppose that a piece of mechanism could play chess we cannot imagine: a man might as well say he had seen an automaton that could guess riddles, or bet on the race-course. It is a little curious that Vaucanson, who made real automata, also made a power-loom, thirty years earlier than this one of Dr. Cartwright's, and vastly superior to it, though, for some unaccountable reason, it was never brought into use. In fact, a power-loom was a trifle to a man who made the famous "Automaton Duck;" at least, if it were, as it was said to be, the same automaton that was exhibited in this country two or three years since.

Another automaton exhibited here, which attracted no attention, and was slighted as a mere toy, was evidently made on the principle of the Jacquard loom for figure-weaving, the great "sight" always for visitors now to the manufacturing towns. Mr. Jacquard, by the way, was no exception to the rule that the great inventions are all made by workmen. He was a straw-hat manufacturer. With the automaton, the visitor selected any one of a number of porcelain disks, with questions printed on them, shut it up in the drawer of the machine, and the right answer was immediately exhibited above. It was managed exactly in the same way as the cards in the Jacquard loom are used, to bring out the pattern, the weaver having no need to know what the pattern is that he is to weave. It was quite an old invention, very likely older than the Jacquard loom; for it is well known that many of the modern refinements in mechanism were introduced in automata, before they got into use in the manufacturing machines. Some of these automata are still unequalled for the delicacy and refinement of their mechanical contrivances. There was a little figure that drew pictures, exhibited in Boston a few years ago, that, for mere mechanism, was as far beyond a chronometer as that is beyond a smoke-jack. The hand was moved by levers which pressed on variously shaped wheels in the box below; it would require nice calculation to determine the shape of the wheels needed to make the hand describe a simple circle; but when it comes to a complicated drawing, — for instance, of a man-of-war, which the figure drew perfectly, every line in the rigging being shown, — the amount of labor required is perfectly appalling.

There is one art, naturally suggested by these automata, that, like them, had no place in the Exhibition, though it well deserved one, either among the Useful Arts, or the Fine Arts; and that is, the art of juggling. It is interesting, at least, as being one of the oldest arts in the world; and besides, like so many other arts, it has often been in advance of science. The jugglers used to handle melted lead and white hot iron, hundreds or thousands of years before M. Boutigny made his experiments. The magic bottle, from which any one of a given number of liquids can be poured at pleasure, will be allowed to be a delicate hydraulic contrivance; and yet it can be proved that it was in use at least two thousand years ago, long enough before the science of hydraulics existed. But we believe the real use of the art is, as Beckmann, in his History of Inventions, says, "that it serves as a most agreeable antidote to superstition, and that popular belief in miracles, exorcism, conjuration, sorcery, and witchcraft, from which our ancestors suffered so severely." If Beckmann were alive now, he might think the posterity of our ancestors was suffering slightly from the same cause, and he might be induced to substitute the words "scientific belief" for "popular belief." It was not so much the lower class, as it was men of education and standing, who believed, a few years since, in Prince Hohenlohe's miracles and Joanna Southcote's messiahship. It is principally the scientific men now who believe that a mesmerized patient can see through a pine board, or a brick wall; and even the last phase of "belief," the idea that, at any time, for a quarter of a dollar, a ghost will come into the room and tip over the table, it is well known, is not confined to the class of uneducated people.

To these kinds of "belief," the study of the elaborate French treatises on juggling, in their Encyclopedias and *Manuels*, could hardly fail to act as an antidote. The student would find that, at least, there was nothing new in the mesmeric exhibitions and the "spirit-rappings"; that the juggler had always known how to perform them, though whether or not his process was the same as that which the mesmerizer and "medium" used, remains to be seen.

For instance, the Hindoo jugglers have always had the art of "snake charming." By mere gestures, and the beat of a drum, they compel a snake to come out of his hole, and to come into their basket,—a perfect parallel to the exhibitions of the mesmerizers, compelling persons among the audience to come up to the stage, by merely willing it, and making gestures. The Hindoo trick consists in training a tame snake to come to be fed at the sound of the drum and smuggling him into the hole just before the performance begins; and with the mesmerized patient, it is barely possible there may have been some slight training beforehand.

So, too, the jugglers were in advance of the "biologists, in exhibiting muscular rigidity in the patient, induced by the will of the operator." It is an old trick of the jugglers, when they find they have got a subject sufficiently "impressible," or, to use a more familiar phrase, sufficiently "soft," to tell him, with a certain look and tone, that he cannot open his hand; and, true enough, he cannot open it, as he asserts and believes.

Admirable *clairvoyant* experiments have always been performed by jugglers, sometimes by the help of such devices as concealed mirrors, or cards so marked as to be distinguished by the touch,— more often, by means of a well-arranged code of signals with a confederate. And as to spirit-rappings and tippings, a very slight acquaintance with the material resources of the juggler, in the way of hairs, wires, trap-doors, &c., would show how they could be imitated. No doubt, to make a successful *clairvoyant*, or spirit-medium, a person should possess, in a high degree, the peculiar intelligence and tact of the old-fashioned fortune-teller; but for the mere experiments themselves, these treatises show that the most ordinary juggling tricks are abundantly sufficient; and so long as they are, it seems very idle to talk of ghosts, and "the mesmeric fluid." It is a cardinal rule in philosophy, never to invent a new cause, as long as the old ones, known to exist, are sufficient. It would be the easiest thing in the world to try an *experimentum crucis*, and settle forever whether mesmerism, "tippings," &c., were mere juggling. The *clairvoyant*, for instance, might prove he could always break the bank, in playing *rouge et noir*, or "twenty-one," by knowing the card before it was turned up;—the ghost might be induced to pick up an apple in the middle of the field, or to trundle a wheelbarrow down street in open day.

Mais revenons à nos moutons. A great industrial museum and school has often been attempted before; but certainly, never on such a scale, or with such advantages, as in this Exhibition. It covered eighteen acres of ground, and cost millions of pounds; the Queen and the Prince gave all their personal influence to it; all the European governments aided, and a body of the most distinguished scientific men in Great Britain devoted to it all their time for months. And yet, as a museum and a school, it was, we believe, an utter failure. If it really had contained, as was intended, all the materials, and all the machines, and all the products, of the arts, it would have covered, instead of eighteen acres, more than eighteen square miles. The machines and tools for working in wood or metal, for instance,—the patented ones alone,—if placed in a row, with room to work, would extend some leagues. Or, take calico printing: suppose there were to be exhibited samples of every tree and shrub, every animal substance and every mineral, from which the drugs are obtained, then all the drugs, and all the processes for obtaining them, and all their preparations when obtained, all the dyeing and printing apparatus, and all the different styles of patterns,—eighteen acres would not give half room enough.

And the museum must be perfect; every process and machine, in use and out of use, must be there, or the inventor cannot go there to see if his invention be really new; any doubt about its completeness destroys its utility. It is easy enough to see, in the manufactories, almost all the processes, and in the shops, almost all the products. The very use of the museum is to give absolutely all. So far as they go, the manufactories and the shops are vastly superior to any formal exhibition. Machines should be seen at real work, not at make-believe. Manufactured articles must be handled, smelled at, tasted, — not merely looked at in a glass case. A wine-grower would hardly think of studying his trade by looking at the labels of a long row of sealed bottles, standing in a museum.

The plan itself, we believe, was simply, clearly, one impossible to execute, — one that no manufacturer, no person who knew what manufactures really are, in extent and amount of detail, would ever for a moment have supposed to be possible.