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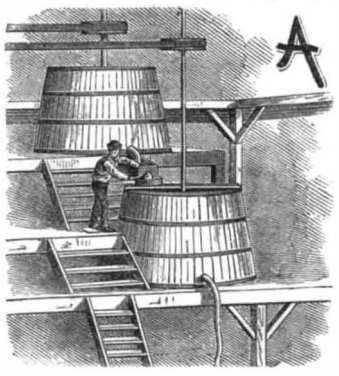
PORCELAIN MANUFACTURE IN NEW YORK.



Augustus II., Elector of Saxony, was of a scientific turn of mind. He loved Science, however, not for its own sake but for his own: in other words, for what he could make out of it. Consequently, when the staid citizens of Berlin drove from their city an unfortunate apothecary's assistant, whose mysterious operations with retort and crucible savored of the black art, he received the outcast with open arms, and shut him up in a laboratory with instructions to fill up the somewhat depleted electoral coffers with gold produced by the aid of the philosopher's stone, at his earliest possible convenience. John Frederic Bottcher, for that was the exile's name, had learned by experience the futility of such speculations; but, in obedience to the sovereign command, he undertook it, and began operations by making some new crucibles from the clay nearest at hand. When these vessels were fired, to his astonishment he recognized in them the appearance of oriental porcelain, and lost no time in communicating his discoveries to his patron. That business-like individual, promptly appreciating the fact that there was more gold to be made in selling the ware than in hunting the marvelous stone, at once locked up Herr Bottcher and his secret in the strong fortress of Albrechtsburg, and then and there embarked in the pottery trade. Now, like every other inventor, before or since, Bottcher was dissatisfied. He could produce red and white stoneware of great fineness, resembling porcelain, but true porcelain baffled his efforts, and such porcelain, he argued, he must produce or remain unhappy.

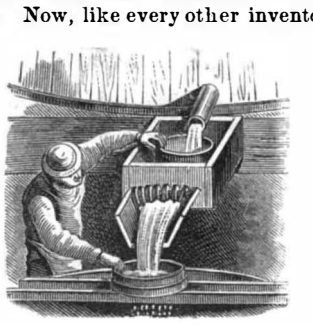


Fig. 3.—THE MAGNETS.

Meanwhile there lived in the neighborhood an ironmaster named Schnorr. Schnorr's horse one day, while his master was on his back, came to a standstill with all four feet stuck in the mud, causing Schnorr to dismount and, doubtless with sundry hearty Teutonic objurgations, to extricate him. Schnorr was not so angry, however, as to prevent his noticing that the mud was pure white, although astonishingly sticky, and it occurred to him that, if he could make the material into a powder, there was the stuff for the wigs of the gentry and, at the same time, the basis of a fortune for him. This idea he put in practice; the powder sold well, and in the course of time fell into the hands of Bottcher's valet, and thence upon the head of Bottcher himself. Bottcher one day, after an application of the substance, discovered that his wig was remarkably heavy, an annoyance, in fact, which interfered with his cogitations over his pet problem. So he removed the covering and, at the same time, whitened his fingers with the powder. He looked at the stuff for an instant, noticed its greasy feeling, and then the thought flashed through his mind: "Why not try this for porcelain?" The next paste that entered his kiln contained the ingredient, and that paste emerged white porcelain. The riddle was solved.

At once every workman was sworn to secrecy under penalty of death. "*Geheim bis ins Grab*" (be secret to the grave) appeared in large letters on the wall of every work room. Even the Elector took the oath, which the laborers repeated monthly, and the factory at Meissen became a fortress fully garrisoned and armed. This was in 1715. One man, however, escaped to Vienna, and betrayed the secret. At once other factories sprung up, and their numbers extended throughout German Europe. France looked on with undisguised jealousy, and set her chemists hard at work. It was reserved for a woman to do that in which the wise men failed. The wife of a surgeon, living near Limoges, ran short of soap for her week's washing. She was too poor to buy more, and hence attempted to use a white unctuous earth found in a ravine hard by. Her husband showed the strange clay to the village apothecary, and he in turn told the chemists, who recognized in it the kaolin of which they were in search. Thus sprang up the great factory at Limoges, and then that of Sevres, both famous to this day.

To trace the course of the porcelain industry for the last hundred years would cause us far to transcend our present limits. Suffice it to say that it is now one of the first in the world, and that the earlier products have been made the subjects of manias which have run their value up to sums far exceeding the actual weights of the articles in gold. We eliminate a century's labor abroad, then, to come at once to the introduction of the manufacture into this country sixty-five years ago, when we find the first record of a company being chartered to manufacture the material from kaolin found in Vermont. Later still, in 1819, Dr. H. Mead began porcelain manufacture in New York, and in 1827 William Ellis Tucker had established a porcelain factory in Philadelphia; while another of considerable extent, employing one hundred persons, had sprung up in Jersey city. Since then the manufacture has been continued, and at the present time the porcelain produced in the neighborhood of this city is, in many respects, equal to the best imported ware.

Fig.1.—MOLDING THE WARE.

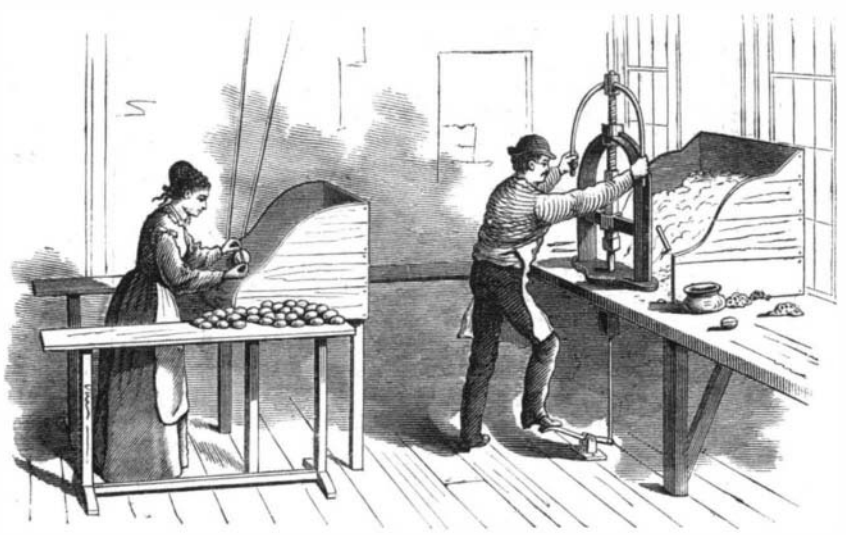


Fig. 2.—PRESSING AND TURNING SMALL WARE.

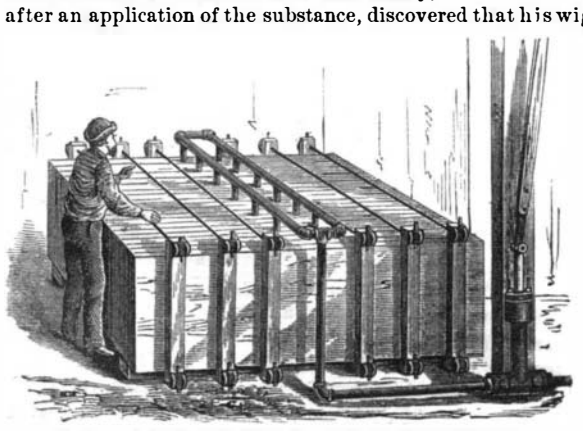


Fig. 4.—PRESSING THE WATER FROM THE SLIP.

We now proceed to describe the processes as carried out in one of the oldest and largest establishments in the United States, premising, however, with a few words as to

THE MATERIAL OF WHICH PORCELAIN IS MADE.

Porcelain clay or kaolin (the word is derived from the name of a mountain in China where the substance abounds) is a silicate of alumina, and has an average composition of 47 per cent silica, 40 of alumina, and 13 of water. It comes from granite rock which, by natural causes, is decomposed, so that the felspar and quartz are separated. The potash extracted from the felspar leaves the kaolin in a soft unctuous condition, white and opaque, and with a characteristic odor when breathed upon. In this condition, it is exported hither from certain districts of England, and is combined in suitable proportions with felspar and quartz. It is unfortunate for the industry here that the necessity exists of obtaining the ingredient from foreign sources, as there is no reasonable doubt but that ample beds of the material exist within our own borders, which careful search and careful development might soon render available.

THE FACTORY

which we recently visited is located in Greenpoint, Long Island, opposite this city, is known as the Union Porcelain Works, and is owned by Messrs. T. C. Smith & Sons.

Fig. 5.

MIXING THE SLIP.

After the kaolin has been combined, as above noted, with felspar and quartz, it is thrown into a huge vat, and there mingled with water to the consistence of a thin paste. This operation we found in process in a lofty lower story. Inside the vat a vertical shaft, supporting a number of radial arms, kept the slip, as it is technically termed, in a state of constant agitation, as the liquid slowly escaped from an orifice beneath into a sieve held by a workman there stationed. The sieve was constantly shaken, and the slip continued its sluggish course down a short channel and between two sets of horseshoe magnets, some horizontal, others perpendicular. The object of these, we were told, is to remove every fine particle of iron which the mixture may contain, for, as we afterwards saw, each speck of the metal, however minute, appears as a black spot on the snowy surface of the finished china. From the magnets (Fig. 3) the liquid ran into a second sieve held by the same man, faucets suitably located enabling him to check the flow at pleasure, and thence into a second vat located on a lower level, where similar apparatus to that already noted kept it stirred. With the initial letter which heads this article, there is a small drawing which shows the arrangement of the vats, after escaping

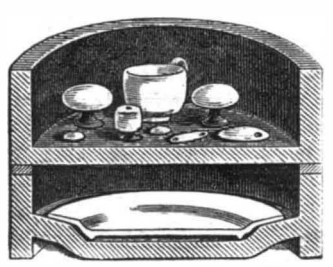


Fig. 6.—THE SEGGARS.

from the last of which the slip is led into storage bins or tanks. The next operation is

SQUEEZING THE WATER FROM THE SLIP,

and to this end the paste is pumped from the bins and into a peculiar press which is represented in Fig. 4. This may be compared to a series of heavy wooden trays set up on end and held together by strong iron bands. Between each pair of trays is a cloth bag, and with each bag a supply pipe communicates. A powerful force pump drives the slip into the bags under a heavy pressure, and an ingenious valve, which may be weighted as required, regulates the backward tending force, and by lifting at the proper time prevents the bursting of the bags. The result is that a large quantity of water is expelled, and the material emerges a heavy dough. This is worked and kept for some time before using as ageing is said to improve it. The Chinese, by the way, have a tradition that the material for their old porcelain was stored away for a hundred years before use. The French missionaries, translating the words "for a hundred years" into their own language, "*pour cent années*," afterwards corrupted the latter phrase into the word "porcelain."

Passing from the press room to another apartment, we were shown an immense heap of smashed crockery. All this, we were told, is utilized, and in fact made over again. The fragments are ground to a coarse powder under two huge revolving burr stones, each weighing some two tuns. This powder is again ground in an ordinary mill, and in its fine state, is mixed with water to go through the regular process. The operation of

MAKING SEGGARS

next claimed our attention. A "seggar" (Fig. 6) is a tray of common baked Jersey red mud. It has no cover, and its depth varies according to the piece of ware it is to contain, during the baking of the same in the kiln. The clay is mixed to a thick plastic mass in a pug mill and subsequently pressed in molds to any desired form. Baking follows, and the finished seggar emerges looking like a piece of coarse red earthenware.

Leaving the lower stories, we ascended through large brilliantly lighted rooms and past tier on tier of crockery in all stages of manufacture. Scrupulous cleanliness pervaded everywhere, and, save the slight whizzing sound of machinery no noise was heard. The workmen—and, very singular to add, girls too—labored silently, obeying the placards commanding stillness, which, appearing on the walls, reminded us of the stern warning in the old German workshop a century ago.

MOLDING THE WARE.

"The potter's lathe," said our guide, "is obsolete here. We abolished that antique apparatus long since;" and leading us to a long table, he showed us a row of men, each one stationed before a horizontal revolving disk (Fig. 1). This, by a mere pressure of the knee on a lever, which threw friction gearing into operation, could be set spinning around. Beside each man was what appeared to be a number of short tubes (Fig. 5), irregularly shaped and made of the clay dough. The disk or rotating head being at rest, the workman placed thereon a mold, the interior of which was of the exact form of the exterior of a bowl. Into this he inserted one of his dough tubes, and set the disk in motion, pressing the plastic mass with his fingers, at the same time, out against the side of the cavity. Then he brought down into the latter a counterpoised metal blade, as shown in Fig. 1, which was so adjusted and shaped as to remove exactly enough material to leave the bowl of the requisite thickness, and at the same time to form its interior. The article, we were told, is subsequently put aside to dry, and, thus completed, is removed from the mold and is ready for baking.

There are very many objects which do not require the use of the revolving head, and are simply pressed into molds, some by machinery, others by hand alone. The machine used for door knobs, for example, is simply a screw press which forces the clay in the condition of moist powder into a properly shaped die. The knob, however, on emerging, is not everywhere round, and is therefore placed on a horizontal revolving spindle and turned. These operations on the knob are shown in Fig. 2. China heads for nails, casters, speaking tube mouths, and an immense variety of other porcelain goods for the hardware trade are made in similar manner.

(*To be concluded in our next.*)

A New White Pigment.

A Mr. Orr, of Glasgow, has recently taken out a patent for a white pigment, which he has endeavored to obtain by forming a compound of zinc and barium. For this purpose he takes crude barium sulphide, and lixiviates it. The supernatant liquid is then drawn off, and divided into two or more equal portions. To one, an equivalent of zinc chloride is added, and to this again zinc sulphate is added, and afterwards another portion of barium sulphide, the result being an intimate mixture of 1 equivalent barium sulphate and 2 of zinc sulphide. The precipitates, composed of zinc and barium, are collected and pressed to expedite drying, after which they are placed in retorts and brought to a red heat. While still hot, they are drawn into water, preferably cold, which, it seems, has the effect of increasing their density and imparting body to the paint to be made from them. They are subsequently washed and ground in water to a fine powder, or they may be first dried and then ground. The inventor states that, by increasing the number of additions of zinc sulphate, the quality may be varied. The pigment thus prepared is to be used in the ordinary way; and if it does but possess the covering power of white lead, and can be sold as cheaply, it will be undoubtedly a useful product, for zinc white retains its color better than any other white pigment in ordinary use.

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NEW YORK, SATURDAY, MARCH 20, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

CROSSING THE BOUNDARY OF THE EXPERIMENTAL EVIDENCE.

It is amusing to see how zealously the non-scientific world insists on the restriction of Science to verified fact, especially when we remember that the sole basis on which its opposition to Science rests is a stupendous hypothesis, not only unverified, but confessedly beyond the reach of human verification, the hypothesis of Divine revelation—something supernatural, superhuman, miraculous.

Professor Tyndall speaks of crossing the boundary of the experimental evidence in pursuit of an explanation of visible phenomena, and straightway a great cry is raised that he is no true friend of Science, or, at best, that he has been betrayed into a false and "unscientific" step in the heat of oratory and by the sympathies of his audience. The speaker disclaims any such apology, assuring his volunteer defenders that he said nothing in heat or haste; that he crossed the boundary deliberately, and said just what he meant to say.

The reply all but breaks the heart of these would-be guardians of the integrity of Science. The admission of imprudence and haste would have simply damaged Professor Tyndall's reputation as a scientist. The avowal of deliberate intention, they fear, will utterly destroy the claims of Science in popular estimation! If years of scientific training and investigation, they say, can produce no better result than to make a professor of Science carry his scientific teachings straight to conclusions in the regions of the absolutely unknowable, what becomes of the boasted virtues of the scientific habit and its supposed effects upon the human judgment and intelligence?

A sufficient reply to this objection would be that one of the chief virtues of a scientific training is, not to keep the mind's action wholly within the bounds of experimental evidence, for that would block all progress, but to enable it to cross that boundary when occasion demands, properly restrained by a knowledge of what is known and a conviction that what is unknown is certain—so far as experience goes—to be in harmony with the known. For this reason the hypotheses of a true scientist are to those of the unscientific or anti-scientific as the speculations of a wise man are to those of a theologian. In the one case the hypothesis, unverifiable though it be, has a basis in reason and reality; in the other it is very apt to fly in the face of fact, and set faith above reason. He would be a curious disciple of Science who should say: "I cannot understand, therefore I believe!"

Fortunately the anti-scientist cannot be unreasonable in all things. In the common affairs of life his mind works like other men's. It is only when his religious prejudices are involved that he kicks at the scientific method. Thus if he should find on his doorstep some morning an infant, with no discoverable clue to its origin, he would be as ready as Darwin himself to pronounce it a human child, born of human parents in the ordinary way, and placed there by human hands, though, under the circumstances, not one of these assumptions would be other than an unverifiable hypothesis.

In no case could we think of a true scientist as deciding otherwise. It is quite possible, however, to suppose that an ecclesiastic might hold a different opinion. "What has happened may happen." If one child, as he devoutly believes, came into the world without a human father, it is possible that this might have had a similar origin. Still more, if his church decreed it, he could not deny that the child was, like the progenitors of the human race, according to his theory, a direct product of creative power, with no parent but the Almighty. Under the supposed circumstances, this would be no less possible of verification than the scientist's hypothesis of human parentage; the two differ simply in the fact that the one has all the verifiable facts we have to support it, while the other has all known facts against it. The great virtue of Science training is to keep men from such unsupported vagaries, not to chain them down to demonstrable fact.

In his late review of Haeckel's "Anthropoginie," Professor Huxley touches this point in defense of the hypothesis of development as applied to living creatures, man included, and shows how few scientific problems, even those which have been and are being most successfully solved, have been or can be approached in any other way than by speculations passing the bounds of positively verifiable fact. "Our views respecting the nature of the planets, of the sun, and stars are speculations which are not and cannot be directly verified; that great instrument of research, the atomic hypothesis, is a speculation which cannot be directly verified; the statement that an extinct animal, of which we know only the skeleton, and never can know any more, had a heart and lungs, and gave birth to young which were developed in such and such a fashion, may be one which admits of no reasonable doubt, but it is an unverifiable hypothesis. I may be as sure as I can be of anything that I had a thought yesterday morning which I took care neither to utter nor to write down, but my conviction is an unverifiable hypothesis. So that unverified and even unverifiable hypothesis may be great aids to the progress of knowledge—may have a right to be believed with a high degree of assurance. And therefore, if it is to be admitted that the evolution hypothesis is, in a great measure, beyond the reach of verification, it by no means follows that it is not true, still less that it is not of the utmost value and importance."

The like is true of other current hypotheses in Science. They may or may not be ultimately demonstrated; many of them may be, and in all probability will be, supplanted in time by new hypotheses having a wider basis in verified fact; nevertheless, they are to be accepted provisionally, as giving the best expression and interpretation of phenomena as we know them, and used as "instruments of research" until something better is found. If the world of thought had waited for absolute truth before going ahead, it would never have got even so far as the crude hypothesis of the books of Genesis. To wait is to go to waste. As Professor Huxley has well said: "Active error may advance knowledge in its efforts to establish itself; and nothing is more remarkable than the number of great things, from the discovery of America to that of the antiquity of man, which have been brought about by the attempt to establish erroneous views. But sitting still and being afraid to stir, for fear of making mistakes, is certain to end in ruin, in Science as in practical life."

FOREIGN EXHIBITORS AT THE CENTENNIAL.

So far from there being a prospective lack of foreign exhibitors at the Centennial, it now appears that so many desire to avail themselves of the advantages offered that it will be impossible to accommodate all in the spaces allotted. The commissioners of several nations have already made requisition for greater areas than have been set aside for their respective countries, and applications, they state, are being constantly received. The German Empire, it is said, will make by far the finest display, both in kind and extent; Austria will follow closely, and her products, comprising the exquisite articles of *vertu* from Vienna, Moravian cloths, Bohemian glass, and Styrian and Carinthian iron, will together constitute an exhibit of great industrial interest. The marked eagerness with which each nation desires to secure prominent representation is noticeable on the part of the small countries, some of which have been assigned in couples to certain spaces. Thus, Holland objects to being assigned floor space conjointly with Denmark, and asserts through her commissioner that she can fill every inch of the space allowed, alone. Hungary will probably insist on a separate department, and refuse to be overshadowed by the Austrian display. Norway declines to be joined with Sweden, and both Scandinavian countries assure very interesting exhibits of iron, furs, and matches. Denmark offers a good display of Copenhagen manufactures, besides collections illustrating the manners, customs, and industries of Greenland and Iceland.

France will also crowd her space with silks, velvets, lace, jewelry, and the thousand productions in which her artisans