Just at this crisis, Mr. S. D. Colwell, an old friend of Mr. Sheehan, and General Freight Agent of the Erie Railway at Dunkirk, chanced to meet our inventor in the streets of that thriving town, and accosted him, with

"Well, Thomas, how are the grapples? I hear they have used you up."

"Yes," was the answer, "the grapples have done my business; I wish I had never seen them."

"Throw 'em away," advised Mr. Colwell. "Have you any now finished?"

"I have one almost done," said Thomas.

"Finish that; I will pay you forty dollars for it, and have it used for picking up coal at the dock. The money will help you in your present emergency, and you can go back to your old place in the shop and earn a good living for your family."

"I will," said Thomas.

Back to his humble home, went our inventor with new hope in his breast, and set himself to finish the grapple with all due speed. But, alas, upon what slender threads do the fortunes of men hang! A tap, the only one our inventor had of the size required, suddenly snapped asunder, and, as it was essential to the progress of the work, he must have a new one or he could not go on.

In this strait, he applied to his wife to lend him twenty-five cents to buy the necessary steel to forge the tap. But she, having no faith in the grapple, refused, for the two very good reasons—first, that she believed the money would be thrown away if she gave it to her husband; and second, that she had not the money to give him, even if so disposed. The refusal was seasoned with some very hot word-spice that made it very unpalatable to Thomas. But he bethought him of a merchant, who, in brighter days, had seen the color of his money, and who, perhaps, would now give him credit for the small modicum of steel he required for the tap.

To this merchant he hied, and, somewhat reluctant to prefer his request, began beating about the bush; and, finally straying into politics, hot words passed between them, and our friend, feeling his manliness would suffer too keenly by asking credit for the steel, came away without it.

With no definite purpose he went home, pondering upon how he should surmount this, now no trifling, obstacle of the broken tap.

He found his wife making ley for soft soap, but her acidity in no way neutralized by the alkaline reaction. Despondent and discouraged, he sat down, in no very enviable mood, when he chanced to spy a piece of iron lying near the tubs at which his spouse was working. Meditating upon how he could make that piece of iron hard enough for a tap, he was led to a rather rude experiment, the results of which have in the end made him a richer man than he ever dreamed of being.

It so happened that from a distant relative, a Roman Catholic priest in Ireland, our friend had inherited quite a library of works on chemistry; some of them rare and valuable. He had read some of these books to very good purpose. "There is surely carbon in that ley," thought he. "If I only could get that into this iron in the proper proportion, I should have steel, and from that my tap, and so finish my grapple."

With little hope or faith that he should succeed, he took some of the ley, and adding, without any particular reason for so doing, some saltpeter and common salt, made a paste with this solution and a hard grudged saucerful of the little remaining flour there was in the house. He then forged the tap, and, enveloping it in the paste, put the whole into a luted iron box and exposed it to heat for two hours in a blacksmith's fire. To his joy and surprise, when he took it out, it was hard enough to cut cast steel. The grapple was finished, and forty dollars flowed into the family treasury of Thomas Sheehan. He went back to his old work, disgusted with patents, and resolved never to have anything to do with one again. But the remembrance of the tap, hardened in so unique a manner, still haunted him. Having a great deal of case hardening to do, he thought one day he would repeat the experiment upon a large scale, which he did with perfect success.

For twelve months he went on to experiment, purchasing the materials with his own money, and working in secret by night, and at odd hours. At the end of twelve months, he reconsidered his sentence of condemnation on patents, and applied for one on his process, which was granted September 4, 1860, the claim being for a combination of damaged flour, potash ley, or ley from hard wood ashes, niter, common salt, and sulphate of zinc, for case hardening iron.

In 1867, he patented an improvement on the above named process, the improvement being the substitution of water impregnated with carbonic acid for the ley of potash or wood ashes.

In 1868, he took out another patent for an entirely new process, which consists in the use of raw limestone, charcoal, black oxide of manganese, sal soda, common salt, and pulverized rosin, combined, for converting iron into steel, which is now widely used, and from which he has reaped quite a fortune.

No less than twenty-three of the leading railways in America now use this process, under license from the patentee, for hardening the links, guides, pins, and nuts of locomotives, effecting, we are told, no less a saving than from five to six hundred dollars annually on each locomotive, in obviating the lost motion consequent upon the wear of links, guides, and pins.

The inventor has already received, for licenses under his patent of 1868, $29,650, and has just sold the remainder of his patent in America for $45,000. If on the day he broke his tap, in his cottage in Dunkirk, it had lasted till he finished his job, or if he had then had twenty-five cents, he would, in all probability, today have been a poor mechanic, working at his forge in the Erie Railway shops, and a process of national importance, in its effects upon the great railway system of the country, might never have been given to the world.

Never, perhaps, has the old adage, "Necessity is the mother of invention," received a more apt illustration, and never was the occasional value of an untoward accident more signally demonstrated.

MARQUARD'S ARTIFICIAL STONE.

If we watch the great amount of labor required to shape the rude stone, as it comes from the quarry, to the ornamental forms required for embellishing our modern architectural structures, we need not wonder that, long since, attempts have been made to produce these elaborate forms by molding. For interior work the plaster of Paris has been the successful substitute for ornamental stone, chiefly for statuary its pure whiteness, nearly imperceptible shrinkage, and the ease with which it is cast in forms, have secured for it the lasting favor of all. However it has grave defects; it is very opaque, of a dead white color, and lacks the semi-translucency of statuary marble, which causes this to be so far superior for all productions of high art; but its great defect is that it is too soft and cannot stand the weather at all; water dissolving it slowly, any product of plaster is ultimately destroyed by the rain. Therefore many attempts have been made to produce artificial stones having the advantages of plaster without the disadvantages just mentioned.

The *terra cotta* is nothing but a fine brick clay, requiring burning after being molded; but as in the burning it shrinks and changes its shape, it is unfit for fine work; also its color, which is either like brick or of a dirty brown or gray, is objectionable.

More successful have been those who experimented in another character, making use of the properties of the soluble silex, to combine with alumina, magnesia, lime, etc.; but here is a delicate distinction to be made, as the use of one or another of these ingredients, in different proportions, gives widely different results.

Among all the artificial stones which have recently fallen under our attention, we noticed in particular a compound, the result of experiments made by Philip Marquard, of 468 Swan street, Buffalo, N. Y., which, at first sight, struck us by its pure whiteness, semi-translucency (like marble), and the ease with which it appears to have been molded, evident from the ornamental shape of the samples sent us; by further investigation, we found it to take polish like marble, and to stand the severest weather, as water does not penetrate it in the least. Chemically, it is silicate of lime, with an excess of the latter; it also contains some alumina.

The inventor states that it is far cheaper than any natural stone worked by hand; and does not shrink in burning, coming out of the fire exactly equal in size and form as it came from the mold. All that is wanted to introduce this invention is a partner with some capital; and we do not doubt that, taking in account the excellence of the article, this will not be a difficult matter for the inventor and patentee to obtain.

SCIENTIFIC INTELLIGENCE.

SIMPLE TEST FOR ARSENIC, ANTIMONY, AND PHOSPHORUS.

The solution of the substance to be examined is first considerably diluted with water, and poured into a wide mouthed bottle, to the cork of which are fastened a number of pieces of parchment paper, previously saturated in acetate of lead, nitrate of silver, and sulphate of copper. A few drops of sulphuric acid are now added, some pieces of zinc thrown in, and the cork put on. In case any gases are liberated, they will react upon the strips of paper, and the color will disclose to what particular element the reaction is due. Phosphuretted hydrogen does not blacken nitrate of silver and acetate of lead, but does act upon sulphate of copper. Antimonetted and arsenetted hydrogen do not affect the nitrate of silver and sulphate of copper, but blacken the lead salt. Sulphuretted hydrogen, however, blackens all three of the above metallic solutions. In order to decide what elements are present, the strips of paper are to be macerated in a solution of cyanide of potassium. If the coloration immediately disappears, it was due to sulphuretted hydrogen: if it slowly changes in cold and more rapidly in heat, it was caused by phosphorus or antimony; if it only bleaches a little and turns brown, and does not disappear when heated, it may be traced to arsenic. For ordinary purposes and rapidity of work, this method appears to be sufficiently accurate and will enable the operator to dispense with the more cumbersome Marsh apparatus.

THE COLORING MATTER OF SMOKY QUARTZ.

In August, 1868, the largest deposit of deep black quartz crystals was discovered, in the canton of Uri, that had hitherto been found. Some of the larger ones weighed respectively 267 pounds, 255 pounds, 210 pounds, 134 pounds, and 125 pounds; and the total weight of the crystals found in the cave was 33,000 pounds. The finest specimens of the collection were purchased for the Cabinet of Berne; and, on their arrival, the cause of the dark color of the crystals was made the subject of lively discussion at the meeting of the Bernese Academy. In order to solve the difficulty, Professor Forster undertook an exhaustive and elaborate study of the whole question. His paper, covering twenty-two octavo pages has just been published in a supplementary number of Poggendorff's *Annalen;* and, without going into the details of his method of research, we give below the results at which he has arrived.

1. The coloring matter of smoky quartz is disposed in more or less regular figures, which display the hexagonal structure of the crystals.
2. The specific gravity of the black quartz is 2·65027.
3. After exposure to a strong heat, the density is 2·65022.
4. The color of smoky quartz is due to organic matter containing carbon and nitrogen.
5. This organic matter is entirely decomposed by heat, and yields, by dry distillation in a current of hydrogen, pure carbonate of ammonia.
6. The dark color disappears on the application of heat.

The results at which Professor Forster arrives will be the subject of considerable discussion in the scientific world, as they seem to point out the organic and aqueous origin of quartz rather than to its igneous irruption, as a majority of geologists have maintained. The almost simultaneous publication of the investigations of Friedel and Crafts on the organic compounds of silica, and the conclusions of Professor Wurtz, published last year in this journal, will be read with renewed interest, now that the subject is attracting so much attention. It would be strange indeed if we were to look to life and organic growth for the source of our sandstones and sand banks. And yet, under present appearances, it is not at all unlikely that we shall be compelled to do so. We have observed in the Berkshire sand, employed in the manufacture of the best crown glass, that innumerable black specks were scattered through it, which we took to be oxide of iron; but we were informed by the director of the works that they were organic and wholly destroyed by heat, thus obviating the necessity of adding manganese to neutralize them. It would be interesting, in this connection, to see if the black sand of the West does not also owe its color to organic matter, instead of to iron as has usually been supposed. The fact could be easily determined by exposing a quantity of the material to a sufficiently high heat.

RAVAGES OF THE BOMBARDMENT OF PARIS.

M. Secretan, the well known manufacturer of philosophical instruments, writes as follows to Abbé Moigno:

"As you know, without doubt, since I have communicated the circumstance to a number of persons, I have al o cruelly suffered by the bombardment. On the 9th of January, at 7 o'clock in the morning, a large bomb fell and burst in my workshop in the *Rue Mechain.* The furniture was much damaged, and a considerable quantity of astronomical instruments, photographs, and optical glass was entirely destroyed.

"The damage amounted to from 18,000 to 20,000 francs. Fortunately my dividing engine was uninjured, my optical plane, for the construction of astronomical objectives according to Foucault, also received no harm; and I must confess that, considering the risk I ran, I am quite satisfied to have escaped as well as I did."

HYDRATE OF CHLORAL.

The hydrate of chloral, which in 1869 cost eighty dollars a pound, so that each sleep produced by it could be reckoned at one dollar, is now advertised on the list of a German chemical factory at about two dollars a pound. Such an enormous reduction in the price of a chemical product in so short a time has rarely occurred. Perhaps the only parallel case is metallic sodium, which, a few years ago, could not be had for two hundred dollars a pound, but can now be made for seventy-five cents. According to Dr. Richardson, the secret use of chloral in England has become so great that the victims must be put in the same class as the opium eaters. In proof of the enormous consumption, he states that, during the last year and a half, four dealers have sold forty tuns, sufficient to give narcotic doses to 36,000,000 people—in other words, every person in England could have had one good sound sleep out of the amount sold. In reference to the *maximum* dose that it would be safe to take, Dr. Richardson puts the amount at one hundred and twenty grains; he regards one hundred and eighty grains as likely to prove fatal. He also warns against the gradual increase of the dose, as its effect upon the organism is just the opposite of opium, the system, in fact, becoming more sensitive the longer it is used.

SOUTHERN LIGHTS.

We have all heard of the northern lights, or *aurora borealis,* but we are not in the habit of reflecting that the same phenomenon is to be seen in the southern hemisphere, where it is called the southern light. In order to establish a relation between the magnetic disturbances in the north and south, and to prove that there is a perfect coincidence and simultaneousness in the auroral light of the two hemispheres, Professor Heis, of Munster, has entered into a correspondence with the directors of observatories at various stations in Australia and the East, and has been able to collect much interesting and novel information, which may serve as data in the solution of the question of the probable origin of this class of phenomena.

From records kept in 1870, it appears that the aurora of the 8th of January was observed at the same time in Oxford, Liverpool, and Melbourne. Magnetic disturbances were noted, on the 4th of January, in Melbourne, Rome, and various stations in France and England. The southern light of February 1, in Melbourne, was the northern light, at the same time, in Paris, London, Königsberg, Stockholm, and other European cities. March shows several instances of similar coincidence in magnetic and auroral phenomena. Some months were exceedingly rich in simultaneous auroras, and there was not a month in which coincident observations were not made. It adds very much to the grandeur of these phenomena to know that they are visible at nearly the same moment entirely around the globe, and, as soon as we have a long series of observations, we shall be better able to give a rational explanation of their probable origin.