intermingled or lodged in the leather, while nothing can compensate for the loss of firmness and durability.

The committee would state that no samples of leather having been offered them prepared by Downey's process, they have judged of the value of the process on general principles.

By order of the Committee,

WM. HAMILTON, Actuary.

Philadelphia, April 10th, 1845.

MECHANICS, PHYSICS, AND CHEMISTRY.

The Progress and Present State of the Daguerreotype Art. By
M. CLAUDET.

The discovery of a new art founded upon some startling facts in science, however perfect it may appear at the beginning, and little subject to improvement, rarely remains long stationary; and still more rarely can we foresee all its useful applications.

As this observation applies particularly to the ingenious and curious discovery of Daguerre, it may be interesting at the present moment to examine the progress it has made during the last four years, and to determine its present state, in order that we may be able to compare, at given periods, the various stages of improvement through which photography has passed.

The daguerreotype has opened two extensive fields of inquiry: the one, for the investigation of facts, by which the sciences are to enrich themselves, and by which some of the phenomena of the laws of nature may be explained; the other, for the advantage of society, in reference to the creation of a new branch of manufacture, and to a new art, which are destined to give employment to many persons; to which may be added the improvements that the daguerreotype will introduce in the fine arts.

It has been remarked that the discovery of photography was as great a step in the fine arts as that of the steam engine in the mechanical arts. There is no exaggeration in this observation; and certainly our age (which is the era, not of wars and conquests, but of social improvements, of emulation in the arts, sciences, and manufactures,) will be celebrated in future times for this extraordinary invention.

It is curious to observe how rapidly sometimes new discoveries are followed by other important discoveries, forming the links of a mysterious and infinite chain, one end of which approaches the great Creator of all things.

In the year 1811, Courtois discovered the chemical substance called Iodine, and, as late as 1826, Balard discovered Bromine; these two elements are the only substances which, in the daguerreotype, form with the silver a compound sufficiently sensitive to the rays of light, and without which substances the daguerreotype could not have existed.

Such is the progress of science, that there is no fact, however insignificant it may appear at first, which does not aid the advancement of philosophy, and the improvement of mankind.

When these new elements were first discovered, how little was it thought that they would so soon become the source of the magic invention of the daguerreotype, which again will undoubtedly lead to other discoveries, perhaps far more important than itself!

There are some persons who, although admiring the daguerreotype in its effects, perceive nothing beyond the mere spontaneous, although beautiful reproduction of objects—the representation of a building or a landscape in their minutest detail, and in the portraying of human features: but this is only the useful and immediate application of the art in its state of infancy; its destinies are of a much higher order.

It may be said that already optical science has been much benefited by it. Never before has it been found so necessary to construct object glasses with the shortest possible focus, without increasing their aberration; this has now been done, and we have double achromatic object-glasses refracting a perfectly well-defined image upon a screen of seven inches in diameter, although the focal length is not more than eight or nine inches: this improvement in the object-glasses of the camera obscura, being also applicable to the construction of telescopes, will enable opticians to make powerful instruments of a considerably smaller bulk.

The science of optics, the study of which was confided almost exclusively to professional opticians and astronomers, is now in the hands of a thousand operators in photography, who are constantly studying and endeavouring to correct the imperfections of their apparatus; and their researches and investigations will, no doubt, ultimately lead to many useful discoveries.

In passing from the practical part of optics to that which is purely theoretical, that which treats of the various rays emanating from the sun, of their laws and properties, and of the principles and phenomena of light, considered as a whole, or a compound of various kinds of matter (if I may be allowed the expression,) as being produced by emission or by undulation; if these interesting points are ever better explained and understood than they are at present, it appears highly probable that the daguerreotype will be the instrument leading to these results: at least it is certain that, in experiments and researches upon this subject, philosophers will be greatly assisted by the innumerable facts collected in the daguerreotype operation.

The existence of invisible or chemical rays is proved by the various processes of photography; for in speaking of the daguerreotype, we cannot omit to mention the beautiful discovery of Mr. Talbot, which he has called the Calotype. Neither must we omit the curious discoveries of Sir John Herschel, forming another step in photography, which is called by that learned astronomer Cryso-type.

The experiments made in these various photographic processes all agree in the fact, that the rays which produce a change upon the sensitive screen are not the rays of light, but other rays traveling with light, and emanating from the same source, which are sometimes more

refrangible than the violet rays, and less refrangible than the red rays under other circumstances; by which it would appear that there exist chemical rays on each extremity of the spectrum: but many facts seem to prove that there is also another kind of ray which is refracted to all parts of the spectrum according to the dispersive power of the lens, and following certain laws of refraction which are different to the laws regulating the other rays; so that different kinds of glasses may have the same power of dispersion for the apparent rays, and be endowed with different dispersive powers for the invisible photographic rays.

I am not prepared to develop the facts by which I have aimed at this conclusion, because my experiments are not yet complete enough to furnish a sufficiently plausible and satisfactory explanation of this phenomenon.

From the application of the daguerreotype to the advancement of practical and theoretical optical science, let us consider how this art is likely to benefit chemistry.

In this respect, is it not sufficient to call to mind that some of the elements we have alluded to, viz. iodine and bromine, have been very little investigated by chemists, and that all their properties are not yet known, neither have the whole of their compounds been ascertained?

Now that they are so much employed by every photographer, and their effects minutely studied, is it not reasonable to expect that in the hands of the chemist, also, the daguerreotype may become the medium of scientific research?

After having enumerated the advantages which several branches of science have already derived from the daguerreotype, and having hinted at those which they are still likely to derive from new investigations arising out of the same subject, we shall now refer to its connexion with the fine arts.

There is a singular anomaly in the history of the progress of human discoveries. They frequently seem to follow each other in an inverted order, and very often the ingenuity and perseverance of man, through immense labour and research, have produced works which previously existed in nature, and which, had nature been first studied, would have been executed in much greater perfection, with the saving of an immensity of trouble.

After ages of civilization, it is only within the last two centuries that Battista Porta, being in a dark room, observed that an inverted image of outwards objects was represented on the wall, opposite to a small hole in the window-shutter; to the hole he applied a convex lens, and then, instead of a diffused and indistinct image, he was able to obtain a well-defined and clear picture.

This accidental discovery was the origin of the camera obscura. Yet in nature such instruments have existed since the creation of man, for the eye is nothing more than a perfect camera obscura.

If philosophers had only turned their attention to the construction of the human eye, if they had been able to examine its beautiful arrangements, the camera obscura would have been discovered at a much earlier period. The same observation applies to the discovery

of galvanic electricity, and the apparatus by which this principle is developed. There exists in nature the most perfect and complete galvanic battery; and if philosophers had been able to examine the *Gymnotus electricus*, or electrical eel, it would not have been left to chance and ingenuity to discover one of the most splendid phenomena in the circle of science.

In all cases we find, that whatever we at first consider as a new invention existed before in nature: therefore, man invents nothing, he merely discovers that which has long before been produced by the hand of the Creator; and, as Bacon asserts, "man is only the interpreter of nature."

By the judicious combination of black lines or black dots upon white paper, or white lines and white dots upon black paper, artists have been able to represent all objects visible to the eye; the effect is complete and identical.

The laws of perspective are well understood by this simple means.

We thought that such a work was quite artificial, a calculated imitation of nature which was not true, but that we learned, as it were, to read by habit. We thought that a child could no more understand a picture than read a book. But here again art has been invented, and it is only lately that we have found that nature operated exactly as art, and produced the very same effects.

The daguerreotype represents the objects which we see by the same rules, by the very same means, and proves that the objects cannot be represented otherwise than as the painters had represented them before.

If the daguerreotype had been invented before the art of painting, then we should have never doubted its accuracy, and we should not have thought that we were deceived or taken by delusion.

The daguerreotype plate is etched in by nature, exactly (although in a more perfect manner,) as is the plate of copper or of steel by the ingenuity of the engraver.

When we submit a daguerreotype plate to the magnifying power of the microscope, we observe upon its surface an infinite number of small white dots, which are more or less close to each other, according to the predominance of light or shadow in the picture. In fact, the magnified surface of the plate has the appearance of the sky on a bright night; the white parts present an agglomeration of bright dots, similar to the milky way seen through a telescope, which to the eye appears as a white drapery or belt thrown across the sky.

It would not, therefore, have been surprising if the arts of drawing and painting had been the consequence of the daguerreotype; but it is really wonderful that, without the help and the labours of the daguerrean process, drawing and painting should have attained the perfection so conspicuous in the works of the great masters. Indeed that single fact proves, more than any thing else, the greatness of their genius.

However, it was only given to a very few to grasp nature, but henceforward young artists, of less genius, will be able, by studying the effects of the daguerreotype, to produce works of great merit.

We may also assert that the great masters would have been still more perfect in their imitations of nature if the daguerreotype had been known to them. When Paul Delaroche, the celebrated painter, was asked his opinion of the invention of Daguerre, he unhesitatingly declared that "the process of M. Daguerre had given to art many conditions so essential to its perfection, that they would become, even to the most skilful artists, subjects of observation and study;" and, further, that "this admirable discovery was an immense service rendered to the fine arts."

Is it, then, surprising that the announcement of the discovery of Daguerre created among philosophers and enlightened men so great an interest? that it was received with such amazement and admiration? Is it surprising that the government of a great nation should have proposed to its parliament to award to the discoverer a national recompense?

Two centuries ago the daguerreotype art would have been looked upon as the work of witchcraft, but in our age of improvement we are accustomed to extraordinary discoveries; we are capable of admiring and appreciating these huge efforts of genius, and nothing surprises us. The steam-engine, that perfect machine, so well organized (which, as an animal, requires only to be fed to work by itself, and to produce continuous motion,) has been created almost in our own time and under our own observation.

After such a triumph of the genius of man and of modern science, we see no limit to human discovery; and, indeed, we might believe, that the word *impossible* should be erased from language.

The year 1839 gave birth to two discoveries, which, from the similarity of their properties and results, may, with propriety, be called sister arts. These are the daguerreotype and the electrotype, both of which re-produce and multiply in the greatest perfection; the one acting under the influence of light, the other under the influence of electricity; these two mysterious agents seem, in fact, to constitute the soul of nature.

In the case of the daguerreotype light draws—in that of the electrotype electricity models; and although their work seems, at first sight, to have no connexion, still the two act in unison. The daguerreotype image may be repeated to any extent by precipitating metal upon it by the action of electricity, producing another plate upon which the original is imprinted in its various tints; in fact, the two images are so identical in their effect, that it would be impossible, without knowing previously of what metal they were respectively composed, to decide which was the original and which the copy. This curious phenomenon may assist in explaining the nature of the formation of the daguerreotype image; it proves, undoubtedly, that the light and mercury acting together upon the iodide of silver, alters the arrangement of the molecules of the surface so that minute crystals are produced, which, like cut diamonds, present in almost every direction a favorable angle of reflection to the eye, from which cause they assume a white appearance; the electrotype surface, moulded upon these crystals, receives exactly their counterpart,

and the two surfaces are to each other as the relief is to the matrix which has produced it; so that parallel faces having the same angle of reflection for the eye, corresponding parts of the image present identically the same effect; and this curious reproduction of the electrototype illustrates better than any other effect the great perfection of these metallic deposits, and also the infinite minuteness of the particles of metal reduced by the galvanic agency.

The original process of Daguerre consisted in submitting a polished plate of silver to the vapor of iodine, until by the chemical combination of the two a compound was found exquisitely sensitive to the influence of light, so that when the image at the focus of a camera obscura was thrown upon a plate thus prepared, the design was invisible, though certainly impressed; and this latent image was afterwards brought out by the action of the vapor of mercury. This was his process in all its simplicity; and it seemed at first to be but little susceptible of improvement; in fact there appeared to be scarcely any room for alteration, at least to advantage. Nevertheless, the manipulation recommended by Daguerre has been greatly simplified, and rendered more effective; although, strictly speaking, the invention has remained the same, the changes consisting chiefly in modifications of the original operations.

It is always a surface of silver, coated with iodine, exposed to the influence of light in the camera obscura, and then submitted to the vapor of mercury for the purpose of bringing out the image, after which it is immersed in a solution of hyposulphate of soda, to remove by solution all traces of the iodine from its surface. Up to the present time it has never been found possible to alter, materially, any of these fundamental principles.

The improvements introduced have been chiefly in the instruments employed, and in some additions to the chemical parts of the operation; by the first means greater artistic effect has been given to these pictures, they have been rendered more forcible and defined in detail; and, by the last-named improvement, the plates have been made much more sensitive to light, so that the time of the operation has been amazingly diminished. With the original process it was considered impossible to apply the daguerreotype to the production of portraits; for, with the iodine alone, and the long-focused camera obscura which was at first employed, no picture could be taken, even under favorable circumstances in less than about a quarter of an hour; and as the correctness of a portrait produced by this art depends upon perfect immobility during the whole of the sitting, the mere idea of such an application of photography was looked upon as altogether absurd.

But the fact that an image could be obtained in a quarter of an hour, gave the hope that, by improving either the optical arrangements of the camera, or the chemical preparation of the plate, means could be devised to arrive at the grand desideratum, viz. the application of the daguerreotype to portraiture.

It was, however, soon found that, by constructing object-glasses having a shorter focus, the operation could be reduced nearly in proportion to the reduction of the length of the focus, so that, by applying

to the camera an object-glass of three inches focus instead of twelve, the operation was four times shorter, or reduced to about four minutes.

From that moment portraits were taken by the daguerreotype; but still few persons could remain in perfect quiescence during such a length of time, and if they were able to do so, it was only by submitting themselves to a painful constraint, which unavoidably gave to the countenance a most unpleasant expression. Nevertheless this was a step which encouraged the idea of further improvements; and about this time an ingenious optician of New York, Mr. Wolcott, thought of substituting for the refracting glasses a concave mirror, of such an aperture, that a greater amount of light from the object might be concentrated at its focus, where he placed the sensitive plate. By this means he could operate much more quickly than by a refracting apparatus, and thus reduce the time of sitting.

This was another interesting step in the improvement of the art, but such a process was subject to many difficulties and defects, which rendered it inferior to the refracting apparatus. If the mirror was made of metal, it was subject to corrosion, by being constantly exposed to the changes of the atmosphere; if it was of glass, then two images of different focus were formed, the one from the silvered surface, and the other from the surface of the glass, so that a sharp and well-defined image could not be produced. Another material defect, however, of this process was that by necessity, in placing the plate between the object and the mirror it was absolutely necessary to operate upon a very small size, or else the plate would have screened the greater part of the aperture, and the advantage of the increased reflecting area would be lost. Besides, the rays producing the best definition and the most correct image, are reflected from the centre of the mirror, and are precisely those which are lost by the unavoidable position of the plate.

To be Continued.

On the Anthracite and Bituminous Coal Fields in China; the System of Mining, and the Prices of Coal, and Labour in its Production, and Transportation to Peking. By RICHARD C. TAYLOR, Philadelphia.

We have seen the recent announcement of the sailing, from hence, of a vessel containing 308 tons of Pennsylvania anthracite, destined for Hong-Kong, in China. Some very natural speculations have arisen from this circumstance, as to the probability of that country furnishing a market for American anthracite. As no details accompany the statement alluded to, we are not in possession of any material facts whereby an estimate can be formed of the probable success of the undertaking, in a commercial sense; and we are not sure but the coal may have been employed for convenience merely, as ballast.

In the East Indies various depots of European coal have been established, for the service of the British government steamers. This fuel, for the most part, it is understood, consists of the anthracitous

and partially bituminous coals of South Wales, of course obtained at great expense. It appears that 5000 tons of English coal, at a freightage of about £2 per ton, are annually imported into Bombay, for the Company's steamers. Bituminous coals have been derived from much less distant sources; among which the Burdwan coal field, in the vicinity of Calcutta, may be named. Mergui Island, also, in the Bay of Bengal, has lately furnished some steam coal to Singapore. The steam ships on the China seas, during the war with that vast country, were supplied from these various sources.

I do not propose to discuss the profitableness, or otherwise, of a Chinese market for our American anthracite. But as during the process of collecting statistical information for a proposed volume on "the geological and geographical distribution of coal and other mineral combustibles," some notes reached me, of an interesting character, which are not generally accessible to the majority of readers, with relation to the Chinese coal fields, it has struck me that a portion of these details, in an abridged form, might be just now acceptable, particularly as the intercourse with that country is on the increase. I venture even to omit, for the present, the authorities for the facts I shall have to communicate; reserving them in detail for the volume adverted to. It must, nevertheless, be premised that to the Jesuit Fathers, the French Missionaries who were permitted to reside at Peking during the 18th and preceding centuries, we are indebted for details of the highest interest, not alone on this subject, but on many other objects of philosophical inquiry in that little-known region.

It is probable that coal was discovered, and was in common use in China, long before it was known in the western world. It is mentioned by a noble traveler of the 13th century, as abounding throughout the whole province of "Cathay," of which Peking is the Capital, "where certain black stones are dug out of the mountains, which stones burn when kindled, and keep alive for a long time, and are used by many persons, notwithstanding the abundance of wood."

The good missionaries were fully capable of describing the coals which were supplied to Peking, since they there erected a furnace or stove, in which they experimented on the properties of those combustibles; particularly with reference to the ordinary domestic uses, and for the warming of apartments and the purposes of their laboratory.

Among the people of Peking, three kinds are in use.

1. That employed by the blacksmiths. It yields more flame than the other qualities; is more fierce, but is subject to decrepitate in the fire; on which account, probably, the blacksmiths use it pounded in minute particles.

2. A harder and stronger coal used for culinary purposes, giving out more flame than the other sorts so employed; it is less quickly consumed, and leaves a residuum of gray ashes. There are several gradations of these. The best are hard to break, of a fine grain, a deep black color, soiling the hands less than the others. It sometimes is sufficiently siliceous to give fire with steel. Others have a very coarse grain, are easily broken, and make a bright fire, leaving a reddish ash. Another species crackles, or decrepitates, when first placed

on the fire; and falls down, almost entirely, in scales, which close the passage of the air, and stifle the fire.

3. A soft, feebly burning coal, giving out less heat than the 2nd class; consuming more quickly, it breaks with greater facility, and in general is of deeper black than the sorts previously mentioned. It is commonly this description, which, being mixed with coal dust and a fourth part of clay, is employed to form an artificial and economical fuel. This being moulded in the form of bricks and balls are sold in the shops of Pekin. Wagon loads of coal dust are brought to that city for this sole purpose.

The coal merchants have also an intermediate quality, between the classes 2 and 3.

We cannot, in this place, recite the numerous details which are furnished by these intelligent Fathers. Suffice it to add, that nearly the whole of the properties and applications are now in every day use in the United States, and are familiar to all. They are, in fact, the natural results suggested by qualities possessed in common by the combustibles of remote parts of the same globe. Even the modern method of warming all the apartments of our dwellings, which we view as the result of superior practical and scientific investigation, was in use with very little deviation, centuries ago, by the Chinese. Many a patented artificial fuel compound both in Europe and America, has been in practical operation in China, at least a thousand years.

4. **ANTHRACITE.** Another description of coal abounding about thirty leagues from Pekin, but which was not then in such general use there as the other kinds, is called by the Chinese Che-tan. Che means a stone, but tan is the name they give to wood charcoal. Therefore, according to the genius of the Chinese language, this compound word signifies a substance resembling or having the common properties of stone and charcoal. There can be little difficulty here, in recognising the variety of coal which, in our day, has been denominated anthracite, a compound word of similar meaning.

The Chinese *glance coal* forms a remarkable exception to the unfavourable conclusion prevailing against Oriental coal; and, according to more recent authority than those we before cited, deserves to rank at the head of the list, in respect of its purity as a coke; although, in specific gravity, it does not come up to the character of the Pennsylvania or Welsh fuel; neither has it the spongy texture which contributes much to the glowing combustion of the latter.

So late as 1840, a Russian officer has described the coal formations of the interior, as occupying the western mountain range of China, in such abundance that a space of half a league cannot be traversed without meeting with rich strata. The art of mining is yet in its infancy among the Chinese; notwithstanding which, coal is thought to be at a moderate price in the capital. Anthracite occurs in the western range of mountains at about a day's journey, or about thirty miles, only from Pekin. The coal formation is largely developed, in which thick beds of coal occur. They appear to be of various qualities. Some of this coal, occurring in shale beds, is singularly decomposed, and its particles have so little cohesion, that they are almost reduced

to a state of powder. Beneath these coal shales are beds of ferruginous sand stone, and below those occur another series, consisting of much richer seams of coal than the upper group.

In this range are seen also both horizontal and vertical beds of conglomerate, accompanied by seams of coal, which have the conglomerate for the roof, and diorite or greenstone for the floor. As might be expected, this coal very much resembles anthracite. It is shining, of compact texture, difficult to ignite, does not flame in burning, or give out any smoke. Its substance is entirely homogeneous. Every thing respecting it, leads to the belief that there had been a great development of heat at the period of its formation, or subsequently. The horizontal coal beds are the most important and valuable, and are denominated large; but no greater thickness than three and a half feet is quoted. The blacksmiths and those who work in copper, prefer this coal, on account of the intense heat which it gives out.

Throughout the whole of this mountain range may be continually seen the outcrops of this combustible, where they have never, as yet, been touched by the hand of man.

In those parts of China where wood is very dear, coal is worked on a great scale for the Pekin market; but the process of mining is very little understood by those people, who excel in the preparation of charcoal.

Coal in other parts of China.—The Missionaries and others inform us that coal is so abundant in every province of China that there is, perhaps, no country of the world in which it is so common. The quays at Nankin are stored with the finest native coal. Some of the coal which was brought down to the coast, from the Pekin country, to the Gulf of Pe-tchee-lee, was anthracite, partaking of the character of plumbago or graphite. Coal, apparently of the brown coal species, exists extensively in the direction of Canton; while all the coals seen on the Yang-tse-kiang river, south of Nankin, resembled cannel coal. Nearer to Canton it possessed the comparatively modern character of brown coal. It was abundantly offered for sale in the different cities through which Lord Amherst's embassy passed, between Lake Po-yang-how and Canton, and the boats were largely supplied with it. It is there obtained by means of pits, like wells; and we infer that, like nearly all the brown coal deposits, the beds were horizontal, and at no great depth. A sulphurous coal, interstratified with slate, and in the vicinity of red sandstone, also prevails towards Canton.

Thus, therefore, we possess evidence, the main object which this communication was designed to exhibit, that extending over large areas in China, are beds of tertiary or brown coal, of cannel coal, a dozen varieties of bituminous coal, of anthracite, glance coal, and graphitic anthracite; all of which, for ages, have been in common use in this remarkable country; and have been there employed for every domestic purpose known to civilized nations of all times; including gas lighting, and the manufacture of iron, copper, and other metals.

Mode of Mining Coal in China.—It might be expected that in China, where most of the practical arts have, from time immemorial,

been carried on with all the perseverance of that industrious people, the operations of mining coal would be conducted with some regard to science, in relation to sinking, draining, and extraction. We have, however, good authority, especially in regard to the environs of Peking, for stating that the process is still in a very imperfect state. Machinery there to lighten labor is unknown. They have not even an idea of the pumps indispensable to draw off the water. If local circumstances allow, they cut drainage galleries; if not, they abandon the work whenever the inundation has gained too far upon them. The mattock and shovel, the pick and the hammer, are the mining instruments—the only ones, in fact, which the Chinese employ in working the coal. The water of the mine is emptied by the slow process of filling small casks, which are brought up to the surface by manual labor. Vertical shafts are not used. In working horizontal coal seams, the timbering is expensive, and the materials cost about 2 copecs per pound, = \$8 50 per ton, English wood being sold by weight in China.

The coal, when mined, is put into baskets, and drawn upon sledges, which are raised to the surface by manual strength. Each basket contains about three pounds of coal, and one man can raise about eight baskets in a day. This is equivalent to 1032 Russian pounds, or to 12 cwt. English, per day. The miners' wages are at the rate of 30 copecs a basket; which is equal to 240 copecs [copper currency,] or 46 cents of United States currency, per day; being \$0 76 U. S., per ton.

Prices at Peking.—At the pit's mouth, this coal is sold for 60 copecs per pound, = \$4 63 per ton of 20 cwt. It is then conveyed on the backs of mules through the mountains, and thence on camels to Peking, where the price is 1½ rouble, = 1½ francs, = 29 cents United States, per pound; which, if our calculation be correct, is equal to \$11 60 United States, or £2 8s. 3d. per ton of 2240 pounds English. We perceive, therefore, that the best of fuel is expensive at Peking, and hence the necessity for resorting to the artificial compounds and substitutes to which we briefly alluded.

There is, however, a kind of coal sold in that city at a much lower price, particularly when it is mixed with one-half of coal dust. This coal, in 1840, sold for one rouble per pound, which is at the rate of \$7 75 = £1 12s. 3d. per ton. It is of indifferent quality, however; giving out but little heat, and is quickly consumed.

The compound fuel, consisting of coal dust and clay, is still prepared after the mode described by the missionaries last century; but its use is chiefly confined to the indigent classes.

Coal Gas Lighting in China.—Whether, or to what extent, the Chinese artificially produce illuminating gas from bituminous coal, we are uncertain. But it is a fact that spontaneous jets of gas, derived from boring into coal beds, have for centuries been burning, and turned to that and other economical purposes. If the Chinese are not manufacturers, they are, nevertheless, gas consumers and employers, on a large scale; and have evidently been so, ages before the knowledge of its application was acquired by Europeans. Beds of coal are fre-

quently pierced by the borers for salt water; and the inflammable gas is forced up in jets, twenty or thirty feet in height. From these fountains the vapor has been conveyed to the salt works in pipes, and there used for the boiling and evaporation of the salt: other tubes convey the gas intended for lighting the streets and the larger apartments and kitchens. As there is still more gas than is required, the excess is conducted beyond the limits of the saltworks, and there forms separate chimneys or columns of flame.

One cannot but be struck with the singular counterpart to this employment of natural gas, which may be daily witnessed in the Valley of the Kanawha, in Virginia. The geological origin; the means of supply; the application to all the processes of manufacturing salt, and of the appropriation of the surplus for the purposes of illumination, are remarkably alike, at such distant points as China and the United States. Those who have read, even within the present month, the account of the recent extraordinary additional supply of gas, and the services it is made to perform at the Kanawha saltworks, must be impressed with the coincidence of all the circumstances with those which are very briefly stated in the previous paragraph, in relation to China. In fact, the parallel is complete.

To the coals and combustible minerals of China, I cannot further advert here. But what a conviction irresistibly presses upon the mind, as to the incalculable utility of the *Railroad system*, and coal mining improvements in such an empire! If ever there were concentrated at one point all the circumstances especially and unequivocally favorable to that system, and imperiously calling for improvements of the character suggested, it seems to be presented in the case of the city of Pekin. Here, with its enormous population of 1,500,000 souls, it is situated only at a day's journey—computed at thirty miles—from an immense region of coal, comprising several varieties. Yet its inhabitants cannot purchase the best qualities of this coal, brought from the mountains on the backs of mules and camels, under \$11 60 per ton, and the very worst for less than \$7 75 per ton.

Without making unnecessary or invidious comparisons, it might not unreasonably be suggested, that a Pekin railroad, in connexion with the coal mines, would be a far more profitable enterprise in its results, than the transportation of American coals to China.

I will only add one circumstance, which had nearly escaped me. Borneo, “the largest island in the world,” which is only twenty degrees due south of Canton, has lately come into repute for the great quantity of coal which it contains, not only accessible to ships along the coast, but extensively occurring in the mountains of the interior. Much information has also been acquired from the natives; and the facts which are already elicited are regarded as of considerable importance, in respect to the facilitating the steam navigation of the China seas.

Philadelphia will, of course, have her share in the enlarged commercial intercourse with China. Would it, then, be asking too much of those who are personally interested in this improving trade, to com-

municate any additional facts, which are either unknown to, or have been omitted by, the author of these scanty notes?

Philadelphia, April 28th, 1845.

[NOTE.—The prices and admeasurements, which are quoted in the foregoing article, were reduced to the United States and English currencies and measures, from the Russian, as furnished by the Engineer Kovanko; who, in like manner, converted them into the Russian from the Chinese standards. In consequence of this triple conversion of standards, additional care has been taken to avoid error in these calculations.]

Description of an Artificial Hand. By SIR GEORGE CAYLEY, BART.

Sir,—About eight years ago, George Douseland, a son of a tenant of mine, had the misfortune to lose his right hand, when I proposed to make him an artificial one, in the hope of rendering his loss rather less severe. The greater portion of this instrument was made, and the whole of it planned, at that time; but the stump was found to be so tender that it could not then be made use of, if completed; and the young man having gone to reside elsewhere, the thing was lost sight of, and was not renewed till about two months ago, when the remaining portion was executed; and he has found it of considerable use to him in his various daily occupations. I send you a sketch and description of this instrument, which is so simple as scarcely to deserve the name of an invention, but trusting that it may be found as useful to others under a similar misfortune, I wish to give it to the mechanical public through your valuable pages.

The instrument can be executed in many ways, though the means of deriving its firm and forcible grasp from the stump must remain much the same in all. Flexible tendons were adopted in the first sketch I made of this instrument, but I shall describe that which is now in use, and subsequently some very essential improvements; and I hope by thus publishing it, to prevent its being pirated and *patented*, as it is quite misfortune enough to lose a hand without being obliged to forego the use of even so humble a substitute, for want of means to purchase it, or otherwise to procure it at an exorbitant price.

I am, sir,

Your obliged and obedient servant,

March 5, 1845.

GEORGE CAYLEY.

Method of making an Artificial Hand, that will forcibly grasp substances of various sizes, and release them at will, so as considerably to supply the place of the natural hand, when that member is lost.

The movements of this instrument, are derived from the stump, by fixing the hand to the upper portion of the arm above the elbow joint, by light frame-work, within which the stump has its movements at full liberty; and by placing a shank or lever, connected with the ma-