STRAW-BURNING PORTABLE ENGINE.

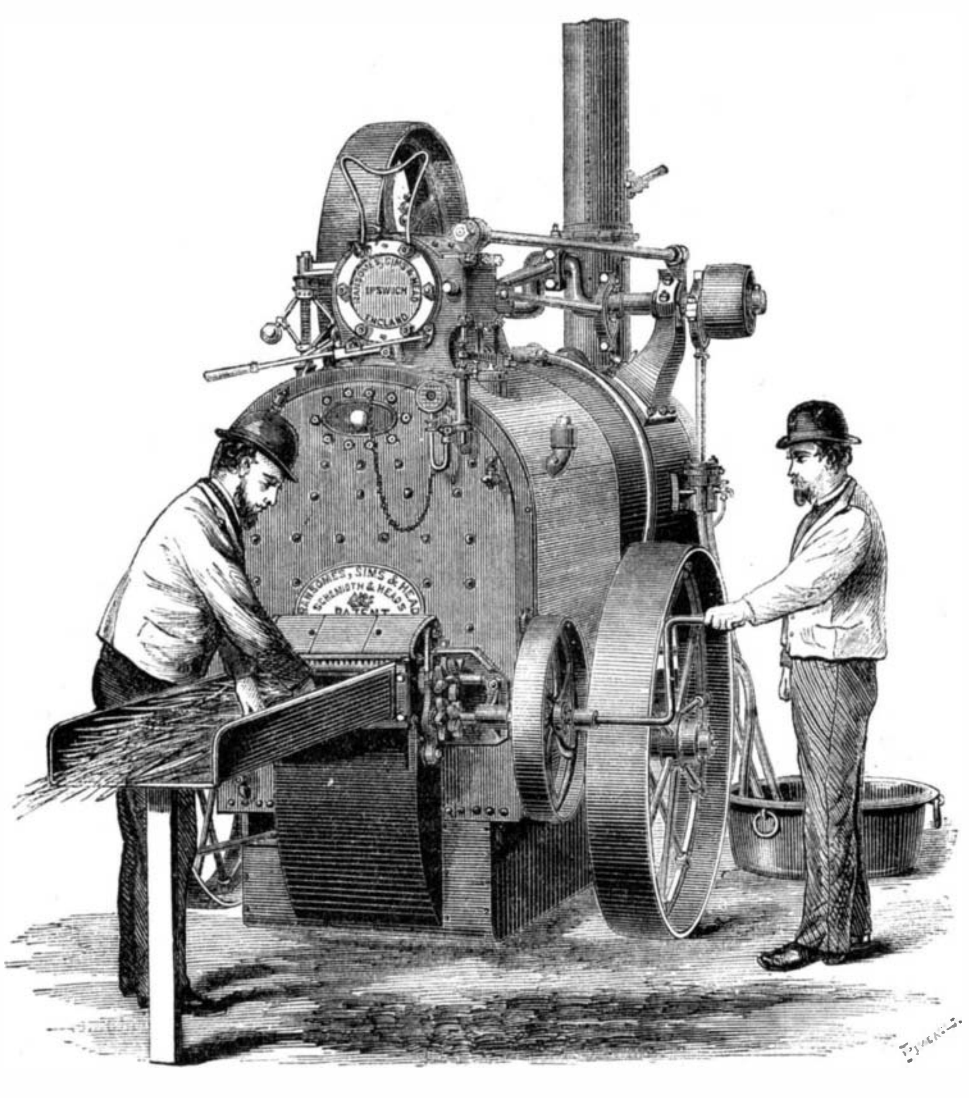
The main obstacle to the employment of steam to any great extent, in the agricultural operations carried on over the great prairies of the West, is the difficulty of obtaining fuel. Forests are scarce, and from this are made the objects of preservation rather than depletion, while the high freights, and consequent expense of coal materially diminish the economical advantages of steam. It was for this reason that corn has recently been burned as fuel, the staple, owing to the excessive transportation charges to the Eastern markets, being cheaper to use for such purposes than either coal or wood. In view of the above facts the importance of the invention represented in our engravings, for which we are indebted to *Engineering*, will be widely appreciated, more especially when we add that it furnishes a means of employing straw, corn stalks, reeds, and similar vegetable matters, which abound in enormous abundance in our Western States, as a valuable and effective fuel, capable of generating sufficient heat to keep up steam in a boiler.

The principal ideas of the device were conceived by Mr. Schemioth, a Russian engineer, who communicated his plans to Messrs. Ransomes, Sims, and Head, of Ipswich, England. This firm, adds *Engineering*, "after fifteen months of continued trial, have at last produced the most perfect engine yet invented for burning straw or other vegetable products."

In some of the early experiments much trouble was experienced in obtaining sufficient atmospheric air through the bottom of the fire box, owing to a deposit of silicious matter which covered the bars with a sort of clinker; and after trying various schemes, the following simple method was found to be the most practical: The bars are placed about 4 inches apart, and between each pair is a blunt knife projecting about 2½ inches above them. Each knife is attached to a cross bar sliding on two guides under the grate, one end of this bar terminating in a long handle extending beyond the ash pan. When the bars require to be cleaned, the fireman moves the knives backwards and forwards, giving them, at the same time, a side action, which cuts out the clinkers, these falling into the ash pan, where they are immediately quenched by a jet of cold water from the feed pump, thus avoiding any danger from the escape of the burning ashes in cases of windy weather.

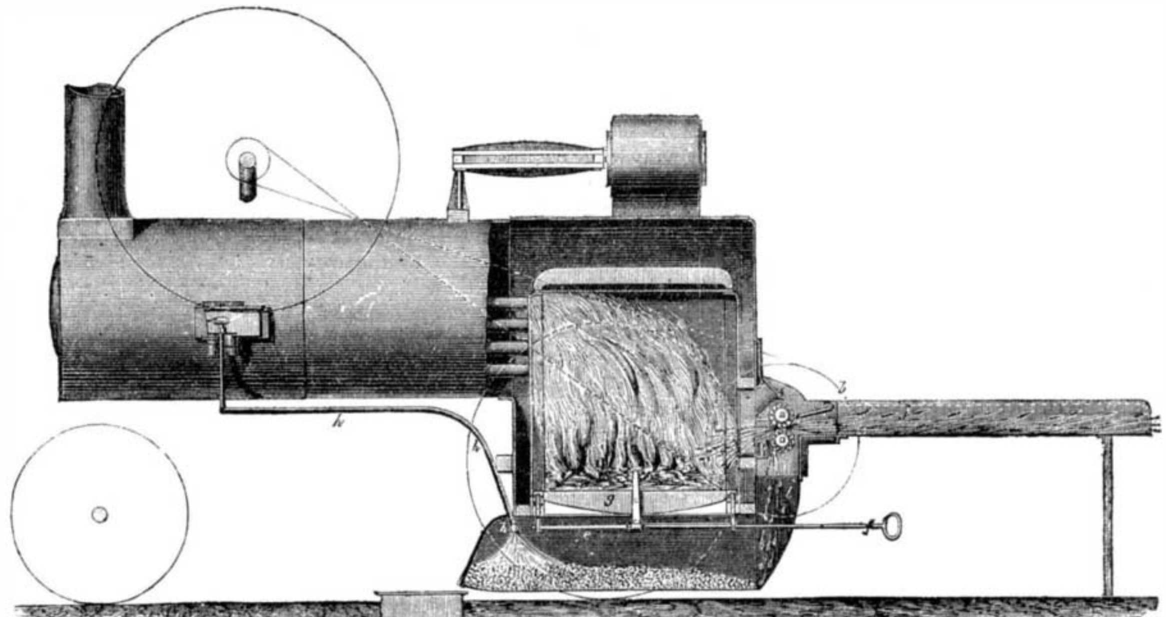
The apparatus for feeding the engine consists of rollers, which force the straw in so that each separate piece comes under the action of the flame. It is self-acting, and driven by means of a strap, and steam may be got up in the same way as with any other combustible, by attaching a handle to the feeding rollers and turning them by hand instead of by steam power. One man only is necessary to feed the straw into the engine, provided the material is brought to him and placed alongside the feeding trough. The average consumption is about four to five times the weight of coal; and according to experiments made, about ten to twelve sheaves of straw are required to thrash one hundred sheaves of wheat.

The engine represented is an ordinary 10 horse power portable, except that it is provided with a larger fire box than is used for coal burning, and that the tubes are of slightly smaller diameter than those ordinarily employed. The straw-burning apparatus is constructed precisely as shown by our engraving, and the straw is burnt in its natural condition, and not subjected to any artificial drying process. On first lighting up, the rollers have, of course, to be turned by hand to feed the straw into the fire box, but this is very light labor and can easily be performed by a boy. On the occasion of a trial, detailed in our cotemporary, in thirty-two minutes from applying a light, the steam had got up to 20 lbs. pressure, and the steam jet in the chimney was then opened. In eight minutes more, or forty minutes from lighting up, the steam pressure had reached 31 lbs., and the engine was then started, the steam jet being shut off and the belt put on to drive the straw-feeding rollers. The steam pressure then began to rise rapidly; and in fifty-one minutes from lighting up, a pressure of 60 lbs. was reached. Subsequently, the pressure was raised to 70 lbs., and a brake, applied to the fly wheel, was loaded so as to cause the engine to develope 20 effective horse power, the speed being 140 revolutions per minute. With this load steam was maintained steadily and with the utmost ease, the whole of the arrangements working admirably. The combustion of the straw was thorough and complete, only a few stray particles of unburnt material occasionally finding their way into the ash pan, while, by an occasional use of the rake or knives already mentioned, the grate bars were readily kept clear The water jets in the ash pan also thoroughly fulfilled their purpose of preventing ignited particles from flying about—an important matter where thrashing is going on—and altogether the trial was a most satisfactory one in all respects.



STRAW-BURNING PORTABLE ENGINE.

One of the illustrations which we give represents a perspective view of one of these engines getting up steam, showing the position of one man feeding and the other turning the rollers by hand. The other engraving consists of a section of the fire box. In these views, *a a* are toothed rollers fitted with malleable teeth, and connected with the engine by means of a pulley, *b*, driven by a strap from the crank shaft. These rollers make 48 revolutions per minute, and can be turned by hand when getting up steam. The movable sliding blunt knives or rake, *c c*, attached to a crossbar, *d*, slide on guides, *e e*, below the grate, as already explained. This rake can be moved with a forward and side motion by the stoker by means of the handle, *f*, thus breaking up the silicious crust deposited on the grate bars, *g*, while a perforated pipe, *h*, is provided for injecting water upon the burning ashes. A shoot, *i*, carries any small pieces of ignited straw back into the ash pan, and *j* is a wooden trough to contain the straw which is to be fed into the furnace, and which can be removed when the engine is traveling. The whole apparatus swings on a hinge, *k*, and can be taken off in a few minutes, and the ordinary fire door substituted when coal or wood is burned.



This is without doubt one of the most important steps that has been made in the construction of portable steam engines since their introduction, as they can now be used in any country where vegetable produce can be raised, instead of, as heretofore, being practically restricted to those countries where coal or wood can be procured.

Trial of the New Electric Light Machinery at the House of Commons.

Gramme's magneto-electric machine has been now for several months before the public, and the effects obtained, says *Engineering*, have been of such a nature as to confirm our statement that, scientifically and practically, it is one of the great inventions of the age.

The essential requisite for the production of electric light is that the machine evolve a current of considerable quantity and tension, for experiment proves that the most effective arrangement for illuminating purposes is neither quantity nor tension alone, but a combination of both, which may be easily obtained by paying due attention to the gage and length of the wire, the connection of the bobbins, and the speed with which they are driven. In the present case, the velocity need not exceed a maximum of 350 revolutions per minute.

Such a moderate rate obviates the great inconveniences caused in other machines by the overheating of the armatures. This is the great drawback in Ladd's and Wilde's apparatus, which in other respects are admirable pieces of workmanship and skill. Practically this advantage appears to us to be of as much importance as the distinguishing feature of the Gramme itself, namely, the absolute continuity of the current and its uniformity of direction. This development of heat causes not only mechanical inconveniences, but also, by raising the temperature of the conductors, it increases the resistance and thus diminishes the strength of the current. Now the heat developed in the Gramme machine becomes perceptible only when the work to be done is not proportional to the current generated. But as the electro-motive force varies with the rapidity of rotation, it is evident that the latter may be regulated to suit the requirements of the case. By attending to this, little or no heat may appear in the coils, and a very large fraction of the power expended may be converted into useful work. On the night of May 25, we had the opportunity of examining the apparatus on the clock tower; the speed was only 300 revolutions per minute. The machine is in the engine room under the peers' lobby; the interpolar wires are bracketed to the walls from which they are insulated by passing through the space between V shaped pieces of ebonite. The wires are not covered, insulation from the air being deemed unnecessary. They are carried from the engine room to the lantern of the tower, a distance of 900 feet; consequently three times that of the Foreland, and the greatest distance, we believe, the terminals of an electric light generator have as yet been carried. The gage used is the 000 B. W. G., or ·425 of an inch in diameter. The intensity of the light on the 25th of May was equal to 8,000 candles. Very dark glasses were required to look at the lantern even from a considerable distance. The beam, as it shot through the air, reminded one of the lustrous silvery appearance of the tail of the comet of 1858 when in perihelion. At the place illumined by the beam, objects could be seen, and books and letters read with as much ease as in solar light, allowance being made for the mellowness of the one and the brilliant argent color of the other. At Trafalgar square, a very black shadow of the pillar was cast over the National Gallery; at the Duke of York's column, a very pleasing effect was produced by the sharp and well defined shadows cast by the trees and their foliage. At these two places, we endeavored to realize the difference between the electric light and that emitted also from the clock tower by the 300 gas burners of Mr. Wigham, enhanced by the most elaborate optical aids; and we must say that the contrast was indeed very striking, a few minutes having elapsed before we were able to discover the path of the beam projected by the latter. In the immediate vicinity of the Houses, Mr. Wigham's light is very soft and pleasing to the eye; but at a distance, by no means considerable, it is scarcely visible. Perhaps the proximity of the electric light may contribute to diminish its splendor; if so, the results are all the more in favor of the new machine.

The carbon points are eight inches long and half an inch in thickness. They last for about four or five hours, and then require to be replaced.

Correspondence.

The New Corundum Mines of Pennsylvania.

To the Editor of the Scientific American:

In company with Professor Garth and Messrs. Willcox and Green, the undersigned made a second visit to the recently discovered corundum mine, near Unionville, Chester county, Pa. The proprietors, Messrs. Ball, Chandler & Perrey, are now engaged in mining the corundum and preparing it for the market. For the latter purpose, they have erected the appropriate machinery to reduce the corundum to powders of various degrees of fineness. In the reduced state, it has a nearly white appearance and looks exceedingly clean.

The mine in its present state exhibits a good exposure of the nearly vertical bed of corundum. A deep excavation exposes a breast of almost fourteen feet in width, disappearing east and west beneath the superincumbent gravel and clay on the sides of the pit. The crest of the bed, upon which the corundum is being removed by blasting, is about five and a half feet in thickness. It is of course impossible to estimate the extent of the bed of corundum. It probably extends along the breadth of the hill, but may reach in depth for many hundred feet. Professor Garth has recently been investigating the corundum and the associated minerals of this mine and those of North Carolina; and he will shortly present us with a highly interesting and valuable communication on the subject. JOSEPH LEIDY.

REMARKS BY THE EDITOR.—Corundum, it will be remembered, is the substance chemically known as alumina, which is an oxide of aluminum, being composed of two parts of the metal aluminum and three parts of oxygen gas. An impure variety of corundum or alumina is known as emery, while the purer varieties rank among the precious stones, known as the ruby and the sapphire. Corundum stands next to the diamond in hardness, and the prepared powders mentioned by our correspondent are extensively used in the arts for polishing and grinding purposes.

The Chlorodizing Process of Extracting Silver from Refractory Ores.

To the Editor of the Scientific American:

I forward you a specimen of refractory silver ore (from the Gilpin mine near Georgetown, Col.), containing argentiferous galena, sulphuret of silver, black sulphide of silver, green carbonate of copper, covelline, copper pyrites, marcasite and zinc blende.

Enclosed you will find a sample of amalgam obtained from the same grade of ore (mineral from the same vein.) It was worked on a large scale, one tun and a half at a time, by the chloridizing process, and afterwards amalgamated at a cost (here) not exceeding ten dollars per tun, the mineral being delivered at the reduction works.

The specimen of retorted silver is from the same amalgam, and is over 920 fine, a quality which I believe has never before been produced in the United States, especially from refractory ore, except by John N. Palmer, Jr., who, in company with your humble servant, worked the ore above referred to. The ore was chloridized to 91½ per cent.

As much has been said about the impossibility of amalgamating refractory ores of Colorado, I forward you the samples so that you may examine them and test them for the benefit of science; and, if you consider this article worthy of publicity in the columns of your illustrious paper, please insert the facts after having tested them.

Georgetown, Col. PERCIVAL STOCKMAN.

REMARKS BY THE EDITOR.—This result evinces considerable progress in American metallurgy. A low bullion of from 300 to 500 fine used to be an ordinary result. The maximum chlorination by the Stetefeldt furnace is 93½, or two per cent less than by Messrs. Palmer and Stockman.

The Retardation of the Earth's Rotation by Tides.

To the Editor of the Scientific American:

Having given John Hepburn, in your number for June 14, permission to ventilate his reasons for holding that the tidal movements cannot influence the earth's rotary motion, please allow me to show why he should change his mind straightway.

Let us suppose that, in the course of a year, the two great tide waves make twelve revolutions, in direct order, that is, from W. to E.: also, that the earth rotates, in the same time and direction, 365 times. It is evident that the earth gains upon the tides over 350 revolutions; which is plainly the same thing, in all its mechanical effects, as if the tides stood still and the earth rotated between them 350 times. And we have here an exact picture of a rotating wheel, to which a brake is applied and held in position by some external power.

I suppose it is well known that the slow retardation of the earth's diurnal motion is an established fact in astronomy. If J. H. will station himself at the opposite celestial pole, perhaps he can favor us with an explanation of this fact.

ORTHODOX.

ALCOHOL FROM FLINT AND QUARTZ.

ABSTRACT OF A RECENT LECTURE BEFORE THE ROYAL INSTITUTION BY PROFESSOR EMERSON REYNOLDS, M. D.

Carbon has hitherto been considered the sole alcohol forming element; but the chief constituent of flint and quartz, namely, silicon, must now be admitted to share in this power, and likewise in the ability to form other remarkable compounds. I have here a quantity of finely divided flint mixed with some powdered fluor spar; when I pour oil of vitriol on the mixture, and apply heat, a colorless gas is obtained, which, when passed into water, produces a highly acid and gelatinous liquid. The gas is a compound of the element fluorine with silicon—the tetrafluoride of silicon—and this, when brought in contact with water, produces an acid called hydrofluosilicic acid and a quantity of gelatinous hydrate of silica.

The clear acid liquid, when treated with caustic soda, yields this white salt, the fluosilicate of sodium, from which we directly obtain the silicon, as you see, by simply heating with some metallic sodium. In this case the sodium replaces the silicon, the latter separating, as you observe, in the tube as a dark brown substance.

Unlike carbon, silicon in any of its forms easily combines directly with chlorine, producing the liquid chloride which I have in this tube. This is a very volatile body, boiling at 50° C., and is half as heavy again as water. It can also be prepared from silica by heating to full redness the finely divided oxide and carbon in a current of chlorine. In composition, this chloride is the silicon representative of tetra chloride of carbon.

We can easily obtain the impure gas by Wöhler's method, in treating a compound of silicon and magnesium with hydrochloric acid. We thus obtain a colorless, spontaneously inflammable gas, which burns with a bright light on contact with the air. In its pure condition, siliciuretted hydrogen is not spontaneously combustible at ordinary pressure, but in a slightly rarefied atmosphere it easily inflames.

The siliciuretted hydrogen is evidently the chemical analogue of marsh gas, the tetrahydride of carbon.

It is usual to regard marsh gas as the typical carbon compound from which some alcoholic series may be supposed to spring, and, in fact, all the alcohols belonging to the group of which the well known wood spirit and spirit of wine are the chief members are commonly regarded as derivatives of marsh gas, in which a part of or all the hydrogen has been replaced by one or more compound radicals, such as hydroxyl, methyl, ethyl, propyl, etc.

In these cases the carbon of the marsh gas is the grouping element of the compound, or that constituent which serves to bind together the different materials of which the molecular edifice is constructed. In the same way, the silicon in siliciuretted hydrogen may be shown to be the nucleus round which can be grouped hydroxyl, methyl, etc., so as to form the alcohols I shall presently have to refer to.

In 1857 Buff and Wöhler obtained a volatile fuming liquid on heating crystalline silicon nearly to redness in a current of dry hydrochloric acid gas. The precise nature of this liquid was unknown until 1871, when Friedel and Crafts published the results of their admirable researches upon Buff and Wöhler's liquid, and showed that it was a mixture of chloride of silicon with a new body, which proved to be the strict chemical analogue of our well known chloroform, silicon replacing carbon.

$SiHCl^3$ Chloroform. $CHCl^3$.

This body is a colorless, mobile, and very volatile liquid boiling at 35° C. I have a quantity of it in this tube. One of its most remarkable properties is that of exploding with great facility when its vapor is mixed with air. If I pass the vapor of silicon chloroform into water nearly ice cold, a white solid body is obtained without any evolution of hydrogen, and an acid liquid produced. The white solid then collected, washed, and dried at a low temperature, forms a white inflammable powder, which was first described by Buff and Wöhler. Friedel and Ladenburg have shown that this remarkable body is the anhydride of the silico-formic acid. According to the results of my own investigations, the acid liquid to which I referred just now contains, in addition to hydrochloric acid, the true silico-formic acid—a body possessing nearly as energetic reducing properties as the corresponding acid derived from wood spirit.

Starting from silicon chloroform, then, we have been led, by analogical reasoning in the first instance, to infer the existence of a simple silicon alcohol precisely corresponding to wood spirit. On testing this induction by experiment, we have obtained answers which are, so far as they go, altogether favorable to the view just stated.

In the course of their elaborate and able investigation of silicon compounds, Friedel and Crafts discovered that chloride of silicon easily acts upon common alcohol, producing a body which Friedel and Ladenburg have recently shown to be easily attacked by a mixture of sodium with a curious substance contained in this tube—zinc ethyl. The product, when treated with caustic potash, yields a body which bears the same relation to silico propyl alcohol that formic acid does to wood spirit.

This silico-propionic acid is in this tube, and is a white combustible powder, like the silico formic-anhydride. It is soluble in warm caustic potash, but not in caustic soda; by which character it can be distinguished from silica. It is only necessary to state that it can be obtained in aqueous solution, and in the pure state, by Professor Graham's valuable dialytic process.

When chloride of silicon acts upon absolute alcohol a body is obtained which, on treatment with zinc ethyl and sodium, yields an ethereal product from which silico-propionic acid can be obtained by treatment with caustic potash. If, however, instead of using the caustic alkali we continue the action of zinc ethyl and sodium, decompose the products with water in sealed tubes, and distil, a liquid is obtained which contains one of the "alcohols from flint" we are in search of. In this tube I have a small quantity of the alcohol. It is the silico-heptyl alcohol, precisely corresponding to a simple carbon alcohol recently discovered by Nanapetian, both being tertiary alcohols. We owe to Ladenburg the discovery of this lowest known term of alcohols containing silicon. As you can observe, it is a colorless liquid, not unlike the ordinary alcohol of wine. It is insoluble in water, but easily dissolved by spirit and ether. Chemically it acts just like any of the other alcohols, producing ethers, and dissolving the alkali metals to form sodium or potassium alcoholates. When common spirit burns, you are aware that its flame is nearly colorless, but I shall now burn some of our alcohol from flint, and you will find, particularly when we feed the flame with oxygen, that a bright light is emitted.

Clearly defined though this alcohol is, it does not stand alone, for at least one other compound of the same order is known. It was suggested in 1870, by Friedel and Crafts, that silicon ethide—a body easily prepared by the action of chloride of silicon on zinc ethide—might be regarded as the hydride of silico nonyl, and should stand in the same relation to an alcohol that marsh gas does to common wood spirit, or ethyl hydride to ordinary alcohol. This happy idea, when put to the test of experiment, was fully justified by the result, for on treating silicon ethide in essentially the same manner that we should adopt in preparing wood spirit from marsh gas, a colorless liquid, lighter than, and insoluble in, water is obtained. The boiling point of this body is 190° C. It yields an ether with acetic acid, dissolves sodium, forming an alcoholate, and, in fact, conforms to the general habits of the alcohols of the series to which common spirit belongs. It is precisely similar to the nonyl alcohol prepared by Pelouze and Cahours from American petroleum.

Ladenburgh has very recently advanced even beyond the point we have now reached, and has shown that the chloride of silicon can be made to yield two ethers, which correspond, as I may suggest, to silico nonyl diatomic and triatomic alcohols.

In all the preceding compounds but one atom of silicon is present, and though the silicon in these cases occupies the chief position as the grouping element, we should much like to see silicon uniting with silicon and forming a more condensed compound with hydrogen. Happily, however, very important evidence, even upon this point is forthcoming, for Friedel and Ladenburg have discovered corresponding hexa-chloride, iodide, and bromide of silicon, and treatment of the hexa iodide with zinc ethyl enables us to obtain the ethide.

It is not improbable that, in the last named compound, we have the starting point of a new series of still more complex bodies, analogous to derivatives of olefiant gas rather than to those of marsh gas.

A rich and beautiful field for chemical research appears to lie before us in tracing out the analogies between the compounds of carbon and silicon, and recognizing the chemical representatives of many of the most complex "organic compounds" in the native silicates which form so large a part of the crust of this earth.

The practical value of scientific research is rarely apparent at first. Who could have suspected that the benzole discovered by the venerable philosopher whose name is so inseparably connected with this institution, would have proved, in the able hands of Perkin and of Hoffman, the chief source of many of the exquisite dyes now largely manufactured in this country? Yet in this, as in a hundred of other instances, the small and apparently useless scientific seedling has gradually expanded into the strong tree, yielding its rich store of useful fruit. Let us hope that a similar future awaits some of the alcohols from flint which have been referred to, and that, in pursuing our studies of the silicon analogues of the more complex carbon compounds, we may be led to appreciate more fully than we have hitherto done the admirable economy and harmony of Nature.

Booming.

"Booming" is the name of an operation with which probably our Eastern readers are not generally familiar. Hence, we extract, from the columns of the *Mining Review*, an explanation of the process as practised by the miners of Colorado. Booms are built and run for two purposes: the discovery of veins hidden under the deep slopes of the mountain sides and the working of gold placers on a large scale.

The reservoir is first constructed at the head of the ground to be worked; into this water is conducted, from the most convenient source still higher up, by flumes or ditches. These reservoirs vary in size from a small pond to an acre or two lake, and the ditches are often eight, ten, and twelve miles long. When the basin is full, and a continuous head of water is in running operation, gates are opened, letting loose the whole volume of the liquid, which tears down the mountain side in a huge volume, sweeping everything before it, carrying tuns of boulders, gravel, and dirt down to the gulch below. If auriferous ground is to be worked, a long and massive wooden flume is built at the foot of the hill, into which the *débris* is carried, with all the force of the falling waters and the sand and rocks washed along in its course while the gold is deposited by its own gravity, behind the riffles in the bottom of the race. These flumes are often thousands of feet long, and as rocks of all sizes and weights are carried along in them, they must be built with great strength and solidity, to withstand the immense wear.

If it is the object, however, merely to uncover the veins of