Cast Glass Rails.

Friedrich Siemens, of Dresden, has succeeded in casting glass in the same way as metal is cast, and obtaining an article corresponding to cast metal. This cast glass is hard, not dearer in production than cast iron, and has the advantage of transparency, so that all flaws can be detected before it is applied to practical use. It will be much less exposed to injury from atmospheric influences than iron. The process of production is not difficult, the chief feature being rapid cooling. The hardness and resisting power of this cast glass are so great that experiments are being just now carried out at the Siemens glass foundry at Dresden with the purpose of ascertaining whether the material could be employed for rails on railways.

A sample of these glass sleepers recently tested at the Anderston Foundry Company (Limited), Glasgow, resisted a falling weight of 3¾ cwt., falling upon a rail placed upon the sleeper set in sand ballast, commencing at 6 inches and rising by succeeding increments of 6 inches up to 9 feet 6 inches—the *maximum* elevation to which the test ram could be elevated—without effect until the blow had been repeated for the sixth time. Cast iron sleepers are expected to withstand a similar test up to 7 feet only.* The cost of glass sleepers will be considerably less than that of either cast iron or steel, while the material is practically imperishable as regards climatic changes and influences, or the ravages of such insects as the white ant.

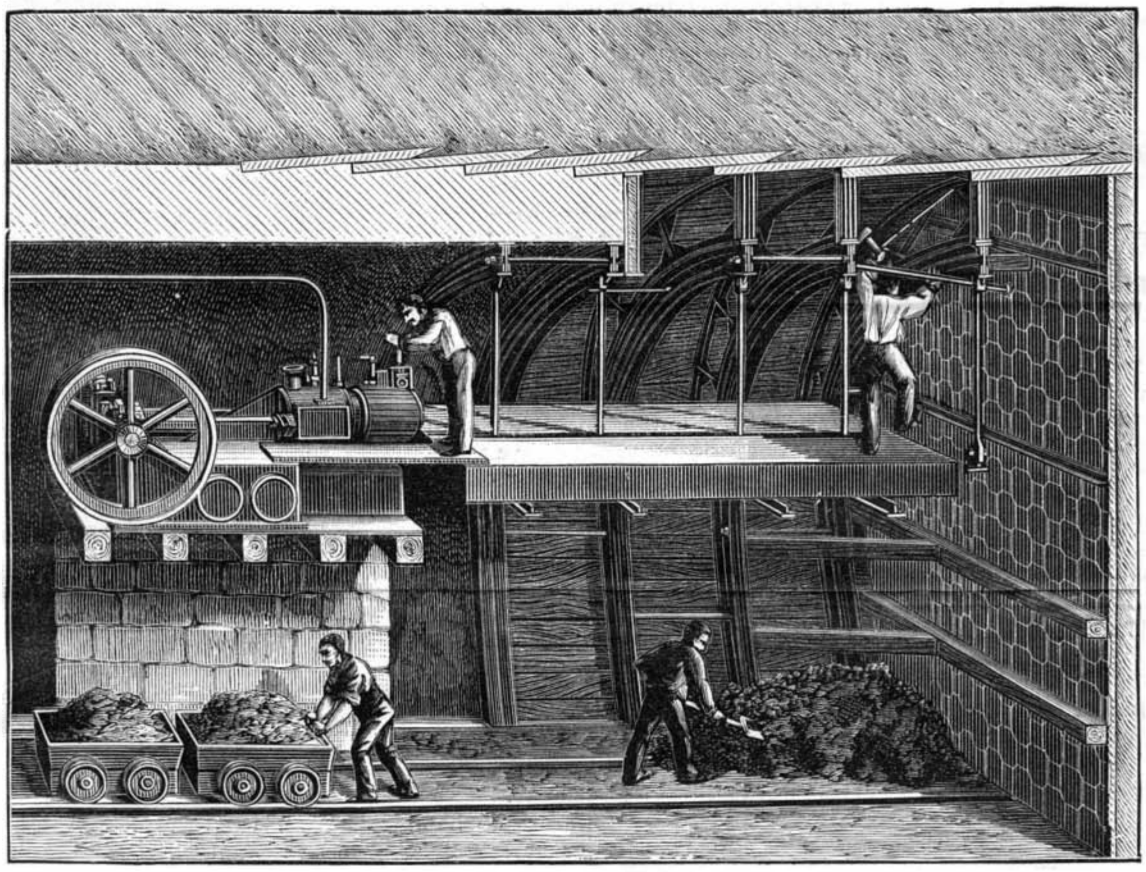


Fig. 1.—TUNNELING BY FREEZING.

FLOODS IN INDIA.

West of the River Jumna, the Northwestern State Railway runs parallel to the Himalayas for some hundreds of miles, and crosses all the five rivers of the Punjab. The country between the hills and the railway is more or less subject to floods throughout the whole of this distance. In the neighborhood of Umballa there are several mountain torrents whose wide sandy beds are dry for nine months of the year, but during the remaining months, whenever there is heavy rain in the lower ranges of the Himalayas, they become broad, rapid rivers, which are eventually lost in the sands of the Bikanir deserts.

The railway crosses the beds of these streams on iron girder bridges, apparently wide enough to carry off the waters of any flood. On the 3d of July an extraordinary spate came down the Markunda and other neighboring rivers between Umballa and the Jumna, and as the bridges were unable to pass all the water, the floods spread all over the country. The railway embankment, which is generally eight or ten feet high, acted as a dam and kept the water back, so that it accumulated, and at last ran over the top of the bank in places. Wherever this happened, a breach in the embankment was invariably caused. Some of the smaller bridges, and culverts, too, were washed away, and holes twenty feet deep scoured out in the places where they had been. In one place there was an almost continuous breach in the railway for more than a mile; ten miles further on there were others very nearly as extensive, and lesser breaches between these two points. But, although the bank was gone in so many places, the rails, with their cast iron sleepers, were left hanging in festoons in the air, and were only actually broken in one spot. Of course, all running of trains was suspended; but the mails had to be got through. The sketch represents the English mail *en route* for Simla being carried on trollies over the damaged portions of the line. The railway was not the only sufferer; the Grand Trunk Road, which runs parallel to

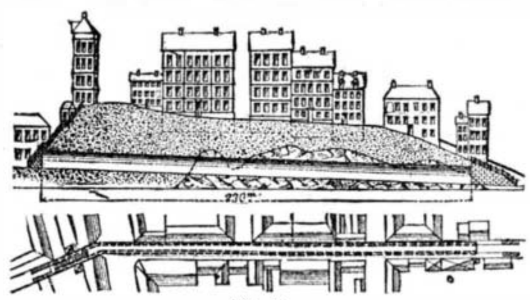


Fig. 2.

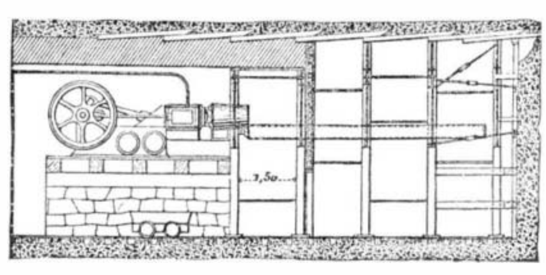


Fig. 3.

it, was destroyed in places, and many villages were wholly or partially washed away.

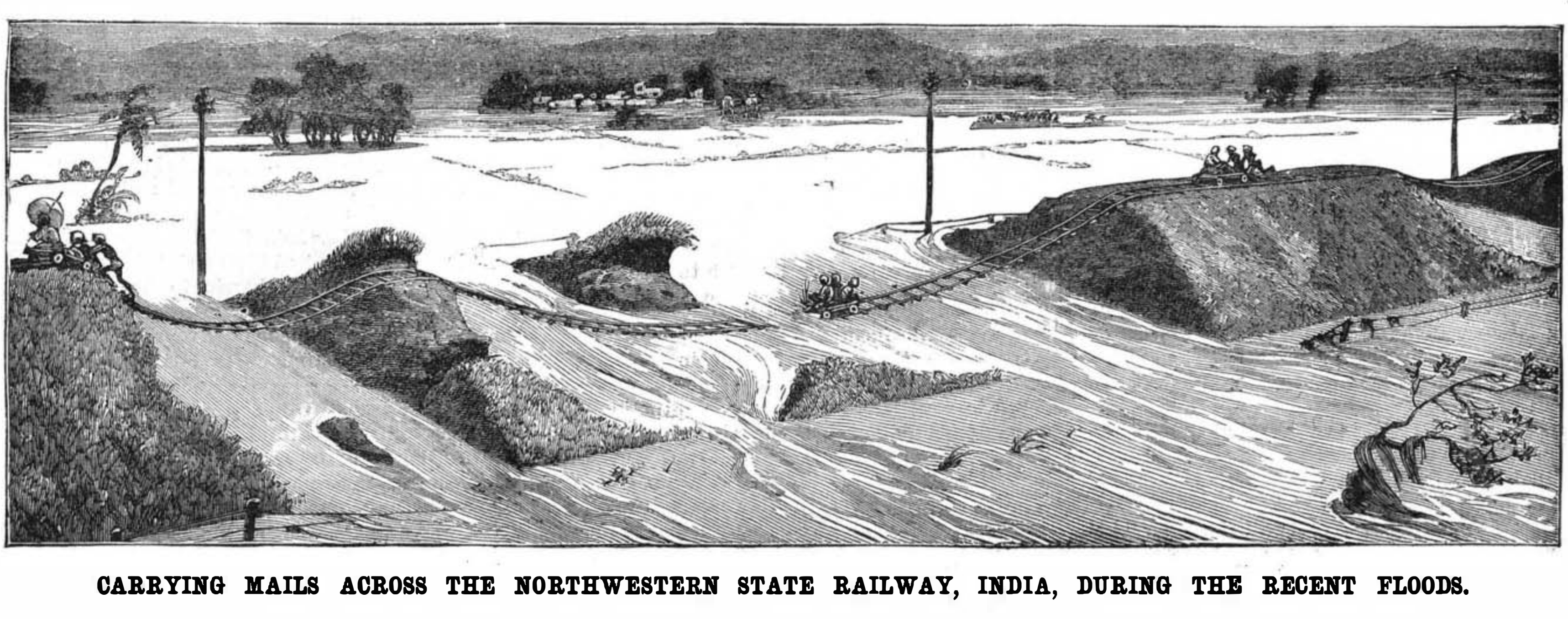
To restore through traffic, it has been necessary to construct an entirely new portion of line to one side of the breaches, the repair of which will take a considerable time. The above account is by Captain William Pitt, R.E., who has also furnished the sketch.—*London Graphic.*

TUNNELING BY FREEZING.

Pœtsch's ingenious system of sinking mine shafts through watery earth by freezing the latter is already known to our readers. An attentive examination of the frozen strata having shown that their respective slopes had but little influence upon the total hold of the mass, it was concluded that no special difficulty would be met with in applying this method of the driving of a tunnel. This opinion has held good in practice, and, although merely the principle of the method has been employed in the tunnel that has just been opened at Stockholm (Fig. 1), we have here an interesting example of the practical solution of the question of tunneling in shifting earth. The tunnel in question is designed to unite two quarters of the northern part of the city that are separated by the crest of a hill which renders communication between them particularly difficult. In order to overcome this difficulty, Capt. Lindmark, of the Swedish Engineers, proposed to tunnel the hill. The total length of the work is 755 feet, the width is 13 feet at the springings, and the height 12½ feet under the key. In order to avoid taking possession of private property at the approaches to the mouths, the line was carried in the direction of the axis of a street; but this latter was already laid out and was quite narrow, and in certain parts, especially near the western extremity, the foundations of the tunnel came under those of the houses (Fig. 2). Such a work therefore presented peculiar features, and required the greatest precaution in order to prevent the subsidence of the structures above.

The direction heading at the base of the tunnel was for the most part excavated in granite by means of dynamite. The widening out of the western part of the work met with no serious obstacles, but it was entirely otherwise with the eastern. The ground met with near the mouth consisted of coarse gravel intermingled with blocks of stone and cemented with a clay that became liquid through infiltrations of water, and caused the sand to flow through even the smallest apertures. Moreover, at fifteen yards from the mouth, the line passed under two five-story houses (Fig. 2), built upon the opposite sides of the hill, and at so slight a distance from each other that the archbutments of the tunnel had to be built under their foundations, which latter extended down to within ten feet of the arch.

Mr. Lindmark, in the first place, thought of the method devised by the Austrian engineer Rziha, which consists in supporting the sides of the excavation with two centerings, one consisting of voussoirs of Vignole rails connected by bolts and stays, and the other of cast iron, formed of pieces of double T section, upon



CARRYING MAILS ACROSS THE NORTHWESTERN STATE RAILWAY, INDIA, DURING THE RECENT FLOODS.

which rest the upper voussoirs. Planking is placed against the way-head, and is kept in position by jack-screws. In measure as the excavating progresses, centerings are placed in the space prepared in advance, while those which have become useless are taken down and replaced with masonry. Such precautions in this case proved barren, and, after some subsidences had occurred before reaching the locality beneath the buildings that we have spoken of, it became necessary to stop work at about twelve yards from the mouth.

It then occurred to Mr. Lindmark to employ freezing, and, to this effect, he set up in the tunnel a cold air machine of the Lightfoot type, that furnished 25,000 cubic feet per hour of air at a temperature of —20° C. Fig. 3 shows the arrangements adopted, and combined with the Rziha method. After a run of sixty hours, a freezing of the sides of the tunnel was effected, and it then sufficed to run the apparatus ten hours during the night to keep up the solidification of the mass to depths varying from five feet to the level of the floor. Toward the key, the thermometer did not indicate more than 0°, while the mean temperature was —4½° C. The temperature rose rapidly to 0°, however, when the laborers began to work. The working chamber was closed by a double partition, which was filled in with charcoal, and which was moved forward in measure as the excavation advanced five feet. The metallic centering, arranged as before, but diminishing from the parts corresponding to the archbutments, was put up against the sides that had become solid. The difference in temperature between these parts and the arch presented no inconvenience; it even permitted of easily sinking the sheet piling, which would, in any event, have had to be used, and the driving down of which into frozen gravel would have been difficult, if not impossible.

In measure as a 5 foot section was completely excavated, the masonry was built up behind the partition; advantage thus being taken of the time during which the walls still remained solid. The operation was carried on in this way for a distance of eighty feet, beyond which there was encountered soil of sufficient cohesion to render freezing useless.

The work, which was begun in the summer of 1885, is now completed. Of the two houses under which the tunnel passes, one has exhibited no subsidence, while the front of the other has settled about an inch. But the construction of this front leaves much to be desired, and fissures could be seen in it before work on the tunnel was begun. The work cost $88 per running foot.

Such an application of the principle of freezing earth might doubtless be made in the work on the Metropolitan Railway of Paris, which, at a certain number of points, has to traverse ground that is more or less watery, and that, at all events, supports high buildings, without speaking of that part of the line which, joining the two banks, runs as a tunnel under the bed of the Seine. It is probable, moreover, that a series of applications made upon a large scale, and the cost of which would be distributed over quite long stretches, would permit of reducing the cost noted above for the Stockholm tunnel, where the expense of purchasing and setting up the cold air apparatus must have weighed quite heavily upon the work as a whole.—*La Nature.*

[For additional particulars and illustrations of this work, see SCIENTIFIC AMERICAN SUPPLEMENT No. 542, May 22, 1886.]

An Electric Boat Crosses the Channel.

On Sept. 13 last the electric boat Volta crossed from Calais to Dover and back again under the propulsion of power stored in secondary batteries. The double trip was made with a single charge, which proved amply sufficient for the purpose, and was in every way successful, although it is not very clear that it demonstrated anything more than could have been shown by a run in the Thames or the Solent. The boat passed the pierhead at Dover at 10:41 A. M., and made the pierhead at Calais at 2:32 P. M., the run having occupied 3 hours and 51 minutes. The return journey was made in 4 hours 23 minutes, the total running time being thus 8 hours 14 minutes. The distance each way, we believe, is 22 miles. This, says *Engineering*, is no great speed, far below the maximum of which the boat is capable, but it was necessary to economize the power in view of the possible contingencies which might arise. Three different speeds can be obtained by various groupings of the two Reckenzaun motors which are employed. These motors are both on the same shaft, which they drive direct. For the slow speed the motors are coupled in series, the current passing through them in succession, and driving them at about 600 revolutions per minute. For the medium speed only one motor is employed, while for the fast speed they are placed parallel, thus affording two circuits to the current.

Under the last condition the speed of rotation is 1,000 per minute, and the brake horse power 16. The motors drive a three-bladed screw, 20 in. in diameter and 11 in. pitch, coupled direct to the main shaft. The motors measure together 3 ft. 10 in. long, by 1 ft. 9 in. wide, by 12½ in. high, over all. They weigh 730 lb., and are worked by 61 E. P. S. cells, weighing about two tons, and each giving one horse power for one hour. On Sept. 13 the battery gave a current of 120 volts and 28 amperes, which was maintained constant until Dover was nearly reached on the return journey, when it had fallen to 24 amperes. The boat, which was designed and built by Mr. Skelton, of Millwall, measures 37 ft. by 6 ft. 10 in. It carried a party of ten, among whom was Mr. Reckenzaun and Mr. Stephens, of the firm of Stephens, Smith & Co., who have supplied the machinery. The noticeable feature in this trip, as in all previous experiments with electric boats, was the perfect stillness of its passage through the water. It is remarkable that the wonderful superiority in this respect over the noisy, puffing steam launch should not already have led to the general use of this method of propulsion for purposes of pleasure.

A Small Locomotive.

Probably one of the smallest and most perfect working models of a locomotive is now on exhibition at the American Institute Fair; it is only one thirty-second the size of the ordinary engine, and yet every detail is accurately represented on this standard. The engine was designed and built by Mr. F. Van Fleet, of Williamsport, Pa., during such time as he could spare from mercantile pursuits, and is a rare example of fine mechanical skill. The building occupied from three to four hours a day for two and a half years. Mr. Van Fleet's only mechanical training was obtained during two years spent at Cornell University; he never worked in a shop, nor has he had any practical experience with machinery, so that the mechanical perfection of his work as shown by his locomotive indicates much genius. His knowledge of the locomotive was obtained by several years of study of books and close examination of engines of various patterns. The miniature locomotive is not copied from any of the large ones, but contains their best features, and constitutes Mr. Van Fleet's ideal of a locomotive.

All the work was performed with hand tools—taps, dies, files, etc.—the only machine used being an ordinary foot lathe. All the valves and pistons were ground, the latter so accurately that, although they will slide of their own weight, they form a steam-tight fit with the cylinders. This accuracy of fit was necessary, since the smallest leak, where the pipes were so minute, would prevent the working of the engine. Some of the pipes measure only one-sixteenth of an inch in diameter outside, and have a bore of one thirty-second of an inch. These were made of thin sheet copper, which was drawn through dies until the proper size was attained, when the meeting edges were soldered.

The length of the engine and tender is 19 inches, the former being 12 inches; the height is 5½ inches, and the width 3½. The cylinders are nine-sixteenths inch in diameter by three-quarters inch stroke. Steam enters the cylinders through ports one-sixteenth by three-eighths of an inch, and makes its exit through ports three thirty-seconds by three-eighths of an inch. These ports are opened and closed by slide valves one-quarter of an inch wide and three-eighths of an inch long. The driving wheels are 2¼ inches in diameter, the truck wheels three-quarters, and the tank wheels thirteen-sixteenths. The main rods are 2¾ inches long, and the side rods 2⅞ inches long and one-eighth inch in width. The boiler is 1½ inches in diameter and 10 inches long, including the extended smoke box; the fire box is 2½ inches long by 1½ wide. One large flue extends through the boiler, it being necessary to make it this way, since the draught would have been choked had the number and size of the tubes found in the ordinary locomotive been followed. The boiler is built of brass lagged with wood and jacketed with Russia iron bound with German silver straps. The steam dome is 1 inch in diameter and 1½ in height, and is provided with two safety valves, a "pop" and lever, and with the usual whistle. The boiler will safely bear a steam pressure of 125 pounds, although the steam gauge, which is one-quarter of an inch in diameter, and whose face is illuminated by a genuine lamp placed directly in front of it, will only indicate up to 100 pounds. The engine is equipped with a perfect "Sellers improved injector" 1¼ inches long by one-eighth of an inch in diameter. It is also fitted with a full Westinghouse air brake system, both automatic and straight, on drivers and tank. The air pump is 1⅜ inches long and three-sixteenths in diameter. The driver brake cylinders are three-eighths of an inch long and one-quarter in diameter. The steel links are 11/16 inch long, and have a slot three thirty-seconds of an inch wide; the link block one-eighth by three-sixteenths inch. All the nuts are hexagonal, and there are 120 threads to the inch in the bolts. The stack is one-half inch in diameter by two in height, and is provided with a headlight five-eighths inch in diameter; one filling of this lamp with oil will illuminate the track for one hour. The signal lamps are one-half inch long, and will burn twenty minutes. The engine is provided with a very perfect steam reversing gear designed by Mr. Van Fleet. The weight of the engine is about 15 pounds. It can be fired and run the same as the ordinary locomotive, and is fitted to burn either oil, coal, or coke. Lubrication is provided by oil cups one thirty-second inch bore.

In constructing this locomotive, no complete drawings were made; the separate parts were taken up, fitted in place, and finished, only such drawings of the details being made as were found necessary. The engine is beautifully finished, and the skill of the builder is shown by the perfection and accuracy of each part, even those which are partially hidden showing the same care and skill. The materials entering into the construction of the engine are gold, silver, German silver, brass, copper, steel, iron, and nickel.

Seeing and Thinking.

Some men, remarks a contemporary, would walk through a machine shop and see nothing but lathes, planers, and other machine tools, together with a lot of unfinished castings and pieces of machinery. Such men never improve methods of doing work. They never think of a better way to do a job. They plod along, thinking chiefly of killing time until pay day. Now and then a man comes along who sees things differently. No matter what object meets his eye, the sight of it suggests something. Perhaps the object is nothing but a piece of scrap iron lying on a junk heap. No matter, our "observing man" sees the whole of that piece of iron, and it stirs up numberless thoughts and calculations as to how that piece was worn out, and what made it wear in that particular manner, and how it could have been made to wear much longer. Perhaps the observing man finds an awkward tool expensively employed in doing a job in an indifferent manner. Our seeing man realizes in an instant the disadvantages of that particular tool, and at once sets to better the matter. A piece of bent iron, a twisted wire, or some commonplace object often gives the impressive mechanic a clew to some point upon which he has been studying for a long time. These men are the ones who make improvements. They are the kind of men needed, and all men should follow their example of trying to see all there is in everything which comes to view, no matter how insignificant or commonplace it is.

Destruction of Our Birds.

Twenty to thirty years ago, it was not an unusual sight to see even the scarlet tanager, a bright red bird with black wings and tail, flitting from tree to tree in the heart of our cities like a fiery meteor in the sun light, and to find their nests, built very lightly of straws and similar material, on the horizontal limbs of our shade trees. But they were killed off and driven back to the woods long before the advent of bird millinery as a fashion. They were, indeed, a "shining mark," and everybody wanted a specimen, or thought they did, until at the present time the scarlet tanager is really a very rare bird throughout the New England States.

The Baltimore oriole, so named because the colors of the bird, black and yellow, resembled those of Lord Baltimore, has almost met the same fate, as it has done duty in ornamenting thousands of ladies' bonnets within the past five years. Four years ago, this bird was quite plenty on the elms of Boston and suburbs. The hanging nests, made of hemp, old twine, etc., were quite common. But the past season showed a great change. These birds have been shot so ruthlessly, both while here and at the South, and during the migration, that hardly a pair could be found during the breeding season of 1886. The ragged nests are occasionally seen, belonging to years gone by, as it sometimes takes the storms of many winters to beat them to the ground. If the different societies organized to protect our native birds do their whole duty, these beautifully plumaged insectivorous birds will soon become common once more. JOS. M. WADE.

Agreement Relating to Unpatented Inventions.

A partner persuaded his copartner to agree to pay the expenses of experiments to perfect an invention made by a third person, in consideration of a share in the results. The firm paid the expenses of the experiments, and afterward the first mentioned partner and the inventor took out a patent for the invention in their joint names, to exclusion of the other partner. The New York Court of Appeals held (Burr vs. De la Vergne) that the copartner could maintain an action to compel his associate to carry out the agreement. The court further held that the agreement was not void under the United States statute requiring every patent or any interest therein to be assigned by an instrument in writing, on the ground that the agreement related to an inchoate invention not perfected or patentable at the time the agreement was made.

PROF. EDWARD ORTON gives the following as the charges for use of natural gas at Bowling Green: For house lights, 20 to 30 cents per month; cooking and heating stoves, $3 per month in winter. At Findlay: For cooking stoves, $1 per month is charged; for sitting room stoves, $1.50 per month; for grates, $2 and $2.50 per month; for house lights, 15 to 30 cents per month; for boilers, $150 and upward per year.