

the red, and the others in order the orange, yellow, green, blue, indigo, and violet. But later observers have studied the spectrum with far more care and minuteness than Newton, in the midst of his multifarious labors, was able to bestow upon; it and their researches have been rewarded by some remarkable discoveries. The most noteworthy of these is the discovery that the sun's ray is not simple, being composed of at least three distinct elements, light, heat, and the actinic rays, as those are called which produce most of the chemical changes. In one experiment by Sir William Herschell, he found that a thermometer suspended in the blue ray rose in three minutes  $1^{\circ}$ , in the green ray  $4^{\circ}$ , in the yellow ray  $6^{\circ}$ , in the red ray  $16^{\circ}$ , and below the red ray, where there was no visible light,  $18^{\circ}$ . Other observers have confirmed these results, and it is now fully established that the maximum heat is below the visible spectrum, where there is no light.

Again, if we place a sensitive plate or paper in the spectrum, where the yellow ray falls upon it, it will not be changed in the least, any more than it will in absolute darkness, the green affects it very slightly, the blue more, and the violet most; while the greatest effect is produced beyond the violet, where no light can be seen. By other experiments the elements of light and actinism in the sunbeam are completely separated, and there is no doubt of their being separate and distinct principles or forces.

How the actinic ray effects chemical changes we do not know; that is one of the mysteries which surrounds us in every department of knowledge. But that it does produce them we have abundant evidence. The changes operated by actinism are of three kinds: 1, chemical decompositions, 2, chemical combinations, and 3, alterations of color, in which we have no evidence of any modification in chemical composition. From the long list of these changes we select a few as samples of the three kinds.

The oxyd of silver will remain in combination for an indefinite period in the dark, but exposed to blue light, or to the dark actinic ray beyond the violet, it is decomposed into its elements, silver and oxygen. The same is true of the oxyd of gold, and of the oxyd of mercury.

Nitric acid is soon decomposed, if exposed to the light, into nitrous acid and oxygen. It is ascertained that this change is not produced by yellow light but by blue and the rays beyond the blue in the spectrum.

Among the combinations produced by light are the following:—

1. If chlorine and hydrogen gases are mixed together they may be kept in the dark for any length of time, but on exposure to the light they immediately unite in chemical combination, forming hydrochloric acid.

2. Carbonic oxyd gas and chlorine gas may also be mixed and kept in the dark, but when blue light, or the full sunbeam which contains it penetrates the mixture, the two substances enter into chemical combination.

3. Mere change of color is effected by light in several substances, among which is chloride of silver, which is changed from snowy whiteness to perfect black.

Now, the whole art of sun painting—including the daguerreotype, ambrotype, &c., as well as all the various processes of photography—consists in combinations of the several substances which are acted upon chemically by the actinic rays of the sunbeam, in their proper exposure to the action of the light, and proper treatment after receiving the picture to prevent it from fading away. Some of the processes are exceedingly simple, especially that of the daguerreotype, but we shall postpone a description of it till our next issue.

In accounts of new discoveries in photography, and in all discussions of the subject, such constant reference is made to the *spectrum*, that we present an illustration of it, to enable those of our readers who have forgotten the order in which the colors are refracted, to refresh their recollections without the trouble of consulting a book. Close observation has detected two additional colors not noticed by Newton—a faint but deep crimson below the red, and a pale lavender beyond the violet. As these are not generally mentioned we omit them in our cut. It has also been found that the seven (or nine) colors are all produced by three primitive rays—red, yellow, and blue; the orange resulting from a lapping-over each other of the red and yellow, the green from a mingling of the yellow and blue, and the indigo and violet being a mixture of the red and blue.

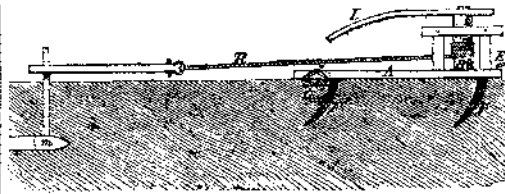
**THE PEMBERTON MILL TO BE RE-BUILT.**  
One of the owners of the Pemberton Mill has purchased the interest of his partner, and has announced that the mill will be re-built without delay. It is said to be his intention to put up a more substantial building than was ever yet erected for manufacturing purposes anywhere in the world.

There is now no doubt that the fall of the building was owing to the most gross negligence and want of fidelity in casting the columns. The cores were so negligently set, and so insecurely fastened, that they were floated by the melted metal to the upper part of the mold, making the upper side much thinner than the under side. In a great number of cases, the thickness of metal does not exceed 3-16ths of an inch, and is often less than  $\frac{1}{2}$  of an inch, on one side.

A column so extremely eccentric, left to cool naturally, would, of necessity, be so crooked by reason of unequal shrinkage as to be rejected, of course, as a dangerous casting. But they could be, and, of necessity, must have been, straightened by weighting them while yet very hot. This process would at once weaken them, and lull to false security by giving them a deceptive appearance of uniform thickness. One overseer testifies that he was looking directly at a spinning frame, and saw it go down through the floor; while a man who was in the roof below says he saw the shafting coming down in this same place. This was the commencement of this awful disaster. In confirmation of this direct testimony, the pillars among the ruins are found to be exceedingly thin; many of them on one side. It is even said that they may be broken with a stamp from the heel of a boot. In the architect's order, allowance was made for strength to support tenfold the weight that was placed upon the pillars; but they were not cast in accordance with the order.

#### MOLE PLOWS.

MESSRS. EDITORS:—Your correspondent, F. A. W., on page 101 of the present volume of the *SCIENTIFIC AMERICAN*, writes that he labors under some disadvantages in taking up and putting in the stakes of his mole-ditcher; that he needs an extra team to move the capstan over the ground, and wishes to know if any machine has been got up that will save some of the labor he alludes to. I do not know what kind of a machine he has got; but annexed hereto I have tried to give him an idea of a mole-ditcher that I have seen in use in Morgan county, Ill., which did very good work, which requires no staking and in the use of which the team is all the time em-



ployed. A represents a plank lying upon the ground upon which plank is erected the capstan, B, in a strong wooden frame, said capstan being turned by the lever, L, to which are attached three to four yoke of oxen, according to the depth of the mole, M, say from three to four feet in the ground. F F are curved iron feet or stakes, curved backward or in an opposite direction to that in which the mole moves. G is a strong plank, say three by six inches thick and about eight feet long, which is tied upon the under side of A, and behind the iron foot, F, to prevent the rear of the machine sinking into the earth. All that is necessary is to put the mole in proper position in the earth, and the frame, A, with capstan, upon the top of the ground. Upon drawing the mole, the feet, F, enter the earth until the machine is firm. After the mole has been drawn up to the machine or capstan, all that is required to move it is to make the team fast to a stout chain or ring, E, and draw the capstan along in the direction of the work, to the extent of rope, replace the oxen to the lever, and go ahead again. If the above is of any use to F. A. W., he is welcome to it. J. G. H.

Philadelphia, Pa., March 1, 1860.

#### INDUSTRY—MANUFACTURES—COMMERCE.

**Boston Shoe Trade.**—The *Boston Traveler* says that there is no place in the world where so many boots and shoes are sold, in an equal area, as in Pearl-street, in that city. The shoe trade has become gigantic in its proportions, and Boston is the center of it. Thirty years

ago the total value of the shoe trade in that city amounted to about \$1,500,000 annually; now it amounts to \$20,000,000, and the prospect is that it will reach \$100,000,000 during the present century. The number of pairs sold in 1859 was 37,500,000. Most of these were for the southern and western States, and 250,000 for Australia and Canada. The number of shoe-dealers in Boston is 340.

**California Silver.**—The newly discovered Washoe silver mines, situated on the eastern slope of the Sierra Nevada, are the richest by far in the world, if all the stories are true which have come to us from California. A ton of ore smelted in San Francisco yields \$3,600, and it also contains a considerable amount of gold. Some of the ore is of a black color, resembling brown coal.

**Michigan Iron.**—The Wyandotte Rolling Mills Company, near Detroit, have commenced the erection of another large mill at Wyandotte (adjoining the Merchant Mill, and about the same size) for rolling boiler plates of Lake Superior iron, nail rods, railroad spikes, and forging heavy shafts. The mill is to be provided with new and improved machinery, and to be erected with all possible dispatch.

**Stuart's Thread.**—This thread (as we have been informed by those engaged in the sewing-machine business) has superseded all other brands for machine sewing, on account of its great strength and smoothness. It is manufactured in Scotland by Messrs. David Stuart & Co., near Glasgow, from which city almost all the cotton thread employed in our country is imported. There has been a most marvelous improvement effected within five years in the dressing of cotton thread by friction surfaces, whereby it is glazed and made more beautiful and smooth. Paisley, in Scotland, is the most celebrated place in the world for thread manufacturing. The rise of this business dates back to the days of witchcraft, when Christiana Shaw, a famous bewitched girl, became celebrated for spinning fine linen thread, since which time this art has progressed in that town until it has surpassed all others.

**Mineral Discovery.**—A correspondent of the *Brockville Recorder* intimates that a very rich mine has lately been discovered in the front of Yonge, C. W. The vein first opened consisted of very pure nickel. The mine is located on the farm belonging to Mr. Benjamin Bayle, and was discovered by a mineralogist. The work has been pursued to some extent last summer, but will be properly opened this Spring.

**Southern Manufactures.**—A cotton factory, capable of running 2,500 spindles, has just been put in operation at Jefferson City, La., by Mr. L. N. Lane, of New Orleans. For the present it will make only cotton yarns. There are two factories in Iredell county, N. C., at which yarn and cotton osnaburgs are made in large quantities. One is located at Turnersburg, and owned by Mr. Turner; the other at the Eagle Mills, and owned by Messrs. Colvert & Co. There are small cotton factories in Yadkin, Surry, Catawba, Cumberland, and other counties of the same State. In the course of the last four months three of the manufactories in Richmond, Va., have shipped to New Orleans 64 steam engines and sawmills.

**A Great Show.**—The Massachusetts Charitable Mechanics' Association have fixed upon Wednesday, Sept. 12th, for the commencement of their "Ninth Exhibition of American Manufactures."

**Piscatorial Productions.**—The herring fishery in Nemasket river, according to the *Middleborough Gazette*, yields 300,000 herrings a year, and below Middleborough, on the Taunton river, are thirteen fishing privileges, yielding annually about 26,000 shad and 2,000,000 herrings.

**Speculations in Screws.**—We see it stated that the Eagle Screw Company and the New England Screw Company (both in Providence, R. I.) have united in one establishment under the name of the American Screw Company. Great speculations are made in the transfer of the stocks.

**Statistics of Salt.**—Three-fourths of the foreign salt consumed in the United States is brought from England, though a large portion of it is not produced there. The value of the salt received last year from England was \$982,638; that from British West India, \$163,212; all other countries, \$149,634; total, \$1,295,534.

**Coffee Mills.**—It has been stated that the first board coffee mills were made by Job King, of Taunton, Mass., and cost \$18 per dozen, and retailed in 1820 at \$2 and \$2.25 each. Previously the box coffee mill was used.