MISCELLANEOUS.

(For the Scientific American.)

Heliochromy.

Having seen nothing on the subject of Heliochromy, in your columns, since my former communication, I now present you another on the same subject, which will I hope stimulate artists, and those fond of scientific experiment, to further discovery; I propose briefly to discuss the action of light on the chloridated plate, and to give you the results of a few experiments on it. It is well known to chemists that light produces little or no change on perfectly pure chloride of silver, but that it is rapidly blackened if organic matter be present, and that this organic matter is generally found in the water with which it has been washed, or in the solution from which it has been precipitated. When the chloridated plate is exposed to light, this organic matter is decomposed, oxygen being eliminated, and the free nascent hydrogen reduces the chloride to a metallic condition, and an opposite state of electrical excitement is induced.

Now M. Becquerel and Niepce de St. Victor have proved that if chloride of silver containing a slight trace of copper be exposed to the prismatic spectrum, or to rays of different colors, while undergoing this reduction, it is susceptible of coloration after a protracted exposure. From this it would seem that this process might be much accelerated, if we were careful to aid nature in her operations, instead of trying mere hap hazard experiments, not based on rational theory. I will show by a few experiments that this may be done, and to avoid being too prolix, will, at present, speak of the chloridated silver plate, unaccelerated by iodine, bromine, fluorine, chrome, or their compounds.

If the plate, covered with the enamelled chloride of silver prepared by Niepce's process, be exposed to a current of hydrogen while receiving the image, the process will be much accelerated, and the image will be impressed in from half an hour to an hour; according to the amount of gas passed into the camera, the light, temperature, electric state of the atmosphere, &c., instead of requiring from three to five hours, as in the original process, and the colors of the picture will be impressed on the plate in all their original beauty. This experiment may be very easily performed, it only requiring a few grains of zinc in a small vial, containing dilute sulphuric acid. The vial and its contents may be placed in the camera, and the hydrogen being nascent is in its most active state, and as it is perfectly transparent, it permits the light to act on the plate, while it is itself engaged in reducing the chloride, which it is only capable of doing in sunlight.

The hydrogen, probably from its affinity for oxygen, hastens the decomposition of the organic matter, and assists in reducing the chloride, thus acting as a deoxydating and dechloridating agent. There is, however, sufficient hydrogen contained in the combined organic matter, to effect the reduction of the chloride, hence it is probable that the excess merely hastens the decomposition.

Following this train of investigation, I have tried many other reducing agents both liquid and gaseous. The most important liquid agents tried have been, the proto sulphate and nitrate of iron, ferocyanide of potassinm, protochloride of tin, and the fluorides of potassium and sodium. The principal gaseous agents tried are hydrogen alone and in combination with carbon and sulphur, ammonia, sulphuric ether in vapor, chloroform vapor, sulphuret of carbon, chloride of sulphur, hydro-sulphuret of ammonia, and sulphurous acid. As very remarkable results followed from the application of the gases, I will speak of them more particularly. Sulphurous acid has a strong tendency to abstract oxygen from organic bodies, it also unites with chlorine in sunlight, and so do light and heavy carburetted hydrogen, the latter, indeed, without the influence of light. Sulphurous acid abstracts oxygen from organic bodies, with which it combines, forming sulphuric acid, and sulphuric acid renders chloride of silver unchangeable to light by destroying the organic matter with which it is combined. I hence inferred that it might be used for the double purpose of reducing and fixing the picture. That it is a powerful accelerator is certain, the fixing requires further experiment. Pictures may be obtained with this gas in half an hour, by passing it nascent and in sufficient quantity in the camera and the colors are preserved. There is, however, sometimes a little sulphur deposited under the enamel, which gives the light parts of the picture a yellowish cast. This color may sometimes be removed by heating the plate. Carburetted hydrogen acts still quicker, probably from the free carbon which results from its decomposition being a powerful reducing agent, and as the carbon is not left under the enamel it probably passes off under the form of the volatile chloride of carbon. I obtained one picture in five minutes, by passing into the camera the gases generated from the distilling alcohol and sulphuric acid in a retort. The gases formed were olefiant gas and sulphurous acid, mixed with a little light carburetted hydrogen and sulphuric ether. The colors were very fairly represented, but not as good as I had previously obtained; I considered this experiment as very encouraging, but having only lately tried it, have not repeated it by itself without the agency of electricity.

As electricity is a powerful agent in decomposing chemical compounds, it might be naturally inferred that it would aid in this process. I have often tried it but without, until lately, any very important results. Dry chloride of silver is not decomposed by electricity, yet its decomposition by light, and other agents, may by it be much accelerated, and I did not at first use a sufficiently powerful current. I now render the plate a part of the conducting medium which terminates at the positive pole and terminate the poles in water, to which some saline constitutent has been added, and by the decomposition of the water am enabled to judge of the power of the current. By using the gases at the same time that the plate is thus excited, I have been enabled to take pictures in from four to five minutes, which would otherwise require from three to five hours for their production. These pictures are developed under a hard, tough enamel of chloride of silver, cannot be rubbed out by the fingers, and will even bear considerable buffing, and, if the enamel is thick, are improved by the operation. I have not been able to permanently fix the picture, but it will keep a long time, if not exposed too often and too long, to the light. From the above experiments it seems that a prolonged exposure is not necessary to produce coloration, hence agents of great energy may be employed in reducing the chloride.

That coloration may be produced, it is important, I think, that the picture by whatever process it is taken, be positive, and complete on its removal from the camera. For fixing, it is important that all the organic matter be destroyed, and then, I believe, it will be fixed. I am at present engaged in experimenting with iodine, bromine, fluorine, sulphur, chrome, and copper, and their compounds, deposited on the silver plate by electric action, or otherwise, but have not, as yet, any results sufficiently matured to publish, though I have produced coloration. Great care is requisite in preparing the enamelled plate of chloride, and some experience is required to judge at what state of its preparation it is most sensitive to light, yet any artist can after a few experiments prepare it.

I have had but little time for experiment, owing to the pressure of other duties, and the weather here has been for the last few weeks unfavorable. I am not a daguerrean artist, and am under many obligations to Messrs. Bisbee and Robinson, of this city, for the loan of a camera and other apparatus for my experiments. Having been obliged also to make the greater part of the chemicals used, I have as yet, been able to make, but a very meagre investigation of this interesting subject.

JAS. CAMPBELL.

Dayton, Ohio, Jan. 20, 1853.

[The above communication from the pen of Mr. Campbell is the most important that has ever been published on the subject of "Heliochromy" in this or any other country We advise all our readers who feel an interest in "sun-coloring," to read the article with attention—ED.

Hot Air and Steam.

MESSRS. EDITORS—I have read with great pleasure your criticism on the Hot Air Engine, and greatly admire your frank and honest course about this invention—your course with every thing. You look the naked facts in the face, and speak out what you think, without fear or favor. By this course your paper has become the real guardian of inventions and inventors. I have looked back over all your articles on the Caloric Engine, and in no case can I see that you opposed this invention, but that in every case (it appears to me) you have been actuated solely by a desire of seeing and exhibiting what the thing really is Yet I cannot agree with you in your conclusions, for I think you have left the relative specific heats of air and water out of your calculation.

So far as your dissertation relates to the vapors of fluids, you are right: you handle Prof. Apjohn correctly, excepting that he is right in saying "that equal volumes of the vapors of different liquids will have the same elastic force at their respective boiling points," for the boiling point is that temperature at which the elastic force of the vapor becomes equal to the atmospheric pressure. But equal bulks of liquids converted into vapor exert a force inversely as the densities of these vapors, hence the vapor of alcohol, ether, &c., cannot do the work of steam. But no comparison can be made between the elastic force produced by that expansion of vapor due to increased temperature, and that due to the making of vapor; unless we take the specific heats in consideration along with the boiling points and latent heats, when the result will be largely in favor of the permanent gas or vapor, or in favor of expansion and against vaporization.

By the doctrine of specific heats, different substances have a capacity or appetite for heat, which is inversely as their atomic weights; a pound of hydrogen will hold as much heat at the same temperature as 100 pounds of gold or quicksilver, 14 pounds of air, or 3 pounds of water: hence a pound of water will require 33 times as much heat to raise its temperature one degree, as a pound of mercury; or the same quantity of heat which will raise the temperature of one pound of water one degree will raise a pound of mercury 33 degrees. The specific heat of water is nearly four times that of air, consequently the heat or caloric which will elevate a pound of water one degree will heat a pound of air four degrees, or four pounds one degree. Now the latent and boiling heat (not the latent and specific, as Mr. Apjohn has it) of water, as steam, combined, are 1150°, or if a cubic foot of water, at 32°, were confined and heated 1150° or to 1182°, then, when released, it would all become 1728 cubic feet of steam at atmospheric pressure, with a sensible heat or temperature of 212°; and the available force would be 1728 feet. But this same heat which raised the water 1150°, and produced a force of 1728, will raise an equal weight of air 864 cubic feet, 4 times 1150° or 4600°, which will expand it 9¼ times its bulk, equal to 8200 cubic feet, which is the measure of its available force—equal to 4¾ times the force gotten from water.

The heat which produces a given volume by expansion is always less than that required to make the same volume by vaporization, and this is the case even with steam and water, which have nearly the same specific heat, for if 62½ pounds or 1728 cubic feet of steam at 212 deg. are heated apart from water to 1182 deg., or raised 980 deg., then it will expand to three times 1728; if water at 212 deg. is then let in, the 980 deg. will become latent in producing one volume of steam from the water, and we shall have two times 1728 at 212 deg. instead of 3 times 1728 at 1180 deg. If we have this odds in favor of hot dry steam, what will it make with air which has four times the advantage in specific heat.

Let us take one more view of the question. One cubic foot of water at 32 deg. will give 1728 feet of steam of atmospheric pressure and 212 deg. temperature, by the application of 1182 deg. more of heat. If the cubic foot of water were resolved into its component gases they would occupy 2000 feet. Now if the water and the gases had the same capacity for heat, then the 1182 deg. which produced 1728 feet by vaporizing the water, would make the 2000 feet of the gases increase 4800 feet more for each degree, would expand it 1-491 of its bulk at 32 deg., which will give 2¾ times advantage in favor of the gases over steam; but the difference of the specific heats will make the advantage about double this; for the specific heat of the steam is so much greater than the gases that, taken with the specific gravity, it is double the gases; for steam, being composed of one volume of oxygen, with two volumes of hydrogen condensed into one volume, makes its specific gravity at 212 deg., and atmospheric pressure, compared with its gases at the same heat and pressure as 24 is to 16, and its specific heat double an equal bulk of the gas: (I use round numbers only for these points about the gravity, and specific heats of the gases cannot be nicely determined).

Hence we see that steam and water will actually hold one-third more heat than the very gases which compose them. Water is a fire-eater, and for this was it made by Infinite Wisdom. How wondrous, then, may be its mechanism; probably it does not consist of two little balls, one of hydrogen and the other of oxygen sticking side by side?

This superior power of expansion over vaporization was first noticed, I believe, by Mr. Frost, who so clearly showed through your paper, that it was the cause of the boiler explosions; and that dry steam (his stame) might greatly economise fuel or increase the power of the engine; and you gave, in the last volume, a letter from a person who says that he saved 25 per cent. by heating the steam (expanding it dry) after it left the boiler. I thought that this was a settled matter-of-fact, by Mr. Frost's experiments and the other things you published in favor of it. I never shall forget the sorrow I felt when I read in your paper that that truly scientific man had breathed his last moments in comparative poverty. How often is this the reward of that friend of man—the Inventor.

I trust that you will receive this in the spirit in which it is given.

I doubt if the "Ericsson" would have a greater speed with larger engines; for the rate of working will be the rate of heating the air, and a larger fire surface will heat no faster—it must be made hotter; or else the motor cylinder must condense into a receiver, and this supply the cylinder which propels the boat.

GEORGE MATHIOT.

Washington, D. C., 1853.

MESSRS. EDITORS—In the "Scientific American" of Jan. 8th, in giving the reasons why hot air must continue to fail in competing with steam as a force to move machinery, I think you have fallen into an error in not taking into account the difference in the specific and relative heat of water and air. The specific heat of air, or the actual quantity of heat required to raise the same weight of air and water, each the same number of degrees, is in the proportion of water 1, air 0·2669, and as air is less dense in the proportion of 830 to 1, the quantity of heat for an equal volume, or, as it is called, the relative heat is as 1 to 0·0003215, or as 1 to 1·3110, that is, the same amount of heat that will raise 1 cubic foot of water 1 deg. is sufficient to raise the same volume of air 3110 deg.; or, what raise 1 cubic foot of water 1184 degrees, converting it into steam, increasing its volume 1728 times, will raise 1 cubic foot of air $3110 \times 1184 = 3682210$ degrees, which, divided by 479 (the number of degrees by the books necessary to double the volume of air) gives 7687 as the number of times its volume is increased by the same amount of heat which changes the same volume of water into steam. Divide 7687 by 1728, it gives 4·45 as the ratio of increase in volume by the same amount of heat in favor of air over water. 7687×2160 gives 16603920 lbs., raised one foot high by the air, against 3,732,480 lbs., by the water, or otherwise the heat that will raise one volume of water into steam will raise 7687 volumes of air 479 degrees, doubling its bulk and coming to the same result. You say that it requires 864 in. of air (it should be 1728 in.) raised 491 deg. to equal 1 cubic inch of water raised into steam. Let us see what proportion of heat it will take. What will raise 1 cubic inch of water one degree, will raise one cubic inch of air