not come into very extensive use; the times not being favorable for the employment of madder extracts. E. Kopp first indicated a method, admitting of practical use, by which the two principal pigments of the madder, alizarine and purpurine, could be separated. The purpurine of Kopp has found but a limited sale, but the yellow alizarine, as obtained from the green alizarine by the use of mineral oils, has become generally employed.

The difficult problem to print alizarine on unmordanted goods was solved about the same time. The conditions for the success of this operation may be enumerated as follows: 1. A very concentrated and pure extract of madder. 2. Employment of a perfectly pure acetate of alumina. 3. A proper acid solvent for the pigment. Crystallized acetic acid is generally used. 4. The use of certain substances, as tin salts, fatty acids, or lime salts, in order to impart to the dye a hygroscopic consistency and to modify its shade. The thus composed and properly thickened dye is printed on simultaneously with the other dyes; the printed goods are now hung up for some time in a warm and moist room, then steamed, and finally passed through soap-water, if required.

For violet, the acetate of alumina must be replaced by acetate of iron. As to the white spots which occur after the application of the color on immature cotton; they do not appear in this process.

Pure alizarine yields a very beautiful violet, but a red of a violet tint. A good red can only be obtained with extracts that contain both alizarine and purpurine, and a part of the yellow coloring matter in proper proportions. Such extracts, however, yield a dull violet. The colors with which red is most successfully employed are aniline-black, chrome-orange, and the genuine albumine colors.

According to our present state of knowledge, it is probable that the madder pigments pre-exist in the root in the form of soluble, readily decomposable glucosides, or sugar-yielding elements. However, there remains no doubt about the existence of the following elements: 1. The alizarine, discovered by Robiquet and Colin. 2. The purpurine, examined by Persoz, Runge, Debus, Wolff and Strecker, and Schutzenberger. 3. The pseudo-purpurine. 4. An orange color. Both of these latter were found in the purpurine of Kopp. 5. Purpuroxanthin, a yellow pigment that has also been isolated by Schutzenberger from commercial purpurine. These pigments are crystallizable, and differ from each other by their physical properties, their solubility in different neutral and alkaline solvents, their composition, and finally by their deportment in dyeing, as shown by the following:

ALIZARINE yields stable colors that resist soap and aqua regia; yields a red with a violet hue, but a very pure violet.

PURPURINE AND ORANGE COLOR are both stable dyes, resisting soap and aqua regia tolerably well; produce very bright reds, but dull and grayish violets.

PSEUDO-PURPURINE.—This color is completely decomposed by nitromuriatic acid (aqua regia); it yields a brick red and pale violet.

PURPUROXANTHIN produces shades of little stability; gives orange-yellow with alumina and a pale gray with iron mordants.

This shows that the different madder colors differ considerably. Only the purpurine and the orange color, which is a hydrate of the purpurine, do not differ with regard to their dyeing properties, but the greater solubility of the latter in alcohol leaves no doubt that they are different bodies. The stability of the shades furnished by their dyes seems to be in reverse proportion to the amount of hydrogen present. The greater the percentage of oxygen the more the colors pass from violet red into a pure red, and from a pure violet into a spotted and gray violet.

In noting these differences, the manufacturer will be enabled to mix the various dyes in the proper proportions, they also account for the unequal qualities of madders of different origin. The fastness of the madder from Alsace is, for instance, not only attributable to its freedom from chalk, but particularly to a great percentage of pseudo-purpurine, which is lacking in the Avignon madder. Garancine furnishes also less enduring shades than the madder flowers. The reason for this has been searched for in the presence of traces of sulphuric acid that adhere to the fiber in spite of constant washing; but it is more probable that the coloring matter, which in the madder flowers is combined with lime, belongs to the purpurine group, and that in isolating it with an acid the color is intensified, but it is so at the expense of stability. The purpurine possesses more affinity for bases than alizarine.

AERIAL NAVIGATION.

A paper read by JOHN WISE, Aeronaut, before the Franklin Institute, Dec. 15, 1869.

Dr. James Bell Pettigrew, in a discourse before the Royal Institute, of Great Britain, on the subject of Aeronautics, said, among other things: "In order to construct a successful flying machine, it is not necessary to imitate the filmy wing of the insect, the silken pinion of the bat,or the complicated and highly differentialed wing of the bird, where every feather may be said to have a peculiar function assigned to it; neither is it necessary to reproduce the intricacy of that machinery by which the power in the bat, insect, and bird is moved; all that is required is to distinguish the power and extent of the surfaces, and the manner of their application, and this has, in a great measure, been already done. When Vivian and Trevithick constructed the Locomotive, and Symington and Bell the Steam Boat, they did not seek to reproduce a quadruped, or a fish—they simply aimed at producing motion adapted to the land and water, in accordance with natural laws, and in the presence of living models. Their success is to be measured by an involved labyrinth of railroad, which extends to every part of the civilized world, and by navies, whose vessels are dispatched, without the slightest trepidation, to navigate the most boisterous seas, at the most inclement seasons.

"The aeronaut has the same task before him, in a different direction, and, in attempting to produce a flying machine, is not necessarily attempting an impossible thing. The countless swarms of flying things testify as to the practicability of the scheme, and nature at once supplies him with models and materials. If artificial flight were not attainable, the insects and birds would afford the only examples of animals whose movements could not be reproduced. The outgoings and incomings of the quadrupeds and the fish are, however,already successfully imitated,and the fowls of the air, though clamorous and shy, are not necessarily beyond our reach. Much has been said and done in clearing the forest and fertilizing the prairie—can nothing be done in reclaiming the boundless regions of the air?"

Certainly there can, if we begin right! As the first sea-ships were not made to be propelled by steam and paddle-wheels, but to be drifted leisurely on the water before the winds, I propose to inaugurate a system of aerial navigation on the like unpretentious principle; namely, drifting in the currents of the trade winds to such points and places as are within the known province of the resources of aeronauts. We have, in this Northern Hemisphere, a system of trade-wind currents, at present so well authenticated and understood as to be acknowledged by the leading scientific institutions of the world as established meteorological facts, of daily recurrence; and I have practically explored them time and again for thirty years past. In the temperate zone these currents blow from the southwest and the northwest, overlapping each other and producing, between them, a compound or eddy current, blowing eastward.

In the spring and in the autumn these two great currents form conjunctions, and produce, for some days, those violent gales termed equinoctial storms, continuing until the balance is restored between the going and the coming of the trade winds, circulating between the equatorial and polar regions. The lower portion of the lower stratum of these currents—that is, the one from the northwest, is all the time, more or less,sliding off toward the south, and gradually curving round until it reaches the intertropical regions, where it is recognized by mariners as the northeast trade wind; and here, meeting the more rapid motion of the earth's surface from west to east, as well as the equatorial heat, it is whirled westward and upward, and pressed outward, as it ascends, producing the great upper current from the southwest; and thus the northwest current has become the southwest current.

On the other hand, our southwest current is all the time passing off a portion of its upper surface to the north, until it reaches the frigid zone, where it sinks down and becomes the northwest trade-wind current, underlapping the upper current,and, by its friction against the latter, producing what I term the eddy current, blowing nearly direct toward the east.

Thus, we have within the practical capability of the ordinary air ship, the means of reaching any place east,northeast, or southeast from the place of departure in our latitude.

It is an easy matter to sail from Philadelphia, New York, Boston, or Baltimore, to St. Petersburg, London, Paris, Madrid, Lisbon, or Gibraltar, or to any point within that range of latitude, as it becomes simply a matter of constructing an aerocraft that is capable of floating in these currents of the atmosphere for a few days, and we know that air ships can be constructed that will retain a sufficient buoyancy for many days. Napoleon the First had one constructed and used, that ascended with its practicing army pupils thirty days after its inflation—time sufficient to circumnavigate the globe with an air-ship.

The change of dimension of the bulk of the inclosed gas by change of temperature between day and night,is to be compensated by a balance rope. When the sun increases the levitating power of the airfloat,it will soon find its equipoise in lifting from the surface of the sea,or the land its equivalent of the balance rope, and its loss by the coolness of the night by giving back to the land or water its equivalent of weight.

I have practiced this current sailing for over thirty years, more or less, made over 400 voyages—from 100 to 1,000 miles in length—and never failed to find these trade-wind currents when an altitude of 5,000 to 12,000 feet was attained.although at these times currents from opposite directions frequently prevailed on the surface of the earth. An air vessel of 100 feet diameter, two thirds filled with coal gas, would have a net carrying power of 9,000 pounds,and would be all sufficient for a practicing machine with a view to sound these currents across the ocean and to test the practicability of establishing an air-line of mail and passenger conveyance from this country to Europe. Pleasure seekers and invalids would find it a swift and easy voyage from America to Europe—no sea-sickness and less than three days to make the voyage.

This is certainly a feasible plan for the inauguration of trial trips, and is seriously worthy the attention and application of the enterprise and genius of the present day and in our own nation. A little barometrical practice in the scheme would soon teach us how to lay our lines for a successful system of trans-Atlantic aerial navigation.

The First Californian Beet Sugar.

A lot of Californian beet sugar has been made, and the business may be regarded as established, with every prospect of speedy and large development. We have heretofore spoken of the experimental factory near Sacramento, intended to test the practicability of making sugar from beets grown in the State of California. There was a doubt about the soil. It was feared that the prevalence of alkali gnerally made it almost certain that, even where not apparent to the eye, there would be enough to prevent the crystallization of the sirup into sugar.

It has already been shown by analysis that our sugar beets are sufficiently rich in saccharine matter. The only question, therefore, being on the crystallizing of the sirup, very rude works were put up, which were considered sufficient to prove the point in controversy. With rusty iron boilers, and rivets covered with oil, the sugar was expected to be dark enough. "But," said the shareholders, "let it be as black as your hat, only so it is crystallized sugar, and the money is ready to put up the right kind of work."

On the 10th of December, 1869, all questions of doubt were set at rest by the production of 150 pounds of crystallized sugar from white Silesian beets grown on the borders of the American river—leaving an unexpectedly small portion of molasses. The experiment was conducted by W. Wadsworth, Esq., who studied in European sugar works, and who is well practiced in the various processes known in France and Germany. The process used in the experiment is very simple A revolving cylinder washes the beets; then revolving knives cut them into very thin ribbons, which are macerated for a short time in cold water, and which extracts every portion of saccharine matter. Some lime is used to extract the bitter principle, and carbonic acid gas removes the lime by precipitation. Steam pipes and evaporating pans follow; boiler, animal charcoal, and settling vessels complete the process. The success of this first experiment will soon lead to the multiplication of sugar mills, and in a few years California may be independent of foreign supplies. The next thing the Sacramento Company will prove will be the percentage of sugar in our beets—which will be determined next week.—*Alta California.*

Immensity and Violence of the Solar Forces, as Exhibited in Recent Photographs.

The astronomer of the *Spectator* is still finding wonders in the sun. He has now been examining some photographs by Dr. Zoller, of the "colored prominences" in the solar atmosphere, and is justly amazed at the immensity and violence of the forces whose action is indicated by them.

"Here," he says, "is a vast cone-shaped flame, with a mushroom-shaped head of enormous proportions, the whole object standing 16,000 or 17,000 miles from the sun's surface. In the cone figure we see the uprush of lately imprisoned gases; in the outspreading head the sudden diminution of pressure, as the gases reach the rarer and upper atmosphere. But turn from this object to a series of six pictures placed beside it, and we see the solar forces in action. First, there is a vast flame, some 18,600 miles high, bowed toward the right, as though some fierce wind were blowing upon it. It extends in this direction some four or five thousand miles. The next picture presents the same object some ten minutes later. The figure of the prominence has wholly changed. It is now a globe-shaped mass, standing on a narrow stalk of light above a row of flame hillocks. It is bowed toward the left, so that in those short minutes the whole mass of the flame has swept thousands of miles away from its former position. Only two minutes later and again an entire change of appearance. The stalk and the flame-hillocks have vanished, and the globe-shaped mass has become elongated. Three minutes later, the shape of the prominence has altered so completely that one can hardly recognize it for the same. The stalk is again visible, but the upper mass is bowed down on the right so that the whole figure resembles a gigantic A, without the cross-bar, and with the down stroke abnormally thick. This great A is some 20,000 miles in hight, and the whole mass of earth might be bowled between its legs without touching them! Four minutes past, and again the figure has changed. The flame hillocks reappear, the downstroke of the A begins to raise itself from the sun's surface. Lastly, after yet another interval of four minutes, the figure of the prominence has lost all resemblance to an A, and may now be likened to a camel's head looking towards the right. The whole series of changes has occupied but 23 minutes, yet the flames exceeded our earth in volume tenfold at least."

The same writer begs those who consider this subject to bear in mind the enormous size of the sun; so great, that if it were represented by a globe two feet in diameter, the earth would appear no larger than a cherry stone. He says:

"We recognize in our hurricane the action of nature in her fiercest moods, but the solar hurricanes would, in an instant, destroy the whole globe on which we live. We wonder at the volcano which lays a whole city in ashes, but our earth would be swept like a mote before the rush of a solar volcano. We see, lastly, in the earthquake, which upheaves a continent, the most energetic of all the forces at work upon our earth, but the least of the throes which convulse the solar surface would toss a globe like ours as waves of the ocean toss the lightest sea drift."

A NATURAL CURIOSITY.—P. C. Mixter, of West Sandlake, New York, has kindly sent us a remarkable root of a fir tree, cut from the interior of a well. The root is a curiosity. He writes us that the tree is about nine inches in diameter, and stands about eight feet from the well. The root entered the well about three feet from the top, and ran down the wall until it reached the water. After descending about nine feet, it divides into three branches which subsequently subdivide until the extremities form a bunch resembling much the tail of a horse. The entire length of the root is not much less than eighteen feet. This power of the roots of plants to search for the water they need almost looks like instinct.