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Improvement in Hot-air Engines.

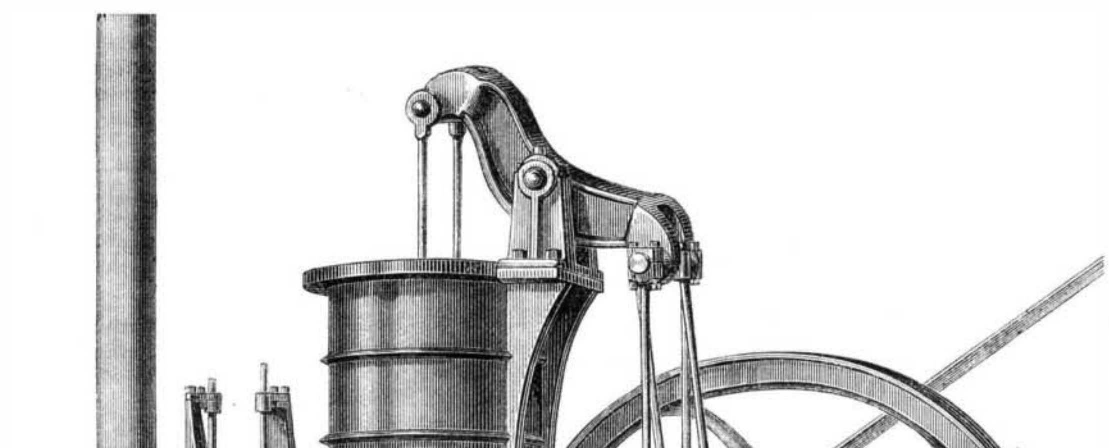
The attempt to substitute air for steam, as a motive power, is not so recent as is generally supposed, patents having been granted in this country as far back as 1824, for atmospheric engines. It appears to have been first used, in a really efficientform, by Rev. Dr. Stirling, of Scotland. He patented an air engine in 1816, and made one which was used for pumping, in 1818, that worked well for a short time. In 1827 Messrs. Parkson & Crosley, of City Road, London, England, constructed an air engine. In 1833 Lieut. John Ericsson, then residing in London, reduced to practice his long-cherished project of a caloric engine, and submitted the result to the scientific world. The invention excited very general attention, and lectures in explanation and illustration of its principles were delivered by Dr. Lardner, Prof. Faraday, Dr. Andrew Ure, and others. In 1837 Sir George Cayley constructed an air engine. In 1851 Ericsson patented his invention in this country, and in 1852 he built the ship *Ericsson*, of 2,000 tuns, driven by his machine, the working cylinder of which was 14 feet diameter, with six feet stroke.

Since then the engine has been considerably improved by himself and others, and it is now recognized as a cheap, safe, and efficient generator of power, within certain limits, and is extensively used in this country. The most perfect form of the engine, with which we are acquainted, is that shown in the accompanying engraving, known as the Roper Caloric Engine, which was first illustrated in No. 7, Vol. VIII., SCIENTIFIC AMERICAN, since which time it has been greatly improved, as the accompanying engraving and description indicates. This engine should not be confounded with other air engines that depend upon heated air alone. Mr. Roper claims to have accomplished, in his engine, what others have attempted and failed, and what experienced engineers claim necessary to a successful caloric engine, viz.: forcing the air directly into the fire, and thereby combining the power of expansion with the power and products of combustion. This result is accomplished, in this engine, by the use of an air pump, close, air-tight doors to the furnace, and poppet valves, arranged as follows:

The air, to supply oxygen for the combustion, is pumped in by pump, A, the carbon is burned rapidly and completely, under pressure, and the resulting carbonic acid gas and uncombined hydrogen gas from the air pass from the generator, or fire box, to the piston by use of poppet valves, B, which act the same as steam marine engine valves.

With this arrangement a quiet, steady pressure is continued in the fire-chamber, or air boiler, and the great difficulty experienced in others, of a blast carrying ashes and too great a heat into the cylinder and burning out packings, is fully obviated. The inside of the fire-box, C, is lined with heavy fire-brick throughout, and a wall of non-conducting material, three inches thick, between the brick and outer jacket, prevents injury to the iron and radiation of heat into the room The late important improvements do not, however, touch the principles of construction so much as the mode of application. At first, Mr. Roper placed his air-pump upon the top of the engine, taking the air, by the use of a pipe, through the casing to the fire-box. In this way the air became partially expanded before reaching the fire. In the improved engine he enlarged the air-pump and placed it on the base near the floor, using the coldest air more direct and with much less friction in clearances, by this means obtaining at once nearly double the power by the same size engine. Next he employed two dampers, one admitting all of the air into the fire-chamber, under the fire-grate, and the other over the fire. The first to be used in time of building the fire, and when it was low, and the other after the fire was complete. Thus the engine can be started as soon as the kindling wood begins to burn. The pump and check valves are made of leather—very simple contrivances. The bearings and all parts of the engine are made stronger and more durable than at first.

One of the greatest improvements obtained is a perfect governor or regulator. The old governor, which was connected with the air-pump, could not be changed so as to vary the speed materially, and did not hold the engine steady when work was thrown on or off suddenly. The present regulator is not much more or less than a safety valve, placed back of the check, taking air from the pressure, in the generator; and



THE ROPER IMPROVED CALORIC ENGINE.

by use of a simple thumb screw, the engine can be made to run with the same power from 40 to 120 revolutions per minute, as required, and that with a steady, smooth, unvarying motion, and nearly as noiseless as steam.

We have examined several of these engines, driving different machinery very successfully, of one, two, and four-horse power; and, by inquiry, we find the amount of coal used is about 40 lbs. per day for a horse power, and that the engines fully show the amount of power claimed.

A one-horse power machine weighs about 2,000 lbs., a two-horse power 3,000, and a four-horse power about 5,000 lbs., so that they are readily moved. No water is required in these engines, there is no boiler to explode, and no extra rates demanded for insurance. A boy can manage one as well as an experienced engineer. The engine is the subject of a number of patents.

All orders or applications for information should be addressed to the Roper Caloric Engine Co., 49 Cortland st., New York city, where the machines may be seen.

WHAT is one man's salvation is another one's bane; this old saying is an axiom. Those who urge their remedies or medicaments on others do not understand that in unanimity or oneness there may be diversity.

CONTRAST AND ADMIXTURE OF COLORS.

From a paper on the science of color, by W. Benson, an abstract of which appears in the *Building News*, we collate the following statements relative to the effect produced by the juxtaposition of colors, which are of great value to all engaged in decorative arts. These statements are based upon deductions from the study of prismatic colors, and are confirmed by all sorts of experiments made with the colors of pigments. We may test the colors of pigments with the prism in a beautifully simple way. We have merely to cover a small part of a strip of white paper with the pigment, and view it over a dark cavity, through the prism, and we see the spectrum of the pigment color adjoining to that of the white, and detect at once the rays which are absorbed or extinguished by the pigment, and those which it sends to the eye, to which its color is due. Thus, with respect to yellow, which many will still maintain to be a primary color, unconvinced by the experiments on the combination of the prismatic rays (which show that the best yellow is produced by throwing together all from the first red to the last green ray); if we analyze the color of aureolin, of chrome yellow, or of king's yellow, or the petal of any bright yellow flower, we uniformly find that, the better and clearer the yellow, the more perfectly the object reflects all the red and all the green rays, absorbing only the blue.

Hence, if blue is a primary color, it is difficult to see how it can be supposed that a color produced by all the other rays of the spectrum, is not made up of both the other primaries combined, whatever those primaries are.

Colors intermediate between two pigments cannot be obtained by their admixture. Gamboge and Prussian blue, for instance, make, by admixture or superposition, a green, darker than either the yellow or the blue of those pigments; the scientific method gives, as their intermediate color, a gray of mean brightness, in agreement with the results obtained by experiments on the combination of the prismatic rays. So, also, it does the colors of king's yellow and cobalt, or lemon yellow and French blue or ultramarine.

Mr. Benson claims that facts determined by his experiments on the combination of prismatic rays, as well as those upon pigments, confirm the opinion that red, green, and blue are the primary, and sea-green, pink, and yellow the secondary colors.

In perfect agreement with these facts, are all those apparent changes of color which are perceived when the retina, having been strongly excited by some one or other color, becomes less sensible to it than usual, and every object to which we direct the eye appears, therefore, more or less tinged with the complementary color, as if a wash had been laid over it. For it is always found that in an eye excited by red, by green, or by blue, objects appear tinged with sea-green, with pink, or with yellow, and the reverse; and that by intermediate colors intermediate effects are produced.

Some of these effects have been otherwise described by several writers; it is usual, for instance, to hear it said that red tinges the adjoining colors with green; but this is not correct, unless the one be a pink-red, or crimson, and the other a sea-green green. So again, it is usual to say, that blue and orange mutually deepen each other; but, for this to be true, the blue must be of a sea-green blue or azure hue, and the orange must be yellowish.

The most careful experiments, made by looking steadfastly at spots colored with those pigments which best represent the principal compounds of the prismatic colors, and brilliantly illuminated upon a black ground, and then suddenly directing the eye to a perfectly neutral gray ground, will always clearly show the gray surface darkened and modified in hue in accordance with what I have already pointed out as the real or natural complementaries. Thus, an eye affected with bright red or scarlet, like that of vermilion, turns the gray into a grayish sea-green of the hue of verdigris; one affected with green, like that of emerald green, turns it a grayish pink, of about the hue of rose madder; one affected with blue, like that of cobalt, turns it into a grayish yellow, of the hue of king's yellow, and the reverse. The same effects are seen in the shadows cast by a sunbeam which has passed through strongly-colored glass, upon a gray surface otherwise illuminated by a neutral light; and in many other ways, if due precautions are used. And no doubt the peculiar improvement in depth, which is evident in truly complementary colors when viewed in juxtaposition, the eye glancing rapidly from one to the other of them, arises from the same cause. It is evident, therefore, that the eye itself is so constituted as to agree, in this respect, with the deductions of science concerning the actual relations of colors.

The attempt to reconcile these obvious ocular effects with the common doctrine as to what colors are complementary to each other has led some to regard the deep prismatic blue, which Newton called indigo, as being violet in hue, and the deep prismatic red as being an orange red.

The terms used to distinguish colors are among the most indefinite in all languages; and the loose way in which they are applied, and the different meanings attached to them by different authors, would lead one to suppose that our color-sensations are so different in different persons, and so variable in the same, that they are more fanciful than real, and that no certainity is attainable in them. Yet, in fact, if we except the comparatively few persons who are only capable of the sensations of yellow and blue, and those whose eyes are less sensible than they should be to red, there is a wonderful uniformity and certainty in the sensations excited by light. Only let the rays which enter the eye be the same in quality and quantity, and let the eye be in the same normal condition, without any present or very recent strong excitement, and we may rely upon the results being the same.

But the difference between the new doctrine and the old is more than a difference of terms, for the utmost latitude of interpretation cannot reconcile them.

Sir J. G. Wilkinson asserts in his work on "Color and Taste" that though red and blue in juxta-position have the appearance of purple, and yellow placed next to red gives it an orange hue, the same illusion is not caused by the contact of the other two primary colors, blue and yellow, and these do not look green when in juxtaposition, except in certain cases. Nor is the change then so marked as when blue and red, or yellow and red, are in contact. And this is one of many proofs that all the three primary colors are not under the same conditions, in relation to each other. It is not, therefore, necessary to lay down the same general and invariable rule respecting the three primaries, that "in making new patterns or ornaments, red and blue should not join, nor yellow and red, nor yellow and blue," as though the three combinations were exactly similar, and subject to the same laws. For yellow and blue do not deceive the eye to the same extent as the others, when in juxtaposition. Nor has red with green the same effect as red with blue and yellow, and still less have red blue and yellow the same effect as these three colors when united in one,—that is, according to the theory which the author received, they have not the same effect as white.

Such anomalies as those noticed in this extract are the necessary consequences of an erroneous theory. Of course, blue and yellow cannot be treated in the composition by the same rules as blue and red; for blue is complementary to yellow and not to red. Still less can yellow and red be treated by the same rules as yellow and blue; for yellow harmonizes with red, itself containing the full red in conjunction with the full green, while it contrasts as the opposite color to blue. No wonder that red, yellow, and blue together have not the same effect as red and green together, nor yet the same effect as white; for the mean of the first combination is always reddish, and of the second yellowish, and neither of them white or neutral, whatever proportions are taken.

We ought, in the opinion of Mr. Benson, to treat red, green, and blue under the same rules as primary colors, and sea-green, pink, and yellow under the same rules as secondaries, if only we bear in mind the differences in the depth and clearness of the pigments we use to represent them; these, of course, modifying the effects in a large degree. Two primaries of similar depth may please the eye when side by side, while the same two, equally true in hue, but not alike in depth, may fail to do so. A great step will assuredly be gained if we establish correctly the hues of the three simple color-sensations, and of their complementaries; for these, together with black and white, will give us the eight principal colors upon which to work, and will enable us to determine all the intermediate colors correctly, and to arrange them all with due regard to their natural gradations and contrast of every kind.

Tolling Great Bells.

A new method of hanging very large bells has been tried at Worcester, England, it would appear with perfect success. The bell upon which the experiment was tried weighed four and one-half tuns. The plan is to make the gudgeons upon which the bell is hung, V-shaped, like the bearings of an ordinary scale beam. These rest on brasses very slightly hollowed. The friction was so greatly reduced by this method, that, according to the *Builder*, this ponderous bell was tolled for afternoon service on Sunday, 17th January, by the Rev. H. T. Ellacombe, that gentleman using only one hand, although a small man and nearly 80 years of age. It is said to be easier than pulling the clapper by a rope, beside being less likely to crack the bell. Another great advantage is that the tone of the bell comes out much more grandly than by clappering. No wheel is required in this mode of bell hanging, the power being applied by a lever fixed to the stock. The gudgeons must not be lower than the top of the bell. The diameter of the mouth of the bell alluded to was seventy-six and one-half inches.

HOW GOLDEN HAIR IS OBTAINED.

Every one who is observing of the peculiarities of fashion, must have noticed the increase of golden hair displayed in such profusion by the belles upon the promenades and elsewhere. It has been a subject much discussed and considerable curiosity has been displayed in regard to the way in which the thing is accomplished. It is quite plain that some artificial means must be employed. Mr. Henry Matthews, F. C. S., has been letting the cat out of the bag; in the London *Chemist and Druggist* he gives the results of some analyses of "Golden Hair Fluids," and for the benefit of our fair readers, as well as the curious of the male sex, we transcribe them.

1. AURICOMUS OR GOLDEN FLUID.

This, to quote from its label and bills, "though harmless as pure water, has the astonishing power of quickly imparting a rich golden flaxen shade to hair of any color. Unlike other preparations, it has neither spirit nor alkali in its composition," etc.

The auricomus is a clear, colorless fluid, smelling slightly of nitric acid, this odor being almost overcome by the perfume which the mixture contains. It certainly does not contain any alkali, inasmuch as its reaction is strongly acid; and it consists entirely of *dilute nitro-hydrochloric acid*, the non-volatile constituents not amounting to one grain in a bottle containing 2·25 fluid ounces, which, upon analysis, furnished 0·955 grains of actual hydrochloric acid (HCl); corresponding to 23·3 minims of the acidum nitro-hydrochloricum dilutum of the *British Pharmacopœia*, or 10·35 minims of dilute acid in one fluid ounce of mixture.

2. ROBARE'S AUREOLINE.

According to the label this is "free from all objectionable qualities," etc. The name of this preparation appears to have been borrowed from that of the well-known golden yellow pigment introduced and manufactured by a celebrated firm of artists' color manufacturers in Rathbone-place.

The Aureoline, like the Auricomus, is a colorless fluid having a strongly acid reaction and an odor of nitric acid, which the amount of perfume used does not conceal, and it also consists of dilute nitro-hydrochloric acid; a bottle containing 3·75 fluid ounces furnishing 1·74 grains of actual hydrochloric acid, an amount equivalent to 42·4 minims of dilute nitro-hydrochloric acid of the *Pharmacopœia*, or 11·3 minims of the dilute acid in one fluid ounce of Aureoline.

3. NICOLL'S GOLDEN TINCTURE.

The label of this article has the merit of not making any professions as to the perfect harmlessness of its ingredients, simply stating that it is "for giving a brilliant golden shade to hair of any color."

This preparation, like the preceding, is a colorless fluid, but containing a very slight deposit, smelling of nitric acid, and having a strongly acid reaction, consisting of dilute nitro-hydrochloric acid, together with a trace of sulphuric acid, the amount of non-volatile constituents being inconsiderable.

A bottle containing 2 fluid ounces gave 0·5 grains of actual hydrochloric acid, corresponding to 12·1 minims of the dilute nitro-hydrochloric acid of the *Pharmacopœia*, or equal to 6 minims of the dilute acid to one fluid ounce of the compound.

4. ROSS'S SOL AURINE.

On the wrapper of this we are told that "The production of a preparation which shall imitate nature in its loveliest aspect with regard to that tint of hair so fashionable in ancient classic ages," etc.,—"and which shall at the same time be harmless, has been a desideratum,"—and the reader or purchaser is left to infer that the said "desideratum" has been attained in the "Sol Aurine."

The Sol Aurine, which has a strongly acid reaction and smells most distinctly of nitric acid, is a clear, colorless fluid, containing a considerable amount of a transparent gelatinous deposit. Like the other preparations examined, it consists principally of dilute nitro-hydrochloric acid, the transparent deposit consisting of precipitated silica. A bottle holding 2·5 fluid ounces furnished 2·77 grains of anhydrous hydrochloric acid, corresponding to 67·2 minims of the acidum nitro-hydrochloricum dilutum, B. P., or equal to 26·8 minims of *Pharmacopœia* acid per fluid ounce of Sol Aurine. Other than the deposite of silicious hydrate before mentioned, the non-volatile constituents were inappreciable in amount, and were, as in the other fluids examined, such as would be evidently due to the use of either common water or impure acids in the preparation of the washes.

In conclusion Mr. Matthews remarks:

"There is little doubt that all of the above preparations would effect the purpose for which they were intended, the principal agent in all of them being the nitric acid, the effect of which is possibly aided by the bleaching power of the very small portion of nascent chlorine derived from the decomposition of the hydrochloric acid by the nitric acid.

"With regard to their use being safe or otherwise I am not prepared to speak positively, but I have been informed by a medical friend, Mr. Charles Matthews, of Southampton-street, Strand, that he has, in the course of his practice, been called upon to attend ladies who, by the incautious use of golden hair fluids, had produced burns from portions of the fluid falling upon their necks and shoulders.

"I am, however, bound to say that I was unable, with any of the preparations mentioned above, to produce even a slight stain upon the skin; but, as of course, I could only experiment upon myself, I cannot say what might be the effect on the whiter and more delicate surface of the necks and shoulders of the fairer sex.

"In conclusion, I would observe that, as far as the preparations examined are concerned, it is satisfactory to find that they contain no compounds of antimony or arsenic."

PRACTICAL SUGGESTIONS ON TANNING LEATHER.

BY C. GILPIN.

(Continued from page 178.)

THE ADVANTAGES OF QUICK-LIMING.

Another subject to which I gave some attention, while paying my respects to the tanners, was that of liming, and observed that a wide difference existed among them in relation to the time occupied in putting the hides through this process, and divesting them of the hair, which is of course the object of liming, primarily considered. Some of the best and most extensive manufacturers are so thoroughly satisfied of the injurious influence of lime upon the gelatin of the hide, that they have abandoned the use of lime altogether. That much of the gelatin can be extinguished by its too free application to the hide there now remains no doubt upon the minds of those who have fully tested it; others claim that by allowing the hides to remain in the lime from six to ten hours, they avoid any injurious influences. The superintendent for the firm of Craigan & Co., Chicago, Ill., informed me that he only allowed the hides to remain in the lime eight hours, during which time they are suspended on reels, kept by the application of steam up to 110° Fahrenheit, and the position of the hides frequently changed by turning the reels, after which they are taken off and placed in a pool containing pure water of a few degrees higher temperature, where they remain for twenty-four hours, during which time the water is changed two or three times, but constantly kept at the necessary temperature, after which the hair is easily removed without injury to the hands of the workman.

The advantages claimed for this method are, that the hide does not by this rapid movement become so thoroughly impregnated with lime, consequently less loss is sustained in gelatin. This is to be accounted for upon the principle, which perhaps is not generally known to those who have given but little attention to the influence of lime upon animal matter in a chemical relation, that by bringing the hide in direct communication with caustic lime and allowing it to remain too long, the texture and strength of the fiber are impaired to a greater or less extent, or in proportion as the lime is allowed to penetrate the hide, entering the pores and remaining in them in the form of caustic, carbonate, or lime soap, and cannot be entirely purged out by any amount of fulling, working, or baiting, without destroying a portion of the gelatin of the hide; and which was dislodged under the primitive method of working the stock through the beam house by low baiting, at the expense of a large portion of the gelatin, and was mainly the reason why the gain was so small in those days when thirty-five to forty per cent was considered all the best hide was capable of. Another evidence of the advantage of low liming, which is known to all practical tanners who have given the subject their attention, is, that all high limed leather is not only loose, and pervious to water, but will not produce the amount of gain that hides will that have been low limed, or divested of their hair, through the sweating process; and under any process tanners should always bear in mind, that it is important that those who have charge of this department should not only be skilled thoroughly in their art but be constantly on duty, and observe closely the condition of the stock while passing through the Beam House; and at the very earliest indication manifested by the hide, of yielding up the hair, it should be removed from the influence of the lime at once, and placed in a soak containing clean water, at a temperature a few degrees higher than the lime liquor they are taken out of, for the reason that it not only prevents the pores of the hide from contracting, but slightly expands them and aids the hide in its effort to give up the hair; this will also avoid setting the hair, which is often the case, when the hide after being taken out of the lime, is thrown into cool water; and by wrenching the hides in the pool through two or three baths of warm water the lime is purged out without the loss of gelatin which is incurred through the wrenching wheel or fulling stocks, while the hide is in this loose and porous condition; at which stage of its progress, great care should be observed that its substance is not wasted; for therein consists in a large degree the profit.

While much has been said upon the subject of gain made by the manufacturer, I took considerable pains to inform myself upon this subject, also the average length of time occupied in tanning out a stock of sole or belting leather, and am satisfied, basing my calculations upon the most reliable data, that the average gain made throughout the entire fraternity, is not over fifty per cent, and the time required to tan out the stock, six months.

Some tanners make sixty and as high as sixty-eight per cent on some stocks, but these are the exceptions, and not the rule. And as further evidence of the influence of time upon the stock, I found that in every instance where the greatest gains were made the hides had either been sweat or very low limed. It is supposed to be generally known that a new lime is more caustic than one that has been made for some time, whether it has been used or not; and will to a considerable extent bind the hair during the first few hours, rather than cause the hide to yield it up. This is caused by the influence of the caustic upon the cuticle of the hide, which, being very delicate, shrinks or contracts to a certain extent when brought directly in contact with the strong alkaline properties of the lime; this can be modified to a great extent, by allowing the