

there is a variation between, say, 15 and 60 tons." The fracture of most of the plates, and at repeated trials both at Chatham and Pembroke, at the rivet-holes, showed clearly the danger and uncertainty to which ships would be exposed if constructed of this metal. Another source of danger discovered itself in the Hercules, at Chatham, which was the source of controversy and curiosity at the time. One of the upper deck plates, made of half-inch Bessemer steel, was found one morning completely cracked, without warning and without any apparent cause. The workmen could not account for it, and were at loss whom to suspect of having committed an apparently wanton act of mischief. It appeared, on inquiry, that it had been riveted into its place on a hot day and during the heat of the day; that an unusually cold night had followed, and that next morning the brittle plate had broken in two.

One of the results of these numerous experiments was to arouse the ingenuity of inventors and manufacturers, and stimulate them to discover some process of counteracting the destructive effects of riveting, or, rather, of drilling holes for the introduction of rivets. Most of them took the form of exposing the metal to a further process of manufacture after it had been punched and prepared for actual use in any vessel. Annealing was proposed, and was found to a large degree successful. At the Hoërde Steel Works, in Prussia, Mr. Rochussen tried the experiment of a melted lead bath for this purpose. His process was proved very successful in toughening and hardening steel. It was adopted at Woolwich in the manufacture of gun tubes. Here, however, oil was used in the annealing process. None of these efforts proved, however, sufficiently successful to induce Naval Constructors to employ steel in ship-building, except in an unimportant way. Indeed, after it had been used in this way for some years, it was for nearly five years altogether abandoned as unprofitable. Yet progress was being made in this period, and the result of experiment, though not conclusive, seemed to warrant the hope, which was soon converted into a certainty, that a satisfactory method of manufacturing steel fit for the construction of men-of-war would be found. At last, at the Landore works, by a process adopted by Dr. Siemens, steel was produced which answered the required conditions, conquered the skepticism or critical exactions of the Admiralty Constructors, and induced the Government not only to commence two corvettes at Pembroke, but to order shortly afterwards six smaller vessels, which are to be built of steel. Dr. Siemens himself, speaking on the subject in 1875, when doubt still existed as to the possibility of using steel for shipbuilding, expressed the greatest confidence in success. "Steel," he said, "is a material belonging to a group varying between the hardness of the diamond and the toughness of copper, and it is also of the highest importance that the manufacture throughout and the construction throughout should be carried on with superior intelligence. Now," he asks, "should we shrink from using a material because intelligence is required in working and using it? Surely that would be a very poor compliment to this age of progress. We should have no difficulty in finding what are the conditions necessary to produce steel of such and such a quality, and should see to it that we obtain this quality and obtain it always." Further on he remarks that "in making steel we formerly dealt with it in small quantities, also by melting it in pots, but Mr. Bessemer has first shown us how to deal with it in large quantities in his converter. I have had," he continues, "considerable experience in dealing with it in large quantities in the open hearth furnace. There, I know, we can produce six, or eight, or ten tons of steel, of perfectly uniform quality. We can take out samples before pouring that steel to assure ourselves of having the quality desired. This metal is thoroughly mixed—it is a perfectly fluid mass—and, therefore, there can be no reason why there should be a difference in the behavior of one part of this metal from the behavior of another part. Now," and he here approaches the point of importance in naval construction, "I have lately seen steel of a very mild quality produced which is eminently suitable for structural purposes. This steel contains hardly any carbon at all—perhaps one-tenth per cent. only; but it contains manganese in a larger proportion than has been given to it hitherto. It is possessed of a toughness which is unapproached by any other kind of metal; and before it breaks it yields even to 50 per cent. Now, if such a material can be produced, and if such a material will resist, say, 30 tons, which is quite enough for all purposes, I think that is the very best material for structural requirements." The importance of this statement is to be judged by the subsequent success Dr. Siemens has gained at his works at Landore, where steel has been produced of a quality fit for the construction of ships of war.

In a very interesting paper read before the Institution of Naval Architects in 1876, Mr. Riley, the manager of these works, published in detail the results of Dr. Siemens' experiments, and gave an analysis, really, of the steel now used in the construction of our new steel corvettes. Interesting as these experiments are, they cannot be detailed here, nor would the details be of much service without the help of illustrations. But we note the tests required by the Admiralty, which are given by Mr. Riley. They are to the effect that—"From every plate made a strip is to be cut, which, after being heated to a 'cherry-red' color, shall be plunged into water having a temperature of 82° Fah. After being thus cooled, the strip is to be bent, without fracture, until the radius of the inner curve equals not more than 1½ times the thickness of the strip. This is known as the 'tempering' test. Further, from each lot of 50 plates or angles, a piece is to be taken, and the edges having been planed parallel, its tensile strength is to be proved. To be satisfactory, this must not exceed 30 tons, nor be less than 26 tons on the square inch; and before fracture takes place there must be an elongation of not less than 20 per cent. on 8 in. of its original length." Under these rigorous, and, indeed, severe conditions, 101 samples were tested, representing more than 5,000 plates or angles, and gave, with few exceptions, the most satisfactory results. One of the most important of them is that the Landore steel, after punching, shows a very small reduction in strength. Summing up the advantages this steel has over previous manufacture, Mr. Riley says:

"(a.) That it has nearly the same strength in both directions of the plate, and that that is much greater than that of iron.

"(b.) That its ductility is equal to that of iron, and greatly superior to that of ordinary steel plates.

"(c.) That the resistance offered to impact, as shown in the percussion tests quoted, as well as in the specimens which have been submitted to the bulging and gun-cotton experiments, is superior to that of plates from either, say, good iron or ordinary steel.

"(d.) That the tempering, and consequent diminution of strength produced by shearing or punching is not as great as is the case with either iron or ordinary steels.

"(e.) That the surface of the plates being much smoother, the friction and consequent loss of power-speed of vessels built of this steel must be less than in the case of iron vessels; and

"(f.) That the superiority in strength of the plates made at Landore over iron, being so great, one of two results must happen in the case of vessels in whose construction these plates are used. Either they will be very greatly superior to iron vessels in strength, or their strength being reduced to that of iron, their weight must be equally reduced and the carrying capacity very largely increased."

The value here claimed for this steel has not been considered exaggerated. It is sufficient to know that it is now being used in the construction of Her Majesty's ships, and that it will shortly, in all probability, be used more extensively. But it is more important to know that its use has introduced a revolution in naval construction, and that, in the process Dr. Siemens has invented, a difficulty has been overcome which has baffled for years invention and experiment, while it opens a path for naval construction whose value we may foresee, but can hardly yet realize.—*London Times*.

DYNOGRAPH EXPERIMENTS.

THE dynograph car of the Eastern Railway Association, in charge of P. H. Dudley, has been running between Springfield and Worcester, on both freight and passenger trains, to test the relative amount of power required at different points along the road, especial reference being had to the Springfield and Charlton grades. The experiment on the Modoc train east, says the *Republican*, leaving Springfield at 6:30 A. M., which on the day in question consisted of two sleepers, four passenger and baggage cars, and the dynograph car, showed power required as follows: For the first 2,920 feet out of the depot the tension on the draw-bar was 6,526 lbs.; for the mile 6,460 lbs., the rate of speed being 32 miles per hour; for the next 6,200 lbs., the speed being 36 miles, and for the last 1,100 feet to the top of the grade 6,250 lbs. The last mile required the engine to produce 19,625,800 foot lbs. of power per minute, the term foot-pound indicating the power required to lift one pound one foot. In going up the grade from East Brookfield to Charlton, beginning at the station, the tension on the draw-bar for the first 3,880 feet was 5,722 lbs.; for the first full mile, the velocity being 37½ miles, 4,280 lbs.; for the second mile, with 37 miles velocity, 5,232 lbs.; third, with 36 miles velocity, 5,450 lbs.; fourth, which contains a sharp curve, with 37 miles velocity, 5,612 lbs.; fifth, with 41 miles velocity, 5,230 lbs.; and, sixth, which ran a little past the summit at Charlton, 4,356 lbs. The engine had an 18x24 cylinder, and the track was in excellent condition. The maximum of the Springfield grade is 60 feet to the mile, and the Charlton grade 51.47 feet. At the sharpest curve the grade is about 49 feet. Similar experiments were made on a freight train of 27 cars drawn by the "Adiron-dack," famous for her trials with the Mogul engine last summer, and showed that the tension on the draw-bar going up Springfield grade at a speed of 5.9 miles per hour was about 16,000 pounds, and the average strain going up Charlton grade at an average speed of about 9 miles per hour was 14,500 lbs., the power required in the first instance being 84,840,000 foot lbs. Near the top of the grade the power of the engine was tested by applying the brakes, and it was found that, running at four miles per hour, the engine could exert a tension of 17,000 lbs. Beyond this point the drivers would slip, and made but little progress.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

March 26, 1877.

Prof. B. BAEYER, Vice-President, in the chair.

Prof. A. W. HOFMANN stated, in connection with the late communications "On Mono-methyl Aniline," that he had obtained this compound by the action of methylic chloride, bromide, and iodide upon aniline, the latter in excess. Dimethyl aniline, regarded by Kern as the sole product, is produced in equal proportions with mono-methyl aniline, when CH_3Cl is used, and in the proportion of 3:1 when CH_3I is used, CH_3Br giving intermediary results. Mono-methyl aniline is obtained quite pure in the form of the acetyl compound by simple distillation of the products of the reaction with acetic anhydride. Commercial dimethyl aniline is found to contain in all cases variable amounts of mono-methyl aniline.

Prof. A. Baeyer communicated the latest results of his investigations "On Phenol-Phthalein." By treatment with HKO it is decomposed into benzoic acid and dioxy benzophenone, $\text{CO}(\text{C}_6\text{H}_4\text{O})_2$, a body obtained in fine colorless crystals.

Prof. A. Baeyer also gave at length various theoretical considerations inclining him to bestow upon "Furfural," $\text{C}_4\text{H}_4\text{O}_2$, a constitutional formula in which four carbon atoms are joined together in a ring, as in the case of benzene.

Prof. O. Wallach described "Chlorine Derivatives of Acetophenone." By the action of chlorine alone, besides $\text{C}_6\text{H}_5\text{COCH}_2\text{Cl}$, he has obtained $\text{C}_6\text{H}_4\text{CO}_2\text{Cl}$. With PCl_5 acetophenone forms $\text{C}_6\text{H}_5\text{CClCHCl}$, which easily takes up two additional atoms of Cl and forms $\text{C}_6\text{H}_4\text{CCl}_2\text{CHCl}_2$.

By the "Reduction of Chloralide" he has obtained dichloroacrylic acid, $\text{CCl}_2\text{CHCO}_2\text{H}$. This compound does not unite with two additional halogen atoms as would be expected, the presence of chlorine seeming to affect the additive properties of acrylic acid.

Prof. A. Oppenheim and R. Helon described "Ethyl-propionyl Propionate," $\text{C}_2\text{H}_5\text{CO}_2\text{C}_2\text{H}_5\text{COOC}_2\text{H}_5$, the next higher homologue of ethyl-acetyl acetate, obtained among a variety of condensation products resulting from the action of sodium upon ethyl propionate. It is a mobile liquid, with characteristic odor and taste, boiling at 200°, and dissolving sodium with ease. The authors were unable to separate out analogous compounds from the liquid products resulting from the action of sodium on ethyl butyrate and isobutyrate.

Prof. A. Oppenheim and T. H. Norton gave an account of a new acid, "Thiorufinic Acid," $\text{C}_{10}\text{H}_{14}\text{S}_2\text{O}_4$, obtained by the action of CS_2 on the mixture of sodium ethylate; and sodium ethyl-acetyl acetate, resulting from the solution of sodium in ethyl acetate, and apparently a condensation product of xanthic acid, and the analogous derivative of ethyl-acetyl acetate. The acid and its salts crystallize in brilliant crimson needles. The salts of the heavy metals are exceedingly insoluble. Treatment with N_2OH yields alcohol, and a new acid likewise of a bright crimson color, and exceedingly soluble in water.

The same described also "Carbo-thio-ethyl-acetyl Acetate,"

$\text{CH}_3\text{CO}_2\text{C}(\text{CS})\text{COOC}_2\text{H}_5$, obtained by the action of PbO and CS_2 upon ethyl-acetyl acetate. It crystallizes in yellow needles, and is sparingly soluble in ordinary solvents.

The following communications have been received from non-resident members:

F. Wöhler, "On the Separation of Arsenic from Nickel and Cobalt." In order to avoid the precipitation with H_2S , the author dissolves the minerals to be analyzed in aqua regia, and adds Na_2CO_3 . The precipitate is treated with oxalic acid, and the insoluble oxalates of the two metals thus obtained are easily and completely separated from the soluble arsenate.

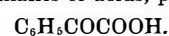
E. Schunck and H. Römer, "On Purpurin." The authors find that purpurin by heating to 300° is changed into chinizarin. Purpurin is also distinguished from analogous compounds by uniting with but a single molecule of bromine.

P. Friedlander, "On Diphenyl-glycolic Acid." This acid $(\text{C}_6\text{H}_5)_2\text{C}(\text{OH})(\text{COOH})$, is obtained by the action of HNao on phenanthrenquinone. By oxidation it yields diphenyl-ketone $(\text{C}_6\text{H}_5)_2\text{CO}$; by heating with water, at 160°, benzhydrol $(\text{C}_6\text{H}_5)_2\text{CH.OH}$; and by reduction, diphenyl-acetic acid $(\text{C}_6\text{H}_5)_2\text{CH.COOH}$, which changes easily into fluorene.

H. Hübner and K. Buchka, "On Phenoxylic Acid." By the action of the HCl on benzoyl cyanide, at 140°, the authors obtain a yellow crystalline compound—



which yields, with alkalis or acids, phenoxylic acid—



It crystallizes in colorless needles, melts at 111°, is very soluble in water, and forms crystalline salts.

L. Claisen describes an acid of the same composition, resulting from the action of HCl on $\text{C}_6\text{H}_5\text{COCN}$ at an ordinary temperature, melting, however, at 66°.

F. Fittica, "On Nitro-benzoic Acids." Additional particulars are given with regard to the fourth isomeric nitro-benzoic acid announced by the author in 1875. He has now succeeded in obtaining it by the action of ethylic nitrate on an ethereal solution of benzoic acid, in the presence of concentrated sulphuric acid. The acid melts at 127°, and is soluble in 380 parts of water. The free acid cannot be changed into its isomers by repeated crystallizations or heating beyond the melting-point. This change is, however, possible in the salts. The barium salt, after repeated crystallizations, yields with HCl meta-nitro-benzoic acid; melting-point, 142°. The ether was obtained by the slow action of ethylic iodide on the silver-salt at a low temperature. It forms yellow needles, and melts at 37°. The fourth isomeric amido-benzoic acid, obtained by reduction from the nitro-acid, melts at 156°, and in the form of the ammonium salt can be changed into metamido-benzoic acid by prolonged heating. Another nitro-benzoic acid, melting at 135°, prepared by the action of HNO_3 and H_2SO_4 on benzoic acid at a low temperature, is regarded as a physical isomer of the acid melting at 127°, because it possesses the same solubility and yields the same ether and amido-benzoic acid. The author has further obtained two nitro-benzoic acids possessing the same melting-points as meta-nitro-benzoic acid, 142°, and the fourth nitro-benzoic acid, 127°; but characterized by a greater solubility in water and by the bright lemon color of not only the acids but also the salts and ethers.

"On Benzoic-nitro-benzoic Acid." This acid is prepared in the form of the ether, by the slow addition of an ethereal solution of benzoic acid to concentrate H_2SO_4 . Saponification with potash yields the free acid. The author gives it the formula—



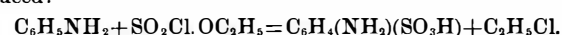
and regards it as a molecular compound, although the ether can be distilled without decomposition. A similar acid was obtained from benzoyl-chloride and ethyl-nitrate. The author has successively applied the above-mentioned reactions for the preparation of nitro-acids to other aromatic acids.

M. Fileti and R. Schiff, "On the Constitution of Cyanamide." By the action of chloral on cyanamide the compound $\text{NC.NH}_2\text{C}_2\text{Cl}_2\text{OH}$ was obtained, and by treating CN.Na_2 with $\text{C}_2\text{H}_5\text{I}$ diethyl cyanamide, $\text{CN.N}(\text{C}_2\text{H}_5)_2$, was prepared, from both of which reactions the authors regard the formula of NC.NH_2 for cyanamide as much more probable than NH.CNH .

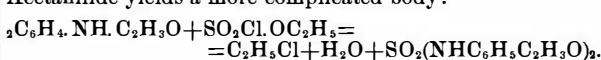
E. Von Sommaruga and E. Reichardt state, in a preliminary communication on the "Action of Ammonia on Iastin," that they have obtained two crystalline bodies differing from those mentioned by Laurent in his investigations on the subject.

A. C. Christomanos, "On Iodine-Trichloride." The best method for the preparation of this compound, free from iodine, is found to be that of mingling gaseous HI and Cl_2 — $\text{HI} + \frac{1}{2}\text{Cl}_2 = \text{HCl} + \text{ICl}_3$. The bright yellow trichloride thus obtained melts at 33°, and changes into a yellow gas at 47.5°. Chlorine gas is the only medium in which it can be preserved indefinitely. In air, oxygen, and especially hydrogen, it is extremely volatile. Phosphorus and potassium burn brilliantly if in contact with the solid substance. CS_2 is decomposed with a violent reaction. It acts as a strong oxidizing agent with ferrous and sulphurous solutions.

L. Wenghöffer, "Action of Sulphuryl Chloride and Ethyl-Sulphuric Chloride on Aniline." The author does not find the reactions of $\text{SO}_2\text{Cl.OC}_2\text{H}_5$ entirely analogous to those of $\text{COCl.OC}_2\text{H}_5$. With aniline, sulphanilic acid is produced:



Acetanilide yields a more complicated body:



By the action of sulphuryl chloride on acetanilide, and subsequent elimination of the acetyl group, a body was obtained with the formula $\text{C}_6\text{H}_4\text{NH.SO}_2$.

B. Blakenhorn finds, in the course of experiments "On the Action of Sulpho-cyanic Acid in statu nascendi on Alcohol," that a sulpho-allophanic ether is produced—



By heating with NH_3 at 100°, it is changed into sulpho-carbamide.

C. Hell and A. Waldbauer have obtained from the "Action of Alcoholic Potash on Mono-brom-iso-butyric Acid," ethyl-oxy-iso-butyric acid—



a colorless liquid, with ethereal odor, boiling at 180°, and

slightly heavier than water. The salts are very soluble and crystallize finely.

C. Hell and E. Medinger, "On the Oxidation of the Acid $C_{11}H_{20}O_2$ in Crude Petroleum." Both by treatment with HNO_3 and potassium bichromate, it is oxidized into acetic acid, and a new acid, $C_9H_{16}O_2$, a nonylonic acid. The authors are of the opinion that the original acid contains no carboxyl group, on account of the decomposition.

A Naumann, "On the Decomposition of Molten Potash Alum in Sealed Tubes at 100°." After melting, a gradual decomposition takes place, which consists of a separation of water of crystallization, and precipitation of the anhydrous compound. The free water causes then, in the liquid portion, the separation of a basic compound of alumina, potash, sulphuric acid, and water.

K. Zulkowsky, "On the Composition of Corallin." The author's experiments lead to the conclusions that the commercial dye stuff known as corallin consists chiefly of the lustrous crystalline substance, rosolic acid, and a dull red resinous body, temporarily termed pseudo-rosolic acid, and yielding by oxidation a dark red compound. A body recently obtained by Liebermann and Schwarzer from phenol and salicylic aldehyd appears to be identical with pseudo-rosolic acid.

R. Nietzki, "Decompositions of some Aniline Derivatives by passing through Heated Tubes." On passing dimethyl aniline through a glass tube, heated to a dull red heat, large quantities of benzo-nitrile were formed. Acetanilide yielded, at a bright red heat, diphenyl-carbamide.

L. Pfaundler, "On the Temperature of the Vapors issuing from Boiling Solutions of Salts." The author seeks to explain the fact that the thermometer surrounded by these vapors always marks a lower temperature than that at which the solution boils, by the hypothesis that the vapors consist of molecules of various temperatures—some above and some below the temperature marked by the thermometer, and even of particles of water. When these come in contact with the surface of the thermometer the colder particles adhere, and as they are caused to evaporate by the collision with the more highly heated molecules, the passage into the gaseous state naturally causes a constant lowering of temperature about the bulb of the thermometer.

L. Loewenherz, in a communication "On Fundamental Thermometric Experiments," states that a noticeable error in the height of the thermometer is to be observed when it is immersed in mercury, due to the external pressure on the bulb. A change, amounting in one instance to 0.3°, in the melting-point of ice, was also observed to ensue after thermometers had been kept for several days in boiling water.—*Chemical News*.

DYEING LEATHER.

By M. W. EITNER, Director of the Imperial Laboratory.

THE author recommends, for leather-dyeing, the aniline colors prepared by the Berlin Aniline Dye and Color Company, which are specially arranged to suit the requirements of this trade. The preparatory operations required present no novel features, it being merely requisite that the leather should be perfectly clean, those intended for light shades being of course washed for a much longer time than those destined to receive dark colors.

For the production of so-called "Russian red"—formerly obtained with the red woods, along with a solution of tin and the occasional addition of alum or of tartar—the "Juchtenrath" or "leather-red" is recommended. It is produced in three shades—G, light; G R, medium; and R, dark. The color required is simply dissolved in 100 parts of clean, soft, boiling water, condensed steam-water being very suitable. The solution thus obtained is left to settle for two or three hours, and the clear liquid is then taken in greater or less quantity, according to the size of the pair of skins to be treated, diluted with warm water, and is then ready for use. It is not desirable to use a concentrated bath at the outset. The first pair of skins is therefore dipped at the beginning in a very dilute bath. They are then taken through a second and a third, each stronger than the foregoing. The second pair of skins is dipped in the second of the baths already used, then in the third, and lastly in a new bath as strong as the third before it had been used. Thus each bath is used three times, and each pair of skins is passed through two old baths and one new one. In this manner the color is thoroughly used up, and an even shade is obtained on the skins, which, if entered at once in a strong dye-bath, would take the color irregularly and become cloudy. When dyed, the skins are plunged in pure cold water, rinsed, placed on the stretcher, and slightly oiled. If birch-oil is used, for the sake of the peculiar odor of Russian leather which it imparts, care must be taken that no free acid is present, as always happens if the oil has been sophisticated with wood-tar; it must be carefully neutralized with carbonate of soda. The dyed leather should be rapidly dried in a room specially fitted up, as the aniline colors can endure higher temperatures than shades obtained from the woods. For moistening the leather for the subsequent finishing operations, very dilute solutions of "G" may be used.

A fourth shade, GG, gives a yellower red. Another, "Red S," gives the cochineal shades, especially pink. In the use of this dye the bath must be made as hot as the leather can bear. An addition of saffron (? safflower, or saffranin) decoction, as in the treatment with cochineal dyes, enhances the brilliancy of the color.

Most yellow dyes derived from coal-tar produced dark spots on such portions of the grain-side of the leather as have been scratched or scraped. Certain colors, however, prepared by the Berlin Company are free from this defect. Phosphine-orange gives the "brightest and most intensely yellow of the yellowish brown shades, commonly termed almond-yellow." It requires 500 parts of water for solution, and must be boiled till no residue remains. The liquid is then ready for use at once without dilution. If a less fiery shade is wanted, treatment with a solution of bichromate of potash lessens the vividness of the dye.

For a gold-orange color, the Philadelphia yellow of the same company is recommended, dissolved in 300 parts of water.

A redder shade is produced by "Berlin brown G," which is well fitted for reddening the darker shades produced with the dye-woods.

A pure orange may be obtained with "corallin" dissolved in 150 parts of water. It must be dyed and afterwards dried as rapidly as possible, as it has a tendency to fade.

A "half-dark subdued blue" is produced with "marine blue" dissolved in 300 parts of water. The skins must not be previously passed through dilute sulphuric acid.

For a pure light blue, "water-blue B B" is taken; and for redder shades, "water-blue R."

Dark blues were formerly obtained by the use of a red dye-ware over a vatted ground. The result is better obtained by grounding in "water-blue R" and topping with "nigrosin" dissolved in 300 parts of boiling water. Nigrosin applied directly to leather dyes uneven shades.

"Methyl-green" is much used for topping skins which have been dyed green with extract of indigo and fustic. All sulphuric acid must first be carefully washed away.

"Methyl violet" can be successfully used even on the worst skins.

The "B" variety yields blue shades, and the "R" produces red shades. The color is dissolved in boiling water, but may be used cold.—*Chem. News*.

OXYGEN OF THE AIR.

By improved eudiometrical methods Regnault afterwards settled conclusively the fact of variations in the percentage of oxygen in the earth's atmosphere, and ascertained with accuracy the amount of the variation in the atmosphere of the same locality, and at different points on the earth's surface. The minimum amount for 100 analyses of the air at Paris was 20.913 per cent., and the maximum 20.999, giving as a mean the number 20.956. The lowest percentage in five analyses of the atmosphere of the ocean was 20.918, the highest 20.965. Of mountain air—in that of the summit of Mt. Pichinchi, which is higher than Mt. Blanc—the oxygen was 20.949 and 20.981 per cent. Of all places, Berlin had the distinction of an atmosphere with the lowest percentage of oxygen, 20.908. This does not appear surprising, when we call to mind the stinking waters of the River Spree flowing through the most crowded portion of the city, under the windows of the Academy of Music, and within a stone's throw of the Emperor's palace, the Opera House, the Royal Library, the Museum, and, worst of all, the famous University. To quote the language of Dr. Folsom, the Secretary of the Massachusetts Board of Health: "Berlin and Munich, the filthiest and most scientific of the German cities, deserve Traube's sarcasm of not being able to stop the cholera, even in winter—a more or less continuous epidemic, so to speak, having lasted since 1866; while in London and Paris, the cleanest of large cities, the last epidemic (in 1866) fell very lightly, and the death rates are one-third lower than in Munich and Berlin." The mean of all Regnault's analyses was 20.95 per cent., a number which should be remembered and quoted.—*Prof. A. R. Leeds*.

COOLING OF CANNON AND OTHER CASTINGS.

By JOHN S. ROBINSON, CANANDAIGUA, N. Y.

THIS relates to a process for the treatment of cannon, shafts, rollers, and other castings before removing them from flasks or moulds in which they are cast. Such treatment consisting in applying pulverized charcoal, or coal of any other kind, which will be ignited by the heat contained in the casting when such coal is reduced to the requisite degree of fineness. The material to be applied while the casting is at as high a degree of heat as is practicable, or as soon as the sand can be removed from its surface without causing a change of form, the object being to prevent the too rapid cooling of their surfaces and the consequent crystallization and weakening of the metal upon such surfaces.

It is a well-known fact that when heavy castings, such as ordnance, shafts, or rollers, are made in the usual way, their outer surfaces cool first, and frequently become quite solid in their character while the metal at their centers is still in a plastic or semi-liquid state, and hence it follows that when the central portion cools the tendency is to cause such portions to shrink away from the outer portions, thus causing upon the intermediate portions an undue strain, the result of which is an elongation and consequent weakening of the crystals of said intermediate portions.

By my improved process, the surfaces of such castings are kept at a high degree of heat until the radiation from the central parts has been such as to reduce the crystals thereof to nearly or quite the same state as those at or near the surface, thus allowing all parts to shrink or contract alike from that point, and thus insure a compression of the crystals at all parts instead of elongating or straining them.

SINGULAR CASE OF THE PRODUCTION OF HEAT.

By M. J. OLIVIER.

A SQUARE rod of steel, 80 centimeters in length and 15 millimeters square, is grasped firmly by both the hands of the operator, one of the hands being placed in the middle of the rod, and the other at one end. The free extremity is strongly pressed against an emery wheel revolving very rapidly. After a few minutes the extremity thus rubbed becomes strongly heated; the hand placed in the middle of the bar does not experience any feeling of heat, but the one at the other extremity is heated to such an extent that the operator is compelled to let go.—*Comptes Rendus*.

IMPREGNATED RAILROAD TIES.*

EXPERIMENTS have been made on the government railroads of Hanover, and on the Cologne and Minden Railroad on the durability of impregnated railroad ties, and it was found that of—

Hemlock ties impregnated with chloride of zinc, 30 per cent. has been renewed after having been in use for 21 years.

Beechwood ties impregnated with creosote, 46 per cent. had been renewed after having been used for 22 years.

Oak ties which had not been impregnated at all, 49 per cent. had been renewed after 17 years' use.

Oak ties which had been impregnated with chloride of zinc, only 20.7 per cent. had been renewed after 17 years' use.

All the experiments were conducted under the most favorable conditions, viz., on good, pure, and porous bedding.

Pieces of wood cut from impregnated ties in use at the expiration of the above periods, showed perfectly sound surfaces.

Observations made on the Northern Railroad of Austria (Kaiser Ferdinands-Nordbahn) have shown the following results:

Of oak ties which were impregnated, 74.48 per cent. had been renewed after 12 years' use.

Oak ties impregnated with chloride of zinc, 3.29 per cent. had been renewed after having been used for 7 years.

Oak ties impregnated with tar containing creosote, but 0.09 per cent. had been renewed after having been in use for 6 years.

* *Wochenschrift des Oesterreichischen Ingenieur und Architekten-Vereines, Wien.*

Hemlock ties impregnated with chloride of zinc, 4.46 per cent. had been renewed at the end of 7 years.

Since 1869 the Northern Railroad of Austria use only oak ties which have been previously impregnated either with chloride of zinc or with tar containing creosote.

ACTION OF CHLORO-CHROMIC ACID UPON ANTHRACENE.

By M. A. HALLER.

WISHING to utilize the action of chloro-chromic acid, at once oxidizing and chlorinizing, the author caused it to act upon anthracene so as to obtain bichlorinated anthracene, which, on treatment with potassa, should yield alizarin; 10 grms. of anthracene were dissolved in glacial acetic acid, and treated with 30 grms. of chloro-chromic acid freed from chlorine by a current of CO_2 . The green liquid was poured into distilled water; the yellowish precipitate collected on a filter, washed, dried, and partly sublimed in a retort, and partly dissolved in alcohol. Both the sublimate and the matter obtained on crystallization had the form of splendid needles, having all the properties of anthraquinone. They dissolved with a reddish yellow coloration in concentrated sulphuric acid. Water precipitates the bulk of the product from the solution. If melted with potassa they gave a violet mass, which on solution in water was partly decolorized, unaltered anthraquinone being precipitated. The potassic solution, acidulated with nitric acid, filtered, and treated with nitrate of silver, did not give a precipitate of chloride of silver. The product therefore, contained no chlorine, and was pure anthraquinone.

PHOTO-CHEMICAL PROCESSES IN THE RETINA.

PROF. A. GAMGEE lately gave in *Nature* an account of certain very remarkable discoveries made by Prof. Kühne, of Heidelberg, which added additional interest to the startling announcement contained in a recent communication made by Prof. Boll, of Rome, to the Berlin Academy, to wit, that the external layer of the retina is, during life, of a purple color, which disappears at death, but which is, during life, continually being bleached by the action of light.

By the most recent results obtained by Kühne on the "Vision Purple" and published by him in the *Centralblatt für die medicinischen Wissenschaften*. The purple color of the retina is now shown to depend upon the presence of a substance which can be dissolved and separated in the solid form. The only solvent of the vision-purple as yet known is bile, or a pure glyko-cholate. The filtered, clear solution of the vision-purple is of a beautiful carmine red, which when exposed to light rapidly assumes a chamois color, and then becomes colorless. As long as it is at all red, the solution absorbs all the rays of the spectrum, from yellowish-green to violet, allowing but little of the violet, but all the yellow, orange, and red rays to pass. Accordingly, bloodless retinae spread out and placed in the spectrum between green and violet appear gray or black.

Kühne has exposed retinae in different parts of a spectrum (obtained by allowing the sun's rays between eleven and one o'clock to fall through a slit 0.3 mm. wide upon a flint glass prism), in which Fraunhofer's lines were shown in great number and with great distinctness, and he has ascertained that in the yellowish green and green regions the vision-purple is bleached most rapidly; that action is less in the bluish green, blue, indigo, and violet; it is still perceptible in the orange and yellow, but not in the red or ultra-violet regions.

THE LIME LIGHT WITHOUT OXYGEN.

It is now upwards of nine years since we gave details of a French invention by M. Bourbouze, by which an artificial light was produced by a mixture of atmospheric air and common gas (as in the well known Bunsen burner) being allowed, when ignited, to impinge against a grating formed of fine platinum wire. The Bourbouze lamp was never much known, at least in this country, and it is now a thing of the past—so far, at any rate, as we have been able to ascertain.

Several years ago the great heat capable of being produced by a proper mixture of air and gas suggested the application of this mixture to lime as a means of rendering it luminous; and in 1869 we recorded the fact that Messrs. Darker, of Lambeth, London, Eng., had applied the principle of mixing air, instead of oxygen, with common gas, with a view to the production of the lime light. We are aware that they subsequently discontinued its use, owing to its not being so successful as they had anticipated.

With the foregoing, by way of introduction, we now proceed to describe a trial of a modified light of the kind referred to which was recently made by Mr. Woodbury in our presence. Mr. Woodbury's connection with the sciopticon, as co-patentee and as its introducer into this country, is known to our readers. Finding that photographers required a twofold advantage not afforded by the ordinary petroleum lamp of the sciopticon, and which is comprised in the two points—first a smaller flame, and secondly a purer light—finding, further, that a widespread objection exists against the making and storing of oxygen, Mr. Woodbury endeavored to ascertain whether by means of some modified burner the "lime light" could be obtained without the use of any oxygen other than that contained in atmospheric air. The advantages arising from heating the air supplied to a furnace are familiar to everyone who has heard of the hot-blast smelting furnace; so likewise has this advantage on a smaller scale been known to those who are familiar with the Fletcher blowpipe, and by a judicious arrangement of the latter, and applying it to the illumination of the sciopticon, the light was obtained which we shall now endeavor to describe.

The burner is one nearly similar to that recognized as the "blow-through" jet—a blowpipe passing up through a larger jet, from which issues common gas. This centre blowpipe is connected with a bag or reservoir containing atmospheric air; but it is so constructed that previous to its insertion in the larger or common gas pipe it winds, like a corkscrew, through the flame of a Bunsen burner placed underneath. But as this corkscrew surrounds the pipe through which the common gas is conveyed, it follows that both pipes are heated, and, in consequence, both the gas and the air are ejected from their respective orifices in an intensely heated condition. A lime cylinder, when subjected to the action of this blowpipe, becomes incandescent and highly luminous.

When two sciopticons were tested side by side, one of them being fitted with the well known petroleum lamp having a double wick, and the other with a burner such as that here described, the two disks presented well marked peculiarities. Previous to the lime light disk being displayed, that from the petroleum-burning sciopticon had been carefully observed, and it was considered to be as bright and