The Photo-electric Action of Light.

The difficulties of working with ordinary polarized light in studying its photo-electric action disappear if the cathodes are formed of the alkaline metals, and advantage has recently been taken of this fact by Dr. J. Elster and H. Geitel. In the circuit of a voltaic battery of about 250 volts were placed a sensitive galvanometer, a commutator, and a sensitive cell of the liquid potassium-sodium alloy of the form described in Wiedemann's Annalen, vol. xlii., p. 564, so inserted that the negative pole wire leads to the surface of the alkali metal. The cell was coated with opaque varnish, with the exception of a small circle 15 mm. in diameter, which was turned toward the source of light. The rays entering this aperture centrally and parallel struck the center of the metal surface under an angle of 65°, and between the source of light and the sensitive cell a lens was introduced for making the light parallel, as well as a polarizing arrangement. It was found with this apparatus that if the polarizing device is turned, while at the same time the strength of the current is measured in the galvanometer, two maxima and two minima are seen in the course of a single rotation. The ratio of maxima to minima is about 10:1. Other observations were made, which we can scarcely refer to here; but it will be remembered that, according to the results of Tronton, Klemencic and Righi, it must be taken for granted that in Hertz's rays of electrical force the plane of polarization is at right angles to the direction of the electrical displacement. So if the motion in the light rays is regarded as analogous, the result of the experiments made by Elster and Geitel would be thus expressed: The luminous electrical current attains its maximum when the electrical displacement in the luminous ray takes place in the plane of incidence, its minimum when they are at right angles thereto. In the former case the electrical vibrations contain a component normal to the cathode, but not in the second. We might be tempted to seek in these changes of potential normal to the cathode, and induced by the electrical rays, the force which impels the negative electricity to leave the cathode. Whether this suggestion is correct can perhaps be ascertained by further experiments on the dependence of the luminous electrical action on the angle of incidence of the polarized light, and their connection with the quantities of light reflected from and retained by the cathode. Further details may be found in a paper communicated by Elster and Geitel to the Phil. Mag., July issue.

Canaigre.

Canaigre is a tanning agent. It is a species of sour dock, and the dried root contains about 33⅓ per cent of tannic acid, or a higher average than the very best oak bark. It grows wild on most of the New Mexican plains or "mesas," and in that state yields from one ton to four tons to the acre, and in rare instances five tons. Under very simple cultivation and scanty irrigation the yield is at least ten tons per acre, and it will average ten tons to twenty tons. The United States experiment station attached to the Agricultural College at La Cruces has two fields planted now, one irrigated, the other dry. The habits and evolution of this plant from the wild to the cultivated state are being watched and recorded. At Deming, extracting works have been erected, and the product is being shipped to several tanneries in the United States and England.

A TRIUMPH in engineering is reported from the mountains of Peru, where a twin-screw steamer of 540 tons, 170 feet long and 30 feet wide, has been successfully launched on Lake Titicaca, the highest navigable waters in the world, more than 12,000 feet above the sea. This steamer, which belongs to the Peruvian government, is to be used for freight and passenger traffic, and was built on the Clyde, then taken apart in more than 1,000 pieces, and shipped to Mollendo by sea. It was then carried inland over the mountains to Puno by railway and put together on arrival at its destination by a Scotch engineer.

THE LYONS UNIVERSAL EXPOSITION OF 1894.

The Lyons Universal Exposition opened its doors on the twenty-ninth of April, but it required several weeks longer to completely finish the work and get the exhibits in shape. Everything has been in readiness since the first of June, however, and the visitor can now admire the Exposition as a whole and in detail. The Exposition is organized in the magnificent Tete d'Or Park, which has an area of two hundred acres, and is certainly one of the most beautiful of its kind in France. There is nothing to be compared, as a panorama, with the beautiful lake of the park, with its islands and the large centenary trees that surround it. It is in the midst of greenswards and of clumps of trees of all species, whose leaves are green, purple or variegated, that the structures stand.

Fig. 1.—MAIN ENTRANCE OF THE LYONS EXPOSITION.

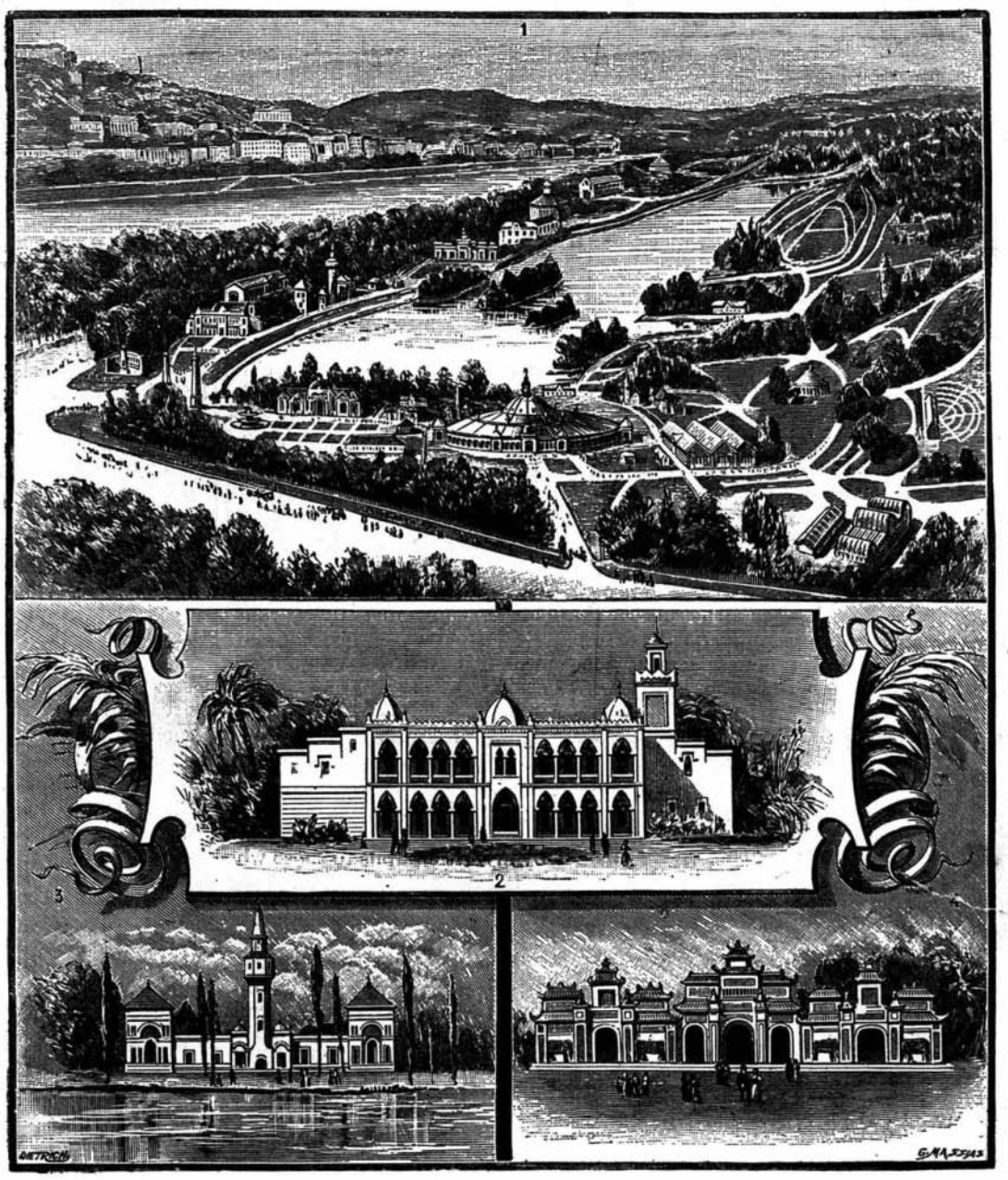

Fig. 2.—BIRD'S EYE VIEW OF THE LYONS EXPOSITION.

1. General View. 2. Palace of Algeria. 3. Palace of Tunis. 4. Palace of Indo-China.

The principal palace of the Exposition is of a peculiar form and huge dimensions. When the visitor enters the dome of this structure, he is struck with wonder at the lightness and method of construction of the immense framework of metal, the external aspect of which is shown in Fig. 1.

The framework of this palace of iron and glass comprises two very distinct parts: the cupola and the annular part formed of two rows of pillars supporting balanced girders.

The central cupola covers a circular surface of 360 feet in diameter. It is not spherical, but has a parabolic form. It is composed of 16 half arches resting upon cast iron rollers 3¼ feet in diameter and assembled at their apex against a crown 16 feet in diameter and 6 feet in height. These arches have a pitch of 33 feet. They are formed of coffers from 4 to 6 feet in height, with solid frame pieces 2½ feet in width, and are connected at the sides by uprights and 3 inch U irons. The upper crown is 180 feet above the floor. The arches were calculated independently of one another and are, in reality, independent, each arch working for itself. They are not connected so as to form a rigid whole capable of supporting and distributing a given stress, and this is one of the curious points of this structure.

The arches are simply braced by iron purlins, the only object of which is to transmit to them the charge of the roof. It is to be remarked that they are charged only in the central part. The arches are calculated for supporting the weight of the iron in the purlins, rafters, etc., plus that of the covering (estimated at 30 pounds to the running foot) and the accidental supercharge.

The great dome of the Exposition covers a superficies of 491,800 square feet, and the diameter of its external framework is 760 feet. The main entrance of this magnificent structure is shown in Fig. 1. The Exposition as a whole is in a manner comprised within the immense hall of this palace, in which the show cases are so placed as to form circular galleries. There are many beautiful things to admire under the vast dome.

The exhibit of the Lyons silk mills is placed at the entrance, and offers to the eyes of the visitor the spectacle of the wonderful products of a great art. The general plan of the Exposition installed in Tete d'Or Park is represented in Fig. 2. The great dome

just described is seen at 1. The legend that accompanies the engraving gives an enumeration of the principal structures. The palaces of Algeria, Tunis, Annam and Indo-China are remarkable from an architectural standpoint, and the objects that they contain are no less interesting. In these palaces are displayed all the natural products of the soil of our colonies and specimens of the art and industry of their inhabitants. An inspection of them is highly instructive and useful.

Fig. 3 gives a panoramic view of the Tete d'Or Park, with all the structures that it now contains. Beneath the general view the artist has represented the palaces of Algeria, Tunis and Indo-China. Those palaces are constructed with much taste in the style of architecture prevailing in the countries whose products they contain. They rise gracefully in the vicinity of the lake, not far from the lawns, and are shaded by clumps of trees. They can be reached either by foot or by crossing the lake in a boat. It is a charming walk.

The palaces of Fine Arts, of Agriculture, of Liberal Arts, of the City of Lyons, and of the Liberal and Religious Arts and the Labor and Water and Forest expositions are no less curious to visit. The collections displayed therein, rich and well composed, gain by being isolated, each in one building, in order to be studied. In the garden of the Tete d'Or there are many amusing installations that offer agreeable diversions to the visitor.

We shall mention a very important exhibit of more than one hundred blacks of Senegal, the Soudan and Dahomey. Not far from there is the railway from Timbuctoo to Dahomey—a very original mechanical sport. The travelers are carried by a wooden elephant, camel and giraffe which glide over circular rails.

We may mention also the panorama of the Battle of Nuits, in which we see the entrance into Lyons of the "Mobiles" of Belfort. This masterly work is due to our celebrated artist, Mr. Poilpot. It has met with great success.

The great horticultural hothouse and botanical garden are yet to be mentioned. The Exposition of Horticulture is remarkable. It comprises over eight acres, divided into two gardens, one of them planted in the French and the other in mixed style.

We reserve for the end a mention of the captive balloon of Mr. Lachambre, one of our most competent balloon constructors.

The inauguration of the captive balloon of the Lyons Exposition, which makes ascensions every day, took place with complete success on the ninth of May, in the presence of the most influential people of the city. The balloon, which in dimensions recalls those exploited at the time of the Exposition of 1889 on the Champ de Mars and at the Trocadero, has a capacity of 113,000 cubic feet. It is made of extra quality Chinese silk, whose resistance at the cap exceeds 440 pounds to the square foot, while the other parts offer a resistance of from 260 to 300 pounds.

The fabric, which is covered with seven coats of varnish, is perfectly tight. The balloon is provided with a hermetical valve at the top covered with a hood to protect it from the rain. Another valve, placed at the lower part, opens automatically under the influence of the excess of the pressure of gas. The balloon is provided at the lower part with a compensating balloonet of a capacity of 17,500 cubic feet, which is provided with two automatic valves.

The netting, which is of Naples hemp, has no less than 24,000 meshes. The circular car, which is 8½ feet in diameter, is padded with silk and will comfortably accommodate 16 persons. The cable is 1,300 feet in length, and is capable of withstanding a stress of 20,000 pounds. It winds around a steam windlass, actuated by a 20 horse power two cylinder engine.

The balloon is inflated with pure hydrogen gas through a stationary apparatus of the Giffard system that produces 5,200 cubic feet per hour. For the first inflation 55,000 pounds of sulphuric acid and 22,000 pounds of iron filings were used.

The ascensions take place whenever the weather permits, from 9 o'clock in the morning till 11 at night. The aerostatic park is lighted at night by six arc lamps. A powerful projector sends its rays upon the balloon, which becomes a luminous globe. A photographic service is organized for photographing each voyage.—La Nature.

M. BOVET, of Pougues, asserts (Bullet. General de la Therapeutique) that he has succeeded in making milk digestible by adding to it legumine. This substance is a vegetable ferment, which, he says, acts upon the casein, turning it into a soluble albumenoid—a sort of lactated peptone. The legumine is also given independently as a food, in doses of fifty grammes or more a day. He reports a number of cases in which patients were able to take this combination of milk and legumine when all other foods were rejected.

The Cultivation of Children's Voices.

There seems to be a wide divergence of opinion regarding vocal training, many great singers contending that girls should not commence study at an age under fourteen years. I think this an erroneous premise when applied to all, for temperament, quality of voice, condition of health and climate have much to do with determining the proper age to begin vocal training. Take Albani as an instance of disproval of Nilsson's position. She began study at four, and whoever listened to a more charming Desdemona than she! The cultivation of a voice of good strength should be commenced as the child begins to sing, whether its age be four or fourteen. But no child with a promising voice should ever be compelled to jeopardize it by singing at inopportune times, or while suffering with a cold, to the utter loss of voice as a penalty.

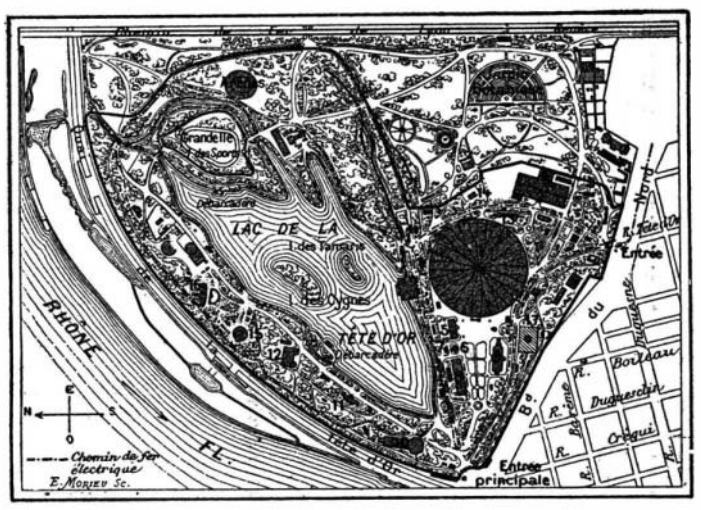

Fig. 2.—PLAN OF THE EXPOSITION.

1. Main Palace. 2. Palace of Fine Arts. 3. Agriculture, Railways, and Engineering. 4. Agricultural Annex. 5. Boiler House. 6. Press Building. 7. Post Offices and Telegraphs. 8. Lyons Palace of Liberal Arts. 9. Palace of Religious Arts. 10. Palace of Algeria. 11. Palace of Tunis. 12. Palace of Annam and Indo-China. 13. Labor Exhibition. 14. Water and Forests. 15. Panorama. 16. Hothouse. 17. Captive Balloon.

One of the first things a good teacher should do is to instill in the minds of pupils the great importance of taking care of the voice, regardless of the urging of those who care not for conditions to sing at inopportune times and when the physical condition warns to the contrary. Each pupil should be taught the limit of the voice, and made to understand that when she goes beyond the acquired compass the danger line has been reached.

While the finesse of teaching is all right enough, the common sense of teaching is all the better. If a child of nine has a good voice, why should tone cultivation be put off until it is fourteen? The breathing exercises, the physical culture, and the broadening of the chest, all tend to physical activity and the development of muscular strength which would otherwise remain unused. The position of the tongue, throat and mouth are no more difficult to attain in the younger than in the older pupils. The younger pupils can be easily taught the rules for speaking the words in song, and the staccatos, trills, crescendos and diminuendos come to children so easily that by the time they are eighteen they have accomplished their acquirement without any apparent effort, provided, of course, they have been under the care of a teacher who understands the delicacy of the human voice. To sing correctly and artistically is to sing without labored effort, and if this is true of adults, why should it not be true of children! The best way to prevent children from acquiring bad habits is to commence early training.

The criticisms made by my little pupils to those who imagine they are singing is quite often amusing. They realize that simply to sing a song by note does not signify that it is being sung musically. They detect the inartistic staccatos, the artificial tremolo, the lack of a foundation in sustained tones in the different registers and the lack of the feeling that makes sacred music sound as the author intended, devotionally.

The public school singing should be condemned. The teachers having so much to occupy their minds in teaching note reading, have but little time to devote to voice culture and to discriminating as to who should sing and who should not, and hence the voices of delicate little children are made to cope with the harsh tones of robust children. This causes little children to wonder why their throats become so tired, and parents to be surprised that at the end of the school term their voices have become so harsh and unmusical. In the school music class some children whose voices are low are compelled to sing with those who screech f, g and a, and many little voices whose tones are naturally high are compelled to sing alto, which I consider the most ruinous of all work, as they believe that chest tones which they force up high and harsh are proper, and when they hear the unmusical tones produced, they imagine that that is true alto, and when so imagining they make a most grievous mistake. The voice is precious. The possessor of a musical voice has a gift from God, and it should be trained properly.—Mary M. Shedd, in Music.

Sympathetic Inks.

Sympathetic or secret ink may be defined, says a writer in Chambers' Journal as "any liquid with which we may write invisible letters that will not appear until some particular agent is employed to give them color." There are several varieties, requiring different treatment, one merely needing exposure to the air; another, to fire; a third, the application of a certain vapor, and so on. Letters written with a solution of gold, silver, copper, tin or mercury dissolved in aqua-fortis, or, simpler still, of iron or lead in vinegar, with water added until the liquor does not stain a white paper, will remain invisible for two or three months if kept shut up in the dark; but, on exposure for some hours to the open air, will gradually acquire color, or will do so instantly on being held before the fire. Each of these solutions gives its own peculiar color to the writing: gold, a deep violet; silver, slate; lead and copper, brown; but all possess this common disadvantage—that in time they eat away the paper, leaving the letters in the form of perforations. There is a vast number of other solutions that become visible on exposure to heat, or on having a heated iron passed over them; the explanation being that the matter is readily burned to a sort of charcoal, simplest among which we may mention lemon juice or milk; but the one that produces the best results is made by dissolving a scruple of sal-ammoniac in two ounces of water.

Writing with rice water, to be rendered visible by the application of iodine, was practiced successfully in the correspondence with Jelalabad in the first Afghan war. The letter was concealed in a quill. On opening it, a small paper was unfolded, on which appeared the single word "Iodine." The magic liquid was applied, and therewith appeared an important dispatch from Sir Robert Sale. In the course of a trial in France last year, a letter was read from a man named Turpin, a chemist, under sentence of five years' imprisonment as a spy, giving directions to a friend with a view to establishing a secret correspondence with him while in prison. This led to an official inquiry on the subject by the French authorities, and some strange revelations were obtained from some of the convicts. It appears that when information has to be conveyed to a prisoner, a formal letter, containing apparently nothing but a few trivial facts of a personal nature, is forwarded to the prison. This is read by the governor, who stamps it, and allows it to be handed to the man to whom it is addressed. The latter, however, is aware that there is another letter to be read within the lines, this being written in milk, and being easily decipherable on being rubbed over with a dirty finger.

Perhaps the most dangerous of its kind is one that consists of an aqueous solution of iodide of starch. In four weeks, characters written with it disappear, preventing all use or abuse of letters, and doing away with all documentary evidence of any kind in the hands of the recipient. But a recent discovery by Professor Braylants, of the University of Louvain, surpasses all, inasmuch as no ink at all is required in order to convey a secret message. He lays several sheets of note paper on each other, and writes on the uppermost with a pencil; then selects one of the under sheets on which no marks of the writing are visible. On exposing this sheet to the vapor of iodine for a few minutes, it turns yellowish and the writing appears of a violet-brown color. On further moistening the paper, it turns blue, and the letters show in violet lines. The explanation is that note paper contains starch, which under pressure, becomes hydramide, and turns blue in the iodine fumes. It is best to write on a hard desk, say a pane of glass. Sulphurous acid gas can make the writing disappear again, and it can be revived a second time.

Voting Laws.

Two general city elections have been held in Kansas City since a charter was adopted which contained a provision imposing a poll tax of $2.50 on every male citizen over twenty-one years old, the same to be remitted if he voted at the general election. No attention was paid to the provision, and nearly $100,000 stands on the books against citizens who failed to vote. In a test case on the constitutionality of the law, Judge Gibson lately decided it valid, and that every tax could be collected with interest and costs. In Mississippi a contrary law prevails. No person is allowed to vote unless he has first paid a tax. The object is to prevent negroes from voting, and the law is a great success in that respect.

29·368 knots, or almost 34 miles per hour, is the rate of speed made by the newest British torpedo boat, the Daring. This boat is 185 feet long and 19 feet beam.