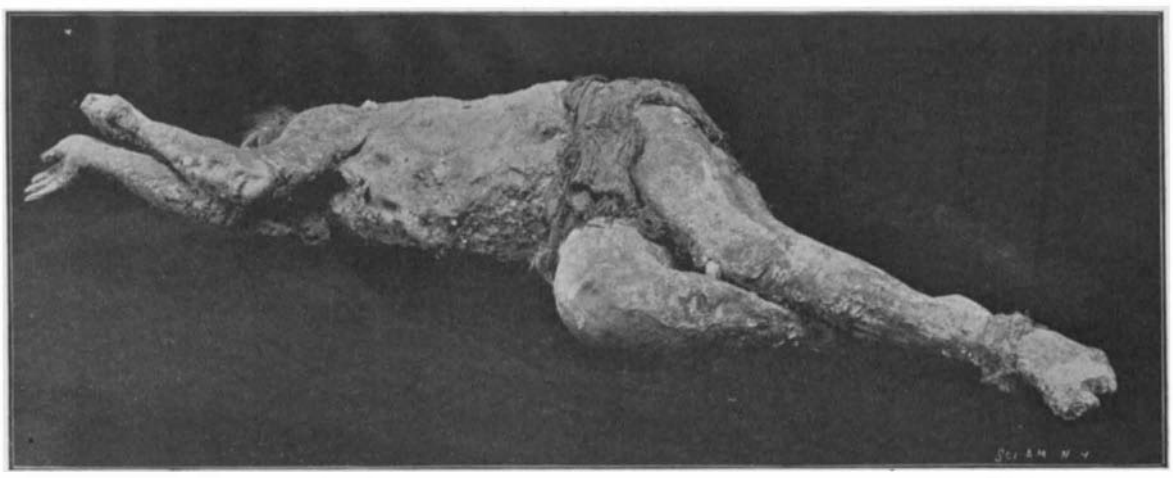
the world over. As compared with the square-rigged vessels of the schooner, brig, brigantine, or bark type, the American fore-and-after has the advantage of being a better craft when sailing close-hauled and of requiring fewer men to man it. In an earlier day of the development of our merchant marine in the coasting trade, the two-masted schooner was the common type; then came the three-masted schooner, and this was followed by vessels of four, five, six, and now seven masts. The carrying capacity of these schooners, the largest of which are engaged almost entirely in the coal-carrying trade, is exceedingly large. Thus, the five-masted schooner constructed at Camden, Me., in 1899, is 318 feet in length, 44 feet beam, and 21½ feet in depth. The vessel will carry 4,000 tons of coal on her maximum draft. Work on this vessel had scarcely been completed before Capt. Crowley, of Taunton, Mass., had given orders for the construction of a six-masted schooner. This vessel is 330 feet in length, 48 feet in beam, and has 22 feet depth of hold. On her maximum draft of 24 feet she will carry 5,500 tons of cargo. Her lower masts are each 116 feet in length, and her topmasts 58 feet.

The latest of these giant schooners is the great seven-masted vessel shown in our accompanying illustration. It has been built from designs by B. B. Crowninshield, of Boston, the designer of many small and very successful racing craft, and of the 90-footer "Independence." Unlike her predecessors, the new schooner is to be constructed throughout of steel. There will be a bar keel of forged steel 3½ inches in width by 12 inches in depth, which will extend from stem to sternpost. There will be a cellular double bottom with a continuous, single, vertical, keel plate weighing 22.5 pounds to the square foot. The upper bilge-strakes will be of 28¾-pound plate for two-thirds of the length. The middle bilge-strakes will be 30 pounds weight for the same distance and the lower bilge-strakes 25 pounds. The bottom strake will be 20-pound plate, while the garboard strake will be 29-pound plate for two-thirds of the length. All of the plating reduces to 18¾ pounds at the ends of the vessel, except in the case of the garboard strake, which will reduce to 25 pounds at the ends. There are three complete decks, which will be of steel plating, the upper deck, forecastle and poop-deck being wood-covered. A collision bulkhead will be worked in at a suitable distance from the stem.

The lower masts throughout the vessel will be built of steel, with lapped edges, flush butts, and stiffening angles extending inside for the full length. The plates will be single-riveted at the edges and double-riveted at the butts. The plating will be double at the mast partners and at the hounds. The masts are all 135 feet in length from the mast step to the top of the upper band, and they have a uniform diameter throughout of 32 inches. The topmasts will be of Oregon pine. They will be 58 feet in length over all, tapering from 18 inches in diameter to 10 inches, except the foremast, which will be 64 feet in length and 20 inches at its point of greatest diameter. The booms of the first five masts will be 45 feet in length by 14 inches in diameter, the spanker boom being 75 feet in length by 18 inches in diameter. The total sail area of the lower sails and topsails will be 40,617 square feet. All of the standing rigging, and in special cases the running rigging for the lower sails, will be of a high quality of wire rope. Although this vessel is to be propelled entirely by sails, she will carry quite a considerable installment of machinery, including one 9-inch by 10-inch Hyde double-cylinder ship engine, and five 6-inch by 8-inch Hyde hoisting engines. There will be two vertical boilers 56 inches in diameter by 90 inches high, one in the forward house and one in the after house. The boilers will be built for a working pressure of 100 pounds to the square inch. There will be two 8-inch by 4-inch by 6-inch duplex pumps and two direct-acting steam pumps, with steam and water cylinder, each 12 inches in diameter by 12 inches stroke.

As the result of the installation of steam power on board for the purpose of hoisting anchors and sails the number of hands necessary to work this large vessel is considerably reduced, the total number required being only nineteen men. The total cost of the vessel delivered will be about $250,000.

We are informed by Mr. Frank N. Tandy, of Boston, who was recently associated with Mr. Crowninshield, that so great is the confidence in the success of this vessel that preliminary steps are being taken by him and others toward the construction of a second seven-masted schooner.



PETRIFIED PERUVIAN INDIAN WOMAN EXHIBITED AT THE PAN-AMERICAN EXPOSITION.

A CURIOUS EXAMPLE OF PETRIFACTION.

In the Chilean Department at the Pan-American Exposition there is on view the semi-fossilized remains of an Indian woman. The specimen has just been submitted to examination by Dr. John A. Miller, who states that it is the body of an Indian woman, supposed to be about five hundred years old. She was found buried in an old copper mine in the Andes, near Colama, which was a part of the territory subjugated by Pizarro and taken from Peru by Chile. It is supposed that while working with stone implements used for extracting copper there was a cave-in which caused the death of the woman. Being at an altitude of 11,000 feet, the rarefied atmosphere and the dryness of the mine, combined with the peculiar metallic qualities of the earth about her, served to preserve the body as it is seen to-day. It weighs less than fifty pounds and is in a half-mummified, half-fossilized condition. There are small stones embedded in the flesh at many points, and the blood which was forced from the ears is still to be seen in the matted hair, which has kept its dark reddish-black color. Several portions of the body are crushed, including the shoulder, the chest and the lower limbs. Around the hips is a cloth of ancient weave, and the tools used and found with the remains make it possible that she was a miner in the realm of the Incas. The sledge-hammer and other hammers are most interesting, as they are still attached by strips of hide to their handles, which are pieces of wood bent in the middle. The stone is placed in the joint, so that both ends were grasped, one in each hand.

The discovery was made in a mine which was opened to take out small pieces of ore. The body was covered by about seven feet of loose earth.

Fig. 1.

PHOTOGRAPHING THE ELECTRIC ARC.

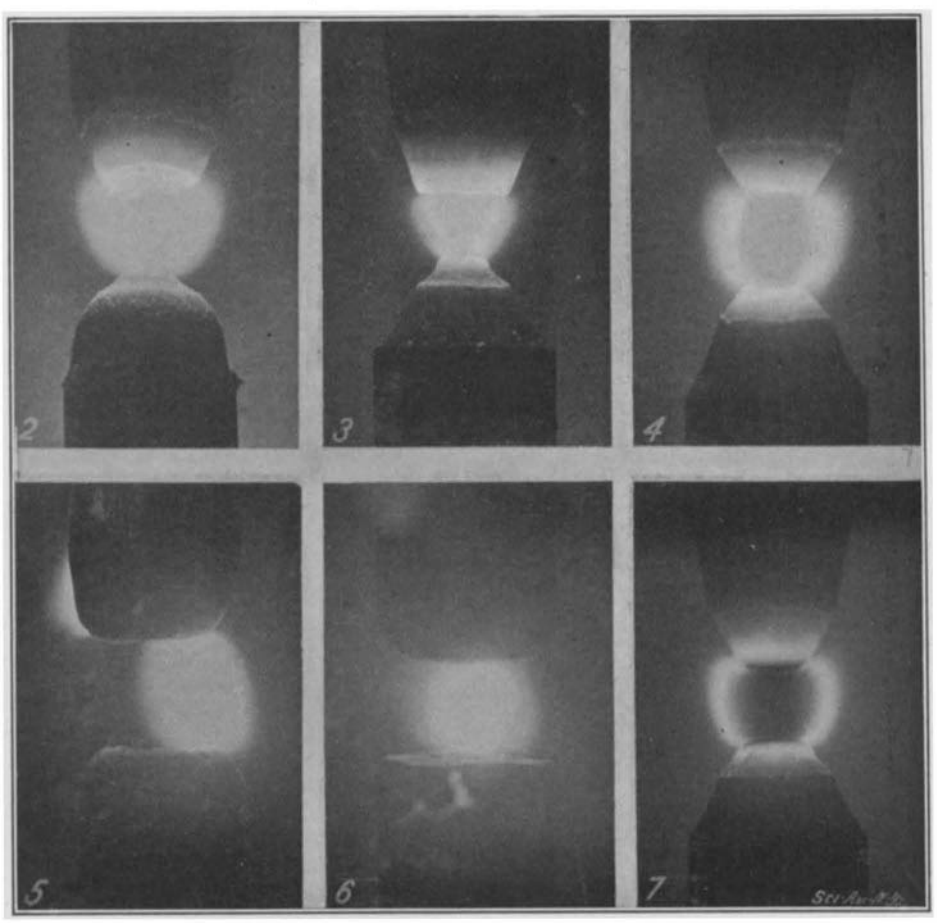
BY PROF. A. C. SCOTT.

The purpose of this article is to notice briefly some points concerning arc light carbons in operation, as indicated by direct photographs of the arc itself.

It is conceded that the classic demonstration in the Royal Institution of Great Britain in 1810, by Sir Humphry Davy, when the voltaic arc was first exhibited, presented the beginning of a world-famed era in artificial illumination. It needs but a glance at the history of artificial lighting to see that some of the greatest minds have been concerned in the final production of that most powerful of artificial illuminants, the electric arc. Though progress in its development was slowly going on during the first half of the century, the last three decades have witnessed by far the most phenomenal results, such results being made possible only after Gramme had, in 1870, opened the way by the invention of the dynamo-electric machine.

Attention is frequently called to the almost innumerable devices and improvements used upon the arc light, along the lines of controlling mechanisms for various purposes, with lamps used on both continuous and alternating-current systems, together with discussions on the substitution of the modern inclosed arc for the open arc, and allied subjects. The question of the carbons, however, does not, and at present need not, receive quite so much attention.

For our purpose it is necessary to consider for a moment a bit of the history in arc light carbon production. The water-quenched charcoal pencils employed by Davy had soon to give way to a harder form of carbon, in order to obtain even moderately satisfactory results with the arc. Gas-retort carbon was subsequently used for some years, and though it was sufficiently hard, it contained impurities, of which silica was a very important one. The effect of such impurities was to produce a constant hissing, and frequent blowouts as well. It is evidently with this class of carbons that the illustrations of the arc so frequently seen in textbooks of physics and electricity have been made. It may be more accurate to say that drawings made of the arc, when carbons containing large quantities of impurities were in use, have been copied and recopied from an early date in the history of the arc down to the present time. One of the commonest of these representations seems to have been handed down from an early drawing, and is shown in Fig. 1. It exhibits a number of globules or wart-like forms of matter on the negative carbon, which are very large in comparison with the carbon pencil itself. It does not seem just to doubt the correctness of this representation,



1. Conventional picture of the arc. 2. Continuous current open arc after burning seventy minutes. 3. The same after burning two hours. 4. Alternating current arc after burning two hours. 5. and 6. Inclosed arcs. 7. From reversed negative.

PHOTOGRAPHING THE ELECTRIC ARC UNDER VARIOUS CONDITIONS.

for in all probability it was made when the carbons contained impurities to such an extent as to give this peculiar appearance.

It is interesting to-day, when the manufacture of carbons has reached such a state of perfection that the carbons are homogeneous in texture and almost entirely free from impurities, to consider the vast difference in their appearance when in operation, in comparison with the earlier forms. This comparison is facilitated by the science of photography, which has reached its present development during practically the same period as electricity. This makes it possible for the arc to now tell its own story, and we have from direct photographs the exact appearance of the arc in operation. No retouching of the negatives, or changes in them to the least extent, have influenced the character of the prints for the half-tone cuts herewith shown. Fig. 2 illustrates a continuous-current open arc after operating for seventy minutes at 110 volts and 25 amperes. This should be compared with Fig. 1 to show the superiority of the present carbons; and also particularly to exhibit the characteristic bridge of incandescent carbon particles which is always present between the poles. The upper carbon shows the crater whence the major part of the light from the continuous current arc emanates, and the appearance of this positive carbon also indicates in an imperfect way the doubly rapid rate of its disintegration compared with the negative. Fig. 3 is another illustration of an open arc after two hours' operation at 110 volts with 25 amperes. The arc is purposely made a little shorter than in Fig. 2 and the crater is less prominent, the photograph being taken with the carbons in an exactly vertical position. A good deal of trouble was experienced in photographing the arc so as to have both carbon pencils show distinctly, as well as the arc itself, because of the hot gases rising about the upper carbon and obscuring it. This difficulty was finally overcome by placing a second arc in such a position as to have its light focused by a lens upon the carbons of the light to be photographed, and then giving either a preliminary or subsequent exposure of the carbons, when the arc was not in operation, to that given upon the burning arc. The exposure of the cold carbons was of course several thousand times that of the arc. No color screen was employed for any of the work, as it seemed better for many reasons to avoid using one, if possible.

Fig. 4 shows an alternating-current open arc after sixty minutes' continuous operation at 108 volts and 30 amperes. It will be noticed that the upper carbon appears to diminish in size a trifle faster than the lower, due to the hot gases passing upward around that pole and assisting disintegration.

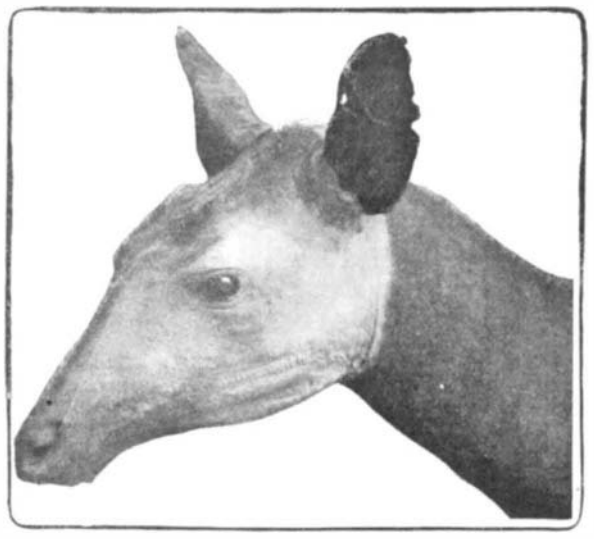
Photographs taken respectively of alternating and continuous-current inclosed arcs are shown in Figs. 5 and 6. These pictures were of course made through the inner cylinder, which immediately incloses the arc, and so are less distinct than those of the open arcs. Fig. 5 illustrates the disposition of the alternating inclosed arc to wander. Fig. 6 does not indicate such a disposition, though it is doubtless present to some extent in the continuous as well as the alternating-current light. It seemed, however, at the time of photographing that the tendency of the alternating arc to wander was much greater than that of the continuous-current arc. The results thus shown in Figs. 5 and 6 were obtained on lamps which had been in operation for a sufficient number of hours to give the carbons a normal, typical appearance, yet the photographs are quite unsatisfactory in some respects, and it is the intention of the writer to improve upon them in the near future.

Fig. 7 is only of interest in so far as it shows a good reversal picture produced by the alternating arc when the exposure is properly timed to obtain this effect. The work of photographing the arc thus described was undertaken by the writer, at the University of Wisconsin, for the purpose of obtaining, if possible, a suitable illustration of the arc to be used in a new book on Electricity and Magnetism, by Profs. D. C. and J. P. Jackson.

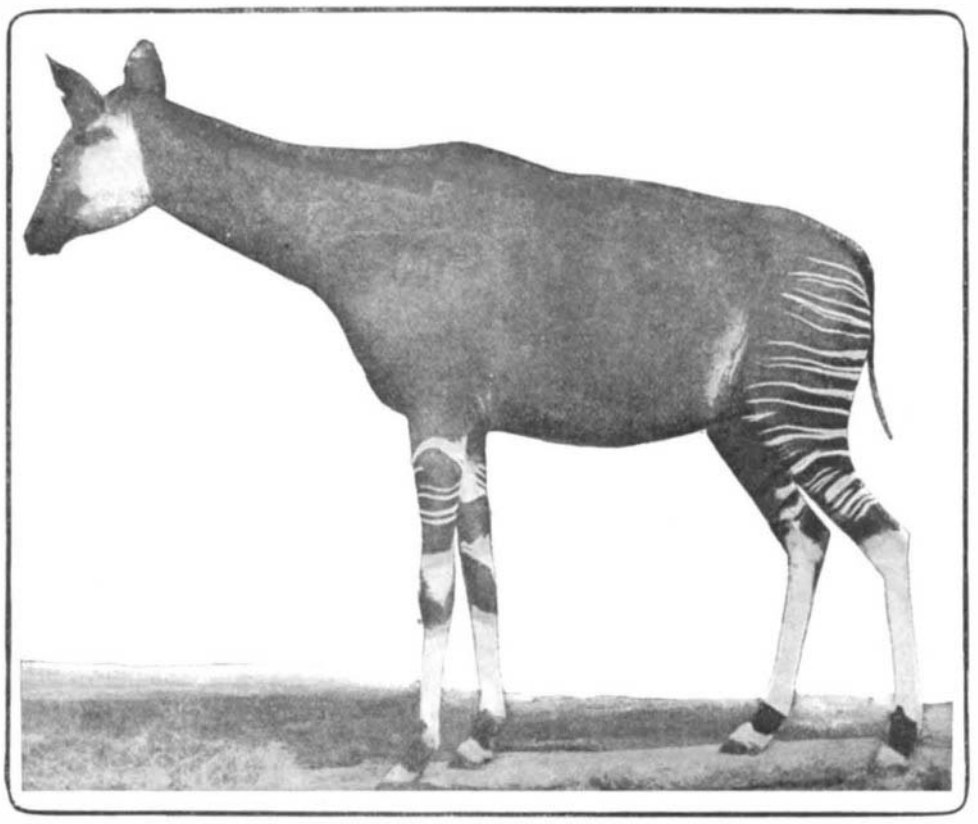
In conclusion, it may be noted that it does not seem necessary to attempt to picture the arc in modern books on physics and electricity by such an antiquated illustration as is commonly used. It is not to be objected to so much, of course, on the ground of ancient history considerations, as upon that of incompleteness and incorrectness. It seems of much importance that new books should exhibit, so far as possible, new and original illustrations. Such illustrations appeal to the eye of the student more readily, assist in elucidating points in the text, and enhance the value of a book.

THE OKAPI—A NEWLY-DISCOVERED ANIMAL.

In the heart of Africa, near the River Semliki, by which Lake Edward and Albert Nyanza are connected and British East Africa (Uganda) and the Congo Free State separated from each other, a new animal has been discovered which has attracted unusual attention among zoölogists. Stanley, at the time of his second journey in this region, had heard from the natives of a peculiar striped animal that was neither antelope nor zebra, and yet as large as a horse. He never had an opportunity of seeing this creature, a fact that he ascribed to his caravan, which was so large that a wild animal would flee before it. Sir Harry Johnston, the British plenipotentiary in Uganda, was more fortunate. He received from the natives two dark-brown striped hides, which he sent to England. Mr. Philip L. Slater, the well-known secretary of the London Zoölogical Society, gave it as his opinion that the animal might be considered a new species of zebra and christened it accordingly Johnston's zebra (*Equus Johnstoni*). Soon after Johnston received from an officer named Ericsson, stationed in the Congo Free State, not far from the Semliki River, a complete hide with the hoofs, together with two skulls. With this material it was finally ascertained that the new animal was a ruminant related, perhaps, to the giraffe, but still more closely related to the Tertiary genera of *Halladotherium* and *Samotherium Boissiori*. The giraffe family, of which these fossil animals and the newly-discovered creature are members, is distinguished from all extinct and living ruminants in so far as the space between the eye tooth and the first molar is greater than the similar space in any other animal, and that the eye tooth is provided, not with a single, but with a double crown. Eye teeth and incisors are found only in the lower jaws in most ruminants. Moreover, all camelopards have an elongated neck and long forelegs and somewhat shorter hind legs, so that the spinal column slopes down sharply to the tail. The Okapi is perhaps one-third the size of the giraffe. At least this would seem to be the relative size from the hides sent by Johnston to London. From the occiput to the first caudal vertebra the animal measures 2.25 m. The height from the ground to the top of the head is 1.83 m. The English zoölogist Ray Lancaster is of the opinion that old bucks would probably attain a length of 3.05 m. and a height of 2.44 m. The hair of the Okapi is short and straight, as in the horse. Nowhere is the hair very long, with the possible exception of the forehead, where it projects in the form of a short, bushy growth over each eye. The neck, the hind-quarters and the crown of the head are a dark chestnut brown; the face is white and has a fox-red stripe on each cheek. The deer-like ears are a bright reddish brown, fringed with blue-black. The tail is also dark brown, moderately long and tuftless. The fore-legs from the carpus to the shoulder are ringed with white. The rear members are similarly marked, but the stripes are extended up the hind-quarters to the very tail itself.



HEAD OF THE OKAPI.



THE OKAPI—A NEWLY DISCOVERED ANIMAL.

The sex of the animal whose hide was sent to London has not been determined. Ray Lancaster, for reasons which he has not given, believes that the animal was a male.

Johnston estimates the number of the Okapi in the forest of Semliki at 2,000 or 3,000. The animals have an elongated upper lip, which may possibly serve as a means of prehension, since the food taken consists of foliage of trees and bushes. The animal is beyond a doubt a surviving species of an old extinct genus closely related to the *Halladotherium* and *Samotherium* of the middle Tertiary, and may possibly be related to the now extinct many-toed ancestors of the horse.

For these particulars and our illustrations we are indebted to our German contemporary, Illustrirte Zeitung.

The Building Edition for October.

It is a rare treat to turn over the pages of the October issue of the building edition. This number is filled with exquisite illustrations of houses of varying prices, and in addition there are two pages of engravings of Mr. P. A. B. Widener's residence near Philadelphia, and also a page devoted to modern colonial porches. The subject of the editorial is "Heating the House," and is one of the technical articles which have proved so popular to readers of the Building Edition. Prof. Warren Powers Laird, of the University of Pennsylvania, talks interestingly on the "Town Beautiful." Those who are reading regularly the "Talks With Architects" find them both interesting and helpful. "Monthly Comment" and the departments, such as "Household Notes," "Legal Decisions" and "New Building Patents" are published as usual.

The Current Supplement.

The current Supplement, No. 1346, has for the leading article an account of the train de luxe of the Cape to Cairo Railway, every modern convenience being offered to travelers through the heart of the African continent. "German Fire Engines" describes in detail a number of the leading types of fire engines. The Inaugural Address to the British Association by Prof. Arthur W. Rücker is continued. "Pig-Iron Casting Machines" describes a unique method of doing away with sand-molds. "Asia, Cradle of Humanity," is by W. J. McGee. "A Simple Method of Light Wave Measurement" is by L. H. Horner and is adequately illustrated. "Further Discoveries in Crete" gives an account of Hogarth's recent discoveries. The usual "Trade Suggestions from United States Consuls" and "Trade Notes and Receipts" are published. The engineers' report on the Brooklyn Bridge is also given.

Contents.

(Illustrated articles are marked with an asterisk.)