not affected by the tse-tse fly; it can ford the most steeply embanked and rapid streams, and, of still greater importance, it can cross the swamp lands encountered so frequently in the Upper Congo, and so often a barrier to men on foot. In establishing lines of communication to the regions so difficult of access, and to supplement the regular commercial routes, elephants may prove indispensable. They should be of even greater value to the white man penetrating Central Africa than in the jungles of Hindustan. Probably in no part of Africa are elephants found in greater number than in the basin of the Congo. Recoiling before the advance of civilization, herds which once thickly occupied all the humid countries of Central Africa, are now thinning or else gathering in regions inaccessible to hunters. They still range freely in many parts of the Congo, though not easily found near posts long established. White hunters must obtain, at a cost of \$100, a permit for killing them as game,

or for ivory, and the number allowed to be killed by each hunter is limited, as well as the time validity of the permit. Natives must also obtain permission to kill elephants. By these provisions, wholesale slaughter is in a measure checked, and the supply of ivory thus partially preserved. But for the permanent preservation of this source of wealth and of the species, the experiments in taming at Api also have their value. By closely studying the habits and characteristics of Central African elephants in the work at the Api farm, much information of scientific value about the comparatively little known Congo variety was obtained. In the region of vast plains cut by rivers and swampy streams of the Uele district the elephants thrive. They live especially in the marshy regions, feeding on the grass of the plains in the early morning, and returning to the shelter of near-by forests when the sun's rays grow warm. Rarely are the solitary "rogue" elephants met in the Congo. The African species are found gen-

erally in families, of three to six animals, but troops of 20, 30, or 100 are not rare, and witnesses even affirm that troops of several hundred exist. Shunning man, and as a rule fleeing at his approach, the African elephant when attacked often shows fight and is dangerous. Congo specimens have, to a marked degree, the characteristics which distinguish them from the Asiatic species. These, to outward appearance, are particularly the form of the skull and the very large ears. The latter even stretch back beyond the neck, and cover part of the flank. In color, the Congo elephants are of a grayish blue, almost of a slate-like tint. No one has ever reported seeing specimens of the sacred white elephant of India, in the Congo. As regards size, Congo elephants have been killed more than 14 feet high at the withers and reckoned at more than eight tons in weight. Tusks obtained are sometimes more than 200 pounds in weight and 6½ feet in length.—Journal of the Royal Society of Arts.

THE KUCH QUARTZ MERCURY VAPOR LAMP.

WHAT THE SUBSTITUTION OF QUARTZ FOR GLASS MEANS.

BY O. BECHSTEIN.

DR. RICHARD KUCH has invented a mercury vapor lamp which appears to possess far greater practical utility than either the Arons or the Cooper Hewitt lamp. The applications of mercury vapor lamps have been restricted by the greenish-blue color of their light, their inconvenient form and size (the tube of a 110-volt lamp being 3 feet long) and their low economy in comparison with arc lamps, due to their comparatively low temperature, which could not be exceeded without melting the glass tube.

The tube of the Kuch lamp is made of the molten quartz introduced into commerce by Dr. Kuch a few years ago. Vessels made of this material not only resist extremely high temperatures without softening, but they do not crack when exposed to sudden and very great changes in temperature. The substitution of quartz for glass makes it possible to raise the temperature of the arc very greatly and thereby improve both the economical efficiency and the color of the light, in addition to diminishing the dimensions of the tube. The quartz tube bears a quartz bulb at each end. These bulbs serve as containers for the liquid mercury and the conducting wires are fused through their walls. Each bulb is surrounded by a fan-like radiator of sheet copper for the purpose of preventing overheating. As the tube is only about 3 inches long and ½ inch in diameter, it can be inclosed, with its radiators, in the globe of an ordinary arc lamp. The lamp is lighted and regulated automatically by a combination of electro-magnets, choking coils, and resistances contained in a housing above the globe. Without entering into the details of this apparatus, which is simple in action though rather complicated in appearance, it may suffice to explain that when the current is turned on its first effect is to energize an electro-magnet, which lifts the positive end of the mercury tube and causes a thin stream of mercury to flow along the tube and make connection with the negative pole. The strong current thus established energizes an electro-magnet in the tube circuit and thereby cuts out the shunt containing the tipping magnet. Thereupon the tube falls back to its original position, the mercury flows back into the positive bulb and, the metallic connection being thus broken, the mercury vapor arc is formed in the tube.

The temperature of the arc has been estimated by Dr. Kuch at from 5,000 to 6,000 deg. C. (9,000 to 11,000 deg. F.). The temperatures produced by a series of low voltages in a lamp designed to operate at 180 volts were measured with a thermo-element. At 60 volts the temperature was about 1,700 deg. C. (about 3,000 deg. F.). This was the highest temperature that the thermo-element was capable of measuring, but as the temperature up to this point was found to be nearly proportional to the voltage, the temperature at 180 volts must be between 5,000 and 6,000 deg. C. if the law holds good up to that point. This high temperature develops a pressure of one atmosphere or more in the nearly exhausted tube, which shows a high vacuum when cold. Other mercury vapor lamps, similarly exhausted, develop a pressure of only about 1/12 inch of water when lighted. As the temperature and pressure in the quartz tube increase, the electric resistance and the difference of potential between its ends increases also. At first this difference is only 30 volts, the light is feeble and the arc fills the whole tube as it does in other mercury vapor lamps, but when the mercury bulbs have been thoroughly heated the arc takes its full voltage. This ranges from 85 to 95 volts in the 110-volt lamp and from 165 to 185 volts in the 220-volt lamp, the remainder of the voltage in

each case being taken up by the resistance coils connected in series with the arc. The lamp then gives its full candle-power. The arc is contracted to a thread and is intensely bright, while the color of the light is no longer green-blue, but yellow-white.

QUARTZ TUBE WITH RADIATORS.

The efficiency of the new quartz lamp is very high, the consumption of energy being about ¼ watt per Hefner candle, when the energy is measured at the ends of the tube and the candle-power in a direction perpendicular to the tube. The following results were obtained in tests made at the Physikalisch-Technische Reichsanstalt.

Voltage between lamp terminals (without resistance)	174	197
Current, in amperes	4.2	4.2
Candle-power, perpendicular to tube	3,080	3,580
Candle-power, mean spherical	2,680	3,110
Watts per Hefner candle, perpendicular to tube	0.24	0.23
Watts per Hefner candle, mean spherical	0.27	0.27

DIAGRAM OF QUARTZ LAMP.

In practice the economy is considerably diminished by the waste of energy in the resistance coils. The radiation is very rich in ultraviolet rays, which pass freely through the quartz tube. As these rays are injurious to the eyes and the skin, the luminous tube, if employed for direct illumination, must be surrounded by a dull glass globe. The globe absorbs luminous in addition to ultraviolet rays, and therefore causes a further diminution in candle-power, amounting to 5 or 10 per cent with matt globes, and 20 or 30 per cent with opal globes. But after all these reductions have been made the quartz lamp still far surpasses the older mercury vapor lamps and equals the best flaming arc lamps in luminous efficiency. It possesses several advantages over the arc lamp, the most important being its small cost of maintenance. It is warranted to burn 1,000 hours and during this period it requires no attention whatever. The lamp is made (by the Quarzlampen Gesellschaft m. b. H., of Pankow, near Berlin) in three sizes—3,000 and 1,500 candle-power for 220-volt circuits and 1,000 candle-power for 110-volt circuits. The lamps, with all accessories, cost from \$40 to \$50 each, and spent tubes can be exchanged for new on payment of \$4. These high prices are due to the great cost of fused quartz, which is now nearly \$7 per ounce, but will probably be reduced before long. The high cost of installation, however, is compensated by the economy of power and low cost of maintenance.

The new quartz lamps are excellently adapted to the illumination of streets and railway stations, and the intensity and peculiar color of their light makes them peculiarly valuable for advertising purposes. For large factory rooms and for indirect illumination of offices and drafting rooms they are also well suited. They are not well adapted for interior illumination in general, except in combination with other lamps, as their light, though of more agreeable color than that of the older mercury vapor lamps, is still deficient in yellow and red rays.—Prometheus.

A NEW THREE-COLOR CAMERA.

SIR W. DE W. ABNEY, K.C.B., F.R.S., exhibited and described before the recent meeting of the British Association for the Advancement of Science a new three-color camera of great ingenuity—a portable box of the usual dimensions. The point for the amateur, he said, was to be able to take three images on the same plate. When the plate was divided into three strips, and a special lens placed in front of each division, the lenses would be at different angles for the different plates, and stereoscopic effects would be introduced. He had hence adopted a central lens combined with reflectors for the three images, consisting of mirrors under 45 deg. and lenses. There might be a certain distortion in the side images relatively to the central image; that did not much matter for three-color work, for which the red and green were essential; the blue might be a little out of focus. But that camera was only suitable for a fixed focus; if we moved the screen, the two side images (red and blue) would not remain in focus with the central image (green). The arrangement finally adopted made all the second principal points at the same distance from the focusing screen, so that the focusing was equally correct with near objects for the three images. There were the central lens and three pairs of bi-concave and convex lenses in the camera exhibited, of 6 inches focal length. As regards the mirrors, Sir William considered varnished silver on glass too difficult to manipulate; such mirrors were no