When the retort becomes stopped with pitch from many distillations adhering to the inside, and cleaning is necessary, the parts *a*, *b*, and *c* are unscrewed, the retort taken from the support *D* and placed in a forge fire where it can be heated until all the pitch is burned out. The parts are then reassembled.

Water-gas tar containing upward of 75 per cent. water has been distilled with this apparatus without loss of material or danger to the operator.

OIL-GAS ANALYSIS APPARATUS.

BY E. C. UHLIG.

This apparatus was designed for gases in which the methane is in greater proportion than the hydrogen. It is based on the observation of E. Jaeger (this J., 1898, page 1190), that when a mixture of methane and hydrogen is passed through copper oxide at 250° C. the hydrogen is burned to water, the contraction in volume being a direct measure of the hydrogen that was present, while the methane is unchanged until the copper oxide is heated to redness when it is burned to carbon dioxide which may be absorbed in sodium hydroxide. The residue of gas left after combustion and absorption is then read, added to the other constituents and the sum subtracted from 100 gives the methane. This apparatus has been used for gases made by decomposing oil in retorts. These gases are of the following type:—

	Per cent.	Per cent.
Carbon dioxide	0.0	0.0
Illuminants	54.2	45.4
Oxygen	0.4	0.4
Carbon monoxide	0.3	1.2
Hydrogen	9.8	5.0
Methane	32.8	43.6
Nitrogen	2.5	4.4

The apparatus consists of an absorption tube, *A*, similar to that used on the Elliott apparatus, but having the part *cd* in addition. This part is made of tubing 1 mm. internal diameter to the bottom of the upright part *d*, this upright part has an internal diameter of 6 mm. and an external diameter of 10 mm., the bulb is 15 mm.

external diameter. The tube *A* may be graduated. The tube, *B*, is 100 c.c. capacity, and is graduated in 1/10 c.c. It is contracted below the bulb, *g*, which is 15 mm. external diameter. The part above *g* is 6 mm. internal and 10 mm. external diameter. *C* is a quartz tube filled with fine granular copper oxide, the ends of this tube are stopped with plugs of asbestos fibre. The

connection with *A* and *B* is made with rubber tubing wired on and covered with wet lamp wick shown at *jj*. This wick must be kept wet during the combustion by running water over it. Two discs of asbestos board through which the tube, *C*, passes are shown at *hh*. The tube, *C*, is heated by the burner, *D*.

To prepare the apparatus, the tubes, *A* and *B*, are filled with water by raising the bottles, *a* and *b*, which are attached to the tubes by rubber tubing. The next step is to fill the apparatus from the cock, *c*, to the narrow part under *g* with atmospheric nitrogen. This is done by lowering the bottle, *a*, and opening the cock, *e*, thus admitting air into *A*, *e* is then closed and the funnel filled with sodium pyrogallol solution, which is gradually allowed to flow into *A*. When all the oxygen has been removed from the air in *A* the cock, *c*, is opened and the nitrogen passed from *A* to *B* and back several times, applying some pyrogallol solution when the nitrogen is in *A*. Finally the bottle, *b*, is raised so that the level of its water is at the narrow part of *B* under *g*. When the water in *B* is at this mark, the cock, *c*, is closed, the 3-way cock, *f*, opened to drain *A*, and *e* also opened. The tube *A*, is then emptied and washed out with water admitted through the funnel, the bottle, *a*, is emptied, washed out, and filled with fresh water. It is then raised above *e*, and when *A* is full of water the cock, *e*, is closed. The apparatus is now ready for the gas which is to be analysed.

The funnel is removed and the gas admitted to *A*. When a little more than 100 c.c. has been admitted to *A*, the cock, *e*, is closed and the funnel replaced. The excess of gas over 100 c.c. is expelled and the volume adjusted in the usual manner. We now have 100 c.c. of gas in *A*, and proceed to make the absorptions in the same manner as in the Elliott apparatus, admitting the reagents in turn through the funnel; the tube *A* being graduated the various contractions are read on it. When all the constituents of the gas have been determined except hydrogen, methane, and nitrogen, the residual gas is passed into *B* and the cock, *c*, closed. *A* and *a* are now washed out and refilled with fresh water. The burner, *D*, is lighted and a small flame permitted to burn about 3 inches below *C*. The gas is passed from *B* to *A* and back about six or eight times. The burner is removed and water run over *C* to cool the gas, when cool to room temperature a reading is taken by raising *b* until its water level coincides with the water level in *B*, the heating and cooling may be repeated to ensure that all the hydrogen is burned. The contraction found gives the hydrogen. The burner, *D*, is replaced and *C* raised to a red heat, the funnel is filled with sodium hydroxide solution (10 per cent.) and the gas passed from *B* to *A* and back; when in *A* the cock, *c*, is closed and some sodium hydroxide admitted. This is continued until no further contraction is observed in the gas volume. The burner is removed and the tube, *C*, cooled with water as before, when at room temperature a reading is taken of the gas in *B*, this gives the nitrogen. The sum of the constituents subtracted from 100 gives the methane. Any ethane is burned and reported as methane.

This apparatus, as originally used, had a platinum tube at *C*, but it was found that the reduced copper alloyed with the platinum and this caused the tube to crack. A quartz tube was tried and found to answer very well; it may be heated to redness and suddenly cooled with water without danger of cracking, and neither copper nor copper oxide have any effect on it. It may be readily cleaned by immersing in *aqua-regia* in a test tube, allowing to stand over night, washing out with water, and drying in a flame. It then can be cooled and refilled with copper oxide.

When an analysis is finished the tube, *C*, is heated again to redness and air passed through; this oxidises the reduced copper to copper oxide; the last of the oxygen is then removed by pyrogallol and the level of the water in *B* adjusted to the narrow part as before. *A* and *a* are emptied, washed out, and refilled with water and the apparatus is ready for the next analysis.

The following comparisons were made of results from this apparatus and from an Elliott apparatus. A portion of the residual gas from the Elliott apparatus was passed

into A by means of a capillary tube, and the combustions made as above described.

	Elliott. per cent.	Copper oxide apparatus. per cent.	Difference. per cent.
Hydrogen	32.5	32.7	0.2
Methane	17.0	18.8	0.9
Nitrogen	4.6	5.3	0.7

THE ELLIOTT STANDARD PHOTOMETRIC LAMP.

BY E. C. UHLIG.

This lamp is designed as a secondary standard for the determination of candle power by the works men, it is intended for the guidance of the gas-maker in place of the unreliable jet photometer. It is of the well-known "student lamp" type of about 16 candle power, the light of which is reduced by means of a screen to 10 candle power and in the latest models to 5 candle power. The fuel burned is "Astral oil." It is furnished with a reservoir which will hold sufficient oil to burn 12 hours. These lamps have also been made with 24 hour reservoirs. The lamp is standardised against candles or against a standardised sample of gas which may be taken from a 5 cubic foot gas holder. When once standardised the lamp will maintain its candle power for 12 hours or even longer. The 5 candle standard permits of more accurate adjustment in this respect. It requires reasonable care in its use; the wick must be properly trimmed according to the directions given with the lamp, the oil must be clean, the burner kept clean particularly in the air holes. Observing all these precautions a careful operator will get results which agree very closely with those obtained with other standards.

The method of using the lamp is as follows: After cleaning, filling, and trimming, it is placed in position at the end of the photometer bar, at the other end of which the candles or standardised gas is burning. The lamp is lighted and allowed to burn about 15 minutes, then readings are taken and the usual corrections applied. The gas to be tested is then put in the place of the candles or standard gas and readings taken with the value of the lamp as standard. These readings may be taken as often as required during the day.

It has been found that this lamp varies very little each day from the value found on the first standardisation, generally the 10 candle power lamp will not vary more than 0.1 candle from day to day, while the variation of the 5 candle power lamp is even less. Any variation will be due mostly to a change in the quality of the oil used. It is good practice to reserve a quantity of oil for use in the lamp only, and not take oil from a receptacle in general use. Of course variations will occur due to wear particularly in the burner, but this can be corrected by occasional repair.

A test of this lamp was made by taking the candle power of gas delivered to two photometers, on one of which (60 inch) the lamp was used as a standard, on the other (100 inch) the standard was sperm candles. The lamp was 10 candle standard, and tests were made hourly on each photometer for 13 hours. The average results were as follows:—C.P. of gas by the lamp, 24.30. C.P. of gas by standard candles, 24.00.

The following results with a 5 candle lamp are communicated. Elliott lamp against Hefner amyl acetate lamp. Hefner lamp adjusted to 1 standard candle.

Elliott lamp	= 5.02	candle power.
After 2 hours	= 5.01	"
" 3 "	= 5.01	"
" 4 "	= 5.01	"
" 6 "	= 5.00	"
" 8 "	= 5.00	"
" 7 "	= 5.00	"
" 8 "	= 5.00	"
" 9 "	= 5.00	"
" 10 "	= 5.00	"
" 11 "	= 5.00	"
" 12 "	= 5.00	"

MOUNTED CUBIC FOOT BOTTLE FOR CALIBRATING VOLUMETRIC GAS TESTING APPARATUS.

BY E. C. UHLIG.

This consists of an oval copper vessel joined at the top and bottom with water tanks. These tanks are of wood,

metal lined, and are connected with each other directly by piping. At the bottom, there is a pump which enables the water to be forced from the lower to the upper tank. There is a funnel on the lower tank, through which water may be added, and a cock by which it may be drawn off. Immediately above and below the copper vessel are two small wooden shelves, which are fastened to the wooden back of the instrument, running from the upper to the lower tank and binding the whole together. The pipe leading from the copper vessel both above and below is all glass for about six inches, and on these glass portions are marked the upper and lower limits of the cubic foot. Six inches above the upper glass tube are a three-way cock and a small tube which permits of the escape of air. Above this is a valve by which the cubic foot may be shut off from the apparatus under test, and there is a similar valve below the copper vessel for controlling the flow of water from the upper tank to it. There is also a three-way cock connecting with the lower tank, the pipe and the vessel above.

This apparatus is standardised and certified by the Bureau of Standards at Washington, and by its means a cubic foot of air or gas can be passed through the outlet connection, and by repeating the operation any number of cubic feet may be passed.

Scottish Section.

Meeting held at Glasgow on Tuesday, January 18th, 1910.

MR. D. J. PLAYFAIR IN THE CHAIR.

EASY PROCESS FOR ESTIMATING WATER IN PETROLEUM.

BY R. WIGHTWICK ROBERTS AND ALFRED FRASER.

A large portion of Californian petroleum—or rather petroleum residues, for it has been freed from the lighter oils by distillation—that comes to the coast of Chile for use as fuel, contains quantities of water varying up to about 20 per cent. This water seems to form an emulsion with the heavier constituents of the oil, and, besides detracting from its calorific value, causes at times serious trouble by clogging the nozzles of the blowers.

As the estimation by distillation is difficult and often unsatisfactory, the attempt was made to determine the water by adding calcium carbide to the oil and measuring the amount of acetylene given off. The experiment was entirely successful. A number of concurrent tests were made (1) by taking two equal portions of the same