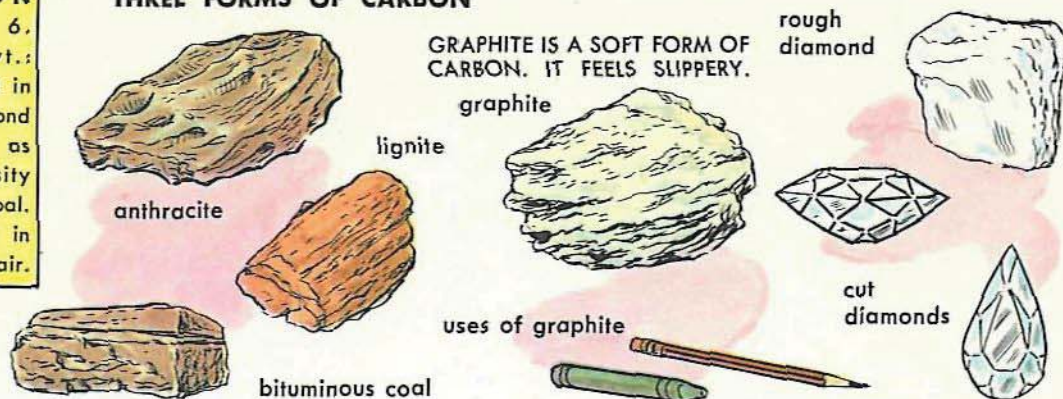


**C CARBON**  
 Element 6.  
 Atomic wt.:  
 12.011. Found in  
 nature as diamond  
 (density 3.52), as  
 graphite (density  
 2.25), and as coal.  
 Diamond burns in  
 oxygen, coal in air.

### THREE FORMS OF CARBON



GRAPHITE IS A SOFT FORM OF CARBON. IT FEELS SLIPPERY.

rough diamond

graphite

lignite

anthracite

bituminous coal

uses of graphite

cut diamonds

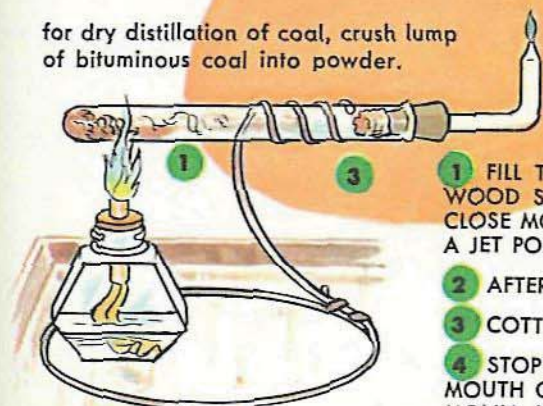
ANTHRACITE IS ALSO CALLED HARD COAL. BITUMINOUS COAL IS SOFT COAL. LIGNITE IS BROWN COAL. GRAPHITE IS A SOFT FORM OF CARBON. IT FEELS SLIPPERY. DIAMOND IS THE HARDEST SUBSTANCE KNOWN.

### DESTRUCTIVE DISTILLATION

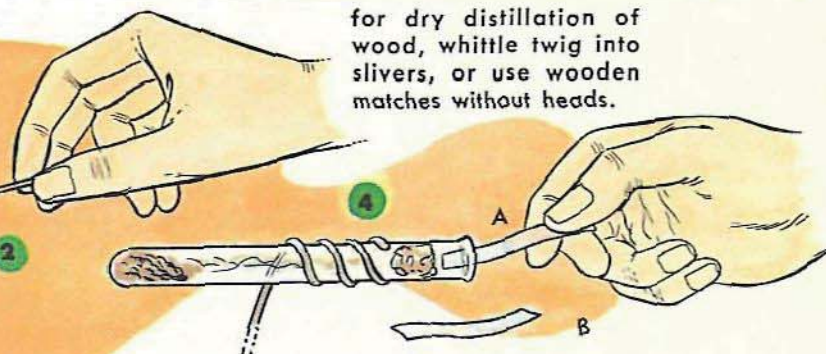
IN REGULAR DISTILLATION (SEE PAGE 61), A CHEMICAL IS PURIFIED. IN DESTRUCTIVE OR DRY DISTILLATION, THE SUBSTANCE IS BROKEN INTO SEVERAL DIFFERENT CHEMICALS.

for dry distillation of wood, whittle twig into slivers, or use wooden matches without heads.

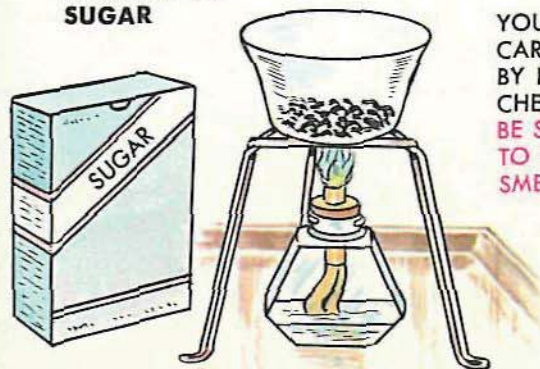
for dry distillation of coal, crush lump of bituminous coal into powder.



- 1 FILL TEST TUBE  $\frac{1}{4}$  FULL OF COARSELY POWDERED BITUMINOUS COAL (OR WOOD SLIVERS). PLACE SMALL WAD OF COTTON AT MOUTH OF TEST TUBE. CLOSE MOUTH OF TUBE WITH STOPPER WITH L-SHAPED GLASS TUBE DRAWN TO A JET POINT. PLACE TUBE HORIZONTALLY IN HOLDER. HEAT COAL (OR WOOD).
- 2 AFTER A WHILE, DENSE FUMES DEVELOP. THEY CAN BE IGNITED AT JET.
- 3 COTTON WAD DISCOLORS FROM TAR CONDENSING AFTER BEING DISTILLED.
- 4 STOP HEATING. REMOVE STOPPER. BRING MOISTENED LITMUS PAPER TO MOUTH OF TUBE. IF YOU DISTILLED COAL, RED LITMUS TURNS BLUE FROM AMMONIA (A). IF YOU DISTILLED WOOD, BLUE LITMUS TURNS RED FROM ACETIC ACID (B). COAL HAS TURNED TO COKE, WOOD HAS BECOME CHARCOAL.



### CARBON IN SUGAR



HEAT 1 TEASPOON CANE SUGAR IN A CUSTARD CUP. FIRST, SUGAR MELTS. THEN IT TURNS BROWN—IT "CARAMELIZES." NEXT IT GIVES OFF THICK VAPORS THAT CAN BE IGNITED. FINALLY, A PURE FORM OF COAL REMAINS.

YOU CAN PROVE PRESENCE OF CARBON IN THE FOOD YOU EAT BY HEATING SMALL SAMPLES OF CHEESE, BREAD, MEAT, SUGAR. BE SURE TO DO THIS OUTDOORS TO PREVENT EXPERIMENTS FROM SMELLING UP THE WHOLE HOUSE.



RUB A LUMP OF SUGAR WITH CIGARETTE ASHES (TO ACT AS CATALYST). IGNITE. DIP TEST TUBE IN LIME WATER. HOLD OVER BURNING SUGAR. FILM OF CALCIUM CARBONATE SHOWS  $\text{CO}_2$  IN FLAME—PROVING THAT THERE IS CARBON IN SUGAR.



**1** HAMMER LUMPS OF BITUMINOUS COAL INTO A COARSE POWDER. FILL FUNNEL WITH IT. BRING FUNNEL INTO LARGE JAR.

**2** TURN JAR UPSIDE DOWN. FILL JAR WITH WATER. PLACE A WATER-FILLED TEST TUBE OVER FUNNEL. IN A FEW DAYS, TUBE IS FILLED WITH METHANE.

### METHANE—CH<sub>4</sub>



IN THE LABORATORY, METHANE IS MADE BY HEATING WATER-FREE SODIUM ACETATE WITH "SODA LIME."

**1** TO MAKE SODIUM ACETATE, ADD WASHING SODA TO ½ CUSTARD CUP VINEGAR UNTIL NO MORE CO<sub>2</sub> IS GIVEN OFF. EVAPORATE MIXTURE AT LOW HEAT TO GET WHITE POWDER OF SODIUM ACETATE.

**2** MIX 5 g SODIUM ACETATE (CH<sub>3</sub>COONa), 5 g SODIUM HYDROXIDE, AND 5 g CALCIUM OXIDE. DROP INTO TEST TUBE. SET UP APPARATUS FOR COLLECTING GAS AS SHOWN BELOW. HEAT TO MAKE METHANE:  

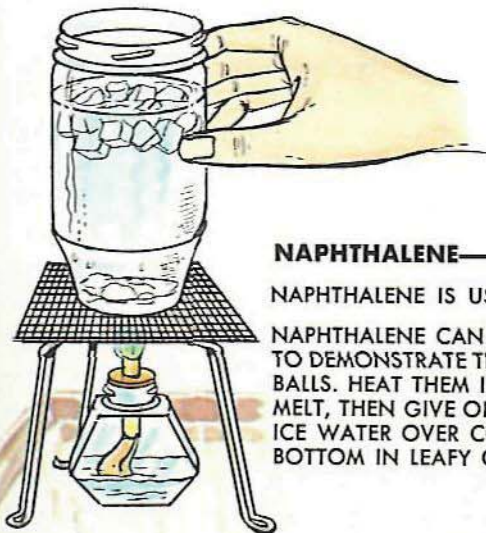
$$\text{CH}_3\text{COONa} + \text{NaOH} \rightarrow \text{CH}_4 + \text{Na}_2\text{CO}_3$$



### NAPHTHALENE—C<sub>10</sub>H<sub>8</sub>

NAPHTHALENE IS USED IN MAKING MOTH BALLS.

NAPHTHALENE CAN BE PURIFIED BY SUBLIMATION. TO DEMONSTRATE THIS, CRUSH A COUPLE OF MOTH BALLS. HEAT THEM IN A CUSTARD CUP. FIRST THEY MELT, THEN GIVE OFF VAPOR. PUT JAR FILLED WITH ICE WATER OVER CUP. NAPHTHALENE SETTLES ON BOTTOM IN LEAFY CRYSTALS.

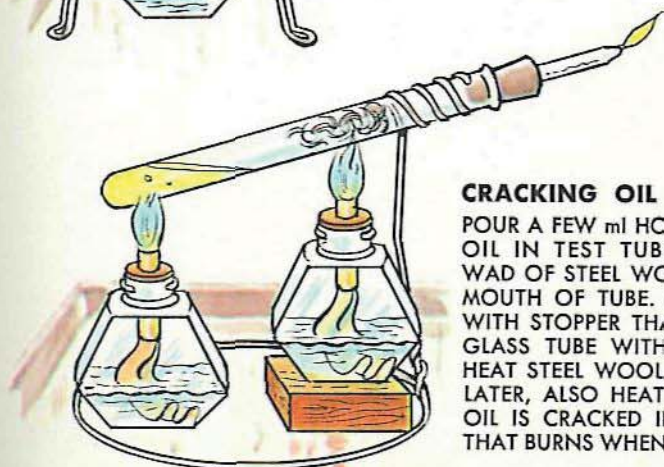


### TURPENTINE—C<sub>10</sub>H<sub>16</sub>



### CRACKING OIL

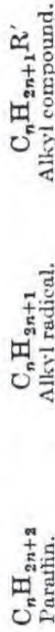
POUR A FEW ml HOUSEHOLD OIL IN TEST TUBE. PLACE WAD OF STEEL WOOL NEAR MOUTH OF TUBE. CLOSE IT WITH STOPPER THAT HAS A GLASS TUBE WITH JET TIP. HEAT STEEL WOOL. A LITTLE LATER, ALSO HEAT THE OIL. OIL IS CRACKED INTO GAS THAT BURNS WHEN IGNITED.



**1** POUR A LITTLE TURPENTINE INTO A BOTTLE CAP. PLACE A SMALL WICK IN IT.  
**2** PLACE BOTTLE CAP ON PIECE OF PAPER. IGNITE TURPENTINE. IT BURNS INCOMPLETELY, GIVING OFF A BLACK SMOKE OF CARBON WHICH YOU CAN COLLECT IN A JAR.



In general, the substitution of a single univalent group for a single hydrogen atom of a paraffin hydrocarbon is said to give an *alkyl* compound:—



The substitution of other groups for two or more hydrogen atoms also occurs, as further explained in §§ 24, 54. The nomenclature of such compounds will be discussed as and when they are encountered.

### INDIVIDUAL HYDROCARBONS

**24. Methane.**  $CH_4$ .—*Occurrence.*—Methane occurs naturally—

- (1) in 'natural gas' evolved from oil-wells (§ 26),
- (2) in the gases evolved from coal when it is mined ('fire-damp'),
- (3) in the gas evolved from swamps, pond mud, etc., in which vegetable matter is undergoing bacterial decomposition in absence of air.

In all the above cases methane is the final product of the decomposition of organic matter, for there is little doubt that petroleum and the gases associated with it are derived from the decay of minute forms of marine life (see, however, § 26).

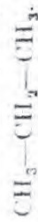
Methane is evolved from coal and wood when they are destructively distilled and therefore occurs in coal gas to the extent of about 35–45 per cent. by volume.

*Laboratory Preparation.*—Methane can be prepared:—

(1) By the action of alkalis on an acetate. Sodium hydroxide, in the form of soda-lime, and anhydrous sodium acetate are commonly employed.



Other paraffin hydrocarbons may be prepared by using the salts of homologous of acetic acid. Thus, a mixture of sodium butyrate,  $CH_3-CH_2-CH_2-CO_2Na$  and soda-lime yields propane



The gas so obtained is not very pure, and contains hydrogen:

ethylene, and traces of complex compounds which give it an *emphyreumatic* odour, as of burnt wood.

*Expt. 1. To prepare Methane.*—Some sodium acetate is melted on an iron tray and heated until its water of crystallisation is driven off, when it solidifies. By further heating the resulting solid is melted, and then allowed to cool. It is powdered and 10 g. of it are well mixed with 10 g. of soda-lime, and loosely charged into a hard-glass test-tube. The mixture is heated and the methane is collected over water. An iron tube or

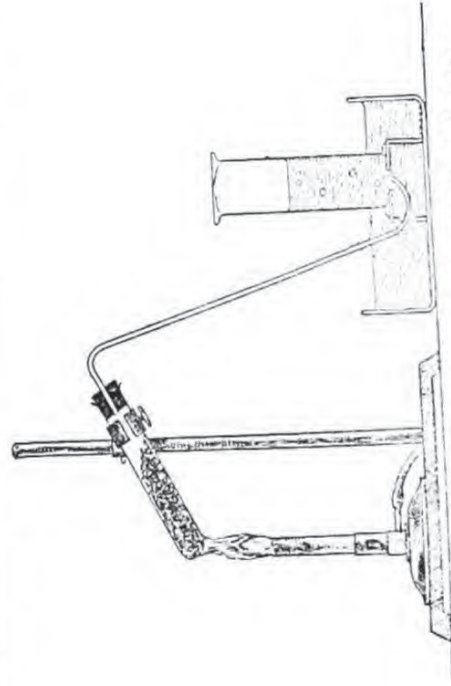


FIG. 14.—Preparation of Methane from Sodium Acetate.

copper flask may with advantage replace the hard-glass test-tube.

(2) The action of aluminium carbide on water yields methane:



The aluminium carbide with a little water may be placed in a flask furnished with thistle funnel and delivery tube and gently warmed. The addition of a little dilute hydrochloric acid accelerates the reaction. The methane is collected over water.

(3) Pure methane is best prepared by the action of the zinc-copper or aluminium-mercury couple on methyl iodide mixed with alcohol.



*Expt. 2. Preparation of Methane from Methyl Iodide.*—Set up the apparatus shown in Fig. 15. In the conical flask place