accurately ascertained by this means. With the Bunsen photometer, experiments gave 5 to 1 as the ratio of the respective luminous intensities of pine and coal gas.

Petroleum gas possesses properties analogous to those of pure gas, but has however a different and very strong odor similar to that of phosphuret of hydrogen. Its illuminating power is even stronger than that obtained from gas derived from coal. On burning petroleum gas in a Bunsen burner of ordinary dimensions, the brilliancy of the flame does not entirely depart, as the quantity of air drawn in is not sufficient to cause the consumption of all the contained carbon. When the cock of the rubber sack containing the petroleum or pine gas, under examination in the Bunsen lamp, is very slightly opened, the flame disappears from the upper portion of the burner and leaps to the inferior orifice of the tube. If, however, the said bag be pressed by the hands, the flame returns to the upper part of the burner. Although this experiment may be repeated as often as desired with the gases above named, it cannot be accomplished with coal gas, of which the flame, once produced at the inferior orifice, is not displaced, even if the same pressure be exerted upon the bag as before, thus indicating the greater mechanical energy of the former gases.

Combustion not being complete in Bunsen lamps of ordinary dimensions, the characteristic bands are not clearly defined in the spectra of pine and petroleum gases. The upper part of the flame gives a continuous spectrum, while that of the lower portion is channeled: the lines have the colors of the bands, while red appears at the extremity of the spectrum. On lighting a jet of compressed pine or petroleum gas, escaping from a tube, similar phenomena to those caused with coal gas are observed. With the former gases, however, the effects are amplified by the greater density and larger quantity of carbon contained. The velocity and the escape being great, the flame never commences at the orifice, but an intervening obscure space is produced. If a tube be employed having an exterior opening 1 millimeter in diameter, the flame of compressed coal gas presents no obscure point near the pipe; for if the cock be opened too wide, total extinction of the flame follows. With petroleum or pine gas, the contrary is the case: a quite large non-illuminated space appears near the escape orifice, and at the same time an oscillation of the luminous jet in the direction of its axis is perceptible. If the flame be observed from the side of the tube, a hollow central space, from which combustion is absent, can be perfectly discerned. This, the author considers, confirms his explanation to the effect that the velocity of a gaseous current is greater at the center than at the surface of the jet, for the friction diminishes the velocity of the molecules of the exterior. The mechanical action of the current is also greater at the center; the flame is projected to a greater distance, and there is a stronger displacement of the air in the region near the axis of the jet than at the periphery.

Another experiment gives additional support to this theory If through a bent tube a current of air be directed upon the flame of compressed pine or petroleum gas, in the direction and path of the gaseous current, the obscure space augments and the flame, drawing away from the orifice of the burner, may be projected so far therefrom as to be extinguished. In this case the air, it is believed, augments the mechanical action of the gas, in throwing the flame to a greater distance. If, on the contrary, a draft be applied to the jet in the direction of its axis but in a path opposite to that of the current, the flame approaches the orifice, diminishing the obscure space until the same disappears and the flame begins directly at the escape opening. By this means the gaseous mass is impressed with a movement contrary to that which it possessed on leaving the compressing apparatus, which diminishes the velocity of escape of the current and consequently its mechanical action on the incandescent portion. Again, if the air be injected transversely to the flame, the latter will deviate to the opposite side, through the composition of the motion which the jet had at the point of escape with that impressed by the draft; and at the same time the dimensions and form, both of obscure space and luminous jet, will vary.

Petroleum and pine gases having more carbon than coal gas, in order completely to ensure their consumption more air is required than is necessary for the combustion of ordinary illuminating gas: and thus for compressed gases it is necessary that the velocity of escape be greater for those derived from petroleum and from pine than from coal, in order to have the highest temperature and to cause the complete disappearance of the brilliancy of the flame. It is also for the same reason that the velocity of escape of the former gases should be greater than that of others less rich in carbon, to enable the spectroscope to exhibit with clearness the spectra characteristic of the flame of compressed gas.

SCIENTIFIC AND PRACTICAL INFORMATION.

A NEW SERIES OF AROMATIC HYDROCARBONS.

In the reaction of zinc powder on a mixture of benzine and chloride of benzyl, there are produced, besides diphenyl-methane (benzyl-benzine) some other hydrocarbons, which M. Zincke has recently succeeded in isolating.

After the distillation of diphenyl-methane, the temperature rises rapidly up to the limit of the indications of the mercurial thermometer, and a liquid is distilled which coagulates on cooling into a clotted and crystalline pasty mass. At the end of the distillation, a solid yellow body is passed and the residue cokes. The crystalline mass was treated with a little ether and pressed between sheets of paper to carry away the liquid portion. The etherized solution slowly deposited the crystalline crusts which were joined to the solid portion, and by complete evaporation gave a non-solidifiable oil.

In boiling alcohol the solid portion is deposited in acicular crystals: the mother waters retain a liquid product and another hydrocarbon. The acicular crystals are a mixture of two hydrocarbons; one, which appears to dominate, crystallizes in boiling alcohol in fine and very brilliant layers, or, if the solutions are extended, in rhomboidal transparent tables. This substance is slightly soluble in alcohol, quite so in benzine, chloroform, and sulphide of carbon, though somewhat less in ether. It melts at about 187° Fah. and coagulates at 172·4° into a transparent mass which becomes crystallizable by heat or friction. It does not combine with picric acid.

The second hydrocarbon is much less soluble than the first, crystallizes in fine needles, melts at 172·3° Fah., and coagulates at 154 4°. The separation of these hydrocarbons is very difficult, and ether is the best agent to employ. Their composition is sensibly the same, and the author regards them as to isomeric di-benzyl-benzine, $C_{20}H_{13}$; one of them may, however, be tri-benzyl-benzine, $C_{26}H_{24}$. Their oxidation may give some indications on their molecular weights.

TO DESTROY FIELD MICE.

Smoke, it is well known, will soon destroy these little pests, but how to introduce it into their holes in an easy way may interest some of our readers. Professor Nessler, of Carlsruhe, has devised a sort of pellet which gives off great quantities of smoke when burning, so that it is only necessary to put some of these into the holes and ignite them in order to suffocate the mice. Their preparation is nearly as follows: Some fiberous substance, such as jute, is soaked in a concentrated solution of saltpeter, dried, then dipped in tar, and, when half dry, flowers of sulphur are sprinkled over it. When fully dry the jute fibers are cut into little pieces like pills and are ready for use. As soon as they are ignited they are stuffed into the hole, which is then stopped up with earth.

FLUORENE.

M. Berthelot announces, under the name of fluorene, a new and very fluorescent carburet contained in the portions of the tar of volatile oils between 300° and 340° C.

In order to extract the substance, instead of causing the portions of solid carburet which have passed the distillation between 300° and 305° C. to be crystalized in alcohol simply, a mixture of alcohol and benzine is used. By this means may be separated a small quantity of acenaphtene which remains in the mother liquor. The point of fusion of the mass, which is ordinarily 105° C. after the first distilation and crystalization in pure alcohol, increases to 112° after crystalization in alcohol mixed with benzine. The remainder of the purification consists in redistilation and crystallization in pure alcohol. The carburet possesses a quite pronounced violet fluorescence which, however, disappears promptly on its being exposed to the light. The chemical symbol is stated to be $C^{26}H^{10}$.

THE BRITISH ASSOCIATION.

We continue, from our last, abstracts from papers read at the late meeting at Bradford:

ON PEAT.—BY MR. F. HAHN DANCHELL.

The prime fact in relation to peat is that, in its raw condition, the combustible parts are combined with from 80 to 90 per cent of water, which, for the most part, must be removed before it can constitute fuel. The peat problem may therefore be defined as the economical separation of the two elements—the retention of the solid and the discharge of the fluid. The simplest mode of effecting this is by cutting the peat as sods or bricks, and leaving them to dry in the air and sunshine. To diminish labor, it is frequently suggested, why not dry peat by pressure? If peat were altogether composed of fibers, the water might certainly be squeezed out as from cotton, or wool, or hair; but a large portion of peat is semi-gelatinous, which, when dry, serves to cement the whole together, and which, moreover, is good for combustion. When peat is compressed, this glutinous constituent escapes with the water, indeed as easily as the water, involving a serious loss. Drying by artificial heat is also frequently proposed; but when it is considered that to obtain 100 tuns of dry peat it is necessary to find space for 500 or 600 tuns of wet peat, which space must be so heated as to permit the evaporation of 500 tuns of water, the economy of the proposition is seen to be highly questionable. But, setting economy aside, it is to be observed that peat cannot be artificially dried without deterioration in quality. The practice of maceration is so old that Pliny refers to it in his description of the inhabitants of North Germany; and yet ever and anon it is advanced as a novelty, and made the subject of patents. The reduction of peat to pulp is one of the easiest of operations. It may be done with the feet, or with any kneading or mincing machine. The most efficient mode of drying is by slow evaporation under roof. Drying goes on more rapidly in the open air if the weather be favorable; but in this country the sky cannot be reckoned upon, and with alternate exposure to wind, rain, and sunshine the quality of peat is much deteriorated. The difference in favor of peat dried under a shed is most marked, and, though the cost of production is greater, the quality affords ample compensation. How much drainage affected the cost of production may be seen from comparing the results from a drained and undrained bog. An undrained bog contains about 90 per cent of water, while a drained one contains 80 per cent. In the one case, therefore, we have 10 per cent of perfectly dry peat, and in the other double that amount. The output will, therefore, be half the quantity from an undrained bog as from a drained one, while the labor is the same. In Holland, Westphalia, Hanover, Holstein and Schleswig, Denmark, Pomerania, and the whole northern part of Germany, Russia, and many parts of Austria, Bavaria, the North of Italy, Switzerland, and extensive districts in both the North and South of France, peat is a general article of consumption, and the inhabitants would, no doubt, hear with some amazement that what is matter of course with them is matter of inquiry with us, and that we want to know whether peat is applicable to iron smelting and other industrial purposes, when they from time immemorial have used little else.

ON THE EFFECT WHICH THE DEPTH OF IMMERSION HAS ON THE RESISTANCE OF A SCREW.—BY PROFESSOR OSBORNE REYNOLDS, M. A.

It has been stated by several writers on the screw propeller, and is, I think, generally supposed, that the resistance of the water to a screw increases with the depth of immersion below the surface. Improvements have been made by Mr. Rennie and Mr. Maudslay which appear to prove this, but I do not think that any theoretical reason has ever been given. Now this idea is so contrary to our fundamental notions of hydraulics that I thought it would be worth while to make experiments. These experiments show us that there is not any increase beyond a certain point, and that this point is that at which the screw ceases to break the surface and get air. In a paper read before the Institution of Naval Architects, I explained how the air getting down to the screw is the cause of racing. In the same way it may be shown that it was the air that was the cause of the diminished resistance near the surface, found by Mr. Rennie and Mr. Maudslay.

The conclusion is that, when a screw is once fairly down below the surface, depth of immersion is of no advantage. Experiments on the effect of immersion on the resistance of screw propeller were made June 8, 1873. The screw was 2 inches in diameter, driven by a spring, which, when wound up, caused it to make 240 revolutions. The resistance at the different depths was measured by the time taken for the spring to run down.

FIRTH'S COAL CUTTING MACHINE.—BY MR. WILLIAM FIRTH, OF LEEDS.

Enough has been said respecting compressed air as a motor to justify the expectation that it is the key to vast and important improvements upon the present system of working coal; and bearing in mind that the wealth, the power, and the greatness of this nation depend primarily upon an abundant supply of coal, it is hardly possible to over rate the importance or over value the advantage which this power places at our disposal. I now turn to the consideration of the machine for cutting the coal, which has for several years been employed at West Ardsley without any interruption. The weight is about 15 hundred weight for an ordinary sized machine; its length, 4 feet; its hight, 2 feet 2 inches; and the gage, 1 foot 6 inches to 2 feet; it is very portable, and easily transferred from one bank to another. The front and hind wheels of the machine are coupled together in a similar manner to the coupled locomotive engines. The "pick" or cutter is double headed, whereby the penetrating power is considerably increased. The groove is now cut to a depth of 3 feet to 3 feet 6 inches at one course, whereas, by the old form of a single blade, we had to pass the machine twice over the face of the coal to accomplish the same depth. The points are loose and cottered into the boss, so that, when one is blunted or broken, it can be replaced in a few moments. It dispenses with the necessity of sending the heavy tools out of the pit to be sharpened, and is an immense improvemen upon the old pick.

When all is in readiness for work, the air is admitted and the reciprocating action commences. It works at a speed of sixty to ninety strokes per minute, varying according to the density of the compressed air, the hardness of the strata to be cut, or the expertness of the attendant. As to the quantity of work in "longwall," a machine can, under favorable circumstances, cut 20 yards in an hour, to a depth of 3 feet, but we consider 10 yards per hour very good work, or say 60 yards in a shift. This is about equal to a day's work of twelve average men, and the persons employed to work the machine are one man, one youth, and one boy, who remove and lay down the road and clear away the *débris*. The machines are built so strong that they rarely get out of working condition. Some of those now working at West Ardsley, and other places, have been in constant use for three or four years. At that colliery there are about eight machines in use. One of the seams is so hard and difficult to manage that it could not be done by hand, and the proprietors had to abandon and did abandon it; but now, by the employment of the machines, it is worked with perfect ease. It is a thin cannel seam with layers of ironstone, and the machines now "hole" for about 1,200 tuns per week. The groove made by the machine is only 2 to 3 inches wide at the face, and 1½ inch at the back; whereas by hand, it is 12 to 18 inches on the face, and 2 to 3 inches at the back. In thick seams worked by hand the holing is often done to a depth of 4 feet 6 inches to 5 feet, and the getter is quite within the hole that he has made; and where the coal does not stick well up to the roof, or where there is a natural parting, there is great difficulty and danger from "falls of coal."

THE consumption of coal for the purpose of gas illumination in Great Britain is estimated at fourteen millions of tuns per annum, valued at sixty millions of dollars. The total annual production of coal in England is one hundred millions of tuns.