steam. To explain these facts two assumptions are possible. Either the chemical and physical properties of all or some of the solid constituents are changed by the distillation, and the paraffine is changed from the amorphous into the crystalline variety, or the change produced by the distillation takes place in the medium (*i. e.*, the mother liquid) in which the paraffine exists. The change effected in ozokerite and in petroleum residues when crystalline paraffine is obtained by distillation is to be regarded as a purification, and can be effected partially by treatment with amyl alcohol. In the same way, by repeated treatment of petroleum residuum with amyl alcohol, a substance of melting point 59° C. can be obtained, which cannot be distinguished from ordinary paraffine.

The treatment with amyl alcohol has therefore accomplished the same results as was obtained by distillation, and the action is probably the same, *i. e.*, a partial separation of colloid substance. These facts point to the conclusion that crystallizable paraffine exists ready formed in both petroleum and in ozokerite, but in both cases other colloidal substances prevent its crystallization. By distillation, these colloids appear to be destroyed or changed so as to allow the paraffine to crystallize.

It is a generally known fact that liquids always appear among the products of the distillation of paraffine, no matter in what way the distillation be conducted. This shows that some paraffine is decomposed in the operation.

The name *proto-paraffine* has been given to ozokerite and to the paraffine of petroleum in contradistinction to *pyro-paraffine*, the name that has been applied to the paraffine obtained by distillation from any source.

According to Reichenbach, paraffine may crystallize in three forms: needles, angular grains, and leaflets having the luster of mother-of-pearl. Hofstadter, in an article on the identity of paraffine from different sources, confirmed this statement, and added further that at first needles, then the angular forms, and then the leaflets are formed. Fritzsche found, by means of the microscope, in the ethereal solution of ozokerite, very fine and thin crystal leaflets concentrically grouped, and in the alcoholic solution fine irregular leaflets. Zaloziński has recently developed these microscopic investigations to a much greater extent. According to this observer, the principal part of paraffine, as seen under the microscope, consists of shining stratified leaflets with a darker edge. The most characteristic and well developed crystals are formed by dissolving paraffine in a mixture of ethyl and amyl alcohols and chilling. The crystals are rhombic or hexagonal tablets or leaves, and are quite regularly formed. They are unequally developed in different varieties of paraffine. The best developed are those obtained from ceresine. Their relative size and appearance give an indication as to the purity of the paraffine, and, as they are always present, they are to be counted among the characteristic tests for paraffine. Reichenbach observed that mere traces of empyreumatic oil prevented their formation.

The old method of determining the amount of paraffine in petroleum was to carry out the refining process on a small scale; that is, to distill the residue from the kerosene oils to coking, chill out the paraffine, press it thoroughly between filter paper, and weigh the residue. The sources of error in this procedure are manifold; the principal one is the solubility of paraffine in oils, which depends upon the character of both the paraffine and the oil, and also upon the temperature. The next greatest source of error is variation in the process of distillation and the difference between working on the small scale and on the large scale.

In most cases, where a paraffine determination is to be carried out, one has to deal with a mixture of paraffine with liquid oils. Now, paraffine is not a substance defined by characteristic physical properties which distinguish it from the liquid portions of petroleum. It consists of a mixture of homologous hydrocarbons, which form a solid under ordinary conditions. The hydrocarbons of this mixture show a gradation in their properties, and gradually approximate to those which are liquid at ordinary temperatures. It is a well known fact that a separation of these homologues is entirely impossible by distillation. It has also been ascertained that the liquid constituents of petroleum do not always possess boiling points that are lower than those of the solid constituents. This shows that we have to deal not merely with hydrocarbons of one, but of several series.

When determinations of the amount of paraffine are to be made, then it becomes necessary to specify with exactness what is to be called paraffine. The most definite property that can be made use of for this purpose is the melting point. For several reasons it is convenient to include under this name hydrocarbons of melting point as low as 35°-40° C.

The method proposed by Zaloziński for the determination of paraffine is the following: The most volatile portions of the petroleum are separated by distillation, until the thermometer shows 200° C. These portions are separated, as they exert great solvent action upon paraffine. At the same time he finds that no pyro-paraffine is formed under this temperature. A weighed portion of the residue is taken and mixed with ten parts by weight of amyl alcohol and ten parts of seventy-five per cent. ethyl alcohol: the mixture is then chilled for twelve hours to 0° C. It is then filtered cold, washed first with a mixture of amyl and ethyl alcohols, and then with ethyl alcohol alone. The paraffine is transferred to a small porcelain evaporating dish and dried at 110° C. It is then heated with concentrated sulphuric acid to 150°-160° C. for fifteen to thirty minutes with constant stirring. The acid is then neutralized and the paraffine extracted by petroleum ether. On evaporation of the solvent, the paraffine is dried at 100° C. and weighed. Zaloziński found, according to this method, in three samples of Galician petroleum, 4.6, 5.8 and 6.5 per cent., respectively, of proto-paraffine. The method was carried out as above with four samples of American petroleum, Colorado oil from Florence, Col.; Warren County oil from Wing Well, Warren, Pa.; Washington oil from Washington County, Pa.; Middle District oil from Butler County, Pa., all furnished by Professor Sadtler.

They were very different in physical properties and in appearance, the Colorado oil being a much heavier oil than the others and the Washington oil being an

amber oil, while the other two were of the ordinary dark green color and consistence. The losses on distillation to 200° C. were very different, being about one-tenth in the case of the Colorado oil and nearly one-half in the case of the others. The percentages of partially refined proto-paraffine in the four reduced oils (all below 200° C. off) were as follows: for the Colorado oil, 23.9 per cent.; for the Warren oil, 26.5 per cent.; for the Washington oil, 26.6 per cent.; and for the Middle District oil, 28.2 per cent.

The question now arises, What value has this determination of the proto-paraffine which may exist in an oil? As before said, a portion of the paraffine is always decomposed in distillation at temperatures sufficiently high to drive over the paraffine oils, so the yield of pyro-paraffine is always less than the proto-paraffine shown to be present originally. Zaloziński found this in the case of the several Galician oils he examined. Corresponding to the 4.6, 5.8 and 6.5 per cent. of proto-paraffine in the several oils he obtained 2.18, 2.65 and 2.35 per cent., respectively, of pyro-paraffine.

For the present, however, the extraction of proto-paraffine on a large scale by means of such solvents as amyl and ethyl alcohols is out of the question on account of their cost. A distillation, under reduced pressure and with superheated steam, would, however, prevent much of the decomposition of the original proto-paraffine and increase the yield of pyro-paraffine.

This study of Zaloziński's method and the examination of American oils was suggested by Professor Sadtler and carried out in his laboratory.

TRANSMISSION OF PRESSURE IN FLUIDS.

By ALBERT B. PORTER.

THE young student of physics occasionally has difficulty in grasping the laws of pressure in fluids. His every day experience has taught him that a push against a solid body causes it to push in the same direction, and he often receives with some doubt the statement that pressure applied to a fluid is transmitted equally in every direction. The experiments ordinarily shown in illustration of this principle prove that pressure is transmitted in all directions, but do not prove the equality of transmission, and in spite of all the text books may tell him, the student is apt to cling to the idea that a downward pressure applied to a liquid is more apt to burst the bottom than the side of the containing vessel.

The little piece of apparatus shown in Fig. 1 was

FIG. 1.

designed to furnish a clear demonstration of the principle under consideration. It is essentially an arrangement by which a downward pressure is applied to a confined mass of air or water, and the resultant pressures measured in the three directions, down, up, and sideways. By means of a broken rat tail file kept wet with turpentine three holes are bored through a bottle, one through the bottom, one through the side, and one through the shoulder, as near the neck as may be convenient. The operation is quick and easy, the only precaution to be observed being to work very slowly and use but a slight pressure when the glass is nearly perforated. The holes may be enlarged to any size required by careful filing with the wet file. From each of the holes a rubber tube leads to one of the glass manometer tubes at the right in the figure, the joints being made air tight by slipping into each rubber tube a piece of glass tubing about half an inch long in order to swell it to the size of the hole it is to fit. The ends of these glass tubes must be well rounded by partial fusion in a gas flame, that there may be no sharp edges to cut the rubber. The bottle rests in a depression in the turned wood base, the lower rubber tube passing out through a hole in the wood. Fig. 2 shows the shape of the manometer tubes. They are made of quarter inch glass tubing bent to shape in a flame and left open at both ends. They are mounted on a scale board which has several equidistant horizontal lines running across it. The two bent wires which support the scale board fit loosely in holes in it and in the base. This method of mounting is very handy, since it permits the scale board to be swung to right or left as may be convenient, or turned round so as to show the fittings on its back, without moving the bottle. The three manometers are filled to the same level with mercury, the quantity being adjusted by means of a pipette. A perforated rubber stopper, fitted with a glass tube on which is slipped a rubber syringe bulb, completes the apparatus.

When the bulb is pinched between the fingers, the mercury is forced up to the same height in each of the manometers, thus proving that the pressure is exerted equally in the three directions, up, down, and sideways. With the bottle filled with water the same effect follows, the law being the same for liquids and gases.

When using water in the apparatus it is essential that the rubber tubes, as well as the bottle, be filled, and when used in the class room it is better to show the experiment with water first, it being easier and quicker to empty the bottle and tubes than to fill them.

PEAR DUCHESSE D'ANGOULEME.

ALTHOUGH well known to fruit growers and generally represented in all parts of Britain, this noble French pear has not become a universal favorite. If the quality of the fruit, independently of its fine, handsome appearance, was bad, or even indifferent, it might be exterminated from our lists, but this we know is not the case, as any one who has tasted good samples grown in France, the Channel Islands, and upon favorable soils in this country will bear out the statement that the flavor is superb. Some fruits, we know, are quite incapable of being good, as they have no quality in them; but here we have one of the hardiest of trees, capable of giving us quantity as well as quality, provided we cultivate properly. Pears, no doubt, are capricious, like our seasons, but given a good average year, soils and stocks which suit them, a light, warm, airy aspect, and good culture, a great number of varieties formerly only good enough for stewing are now elevated, and most deservedly so, to the dessert table. But, assuming that some sorts known to be good do not reach their highest standard of excellence every year, they are infinitely superior to many of the old stewers, as they carry their own sugar, a quality which fits them for consumption by the most delicate invalids. Indeed, so prominently have choice dessert pears, and apples too for that matter, come to the front for cooking purposes, that a new demand is now established, and although Duchesse d'Angoulême, always juicy and sweet, from bad situations does not always come up to the fine quality met within Covent Garden in November, it is worthy of our skill, as we know it has all the good points of a first rate pear when properly ripened.

The original tree of this pear was observed by M. Anne Pierre Andusson, a nurseryman at Angers, growing in a farm garden near Champigne, in Anjou, and having procured grafts of it, he sold the trees, in 1812, under the name of Poire des Eparannais. In 1820, he sent a basket of the fruit to the Duchesse d'Angoulême, with a request to be permitted to name the pear in honor of her. The request was granted, and the pear has since borne its present name.

That such a fine pear, which does so well in France, would soon find its way to England there exists little doubt, as we find that within a few years it became established and well known throughout the United Kingdom. All the earliest trees would be worked upon the pear or free stock, and as root pruning until recently was but little practiced, we may reasonably suppose that the majority of them are deeply anchored in clay, marl, and other subsoils calculated to force a crude, gross growth from which high flavored fruit could not be expected. These defects under modern culture upon the quince and double grafting are giving way, as we find, on reference to the report of the committee of the pear conference, held at Chiswick in 1885, that twenty counties in England, also Scotland, Ireland, and Wales, contributed no less than 121 dishes to the tables, and thirty-eight growers voted in favor of the Duchesse being recognized as one of our standard dessert varieties. This step looks like progress, as it is a record of facts which cannot be gainsaid, and it now remains to be seen whether the English grower, whose indomitable will has brought him to the front in the subjugation of other fruits, will be successful with the fine Duchesse d'Angoulême. Although this remarkable pear cannot easily be mistaken, for the benefit of those who do not know it, the following description may not be out of place. Fruit large, often very large, 3½ inches wide and 3 inches to 4 inches high, roundish obovate, uneven, and bossed in its outline. Skin greenish yellow, changing to pale dull yellow, covered with veins and freckles of pale brown russet, and when grown against a south wall it acquires a brown cheek. Eye open, with erect dry segments, set in a deep irregular basin. Stalk 1 inch long, inserted in a deep irregular cavity. Flesh white, buttery, and melting, with a rich flavor when well ripened; otherwise rather coarse grained and gritty.

As to culture, experienced fruitists say the tree grows vigorously and well. It bears abundantly, and succeeds either on the pear or quince stock, forming handsome pyramids, but is better on the quince. Here, then, we have the key to the secret of success: The cordon on the quince; roots near the surface; loam, sound, sandy, and good; and good feeding. Aspect, a good wall facing south or west—the latter, perhaps, the best. Those who have not already done so, should try trees on the quince as pyramids and bushes, as this, like some other capricious pears, although the fruit be smaller, may put in better flavor than is met with in fruit from hot walls.—*The Garden.*

SUCCESSION OF FOREST GROWTHS.

THE following is from an address delivered by Mr. Robert Douglas before the Association of American Nurserymen at the meeting in Chicago recently.

It is the prevailing and almost universal belief that when native forests are destroyed they will be replaced by other kinds, for the simple reason that the soil has been impoverished of the constituents required for the growth of that particular tree or trees. This I believe to be one of the fallacies handed down from past ages, taken for granted, and never questioned. Nowhere does the English oak grow better than where it grew when William the Conqueror found it at the time he invaded Britain. Where do you find white pines growing better than in parts of New England where this tree has grown from time immemorial? Where can you find young redwoods growing more thriftily than among their giant ancestors, nearly or quite as old as the Christian era?

The question why the original growth is not reproduced can best be answered by some illustrations. When a pine forest is burned over, both trees and seeds are destroyed, and as the burned trees cannot sprout from the stump like oaks and many other trees, the land is left in a condition well suited for the germination of tree seeds, but there are no seeds to germinate. It is an open field for pioneers to enter, and the seeds