gressively subjected to temperatures ranging from 300° to 1,000° C. The retorts, which are wide but shallow, are inversely inclined so that the lower end of each retort communicates with the upper end of the retort below it. The vapors from the lower retort are then passed to a condenser.

Nikiforoff,[a] who has long been one of the most noted and brilliant workers in this field, has patented a process for benzene-toluene manufacture involving two-stage decomposition under varying conditions. The crude oil is fed into a series of decomposition retorts, the course of the liquid being obstructed by baffle plates so as to prolong the action of the heat. A temperature of 500° to 525° C. is maintained without pressure. The vapors pass through these retorts to a separating tank maintained at a temperature of 200° to 250° C., where the heavier products are condensed. The more volatile products (products boiling at less than 200° C.), which remain uncondensed at that temperature, are then conducted to a separate retort where they are subjected to a temperature of 900° to 1,000° C. and to a pressure of about 2 atmospheres (30 pounds per square inch).

In a later patent Nikiforoff[b] proposes to obtain aromatic hydrocarbons by the coking of naphtha in a metallic retort provided with troughs along which the naphtha flows, the hydrocarbon vapors given off below 200° C. to be used in carbureting water gas. Air is blown through heated coke or anthracite to obtain a generator gas. Superheated steam is blown into the generator gas to obtain a water gas. The water gas is then carbureted with the decomposition products of the naphtha. The heated water gas and hydrocarbon vapors are placed under a pressure of not less than 1 atmosphere (15 pounds per square inch.) The gas and vapors are passed through a washing apparatus, where the water and heavier hydrocarbons are collected, and the gas and vaporous hydrocarbons boiling under 200° C. pass on to a condenser, which separates the liquid aromatic products and allows the gas to pass on to a collector.

In 1897, Pamfilow[c] was granted a patent[d] for a process involving the passage of petroleum residues through a preheater into a vaporizer, and then into a coil of many turns and great length, where the vapors are exposed to gradually increasing temperatures. He claims the production of a tar, consisting almost exclusively of aromatic hydrocarbons, which upon distillation gives 15 per cent benzene, 1 per cent naphthalene, and 0.5 per cent anthracene on the basis of the original oil.

[a] Nikiforoff, Alexander, Russian Patent 290, Dec. 31, 1894; German Patent 85, Mar. 12, 1895; French Patent 315428, Oct. 29, 1901; English Patent 10957, Aug. 27, 1886; U. S. Patent 755309, Mar. 22, 1904.
[b] Nikiforoff, Alexander, English Patent 17450, July 30, 1907.
[c] Pamfilow, S. M., Gewinnung von Leuchtgas und aromatischen Kohlenwasserstoffen aus Erdöl: Chem. Ztg., Jahrg. 21, Bd. 2, 1897, p. 1069.
[d] Russian Patent 322, Sept. 13, 1897.

Zelinsky[a] and Ogloblin[b] report the obtaining of excellent results by Nikiforoff's process. The former, however, employed the method only on a small scale, treating several liters of petroleum a day. They report having been able to obtain a fraction boiling between 75° and 180° C., which represented 14.1 per cent of the original oil, and contained 58 per cent of benzene and 28 per cent of toluene.

Hausman and Pilat[c] proposed a process for producing aromatic hydrocarbons that involves the introduction of "naphtha hydrocarbons" in a vaporized form into heated tubes placed at a slight inclination in a long combustion furnace, such tubes being filled with any suitable catalytically active material, such as oxides of lead, manganese, etc. Air or superheated steam is forced into the tubes by means of a pump, so that the free hydrogen from the hydrocarbons and the oxygen from the air or steam may unite.

Holcgreber,[d] in a late patent, proposes to pass petroleum in the form of vapor, together with an excess of pure hydrogen, through pipes filled with suitable catalytic agents, such as iron, copper, nickel, or cobalt. The catalytic agents are used alone or mixed with an inert material such as asbestos. The tubes are kept at a temperature of 180° to 300° C.

Another recent patent along somewhat different lines is that granted to Starke[e] for the production of benzene and its homologues from petroleums, particularly Japanese and California petroleums. The petroleum distillate containing the benzene and its homologues is mixed with concentrated sulphuric acid, which is heated and agitated until the evolution of sulphur dioxide has ceased. The mass is then allowed to settle until the sulphonic acids have separated from the petroleum, and the benzene is then recovered by ordinary distillation.

Other processes of the same type as that last mentioned are those patented by the Disconto Gesellschaft[f] in Berlin and by Tammann.[g]

Testelin and Renard[h] and Meffert[i] propose to use a mixture of superheated steam and oil, which is then highly heated, to produce aromatic hydrocarbons. Testelin and Renard pass the mixture over a layer of red-hot clay, whereas Meffert heats the mixture in refractory retorts to a temperature of 1,200° to 1,400° C. Neither process employs pressure. In fact Testelin and Renard claim that the use of pressure is prejudicial.

[a] Zelinsky, N. D., Vortrag über die Darstellung aromatischer Kohlenwasserstoffe aus dem Erdöl (Preparation of aromatic hydrocarbons from petroleum): Chem. Ztg., Jahrg. 26, Bd. 1, 1902, p. 68; Jour. Soc. Chem. Ind., vol. 21, Feb 15, 1902, p. 166.
[b] Ogloblin, W. N., Die Darstellung von Benzol und seiner Homologen aus russischem Naphta nach Verfahren von A. N. Nikiforoff: Chem. Central-Blatt., Jahrg., 75 Bd. 2, 1904, p. 830.
[c] Hausman, Joachim, and Pilat, Stanislaus, German Patent 227178, April 1, 1909.
[d] Holcgreber, Jean, English Patent 17272, July 28, 1913.
[e] Starke, E. A, U. S. Patent 913780, Mar. 2, 1909. See also U. S. Patent 1109187, Sept. 1, 1914.
[f] Disconto-Gesellschaft in Berlin, German Patent 216459, May 23, 1908.
[g] Tammann, Gustav, German Patent 95579, Mar. 3, 1897.
[h] Testelin, Auguste, and Renard, Georges, German Patent 268176, Aug. 11, 1908.
[i] Meffert, Friedrich, German Patent 99254, Mar. 13, 1897.