in the Old Testament (Jer. ii. 22; Mal. iii. 2, &c.) refer to the ashes of plants and other such purifying agents (comp. vol. x. p. 697).

Soap appears to have been first made from goat’s tallow and beech ash; in the 13th century the manufacture was established at Marseilles from olive oil, and in England during the next century. The processes and extent of the manufacture were revolutionized at about the beginning of the 19th century by Chevreul's classical investigations on the fats and oils, and by Leblanc's process for the manufacture of caustic soda from common salt.

Previous to Chevreul's researches on the fats (1811-1823) it was believed that soap consisted simply of a binary compound of fat and alkali. Claude J. Geoffroy in 1741 pointed out that the fat or oil recovered from a soap solution by neutralization with a mineral acid differs from the original fatty substance by dissolving readily in alcohol, which is not the case with ordinary fats and oils. The significance of this observation was overlooked; and equally un­heeded was a not less important discovery by Scheele in 1783. In preparing lead plaster by boiling olive oil with oxide of lead and a little water—a process palpably analogous to that of the soap-boiler— he obtained a sweet substance which, called by himself “ Ölsüss ” (“ principium dulce oleorum ”), is now known as "glycerin.” These discoveries of Geoffroy and Scheele formed the basis of Chevreul's researches by which he established the constitution of oils and the true nature of soap. In the article Oils it is pointed out that all fatty oils and fats are mixtures of glycerides, that is, of bodies related to the alcohol glycerin C3H5(OH)3, and some fatty acid such as palmitic acid (C16H31O2)H. Under suitable conditions

C3H5(OH)3+3(Cl5H31O2)H give C3H5(C16H31O2)3+3H2O

Glycerin. Palmitic Acid. Palmitin. Water.

The corresponding decomposition of a glyceride into an acid and glycerin takes place when the glyceride is distilled in superheated steam, or by boiling in water mixed with a suitable proportion of caustic potash or soda. But in this case the fatty acid unites with the alkali into its potash or soda salt, forming a soap—

C3H5(Cl6H31O2)3+3NaOH=3NaC16H31O2+C3H5(OH)3

Palmitin. Caustic Soda. Soap. Glycerin.

Of the natural fats or glycerides contained in oils the most important in addition to palmitin are stearin and olein, and these it may be sufficient to regard as the' principal fatty bodies concerned in soap- making.

The general characters of a soap are a certain greasiness to the touch, ready solubility in water, with formation of viscid solutions which on agitation yield a tenacious froth or “ lather,” an indisposi­tion to crystallize, readiness to amalgamate with small proportions of hot water into homogeneous slimes, which on cooling set into jellies or more or less consistent pastes. Soaps give an alkaline reaction and have a decided acrid taste; in a pure condition—a state never reached in practice—they have neither smell nor colour. Almost without exception potash soaps, even if made from the solid fatty acids, are “ soft,” and soda soaps, although made with fluid olein, are “ hard ” ; but there are considerable variations according to the prevailing fatty acid in the compound. Almost all soda soaps are precipitated from their watery solutions by the addition of a sufficiency of common salt. Potash soap with the same reagent undergoes double decomposition—a proportion being changed into a soda soap with the formation of potassium chloride. Ammonia soaps have also been made, but with little commercial success; in 1906 H. Jackson patented the preparation of ammonium oleate directly in the washing water, and it is claimed that for cleansing articles it is only necessary to immerse them in the water containing the pre­paration and then rinse.

Soap when dissolved in a large amount of water suffers hydrolysis, with formation of a precipitate of acid salt and a solution con­taining free alkali. The reaction, however, is very complicated. Chevreul found that a neutral salt soap hydrolysed to an acid salt, free alkali, and a small amount of fatty acid. Rotondi in 1885, however, regarded a neutral soap as hydrolysing to a basic salt, soluble in both hot and cold water, and an acid salt, insoluble in cold and sparingly soluble in hot. Chevreul's views were confirmed in 1894 by Krafft and Stern. The extent to which a soap is hydrolysed depends upon the acid and on the concentration of the solution ; it is also affected by the presence of metallic salts, *e.g. of* calcium and magnesium. As to the detergent action of a soap, Berzelius held that it was due to the free alkali liberated with water; but it is difficult to see why a solution which has just thrown off most of its fatty acids should be disposed to take up even a glyceride, and, moreover, on this theory, weak cold solutions, in which the hydrolysis is consider­able, should be the best cleansers, whilst experience points to the use of hot concentrated solutions. It is more likely that the cleansing power of soap is due to the inherent property of its solution to emulsionize fats. This view is supported by Hillyer *(Jour. Amer. Chem. Soc.,* 1903, p. 524), who concluded that the cleansing power depended upon several factors, viz. the emulsionizing power, the property of penetrating oily fabrics, and lubricating impurities so that they can be readily washed away.

Resin soaps are compounds of soda or potash with the complex acids (chiefly abietic) of which coniferous resins consist. Their formation is not due to a true process of saponification; but they occupy an important place in compound soaps.

*Manufacture.—*Numerous varieties of soaps are made; the purposes to which they are applied are varied; the materials employed embrace a considerable range of oils, fats and other bodies; and the processes adopted undergo many modifications. As regards processes of manufacture soaps may be made by the direct combination of fatty acids, separated from oils, with alkaline solutions. In the manufacture of stearin for candles, &c., the fatty matter is decomposed, and the liquid olein, separated from the solid fatty acids, is employed as an ingredient in soap-making. A soap so made is not the result of saponification but of a simple combination, as is the case also with resin soaps. All other soaps result from the combination of fatty oils and fat with potash or soda solutions under conditions which favour saponification. The soap solution which results from the combination forms soap-size and is a mixture of soap with water, the excess alkali, and the glycerin liberated from the oil. In such condition ordinary soft soaps and certain kinds of hard soap are brought to the market. In curd soaps, however, which form the basis of most household soap, the uncombined alkali and the glycerin are separated by “ salting out," and the soap in this condition contains about 30% of water. Soap may be framed and finished in this state, but almost invariably it receives a further treatment called “ refining ” or “ fitting,” in which by remelting with water, with or without the subsequent addition of other agents to harden the finished product, the soap may be made to contain from 60 to 70 % of water and kept present a firm hard texture.

Almost any fatty substance can be employed in soap-making; but the choice is naturally restricted by the price of the fat and also the quality of the soap desired. The most important of the animal fats are those of the ox and hog, and of the vegetable oils cotton-seed and coco-nut; it is also to be remembered that resin, although not a fat, is also important in soap-making. Ox and sheep tallow, with the addition of resin, are the primary materials for making the hard yellow or primrose soaps; these tallows are often adulterated. The cheaper mottled and brown soaps have for their basis bone fat, ob­tained by treating bones with superheated steam or other methods. Lard yields lard oil, which is mainly applied in making hard toilet soaps. Curd soap and London grey mottled are prepared from kitchen or ship fat, whilst fuller’s fat is employed in the manufacture of soft soaps. Of the vegetable oils, in addition to cotton-seed and coco-nut, olive oil is the basis of soaps for calico printers and silk dyers; castor oil yields transparent soaps (under suitable treatment), whilst crude palm oil, with bone fat, is employed for making brown soap, and after bleaching it yields ordinary pale or mottled. The alkalis are used almost exclusively in the condition of caustic lyes— solutions of their respective hydrates in water. Caustic soda is now obtained direct from the soda manufacturer, and one operation, causticizing the soda, is thus spared the soap-boiler. Potash lyes also may be bought direct, but in some cases they are sharpened or causticized by the soap-boiler himself from the carbonate.

The processes of soap manufacture may be classified (a) according to the temperatures employed into (1) cold processes and (2) boiling processes, or (b) according to the nature of the starting material— acid or oil and fat—and the relative amount of alkali, into (1) direct saturation of the fatty acid with alkali, (2) treating the fat with adefinite amount of alkali with no removal of unused lye, (3) treating the fat with an indefinite amount of alkali, also with no separation of unused lye, (4) treating the fat with an indefinite amount of alkali with separation of waste lye. In the second classification (2) is typical of the “ cold ” process, whilst (1), (3), (4) are effected by the “ boiling ” process.

The cold process, which is only applicable to the manufacture of soaps from readily saponifiable oils, such as those of the coco-nut oil group and also from castor oil, is but little used. In it the oils at 35° C. are stirred with concentrated alkali in an iron or wooden tub, whereupon saponification ensues with a development of some heat; the mixture being well agitated. After a few hours the mixture becomes solid, and finally transparent; at this point the perfume is added, and the product framed and crutched (see under *Marine Soap).* By blending the coco-nut oil with other less saponifiable substances such as tallow, lard, cotton-sced oil, &c., and effecting the mixing and saponification at a slightly higher temperature, soaps are obtained which resemble milled toilet soaps. . Soaps made by this process contain the glycerin originally present in the oil, but, in view