not the result of saponification hut of a simple combination, as is the case also with resin soaps. All other soaps result from the com­bination of fatty oils and fats 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 per cent, 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 per cent. of water and yet present a firm hard texture.

Among the raw materials used by the soap-boiler the principal fatty bodies are tallow, lard, palm oil, palm-kernel oil, olive oil, cotton-seed oil, sesame oil, and cocoa-nut oil for hard soaps, and fish oils, linseed oil, marrow fat, and the lower qualities of other oils obtained by extraction, &c., for potash or soft soaps. Almond oil, spermaceti, cocoa-butter, ground-nut oil, and some others form the basis of certain toilet and medicinal soaps. Resin and colophony form essential ingredients in yellow soaps. 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 are, however, principally sharpened or causticized by the soap-boiler himself from potash carbonate, the process for which is described under Potassium Metals (vol. xix. p. 589).

The process of soap-boiling is carried out in large iron boilers called “soap pans” or “coppers,” some of which have capacity for a charge of 30 tons or more. The pan proper is surmounted by a great cone or hopper called a curb, to provide for the foaming up of the boiling mass and to prevent loss from overflowing. Formerly the pans were heated by open firing from below ; but now the almost universal practice is to boil by steam injected from per­forated pipes coiled within the pan, such injection favouring the uniform heating of the mass and causing an agitation favourable to the ultimate mixture and saponification of the materials. Direct firing is used for the second boiling of the soap mixture ; but for this superheated steam may with advantage be substituted, either applied by a steam-jacket round the pan or by a closed coil of pipe within it. In large pans a mechanical stirring apparatus is pro­vided, which in some cases, as in Morfit’s steam “ twirl,” is formed of the steam-heating tubes geared to rotate. Closed cylinders in which the materials are boiled under pressure are also employed for certain soaps.

*Curd Soap.—*The oil mixture used differs in the several manu­facturing countries, and the commercial name of the product is correspondingly varied. In Germany tallow is the principal fat ; in France olive oil occupies the chief place and the product is known as Marseilles or Castile soap ; and in England tallow and palm oil are largely used. But in all countries a mixture of several oils enters into the composition of curd soaps and the proportions used have no fixity. For each ton of soap to be made from 12 to 16 cwts. of oil is required. The soap pan is charged with the tallow or other fat, and open steam is turned on. So soon as the tallow is melted a quantity of weak lye is added, and the agitation of the injected steam causes the fat and lye to become intimately mixed and pro­duces a milky emulsion. As the lye becomes absorbed, a condition indicated by the taste of the goods, additional quantities of lye of increasing strength are added. After some time, the contents of the pan begin to clear and become in the end very transparent. Lye still continues to be poured in till a sample tastes distinctly alkaline,—a test which indicates that the whole of the fatty acids have been taken up by and combined with the alkali. Then with­out further addition of alkali the boiling is continued for a few minutes, when the soap is ready for salting out or “graining.” Either common salt or strong brine in measured quantity is added to the charge, and, the soap being insoluble in such salt solution, a separation of constituents takes place : the soap collects on the surface in an open granular condition, and the spent lye sinks to the bottom after it has been left for a short time to settle. Suppos­ing now that a pure soap without resin is to be made—a product little seen in the market—the spent lye is run off, steam is again turned on, pure water or very weak lye run in, and the contents boiled up till the whole is thin, close, and clear. The soap is from this again grained off or salted out, and the underlye so thrown down carries with it coloured impurities which may have been in the materials or which arise from contact with the boiler. Such washing process may have to be repeated several times when im­pure materials have been used. The spent lye of the washing being drained off, the soap now receives its strengthening boil. Steam is turned on, and, the mass being brought to a clear condition with

weak lye or water, strong lye is added and the boiling continued with close steam till the lye attains such a state of concentration that the soap is no longer soluble in it, and it will separate from the caustic lye as from a common salt solution. The contents of the pan are once more allowed to cool and settle, and the soap as now formed constitutes a pure curd soap, carrying with it some pro­portion of uncombined alkali, but containing the minimum amount of water. It may be skimmed off the underlye and placed direct in the frames for solidification ; but that is a practice scarcely at all followed, the addition of resin soap in the pan and the sub­sequent “crutching in” of silicate of soda and adulterant mixings being features common to the manufacture. The lye from the strengthening boil contains much alkali and is used in connexion with other boilings.

*Mottled Soap.—*A pure curd soap always carries with it into the cooling frame a considerable amount of coloured impurity, such as iron sulphate, &c. When it is permitted to cool rapidly the colouring matter remains uniformly disseminated throughout the mass ; but when means are taken to cause the soap to cool and solidify slowly a segregation takes place : the stearate and palmitate form a semi - crystalline solid, while the oleate, solidifying more slowly, comes by itself into translucent veins, in which the greater part of the coloured matter is drawn. In this way mottled or marbled soap is formed, and such mottled appearance was formerly highly valued as an indication of freedom from excess of water or other adulteration, because in fitted soaps the impurities are either washed out or fall to the bottom of the mass in cooling. Now, however, the most perfect mottle can be produced by working colouring matter into the soap in the frame, and mottling is very far from being a certificate of excellence of quality.

*Yellow Soap* consists of a mixture of any hard fatty soap with a variable proportion—up to 40 per cent. or more—of resin soap. That substance by itself has a tenacious gluey consistence, and its intermixture in excess renders the resulting compound soft and greasy. The ordinary method of adding resin consists in stirring it in small fragments into the fatty soap in the stage of clear- boiling ; but a better result is obtained by separately preparing a fatty soap and the resin soap, and combining the two in the pan after the underlye has been salted out and removed from the fatty soap. The compound then receives its strengthening boil, after which it is fitted by boiling with added water or weak lye, continu­ing the boil till by examination of a sample the proper consistency has been reached. On settling a dark-coloured “nigger” or under­lye separates out, which, because it contains some soap and alkali, is saved for future use.

*Marine Soap.—*Cocoa-nut oil behaves as regards saponification quite differently from all other oils and fats in relation to the caustic alkalis. It does not form an emulsion with weak alkalis ; these even under prolonged boiling have no influence on the fat. With strong alkaline solutions, on the other hand, it saponifies with the utmost readiness even without heat, and forms without the separation of any underlye a soap of stiff firm consistence notwith­standing the presence of a very large percentage of water. Such soap is not insoluble in a strong solution of salt ; hence it forms a lather and can be used for washing with sea-water, from which peculiarity it derives its name “ marine soap. ” Being thus soluble in salt water it cannot of course be salted out like common soaps ; but if a very concentrated salt solution is used precipitation is effected, and a curd soap is separated so hard and refractory as to be practically useless. Cocoa-nut soap is usually prepared by the so-called cold method, in which the fat heated to 80° C. is treated with a calculated quantity of caustic soda solution of sp. gr. 1∙350, the two constituents being stirred together till the setting and hardening of the combination prevents further agitation. The property that cocoa-nut soap possesses of absorbing large propor­tions of water, and yet presenting the appearance of a hard solid body, makes the material a favourite basis for highly sophisticated compounds, in which water, sulphate of soda, and other alkaline solutions, soluble silicates, fuller’s earth, starch, &c., play an im­portant and bulky part. Cocoa-nut soap is little prepared by itself ; but it forms a principal ingredient in compound soaps meant to imitate curd and yellow soaps. Two principal methods of prepar­ing such compound soaps are employed. In the first way the ordinary oil and the cocoa-nut oil are mixed and saponified together with such a measured quantity of alkaline solution as serves to produce a hard soap without any salting out or separation of under­lye. According to the second plan, the ordinary oil is treated as for the preparation of a curd soap, and to this the cocoa-nut soap separately saponified is added in the pan and both are boiled to­gether till they form a homogeneous soap.

*Silicate Soaps.—*A further means of enabling a soap to contain large proportions of water and yet present a firm consistence is found in the use of silicate of soda. The silicate in the form of a concentrated solution is crutched or stirred into the soap in a mechanical mixing machine after the completion of the saponifica­tion, and it appears to enter into a distinct chemical combination with the soap. While silicate soaps bear heavy watering, the