removing the cool burnt lime from the front of each section, whilst another gang is stacking the limestone at the back of each section. Like the brick kiln of this type, the sequence of operations is advanced by a chamber each day, and thus, as there are two sections, the equivalent to two chambers is being unloaded and two loaded daily. The limestone is stacked, with horizontal flues parallel to the length of the kiln formed at the base, and vertical flues formed under the feed-holes provided at the top. Coal slack is the fuel used, and this is fed to the lime which is being subjected to the maximum temperature. The wickets to the drying and burning chambers are sealed with half-brick thick walls daubed over with grouted lime, and the face of the last stacked chamber in each section is covered with brown paper to exclude draught from the open wickets in front. Lightly burnt lime suitable for building purposes (mortars and plasters) is obtained at normal temperatures of 1,100° to 1,200° C. in the firing chambers, but proximity to the flues and longer heating periods produce a proportion of more solidly burnt lime suitable for the preparation of caustic soda. Whilst unloading the burnt lime, it is hand-picked, selected and graded, the lightly burnt being white in colour and the hard-fired or overburnt being dark coloured.

Slaking, Setting and Hardening of Lime.—Pure limestone or chalk is composed of carbonate of lime ($CaCO_3$). When this is heated in a kiln it yields calcium oxide (CaO) or *quicklime* and carbon dioxide (CO_2) which is driven off.

When the quicklime is *slaked* by the addition of water heat is evolved, and the lime expands and falls to powder. If just sufficient water is added to accomplish this action, the powder is dry and is called *hydrated lime* (see p. 21). This slaked or hydrated lime is calcium hydroxide ($Ca(OH)_2$), the action of slaking being expressed by the equation $CaO + H_2O = Ca(OH)_2$. If more water is added to the slaked lime it does not chemically combine with the lime but reduces it to a paste known as *lime putty*.

On lime putty being exposed to the atmosphere, it begins to set and gradually hardens to form carbonate of lime as the water evaporates and carbon dioxide is absorbed from the air. *This is known as "carbonation," and is an important property, as the hardness of certain lime mortars is dependent upon it.* The chemical action which takes place on carbonation is represented by the equation $Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$ (which is evaporated).

The slaking of hydraulic limes is referred to in the next column.

Classification.—The composition of various limestones differs considerably, and thus there are a number of different kinds of limes each having characteristic properties which influence the purposes for which they are used. This is one of several classifications[1] of lime: (1) Pure, Fat, White or Rich; (2) Lean, Poor, Grey Chalk or Stone; (3) Hydraulic or Blue Lias; and (4) Magnesian. The schedule at the top of next column shows an approximate analysis of a typical specimen of each of these varieties.

	Pure.	Lean.	Hydraulic.	Magnesian.
Calcium oxide (CaO)	93·0	82·0	67·0	57·22
Magnesium oxide (MgO)	0·4	0·6	1·0	38·38
Silica (SiO_2)	1·0	6·0	17·5	2·19
Alumina (Al_2O_3) }	0·6	3·7	7·0	0·69
Iron oxide (Fe_2O_3) }		1·7	2·5	0·68
Carbon dioxide, water, etc.	5·0	6·0	5·0	0·84
	100·0	100·0	100·0	100·00

1. *Pure, Fat, White or Rich Lime* contains less than 5 per cent. of impurities such as silica and alumina (in the form of clay). In the analysis the specimen is shown consisting almost entirely of calcium oxide. It slakes rapidly, evolves much heat, and expands from two or three times its original bulk during the process, has a high degree of plasticity (hence the name "fat"), is slow setting and very slow in hardening. This stiffening up can only occur when the lime is in contact with the air (see preceding column). Whilst pure lime, which is white in colour, is extensively used for plastering, it is not so suitable for lime mortar on account of its slow-hardening characteristic and lack of strength (unless gauged with cement, see p. 27).

2. *Lean, Poor, Grey Chalk or Stone Lime* contains more than 5 per cent. of clayey impurities and is therefore less pure than fat lime. In the above analysis the impurities of silica, alumina and iron oxide amount to over 11 per cent. The characteristics are somewhat similar to those of fat lime, but on account of its impurities it slakes less rapidly (resulting in a diminution of heat and volume) and its iron content is responsible for its grey colour. Like fat lime, it sets and hardens slowly. It is used for both plaster and lime mortar.

3. *Hydraulic or Blue Lias Lime.*—This class of lime is capable of setting and hardening when not in contact with air and even if submerged in water, hence the name. Hydraulic lime is therefore unlike both pure and lean limes which, as already stated, will only stiffen when the water is evaporated from the putty and carbonation takes place as the CO_2 is absorbed from the air.

Limestones from which hydraulic limes are prepared contain varying proportions of silica and alumina (in the form of clay), in addition to the calcium oxide (see analysis). The clay and iron oxide play an important part in the setting and hardening of such limes. Quicklime is formed when the carbon dioxide is driven off the calcium carbonate as the limestone is burnt in the kiln. This quicklime, having a strong affinity for the clay, combines with it to form silicates and aluminates of lime.

Slaking.—If water is added to this burnt product after it has been finely ground the mass begins to set and harden as the water combines with the various products. As this action is not dependent upon the presence of carbon dioxide the hardening will continue even when air is absent. The setting and hardening are therefore similar to the behaviour of Portland cement, the composition of which it closely resembles—compare the above analysis of hydraulic lime with that of Portland cement on p. 23.

These limes have been subdivided into (*a*) feebly hydraulic, (*b*) moderately

[1] The latest classification appears in the British Standard Specification for Building Limes, No. 890—1940, which divides quicklime into two classes, *i.e.*, Class A—Lime for plastering finishing coat, coarse stuff and building mortar, and Class B—Lime for coarse stuff and building mortar only. It gives particulars of several tests.