

## 11.

### Calcareous Earth Calcareous earth for the English, Kalkerde for the Germans Carbonate of Lime in the new nomenclature

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Calcareous earth is, with the argillaceous and quartzose, the most widely distributed over the surface of our globe. In this respect, it even rivals argillaceous earth, having been formed, as we shall see in the different parts of this catalogue dealing with its various divisions, at several different periods and also by different natural procedures. It is seen forming great mountain chains back to back with primitive ones or piled on them; making up other more recently formed mountain chains which cross our plains and deep valleys; and finally forming strata of varying thickness on which the soil of these valleys rests, which are separated by strata of argillaceous or sandy substances varying in significance and number.

In spite of this great abundance of calcareous earth, with the exception of some completely colourless spars, it is usually seen mixed to a greater or lesser extent with some of the other earths in the stones and rocks which form an essential part of it. Mr Bergman, consequently, outlines a procedure to obtain it in the pure state, without any other substance mixed with it: it consists of reducing chalk to very fine powder; of boiling it several times in distilled water; then dissolving it in distilled vinegar and precipitating it out by volatile aerated alkali.

Pure calcareous earth is whitish, opaque and infusible with no definite taste; however, Mr Fouroroy

has observed that when it has remained for some time in the mouth, it has an astringent quality which slightly contracts the fibres of the palate and the tongue. It is soluble and effervescent in all acids, which form new compounds with its base while releasing carbonic acid with which the base was combined and which can then be collected. According to Bergman this acid accounts for 34 pounds per  $\times$ quintal $\times$  in the weight of calcareous earth. Its specific gravity is 27,200.

It is, therefore, quite certain that calcareous earth is not a simple earth but a combination of a simple earth with carbonic acid. According to the rule accepted by chemistry, this earth, free from all kind of combined material, is lime such as we usually obtain by the calcination of calcareous stone, since it is by an analogous operation that this earth is obtained.

In this state, this earth, which has retained the name of lime, is white, opaque and infusible; it has a burning taste and exercises a corrosive action on all animal substances. It turns violet syrup green. It is soluble in water requiring, at the temperature of 60° between 6 to 700 times its weight in water. It is dissolved by and is combined with all acids, but the dissolving is slow and there is no effervescence with it. Placed in water, it is penetrated by this liquid with great force accompanied by a loud humming, which frees much heated matter from it. This abundance in the released heated matter is such that when one

$\times$ quintal = 100 kg

stops it being absorbed by water, merely by plunging a piece of lime in this fluid and taking it out instantly, a wisp of straw, placed in the fissures which form with crackling on this piece, is burnt and completely changed into carbon. Mr Pelletier has even observed that in darkness the release of heated matter is made visible by a fiery glimmer. Its specific gravity, according to Kirwan, is 23,000.

This earth seems to have a particular tendency to combine with carbonic acid. If one exposes to the open air for any length of time the clear solution of lime in water, known as lime-water, the union that takes place with it and carbonic acid, which is disseminated in the air, disturbs this water, turns it whitish and a white skin forms on its surface which is none other than a calcareous spar, or the combination in the crystalline state of this earth with carbonic acid. As this skin, which is known as lime-cream, is lifted off it reappears in proportion to the parts of lime dissolved in water.

I believe I must conclude with all the chemists that from the characteristics shown by lime which we have just seen, this substance differs considerably from calcareous earth and that the latter is brought to this state by calcinations. But I do not think, as they do, that lime is the base of calcareous earth, and still less that it is a pure and simple earth, In this substance, I see merely a combination of basic earth different from calcareous earth, a combination which seems to me to be due for the greater part, if not completely, to heated matter itself

The solubility of lime in water would alone be enough to consider it as not being pure, but already the result of a combined earth: and then, its strong taste and its causticity, it seems to me, give more weight still to this way of considering it.

The great affinity that the basic earth of calcareous earth has with acids and principally with carbonic acid, means that it is never found pure in nature. It never leaves this last acid except to combine with others; and limestone gives only a calcareous earth analogous to the stone itself, far from producing, through its decomposition, a simple earth as does with clay the stones of which it consists in the number of their constituent parts; and so the decomposition of the limestones is only a disintegration and not a true decomposition.

In my opinion, by the violent action of calcination, the freeing of this earth from the carbonic acid with which it is combined comes about; but at the same time a new union is brought about with the heated matter which gives it new properties, particularly a corrosive one.

The great tendency of this earth to combination, a tendency which, as I have just said, means that we never find it pure in nature, ought, when it has been obtained artificially, to cause it to keep this state for a very short time and to return very promptly to the state of calcareous earth. But this is so only when this earth is very broken up and even dissolved and is introduced to the carbonic acid in the simple molecular state

as exists in its dissolution named lime-water. In any other state, it indeed does pass back to the state of calcareous earth, but it is by a slow operation and such as always occurs at the time of the natural decomposition of a compound by the introduction of a new principle which frees one of those parts which formed the compound.

However, the large quantity of heated matter which is freed from the lime when it is moistened does not entirely belong, I think, to the matter in the compound, but comes from a latent heat which envelopes each of the lime molecules and is retained in this way only through its affinity with the heated matter in the compound. The water, which is poured over this lime, having a great affinity with the heated matter, combines with it, breaks its bonds and while a part combines to form an aqueous gas, the other is freed in its pure state. It is this last which burns and carbonises the wisps of straw placed in the interstices of the piece of lime, while the combined part in the state of aqueous gas appears in the guise of a vapour.

This same operation takes place, but much more slowly, just through the humidity of the air, and then the lime breaks up to a great extent and passes to a powdery state to which has been given the name slaked lime. Through this operation a part of the earth, the lime base, has combined with carbonic acid, which it has extracted from the air and has changed to calcareous earth. But lime does not lose all the heated matter at the same time as combining with carbonic acid; if one examines it at the point when it is passed to this powdery state, although it causes effervescence with the acids because of the parts which are in

the state of calcareous earth, it still keeps a major part of its causticity and can still make alkalis caustic.

It is to this property of the basic earth of lime to change gradually into the state of calcareous earth by uniting with carbonic acid, as it loses the combined heated matter, and even sometimes to crystallise haphazardly by that combination - it is to this property that is owed the great hardness of walls constructed of good quality lime or of which the limestone with which it has been made did not contain a considerable quantity of foreign earths or substances. The sand that they mix with it results only in a fault of compatibility, which contributes to the introduction of carbonic acid and its compound.

Lime which has changed to calcareous earth has increased in weight from 45 pounds to the quintal because it admits into the compound which causes it to pass to this state, 11 pounds of water in addition to the 34 pounds of carbonic acid.

Limestone, therefore, seems to me to be a compound of carbonic acid and water with a special earth whose nature we do not yet know; and lime cannot be this simple earth but is a compound of the same unknown earth and a substance which for many reasons we have to think is heated matter.

There certainly exist, as I have said at the beginning of this article, several different periods in the formation of limestone; and one of them having preceded by a long way that of the others and even beginning to appear towards the end of the formation of the primitive rocks is

known under the name of primitive limestone. Many authors, naturalist and chemical, consider this limestone to be of absolutely primitive formation and consequently, contemporaneous with the argillaceous and quartzose earths, which we have said existed alone in the truly primitive rocks, the first-formed granite.

I am of an absolutely different opinion and will deduce the reasons that can be easily foreseen in the article in this catalogue in which I shall describe the pieces belonging to the correctly called limestone.

Respect for the old names and the great inconvenience that the new ones nearly always bring with them in a science, make me keep the name of lime which was given to the basic earth of calcareous earth. I shall merely observe that by this name I do not mean to express a nature like that of lime as it is produced by the calcination of limestone, but the still unknown earth which serves as a base for this lime as for limestone.

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