

what is commonly used as whitewash. The addition of one pound of alum to every five gallons of whitewash, will greatly improve the composition, and it will remain in the pellicle of lime which covers every straw, so as never to be washed out by the rain. I have poured a bucket of whitewash over a heap of dry furze, then kept it in the July sun until as dry as possible, and then (let any man try it) it will not burn, even aided by ten pair of bellows.

When any building is being thatched, what more easy and cheap than to keep paying the straw with such whitewash? It will also prevent corruption, and cause the thatch to last incomparably longer than that of clean straw. Of course, the solution of lime should have the addition of a little size. The lime, size, and alum will form a crust insoluble in water, protecting each straw to which it adheres. Of course, the straw next the house must be protected as well as the exterior.

I wonder how any family can sleep quietly under a roof that may be set in a blaze by a spark from a chimney, or from a pipe, or a cigar, or a flash of lightning! We almost daily hear of people being burnt out of their cottages in Ireland, by the thatch being ignited. I hope your readers will think of this preservative, try it, and promulgate its importance. I have the honour to be, Sir, your obedient servant,

FRANCIS MACERONI.

Ibid.

Progress of Physical Science.

On the Formation of Mould, by CHARLES DARWIN, Esq., F. G. S.

The author commenced by remarking on two of the most striking characters by which the superficial layer of earth, or, as it is commonly called, vegetable mould, is distinguished. These are its nearly homogeneous nature, although overlying different kinds of subsoil, and the uniform fineness of its particles. The latter fact may be well observed in any gravelly country, where, although in a ploughed field, a large proportion of the soil consists of small stones, yet in old pasture-land not a single pebble will be found within some inches of the surface. The author's attention was called to this subject by Mr. Wedgwood, of Maer Hall, in Staffordshire, who showed him several fields, some of which, a few years before, had been covered with lime, and others with burnt marl and cinders. These substances, in every case, are now buried to the depth of some inches beneath the turf. Three fields were examined with care. The first consisted of good pasture land, which had been limed, without having been ploughed, about twelve years and a half before: the turf was about half an inch thick; and two inches and a half beneath it was a layer, or row, of small aggregated lumps of the lime forming, at an equal depth, a well-marked white line. The soil beneath this was of a gravelly nature, and differed very considerably from the mould nearer the surface. About three years since cinders were likewise spread on this field. These are now buried at the depth of one inch, forming a line of black spots parallel to, and above, the white layer of lime. Some other cinders, which had been scattered in another part of the same field, were either still lying on the surface, or entangled in the roots of the grass. The second field examined was remarkable only from the cinders being now buried in a layer, nearly an inch thick,

three inches beneath the surface. This layer was in parts so continuous, that the superficial mould was only attached to the subsoil of red clay by the longer roots of the grass.

The history of the third field is more complete. Previously to fifteen years since it was waste land; but at that time it was drained, harrowed, ploughed, and well covered with burnt marl and cinders. It has not since been disturbed, and now supports a tolerably good pasture. The section here was. turf half an inch, mould two inches and a half, a layer one and a half inch thick, composed of fragments of burnt marl (conspicuous from their bright red colour, and some of considerable size, namely, one inch, by a half broad, and a quarter thick,) of cinders, and a few quartz pebbles mingled with earth; lastly, about four inches and a half beneath the surface was the original, black, peaty soil. Thus beneath a layer (nearly four inches thick) of fine particles of earth, mixed with some vegetable matter, those substances now occurred, which, fifteen years before, had been spread on the surface. Mr. Darwin stated that the appearance in all cases was as if the fragments had, as the farmers believe, worked themselves down. It does not, however, appear at all possible, that either the powdered lime or the fragments of burnt marl and the pebbles could sink through compact earth to some inches beneath the surface and still remain in a continuous layer. Nor is it probable that the decay of the grass, although adding to the surface some of the constituent parts of the mould, should separate, in so short a time, the fine from the coarse earth, and accumulate the former on those objects which so lately were strewed on the surface. Mr. Darwin also remarked, that near towns, in fields which did not appear to have been ploughed, he had often been surprised by finding pieces of pottery and bones some inches below the turf. In a similar manner on the mountains of Chili he had been perplexed by noticing elevated marine shells, covered by earth, in situations where rain could not have washed it on them.

The explanation of these circumstances, which occurred to Mr. Wedgwood, although it may, at first, appear trivial, the author did not doubt is the correct one, namely, that the whole is due to the digestive process, by which the common earth-worm is supported. On carefully examining between the blades of grass in the fields above described, the author found, that there was scarcely a space of two inches square without a little heap of the cylindrical castings of worms. It is well known that worms swallow earthy matter, and that having separated the serviceable portion, they eject at the mouth of their burrows, the remainder in little intestine-shaped heaps. The worm is unable to swallow coarse particles, and as it would naturally avoid pure lime, the fine earth lying beneath either the cinders and burnt marl, or the powdered lime, would, by a slow process, be removed, and thrown up to the surface. This supposition is not imaginary, for in the field in which cinders had been spread out only half a year before, Mr. Darwin actually saw the castings of the worms heaped on the smaller fragments. Nor is the agency so trivial as it, at first, might be thought; the great number of earth-worms (as every one must be aware, who has ever dug in a grass-field) making up for the insignificant quantity of work each performs.

On the above hypothesis, the great advantage of old pasture land, which farmers are always particularly averse from breaking up, is ex-

plained; for the worms must require a considerable length of time to prepare a thick stratum of mould, by thoroughly mingling the original constituent parts of the soil, as well as the manures added by man. In the peaty field, in fifteen years, about three inches and a half had been well digested. It is probable, however, that the process is continued, though at a slow rate, to a much greater depth; for as often as a worm is compelled by dry weather, or any other cause, to descend deep, it must bring to the surface, when it empties the contents of its body, a few particles of earth. The author observed, that the digestive process of animals is a geological power which acts in another sphere on a greater scale. In recent coral formations, the quantity of stone converted into the most impalpable mud, by the excavations of boring shells and of nereidoid animals, is very great. Numerous large fishes (of the genus *Sparus*) likewise subsist by browsing on the living branches of coral. Mr. Darwin believes, that a large portion of the chalk of Europe was produced from coral, by the digestive action of marine animals, in the same manner as mould has been prepared by the earth-worm on disintegrated rock. The author concluded by remarking, that it is probable that every particle of earth in old pasture land has passed through the intestines of worms, and hence, that in some senses, the term "animal mould" would be more appropriate than "vegetable mould." The agriculturist in ploughing the ground follows a method strictly natural; and he only imitates in a rude manner, without being able either to bury the pebbles or to sift the fine from the coarse soil, the work which nature is daily performing by the agency of the earth-worm.*

Lond. & Edin. Philos. Mag.

Report to the Royal Geographical Society, of an expedition in the interior of Africa.

A very full meeting of members was held on Monday evening, for the purpose of hearing the report of Captain Alexander, of his late expedition in the interior of Central Africa, directed towards the north-west coast, and the Damhara country. This expedition, originating with the society, by whom the expenses were paid, with the assistance of a grant from government, was delayed some time, till the termination of the Caffre war; but in September, 1836, Captain Alexander started on his journey, from which he returned home to the Cape on the 20th

* Since the paper was read, Mr. Darwin has received from Staffordshire the two following statements:—1. In the spring of 1835 a boggy field was so thickly covered with sand that the surface appeared of a red colour; but the sand is now overlaid by three-quarters of an inch of soil. 2. About eighty years ago a field was manured with marl; and it has been since ploughed, but it is not known at what exact period. An imperfect layer of the marl now exists at a depth, very carefully measured from the surface, of twelve inches in some places, and fourteen in others, the difference corresponding to the top and hollows of the ridges or butts. It is certain that the marl was buried before the field was ploughed, because the fragments are not scattered through the soil, but constitute a layer, which is horizontal, and therefore not parallel to the undulations of the ploughed surface. No plough, moreover, could reach the marl in its present position, as the furrows in this neighbourhood are never more than eight inches in depth. In the above paper it is shown, that three inches and a half of mould had been accumulated in fifteen years; and in this case, within eighty years (that is, on the supposition, rendered probable from the agricultural state of this part of the country, that the field had never before been marled) the earthworms have covered the marl with a bed of earth averaging thirteen inches in thickness.

JOURNAL
OF THE
FRANKLIN INSTITUTE
OF THE
State of Pennsylvania,
AND
MECHANICS' REGISTER.

MAY, 1838.



Practical and Theoretical Mechanics and Chemistry.

Extracts from "Researches as to Lime-burning. By M. PETOT, Engineer of Roads and Bridges. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

ARTICLE XVII.—*On the preparation of Factitious Puzzolanas, and particularly of that afforded by Gneiss Sand.*

§1. *On different kinds of Puzzolana.*

The important part that puzzolanas play in the improvement of hydraulic mortars, sufficiently explains the interest that belongs to an examination of this subject. As yet we know of no other means of forming mortars susceptible of hardening in water: and even since hydraulic limes have become the subject of particular study, that of puzzolanas has not been the less attended to, because hydraulic limes are not to be found in every locality, nor is it always possible, or economical, to manufacture them; and because in many circumstances they give mediocre results only, unless mixed with a certain dose of puzzolana.

Puzzolanas may be arranged in two principal classes, namely, natural puzzolanas, and artificial puzzolanas. Among the first, the most energetic are, generally, volcanic matters of a composition analogous to clays. These were discovered first in Italy, where their use goes back to time immemorial. Afterwards they were found in countries possessing extinct volcanoes, as Auvergne, Vivarais, Guadeloupe, &c. The matters which furnished them have sustained, by igneous action, a change in the primitive mode of combination in their elements; but as the intensity of this action was not every where the same, there resulted products of various degrees of cohesion: and it is not difficult to conceive that great differences may exist in their qualities, although none may exist in their chemical composition.

It may, nevertheless, be possible that a puzzolana is no more than of medium quality, merely because, as is said in common parlance, it is still *too*

*Paris, from the Royal press, 1833.