January 1960

Concerning the Clayish-Slimy Formations Termed Vermicular

Pietro Parenzan

Rudolfo Musco

Francis X. Connelly

PIETRO PARENZAN

CONCERNING THE CLAYISH-SLIMY FORMATIONS TERMED VERMICULAR

International symposium of Speleology

Varenna (Lake of Como), Italy 3-6 October 1960

From Memoria V della Rassegna Speleologica Italiana, translated by Rodolfo Musco and Francis X. Connelly, edited by William R. Halliday

PIETRO PARENZAN

CONCERNING THE CLAYISH-SLIMY FORMATIONS TERMED VERMICULAR

International symposium of Speleology
Varenna (Lake of Como), Italy 3-6 October 1960

From Memoria V della Rassegna Speleologica Italiana, translated by Rodolfo Musco and Francis X. Connelly, edited by William R. Halliday

* * * *

During recent speleological meetings certain scholars have pointed out characteristic clayish formations noticed on walls and ceilings of some caves and have formulated some hypotheses about their origins.

The subject seems interesting, not only because the genetic factors still are not completely known--and indubitably they must be many in relation to the variety of the formations about which we are speaking in their macroscopic aspects--but also because they are discovered in various caves. They have been found particularly in Italy, in southern caves, and also in coastal caves whose origins are connected with the sea (Zinzulusa Cave, Puglie, etc.)

These formations, improperly named "clayish vermicular formations" with respect to Kyrle's classifications ought to belong, in my opinion, to a third group: mixed, because although they are mostly allochthonous deposits, they have, at least in part, character of autochthonous deposits. In fact, Kyrle defines deposits in this way:

AUTOCHTHONOUS DEPOSITS: 1) of physical origin as waters of internal condensation; ice from freezing of waters of condensation; rocky sediments caused by landslip or by internal splitting, etc.; 2) of chemical origin as crystalline concretions, concretions of soldering, moon milk concretions;
3) of biological origin as veils of the subterranean bacterial activity; ferrobacteria; sulphobacteria, etc.

ALLOCHTHONOUS DEPOSITS: They include water coming from the outside: water of subterranean streams and lakes; snow and ice; water-borne gravels, sands, slime and clays (red earth, bauxites); pyroclastic material of hydric and aeolian transportation; sands and dust of aeolian deflation; coarser gravels and sediments of glacial transportation; vegetal and animal organic remains (coprolites, phosphatic earths, guano, ossiferous breccias), etc. (Anelli, 1959).

In fact, these formations are internal, with material of both internal and external origin, and the genetic factors also belong to both groups: external and internal.

Anelli, in one of his recent works (1957-59), in the chapter about fill deposits, did not mention these formations, not even among the "clayish-slimy concretions" and among deposits of internal degradation. He did not mention in any way the often-used words "leopard hide" and "vermicular formations".

Martel, in his description of the Grand Aven de Canjuers in France, pointed out for the first time some worm-like formations that he called "clayish ribbons".

Jeannel and Recovitza pointed out similar formations in the Rumanian cave "Pestarea mare de la Soronista", expressing the opinion that those ought to be attributed to dropping of water on levigated rock walls.

Also Gortani mentioned formations of the same kind in the caves of the Marches in eastern Italy, and in the Postumia Caves, one of the largest caves in northern Italy near the Yugoslavian borders.

Geze, in Renault's report, mentioned vermicular formations in Rochefort cave in Mayenne, France.

Marchetti calls the vermicular formations "leopard hide". Perna and Pozzi describe types completely differing from place to place in the Grotta del Fiume. They, however, could not identify a common characteristic aspect of the phenomenon in relation to their location. Those authors described these formations: "They are clayish ribbons, reddish, brown or yellowish, containing much water and can be removed by a touch of a finger. They are often interlinked while at other times they appear as rounded and isolated maculations."

Perna and Pozzi (1959) say that some particular aspects "give the idea of worm-eating," and that others ..."give the idea of tiger hide more than leopard hide".

In the Cave of Castel Lueghi (Istrian Peninsula), the same authors have found, as in the Cave of the Holy Virgin of Frasassi, in the Grotta Bella and in the Grotta Sulfurea, some vermicular formations ..."that would merit more study." They have also found similar deposits in the "Pont Niv" or "Native Bridge", the upper branch of the Cunardo Cave in the Province of Varese, in the Ladin Dolomites. "They look mostly like half-ellipsoid spots; about 1-1.50 cm. long, and are mostly located on concretional deposits on walls and niches. In some points those recoverings are so thin that they cover exactly the form of the greatly eroded, sub-standing wall. Some spots are covered with a very thin veil of calcite...are always of a great interest because they are the only ones known in Lombardy and are among the very few of this kind found in Italy."

Jeannel and Recovitza have defined a type of formation as "clayish vermiculations" ("vermiculures argileuses").

From a genetic point of view, Jeannel and Recovitza are of the opinion that these formations, in their different aspects, have to be considered due "to dropping of water on vertical walls"; but Perna and Pozzi do not think that this explanation is sufficient for those formations that are "on non-vertical walls or even on ceilings of tunnels, where drops of water have a tendency to drip instead of flowing along the walls." The same authors believe that Renault's hypothesis is more appropriate, if not sufficient. They believe that it is a residual product of decalcification deposited near networks of tiny fractures, and they compare these formations with those figures that appear on certain cement-manufactured articles that ..."are constituted of calcium carbonate coming from the carbonation of free lime-mortar contained in cement that is left as a deposit in holes of retirement."

Formations of this type have been attributed by Marchetti (1950) also to sulphur water, but Perna and Pozzi point out that in the caves studied by them there is a lack of sulphur water. They postulate "many other factors, as humidity of atmosphere (vermiculations are found on walls covered with little drops of condensed water), air currents, variations of temperature, gas dissolved in the atmosphere, etc."

At this point there are three questions that arise from the examination of these formations: a) their nature, meaning their constitution; b) their morphological structure, that gives the characteristic various macroscopic aspects; c) their genesis.

Regarding their nature, all the formations of this kind observed by me in different southern caves are constituted neither of products of decalcification nor of any other chemico-genetic process, but simply of material transported from the overburden, from material that fills niches, crevices, stratifications, etc., often mixed with surface material transported by draughts, bat guano and sand and bits of debris carried by waters.

An exceptional field of research about this subject that I have the pleasure to put to the scholars' disposition, is represented by the Experimental Subterranean Biological Station of Naples, founded by me many years ago in the caves and holes under Naples. The "nursery station" is a room covered with "opus reticutalum" of volcanic tufa that was part of the "cavea" of a Roman Theater built about 20 centuries ago. Its walls and ceiling are almost entirely covered by clayish-slimy formations, of the kind known as "leopard hide". It is not a calcarean cave, and we cannot talk, then, of calcification.

The material of clayish-slimy formations, of a dark brown color, examined through the microscope, is of nothing else but heterogeneous material, containing the same elements contained in the ceiling earth. Also present are fungus elements, some protozoic cysts, etc. I also found, in a preparation, some hooks attributable to cestodes of a microtenia (Echinococcus).

For my observations which agree also with observations of similar material found in various natural caves, let us go back to the hypothesis of Jeannel and Recovitza. I found that on non-vertical surfaces and on the ceiling of caves, water can move without having necessarily to drop from the ceiling, depending on humidity, saturation of the overburden, condensation and surface variations.

Also, the heterogeneousness of materials that may contain elements of varying weight and thickness may be added to the different factors that determine the formation of clayish earthy of these clayish-slimy structures.

I would like to point out that I was able to reproduce some vague similar formations experimentally. I used a glass ceiling, covered with a mixture of earth, sand, cement and sawdust, and I produced specified vibrations as a substitute for the hypothetical natural effects of air. Also I allowed little veins of water to flow on the prepared glass and they made similar formations, even if--as is natural--they were not so clear-cut as those formed naturally, through long periods of time under the action of complex factors not entirely known. Nevertheless, among the factors that enter without doubt in the genesis of this phenomenon, "water droppings" have a primary importance, following Jannel and Recovitza, because without them the other factors could not have a way to be developed.

The theories and hypothesis formulated about the genesis of these formations are four: biological (which cannot be true); as a deposit of transportation (including also aeolic deposits); as an in situ product of corrosion; and, finally, as a fossil deposit. In this last case this filling up ought to be the remains of an older and more complete filling of the cave. The described case of the Subterranean Station of Naples, however, breaks down this hypothesis, because from the time of its formation to the present time the local has never been filled up with clay or earth, nor invaded afterwards by water.

According to Renault, a formation "in situ" produced by corrosion of waters of infiltration which had perspired through microholes could explain some cases. But this could not be applied to vermiculations which are found on stalagmitic casts.

The nature of the substratum of these formations of pure or stalagmitic limestone should force us, following Renault, to investigate the existence of phenomenona of substitution if the studied forms, as ribbons or spots, were not in contrast with this interpretation.

Seeing superficially the nature of the material and of the phenomenon, and considering the different opinions about the genesis of these formations, I believe that what we know better are the different aspects of this phenomenon. I think it is better to put together these aspects in a scheme of classification as it is usual to do in similar cases. In fact, these deposits have different forms.

In southern caves I could find the types mentioned by the different authors, in formations that go from macular formations to thick and bubbled ones and more or less thin and sketched ones; from the hieroglyphic-like formations to those which are dendritic, and from the interlinked linear form to the irregular reticulum, etc.

Renault has tried to tabulate different types of vermiculations of two families, as follows:

FAMILIES	FORMS OF CORROSION	FORMS OF DEPOSIT
I. Fluoform Vermiculations	a) vermiculations of corrosion of saharian rocks.	b) vermiculations of calcite.
II. Structural vermiculations	a) Stilolytes. b) Alveolar vermiculations	c) manganese dendrites. d) clayish vermiculations

The character of genetic order common to these formations consists, according to Renault, of a slow and reduced water alimentation.

Both corrosional and depositional forms show well the aspects of vermiculations, considering, however, also the formations opposed to these forms of caves--i.e., the vermicular and alveolar furrows frequent in calcareous surface rocks.

I desire, to present a classification merely for forms of cavern deposits that cannot be all included under the d) letter of Renault's tabulation, because not all of them seem "vermicular". In fact, macular or blistered formations frequently do not have a vermicular aspect. For this reason I believe that all these formations may be classified as follows:

1st group:

CLAYISH-SLIMY MACULATIONS

1) Point-like maculae
2) Placoid maculae
3) Blistered maculae
4) Irregular, elipsoid or elongated maculae.

2nd group:

CLAYISH-SLIMY VERMICULATIONS

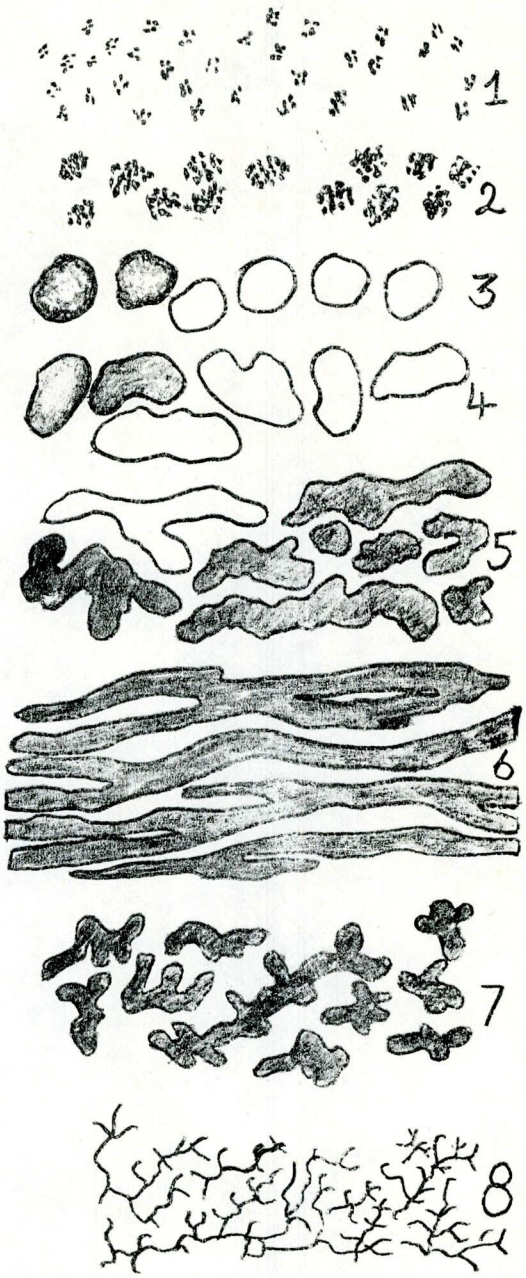
5) Large vermiculations (leopard hide)
6) Linear, elongated, simple or interlacing vermiculations (tiger hide)
7) Hieroglyphic-like vermiculations
8) Dendrite-like vermiculations

This table (see figure), I think, is useful to classify all the forms known today in an ordered series.

To conclude, up to this time there have been reported and more or less adequately described 8 fundamental forms of spelean clayish-slimy formations, whose genesis still is not entirely understood.

Nevertheless, we can recognize that, at least in the cases examined up to now, they are derived from materials of internal transfer, most likely from dropping, flowing or percolating water, through joints, microfissures, etc. These formations contain all the elements that may be found in the ground overlying the cave or in materials of old filling of niches, clefts, etc., mixed, sometimes, with elements coming from guano.

Also considering the examined formations, we have to exclude any chemico-genetic factor, giving more value to merely physical factors. I do not think, however, that we have to exclude a biological factor "of maintenance", at least for those cases--perhaps scarce--in which constituent materials of clayish-slimy formations are within reach of biological elements (fungus, bacterial and protozoan forms). The different kinds of formations, following Prof. Parenzan's classification, found in the Oregon Caves are those number 2, 4, 5, 7 and 8.


1
2
3
4
5
6
7
8