U. S. Geological survey.
Reports. Open file series.

U. S. Geological survey.
Reports Open file series. Translations 1 to 5 (articles on engineering geology) by Mrs. Severine Britt.

Allen - Int. 3978

DEPARTMENT OF THE INTERIOR

INFORMATION SERVICE

GEOLOGICAL SURVEY

For release JULY 27, 1948.

TRANSLATIONS OF FIVE FRENCH PAPERS RELEASED

Translations of five French papers on various phases of engineering geology have been placed in open file by the Geological Survey, Director William E. Wrather announced today.

1. "Choice of materials most suitable for ballast", by Leo Maddalena, describes the properties needed for good railroad ballast material. Important rocks of Italy and general rock types, such as granite, syenite, lavas, sandstones and limestones, are considered with respect to their structure, texture, compaction, accessory elements, porosity, alteration, and strength. Five pages.

2. "Special problem caused by the epigenetic alterations of Liassic rocks", by Henry Joly and Ninck, describes damages to the foundation of a building in Nancy due to swelling of a Jurassic shale bed. The swelling was due to the formation of calcium sulphate by chemical reaction of constituents of the shale resulting from circulation of damp air in the shale bed. Remedial measures are described. Seven pages.

3. "Protection of roads against rock falls", by Leo Maddalena, describes the relation between rock falls and the degree of fissuring and the mineralogy of the rocks involved. The characteristics of various types of rocks are outlined and suitable types of protection described. Four pages.

4. "Geology applied to modern highways", by Leo Maddalena, is a study of the contribution of geologic work to the construction of a heavy-duty highway through rugged terrain in the Apennine Mountains of Italy. Ten pages.

The above four papers are from the "Congres International des Mines, de la Metallurgie et de la Geologie Appliquee", vol. 2, Paris, 1935.

5. "Tests and researches on building stones", by M. R. L'Hermite and L. Feret, is a detailed report of tests made on nine limestones by the Laboratory of Building and Public Works, Paris, in 1943. Correlations are made between various properties of the stones such as composition, density, porosity, crushing strength, difficulty of dressing, elastic constants, permeability to water, resistance to abrasion, and thermal expansion. Thirty-one pages, twenty-one figures.

These translations, made by Mrs. Severine H. Britt, may be inspected in open files at the Geological Survey, Room 1033 (Library) Federal Works Agency Building, Washington, D. C., and in Building 12-B, Denver Federal Center, Denver Colorado. A limited number of copies of the translations have been mimeographed, and, as long as the supply lasts, copies can be obtained by those directly interested by writing the Director, U. S. Geological Survey, Washington 25, D. C.

P.N. 41741

x x x

Translation No. 3

PROTECTION OF ROADS AGAINST ROCK FALLS
(A translation)

Maddalena, Leo, Protection des voies contre la chute des rochers: Congres International des Mines, de la Metallurgie et de la Geologie appliquee, Paris, 1935, vol. II, pp. 559-561.

Translation by Mrs. Severine Britt, U. S. Geological Survey, 1947.

A great number of Italian roads and railroads run through the Alps valleys, most of which are of glacial origin; it will, therefore, be easily understood that at the time when the ice melted, important rock falls may have occurred, leaving the slopes in a state of unstable equilibrium, so that today they are not yet in a condition of perfect security due to the continuous action of weathering. In the Apennine valleys, because of the greater facility of erosion of the more recent and generally sedimentary rocks, and also due to the fact that the valleys belong to an even more recent period, the dangers of rock falls are at all times present.

The dangers of rock falls are mostly related to the fissuring of the rocks and to the particular character of the mineralogy of the rock itself. From the experience acquired by half a century of observations, it may be said that when there is a question of stratified calcareous rocks (Tertiary as well as Mesozoic), which are easily cracked, but only in one direction which is generally normal to bedding, it is possible to foresee the danger of the rocks breaking off.

On the contrary this will not hold true when the direction and the degree of ease of fissuration are different. For instance, the crystalline and marmorean limestones often split following the characteristic planes of the calcite

rhombohedron; in sandstones, besides the fracture in the direction normal to bedding, other fractures which are sometimes dangerous occur easily.

The fissurations of eruptive rocks in general and mostly of other igneous rocks (porphyries, trachytes and basalts) are especially complex, because in addition to the fracture planes determined by the dislocations within the earth crust, there are others, sometimes even 3 or 4, which are due to shrinkage resulting from the cooling of the magmatic mass. These are called contraction joints whereas the first ones are called compression joints (piezoclases).

The rocks with contraction joints are a source of danger of more numerous rock falls because it cannot be foreseen in which direction the splitting will occur due to the numerous fissure planes concealed in the mass as a consequence of its origin. Such are, for instance, the porphyritic rocks of the Isarco valley.

The rocks of the granitic type generally do not present such dangers because they originated from magmas solidified in depth and which cooled off slowly without indicating contraction joints. They only have one or two directions of fracture along well defined planes. The rocks of the Novate Mezzola wall, along the line Colico-Chiavenna, belong to this type.

However, if violent mechanical actions contributed to determine some fractures in the rock (mylonites) after orogenic movements, then no law can be established, and if granites, limestones, dolomites, sandstones or schisto-crystalline rocks (gneiss, amphibolites, mica-schists, etc.) are concerned, the danger of rock falls is particularly serious and the fracturing can not be foretold by personal observation. Such is the case for some dolomitic slopes broken by the orogenic pressures, which are sometimes met in the valleys of the Alps and the Apennines.

Finally, in the case of rocks which can be easily weathered, such as those which may be frost-riven (molasse, Tertiary conglomerates with argillaceous cement, and even granitic rocks when these are deeply altered), a simple superficial protection may be effective against the chemical or physical action of these agents, by means of a masonry covering or perhaps with an appropriate coating of gunite.

As a conclusion, it seems that in a very general way, it would be advisable to stick to the following rules for the protection of railroads against rock falls:

Artificial tunnels.--To be used in cases of rock faces constituted of materials having a volcanic origin of the igneous type (porphyries, trachytes, basalts), and having numerous fissure planes. The artificial tunnels can also be used in cases of rocks of any nature with fractures due to strong mechanical actions, which would allow the breaking off of rocks having large dimensions.

Rock-retaining walls and crib walls made of rails and wooden ties.--Appropriate for protection against fragments falling from rock faces formed by eruptive origin as well as sedimentary, which are finely broken and liable to cause the fall of debris or blocks having small dimensions.

Tie-bars and underpinnings.--Suitable whenever sedimentary rocks are concerned (calcareous or arenaceous) which present obviously only one plane of fissuration, or rocks of granitic type with one or at most two planes of fissuration, which may split easily, and whenever it is possible for an expert to tell at a glance the degree of probability of splitting.

In general, the vegetation on the slopes under the rock walls where rock falls may occur, has a fundamental importance in stopping the fallen rocks, not only the full-grown trees but mainly the bushes and stumps are most effective for this defense against rock-falls.

It results from what has been said above that the geognostic study is always very useful before taking measures for the defense against rock falls. These measures depend, as a matter of fact, on the nature of the rock causing the danger and on the degree and characters of its fissuration. It is known that the latter are inherent to the mineralogic composition of the rock, to its state of preservation, and to its stratigraphic behavior.