But, *after all our labours and strivings* to reach the beginning of all things, let us take comfort in this, that, like Pandora of old, we still have Hope left us in the Box (or shall we say *in the Rocks*?).

Those Eozoic rocks which underlie our present oldest fossiliferous strata may yet yield to the geologist and biologist in the future an earlier and more primitive fauna and flora, just as the Lower Cambrian rocks have done for us in the past.

CORRESPONDENCE.

THE GEOLOGY OF GAVARNIE.

SIR,—The latest number of the *Bulletin des Services* (No. 93) of the French Geological Survey establishes in 300 elaborately illustrated pages a new stratigraphical paradox, confirming those already noticed in your pages. Having mapped the entire district in question on a larger scale some years ago, and having again verified the facts on the spot, I would point out the decisive features recognizable by the practical geologist.

At Gavarnie the tourist observes a gigantic precipice which is the northern edge of the Secondary and Tertiary sheet that composes the Spanish Pyrenees. Its abrupt contact with the Palæozoic rocks traversed by the entire road of approach, and the consequently sudden opposition between the character of erosion exhibited by the Cirque, excavated in the Secondary rocks, and the very different erosion of the Palæozoic, is unique in the Pyrenees.

In the *Bull. Soc. Geol.* of 1868 I first figured the fault of contact, and I have since traced its outcrop through the Cascade Hotel, the Port de Pailla, the Port Neuf de Pinede, and the Port de Gavarnie. *In front of it*, the tourist perceives a gigantic wedge of white limestones which are visibly continuous with the Devonian limestones of the Palæozoic valley in which he stands. This wedge forms the Pic Rouge de Pailla, and there contains a lead lode such as abound in the Palæozoic and are unknown in the Upper Cretaceous of the Pyrenees. Throughout its base, hollow concretions of chert and calcite abound, whose broken sections are easily confounded with Rudists and other shells; but the only authentic fossil I have found in it was a fairly characterized *Atrypa reticularis* at a few feet from the fault. The pseudo-fossils have for more than thirty years been mistaken for Rudists such as abound in the glacial blocks abundantly dispersed from the overhanging Secondary precipice. The author in question has accepted the consecrated error, and has inadvertently classed the Palæozoic wedge as a portion of the Secondary that lies beyond the fault. Inevitably, he is hence compelled to class the visible continuance of that wedge to the north as a tongue of Cretaceous extending between the granite base and the remaining Palæozoic rocks of the French valley.

His efforts to confirm the initial illusion are ingenious and inevitable. As type of the structure he imagines, he selects a section east of Gedre, where he himself admits that the Devonian limestone directly rests upon the granite. At the point he figures

there is a thin intercalation of Silurian, but only the white and fissile surface of the granite can be mistaken for any independent limestone. That granulitic surface has certainly misled him in his sections of Heas; and in general he has taken for a regular outcrop of limestone the very regular band of fallen and glacial blocks which skirts the steep talus of the Silurian schist at the foot of the precipices of Devonian limestone. Among these chaotic blocks I have found no Rudists in place, but plenty in transported fragments. At the end of the Estaubé valley the confusion is repeated between the Secondary precipice and the Palæozoic wedge, here limited by a friction breccia.

In following a phantasm, the author has ignored the fact that the limestone he classes as Cretaceous descends abruptly in thin sheets both at the bridge of Gavarnie and at two kilometres to the south of it, these sheets being pinched between the granite to a depth beneath the floor of the valley. Strongly metamorphosed and visibly intersected by granite veins, these sheets prove that the granite was both active and flexible after the deposition of the supposed Cretaceous. At Bareilles the author has figured as a limited projection a third similar sheet. Here I formerly described, as undoubtedly in place, circular sections which I compared to the Jurassic corals I had found at the Col de l'Espandels, west of Argeles. But the author himself figures the limestone of the Col in question as Devonian, and I have ascertained that the apparent fossils of Bareilles are mere sections of pipes and other concretions of calcite.

The paradox in question hence arises from common illusions and the existing obstacles to their discussion. It is also an attempt to justify and excuse the former classification of the *dalle* limestone as Cambrian, because beneath the Silurian. In view of the fact that the official map of 1890 is proved entirely wrong by the new survey here in question, it should be remembered that the said map was in entire defiance of local observation.

Between the present paradox and the case of Eaux Chaudes an analogy is suggested by ignoring the fact that the fossils are there both specifically determinable and visibly in place; and the further fact that the Cretaceous there penetrates, vertically or reversed, from the surface, and accompanied by numerous ophites along its contact with the Palæozoic. At Gavarnie the fossils are worthless, the stratigraphy figured is in contradiction to salient facts, and the resulting paradox is itself an indication of the erroneous observation demonstrable on the spot. The relations of the Secondary, as followed by the Spanish geologists and by myself to the Pic d'Anie and the Maladetta, are in flat contradiction to what is here imagined. It is unfortunate that the work in question ignores those relations on every side. Even in the only other inclusion of Secondary rocks figured and described, the author entirely ignores the presence of the extensive bands of ophite by which it is limited between Argeles and Arbeost. Supposed "fragments of the tests of Rudists" are only valuable when confirmed by unquestionable fossils or by stratigraphic identification with adjoining fossiliferous bands.

CAUTERETS, *July* 18, 1903. P. W. STUART-MENTEATH.