ments comparatively low pressures, and materials, such as paper, wax, clay, &c.—much less resistant than the rocks themselves—were employed, so that while they have thrown much light upon the dynamics of mountain making, they have left the aspects of the subject referred to above, and especially dealt with in the present paper, untouched. In another series of interesting investigations, specimens of the rocks themselves have been submitted to the action of direct pressure or heat, the conditions being otherwise those which obtain at the earth's surface. HODGKINSON,* for instance, showed that if thin ribs of stone, 7 feet long and 1 inch thick, properly supported at the extremities, are submitted to transverse strain they undergo a permanent deformation, no matter how small the strain to which they are subjected may be. He does not, however, state what stone he employed. MIALL,† in more elaborate experiments of a similar character, measured the amount of permanent deformation produced in thin slabs of gypsum and limestone. He found that a more marked deformation without rupture could be obtained if these rocks were embedded in pitch before being submitted to the action of pressure. He could not, however, succeed in permanently deforming slates or sandstones to any noticeable extent. In the tests made at the Watertown Arsenal,‡ by employing greater pressure, a slight though permanent "set" was given not only to marble but to sandstone, and the same effect was produced by the simple application of heat without pressure. REYER§ has stated, as the result of experimental study, that while it is possible to slowly deform gypsum by the aid of low pressures continuously applied, the action is greatly accelerated if the material be kept moist.

A few other investigations, among which those of GÜMBEL and KICK are especially worthy of mention, bear more directly upon the question at issue. These have been designed with the object of reproducing, at least in some of their features, the conditions existing at great depths in the earth's crust, and in this way bringing about such rock deformation as there results. GÜMBEL|| subjected little cylinders of orthoclase, quartz, Iceland spar and alabaster, enclosed in steel collars, and having an area of 1 centim. in cross section, and a height of between half a centim. and 1 centim., to pressures varying from 22,000 to 25,000 atmospheres in a powerful testing machine. The cylinders of orthoclase and quartz crushed to an incoherent powder. The cylinder of calcite, on the other hand, retained its coherence. It became perfectly opaque, and while still retaining its cleavage, is stated to have had a conchoidal fracture induced in it by the pressure. The cleavage faces showed their usual lustre,

* 'Athenaeum,' 1853, p. 1165: "Report of the 23rd Meeting of the British Association for the Advancement of Science."

† "Experiments on the Contortion of Mountain Limestone," 'Geological Magazine,' November, 1869; and a subsequent paper in the 'Popular Science Review.'

‡ *Loc. cit.* See also MELLARD READE'S 'Origin of Mountain Ranges,' pp. 16 and 24.

§ 'Theoretische Geologie,' p. 444.

|| "Das Verhalten der Schichtgesteine in gebogenen Lagen," 'Sitzungsber. d. königl. Bayer. Akad. d. Wiss.'; Math. Phy. Classe, 1880, 4, 596–623.