the Laramide revolution. Movement on these faults, which do not involve the crystalline rocks of the basement complex, is believed to have been dissipated at depth by shearing along bedding planes. The name "geosynclinal" thrust fault is proposed for faults of this type.

In contrast, the low-angle thrust faults of central Wyoming and southern Montana were produced by the further compression of large faulted blocks previously uplifted during an earlier stage of the Laramide revolution. The crystalline cores of these uplifts contributed large quantities of detritus to the Paleocene strata forming the foot-wall blocks of some of the thrusts. A study of the structures of the basement complex indicates that the present uplifts occupy the sites of pre-Cambrian mountain ranges. Hence, this group of thrust faults borders areas that have been recurrently structurally positive throughout geologic time. The name "geanticlinal" thrust fault is proposed for thrust faults of this type.

BAILEY WILLIS, Stanford University. Terrestrial Dynamics.

The progress in physics and geology requires a revision of geologic theories. We now know that the earth has a molten core, 4,000 miles in diameter, which is covered by a shell 1,800 miles thick, that is solid and mostly crystalline. It is called the mantle. And there is an outer crust 20 to 30 miles thick. The effective forces operating throughout this structure are gravity or load pressure, heat, and atomic attractions and repulsions. The heat may be attributed to compression and radioactive disintegration of atoms, but probably not to survival from an originally molten globe. In this hypothesis it is regarded as mainly due to radioactive processes.

It is reasonable to assume that radioactive minerals are present in the core and are its principle source of heat. Since the heat cannot escape the core must be heating and growing at the expense of the mantle. The earth is growing hotter, not cooling.

The boiling core emits gases and superheated liquids that bore into the mantle and form bubbles of magma. The bubbles rise by virtue of their bouyancy and boring activity. Their mineral composition changes by assimilation and adjustment of mineral species to environment. Starting from the core as nickel-iron and accessories they emerge in the crust as basalt and granite.

The mechanics of the pressure in and around a bubble of magma give it the shape of a pear, biggest at the top. On approaching the surface this effect develops the tack-shaped batholith. The cover over such a batholith is liable to uplift, indicated at the surface by elevated plateaus and broad domes or elongate swells, and to metamorphism, which may produce lateral pressures. The unbalanced load of an elevated mass also creates lateral pressure. Under certain circumstances the effect of lateral stress and strain in combination with magmatic heat may produce extensive horizontal intrusions 20 miles below the surface. Such a one is thought to have been the mass under the Appalachian geosyncline during the Paleozoic era. To that mobile foundation we may attribute the sinking of the sediments, and by a logical development of load stresses in combination with magmatic pressures we may explain the folding of the Appalachians, the outthrust of the Himalayas, and similar displacements.

Bubbles of igneous rock have risen to the surface at intervals during the last 2 billion years. They consist of two principle kinds, basalt and granite. They differ in fluidity or viscosity. The basalt reaches the surface and spreads out, forming such features as ocean beds and plateaus. The granite lifts the surface without breaking through, causes lateral stresses, and becomes the core of a mountain range. The possible mechanical effects are varied. We can not reason from one orogeny to another, without due consideration of the facts of unlike histories. The Appalachian mechanics will not explain the Rockies, or the Basin ranges, or the Alps. Each orogeny is a problem in itself. But they all are to be ex-

plained through a study of the reactions of the forces of gravity, magmatic intrusion, and atomic activity.

The prolonged sequence of intrusions of the surface by magmatic bubbles is regarded as the source of the crust. The process is not finished or ever can be, since radioactive disintegration continues to heat the core. We may infer that the thinning mantle will ultimately disappear and the planet will become a star.

CLAUDE LEACH and HENRY H. NEEL, Tide Water Associated Oil Company, Ventura.

Landslides-Ventura Avenue Oil Field.

The soft Pliocene formations in the Ventura district are particularly susceptible to landsliding. Resultant movement has presented difficult and expensive problems in connection with the development of oil-producing properties. Extensive work has been undertaken by the Tide Water Associated Oil Company in an effort to stop existing slides and to prevent the development of new slides in the Ventura Avenue oil field.

The landslides in this field are of two types, bedding-plane slides and circular-type slides. Bedding-plane slides move along parallel bedding planes in areas where the dip of the formation exceeds 15° and is in the same direction as the surface slope. Circular-type slides are independent of the stratification of the formation. They occur in stratified material which is not dipping in the same direction as the surface slope, and in unstratified material such as old slides where the bedding has been destroyed.

The two principal causes of landsliding are the presence of water in the formation and the disturbance of equilibrium. Water is probably the most important cause for it lowers the coefficient of friction within the slide itself and along existing slide planes, reduces the shear and tensile strength of the formation, increases the weight of the landslide mass, and creates a lifting force due to hydrostatic pressure in the lower part of the slide. The state of equilibrium may be disturbed by a redistribution of weight by either natural or artificial means.

Three basic methods of landslide control are practiced in the Ventura Avenue field. They are the removal of water from the slide, the elimination of the source of the water, and the redistribution of the load. Water is removed by nearly horizontal "Hydrauger" holes, vertical water-well shafts, drain tiles, and tunnels. Elimination of the source of the water is accomplished by dressing and oiling the surface to facilitate rainwater run-off, and by preventing waste water, drilling mud, et cetera, from seeping into the formation. Redistribution of the load consists in removing earth from the head of the slide and compacting this material at the toe.

It is perhaps too early to judge the full effect of the corrective measures employed. However, results of observation in the past 3 years indicate that the measures taken have been highly successful.

FINAL REPORT OF COMMITTEE ON METHOD OF ELECTION OF OFFICERS[1]

The committee on method of election of officers, a special committee appointed in 1944 to consider possible methods of electing Association officers by the use of a mailed ballot, and reappointed in 1945 to study the results of a questionnaire on the same subject, has completed its study of methods of election, reviewed the results of the questionnaire, and reports the following conclusions.

1. A majority of Association members, answering the questionnaire, wish to change to

[1] John G. Bartram, chairman; Ronald K. DeFord, W. Dow Hamm, John Smith Ivy, Hugh D. Miser, Clarence L. Moody, and Earl B. Noble. Submitted to M. G. Cheney, chairman of the executive committee, October 27, 1945.