in cemeteries gave widely divergent results, from as low as 0·17 *g* to as high as 0·5 *g*, but in several cases there were marks showing that the monuments moved on their bases before overturning.

With regard to vertical acceleration, nothing worth recording was observed.

Several electric-light pendants were smashed by swinging against the ceiling, but were very short (under 2 ft.). I was told of one about 4 ft. 6 in. long which was broken, but this was in a building later destroyed by fire.

The breakwater slip shows an interesting example of material falling well clear of the base of the slip. It appears to indicate a heavy horizontal thrust.

As evidence of a vertical thrust, chimneys which fell clear of the eaves were investigated; but this could have been caused by a horizontal thrust when the chimney had reached a horizontal position in falling.

Ground-movements.—Several bridges showed remarkable displacement of piers with no corresponding earth-movement showing on the surface. This, however, may have taken place well below the surface, the movement being damped out in the surface shingle.

Public Utilities.—The water-supply was seriously interrupted by the first shake, and the lack of water greatly hindered fire fighting. The cast-iron mains were badly fractured at junctions, and at joints the lead packings were disturbed, allowing extensive leakages. The reservoirs on the hill were badly fractured, and the high-pressure tower on Bluff Hill was overturned.

The sewerage system was also badly damaged, but sufficient lengths have not yet been opened up to enable definite conclusions to be made as to the behaviour of the various classes of pipes used. In three lengths opened up, on silt, 5 ft. to 6 ft. deep, earthenware pipes, whether on a concrete bed or not, were badly fractured, and concrete pipes without a concrete bed were much less damaged.

Chimneys.—Only a few chimneys were left standing, and these include several reinforced-concrete ones. In many cases the failure of massive chimneys caused very extensive damage to the building.

(NOTE.—This general report was based on a detailed analysis of the damage sustained by a large number of individual buildings. Full particulars of his detailed investigations, illustrated by photographs and plans, were forwarded to the Committee by Mr. Harris.)

(*b*) HASTINGS.

By A. BRODIE, B.E., M.Sc., Public Works Department.

The three shocks of major intensity occurred: (*a*) 11 a.m., Tuesday, 3rd February, 1931; (*b*) 9 p.m., Tuesday, 3rd February, 1931; (*c*) 1.30 p.m., Friday, 13th February, 1931.

It appears that the tremors of 3rd February were of two distinct types—viz., a vertical wave or severe upward jolt, and a horizontal wave. That these waves struck Hastings from varied directions is definitely proved by evidence from several distinct sources—

(*a*) Monuments in local cemeteries exhibit the most convincing proof. Columns fell in the general directions of north, south, east, and west. Portions of monuments were projected from their bases. A marble slab thrown forward, turned completely round, falling face up on the ground.
(*b*) From marks on the plaster it is apparent in the High School that two pictures on walls at right angles to each other both oscillated through angles of 60 degrees.
(*c*) The collapse of buildings along transverse axes in streets running at right angles.

These phenomena are produced by the complex principal types of waves, longitudinal and transverse, and serve to indicate the severe and involved forces that constitute an earthquake. The two severe shakes of 3rd February wrought the greater part of the damage, although that of 13th February was of comparable intensity. Thus structures that have endured these shocks and the subsequent intermittent tremors of somewhat less, but nevertheless severe, intensity have survived a searching test, the results of which can therefore be accepted with every confidence.

Subsoil.—In the Hastings business area foundation conditions are such as to accentuate or intensify the wave-action. Generally speaking, west of Market Street the subsoil is wet pug clay with ground-water level at an average depth of 3 ft. below the surface; east of Market Street fine blue running sand with water at a depth of 4 ft. to 5 ft. is encountered. The area was originally a swamp.

General.—Well-known considerations of general applicability that need no expounding are—

(*a*) Site: Made ground, and particularly situations having adjoining substrata of different types, are to be avoided.
(*b*) Foundations should preferably be on rock; otherwise deep substantial footings well tied together and reinforced, giving low uniform unit soil-pressures, are recommended.
(*c*) Shape: The plan should be compact, regular, and without attachments or "wings."
(*d*) Superstructure should be of homogeneous construction and of uniform height, without heavy cornices, parapets, &c.