

interaction must result in a downward thrust on the tube equal to the weight of liquid above the bath level. From the atomic point of view, this means that the interacting atoms are steadily transferring momentum in a downward direction to the tube, just as the thrust on the walls of a vessel containing gas implies that the atoms steadily lose momentum to the walls as they are reflected. This has the interesting consequence that the main heat transport in helium II at these temperatures (below 2.19°K .) cannot be due to the propagation of elastic waves as in ordinary liquids and solids, since elastic waves do not carry momentum.

Many and varied hypotheses have been made concerning the constitution of helium II. Michels, Bijl and de Boer and the present authors independently suggested that certain atoms which have more than the average energy in helium II

have, as well, a larger than average mean free path inside the liquid, and that heat flow represents a drift of these moving or 'excited' atoms. Later, this idea of energetic particles moving through the unexcited or 'condensed' atoms was developed by Tisza to include a theory of flow. This theory has not yet reached a quantitative stage, but has proved interesting and suggestive.

Note added in proof: Since this article was written, F. London has published (*Phys. Rev.*, 54, 947; 1938) an enlargement of the theory which he based on the consideration that helium at low temperatures exhibited Bose-Einstein condensation phenomena. His theoretical interpretation of the behaviour of liquid helium II appears to be quite in accordance with the experimental deductions given above, particularly with regard to the properties of flow of both heat and liquid.

The Earthquake in Chile

THE recent earthquake in Chile (*NATURE*, Feb. 4, p. 197) may justly be regarded as one of the greatest of such catastrophes in that country, and also in the world. According to local reports by survivors, the shock started about 11.35 p.m. local time on the night of January 24, and during the two or three minutes which it lasted ruined four towns and several villages, whilst doing severe damage to several others. The earthquake was felt from Valparaiso in the north to Puerto Montt in the south, the area affected now being estimated at 300,000 square miles. Large-scale damage was done from Talca in the north to Valdivia in the south, the area chiefly concerned being the province of Nuble, and the damage to property is estimated at £1,500,000. Altogether approximately 30,000 people were killed, 50,000 injured and there are about 100,000 homeless refugees.

At Chillan, a town of 45,000 inhabitants forty miles east of Concepcion, in the neighbourhood of the epicentre, two walls of the massive cathedral, the post office and telegraph building, the O'Higgins Infantry Barracks and most of the houses collapsed immediately. A theatre and a cinema collapsed, killing all the people inside. The hospital, although badly cracked, was one of the three or four buildings left standing after the initial shocks; but owing to the number of casualties the supply of anæsthetics ran out and the surgeons were obliged to operate without. Immediately after the shock the supply of electric power and

water ceased, so that the surviving firemen with the one remaining engine were powerless against the fires which followed. Moreover, transport was impossible on the railway and difficult on the roads around. After rescue operations, the Government ordered the evacuation of the town, it being estimated that here 10,000 lost their lives.

Parral, San Carlos and Egun, within the isoseismal 10, were also razed and evacuated. The villages of Retiro, Copihue, Zongavi, Bulnes and Quirihue were completely demolished. Andotros was very severely damaged, San Rosendo had 2,000 dead, and at Cauquennes, the town celebrated for its mineral springs, half the property including the hospital and prison was destroyed, killing 4,000 and injuring 800. At Concepcion, the fourth largest city in Chile, situated near the mouth of the Bio-Bio River and having a population of 89,000, three fifths of the city is in ruins and there are 2,000 dead. Many famous buildings, including the Teatro Campo Club and hospital, were destroyed. Here also a kinema collapsed killing 300 people inside it at the time, and fires added to the destruction in the city. It is expected that some of the fine modern buildings such as the Banco Central, the University and the Plaza Hotel which have been built to withstand earthquake shocks will have survived, unlike on the fifth occasion when Concepcion was completely destroyed on February 20, 1835. The damage was severe, but not so great at Los Angeles, Longavi and Linares. At Talcahuano, the port

and naval base, 19 are reported dead and 100 injured, fires adding to the destruction caused by the shock. At Talca many buildings were injured and the prison collapsed killing 10 convicts and injuring 20 others. Farther away, at Valparaiso, the church spire was damaged and at Santiago, 250 miles north of Concepcion, the earthquake was strong enough to cause cracks in buildings.

Faulting has been on a considerable scale, and in the Province of Nuble the fissures caused by the earthquake are several kilometres long and often five metres deep.

So far as instrumental evidence is concerned, the shock was world shaking. At Santiago the shock was felt about 11.35 p.m. local time on January 24 (Jan. 25, 3h. 35m. G.C.T.). From Fordham, New York, the shock was reported double with an interval of 10 minutes between the shocks and the needle swung approximately eight inches for both shocks at maximum. It was recorded by instruments in Great Britain, and at Stuttgart in Germany the registration was complete, including eP at January 25, 3h. 46m. 51s., ePP 51m. 45s., $SKKS$ 58m. 25s. and LQ at 4h. 25m. with $T = 50-55$ sec. all in G.C.T. At Hamburg one eP' was registered at 3h. 47m. 8s. and another at 50m. 49s., both on the vertical seismograph, e_zPP at 51m. 44s., eL_{EN} at 4h. 20m. and eL_z at 4h. 24m. all in G.C.T. together with other pulses. Taking into consideration all the above evidence, it appears that the epicentre was near lat. $36^\circ 45' S.$ and long. $72^\circ 15' W.$, probably correct within 10 minutes of arc, that the depth of focus was normal and that for the first shock the origin time was January 25 at 3h. 32.0m. G.C.T.

Since the first shock, aftershocks have been frequent and often of considerable severity. The frequency and intensity has as usual in general

diminished, though there have been notable exceptions. There were severe disturbances on the night of January 27 and on January 28. On January 30, at 3h. 45m. G.C.T. a severe shock with the same epicentre occurred and completely demolished the three or four remaining buildings and walls at Chillan.

Sympathetic occurrences in the Andes probably due to the disturbance of the Chilean shock or resulting from the same deep initial cause are reported, including further earthquakes and tremors, and on Mt. Lliama volcano was in eruption.

Further news of the catastrophe is expected in reports of the Chilean seismologists and geologists who left Santiago for the epicentral region immediately after the shock.



MAP SHOWING ISOSEISMAL LINES AS AT PRESENT KNOWN. + = APPROXIMATE EPICENTRE

Obituary Notices

Prof. H. H. Woollard, F.R.S.

THE very sudden death of Prof. H. H. Woollard on June 18, at the age of forty-nine years, is a tragic loss for the science of anatomy in Great Britain.

Woollard was a product of the University of Melbourne, where he took his medical degree in 1910. During the Great War he saw active service with the Australian Army Medical Service and attained the rank of Lieut.-Colonel. After the War he intended to work for the fellowship of the Royal College of Surgeons, and to this end went to University College, London. Here he came under the inspiring influence of the late Sir Grafton Elliot Smith, an influence

which led him completely to change his original plans; for he now decided to take up the study of anatomy as a scientific career. He was appointed to the staff of the Department of Anatomy at University College, where he worked until 1928. He was afterwards appointed to the chair of anatomy and histology in the University of Adelaide, to the chair of anatomy at St. Bartholomew's Hospital Medical School, London, and finally as successor to his distinguished teacher Elliot Smith, in University College, London, in 1936.

Woollard's contributions to anatomy, direct and indirect, were outstanding. His early papers were mainly morphological in character, and of these may be mentioned an important and comprehensive