sequent disintegration of the upper layers of epidermal cells. The deepest, least-differentiated cells survived, and scattered excretory cells and sometimes areas of true metaplasia appeared in this region; metaplasia was less frequent and usually less extensive than in explants of 13-day skin. When transferred from high vitamin A to normal medium, both the 13- and 18-day skin eventually reverted to the squamous keratinizing type. Dr. Fell suggested that, in the organ cultures, the skin was subjected to conditions which probably could not be reproduced in the intact animal; thus experiments *in vitro* with excess vitamin A involved developmental potentialities which perhaps could not have been demonstrated *in vivo*. G. H. BOURNE

PHYSICAL STRUCTURE AND ENGINEERING PROPERTIES OF CONCRETE

T. C. POWERS, who is in charge of fundamental research on the properties of concrete at the laboratories of the American Portland Cement Association, is well known for his work in collaboration with T. L. Brownyard on the distribution of water in set cement. Taking advantage of Mr. Powers's attendance at the Stockholm Conference on Winter Concreting, the Cement and Concrete Association asked him to give a lecture to an invited audience in London on March 1 at the Institution of Civil Engineers. More than seven hundred persons attended, covering a wide range of interests in civil engineering and concrete technology. It is a tribute to Mr. Powers's skill and enthusiasm that the highly specialized subject-matter of his talk was nevertheless received with absorption by his large audience, who were obviously stimulated by the many original observations.

Mr. Powers began by narrowing the field of discussion to the paste of cement and water which binds together the sand and larger aggregate. In his view, the major properties of concrete are largely determined by the paste alone, and the over-riding factor controlling the quality of the paste is the ratio of water to cement in the original mix. As hydration of the cement proceeds, some of the water becomes chemically combined, some is adsorbed in the gel resulting from the hydration, and some remains as free water in the capillaries present in the set mass. The properties of the gel, as quoted by Mr. Powers, are: density, 2·15 gm./c.c.; porosity, 26 per cent by volume; and coefficient of permeability to water, 2×10^{-15} cm./sec. The last is a remarkable figure for a substance of 26 per cent porosity, being less than is obtained with natural rocks of only 2–3 per cent porosity.

Mr. Powers then went on to elaborate a theory which caused a considerable controversy. It is well known, he said, that Portland cement is composed principally of tricalcium silicate, dicalcium silicate and various aluminates. Cements high in tricalcium silicate hydrate more rapidly and gain strength more quickly than others. This is usually explained by the fact that the aluminates react quickly with water, followed by the tricalcium silicate, while the dicalcium silicate hydrates react only slowly. Nevertheless, the evidence shows that in practical cement there is no preferential hydration of the different minerals. The evidence is threefold: constant specific surface of the gel from 1 day to 14 years; constant heat of reaction per unit of combined water from 1 day to 14 years; constant ratio of tricalcium to dicalcium silicate, as determined by the X-ray method, from the original cement up to 28 days. Mr. Powers did not offer an alternative theory to account for the differing reactivity of cements of different mineralogical composition.

The strength of the cement paste, on Mr. Powers's theory, is determined by how much of the capillary space is filled with gel. This gel/space ratio can be calculated from the original volumes of cement and water and the degree of hydration of the cement. A good relation was shown, graphically connecting the compressive strength of neat paste and the gel/space ratio. Mr. Powers then went on to use his theory to explain the variable coefficient of thermal expansion of concrete and to consider the bulk permeability and the frost resistance of concrete; especially in dealing with the latter property, it is necessary to allow for the accidental or deliberate entrainment of air during the mixing operation.

The discussion that followed the lecture mostly centred around the question of the differential hydration of cement minerals, and it is clear that this question will exercise the minds of cement technologists for some time to come. In replying to the vote of thanks, Mr. Powers made it clear that his work is not complete and that he had offered it for discussion in the hope that any errors or weaknesses might be repaired. R. W. NURSE

MOISTURE BALANCE OF THE ATMOSPHERE

FOR his presidential address to the Royal Meteorological Society, given on April 25, Dr. R. C. Sutcliffe chose for his subject "The Moisture Balance of the Atmosphere". With so much expression of opinion, both informed and uninformed, regarding the possible effects of nuclear explosions on weather and the possibility of artificially inducing precipitation from clouds, the subject was clearly a topical one; however, Dr. Sutcliffe, who is deputy-director of the Meteorological Office, had very little to say about the narrow 'rain-making' aspect and concentrated on presenting a broad picture of the various inter-related processes going on in the atmosphere, without an understanding of which attempts to tamper with the weather may lead to confusion and, possibly, disappointment.

After lamenting the tendency for new specialist branches of meteorology and applied meteorology to channel-off research energy from the main stream, which should be concerned with atmospheric processes as a whole and which has been very much neglected, Dr. Sutcliffe made the point that the circulation of water and water vapour in the atmosphere is but one aspect of the 'general circulation' of the air which carries it. The transport of water vapour is governed by the 'macro-dynamics'—that is to say, by the equations of fluid dynamics applicable to large-scale movements of air—though processes such as condensation and evaporation affect the application of mechanical principles by reason of alterations produced in the air-density. Precipitation, produced by the coalescence of cloud particles, also reacts back on