DISCUSSION.

Mr. W. Shellshear stated that the nature of the clay in the Hawkesbury series was very well known to many people, and especially a certain white clay, which was used very largely in connection with the Prospect Dam. If a sample of this clay were placed in water, it resolved itself down to the consistency of "spue" or porridge; it had not the power to carry even its own weight under such circumstances. It certainly seemed strange to him that no attempt had been made to ascertain the mechanical qualities of this clay before using it in such positions, and under such conditions, as had been done. At the point where the slip happened, he noticed a large portion of this clay was in a plastic state. Where sand was used, no movement had taken place. A space in which the puddle was placed, was so constructed as to resist the weight of the water, and the clay was only supposed to afford a puddle wall, yet at Prospect the whole of the bank was nothing more or less than one mass of puddle, caused by the employment of this material. If a test like that numbered four in the paper had been made, no movement would have taken place. It appeared to him that sufficient care was not taken to prevent this stuff from getting in. He did not profess to be an expert in dam construction, yet it seemed a mystery to him that such a course could have been taken. His experience taught him that the moment water touched this particular clay, down it went. The remarks made by Mr. Mackay were very interesting, and the chemical change he described was very noticeable, particularly in the red clay. As far as the trouble at Prospect was concerned, he (the speaker) attributed it to this white clay, but the

difficulty could be easily overcome by facing the bank with stone, and he considered that this was the only course that could now be followed.

Dr. Storer stated that in England the question was always to get a fat clay, that was to say, having large cohesive power. Recently a new method of making puddle had been resorted to, and, he believed, with success. Instead of plastic clay, the clay used was well dried and then ground and put in the wall, and, as soon as the water reached to it, expansion took place, and the whole work became perfectly solid. With reference to the aid of chemistry to engineering, a forcible example of this was shown a few years ago in Tasmania, where abortive efforts were made to establish ironworks, and thousands of pounds were squandered, when a chemist's fee of ten guineas would have prevented all this waste and labour. He had no doubt that if a similar thing had been done at Prospect the trouble would have been averted.

Mr. J. B. Henson remarked that Mr. Mackay had referred to the Wainamatta clays or shales. The speaker had given some attention to these clays and all the clays prevalent in the County of Cumberland. These Wainamatta shales at a distance below the surface were laminated, but near the surface they appeared in a form of clay more or less plastic. It was almost impossible to find two parts alike, the percentages of the constituents varying greatly. The deposition of the various substance had taken place in different parts of the country. This might be seen at the Newtown railway cutting, Petersham cutting and at Rookwood. In the cuttings the clay was taken out in blocks, and after a short time these blocks took the appearance of mounds, as the disintegration, due, he believed, to the existence of pyrites, set in. Mr. Mackay explained this as due to the oxidation of the iron. The inference apparently drawn in the paper of the analysis as tabulated, did not seem justifiable to him (the speaker) as the process of oxidation was limited to pure iron. With regard to the presence of sand, he had seen dams in which the materials largely consisted of a red sand and a little clay mixed with it, and he believed these dams were very stable, and where the silica was

so fine that it could be used almost like emery for sharpening purposes. The Wainamatta shales had proved a most interesting study to him, and he was sure they would well repay investigation.

Mr. Poole would have been pleased if the author had shown the essential difference between the Wainamatta shales and similar clays in the mother-country. With regard to the Prospect movement, there could be no blame attachable to anyone. It was apparent that this clay had some unspecified quality which came to the fore when mixed with water. On one of his visits to the dam just after the first serious movement, he took a piece of the material, sun-dried as it was, from above the water level, and laid it on the stone face of the dam, and in an hour the piece, which was originally as large as his two fists, had resolved itself into a fine sludge. It was certainly strange that some simple test had not been made to ascertain its stability for the purpose required. The construction of the dam was without doubt heavy and massive, but it was simply a large piece of earthwork with a puddle wall running through it. If the outer face had been constructed of the same material as the inner face there would have been no movement.

Mr. Seaver had not seen the Prospect dam, but he thought the bank could not have been made in layers. In many specifications it was stipulated that the tramways should be lifted and laid at different places. In Ireland, the whole earthwork of the last construction he was engaged upon was laid about two feet at a time. It appeared strange to him also that no authoritative test had been made with the clay used in the dam. The first thing to be looked to by the engineer or contractor was to find out what the clays were like. The Johnstone dam in America was made in the same way as the Prospect dam appeared to him to have been made.

Mr. Fischer: The dam was made in layers.

Mr. Haycroft thought Mr. Mackay's paper had more value from a chemical point of view, than from an engineering standpoint. He had had some experience of earthwork, but this was the first time he had heard of a water face being formed of clay

in the body, although the puddle wall at the back was, of course, formed of that material. His idea was that clay should enter into the puddle-wall, and be buttressed by the two sides. The same material being used on the outer face was not so important. No doubt it was open to atmospheric influences in that position. He had recently visited the dam, and he could see no cause for any anxiety regarding its stability.

Mr. Salmond had been on the works several times during their progress, and he might say the work was carried out in a perfectly satisfactory manner, the only point being the unfortunate selection of the clay. The clay was to be selected material, and the engineer was very careful. There was no tram laid down, but the bullock teams were managed in as careful a way, with regard to traversing the work, as was possible. In any future work no doubt the hint thus given at Prospect would not be lost sight of.

The President (Mr. A. D. Nelson) endorsed all that Mr. Salmond had said with regard to the care manifested in the construction of the dam. The prevailing opinion among many of the engineers who visited the works was that the engineer in charge was excessively careful. The bullock teams had been scientifically managed over the surface, and the workmen were carefully looked after, so that only the best material and best workmanship were employed. The prevailing opinion as to the cause of the trouble was that the water was permitted to rest upon the material too soon. The evidence was clear that the clay was not the substance it should have been. It was a matter that the Government should in any future works give their attention to.
