(4) Are there any points in connection with the scheme on which you have reason for adverse criticism? If so, give particulars.

All my reasons for criticism have been laid down in my report and in my reply to the other clauses of the order of reference.

Also reply to the following question:—

(*a*) Whether, in view of the geological formation between the gorge and the headrace and spillway, the locations of the spillway-weir, the penstock-tunnels, the outdoor station, and the power-house are situated in the best relation to each other from the viewpoints of (*a*) electrical engineering practice and (*b*) civil engineering practice?

From the civil-engineering point of view I have no adverse criticism to pass upon the general location of the different parts of the plant in relation to each other.

On the electrical side of the problem I can make no comment.

(5) Has the constructional work been well carried out?

As far as can be seen from a detail visual inspection on the site, the constructional work has been well carried out.

(6)–(7).

(6) Was the cracking which took place on the 7th June a phenomenon which should have been foreseen by those responsible for the installation?

(7) If your reply to No. (6) is in the affirmative, what steps do you consider should have been taken to prevent this cracking?

When it is taken into consideration that the nature of the ground at Arapuni is so complex and unusual that, even now after the occurrence of the rupture and with new information available as a result of special investigations subsequently carried out, opinions differ widely as to the exact cause of the rupture, it may well be said that no reproach can reasonably be supported by such principles of engineering as were generally accepted prior to the occurrence. It must not be forgotten that most hydraulic engineering undertakings of great magnitude contain items of uncertainty; that the number of such items increases in proportion to the number of unusual geological factors involved; and, last but not least, that the designer is morally bound to try to reach his objective at the smallest possible cost consistent with a reasonable prospect of safety. I want also to express the opinion that, at Arapuni, no rupture would have occurred had the bottom and sides of the headrace been provided with a suitable watertight lining. The original plans and specifications indicate that the Public Works Department was not unmindful of the possible necessity of lining portions of the headrace, and I do not think, in the light of information known prior to the failure, that the engineers responsible took an unjustifiable risk in not lining the headrace originally.

(8)–(8*v*).

(8) What, in your opinion, was the cause of the cracking? Also reply to the following points:—

(*a*) To what extent, if any, the following factors contributed towards the fracture in the hill between the gorge and the headrace and spillway:—

(i) Geological weaknesses in the headrace;
(ii) The driving and operation of penstock-tunnels;
(iii) The weight of the outdoor transformer station;
(iv) The moment exerted by the weight of water in the headrace and spillway as a force applied against the hill in the direction of the gorge;
(v) Weakening of the hill by water absorption.

The cause of the cracking which took place on the 7th June has been thoroughly discussed in my report, to which I refer.

In reply to section (iii), I am of opinion that the weight of the outdoor transformer station had no appreciable influence on the fracture in the hill.