(3) There were the very heavy blows against the rear buffer-beam of the leading car, which wrecked the upper walls of nearly half the leading compartment of each of the three following cars and tore off and broke into scrap iron the bogies and other undergear. This involved the dissipation of a great amount of energy for which a precise retardation value in feet per second per second cannot be assessed, but which nevertheless must be considered.

Without controlled tests it is not, in fact, possible to determine closely what the resistance might be in such circumstances. However, experiments on sanded catch sidings on the Burma (Metre Gauge) Railways in 1901–2 (I.S.R. Technical Paper No. 115) showed that with only 2 in. of sand on the rails, and *without any derailment* of the vehicles, the retarding effect, exclusive of the normal running resistances, ranged from approximately 9 per cent. to 12 per cent. The retardation over ballast and sleepers of a train derailed, though still on its wheels, would be very much higher; and for a train that was not only derailed but upset it would be vastly higher still.

It appears that the sum of these decelerating forces must be considered as acting, at the least, for a distance of over 250 ft. and probably of over 300 ft. The second car came to rest at a point 304 ft. distant from the position that it had occupied at the time of the derailment of the engine. However, whether 250 ft. or 300 ft. is adopted, the arithmetical result as to initial speed is not greatly affected, for the decelerating forces operating during the fraction (probably two-thirds) of a second that was occupied in travelling the first 50 ft. were less than at any other part of the action, and would not make any substantial difference in miles per hour.

We have applied degrees of retardation varying, in accordance with the continually increasing obstacles to progression, between that due to emergency braking on rails and that due to the maximum retarding effect probable (this latter acting only for the last second or less). The result is that we see no reason to consider excessive the speed estimate of 50 miles per hour arrived at by Mr. Wansbrough for the train on entering the curve: in fact, we lean rather towards the view that the speed was even higher.

Attacking the problem from a consideration of the progress of the locomotive, and adopting a conservative value for the shearing of the clay involved in the burying of the front of the engine up to the buffer, we have arrived at a figure which harmonizes reasonably with that obtained from the other calculations.

Without attempting to assess the actual values of the retarding forces, to which we have referred, we are satisfied that there are good grounds for the view that the approximation adopted by Professor Scott was, indeed, very conservative; that higher values would be appropriate in the present case; and that the observed results of the accident to train W 4 are compatible with an initial speed possibly more, but certainly not less, than about 50 miles per hour. Professor Scott's values were worked out for submission to a Board of Inquiry that investigated a derailment that took place at Opapa in 1925. At Opapa, under conditions extraordinarily similar to those found at Ratana, the locomotive after derailing travelled 120 ft., as against 142 ft. at Ratana, and the second and succeeding cars travelled 255 ft., as against 304 ft. at Ratana.

The fact that at Opapa there was a total of nine vehicles running down a steep grade, as against a total of seven vehicles at Ratana running on a level stretch of track, would lead, if equal speeds and conditions otherwise similar are assumed, to the expectation of greater travel at Opapa than at Ratana. As the reverse ratio of travel existed, it seems a reasonable conclusion, though we do not stress it, that the initial speed at Ratana exceeded that at Opapa, which, according to Professor Scott's values, was 50 miles per hour.

COMMENTS ON OTHER MATTERS.

After the accident a number of rumours gained currency, and circumstantial statements were made by witnesses regarding the subject-matter of these rumours. In particular, it was suggested that a third man travelled on the engine, that alcoholic liquor was consumed on the engine by the engine-crew, and that an emergency signal of three whistles for brakes was given immediately before the accident occurred. We have fully investigated the grounds for these rumours and statements, and are completely satisfied that they are unfounded. We find specifically that no person except the members of the engine-crew travelled on the engine at any stage of the journey, that no alcoholic liquor was consumed by the members of the engine-crew while they were on duty, and that they were not in any way under the influence of alcohol when they booked on for duty. We find also that the so-called emergency signal was nothing more than the sound made by escaping steam after the locomotive had crashed into the bank.

FINDINGS ON SPECIFIC QUESTIONS.

We have dealt with the salient features of the evidence, and now answer the specific questions addressed to us as follows:—

(1) *Question:* What was the cause of the derailment of the said train?

Answer: The cause of the derailment was the overturning of the engine, due to it entering a curve of 6·4 chains radius at a speed of approximately 50 miles per hour.

(2) *Question:* Was any employee in the service of the Government Railways Department guilty of any dereliction of duty which directly or indirectly contributed to the said derailment?

Answer: Engine-driver Percival drove the engine at a speed of approximately 50 miles per hour over a section of the line in respect of which a maximum speed-limit of 35 miles per hour is imposed, and over part of which a special speed-restriction to 20 miles per hour applies. He was sufficiently familiar with the line between Marton and Wanganui, but, owing to the presence of haze and banks of fog on the Ratana Flat, he misjudged his speed and position after passing Ratana. In strict