Mr. James Dunn said that in his opinion the judge's ruling and interpretation of the clauses in the specification were perfectly correct. Had the judge had some knowledge of the iron trade, he might have known that there was something better than *best* iron; but without this technical knowledge, and having no technical evidence to guide him, he was bound to fall upon the simple meaning of the word according to the English language. Therefore, he (the speaker) held that his Honor was right. The main question was the meaning of the term—*best Staffordshire iron for girders*. Of course they must allow the architect to know his own business best, and by specifying "best Staffordshire" he made certain of the girders being constructed from iron of high tensile strength; but that it was ever expected that they should be constructed of the very best iron, viz., B.B.B., he (the speaker) could not for one moment believe. Had the girders been built of iron of Staffordshire manufacture of the ordinary "best" quality, he presumed no objections would have been raised. At the same time, he considered iron of the *Consett best* brand quite good enough for girder work.

Mr. Robert Pollock said that on this question the learned judge decided, that as one clause in the specification specified that all the iron *used must be of the best quality*, and further, in another clause, it stated that "the girders must be constructed of *the best Staffordshire iron for girders*," that plaintiffs were bound to supply iron of the best quality of Staffordshire brand, and this question of *best* did not accordingly apply. That was to say, the judge decided that the girders were to be made from the *best* Staffordshire iron—the word *best* meaning the best quality in the *general*, and not in the *technical*, acceptation of the term. The *best* Staffordshire iron was *charcoal iron*, and Staffordshire charcoal and other plates, by quotations of December last, for charcoal ordinary sizes were £19 per ton; best, £10; B.B., £11; and B.B. best, £12 per ton; but in the same list, steel plates were quoted at £8 to £9 per ton, or just one half the price of the *very best* iron; at the same time, this steel was 30 per cent. stronger than the very best iron, or, in other words, the money value, or cost for strength of the *very best*

iron which the law had decided the contractors must supply, was three times the price of steel. The important point to consider was this: Tenders were called for a large work on certain plans and a specification, and the contractor read the specification, putting the ordinary every-day construction on it. It was a vague specification, but to an expert the meaning was perfectly clear, and conveyed that nothing more than ordinary material or workmanship was required. In all great public or other buildings in Europe, an engineer was associated with the architect in the design of such structures, and this he (Mr. Pollock) considered was the correct course, as the structural strengths were positively engineering matters, and outside of the architectural part of the work. There were, as was well known, numbers of roofs of churches and other buildings in and about Sydney that had failed, and had to be strengthened, simply because they were not designed on engineering principles; the number had been increased during the past few weeks by the failure of the Garden Palace at Ashfield, and the Grand Stand at the Agricultural Society's Grounds.

Mr. A. D. Nelson said that in speaking on this question, he felt that it was the duty of every engineer to raise his voice, as it was one of the greatest importance to the whole engineering and contracting community; it should also be one of considerable moment to the bench and bar, as when a ruling was given by a Supreme Court judge it became a precedent for guidance in the future. In glancing over the specification, they would notice that certain technical terms were used which every practical man would accept in their technical sense when making his tender, basing his calculation upon them entirely. The specification stated that the whole of the material was to be of the *best Staffordshire iron for girders*, and to be approved by the architect or clerk of works. Certainly this was as vague as it was possible to specify under the circumstances. Had a certain special brand or tests been specified, the contractor would have known beyond doubt what quality of iron he would have to use; but the trade terms *best, best best, best best best* being well understood in the profession, he could only arrive at the conclusion that *best*, or third quality of iron was

to be used in the work. He (Mr. Nelson) could not conceive that the person who drafted the specification had any other idea in his mind at the time than that the third quality of iron was to be used for if it was absolutely necessary for the very best quality of iron manufactured, according to his honor's ruling, to be used, why was it necessary to go to that expense when steel, which was one-third stronger, and in every way superior to iron, could be obtained at one-half of the cost. There were many cases in which technical terms and points arose, which placed a judge in a very peculiar position, and although he might be thoroughly conversant with law, it was impossible for him to be so with engineering practice. Had his Honor permitted Mr. Harrison to explain the terms in his evidence, the verdict would no doubt have been different. It was a very easy matter for an architect to step outside the sphere in which he had been educated, in which he had gained experience, and of which he was supposed to know something, and draft a specification for a structure which was foreign to him, and of which he, comparatively speaking, knew nothing. He maintained that the designing and constructing of girders was engineers work. The condition under the specification—which empowered the architect as sole judge of the work—was most unfair, and placed the contractor entirely in his hands, without the possibility of appeal or redress. The contractors in this instance had not been fairly treated, as the continued alterations in dimensions and number of the girders, clearly proved that the designers were very undecided as to what they wanted, or that their knowledge was very limited. If the matter had been placed in the hands of a competent engineer, there would have been no necessity for these alterations. He (the speaker) considered that some steps should be taken in dealing with cases where technical, or trade terms were used. Germany had made an advance in this direction which had met with the approval of the people, and had reduced litigation to a minimum.

Professor KERNOT said that a specification should be drafted in as clear and concise a manner as possible, to prevent any misunderstanding. He strongly advocated having an engineer

acting with the architect in designing structures where iron was to be used, as the man who could design a beautiful front would most probably get befogged with the girders and other iron work, and *vice versa*.

He had tested a piece of what was professed to be very ordinary Staffordshire iron, a few days back, with the result that it elongated 8″ in 6 feet, before it fractured. This, according to some specifications he had seen, would have been an objection, and, as an example, he might mention the standard specification under which a half million pounds worth of bridges had been built in Victoria. He had called attention to this point, and it had been remedied. On the Victorian railways they were now working under a very reasonable specification. The elongation in the testing of iron was to be at least 7 per cent.

Professor WARREN said he wished to compare the specification under discussion with others which had been drafted by some of the most eminent engineers, and cited the following examples:— 1st. The Londonderry Bridge, by Sir John Hawkshaw, "the wrought iron shall be equal to the very best Staffordshire." 2nd. The Tumna Bridge, by Messrs. Rendall, "all parts in tension shall be capable of bearing a strain of twenty tons per square inch under the concussion of a blow struck with a heavy hammer." 3rd. Taptee Viaduct and other bridges on the Bombay and Baroda Railway, by Lieut-Col. J. P. Kennedy, the specification states "wrought iron shall stand twenty-four tons without fracture." 4th. Charing Cross Bridge, by Sir John Hawkshaw, "the whole of the wrought iron to be equal in quality to the very best Staffordshire." 5th. Pimlico Bridge, by Sir John Fowler, "the iron must stand—

18 tons without a greater elongation than $\frac{1}{8}$″ in $6\frac{1}{4}$″
21 ,, ,, ,, ,, ,, $\frac{1}{4}$″ ,, ,,
23 ,, ,, ,, ,, ,, $\frac{1}{2}$″ ,, ,,
24 ,, ,, ,, ,, ,, $\frac{3}{4}$″ ,, ,,

and all bars must bear a tensile strain of twenty-six tons before fracture, the brand to be guaranteed Monk Bridge Crown plates or equal quality." He had not selected these examples as bad

specifications, as the names associated with them was a sufficient guarantee, and he contended that the specification for the Town Hall girders compared favourably with these. He might mention that Sir John Fowler had latterly modified his specifications to twenty-two tons per square inch with an elongation of ten per cent., and the iron to be equal in quality to the best Staffordshire plate.

With regard to his action in condemning the iron, he wished to state that the specimens tested in tension were prepared in a most accurate manner by Mr. Key. The contraction of areas were carefully measured with vernier callipers to $\frac{1}{1000}$ of an inch, and everything possible was done to ensure accuracy. Some of the samples were tested by Mr. Max Thompson, Assistant Engineer of the Existing Lines Department, and were considered by that gentleman good enough for the purpose, and that it would be received by his Department as suitable for bridges according to the position in which it was used. The results upon which Mr. Thompson based his opinion were obtained with the Government testing machine, the measurements were taken to $\frac{1}{64}$ of an inch, the machine itself although good enough for rough testing could not be compared with the one at the University for accuracy. Still the results obtained were unsatisfactory, and he could not understand how Mr. Thompson could think the iron good enough for bridges. It was most important for bridge work and large girders, such as those for the Centennial Hall, that the material should be uniform in quality and possess the necessary strength and ductility. The iron supplied by the contractors as the "best Staffordshire girder iron" was not uniform in quality, in two cases out of fifteen the strength was insufficient and the ductility unsatisfactory, moreover the fractures showed considerable lamination and crystal. He would like to ask those members who consi lered the iron good enough the following questions:—1st. What would be the effect of using a very hard and a moderately ductile piece of iron in the same flange of a girder? 2nd. How would the stresses be distributed over the rivets in consequence of this want of homogeniety? 3rd, How would it be affected by sudden loads brought on it by heavy

traffic? 4th. Upon what principles would he design the joints in the flanges knowing that the stress could not be equally distributed over the rivets? Taking all these points into consideration he came to the conclusion that it would be unsafe to use such material in the Centennial Hall girders.

With regard to an ideal specification for future guidance, he had submitted a specification of tests, which he had drawn up to supersede those clauses over which there had been so much discussion, to the President (Mr. W. Cruickshank) and Mr. Norman Selfe, and these gentlemen had signed it on behalf of the contractors. They were as follows:—"The wrought iron must be uniform in quality, and free from scales, blisters, laminations, and all other defects, and every plate and bar must be branded. The plates to be perfectly true, and of uniform thickness. The angle irons and bars to be sound, and regular on their edges.

"Tests: Four samples will be selected from each scantling of the boom plates, web plates, angle and tee bars in the main and longitudinal girders, and from the tee iron rafters, tie bar struts and purlins of the roof. Two of each of the samples to be cut and prepared for test in tension in the University machine, and two of each for testing, by bending under the steam hammer or hydraulic press. If in any case two or more brands should be supplied for iron of the same scantling, then, from each brand of iron so supplied, four samples will be selected and prepared for testing in the manner above described. The plates and tee bars must not fracture under a tension of less than 22 tons per square inch with the fibre, and 18 tons across the fibre. The contraction of area, at fracture, to be not less than fifteen per cent. when tested with the fibre, and five per cent. when tested across the fibre. The bars and angle iron must not fracture under a tension of 23 tons per square inch, and the contraction of area, at fracture, must not be less than eighteen per cent. The plates must bend cold round a bar one inch in diameter through the following angles:—

$\frac{1}{2}$ in.	thick	with	the	fibre...	... 35°
$\frac{1}{12}$,,	,,	across	,,	,, ...	... 15°
$\frac{5}{16}$,,	,,	with	,,	,, ...	... 60°
$\frac{5}{16}$,,	,,	across	,,	,, ...	... 250°

and other thicknesses in proportion. Should any specimen fail to stand the above tests, the whole of the iron of the same brand and scantling as that from which the specimen has been prepared will be rejected."

The mathematical and practical knowledge necessary in the design of ironwork, was quite distinct from that knowledge which enabled a man to design the elevation of an important building, and he doubted if it was possible to combine the two faculties in the one man, except in very rare cases. If an architect was anxious to do his best for his client, and also avoid any risk to public life, he should call in the assistance of an engineer for designing the ironwork.

Mr. NORMAN SELFE said in drafting specifications, an arbitration clause should always be inserted, so that in the event of a dispute arising experts would be appointed representing both sides. By this means matters might be arranged between the disputants without having recourse to law.

Mr. FISCHER then moved, seconded by Mr. J. P. Franki, the adjournment of the discussion until the next meeting.