know as little of their manufacture. In order to develop a product, it is necessary to know something of both. This knowledge it also necessary in order to draw up an intelligent specification; otherwise you are going to require something not essential which will increase the cost, or you may omit something which will not affect the cost, but will be injurious to the product. At an instance, I would again cite the quench test contained in numerous specifications for seamless steel locomotive tubes. This test requites a strip or section of tube to stand bending without failure after being heated to a cherry red in daylight and quenched in cold water. The requirement was copied into specifications for seamless tubes, from older specifications for welded tubes, no consideration being given to the difference between the two materials. Welded tubes are necessarily made from low carbon material and, hence, can stand the test; while seamless steel tubes are necessarily made from a higher-carbon steel, which hardens slightly under the specified treatment. The test does not copy any service condition and shows no other quality of the material, except that it hardens slightly under the treatment. The evil of the requirement lies in the indefiniteness af the term "cherry red." If the temperature to which the test piece is heated is not more than 700°C., seamless material will stand the test; but, if the test piece is heated to 900°C., a failure is certain. In fairness to manufacturer and user, the specification should be made definite or omitted.

On the other hand, the flattening test, the expanding test, and the crushing test are all practical tests. The expansion test shows the ductility, the flattening test provides against crystallization, and the crushing test indicates very clearly how that tube is going to act under the beading tool.

Chairman,—

For the benefit of the members who are not acquainted with the manner of making these tests, would you mind illustrating them on the blackboard.

Mr. Dunn then described various tests with sketches on the blackboard.

Mr. Dunn,—

I understand that the time is limited. When I get to talking on this subject, I never stop. You have asked a large number of very interesting questions, and I am very sorry that I have not answered them more clearly. I thank you very much for the attention you have given me.