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DEVELOPMENT OF QUALITY JURISPRUDENCE

By W. A. Sheehar

My colleagues have often confronted me with the question: If quality jurisprudence is as important as you think it is, why in the name of heaven have we engineers not heard more about it than we have in the past? Well, the answer to such a question is not hard to discover as I shall now attempt to show.

In the light of the theory and art of quality control as we see it today, there must first come an appreciation of the need for generally accepted specifications of the qualities of the things wanted, then an appreciation of the need for making things of the quality specified and then, after engineers have squabbled long enough over trying to find out whether the things made have the quality specified, an appreciation of the need for a generally accepted science and art of judging quality. Now it took the Great War to get engineers to appreciate the need for national and international standards. It took several years for industry to establish the necessary standardizing bodies; it took several years more for such specified standards to become more or less generally accepted. Now that producers have had several years of experience trying to produce in accord with specifications and consumers have had a chance to try to buy in accord with specifications, we are beginning to appreciate some of the real problems of judging quality or, in other words, some of the problems involved in trying to determine whether or not the quality of a thing is that specified or, more important yet, whether or not it is that which is wanted. Hence it is not to be wondered at that we as engineers are only now beginning to sense the need for a uniformly acceptable theory of quality jurisprudence.

However, there is another reason why we have not heard much about this new field of interest. That reason is simply that the subject matter is by its very nature pretty much foreign to the training and experience of the average engineer. Hence two consequences: It will take some time to develop an adequate quality jurisprudence acceptable to the representatives of organized society and it will take still longer for engineers to become familiar with it in much the same way that in the beginning of the history of law it took considerable time for the development of the theory and practice of law and a considerable additional time for the development of the necessary practicing lawyers. Let us develop these two reasons a little further.

- 1. Representatives of industrial corporations, standardizing bodies industrial and governmental, technical and scientific societies, and the like.



Let us look at this matter of the time required to make any important headway in giving official status to specifications. It is significant that whereas mass production really started about 1787, it was more than a century - not until 1898 - that the interest in developing generally accepted specifications of quality became sufficient to bring about the organization of the first industrial standardizing body. In fact, up to the outbreak of the Great War only one society of this character had been formed. Between 1917 and 1935, however, 24 industrial standardizing societies, either national or international, came into existence.

The number of specifications issued by these various groups increased rapidly and so soon as they had been more or less generally adopted and put into application it was but natural to expect that questions would arise as to whether or not the quality of the things as manufactured was actually that which was specified. For example, in many instances it was necessary to rely on the process of sampling to get a picture of the quality of the product either because of the destructive nature of the test or because of the prohibitive cost of 100% inspection. Gradually more and more engineers became alive to the fact that assurance as to the quality of the uninspected portion of the lot depended among other things upon the sample size and the method of inspection. In this way they first began to appreciate the need for adopting more or less generally acceptable and uniform practices in the determination of sample size and the specification of tolerances for sampling variations and the like. It was in this way that some ten or fifteen years ago engineers began to sense one of the elemental problems in the process of judging quality of product as to whether or not it was in accord with that specified.

However, to sense the sampling problem was one thing and to solve it was another. In the first place, it took several years to sense it and in the second place, it then took several more years for these engineers to get in a position where they could talk about it intelligently. To handle the problems which arose, it was necessary to make use of the available theory of probable inference and the theory of statistics both of which are subjects with which most engineers were and many still remain to a large extent unfamiliar. In fact, the theory of sampling and the theory of probable inference are two subjects that are scarcely touched upon in engineering schools and very few engineers indeed have ever been exposed in their formal courses of training to even the elements of such theory. Although a few indications of the appreciation of the existence of the general problems of sampling in the

control of quality and still fewer attempts to solve some of these problems appear in the engineering literature since 1900, it was not until the formation of the Joint Committee for the Development of Statistical Applications in Engineering and Manufacturing in 1929 that the statistical aspect of the subject of judging quality was given more or less official status by some of the important engineering societies.<sup>1</sup> Since that time similar committees have been established in England, Germany, and elsewhere. The need for such work has been officially recognized in both industrial and government circles in India, Poland, Roumania, and the U.S.S.R. In England, for example, the British Standards Institution has already published a monograph (1935) on the application of statistics in the field of standardization and the Royal Statistical Society has inaugurated (1934) a supplement to its regular journal for the sole object of treating what may be considered to be the statistical aspects of quality control problems in industry and agriculture.

The situation as just considered illustrates how the appreciation of the need for the solution of the sampling problem of judging lagged several years behind the introduction of specifications and in turn how the development of even the more or less generally accepted preliminary steps in the application of statistics lagged behind the appreciation of the problem. Here we are in 1936 and still it is true perhaps that the majority of those who really need to know something about the theory of sampling in their every day quality control work still do not know what a standard deviation means. But as already indicated, this situation is rapidly improving.

What is far more important, however, the sampling problem is only one of the aspects of the more general problem of judging quality as has already been pointed out in previous discussions of quality control originating in the Bell System. The really difficult problem is to judge whether or not a thing is satisfactory, adequate, dependable, and economic as fixed in terms not only of specifications but also of custom, precedent, authority, and natural law holding at any given instant. Furthermore, the quality of greatest interest from this viewpoint is the wantableness of the thing which may not be fixed rigorously by the specifications of a finite number of physical characteristics. It is but to be expected, therefore, that even where engineers have tackled and solved the sampling problems involved in determining the quality of lots in terms of specified quality characteristics, they have come sooner or later to see that the solution of such problems is

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1. The sponsor bodies of this committee are The American Society of Mechanical Engineers, the American Society for Testing Materials, along with the American Mathematical Society, and the American Statistical Association. The American Standards Association cooperated although its organization is of such a nature that it could not formally act as a sponsor.

not the be-all and end-all of judging quality. Hence we are in 1936 in respect to the broader aspects of the problem of judging quality about where we were in 1929 in respect to the sampling problems involved in judging. We are, I hope, at the place, where some definite step will be taken by separate industries, as was done in 1929, to cooperate with some of the standardizing bodies in establishing the necessary committee organization to sponsor a straightforward scientific attack upon the broader aspects of the problem of judging quality.

Just as in 1929 it was necessary to go outside the field of engineering into the theory of statistics and mathematical probability to get the necessary techniques for solving the sampling problem, it will be necessary in the present instance to tap still other reservoirs of scientific information just as foreign, if not more so, to the field of engineering as was the theory of sampling in 1929. For example, in order to get an adequate basis for rating quality it will be necessary to take into account the theory of value and the psychology of the wants of an individual and of a social group. In order to solve the problem of determining when a specification has said something in a perfectly definite operationally verifiable manner, it will be necessary not only to apply what has already been done in the field of the operational theory of meaning but also to develop this theory beyond the point of its development now in the literature. Incidentally, some important steps have already been taken by members of the staff of the Laboratories in this direction although this material has not as yet been published.

Enough perhaps has been said to indicate a pretty rational answer to the question of the first paragraph or, in other words, enough has been said to show why it is that inspection engineers are only now getting under way in developing a rational theory of quality jurisprudence. With the same cooperation on the part of industrial groups and scientific societies<sup>1</sup> in setting up a plan of sponsoring such a development as existed in 1929 in the case of the sampling problem, we may hope within a comparatively short time to go a long way to provide a rational basis for judging quality acceptable to the representatives of the organized groups involved. It will, however, as in the case of the application of the theory of sampling in quality control, be necessary to get this general theory before the many engineers who are now responsible for judging quality in the various industries.

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1. Whereas statistical and mathematical societies cooperated in forming the 1929 committee, in the present case we shall need in addition the cooperation of those interested in psychology, logic, legal jurisprudence, and management, as well as certain others as the developments proceed.

One thing quite favorable to progress is that many of the problems involved are so closely analogous to the similar legal problems of judging that many aspects of legal jurisprudence can be carried over and modified in the field of quality jurisprudence. Likewise, the quality engineer will find available for his use many important developments in the field of the theory of value and the theory of meaning.

In considering thus briefly the development of quality jurisprudence, it is perhaps fitting to call attention to some of the signs of the times indicating the importance of proceeding as rapidly as possible with the development and practice of an adequate quality jurisprudence. As already noted, the quality of product that industry sets itself up to give is that which is wanted or, in other words, that which is satisfactory, adequate, dependable, and economic from the viewpoint of organized society. That is, organized society wants something and industry sets about to satisfy these wants. Already we hear in many quarters criticism of industry because it fails to give what is wanted, because in certain cases it fails to use specifications that give adequate protection to the consumer. In most, if not all, of these instances, however, such criticisms are levelled by persons ignorant of the fundamental problems involved in the judging of quality. It is not only desirable, of course, to develop as rapidly as possible an adequate quality jurisprudence to acquaint engineers therewith, but also it is desirable and necessary to acquaint those in the key positions of organized society with such a quality jurisprudence in order that it may be made acceptable to them as a rational basis upon which to decide quality questions involving society, on the one hand, and industry on the other.

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