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Glass as Evidence

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Mr. President, Ladies and Gentlemen, I must first express my strong disapproval of the use of the word Evidence associated with the work of the forensic scientist. It is the job of the scientist to produce information—specialised information—and to give this information, together with an assessment of the scientific value of the information, to the appropriate authorities. It is rare that the scientist has any extensive knowledge of the whole case for the prosecution and, therefore, it is rare that he can assess the value of his information as evidence. This applies even more strongly with respect to the case for the defence.

Certain information regarding glass may be of great value in one case and valueless in another. The finding of glass fragments in the trouser turn-ups of a young man, charged with breaking a shop window and stealing, was of considerable evidential value when he explained the fragments by saying that he had been sleeping rough and must have slept on a heap of broken glass. The same information was valueless in a similar case where the defendant said that he was a painter and decorator and he had recently been cutting and fitting new windows in a house.

This is not to say that the expert witness does not need a high degree of experience and skill in knowing what type of information is likely to be of value to a Court and the best way of obtaining it. I remember a case when a member of my staff went to court and gave evidence that certain fragments of glass found on the clothing of the accused were identical in physical properties with a control sample from a broken window. A very high powered expert called by the defence, who had the highest academic qualifications and years of experience in glass technology, testified that he had examined the fragments, the control glass and a number of other similar glasses by spectrographic analysis and had been unable to distinguish between any of them and, in his opinion, it was not possible to identify glass fragments. My assistant was called in rebuttal and said that spectrographic analysis was useless in such cases but without effect and the accused was acquitted. My assistant, of course, was right and the defence expert did not have the necessary expertise in this field despite his qualifications and experience.

What are the properties which are available for identifying the source of glasses? Obviously the best form of identification is one which enables the expert to assert definitely that two pieces of glass come from the same original article. There are three ways of achieving this. Firstly, there is the mechanical fit. This is most usually achieved with fragments of headlamp glass or bottle fragments. This is because the objects are discrete and it is possible to find and collect all the broken fragments. The most celebrated case of this type was the bottle used in a case of manslaughter which was completely assembled by Thompson of the Preston Laboratory and a fragment found in the hair of the deceased was fitted into the assembled bottle—a prodigious task.

The second method of positive identification is by means of hatch marks. These are marks on the edges of pieces of glass along the line of the fracture and they consist of a series of parallel lines approximately at right angles to the surface of the glass which are caused by the relief of the stress due to the bending of the glass prior to breakage. Since the position of the hatch marks is purely at random depending on the angle and degree of stress and the strength and support of the pane of glass, it can be readily shown that the odds against any particular pattern occurring at random is many millions to one against even in the simplest of cases.

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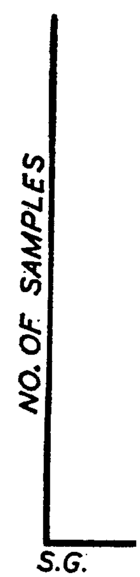

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The third method is the presence of conchoidal fractures. When a fragment of glass flakes off the surface of a pane of glass, the broken surface bears on it a series of concentric conchoidal markings caused by the same mechanism as that producing hatch marks and the degree of uniqueness of these markings are of the same order as those of hatch marks. Although these last two methods are applied only in certain specialised cases, they can be employed in any case involving glass although a considerable amount of work may be involved in finding the fit. Nevertheless, where the seriousness of a case warrants the work and all the broken glass can be recovered, the methods have great merit.

It is not always possible to find conclusive evidence of this nature. In fact, in most cases which involve broken panes of window glass, it is necessary to find other means of identification. As already stated, spectrographic analysis is useless. This is because window glass is made on a very large scale from standard ingredients—soda, lime and sand—to close limits. It is only because the high viscosity of molten glass renders perfect physical mixing almost impossible that anything can be done at all. There are, however several methods available of which the two most valuable are the determination of specific gravity and of refractive index. These properties are not completely independent of each other, in general the higher the S.G. the higher the R.I. Although, however, there is a correlation between the two, nevertheless, there are distinctive differences so that the determination of the two properties increases the chances of identity.

In the 1930s when window glass was made by a number of firms using simple and unstandardised methods there was a considerable range in the values obtained for both S.G. and R.I. The numbers of glasses falling at increasing

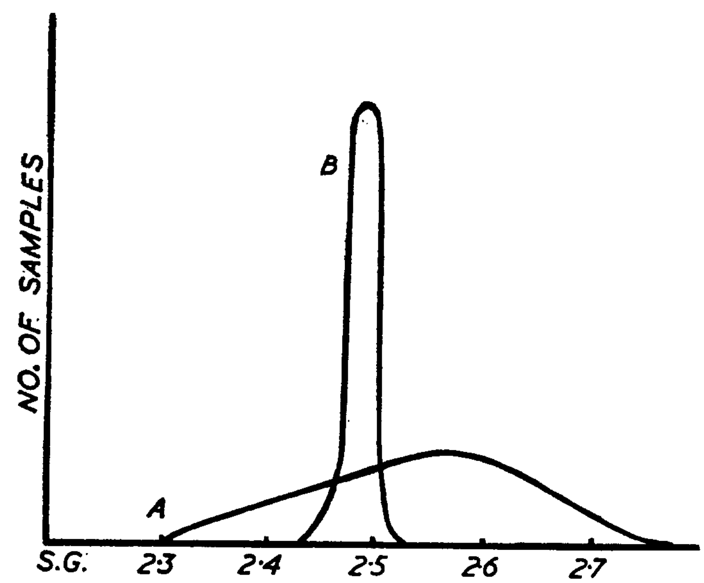

FIGURE 1.—Range of specific gravities in glass samples in Britain for (A) 1930 to 1940 and (B) modern glass manufacture.

values of these properties produces a gaussian type curve as shown at A in Fig. 1. The area covered by a determination of S.G. together with the probable error of ±0.0005 is a small proportion of the total curve and, therefore, as will be explained in more detail by a later speaker, the identity value of the determination is high. In post war years, however, the manufacture of window glass has become essentially concentrated in one firm using large scale automated methods of manufacture and conducted to close tolerances. As a result the distribution curve more resembles curve B, Fig. 1. It will be seen that in this case, with the same probable error in the determination the identity value of the determination is low.

In all cases where the information is not conclusive in itself it is necessary to advise the court of the probable value of the information. This is not easy to determine exactly and the value depends on the circumstances. My observations would indicate, for example, that, for a window on an estate of houses all built at the same time, the probability of obtaining two identical windows at random is of the order of 10 to 1 against. In a more miscellaneous area this probability becomes 50 to 1, while in an area of diverse housing the figure may rise to as much as 1,000 to 1.

Finally there are the special glasses, barium glasses are used for headlamps, lead glasses for ornamental glassware, borosilicate glasses for kitchen ware and arsenic glasses for jewellery to name a few. Spectrography is of great value in examining such glasses though useless for window glasses. Coloured glasses are also examined by spectrography to identify the colouring agent. The transmitted spectrum of visible light is also of value. These additional tests add to the value of information already obtained by the more usual methods.

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