Section on Scientific Papers

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THE CHEMIC EXPERT WITNESS.

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General. The flow of evidence on the witness stand might be likened to the alternating electric current: the change from attack to defense is the change of polarity; the ordinary witness furnishes a monophase current; and the expert witness furnishes a polyphase current. Or, passing from analogy to fact, court precedents establish a great difference between the ordinary witness and the expert witness. The ordinary witness has the sole function of testifying to the pertinent facts which have come under his personal observation. On the other hand the expert witness has no less than six functions, namely:

(1) Testimony as to *ordinary facts;;*
(2) Testimony as to *expert facts personally observed;*
(3) Testimony as to *expert facts observed by others* and within his field and knowledge as an expert;
(4) Testimony as to his *direct expert opinions;*
(5) Testimony as to the *opinions held by other experts;*
(6) Testimony as to his *opinions of other expert opinions.*

The expert's testimony as to ordinary facts includes such matters as his qualifications as an expert; the history of his connection with the case; dates and localities of viewing objects in the case; of persons present during stated times and at stated places; when, how and from whom samples and exhibits were received; histories of samples, etc., before and after being received by him; conditions of containers; and so on indefinitely. What may easily be overlooked in this line of testimony may also be vital to the whole case. For example, if the chemic expert receive a sample which, on the witness stand, cannot be completely and legally identified, then the chemist's labor and testimony are valueless. Such a break in the complete chain of identity of a sample may occur either before or after the chemist receives it. The expert must be careful to provide against this line of attack—which has such great possibilities that one is surprised at the perfunctory manner in which acute counsel often conduct this portion of their examination.

Testimony as to expert facts personally observed, includes such matters as the expert's experience; the rationale and minutiæ of his tests; and his personal knowledge of the scientific data upon which his tests, observations and conclusions are founded. This is the most difficult portion of the chemic expert's testimony.

Testimony as to expert facts observed by others, and within his knowledge

and field as an expert include the pertinent recorded facts of science as they are understood by the expert, and employed by him explicitly or implicity; consciously or subconsciously; correctly or erroneously. This, though unconsciously so, is really the major portion of the scientific expert's testimony—and it is one of the easiest portions. If the recorded facts of science had the same force as the recorded decisions of courts, which conclude judicial proceedings, it would simply be necessary to state the references involved; but, unfortunately, it is a truism that the records of science are not always rigidly exact and that they are a multitude of unprecise or erroneous statements of facts. For example, there exist, as it were, no "supreme court decisions" in chemic records. Practically the only court in which such matters are decided is the "Court of Common Consent" by scientific men. As this court, however, has neither official existence nor official records of decisions, from which citations may be made, the expert essays to guide the court and jury in these matters for the purposes of the trial. His essays may or may not truly reflect the general opinion of scientific men. Thus in drug, food and fertilizer cases, if the chemic expert cited atomic weights from the latest report of the Atomic Weight Committee of the American Chemical Society; drug standards from the United States Pharmacopœia and National Formulary; and food and fertilizer standards from the regulations of the federal and state agricultural departments and from the official methods of the American Association of Official Agricultural Chemists, he would truly report the prevailing scientific decisions in the premises. On the other hand, he might state with Professor Ramsay that certain elements had been transmuted, whereas the general opinion might agree with Mme. Curie to the contrary.

Testimony as to the expert's opinions is of minor importance in chemic expert testimony, but is of major importance in the testimony of most other expert witnesses—such as therapeutists upon the cause of death; of alienists upon the sanity of persons; of handwriting experts upon the authorship of signatures; etc.

This form of testimony when explicitly an opinion is usually based upon a hypothetic question. Ofttimes, however, the expert is asserting as a fact something which upon analysis proves to be but an opinion. The chemic expert should analyze his testimony as carefully as he analyzes his samples; and should preserve in his mind that orderly array of his testimony that will as surely assign to each part its proper sequence, designation and value as his chemic tests should assign to each reported constituent of a substance its proper identity and quantity.

Testimony as to the opinions of other experts: In this phase of his testimony, the expert merely reports without criticism the theories and conclusions which others have stated in speech, journals and text books—in contradistinction to the facts so recorded. He should guard, however, against confounding facts with theories. Much expert testimony is inaccurate owing to the expert's failure, through ignorance or inadvertence, to make clear that particular assertions are theories and not experimental facts. The truly alert cross-examiner will be alive to this distinction; and may in this way often confound an otherwise excellent expert witness.

Testimony as to the expert's opinions of other experts' opinions is ever of major importance. It consists of the expert's critiques upon journal or text book quotations; or upon the evidence of the opposing experts at the trial.

Should there be opposing experts in courts of justice? The answer is, emphatically, yes. Much has been said and written to the contrary. The "battle of experts" has been decried. Chagrined experts have cavilled against the indignities they have imagined themselves to have suffered at the hands of opposing counsel. The serene and beautiful dignity which would maintain were an "official expert" to act alone in guiding the court and jury in all questions relating to his specialty has been pictured. The injury which experts in general suffer in the newspaper and popular imagination because of the extravagant assertions on the part of some experts, and because of the conflicting evidence of opposing experts, has been deplored; and the usual ready cure-all has been suggested. But suggestions for alteration of the present court procedure are, to say the least, amateurish.

While our courts may at times dispense injustice, it is but accidental. On the whole, our court procedure is the very best machinery that man throughout his generations has been able to devise for the protection and happiness of all; and this procedure is based upon the right of trial by jury. A single judge may indeed decide upon questions of law; but his decisions are subject to appeal and revision by a higher court—in which a plurality of judges but constitutes a special kind of jury. It is just as common to have a minority opinion from a court of appeal diametrically opposed to the majority opinion as it is to have two diametrically opposed expert opinions expressed in a trial. Yet one hears no outcry against a plurality of judges; and the judges themselves are not reproached for diversity of opinion. The argument for a single expert is, when carried to its logical conclusion, but parallel with argument for trial without jury, before a one-man court of first and last resort; or for a despotism as against a constitutional monarchy; or for a constitutional monarchy as against a republic.

The mass of accumulated scientific knowledge is so vast, the opportunities for error so abundant, the stimulus to best efforts so active under criticism and so dormant in its absence, that justice is just as surely toned by the "battle of experts" as it would atrophy under the reactionary, un-American policy of the *Expert Overlord.*

The opprobrium of the expert witness. Said Pope in his moral assays:

> "Who shall decide when doctors disagree,
> And soundest casuists doubt like you and me."

It is a fact that the extravagant and conflicting character of some experts' testimonies have cast just reproach in the lay and legal mind upon expert testimony as a whole. A discussion of this condition is in order. First, is it to be noted that the condition has arisen mainly from the testimonies of handwriting experts and expert alienists. To a lesser degree, general medical experts and real estate experts have contributed to the prevailing impression. On the other hand, engineering and chemic experts, dealing as they do with so-called "exact sciences," have, on the whole, maintained a standard of testimony which is above any save nondiscriminating or captious criticism. The public, however, classes all experts together and does not differentiate between kinds of experts. Neither does it analyze the items of honest difference as seen from two meritorious viewpoints. The meritorious experts are classed with the frail.

Second, the frailty of expert testimony is rarely due to deliberate misstatements. Generally the whole trouble arises from the failure of court, counsel, jury, expert, press and public to keep at all times plainly in view the great difference between the statement of expert *fact* and the statement ofexpert *opinion*. Expert opinions are continually being rated as expert facts. Human opinions must ever differ—be they expert or otherwise. But real expert facts are more certain than other facts. Thus, a handwriting expert could say without fear of contradiction that a certain chirography exhibits specified characteristics—the writing itself can be examined and his measurements verified. He is then in the same position as an architectural expert who asserts that a building has a certain ground plan and dimensions. When, however, the handwriting expert asserts, with no further evidence than the writings themselves, that two writings were penned by the same person, he is but stating an expert opinion and not an expert fact. It may be a very valuable opinion and most necessary for the purposes of the trial; but it is, nevertheless, an opinion only. It should be clearly recognized as an opinion; every reason for the opinion should be stated with the opinion; and, if an opposing expert gives a contradictory opinion, it should be clearly stated to be an opinion and the pro and contra reasons specified in such language as to make the subject intelligible to the jury which must decide the question at issue. It is no excuse to point to the incapacity of jurymen in the premises. The jurymen may be trusted to reach the conclusion justified by the conflicting expert evidence. If the conclusion reached be false, the fault lies with the losing expert and counsel in not being properly skillful with their portion of the testimony. The court and jury have the right to expect that the counsel and expert will employ whatever time and labor are necessary for the preparation of their side of the case, so as to render it intelligible, in its salient arguments, to the average mind. Much of the criticism of jurymen is really due to the lack of preparation of the litigants. Time and labor, skill and knowledge, are so difficult to bestow in the preparation and conduct of a case—and it's so easy to say, "My failure is due to another's fault." The wise expert will refuse to serve with careless and unskilled counsel; and the wise lawyer will shun the careless and incompetent expert.

Thirdly, much of the trouble with expert testimony is due to the weakness of the expert in not saying promptly, "I do not know," in answer to what might be called "dictionary" questions in his specialty. No man carries in his mind ***all*** of the data pertaining to his profession—or even to those portions pertinent to the trial in which he may be testifying. If the expert be worthy the name, those data *essential* to his direct testimony; and, in view of the limitations of the human mind, is perfectly justified in saying, "I don't know," with respect to unessentials. That it may wound his pride is beside the point, as court procedure is not concerned with the self-love of experts. The experts—and they, alas, are too numerous—who don't know, but who strive to conceal the fact, either make guesses if they be reckless; or attempt to evade the issue if they be crafty. In both cases they are weak and unworthy.

Fourthly, the ideal expert will, *caeteris paribus,* have a perfectly logical mind; and will successfully resist the guileful methods of opposing counsel in his endeavor to befog and pervert the expert's premises and conclusions. The expert is usually beguiled by the hackneyed artifice of partial or ambiguous truths. The

cross-examiner's question will contain not only a direct question; but also one or more additional statements. The "yes" or "no" in answer to the direct questions leaves the wrong impression with regard to the additional statements. It is absolutely untrue to say, as does the cross-examiner, that any question may be answered "yes" or "no." One may illustrate by the question put to the prisoner accused of stealing a pig: "Did you steal this pig at night?" Obviously either "yes" or "no" carries the admission of theft. This homely illustration portrays clearly the method used so frequently with far more skill and artfulness by many cross-examiners. But if the expert be so beguiled, he is but silly. It is the business and duty of the expert to have his mind so orderly and his case so logically prepared that he will instantly perceive this ancient and moss-grown pitfall of the wily cross-examiner. He will evade it by answering the question as ostensibly asked; and will then insist upon continuing his answer sufficiently far to dispel the designedly erroneous inferences. Here, if he be at all tactful, he will be assisted by his own counsel and the court—but they can only protect his rights after he himself has claimed them.

Whenever an expert is caught in other pitfalls, he usually deserves his discomfiture. A familiar plan of the cross-examiner is to show where the expert's statements on the witness stand are not in harmony with opinions expressed in publications made by the expert. This line of argument is not conclusive, however, for the expert may merely have been quoting others; or may have altered his opinions. Nevertheless, it may be more or less injurious to his case. As another illustration, one may mention a case in the Philadelphia courts where a well known alienist testified that from the horizontal outline of a head at the forehead level he could determine the general mentality of a person. He was subsequently shown a number of such diagrams pricked on paper by the familiar hatters' machine for this purpose. One such diagram, declared by him to be the diagram of an idiot, was subsequently proved to be a diagram of his own head. However, his analysis of this diagram was probably correct.

The expert should avoid unnecessary emphasis of heat—which tend even though falsely, to give the impression of partisanship; but should testify quietly and with simple dignity in good English. He should indulge in no sharp rebuke or repartee. His rebuke should be by inference; and his repartee in the words and with the manner of matter-of-fact statement. This is true no matter how great his provocation.

Fifthly, the expert has often been willing to serve for such an absurdly small and pitiful fee as to preclude the possibility of the extensive care, thought and labor incident to the preparation of a case for court. In chemical work there is absolutely no parallel between analyses made for commercial purposes and analyses made for court. Yet the State of Pennsylvania has, through its agents, offered the magnificent renumeration of 50 cents per determination and $5 per day for court work in pure food and drug cases. Further comment is unnecessary.

Experience has shown that it may be necessary to give as much as three months hard work to the preparation of a single expert chemic case. One of the chiefs of division of the U. S. Bureau of Chemistry has said (privately) that if he could have a year to prepare each case, he might pose as a chemic expert. While this statement was excessive and made for emphasis of an important truth, it serves

to impress the right ideals and practice in the premises. While no exact time can be defined as the maximum for the preparation of chemic evidence, the general principle may be laid down that it requires so much time and expert skill that fees at least ten times as large as those demanded for the best commercial work should serve as the base price; and that, as with lawyers, physicians and surgeons, the chemists' time and skill should be further rewarded according to his demonstrated efficiency.

Sixthly, experts have often brought discredit upon themselves and their kind by attempting to carry their testimonies as experts beyond that field in which they are strictly qualified as experts. The courts are also to blame for this. The public is beginning to perceive that the present chaotic condition of affairs in governmental inquiries into the effect of sodium benzoate upon the public health is due to this cause. Since the two views so prominently before the public are essentially contradictory, the public knows that at least one view is false—and the shrewd suspicion has arisen that neither side has proved its case. No better example could be given of the frailty of the principle of the rule of the Expert Overlord; nor of the good that would ensue should these opposing experts be placed in such a position that their contentions would have to be conducted and decided under the admirable and orderly process of our American judicial procedure. Let us hope that some great lawsuit will come to clarify this now hopelessly entangled condition of one of the most important economic and hygienic problems in the world today.

THE RATE OF DISINTEGRATION OF PILLS.

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During the past year we have been asked to determine the fitness for medicinal use, of a number of samples of old pills. As a first step in this investigation it was decided to ascertain their rate of disintegration, since it is generally believed that old pills disintegrate, if at all only very slowly.

We endeavored to make the conditions of our experiments as favorable at least as those existing within the human body. In order to secure continued action from the disintegrating solution the pills were placed in wire cloth baskets and suspended in test-tubes about one-half inch below the surface of the 20 cc. of solution. These test-tubes were placed in a water bath and a temperature of from 37° to 38° C. maintained throughout the experiment. The pills were rubbed gently with a glass rod about every five minutes to note the progress of disintegration as well as to simulate the action of the muscular coats of the digestive organs. The effect of this manipulation with the glass rod was subsequently ascertained to have shortened the time of disintegration about 20%.

Two disintegrating liquids were used: No. 1, an aqueous solution containing 2% of pepsin and 0.25% of hydrochloric acid, and No. 2 distilled water. The results given are the means of several trials. The maximum variation in any case was not more than 10% of the mean result. The samples examined were