The Principles of Humane Experimental Technique

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CHAPTER 7

REFINEMENT

... endless forms most beautiful and most wonderful have been, and are being evolved.

The Choice of Procedures

The remainder of refinement can be reduced in principle to the matter of *choice between procedures* for a given objective. This arises especially in research, where a new problem is set in every experiment, and only subsidiary or superimposed methods are routine. But much of what we shall say applies equally to choice between procedures which are to be applied in large-scale and long-term routines.

Almost any research question, and certainly any research question of any degree of generality, can always be answered in principle by a number of different procedures. The cachet of the great experimenter is a knack for choosing the most rapid, elegant, and simple one. There is an old story of an expert called in to cope with a machine which was misbehaving. The expert looked at the machine for a few seconds, and then give it a light tap with a hammer, after which it worked perfectly. His bill for £50, when presented, seemed excessive to his clients, in view of the amount of time he had expended in their service, and they queried the amount. In reply, the expert broke down his account into a detailed statement as follows:

	£	s.	d.
To administering light tap with hammer	49	19	11-1/2
To knowing where to tap	50	0	0

Great experimentalists have always excelled in knowing where to tap, though unlike this expert they have often left their knowledge at home when engaged in tapping funds.

But are there, in this context, any simple rules? The practice of the great men seems to convey at least some guidance. One general principle important for both humanity and efficiency, is that of avoiding elaborate and roundabout methods, the great trap in a highly mechanized laboratory where apparatus of all kinds lies temptingly around (cf. e.g. Weyl, 1957). In the study of animal behavior, in particular, mechanization can be employed to great effect (e.g. by Eckhard Hess, 1957). But too often it has been a substitute for patient observation, and there has sometimes been a tendency to suppose that any technique employing visible apparatus must be more "exact" or "scientific" than a behavioral test which is really capable of much more precise and meaningful behavioral test which is really capable of much more precise and meaningful calibration. (For a particular excellent example of quantitative behavioral work with a minimum of apparatus, see Baerends *et al*, 1955; cf. also Spurway and Haldane, 1953, especially pp. 9-10.)

Another and more general rule is the very careful formulation of questions. It is a useful guiding principle in experimentation to ask the question and then draw up, at least mentally, a list of the procedures by which it could be answered. Such a process at once provides some impression of the degrees of freedom of action the experimenter is permitting himself. In the technical sense of the term, it displays the information content of the investigation. If such a list is drawn up, the best procedure may be chosen. But this is by no means all. For the poverty of the list may stimulate a reformulation of the question which, without loss of knowledge to be obtained, may permit a wider range of procedural choice. The great experimentalist probably does all this very rapidly in his head. But of course, for the drawing up of such a list, wide and often apparently useless knowledge may be indispensable. For in research we are exploring new territory, where we cannot be too well equipped.