CHAPTER VII

THE MEANING OF RISK AND UNCERTAINTY

STARTING with the individual psychology of valuation and adding new factors step by step, we have now built up a competitive industrial society involving valuation and distribution under the highly simplified conditions necessary to perfect competition. The drastic assumptions made were necessary to show the operation of the forces at work free from all disturbing influences; and impossible as the presuppositions have been, the principles involved have not been falsified or changed, but merely exhibited in purity and isolation. Chief among the simplifications of reality prerequisite to the achievement of perfect competition is, as has been emphasized all along, the assumption of practical omniscience on the part of every member of the competitive system. The task of the present chapter is to inquire more fully into the meaning of this assumption. We must take a brief excursion into the field of the theory of knowledge and clarify our ideas as to its nature and limitations, and the relation between knowledge and behavior. On the basis of the insight thus gained, it will be possible to illuminate that large group of economic phenomena which are connected with the imperfection of knowledge.

The problem may be set in view and its significance made clear by recalling certain points already brought out in the previous discussion. In chapter II it was pointed out that the failure of competition and the emergence of profit are connected with changes in economic conditions, but that the connection is indirect. For profit arises from the fact that entrepreneurs contract for productive services in advance at fixed rates, and realize upon their use by the

sale of the product in the market after it is made. Thus the competition for productive services is based upon anticipations. The prices of the productive services being the costs of production, changes in conditions give rise to profit by upsetting anticipations and producing a divergence between costs and selling price, which would otherwise be equalized by competition. If all changes were to take place in accordance with invariable and universally known laws, they could be foreseen for an indefinite period in advance of their occurrence, and would not upset the perfect apportionment of product values among the contributing agencies, and profit (or loss) would not arise. Hence it is our imperfect knowledge of the future, a consequence of change, not change as such, which is crucial for the understanding of our problem.

Again, in chapters III and IV, it was found necessary to assume static conditions in order to realize perfect competition. But, as expressly stated, this assumption was made because it follows from it as a corollary that the future will be foreknown, and not for the sake of the proposition itself. It is *conceivable* that all changes might take place in accordance with known laws, and in fact very many changes do occur with sufficient regularity to be practically predictable in large measure. Hence the justification and the necessity for separating in our study the effects of change from the effects of ignorance of the future. And chapter V was devoted to a study of the effects of change as such with uncertainty absent. Here it was found that under such conditions distribution or the imputation of product values to production services will always be perfect and exhaustive and profit absent.

Furthermore, as also argued in chapter II, it is unnecessary to perfect, profitless imputation that particular occurrences be foreseeable, if only all the alternative possibilities are known and the probability of the occurrence of each can be accurately ascertained. Even though the business

man could not know in advance the results of individual ventures, he could operate and base his competitive offers upon accurate foreknowledge of the future if quantitative knowledge of the probability of every possible outcome can be had. For by figuring on the basis of a large number of ventures (whether in his own business alone or in that of business in general) the losses could be converted into fixed costs. Such special costs would, of course, have to be given full weight, but they would be costs merely, like any other necessary outlays, and would not give rise to profit, which is a difference between cost and selling price. Such situations in more or less pure form are also common in everyday life, and various devices for dealing with them form an important phase of contemporary business organization. Some of the more important of these devices will come up for brief discussion later. At present we are concerned only to emphasize the fact that knowledge is in a sense variable in degree and that the practical problem may relate to the degree of knowledge rather than to its presence or absence *in toto*.

The facts of life in this regard are in a superficial sense obtrusively obvious and are a matter of common observation. It is a world of change in which we live, and a world of uncertainty. We live only by knowing *something* about the future; while the problems of life, or of conduct at least, arise from the fact that we know so little. This is as true of business as of other spheres of activity. The essence of the situation is action according to *opinion*, of greater or less foundation and value, neither entire ignorance nor complete and perfect information, but partial knowledge. If we are to understand the workings of the economic system we must examine the meaning and significance of uncertainty; and to this end some inquiry into the nature and function of knowledge itself is necessary.[1]

[1] The problem of uncertainty and risk in economics is, of course, not new. Some reference has already been made to the literature. It has

The first datum for the study of knowledge and behavior is the fact of consciousness itself. Apparently the higher mental operations of reason are different only in degree, only elaborations of what is inherent in the first spark of "awareness." The essence of mentality from a functional standpoint seems to be its forward-looking character. Life has been described as internal adaptations to external coexistences and sequences. On the vegetable or unconscious plane, the internal changes are simultaneous with the external. The fundamental difference in the case of animal or conscious life is that it can react to a situation before that situation materializes; it can "see things coming." This is what the whole complicated mechanism of the nervous system is "for," in the biological sense. The readjustments by which the organism adapts itself to the environment require time, and the farther ahead the organism can "see," the more adequately it can adapt itself, the more fully and competently it can live.

been recognized and discussed in three connections: (1) insurance; (2) speculation; and (3) entrepreneurship. For a full treatment of the last-named it is necessary to go to the German works cited in the historical portion of this study. English economics has been too exclusively occupied with long-time tendencies or with "static" economics to give adequate attention to this problem. For a very general discussion of uncertainty see, in addition to works already cited, Ross, *Uncertainty as a Factor in Production, Annals*, American Academy, vol. VIII, pp. 304 ff. See also Leslie, T. E. Cliffe, "The Known and the Unknown in the Economic World," *Essays in Political Economy*, pp. 221–42; Lavington, F., "Uncertainty in its Relation to the Rate of Interest," in *Economic Journal*, vol. XXII, pp. 398–409; and "The Social Interest in Speculation," *ibid.*, vol. XXIII, pp. 36–52; Pigou, A. C., *Wealth and Welfare*, part V; Haynes, John, "Risk as an Economic Factor," *Quarterly Journal of Economics*, July, 1895.

In this superficial sketch of the theory of knowledge it has not seemed important to give extended reference to philosophic literature. It will be evident that the doctrine expounded is a functional or pragmatic view, with some reservations. By way of further "reservation" we should point out that the tone of the discussion merely results from the fact that it is the function of consciousness and knowledge in relation to conduct that we are interested in, for present purposes, and the text must not be taken as expressing any view whatever as to the ultimate nature of

Just what consciousness as such has to do with it is a mystery which will doubtless remain inscrutable.[1] It is a mere brute fact that wherever we find complicated adaptations we find consciousness, or at least are compelled to infer it. Science can find no place for it, and no rôle for it to perform in the causal sequence. It is epiphenomenal. An explanation of the readjustment necessarily runs in terms of stimulus and reaction, in this temporal order. Yet in our own experience we know that we do not react to the past stimulus, but to the "image" of a future state of affairs; and for common sense, consciousness, the "image," is both present and operative wherever adaptations are dissociated from any immediate stimulus; i.e., are "spontaneous" and forward-looking. It is evident that all organic reactions relate to future situations, farther in the future as the type of life and activity is "higher." However successful mechanistic science may be in explaining the reaction in terms of a past cause, it will still be irresistibly convenient for common sense to think of it as prompted by a future situation present to consciousness. The rôle of consciousness is to give the organism this "knowledge" of the future. For all we can see or for all that science can ever tell us, we might just as well have been unconscious automata, but we are not. At least the person speaking is not, and he cannot help attributing to other creatures similarly constituted and behaving in the same way with himself "insides," to use Descartes' picturesque term, like his own. We *perceive* the world before we react to it, and we react not to what we perceive, but always to what we *infer*.

The universal form of conscious behavior is thus action designed to change a future situation inferred from a

reality or any other philosophic position. The writer is in fact a radical empiricist in logic, which is to say, as far as theoretical reasoning is concerned, an agnostic on all questions beyond the fairly immediate facts of experience.

[1] See the brilliant lectures of E. DuBois-Raymond, "Uber die Grenzen des Naturerkennens" and "Die sieben Welträtsel."

present one. It involves perception and, in addition, *twofold* inference. We must infer what the future situation would have been without our interference, and what change will be wrought in it by our action. Fortunately or unfortunately, none of these processes is infallible, or indeed ever accurate and complete. We do not perceive the present as it is and in its totality, nor do we infer the future from the present with any high degree of dependability, nor yet do we accurately know the consequences of our own actions. In addition, there is a fourth source of error to be taken into account, for we do not execute actions in the precise form in which they are imaged and willed. The presence of error in these processes is perhaps a phase of the fundamental mystery of the processes themselves. It seems to be an earnest of their non-mechanical character, for machines, generally speaking, do not make mistakes. (Though it may not be legitimate to draw inferences from the crude machines of our own construction to the infinitely more sensitive and intricate physico-chemical complexes which make up organic systems.) In any case the fact of liability to err is painfully familiar and is all that concerns us here. It is interesting to note that the perceptive faculties seem often to be less acute and dependable in the higher forms of life than in some of the lower. At least civilized man is often weak in this respect in comparison with primitive man and the higher animals. Higher powers of inference may take the place of perceptive faculties to a large extent, and we have undoubtedly developed reasoning power and lost ground with respect to keenness of sense.

It must be recognized further that no sharp distinction can be drawn between perception and reason. Our perceptive faculties are highly educated and sophisticated, and what is present to consciousness in the simplest situation is more the product of inference, more an imaginative construct than a direct communication from the nerve terminal organs. A rational animal differs from a merely

conscious one in degree only; it is *more* conscious. It is immaterial whether we say that it infers more or perceives more. Scientifically we can analyze the mental content into sense data and imagination data, but the difference hardly exists for consciousness itself, at least in its practical aspects. Even in "thought" in the narrow sense, when the object of reflection is not present to sense at all, the experience itself is substantially the same. The function of consciousness is to infer, and all consciousness is largely inferential, rational. By which, again, we mean that things not present to sense are operative in directing behavior, that reason, and all consciousness, is forward-looking; and an essential element in the phenomena is its lack of automatic mechanical accuracy, its liability to error.

The statement that a situation not in physical relations with an organism, not even in existence, influences that organism, is of course in a sense figurative; the influence is indirect, operating through a situation with which the organism is in contact at the moment. Hence, as already pointed out, it is always theoretically possible to ignore the form of the conscious relation, and interpret the reaction as a mechanical effect of the cause actually present. But it remains true that practically we must regard the situation present to consciousness, not the one physically present, as the controlling cause. In spite of rash statements by over-ardent devotees of the new science of "behavior," it is preposterous to suppose that it will ever supersede psychology (which is something very different) or the theory of knowledge, in something like their historic forms.

It is evident that the possibility of a situation not present, operating through one which is present, is conditioned upon some sort of dependable relation between the two. This postulate of all knowledge and thought has been variously formulated as the "law" or "principle" of "causality," and "uniformity" or "regularity" of nature, etc.

Remembering that we are speaking of the surface facts, not metaphysical interpretations, we may say that all reasoning rests on the principle of analogy. We know the absent from the present, the future from the now, by assuming that connections or associations among phenomena which have been valid will be so; we judge the future by the past. Experience has taught us that certain time and space relations subsist among phenomena in a degree to be depended upon. This dogma of uniformity of coexistence and sequence among phenomena is a fairly satisfactory statement of the postulate of thought and forward-looking action from the standpoint of the philosopher. But from the more superficial standpoint of common sense (and hence of an inquiry such as the present) the term "phenomenon" is rather vague and elusive, and a more serviceable formulation seems possible. Common sense works in terms of a world of objects or merely "things." Consequently the idea of things manifesting *constant modes of behavior* seems to be a better "category" than that of uniformity of relation among phenomena. This may be unsatisfactory to the philosopher, who will protest at once that the thing is merely a sum of its modes of behavior, that no such separation is really possible. It is the ancient riddle which so puzzled Locke, of the attribute and substratum, the substratum, of course, tending to evaporate under critical scrutiny. But this weakness may prove rather a source of strength for the use which we intend to make of the notion, as will be argued.

We have, then, our dogma which is the presupposition of knowledge, in this form; that the world is made up of *things*, which, *under the same circumstances*, always *behave in the same way*. The practical problem of inference or prediction in any particular situation centers around the first two of these three factors: what things are we dealing with, and what are the circumstances which condition their action? From knowledge of these two sets of facts it must be

possible to say what behavior is to be expected. The chief logical problem, as already noticed, lies in the conception of a "thing." For it is obvious that the "circumstances" which condition the behavior of any particular thing are composed of other things and their behavior. The assumption that under the same circumstances the same things behave in the same ways thus raises the single question of how far and in what sense the universe is really made up of such "things" which preserve an unvarying identity (mode of behavior). It is manifest that the ordinary objects of experience do not fit this description closely, certainly not such "things" as men and animals and probably not even rocks and planets in the strict sense. Science has rested upon the further assumption that this superficial divergence of fact from theory arises because the "things" of everyday experience are not the "ultimate" things, but are complexes of things which really are unchanging. And the progress of science has consisted mostly in *analyzing* variable complexes into unvarying constituents, until now we have with us the electron.

But *workable* knowledge of the world requires much more than the assumption that the world is made up of units which maintain an unvarying identity in time. There are far too many objects to be dealt with by a finite intelligence, however unvarying they might be, if they were all different. We require the further dogma of identical similarity between large numbers of things. It must be possible not merely to assume that the *same* thing will always behave in the same way, but that the *same kind* of thing will do the same, and that there is in fact a finite, practically manageable number of *kinds* of things. Hence the fundamental rôle which *classification* has always played in thought and the theory of thought. For our limited intelligence to deal with the world, it must be possible to infer from a perceived similarity in the behavior of objects to a similarity in respects not open to immediate observa-

tion. That is, we must assume that the properties of things are not shuffled and combined at random in nature, but that the number of groupings is limited or that there is constancy of association. This is the dogma of the "reality of classes," familiar to students of logic.

But even this is not enough. If the classification of objects be restricted to the grouping of things in *all* respects similar or substantially identical, there would still be a quite impossible number of *kinds* of things for intelligence to grasp. Even in the sense of practical degrees of completeness of similarity, identity to ordinary observation, our groups would be far too small and too numerous. It is questionable whether classification would be carried far enough on this basis to be of substantial assistance in simplifying our problems to the point of manageability. It is not that kind of a world. And even abstracting from mere differences in degree such as size and the like, for which intelligence readily makes allowance, the same would still hold true. It is clear that to live intelligently in our world, — that is, to adapt our conduct to future facts, — we must use the principle that things similar in some respects will behave similarly in certain other respects even when they are very different in still other respects. We cannot make an exhaustive classification of things, but must take various and shifting groupings according to the purpose or problem in view, assimilating things now on the basis of one common property (mode of behavior) and now on the basis of another. The working assumption of practical inference about the environment is thus a working number of properties or *modes of resemblance* between things, not a workable number of kinds of things; this latter we do not have. That is, the properties of things which influence our reactions toward them must be sufficiently limited in number and in modes of association for intelligence to grasp.

We may sum up these facts about the environment of

our lives which are fundamental for conduct in the following propositions:

1. The world is made up of objects which are practically infinite in variety as aggregates of sensible qualities and modes of behavior not immediately sensible. And when we consider the number of objects which function in any particular conduct situation, and their possible variety, it is evident that only an infinite intelligence could grasp all the possible combinations.
2. Finite intelligence is able to deal with the world because
   a. The number of distinguishable properties and modes of behavior is limited, the infinite variety in nature being due to different combinations of the attributes in objects.
   b. Because the properties of things remain fairly constant; and
   c. Such changes in them as take place occur in fairly constant and ascertainable ways.
   d. The non-sensible properties and modes of behavior of things are associated with sensible properties in at least fairly uniform ways.

It is to be noted under (a) that differences in kind are referred to rather than differences in degree, and we should add that

3. The quantitative aspect of things and the power of intelligence to deal with quantity is a fundamental element in the situation.
4. It is also fundamental that in regard to certain properties objects differ *only* in degree, that mass and spacial magnitude are *universal* qualities of things, which do not exhibit differences in kind.
5. Following out the same principle of (4) many of the most significant properties are common to very large groups; in respect to the qualities most important for

conduct, there are a very few kinds. The intelligibility of the world is enormously increased if not actually made possible by the simplicity of the great divisions into solid, liquid, and gas, into living and not-living things, and the like. And there is a hierarchy of attributes [1] in order of generality down to the slight peculiarities which probably distinguish in some manner and degree (other than mere situation) every nameable thing in the universe from every other, giving it individuality.

6. The postulates of intelligent behavior would be very incomplete without formal insistence on the rôle played by the fact of consciousness in "objects" outside ourselves, human beings and animals. The behaviorist notwithstanding, the inferences as to the behavior to be anticipated which we draw from the configuration of the lines about the mouth, the gleam or "twinkle" of an eye or a shrill or "soft" vocal sound, are not made from these physical features as such or alone, but through "sympathetic introspection" [2] into what is going on in the "mind" of the "object" contemplated, and would be impossible without this mysterious capacity of interpretation. It is always possible for the scientist to argue the contrary, as it is for him to demonstrate that we are not really conscious ourselves, but common sense properly revolts against the one conclusion as against the other.
7. It goes without saying that we must know ourselves as well as the world. Hence we must list our sense of our own powers of movement, etc.

It is perhaps superfluous to speak here of the syllogism and its place in logical theory. Empirical logicians such

[1] Cf. Comte's *Classification of the Sciences.*

[2] Professor Cooley's descriptive phrase. See *Social Organization*, chap. I.

as Mill and Venn have ventilated the subject sufficiently and shown that no real inference is involved in the syllogism itself, that the inference takes place in the formulation of the premises and consists in the recognition of a constant factual connection between the predicates denoted by the different terms.

We are rather concerned here with pointing out that the theory of knowledge as it is worked out by logicians is primarily a theory of *exact* knowledge, of rigorous demonstration. It has become somewhat the fashion, especially since Bergson came into vogue, to be irrationalistic, and question the validity of logical processes. It seems to the writer that there is much ground for this position, but that its implications are very liable to be misunderstood. There is to my mind no question of understanding the world by any other method. There is, however, much question as to how far the world is intelligible at all. This will be seen to be a question of the facts as to the uniformity of behavior of natural objects and the similarities subsisting between them, on the ground of which inference is made from one to another. In so far as there is "real change" in the Bergsonian (i.e., Heracleitean) sense it seems clear that reasoning is impossible. In addition we have to make the still more questionable assumption that the situation elements or fundamental kinds of object properties upon which we fall back for simplicity (practically finitude) in view of the unmanageable number of kinds of objects as wholes, are unvarying from one "combination" (i.e., one object) to another. This assumption is doubtless valid in some connections. Thus weight, inertia, etc., are undoubtedly the same in a living as in a non-living object. But that the quality "living" is really the same in any two kinds of living things is more open to doubt. In so far as these general attributes are not uniform and cannot be given a definite meaning which is the same for all the objects in the class which they designate, reasoning from one

member of the class to another is clearly invalid. That is, valid classification assumes identity in some respect. It is not absolutely certain that the ground on which we ascribe similarity to things and class them together and reason from the behavior of one to that of the other is always of this character. The power of one thing to suggest another is often quite mysterious, and may possibly not rest upon the possession of any common real qualities which will support a valid inference.[1]

The practical limitation of knowledge, however, rests upon very different grounds. The universe may not be ultimately knowable (we speak, of course, only of objective phenomena, of behavior, not of problems which transcend ordinary experience of fact); but it is certainly knowable to a degree so far beyond our actual powers of dealing with it through knowledge that any limitations of knowledge due to lack of real consistency in the cosmos may be ignored. It probably occasions surprise to most persons the first time they consider seriously what a small portion of our conduct makes any pretense to a foundation in accurate and exhaustive knowledge of the things we are dealing with.

It is only when our interest is restricted to a very narrow aspect of the behavior of an object, dependent upon its physical attributes of size, mass, strength, elasticity, or the like, that exact determination is theoretically possible; and only by refined laboratory technique that the determination can be actually made. The ordinary decisions of life are made on the basis of "estimates" of a crude and superficial character. In general the future situation in relation to which we act depends upon the behavior of an indefinitely large number of objects, and is influenced by so many factors that no real effort is made to take account of them all, much less estimate and summate their separate significances. It is only in very special and crucial

[1] See James, *Psychology*, chap. XXII, on "Association by Similarity."

cases that anything like a mathematical (exhaustive and quantitative) study can be made.

The mental operations by which ordinary practical decisions are made are very obscure, and it is a matter for surprise that neither logicians nor psychologists have shown much interest in them. Perhaps (the writer is inclined to this view) it is because there is really very little to say about the subject. Prophecy seems to be a good deal like memory itself, on which it is based. When we wish to think of some man's name, or recall a quotation which has slipped our memory, we go to work to do it, and the desired idea comes to mind, often when we are thinking about something else — or else it does not come, but in either case there is very little that we can tell about the operation, very little "technique." So when we try to decide what to expect in a certain situation, and how to behave ourselves accordingly, we are likely to do a lot of irrelevant mental rambling, and the first thing we know we find that we have made up our minds, that our course of action is settled. There seems to be very little meaning in what has gone on in our minds, and certainly little kinship with the formal processes of logic which the scientist uses in an investigation. We contrast the two processes by recognizing that the former is not reasoned knowledge, but "judgment," "common sense," or "intuition." There is doubtless some analysis of a crude type involved, but in the main it seems that we "infer" largely from our experience of the past as a whole, somewhat in the same way that we deal with intrinsically simple (unanalyzable) problems like estimating distances, weights, or other physical magnitudes, when measuring instruments are not at hand.[1]

The foregoing discussion of reasoning relates to ideal or complete inference based on uniformity of association of predicates and which can be formulated in universal propo-

[1] Marshall remarks that the business manager's decisions are guided by "trained instinct" rather than knowledge. (*Principles*, 6th ed., p. 406.)

sitions. The theory of formal deductive logic has, of course, always recognized also reasoning from what are undescriptively called "particular" propositions — "occasional" would be a better term — asserting that two predicates *sometimes* belong to the same subject, or that two classes of objects overlap. The goal of science is always to get rid of this form of assertion, to "explain" the occurrence and non-occurrence of the quality by finding some other general fact in the past history of the object with which the association is universal. But there are large classes of cases in which this cannot be done even scientifically, and the rough operations of everyday unscientific thinking employ the form quite commonly. In the crude form of "*some* X is Y," such generalizations are very unsatisfactory to the scientific mind and practically useless except as a challenge and starting-point for further inquiry. But when, as is so commonly the case, it is impossible or impracticable to do better, the data can often be put in a form of a great deal of scientific utility. This is done by ascertaining the numerical proportion of the cases in which X is associated with Y, which yields the familiar probability judgment. If, say, ninety per cent of X is Y, — i.e., if that fraction of objects characterized by property X shows also property Y, — the fact may obviously have much the same significance for conduct as if the association were universal.[1]

Furthermore, even if the proportion is not approximately one hundred per cent, even if it is only half or less, the same fact may hold good. If in a certain class of cases a

[1] When variations in degree in the attributes X and Y are taken into account, the problem must be dealt with by applying the statistical theory of correlation, which is a further development of probability theory. See especially the works of K. Pearson and F. Y. Edgeworth. An elementary discussion will be found in any treatise on statistics. A. L. Bowley's *Measurement of Groups and Series* is particularly serviceable for the general reader. A rough idea may be obtained from Elderton's *Primer of Statistics*. Pearson's *Grammar of Science*, chaps. IV and V, may be consulted on the whole ground of the present chapter.

given outcome is not certain, nor even extremely probable, but only contingent, but if the numerical probability of its occurrence is known, conduct in relation to the situation in question may be ordered intelligently. Business operations, as already observed, illustrate the point perfectly. Thus, in the example given by von Mangoldt, the bursting of bottles does not introduce an uncertainty or hazard into the business of producing champagne; since in the operations of any producer a practically constant and known proportion of the bottles burst, it does not especially matter even whether the proportion is large or small. The loss becomes a fixed cost in the industry and is passed on to the consumer, like the outlays for labor or materials or any other. And even if a single producer does not deal with a sufficiently large number of cases of the contingency in question (in a sufficiently short period of time) to secure constancy in its effects, the same result may easily be realized, through an organization taking in a large number of producers. This, of course, is the principle of insurance, as familiarly illustrated by the chance of fire loss. No one can say whether a particular building will burn, and most building owners do not operate on a sufficient scale to reduce the loss to constancy (though some do). But as is well known, the effect of insurance is to extend this base to cover the operations of a large number of persons and convert the contingency into a fixed cost. It makes no difference in the principles whether the grouping of cases is effected through a mutual organization of the persons directly affected or through an outside commercial agency.

It will be evident that the practical difficulties of ordering conduct intelligently are enormously increased where the inference is contingent instead of being positive. The difficulties of establishing an association between predicates are great enough where the association is universal; so great, as we have already seen, that it is never done with any approach to accuracy except for critical cases of very

special importance justifying extensive study in laboratory or "field." Where the connection is occasional, demonstration of a dependable connection is vastly more difficult, and there is the added problem of ascertaining the precise proportion of cases in which the connection occurs. In relation to everyday problems, where rigorous scientific procedure is excluded, the difficulty and chance of error are, of course, multiplied in still greater degree. We have to "estimate" not merely factors whose associates, implications, or effects are known, but in addition the degree of dependability of the association between the (estimated) factors (the immediately perceptible attributes or modes of behavior) and the inferred factors with relation to which our action in the case is to be controlled. Most of the real decisions of life are based on "reasoning" (if such it may be called) of this still more tenuous and uncertain character, and not even that which has already been described. We have to estimate the given factors in a situation and also estimate the probability that any particular consequence will follow from any of them *if* present in the degree assumed.

For logical accuracy and in order to understand the different kinds of situations and modes of dealing with them in practice, a further distinction must be drawn, a distinction of far-reaching consequences and much neglected in the discussion of economic problems. There are two fundamentally different ways of arriving at the probability judgment of the form that a given numerical proportion of X's are also Y's. The first method is by *a priori* calculation, and is applicable to and used in games of chance. This is also the type of case usually assumed in logical and mathematical treatments of probability. It must be strongly contrasted with the very different type of problem in which calculation is impossible and the result is reached by the empirical method of applying statistics to actual instances. As an illustration of the first type of

probability we may take throwing a perfect die. If the die is really perfect and known to be so, it would be merely ridiculous to undertake to throw it a few hundred thousand times to ascertain the probability of its resting on one face or another. And even if the experiment were performed, the result of it would not be accepted as throwing any light on the actual probability. The mathematician can easily calculate the probability that any proposed distribution of results will come out of any given number of throws, and no finite number would give *certainty* as to the probable distribution. On the other hand, consider the case already mentioned, the chance that a building will burn. It would be as ridiculous to suggest calculating from *a priori* principles the proportion of buildings to be accidentally destroyed by fire in a given region and time as it would to take statistics of the throws of dice.

The import of this distinction for present purposes is that the first, mathematical or *a priori*, type of probability is practically never met with in business, while the second is extremely common. It is difficult to think of a business "hazard" with regard to which it is in any degree possible to calculate in advance the proportion of distribution among the different possible outcomes.[1] This must be dealt with, if at all, by tabulating the results of experience. The "if at all" is an important reservation, which will be discussed presently. It is evident that a great many hazards can be reduced to a fair degree of certainty by statistical grouping — also that an equally important category cannot. We should note, however, two other facts. First, the statistical treatment never gives closely accurate quantitative results. Even in such simple cases as mechanical games of chance it would never be final, short of an infinite number of instances, as already observed. Furthermore, the fact that *a priori* methods are inapplicable is

[1] The calling of bonds by lot is an illustration. In Germany bondholders often insure against this chance.

connected with a much greater complication in the data, which again carries with it a difficulty, in fact impossibility, of securing the same degree of homogeneity in the instances classed together. This point will have to be gone into more fully. The second fact mentioned in regard to the two methods is that the hazards or probabilities met with in business do admit of a certain small degree of theoretical treatment, supplementing the application of experience data. Thus in the case of fire risk on buildings, the fact that the cases are not really homogeneous may be offset in part by the use of judgment, if not calculation. It is possible to tell with some accuracy whether the "real risk" in a particular case is higher or lower than that of a group as a whole, and by how much. This procedure, however, must be treated with caution. It is not clear that there is an ultimate separation between the calculation of departures from a standard type and more minute classification of types. There is, however, a difference in form, and insurance companies constantly follow both practices, that of defining groups as accurately as possible and also that of modifying or adjusting the coefficient applied within a class according to special circumstances which are practically always present.

We thus find that there are two logically different types of inference included in the probability judgment. We shall refer to these for brevity under the names of the "*a priori*" and the "statistical" respectively. The relations between the two concepts as employed in the crude usage of common sense are much confused and the ideas themselves blurred, so that it is important to emphasize the contrast. The precise meaning of "real probability" will have to be examined more in detail presently, but we can see that there is a difference in this respect in our feelings toward the two classes of cases. It seems clear that the probability of getting a six in throwing a die is "really" one in six, no matter what actually happens in any particular

number of throws; but no one would assert confidently that the chance of a particular building burning on a particular day is "really" of any definite assigned value. The first statement has intuitive certainty with reference to a particular instance; in case of the second it is merely an empirical generalization with reference to a group. Possibly the difference is partly a matter of habit in our thinking and to some extent illusory, but it is none the less real and functional in our thinking. There is, indeed, a sort of logical paradox in the problem. If the probability in a game of chance is questioned, there is no test except that of experimental trial of a large number of cases, and under some circumstances we should conclude that the die was *probably* "loaded." This would itself be a probability judgment, to be sure, and would depend on the fact of our ignorance of the composition and manufacture of the die. Given this ignorance, a mathematician could tell the probability that the die is false, indicated by any given number and distribution of throws.

The practical difference between *a priori* and statistical probability seems to depend upon the accuracy of classification of the instances grouped together. In the case of the die, the successive throws are held to be "alike" in a degree and a sense which cannot be predicated of the different buildings exposed to fire hazard. There is, of course, a constant effort on the part of the actuary to make his classifications more exact, dividing groups into subgroups to secure the greatest possible homogeneity. Yet we can hardly conceive this process being carried so far as to make applicable the idea of real probability in a particular instance.

There is a further difficulty, amounting to paradox, in the idea of homogeneous grouping. Much is made of this point in treatises on statistics, the student being warned against drawing conclusions from distributions in non-homogeneous groups. Perhaps the most familiar example

is the age and sex distribution of population aggregates. An illustration (used by Secrist) is the death rate of the American soldiers in the Philippines, which was lower than that of the general population in the United States. The fallacy in the inference as to healthfulness of environment is, of course, that the "general population" is not a homogeneous group, but is made up of numerous age, sex, race, and occupation classes, "naturally" subject to widely different death rates. The paradox, which carries us at once into the heart of the logical problem of probability, is that if we had *absolutely* homogeneous groups we should have uniformity and not probability in the result, or else we must repudiate the dogma of the ultimate uniformity of nature, the persistence of identity in things. If the idea of natural law is valid at all, it would seem that men exactly alike and identically circumstanced would all die at once; in any particular interval either all or none would succumb, and the idea of probability becomes meaningless. So even in the case of the dice; if we believe in the postulates which make knowledge possible, then dice made alike and thrown alike will fall alike, and that is the end of it.

Yet practically there is no danger, figuratively speaking, that any of these phenomena will ever be amenable to prediction in the individual instance. The fundamental fact underlying probability reasoning is generally assumed to be our ignorance. *If* it were possible to measure with absolute accuracy all the determining circumstances in the case it would seem that we should be able to predict the result in the individual instance, but it is obtrusively manifest that in many cases we cannot do this. It will certainly not be proposed in the typical insurance situations, the chance of death and of fire loss, probably not even in the case of gambling devices. The question arises whether we should draw a distinction between necessary and only factual ignorance of the data in a given case. Take the case of balls in an urn. One man knows that there are

red and black balls, but is ignorant of the numbers of each; another knows that the numbers are three of the former to one of the latter. It may be argued that "to the first man" the probability of drawing a red ball is fifty-fifty, while to the second it is seventy-five to twenty-five. Or it may be contended that the probability is "really" in the latter ratio, but that the first man simply does not know it. It must be admitted that practically, if any decision as to conduct is involved, such as a wager, the first man would have to act on the supposition that the chances are equal. And if the real probability reasoning is followed out to its conclusion, it seems that there is "really" no probability at all, but certainty, if knowledge is complete. The doctrine of real probability, if it is to be valid, must, it seems, rest upon inherent unknowability in the factors, not merely the fact of ignorance. And even then we must always consult the empirical facts, for it will not do to assume out of hand that the unknown causes in a case will distribute themselves according to the law of indifference among the different instances. We seem to be driven back to a logical *impasse*. The postulates of knowledge generally involve the conclusion that it is really determined in the nature of things which house will burn, which man die, and which face of the thrown die will come uppermost. The logic which we actually use, however, assumes that the result is really indeterminate, that the unknowable causes actually follow a law of indifference. The phenomenal constancy of distribution to which we are forced to appeal justifies this reasoning on the whole, but clearly is not its actual basis in our thinking. Wherever we find that there is not indifference, that the results show "bias," we assume some determinable cause at work; and the results of experience on the whole justify this assumption also.

There is a further point of some interest in regard to our probability reasoning. Examination of the mathematical theory of probability will show that the argument always

proceeds on the assumption that there is no middle ground between complete determination and complete indifference. That is, the *elementary* probabilities in any form of problem must always be equal. If the chance of any particular result is more or less than one half, it is held to be axiomatic that there is a greater number of possible alternatives which yield this result (or do not yield it) than of the other kind; the alternatives themselves must be *equally probable.* The whole mathematical theory of probability is obviously a simple application of the principles of permutations and combinations for finding out the number of alternatives. Absolute indifference between the alternatives is taken for granted. Wherever the results do not show complete indifference between alternatives it is assumed that these are not simple, and further analysis is applied to reduce them to combinations of equally possible ones. And experience confirms these assumptions also.

Are we, then, to assume real indeterminateness, in the cosmos itself? This was the view of Cournot, and the mere ignorance theory common among writers on probability seems inadequate and untenable. There are, to be sure, cases which it seems to fit, like that referred to, where the probability of drawing a red or black ball is even to one who knows only that there are balls of the two colors in the urn, but is ignorant of the numbers of each.[1] But the case of the man who does know the numbers of each seems to be different. The dogmatic determinist can always maintain that there are causes at work which decide the result, but common sense is not satisfied. How does it "happen" that experience justifies the calculation of probabilities unless these unknown causes are really indifferent? Whenever we find "bias" in the results, a divergence from the anticipations on the basis of probability theory, we assume

[1] Professor Irving Fisher is particularly insistent upon the interpretation of probability as due to ignorance alone. See *The Nature of Capital and Income*, chap. XVI, sec. 1.

the presence of some cause which is not indifferent, and this procedure is also justified of its fruits. When we can be sure that we have eliminated every circumstance which can be measured or which might act consistently, we feel confident in assuming that in a large number of trials the results will come out in accordance with the assumption that the factors not subject to measurement or elimination are in fact indifferent. And not merely do we feel this way, but "it works."

It is interesting to observe that the common applications of probability in games of chance relate to some action of the human organism itself, the drawing of a card from a deck or ball from an urn after random manipulations, the impulse given to a wheel or coin or die, etc. The facts suggest a connection with that other age-old bone of contention, the freedom of the will.[1] If there is real indeterminateness, and if the ultimate seat of it is in the activities of the human (or perhaps organic) machine, there is in a sense an opening of the door to a conception of freedom in conduct. And when we consider the mystery of the rôle of consciousness in behavior and the repugnance which is felt by common sense to the epiphenomenal theory, we feel justified in further contending for at least the possibility that "mind" may in some inscrutable way originate action. Just how much or what sort of significance the admission may have for practical ethics is another question, which must be passed over here. Of course we cannot prove that the exact distribution of all the *coups* of the roulette wheels at Monte Carlo was *not* stowed away somewhere in the primeval nebula; the final appeal must be to "intrinsic reasonableness," the inveterate and necessary preference of intelligence for the simplest formulation which conforms to the facts. And about this, there may indeed be differences of opinion, and from these there is apparently no appeal.[2]

[1] Cf. E. Borel, *Le Hasard*, pp. 196–97.

[2] See Karl Pearson's essay on "The Scientific Aspects of Monte Carlo

There may be different brands of "common sense" (which some wag has averred is so called because so very uncommon). In the writer's view the doctrine of ignorance or "insufficient reason" is untrue to the feelings of unsophisticated intelligence. We do not merely feel that we know no reason why the coin shall fall heads or tails; we know in a positive sense that there *is no reason*, and only under this condition do we make the probability judgment with any confidence. And furthermore, as already argued, it appears that only on condition that there is no reason would the results of experience confirm the judgment, as they do. The entire science of probability in the mathematical sense is based on the dogmatic assumption that the ultimate alternatives are really *equally probable*, which seems to the writer to mean real indeterminateness.[1]

Professor Irving Fisher's view of probability as "always an estimate" becomes conditionally valid, however, on two interpretations. In the first place, it may be saved "theoretically" if the term "estimate" is construed broadly enough. If there is no difference between our *a priori* judgment of the absence of any cause which should lead a

Roulette," in *The Chances of Death and Other Studies in Evolution*. The necessity of constant appeal to a dogmatic preference of simple to complicated hypotheses is brilliantly treated in Poincaré's chapter on "Probabilities," in *The Foundations of Science, Science and Hypothesis*, chap. XI. See also Poincaré's fascinating treatment of the relations between small causes and large effects in the same volume, *Science and Method*, chap. IV. Poincaré bases the doctrine of equal probability on the mathematical principle that for small changes any continuous analytical function changes in the same ratio as the variable. The same unsatisfactory, if not absurd, doctrine of "intrinsic reasonableness" (for how can one thing be "intrinsically" more probable than another?) is developed from a different point of view in Balfour's *Theism and Humanism*, lecture VII, on "Probability, Calculable and Intuitive."

[1] For an excellent brief discussion of the issue, with references to the literature, the reader is referred to Arne Fisher, *The Mathematical Theory of Probability*, chap. I: "General Principles and Philosophic Aspects." The writer's position is that taken by Fisher and designated the principle of "cogent reason" in opposition to the older view common among mathematicians, of "insufficient reason." Compare also La Place, *Essay on the Philosophical Theory of Probability*.

coin or a die to fall on one face rather than another and an "estimate" of equal probability, then there is no opposition between the two views. This is, however, repugnant to common sense (the present writer's brand). We seem to experience an "apodeictic certainty" about the situation of a game of chance, on a level with our confidence in the axioms of mathematics, and quite different from an "estimate." To illustrate, suppose we are allowed to look into the urn containing a large number of black and red balls before making a wager, but are not allowed to count the balls: this would give rise to an estimate of probability in the correct sense; it is something very different from either the mere consciousness or ignorance on which we act if we know only that there are balls of both colors without any knowledge or opinion as to the numbers or the exact knowledge of real probability attained by an accurate counting of the balls. In the second place, we must admit that the actual basis of action in a large proportion of real cases is an estimate. Neither of these interpretations, however, justifies identifying probability with an estimate.

But the probability in which the student of business risk is interested *is* an estimate, though in a sense different from any of the propositions so far considered. To discuss the question from this new point of view we must go back for a moment to the general principles of the logic of conduct. We have emphasized above that the exact science of inference has little place in forming the opinions upon which decisions of conduct are based, and that this is true whether the implicit logic of the case is prediction on the ground of exhaustive analysis or a probability judgment, *a priori* or statistical. We act upon estimates rather than inferences, upon "judgment" or "intuition," not reasoning, for the most part. Now an estimate or intuitive judgment is somewhat like a probability judgment, but very different from either of the tyres of probability judg-

ment already described. The relations between the two sorts are in fact amazingly complex and as fraught with logical paradox as the probability judgment itself. If the term "probability" is to be applied to an estimate — and the usage is so well established that there is no hope of getting away from it — a third species under that genus must be recognized. Such a third type of probability fits very nicely in a scheme of classification with the two already discussed. We have insisted that there is a fundamental difference between "*a priori*" probability, on the one hand, and "statistical," on the other. In the former the "chances" can be computed on general principles, while in the latter they can only be determined empirically. This distinction is in opposition to the views of writers such as Venn and Edgeworth,[1] who reduce the former type to the latter on the basis of an empirical law of large numbers and accept practically the assumption of real indeterminateness. We have already raised the question of accuracy of classification in this connection, suggesting that the "instances," "throws," or "*coups*" in a game of chance form a homogeneous group in a higher sense than can be predicated on life or fire hazards. This view and our entire theory tend to be confirmed by the attempt to secure complete homogeneity through more minute classification. The end result of this endeavor would be groupings in which only really indeterminate factors should differ from one instance to another.

Taking, then, the classification point of view, we shall find the following simple scheme for separating three different types of probability situation:

1. *A priori* probability. Absolutely homogeneous classification of instances completely identical except for really indeterminate factors. This judgment of probability is on the same logical plane as the propositions of mathematics (which also may be viewed, and are

[1] "The Philosophy of Chance," *Mind*, vol. 9, 1884.

viewed by the writer, as "ultimately" inductions from experience).

2. Statistical probability. Empirical evaluation of the frequency of association between predicates, not analyzable into varying combinations of equally probable alternatives. It must be emphasized that any high degree of confidence that the proportions found in the past will hold in the future is still based on an *a priori* judgment of indeterminateness. Two complications are to be kept separate: first, the impossibility of eliminating all factors not really indeterminate; and, second, the impossibility of enumerating the equally probable alternatives involved and determining their mode of combination so as to evaluate the probability by *a priori* calculation. The main distinguishing characteristic of this type is that it rests on an empirical classification of instances.
3. Estimates. The distinction here is that there is *no valid basis of any kind* for classifying instances. This form of probability is involved in the greatest logical difficulties of all, and no very satisfactory discussion of it can be given, but its distinction from the other types must be emphasized and some of its complicated relations indicated.

We know that estimates or judgments are "liable" to err. Sometimes a rough determination of the magnitude of this "liability" is possible, but more generally it is not. In general, any determination of the value of an estimate must be merely empirical, secured by the tabulation of instances, thus reducing it to a probability of the second or statistical type. Indeed, since, as we have noticed, entirely homogeneous classification of instances is practically never possible in dealing with statistical probability, it is clear that the divergence from it of this third type where all classification is excluded is a matter of degree only. There are all gradations from a perfectly homogeneous group of

life or fire hazards at one extreme to an absolutely unique exercise of judgment at the other. All gradations, we should say, except the ideal extremes themselves; for as we can never in practice secure completely homogeneous classes in the one case, so in the other it probably never happens that there is *no* basis of comparison for determining the probability of error in a judgment.

The theoretical difference between the probability connected with an estimate and that involved in such phenomena as are dealt with by insurance is, however, of the greatest importance, and is clearly discernible in nearly any instance of the exercise of judgment. Take as an illustration any typical business decision. A manufacturer is considering the advisability of making a large commitment in increasing the capacity of his works. He "figures" more or less on the proposition, taking account as well as possible of the various factors more or less susceptible of measurement, but the final result is an "estimate" of the probable outcome of any proposed course of action. What is the "probability" of error (strictly, of any assigned degree of error) in the judgment? It is manifestly meaningless to speak of either calculating such a probability *a priori* or of determining it empirically by studying a large number of instances. The essential and outstanding fact is that the "instance" in question is so entirely unique that there are no others or not a sufficient number to make it possible to tabulate enough like it to form a basis for any inference of value about any real probability in the case we are interested in. The same obviously applies to the most of conduct and not to business decisions alone.

Yet it is true, and the fact can hardly be over-emphasized, that a judgment of probability is actually made in such cases. The business man himself not merely forms the best estimate he can of the outcome of his actions, but he is likely also to estimate the probability that his estimate is correct. The "degree" of certainty or of confidence

felt in the conclusion after it is reached cannot be ignored, for it is of the greatest practical significance. The action which follows upon an opinion depends as much upon the amount of confidence in that opinion as it does upon the favorableness of the opinion itself. The ultimate logic, or psychology, of these deliberations is obscure, a part of the scientifically unfathomable mystery of life and mind. We must simply fall back upon a "capacity" in the intelligent animal to form more or less correct judgments about things, an intuitive sense of values. We are so built that what seems to us reasonable is likely to be confirmed by experience, or we could not live in the world at all.

Fidelity to the actual psychology of the situation requires, we must insist, recognition of these two separate exercises of judgment, the formation of an estimate and the estimation of its value. We must, therefore, disagree with Professor Irving Fisher's contention [1] that there is only one estimate, the subjective feeling of probability itself. Moreover, it appears that the original estimate may be a probability judgment. A man may act upon an estimate of the chance that his estimate of the chance of an event is a correct estimate. To be sure, after the decision is made he will be likely to sum all up in a certain degree of confidence that a certain outcome will be realized, and in practice may go farther and assume that the outcome itself is a certainty.

Two sorts of difficulty tend to obscure the relation between our second and third types of probability, that which rests upon an empirical classification of instances and that which rests upon no classification, but is an estimate of an estimate. In the first place, nothing in the universe of experience is absolutely unique any more than any two things are absolutely alike. Consequently it is always possible to form classes if the bars are let down and a loose enough interpretation of similarity is accepted. Thus, in

[1] See *The Nature of Capital and Income*, p. 266.

the case above mentioned, it might or might not be *entirely* meaningless to inquire as to the proportion of successful factory extensions and the proportion of those which are not. In this particular case it is hard to imagine that any one would base conduct upon a judgment of the probability of success arrived at in this way, but in other situations the method could conceivably have more or less validity. We must keep in mind that for conduct a probability judgment based on mere ignorance may be determining if it is the best that can be had. It would be a question, however, whether the person placed in the position of our business manager should regard the probability *for him* of success as that indicated by statistics of "similar" instances or simply even chances each way based on the fact of pure ignorance. What does appear certain is that his own estimate of the value of his own judgment would be given far greater weight than either sort of computation.

A still more interesting complication, and one of much greater practical significance, is the possibility of forming a class of similar instances on entirely different grounds. That is, instead of taking the decisions of other men in situations more or less similar objectively, we may take decisions of the same man in all sorts of situations. It is indisputable that this procedure is followed in fact to a very large extent and that an astounding number of decisions actually rest upon such a probability judgment, though it cannot be placed in the form of a definite statistical determination. That is, men do form, on the basis of experience, more or less valid opinions as to their own capacity to form correct judgments, and even of the capacities of other men in this regard. To be sure, both bases of classification are more or less taken into account; the estimate (by A or any one else) of the probability that the outcome of a situation will be that which A has predicted is not based on a perfectly general estimate of A's capacity to form judgments, but of his

powers in a more or less defined field of prediction. It will at once occur to the reader that this capacity for forming correct judgments (in a more or less extended or restricted field) is the principal fact which makes a man serviceable in business; it is the characteristic human activity, the most important endowment for which wages are received. The stability and success of business enterprise in general is largely dependent upon the possibility of estimating the powers of men in this regard, both for assigning men to their positions and for fixing the remunerations which they are to receive for filling positions. The judgment or estimate as to the value of a man is a probability judgment of a complex nature, indeed. More or less based on experience and observation of the outcome of his predictions, it is doubtless principally after all simply an intuitive judgment or "unconscious induction," as one prefers.

It seems likely that a still further distinction may be drawn, leading to the recognition of another basis of classification of instances in order to reach a probability judgment. We mean the subjective feeling of confidence of the person making a prediction. I may have an intuitive feeling or "hunch" that a situation will eventuate in a certain way, and this feeling may inspire a more or less deliberative confidence by its very strength and persistence. The confidence in a prediction which is based on the strength of an intuition may appear to be compounded to the point of nonsense, but in so far as there exist such feelings reached unconsciously or without deliberation and in so far as they may become the objects of deliberative contemplation, the situation is none the less real. However, we cannot extend our inquiry to cover all the grounds on which men, even educated men, actually make decisions, or it will degenerate into a catalogue of superstitions. Let us try, then, to sum up the conclusions, significant for present purposes, to which the argument of the chapter leads.

The importance of uncertainty as a factor interfering with the perfect workings of competition in accordance with the laws of pure theory necessitated an examination of foundations of knowledge and conduct. The most important result of this survey is the emphatic contrast between knowledge as the scientist and the logician of science uses the term and the convictions or opinions upon which conduct is based outside of laboratory experiments. The opinions upon which we act in everyday affairs and those which govern the decisions of responsible business managers for the most part have little similarity with conclusions reached by exhaustive analysis and accurate measurement. The mental processes are entirely different in the two cases. In everyday life they are mostly subconscious. We know as little why we expect certain things to happen as we do the mechanism by which we recall a forgotten name. There is doubtless some analogy between the subconscious processes of "intuition" and the structure of logical deliberation, for the function of both is to anticipate the future and the possibility of prediction seems to rest upon the uniformity of nature. Hence there must be, in the one case as in the other, some sort and amount of analysis and synthesis; but the striking feature of the judging faculty is its liability to error.

The real logic or psychology of ordinary conduct is rather a neglected branch of inquiry, logicians having devoted their attention more to the structure of demonstrative reasoning. This is in a way inevitable, since the processes of intuition or judgment, being unconscious, are inaccessible to study. Such attention as has been given to the problem of intuitive estimation has been connected with and largely vitiated by confusion with the logic of probability. A brief examination of the probability judgment shows it to fall into two types, which we called the *a priori* and the statistical. In the latter type of situation, we cannot, as we can in the former, calculate the true

probability from external data, but must derive it from an inductive study of a large group of cases. This limitation involves a serious logical weakness, since at best statistics give but a probability as to what the true probability is. In practice we are still further handicapped by the impossibility of attaining complete homogeneity in our groups of instances, in the sense in which the "*coups*" in *a priori* probability are homogeneous; that is, that the divergences are practically indeterminate as well as undetermined.

The liability of opinion or estimate to error must be radically distinguished from probability or chance of either type, for there is no possibility of forming *in any way* groups of instances of sufficient homogeneity to make possible a quantitative determination of true probability. Business decisions, for example, deal with situations which are far too unique, generally speaking, for any sort of statistical tabulation to have any value for guidance. The conception of an objectively measurable probability or chance is simply inapplicable. The confusion arises from the fact that we do estimate the value or validity or dependability of our opinions and estimates, and such an estimate has the same *form* as a probability judgment; it is a ratio, expressed by a proper fraction. But in fact it appears to be meaningless and fatally misleading to speak of the probability, in an objective sense, that a judgment is correct. As there is little hope of breaking away from well-established linguistic usage, even when vicious, we propose to call the value of estimates a third type of probability judgment, insisting on its differences from the other types rather than its similarity to them.

It is this third type of probability or uncertainty which has been neglected in economic theory, and which we propose to put in its rightful place. As we have repeatedly pointed out, an uncertainty which can by any method be reduced to an objective, quantitatively determinate

probability, can be reduced to complete certainty by grouping cases. The business world has evolved several organization devices for effectuating this consolidation, with the result that when the technique of business organization is fairly developed, measurable uncertainties do not introduce into business any uncertainty whatever. Later in our study we shall glance hurriedly at some of these organization expedients, which are the only economic effect of uncertainty in the probability sense; but the present and more important task is to follow out the consequences of that higher form of uncertainty not susceptible to measurement and hence to elimination. It is this *true uncertainty* which by preventing the theoretically perfect outworking of the tendencies of competition gives the characteristic form of "enterprise" to economic organization as a whole and accounts for the peculiar income of the entrepreneur.