VARIATION IN FLOOD HAZARD PERCEPTION: IMPLICATIONS FOR RATIONAL FLOOD-PLAIN USE

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Recently I had occasion to take part in an informal university symposium entitled "The Other Two Cultures." Unlike C. P. Snow's two cultures, which were essentially that of the scientists and the humanists, the other two cultures dealt with the gap between the world of academia and the rest of the world.[1] While opinions varied, there was a consensus that such a hiatus exists, although few shared one panelist's characterization of the polarity as that lying between "us and the boobs."

I would suggest it even less likely that the insulting dichotomy of "us and the boobs" would find many adherents at this symposium. To the contrary, the healthy respect that planners and technical people hold for their clientele in the United States is a source of envy in many nations where the attitude of the educated elite to the resource managers, particularly in agriculture, seems marked by a thinly disguised veneer of contempt.

Yet it is my thesis that there is a real dichotomy between the way the technical-scientific community concerned with resources management approaches certain problems and the way the resource manager, particularly in the private sector, views similar situations. We do not go around calling land owners boobs but we do, I suggest, partly ascribe the views of resource managers that fail to be in accord with our own to three equally unflattering reasons: ignorance, cupidity, or irrationality.

The Flood-Damage-Protection Treadmill

Before exploring this theme, let me sketch the broad area of concern of the technical-scientific community in relation to the use of flood-plain land that diverges from that of resource managers. The concern is simply this: the land-using decisions of the many resource managers, large and small, have placed us on a treadmill leading to escalating flood damages and demands for flood control and protection.

From J. G. Jensen (ed.), Spatial Organization of Land Uses: The Willamette Valley (Corvallis, Oregon: Oregon State University, 1964), pp. 96-112.

1. C. P. Snow, The Two Cultures and the Scientific Revolution, (New York: Cambridge University Press, 1959).

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After a quarter of a century of effort, measured in dollars in excess of six billion, we have not reduced the annual toll of flood damages, although we have possibly prevented their substantial increase. Allowing for improved methods of data collection and a possible short-run increase in flooding, development on the flood plains of the United States is the major cause of the increase in flood-damage potential. The increase in damage potential has been variously estimated by the Corps of Engineers at 1.4 percent, and by Gilbert White at 2.7 percent, annually.[2] Using the more modest growth figure and projecting the authorized program of protection, the Corps of Engineers concluded that 1980 would find the nation just about holding flood losses to their present levels, and thus my metaphorical use of the treadmill.[3]

This persistent development in areas subject to flood hazard has alarmed the technical-scientific community for some time and a variety of explanations are offered. Prominent among these explanations of flood-plain development are those that assume either ignorance, cupidity, or irrationality on the part of resource managers. It is suggested that the nature of the hazard is not known to the resource manager, or that encroachment is encouraged by the avarice of speculators and land developers who would conceal the hazard from would-be land users, or finally, that land users ignore the proferred warnings of technicians and scientists.

Examples of these types of explanation are the following:

1. Ignorance:

   Unknowingly and often without the means of knowledge, far too many buy or build homes on lands subject to flood.[4]

2. Cupidity:

   Floodable tracts on the outskirts of many cities seem to attract that type of developer who is not embarrassed if he happens to forget to tell the buyers that they will be subject to flood.[5]

3. Irrationality:

   It is likely that the pessimistic or optimistic attitudes (towards future flooding) of the individual are derived from basic factors in his personality, and may be relatively little influenced by what he hears and reads.[6]

2. Gilbert F. White, et al., Changes in the Urban Occupance of Flood Plains in the United States (Chicago: University of Chicago, Department of Geography Research Paper No. 57, 1958), p. 226; United States Senate, Select Committee on National Water Resources, Floods and Flood Control, Committee Print No. 15, 86th Congress, 2nd Session, 1960, pp. 3-7, 27-28.
3. United States Senate, p. 28.
4. William G. Hoyt and Walter B. Langbein, Floods, (Princeton: Princeton University Press, 1955), p. 95.
5. Harold V. Miller, Flood Damage Prevention for Tennessee (Nashville: Tennessee State Planning Commission, 1960), p. 43.
6. Wolf Roder, "Attitude and Knowledge on the Topeka Flood Plain," Papers on Flood Problems, (Chicago: University of Chicago Press, Department of Geography Research Paper No. 75, 1960), p. 71.

Finally, White, in an early work, apparently cited all three reasons:

> The flood hazard is underestimated by most flood-plain dwellers because of the infrequency of major floods (ignorance), the frailties of human memory (ignorance), and the reluctance of some people, for economic reasons (cupidity) or from sheer obstinancy (irrationality), to admit that past floods may be repeated or exceeded.[7]

Since 1961, with Ian Burton and Gilbert White, I have been carrying on studies designed to shed light on the process by which resource managers adjust to hazardous natural environments including flood plains.[8] Drawing upon these studies, I would like to consider the limitations of these explanations and offer additional ones.

Ignorance of Flood Hazard

If, by ignorance, total unawareness of the existence of natural phenomena of floods or high water is implied, then ignorance is surprisingly uncommon on flood plains. In interviews with 216 managers of flood-plain land units, in a variety of communities, only 11 percent appeared totally unaware of any flood hazard.[9] From more limited data, describing ignorance at the time that the original decision to locate on the flood plain was made, ignorance was found to be greater, but still not widespread. As might be expected, the extent of ignorance is related to the environment, being greatest in an arid area with infrequent flood experiences.

While ignorance itself is uncommon, the failure to perceive a personalized flood hazard is widespread. But here we are not dealing with ignorance, but with the varied interpretations men ascribe to events the awareness of which is shared in common. This is a much more complex phenomenon and requires additional explanation.

Cupidity of Resource Managers

At least two types of actions that lead to increased flood damage are attributed to the greed of managers. The first is the allegation that land developers, particularly in residential land use, subdivide land that is subject to a recurrent flood hazard, but fail to inform the prospective purchaser of the hazard.

7. Gilbert F. White, Human Adjustment to Floods, (Chicago: University of Chicago, Department of Geography Research Paper No. 29, 1945), p. 51.
8. Ian Burton, Types of Agricultural Occupance of Flood Plains (Chicago: University of Chicago Press, Department of Geography Research Paper No. 75, 1962); Robert William Kates, Hazard and Choice Perception in Flood Plain Management (Chicago: University of Chicago, Department of Geography Research Paper No. 78, 1962); Ian Burton, "Invasion and Escape on the Little Calumet," Papers on Flood Problems, pp. 84-92; Ian Burton and Robert W. Kates, "The Perception of Natural Hazards in Resource Management," Natural Resources Journal, III: 412-441, 1964.
9. In the following communities: Desert Hot Springs, Cal.; Watkins Glen, New York; El Cerrito-Richmond, Cal.; Farmington, Conn.; La Follette, Tenn.; Darlington, Wis.; and Aurora, Ind.

Such actions surely take place, but I think they are relatively rare. Instead of a clear desire to defraud, what is commonly found is the minimization by developers of the degree of flood hazard. Part of this is salesmanship and part is wishful thinking. But, from scattered interviews with developers and real estate people, many appear to believe themselves in what they tell others. In this they are not unique, for the quality of wishful thinking and the desire to minimize potential hazard is endemic in hazardous situations.

It might be asserted that developers should be overly scrupulous in investigating and making clear the dangers from flood hazard. Many of us would share in such an assertion. Yet I am afraid that we would be demanding a standard of behavior from private individuals which is not found widely even in public servants whose duties cover such situations. I am thinking now of the responsibility of the FHA and V. A. in policing standards of construction and site location in connection with their insured loans for residential housing. A great deal of this type of housing is to be found on flood plains despite the agencies' avowed policies.[10]

The second type of behavior that leads to great flood damages is the constriction, by fill or other construction, of the stream channel, with a consequential increase in the depth of flooding experienced by other land users. This is a common practice, but it is of some interest to note the public character of many of the offenders. The most common constrictions are the bridge and culvert openings designed by highway engineers. The choice of inadequate openings might reflect poor hydrologic analysis or the harsh economics of the extreme event, but seldom cupidity.[11] Both for these public agents and their private counterparts, there may be explanations that do not require moral judgments of motivation.

Rationality of Resource Managers

Why do men persist in the face of recurrent floods in areas of high hazards, often with alternatives seemingly available? Is such behavior inscrutable and not to be explained on a rational basis? In the absence of other explanations, irrationality may be a convenient, if not a particularly illuminating, substitute. But to a considerable extent such judgments involve definition of rationality.

Rationality, as commonly used, appears to be an abused word. Rational use may mean reasonable use, wise use, best use, but almost always a single standard of rationality is implied. Behavioral scientists will accept much more modest but varied definitions. In a choice situation, with a defined end, the rational man chooses that means most efficacious for achieving the desired end. The irrational man, motivated by subconscious considerations, does not so choose. Other models of rationality are also available. Bounded rationality as described by Simon deals with rational choice of perceived means for perceived ends, a rationality found in the personal worlds of our

10. Francis C. Murphy, Regulating Flood Plain Development, (Chicago: University of Chicago, Department of Geography Research Paper No. 56, 1958), p. 122.
11. William D. Potter, Peak Rates of Runoff from Small Watersheds, United States Bureau of Public Roads Hydraulic Design Series No. 2 (Washington, D. C.: Government Printing Office, 1961), p. 17.

own making.[12] Kurt Black offers the nonrational model, for the common case where the outcomes of actions are uncertain.[13] The complex discussion of rationality is beyond the province of this paper but the point to be noted, so frequently forgotten in our resource managements' concerns, is the possible coexistence of a variety of rationality schema.[14]

In general, I find resource managers rational on the level of the problems being discussed today. By this, I mean they adopt from a limited range of choice appropriate but not necessarily optimal means for accomplishing perceived ends. Such a conclusion does not arise from administering some test of rationality, but rather, by inference. Enough differences appear between the perceived ends and means of the technical-scientific community and resource managers to suggest that both groups may be composed of rational men who just happen to look at the world differently.

I would suggest three factors that lead to differences in the way the technical-scientific community and resource managers perceive flood hazards. These are: 1) the ambiguity of flood hazard, 2) basic attitudes towards uncertainty, and 3) differing intensities of focus and concern. Before elaborating on these factors, I would like to present a schematic representation of the chain of relationships and choices posed by flood hazard and ensuing damage.

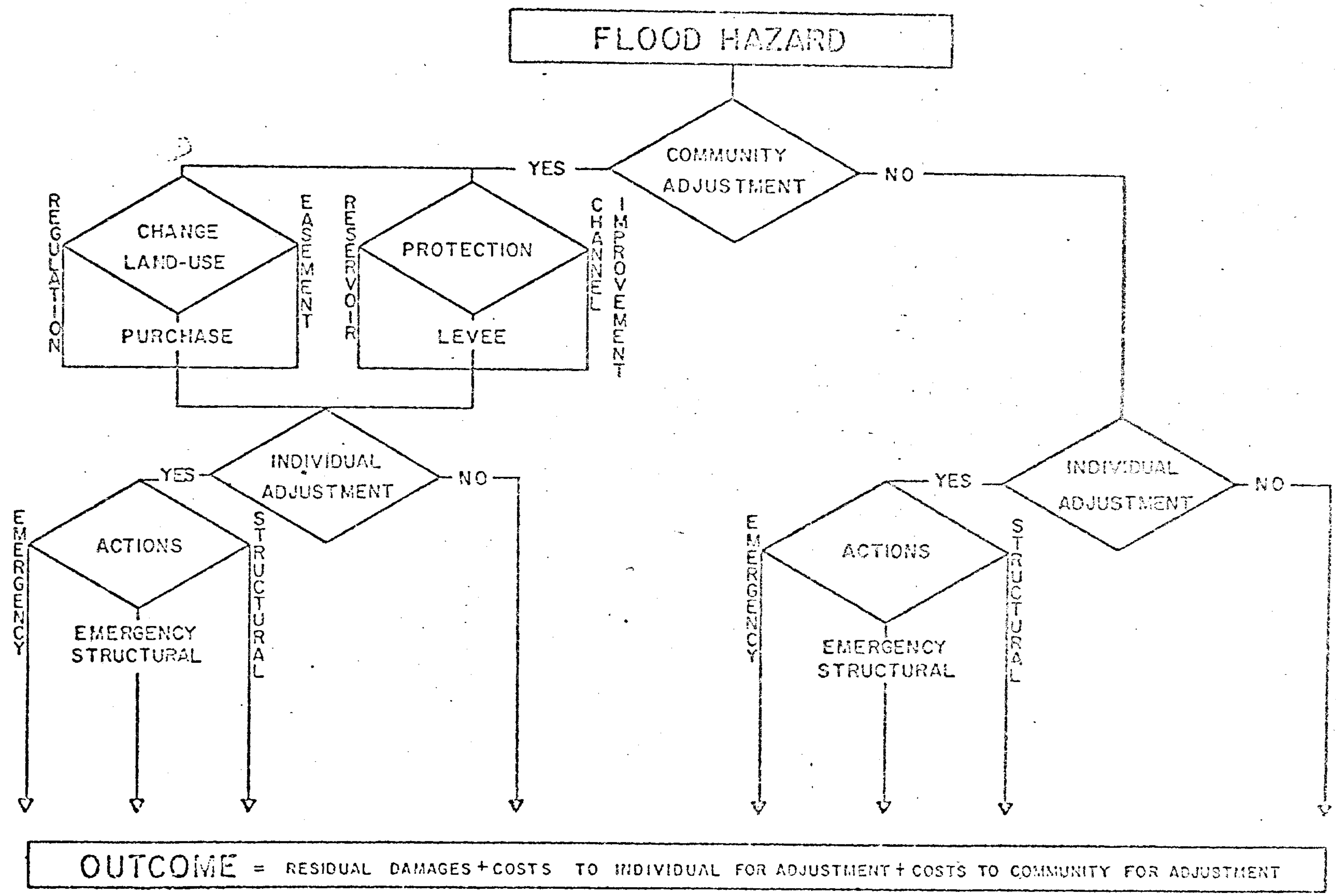
A Schematic of Human Adjustment to Flood Hazard

The schematic (Figure 1) begins with a box labeled flood hazard. It is not really a neat little box and the technical consensus would consider it as a probability distribution of floods of varying magnitude that might occur at a single point along a stream. The diamonds represent choice situations of alternative adjustments. For simplicity, some possible adjustments have been omitted. The first choice is that of protective works: reservoirs, levees, and channel improvements. Another but not mutually exclusive choice, would involve change in land use. These for the most part involve collective action through the community. In the lower line are individual choices: 1) combinations of emergency actions that follow a flood warning and include the removal of persons and property and the rescheduling of production; and 2) structural adjustments of the more permanent type including flood-proofing and land elevation.

The final line represents a series of outcomes in a form that White has called residual costs.[15] They are the total tangible costs of using the flood plain as opposed to land of equal utility without a flood hazard. They do not include additional social costs that are intangible: loss of life, disruption, anxiety, and tension. These residual costs have three components: 1) the costs borne by the community in installing the adjustment, 2) the costs borne by the resource manager, and 3) the residual flood damage accruing to the manager after installation of the adjustment.

12. Herbert A. Simon, Models of Man: Social and Rational (New York: John Wiley and Sons, 1957), p. 198.
13. Kurt Black, "Decisions Under Uncertainty: Rational, Irrational, and Nonrational," American Behavioral Scientist, IV: 14-19, 1961.
14. For a discussion of rationality and decision-making in resource management see Kates, Hazard and Choice Perception ..., pp. 12-28.
15. Gilbert F. White, Choice of Adjustment to Floods, (Chicago: University of Chicago, Department of Geography Research Paper No. 93, 1964).

FIG. I. SCHEMATIC OF HUMAN ADJUSTMENT TO FLOOD HAZARD (ABRIDGED)



These residual flood damages arise from the inability of almost all adjustments, including protection, to eliminate all the damages. The costs of the adjustment are added to the residual damage. In the case of a reservoir, the costs accrue to the national community; in the case of a levee, they are shared with local communities. They may also be borne completely by a manager, as in flood-proofing a building.

The outcomes may be drawn in proportional size to suggest a general relation. Only recently have data been developed to quantify these outcomes. Figure 2 is a modest attempt at specifying these relations for a single industrial plant on the Lehigh River in Pennsylvania.

The purpose of this schematic is to set forth a framework within which to examine the divergent effects of private perceptions. Using these diagrams we might think of three key sections: the hazard itself, the alternative choice situation, and the outcomes. The three factors affecting hazard perception operate in these sections in differing degrees.

The Ambiguity of Hazard

The technical-scientific community has long thought of flood hazard in terms of a probability distribution.[16] At any given point on a stream, floods will occur through time in an apparently random manner. These floods will be of varying magnitude or depth and there is a tradeoff between magnitude and frequency; i.e., the larger the flood, the less frequent its occurrence in the long run. The long-run frequencies of floods are determined by records of various sorts and a probability of occurrence is assigned to each level of magnitude. This probability might be expressed as a percent chance of occurrence in any year or as a recurrence interval. The 50-year flood, also called the two percent chance flood, means that a flood of that given magnitude or greater might be expected to have 2 chances in 100 of occurring in any year or to occur, over the long-run average, once in fifty years.

Unfortunately, in defining these flood probabilities we are prisoners of experience and in terms of climatological time, our experience is very limited. Records of streamflow are collected at about 7,000 places and few records are as long as 60 years; most are for less than 30 years.[17] In the Willamette Valley some of the stations have fairly long records, the continuous record for the gage at Albany being 64 years and historical data on larger floods going back over 100 years.[18]

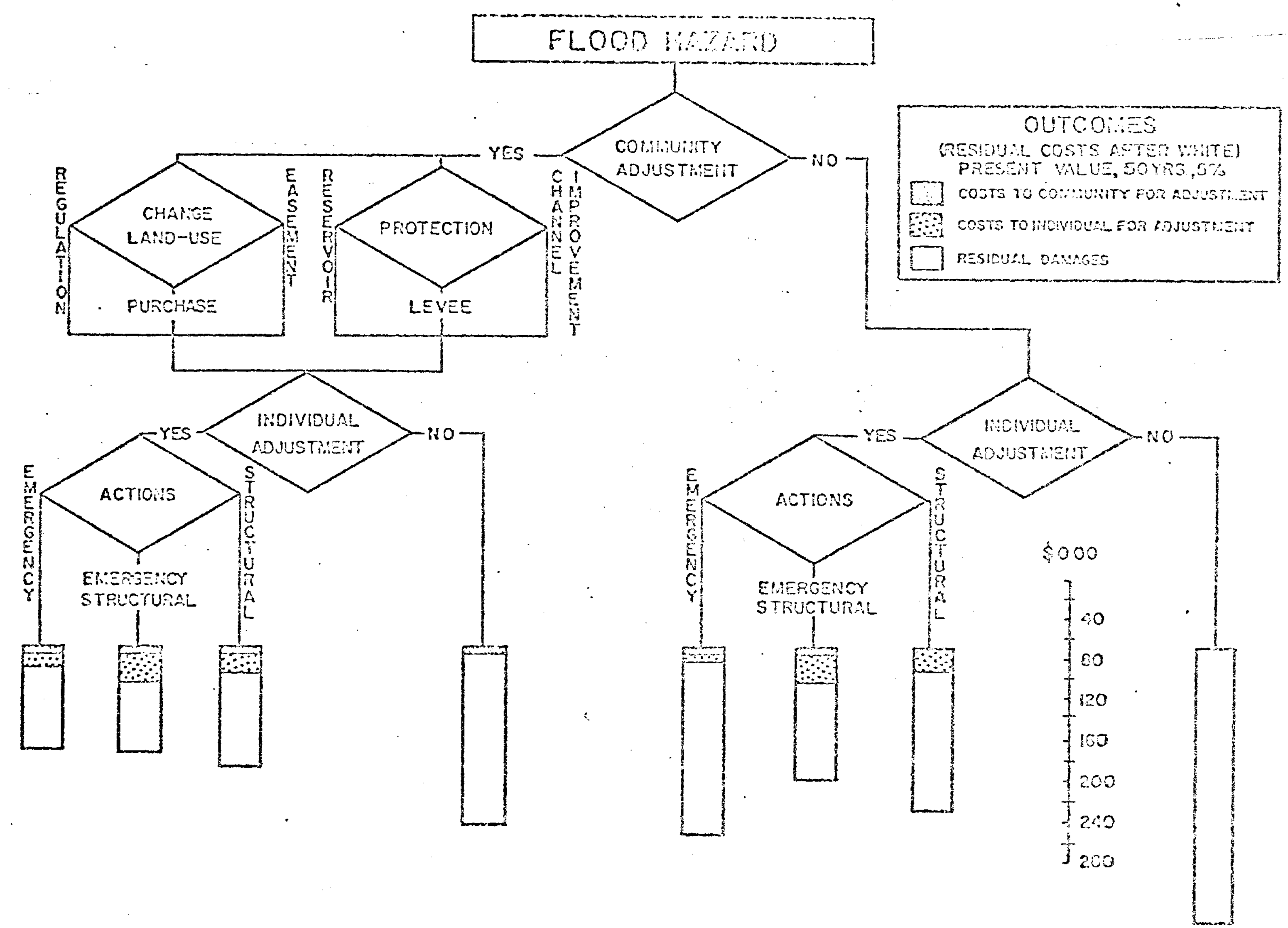
But even with fairly long records, respected methods of analysis result in quite different estimates of frequency. Even though we have some information on flood occurrence going back to 1675, estimates of flood frequency for the flood record in Lehigh Valley give a long-run average return period

16. Manuel A. Benson, Evolution of Methods for Evaluating the Occurrence of Floods (Washington, D. C.: United States Geological Survey Water Supply Paper 1580-A, 1960).

17. Tate Dalrymple, Flood-Frequency Analysis (Washington, D. C.: United States Geological Supply Paper Paper No. 1543-A, 1960), p. 3.

18. Harry Hulsing and N. A. Kallio, Magnitude and Frequency of Floods in the United States, Part 14, (Washington, D. C.: United States Geological Survey Water Supply Paper 1689, 1964), p. 178.

FIG. 2. SCHEMATIC OF ADJUSTMENT, INDUSTRIAL PLANT, LEHIGH VALLEY, PA.



of either 27, 45, or 75 years, depending on the method used.[19]

There are really only two ways of defining a probability distribution, theoretically or empirically.[20] We do not have either type of knowledge. We lack a theory that commands sufficient respect and that would define the shape of the flood probability distribution. We lack the long and consistent records that would enable us to determine the distribution empirically, by counting the relative frequencies of floods.

In the face of this ambiguity, the technical-scientific community responds with great ingenuity, attempting to extract the last full measure of information from the scattered samples of records available to them. The use of regional frequency analysis is one such technique, and new tools employing simulation and synthetic hydrology are being developed.[21] But in the meantime, we plan river basin development, pass flood-plain regulation ordinances, and provide flood hazard information based on estimates of recurrence with a large but undetermined variance.

Even if we knew the probability distribution for the Willamette or any other valley, we must face still another question. If the manager knew and understood these probabilities, what is a reasonable level of risk to incur from flood hazard? For example, if a community wants to delimit an area to be restricted to certain open uses in a zoning ordinance, what should be the outer boundary of that area? One common choice is that of the 50-year flood and, we might ask, shall the city fathers reject risks of greater likelihood than two percent probability and accept lesser ones? What guides are readily available? Certainly not those prevalent in our own technical-scientific community.

In our professional lives we manipulate levels of statistical significance, which are measures of our willingness to tolerate risks of error by arbitrary convention at the five or one percent levels of probability or significance. In fact, we would be suspicious of the choice of a nonconventional two percent level equivalent to the 50-year flood, suspecting manipulation of the significance of the data. Or consider the range of risks that we tolerate in our personal lives, from automobile driving to cigarette smoking.

If we could decide on a level of reasonable risk, we face the problem engendered by the long-run assumption that underlies these probabilities. When we calculate average annual damages we assume an ongoing process of continuous flood-plain occupance. But the individual manager does not and should not work on the same basis in his private calculus. In the language of the economist, his time horizon is fundamentally different from that assumed by the technician.

19. United States House of Representatives, Delaware River Basin, New York, New Jersey, Pennsylvania, and Delaware (Washington, D. C.: House Document 522, 87th Congress, 2nd Session, 1962) Vol. IV, Plate 42.

20. For an extended discussion, see Kates, Hazard and Choice Perception ..., pp. 49-57.

21. See Dalrymple, Flood Frequency Analysis, for a description of regional flood frequency methodology, and Arthur Maass; et. al., Design of Water-Resource Systems, (Cambridge: Harvard University Press, 1962), pp. 324-493 for discussion of simulation.

The resource manager is not accepting a long-term risk, but rather a discrete period of short-term risk. This period may be quite short, even shorter than the manager expects. Farmers in western Iowa were found to change managership on the average every nine years, and ownership every fourteen.[22] In a study of flood-plain occupance the median length of commercial managership was between 11 and 15 years.[23] In the managership of a farm, instead of expressing the long-term risk in an annual probability of occurrence, a much more appropriate criterion would be the expectation of hazard over the entire period. This has been formalized in a recent paper by Borgman in what he calls encounter probability.[24] Assuming that a 50-year flood is one that is troublesome for an Iowa farmer, Borgman's encounter probability gives the probability of encountering an event with the magnitude of a 50-year flood or greater during the nine-year period. The probability is 16.6 percent or, expressed optimistically, the manager has five chances out of six of not being flooded even once during his tenure.

In concluding this point, it should not surprise anyone if assessments of the hazards of resource managers diverge from our own when the true probabilities of their recurrence are ambiguous, the guidelines as to what constitutes reasonable acceptance of risk do not exist, and the divergence in time horizons provides different expectations from the same decision calculus.

Attitudes Towards Uncertainty

Up to this point I have stressed differences that might arise from the common sharing of the same knowledge between resource managers and the scientific technical community. Unfortunately, this communality only partly exists because of fundamental differences in the treatment of uncertainty. In the face of uncertainty the technical-scientific community constantly strives to improve their best estimates of flood hazard. For uncertainty in science is a fact of life, something to be studied and analyzed, overcome where possible, lived with where not. The scientist speaks of uncertainty without anxiety, but the resource manager does not.

There is evidence that many managers find the uncertainty of flood hazard discomforting and seek to eliminate it. With Ian Burton, I have set forth a typology of these responses as they apply to floods and other hazards (see Table 1). Among these responses, the most frequent is to make the hazard determinate or knowable; floods are assumed to come in cycles and the 50-year flood is literally interpreted as meaning one flood every fifty years. The transfer of uncertainty to the higher power of God, government, or what have you, is fairly common, and, more rarely, the wishing-away phenomenon occurs with the denial of the very existence of floods or their recurrence.

This attitude towards uncertainty not only affects the flood hazard but also other sections of our adjustment schematic as well. The desire

22. R. Burnell Held, Melvin G. Blase, and John F. Timmons, Soil Erosion and Some Means for its Control (Ames: Iowa State University Ag. and Home Ec. Expt. Sta. Special Report No. 29, 1962).
23. Unpublished data from La Follette, Tenn.
24. Leon E. Borgman, "Risk Criteria," J. of the Waterways and Harbors Division, Proc. ASCB, LXXXIX, 1963, pp. 1-35.

Table 1. COMMON RESPONSES TO THE UNCERTAINTY OF NATURAL HAZARDS*

ELIMINATE THE HAZARD		ELIMINATE THE UNCERTAINTY	
DENY OR DENIGRATE ITS EXISTENCE	DENY OR DENIGRATE ITS RECURRENCE	MAKING IT DETERMINATE AND KNOWABLE	TRANSFER UNCERTAINTY TO A HIGHER POWER
"We have no floods here, only high water."	"Lightning never strikes twice in the same place."	"Seven years of great plenty....after them seven years of famine."	"It's in the hands of God."
"It can't happen here."	"It's a freak of nature."	"Floods come every five years."	"The government is taking care of it."

*From: Ian Burton and Robert W. Kates, "The Perception of Natural Hazards in Resource Management," Natural Resources Journal, Vol. 3, No. 3, p. 435, January 1964.

to wish away danger leads to exaggeration of the efficacy of protective works and the perceived outcome of such a choice for these managers is zero residual damage.

Are these irrational responses on the part of resource managers? The evidence is not conclusive. For we are trained to dispel uncertainty by seeking more data, conducting further analysis, or just waiting. Lacking that background, the resource manager uses other forms of analysis to dispel uncertainty, forms alien to ours, but not necessarily irrational if considered in the light of his personal training and framework.

Intensity of Focus and Concern

Technical-scientific people and the resource manager display different concern and intensity of focus in their adjustment to flood hazard. This meeting is a reflection of our shared concern. All of us here this morning are considering in depth various aspects of the process of adjustment, and within the schematic of human adjustment some of our own professional activity fails.

The reverse is true for the resource manager. The entire schematic of human adjustment is just one set of decisions in a framework of land-use decisions. We know little of the decision process of residential location, but surely the factors of neighborhood, amenities, schools, accessibility, available alternatives, and price dominate in great part such choices. Or consider a commercial or industrial establishment. What is the importance of flood hazard within the welter of hazards that confront the manager? A recent advisory to the small businessman on risk management cited insurance coverage for 21 classes of insurable risks.[25] Flood insurance was notably absent except as a warning that it was excluded from the coverage of common policies.

Evidence of the over-riding importance of other decision factors comes from agricultural experience. Burton has found that predicted changes in land use that were to follow the removal of a flood hazard did not take place. In one such study labor, price, acreage controls, and alternative employment overrode the potential for changed land use following flood-hazard reduction.[26]

If the concern for floods is submerged beneath other factors, the attention span or intensity of focus is limited as well. While managers are intensely preoccupied with a flood during its occurrence, this interest rapidly diminishes and is only continuously high in areas of very frequent flooding. The type of experience that a manager suffers is also important. If the flood has been relatively small or his adjustments successful, the net affect of the flood might be to diminish rather than heighten attention.

This attention span differs where the technician is concerned. In the fleeting moments of concern by resource managers, demands for studies and reviews are generated that guarantee for the technician a constant preoccupation with flood in one area or another.

25. Mark R. Greene, Insurance and Risk Management for Small Business (Washington: Small Business Administration, 1963).

26. Burton, Types of Agricultural Occupance ..., p. 71.

The upshot of the difference in intensity and concern is in our expenditure of a truly scarce resource: the time required to obtain and interpret information. Thus, the decisions that managers make reflect the casual and sporadic interest in flood hazard problems that ebbs and flows as the flood waters themselves. We, on the other hand, with our heightened involvement, arrive at our evaluations through fairly well-defined processes and are disturbed by the apparent lack of concern of resource managers.

Implications for Rational Use of the Flood Plain

We started with the assertions that the divergence in perception and behavior of the scientific-technical community and the flood-plain user was often ascribed to ignorance, cupidity, or irrationality.

I have suggested that total ignorance of flood hazard is not as widespread as imagined, while on the other hand there is resistance to attaining higher levels of understanding of flood hazard because of the cost in time and energy of assimilating such data, the casual decision-making process related to flood hazard adjustment, and the ambiguity contained in even the best available data. If we accept this, we must revise the perennial admonition to educate the resource manager. On the one hand, he is not as ignorant as we would make him, nor as receptive to learning as most educational programs assume. The various flood-plain information programs should be expanded because they cut the high cost in time, effort, and money of obtaining information and to some extent reduce the ambiguity surrounding the data. But to expect an expanded flow of information to result directly in massive flood-loss reductions is a sanguine hope.

These programs should also expand their activities in providing knowledge of the alternative choice situation. One encouraging result of the perception studies is the finding of an association between the adoption by managers of flood-damage reduction behavior and their knowledge of the alternatives available to them.[27] However, even among managers who adopt actions, the casual and sporadic nature of their analysis is shown. White has compared the perception and adoption of alternative emergency actions and their residual costs and has concluded that:

"There appears to be a significant but not particularly strong association between economic efficiency and perception-adoption. Some managers have adopted apparently uneconomic measures, others have ignored apparently productive ones."[28]

Neither do we have need to make widespread judgments as to the motivations of resource managers. It is sufficient to note the substantial grounds that might induce men of good will to make commitments in their land-use patterns that provide high direct and indirect costs to others. Despite some hopes to the contrary, there is a real hiatus between individual and community interest, and the whole of the community is not equal to the sum of its individual parts.

27. Kates, Hazard and Choice Perception ..., pp. 123-124.

28. White, Choice of Adjustment ...

The recognition of this state of affairs enhances the need for intelligent community control of flood-plain use but increases our responsibility as well. We cannot justify decisions simply as between the "good guys" and the "bad guys." The assertion of community police powers should be accompanied by a careful analysis that demonstrates the weight of social costs and benefits that might ensue from unrestricted use of the flood plain.

Finally, what follows from a view of rationality that accommodates more than one rationale? The judgment of rationality implies the adequacy of means for specified ends. For managers there are a multiplicity of means-ends schemes, not merely one reflecting the desire to reduce flood damages. This is paralleled in many communities to which technical-scientific personnel lend their skills. Communities propose to regulate land use, in the name of reducing flood damages, by zoning, easement, or purchase, but this purpose might include, as well, urban renewal, open space preservation, provision for scenic or recreational land, preservation of agriculture, production and protection of wildlife, and watershed management.

The recognition of the multiplicity of ends and a variety of means for both individuals and communities challenges the technical-scientific community to develop appropriate techniques of analysis to handle such problems. Recent advances in computer techniques may lead to programs for optimizing combinations of means and ends under conditions of uncertainty. Unfortunately, these techniques require the specification of well-defined ends and there is a considerable lag in the development of the political dialogue required to select these ends amidst the conflict of interests and values. One prerequisite for such dialogue is to recognize the genuine areas of difference between interests. The discussion today was designed to define some of these differences as they involve the technical-scientific community to which most of us belong.