MEANING REVISITED

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The feasibility of building a mechanical system to perform high quality translation has been aired for some twenty years, not without emotion or result. At early conferences concerning the outlook of mechanical translation the discussants were apt to fly off the handle and go home in a pout, appearing to differ on the meanings of words such as "translation," "quality," "high" and "feasibile." But sponsorship supplied the lubricants that in time subdued their disagreements toward a comradery of benign misunderstanding. Volatile research groups formed. Some of them held together long enough to actually attempt preliminaries of the approaches they visualized, so that consequences of diverse methods and theoretical dispositions can be estimated.

I'm not a detached or objective judge of that grand experiment, which began with such irrational optimism that it had to end with irrational pessimism. I participated in it as passionately as the rest, since I'm convinced research of any kind requires passion.

As for objectivity, I came to believe that an objective point of view is out of place in translation research or in any inquiry whose subject matter depends on the very nature of meaning; that "objective" pertains to a particular class of meanings which, as a vehicle of scientific communication,

denies access to the full universe of meanings.

These conclusions, once gleaned from my own research experience, profoundly changed my personal assessment of the prospects of high quality mechanical translation. What I want to communicate is the movement of my private judgments, neither detached nor objective, toward a point of view that you might think to be unscientific. At least, my viewpoint may seem at odds with that of empirical science and its derivative common sense.

I refer to the unique point of view of one sentient life, which each of us knows privately. Whether we like it or not, language often conveys private information and those conveyances, although supposedly at a minimum in technical documents, must also be translated. More important, only from a personal standpoint can we actually use language. This is our point of view as hearers or speakers of language who, in order to understand or to be understood, do make use of private information along with information which we as individuals infer to be accessible to others.

With discipline we can limit our conversations to public information, so carrying out a social contract that has worked well for physical sciences in their investigations of our common environment. But evidently the study of translation, except for superficialities, does not belong in that context. It involves, in addition, an investigation of ourselves.

Human translation is known to be most successful when the translators are informed about the subject matter they are translating as well as about the languages. This much is ascertainable by the empiricist's test: to translate well, one must understand. Why, then, should we look for "high

quality" translation from machines that obviously do not understand; that merely manipulate rather than use language?

Indeed, one of the convincing findings of the past decade is the impotence of mechanical translation processes working on the surface of language and dealing almost exclusively with those linguistic features or forms ostensively available through empirical description. Processes of this kind have persistently demonstrated an inability to make useful selections among the immense number of possible constructions which give language its innate flexibility.

Defective translation processes do of course make choices; as Ida Rhodes gleefully pointed out, they produce "garbage." What we would find useful, instead, is mechanical selection closely analogous to patterns of human preference. Or, better still yet probably less attainable, we want a good and faithful servant: a machine whose choices would make ours more successful.

At the start, translation researchers did not express such lofty aims as these. They thought simple conditions for choices could be found in the text being translated and very near to the point of selection, in proximate words or phrases of the sentence momentarily under consideration. When such innocent expectations led to disappointment, investigators modified their attack in two different though complementary ways.

First, they set out to place more knowledge of the "source" and the "target" languages at the disposal of mechanical processes making choices. This was done initially by incorporating into the programming of the translation

process some of what was then known about grammar. The result was a translation routine or "algorithm" specialized not only to particular languages but also to particular grammatical constructs. Because any change of grammatical detail required reprogramming of complicated relationships, translation algorithms were seldom completed in a programming sense; much less in a linguistic sense. Progress was therefore deadly slow.

Efforts to free researchers from the nuts and bolts of programming resulted in an understanding of the principles of "generalized" linguistic processes. That innovation made it possible to simply "store" grammatical data in the machine to be retrieved mechanically as needed as a basis for language choices. One result was a more rapid exploration of new formulations of grammar. At the same time, this new practice focused attention on theoretical problems besetting the mechanical translation enterprise.

The trick of generalized linguistic processes is that all of their choice-making is done in one of two ways. On the one hand, the choice is made with reference to some structural aspect of the deliberately constructed "metalanguage" being used by a given researcher to convey grammatical information about a specific language, say for example English. For the rest, the choice is based on the result of a comparison in which some grammatical detail so conveyed is matched against a possible instance of that detail in a specific discourse.

The former kind of choice is "formal" in the sense of being determined solely with reference to the metalanguage selected by that researcher for the purpose of describing grammatical details of English, or of another language.

In so far as one and the same metalanguage is used to record such details about a number of languages, all formal choices remain invariant among those languages. The latter kind of choice is "factual" by virtue of being specific to each language, and thus is variant among them.

However factual choices might vary from one language to another, the comparison process actually making factual choices can itself be generalized. That is to say, all of the auxiliary choices guiding the inner workings of each comparison can be referenced to forms or features of the metalanguage. From this, one can see that every choice necessary to specify the programming of a generalized linguistic process is formal.

It is precisely this characteristic of being separated or isolated from variant factual choices which justifies the label "generalized." This separation, now a familiar one in science, can be made as soon as the researcher has decided on the symbolic apparatus he will use for the purpose of recording the empiric facts imposed by his next experiment. For a linguist, his metalanguage is that apparatus. It makes explicit his theoretical bent from the point of view of scientific communication, since it embodies those invariant relationships which he hypothesizes for language in general, or for some family of languages whose factual details he intends to describe.

Although one can study the formal characteristics of individual metalanguages or of relations among metalanguages, attempts to "prove" that a given metalanguage is inadequate for the purpose of recording facts of language, or that one is better than another for this purpose, are in my opinion absolute nonsense. If they have meaning, such proofs are a part of the researcher's

own decision process leading toward his choice of a specific metalanguage for the experiment he has in mind. His proof has nothing to do with whether he would have been right or wrong in choosing a different metalanguage than the one he finally selects. Most of all, his proof does not make his experiment unnecessary.

My personal assumption is that the selection of a specific metalanguage is not final, nor is the specification of generalized processes which that metalanguage allows. Both are theoretical choices in the design of an experiment about to be carried out. Both are preliminaries of that experiment, for which the metalanguage can and should be fixed and the generalized processes completed beforehand in a programming sense. Both, as instruments of formal as well as factual learning, can only be justified by the outcome of the experiment itself. For the present, the paramount goal of experimentation is to bring mechanical choicemaking into close conformity with human preferential behavior.

Clearly this goal has not been achieved, although much has been learned about language. Empirical studies of language, as such, have been expanded to also include the description of relationships among the things that language mentions, and among persons who are using language. All of this is symptomatic of a fuller awareness of the surface phenomena which human choices might take into account. So far, nonetheless, results of formal linguistic inquiry especially are tentative. Theoretical research has been unable to effectively demonstrate principles of an underlying formal organization which would shape factual findings about language in ways more useful for mechanical

selection processes.

It can be shown, for example, that the entire translation process can be generalized through use of metalanguages capable of conveying inter-lingual relations of various kinds. However, this merely extends the idea of enlarging the machine's store of knowledge about language, an idea which by itself has not benefitted mechanical selection as much as researchers had originally hoped.

Accordingly, the second thrust of research on mechanical selection has been to widen the search for conditions attending choices. In addition to examining the expression undergoing translation, mechanical processes have been permitted to range over surrounding sentences, paragraphs, whole discourses, or data representing an increasingly extensive experience of language events located in the machine itself.

Due as much to disappointment as to expanding interests, mechanical translation research overflowed vaingloriously and became computational linguistics. This new domain of experimentation is *a* conglomerate of studies in which mechanical translation shares the limelight with information storage and retrieval, automatic extracting and abstracting, fact correlation, question asking and answering, and similar applications where language is manipulated mechanically. After an unsettling beginning, during which the old guard felt compelled to recant its former commitments, the new milieu of jargons did provide a sounder medium for testing language theories and methods than mechanical translation alone.

In consequence of this new opportunity to compare computational

linguistic applications of various types, it has been noticed that mechanical selection comes closest to human patterns of choice in those instances where a little knowledge of language, things, or persons is brought to bear on an experience sufficiently extensive as a source of conditions for choices. In other words, mechanical selection appears to be improved by a better balance between mechanical analogues of experience and knowledge. Machines that ask or answer questions are examples of applications seemingly avoiding the narrow window of experience through which mechanical translation research tried unsuccessfully to squeeze great concentrations of knowledge.

In my opinion there are three lessons to be learned from this curious result of so much effort. The first concerns the way we might reasonably go about developing a mechanical translation system; the second concerns the type of system we might reasonably develop; the third concerns finding reasonable people to do the work. These problems are the ones requiring cogent solutions before feasibility estimates can be meaningful.

I think, however, that we have cause to doubt the optimistic assumption that men of good will must always reach similar conclusions on exposure to similar evidence, especially when part of the evidence is about themselves. By now it should be plain that no methodological consensus exists in mechanical translation research, without which comparisons of both formal and factual results are, at best, misleading. Before sitting down to make a second round of feasibility estimates, it might be proper to ask seriously why in our estimates thus far we seem to be getting "garbage" out of our own selection process

One possibility is that, because mechanical translation researchers

were gathered from a variety of technical specialties, we have not been looking in the same place for conditions on which to base our choices of method. By and large, it must be admitted that we have been a mixed lot, though sharing the prudent wish of every specialist: not to be caught on lame feet outside of his territory.

Another is the possibility that, as heirs of commonly accepted notions about the nature of man, we have been looking too much in the same place for the conditions determining our methodological choices. By preferring the narrow window of empirical science, we have avoided those taboo territories made uninhabitable by the "garbage" production of our predecessors.

As a prolific example of the latter I cite René Descartes, who ground his garbage so exceedingly fine to assay psychical as well as physical substances. Surely it is for lack of these psychic essences that machines are unable to use or to understand language; while we, brimming full, need only introspection to understand and master all of the configurations of our own choicemaking.

We have said a great deal in translation research about the dangers of anthropomorphising machines and so little about the dangers of anthropomorphising ourselves. What if it should turn out, as Charles Peirce claimed a full century ago, that we have no special vantage point to our own psyche, but must learn about that too by careful methods of inquiry?

Thus a third possibility is that our difficulties with mechanical selection are the result of self-ignorance, whose remedy should be a disciplined study of the ways we make choices ourselves. If in fact each of us is engaged in a

quest for self-knowledge, then disparities in private understandings of the state of the art of human choicemaking might well account for some of the troublesome goings on in research which takes these understandings as its very ideal.

My personal conviction is that all of these factors are at work to make a second set of feasibility estimates as uncertain as the first. Before taking up the lessons which such estimates might turn to account, therefore, I consider it essential to make public some of the private assumptions unavoidably the source of my judgments.

A summary like this one can do no more than lay out the bare bones of choicemaking activities which in each human organism are vastly convoluted and subtle. However, it is part of my purpose to spotlight the very hazard of abandoning oneself prematurely to mere facts so as to find solace in work of exceptional professional complexity. Formal investigation is, in its truest sense, an attempt to bypass variety in order to describe invariance.

This is not to say that formal inquiry, when it confines its interest to techniques of symbol manipulation, somehow escapes the same vice of specialization. Rather, I mean that my private fascination has been a train of formal thought with a different aspiration, running through the definitive studies of John Locke, David Hume, Charles Peirce, George Mead, John Dewey, Alfred Whitehead, Charles Morris, and others, and recently producing works of formal description like those of Jean Piaget, Lawrence Kohlberg, and Susan Langer.

The interesting characteristic of this line of formal reasoning is that it makes its theoretical choices increasingly on the basis of a disciplined interplay between formal hypotheses and empirical observations of invariants in human behavior. Thus it seeks to institute for forms an extension of those methods which successfully removed facts from the domain of fickle manipulation under control of human preference, and placed them under empirical control. In this aim it is the very antithesis of methodological opinion which sees theorizing as primarily a competitive arena for personal invention and argumentative directorship.

Piaget's study of the origins of intelligence in children is an elegant instance of this empirically disciplined formal method at work. It is consequently a good starting place for my summary, and a center line along which I will embroider my own thoughts or those of others caught up in the same intrigue of intellect.

From his observations of behavior in the human infant and child, Piaget isolates and describes six early stages of psychological adaptation. Each stage is evidenced by a characteristic scheme of choicemaking. It consists, on one hand, of the child's attempt to assimilate the environment by incorporating within his existing framework of knowledge and experience all new data given by his senses. On the other hand, it consists of his accommodation to the environment by using that modified framework as a basis for new acts. The existing adaptation at every stage, is an imperfect equilibrium constantly being repaired by successful assimilative and accommodative choices of its special kind, or being ruptured by unsuccessful choices of that kind.

Psychological adaptation, like the organic, can be explained in terms of relationships that are essentially ecological. Always and everywhere, adaptation is only accomplished when it results in a more or less stable organization of relations between an organism and an environment.

The point of supreme interest to us is the perspective from which Piaget chooses to construct his formal hypothesis. By observing stabilities in the child's relations to the environment as they appear from without, which is to say from the commonly accessible frame of reference of empirical

science, the observer goes on to hypothesize how those somewhat unsettled ecological relations are felt from the personal standpoint of the child as his mind works out its first contacts with reality.

From the point of view of the investigator, then, factual data are those that can be observed to vary from child to child because they are imposed by environmental details that differ with the time, the place, the culture in which a person lives. Formal data by contrast are found to be invariant among children because, Piaget hypothesizes, these are necessary and irreducible data imposed on the child by his own genetically inherited biological organization. That is functionally the same for all of our species.

As a consequence one can deduce that, from the personal standpoint of a child, invariance is an aspect of experience distinguishing form from fact. And we have already seen that this same invariance is what the investigator might look for himself from the personal standpoint of his own research experience, when he is making theoretical choices.

Such a coincidence should warn us that formal hypotheses about the organization of human minds have direct methodological consequences which mark them as being basically different than factual hypotheses about the organization of the physical environment. When the investigation probes into the foundations of meaning and of understanding, there is a new need for consistency between any theory about the mind of the human subject under observation and that of the observer himself. What is hypothesized for the mental organization of the subject applies equally for the observer, and as a result can modify the choices of method open to the latter in his investigative role.

In short, the process of formal inquiry itself is seen to consist of a cycle of assimilation and accommodation. From observations of invariants in the subject's behavior, the observer assimilates new understandings of mental organization, to which he then accommodates his investigative behavior.

In this cycle of formal investigation, methodological choices can be recognized as instruments of formal accommodation for the investigator, just as theoretical choices are his instruments of formal assimilation. Choices of theory and method are both tentative and are "hypothetical" in the sense of self-consciously awaiting the test of use. Consequently, these are tools of formal learning for a mature intelligence, not for the infant just starting out in his feeble thrust toward consciousness of self.

The infant has his own instruments of formal assimilation and formal accommodation, for he can be observed to progressively modify the essentials of his scheme of choicemaking. Should that occur, one can tentatively assume that he has learned something, not about the environment, but about the organismic basis of himself.

Once the child understands the next stage of psychological adaptation, he prefers to use its new scheme of choicemaking, although it can be shown that he still knows how to use all of the schemes he acquired in earlier adaptations. The next stage is always a more desirable frame of knowledge and experience than the one before it, taking into account everything in the previous stage, but making new formal distinctions and organizing facts into a more comprehensive and equilibrated structure.

That each scheme of choicemaking is formally a prerequisite of its

successor is argued by the observation that no stage in the progression of psychological adaptations is skipped. Each stage of adaptation has its own formal organization whose chief aspects my summary will try to illuminate. In addition, one should look for a progression of formal experience and knowledge in states of adaptation which are ever broader and more poised. It is this progression which allows us to think of the successive, states as cumulative stages of mental development.

One must distinguish carefully between any existing state of psychological adaptation and the process of adaptation by which that state is changed. As Peirce was shrewd to notice, only when the investigator identifies formal inquiry with the process rather than the state, does it become necessary for his own state of mind to change should his investigative process succeed.

Formal reasoning has a dual purpose: to clarify the state of contemporary thought, and at the same time to benevolently undermine the world view that its fund of experience and knowledge represents. The aim of that benevolence is to carry forward the cultural process by including an established universe in a still broader and more stable one.

The central role of formal communication as a determinant of the state and the process of cultural adaptation has been explained by Mead and again eloquently by Whitehead. Each language has a formal component for talking about the everyday language to be used in talking about facts. Men also invent symbols for precise forays of factual description, as is well exemplified by the linguist's use of his metalanguage. Whatever the motivation, formal communication can either consolidate a cultural state by

perfecting the symbols already being used to mention facts, or it can offer new symbols to further the cultural process by making possible the mention of facts until then unmentionable.

Whereas at this moment the need of the state of culture is to consummate an objective universe through the use of symbols that successfully organize vortices of objects in a continuum of time and space, the clear need of the cultural process is a new basis of symbolizing with which to organize a more comprehensive universe, incorporating subjective as well as objective facts, and a more equilibrated one by virtue of providing functional mechanisms for formal as well as factual adaptation.

How can a universe be symbolized to bring these neglected cultural ingredients to critical public purview? Langer has proposed that the basic symbols of such a world would name acts, and that the symbolic facility of a universe of acts would allow us to communicate about complex acts, composed of those elements.

The gist of the line of reasoning being pursued is that it is about the symbols of Langer's universe instead of those of Newton's universe which have become, after three centuries, so comfortable to a mechanistic sense of life. At first contact, a universe of acts is certainly a strange world; but then, any really new world must be strange. And a world view which aspires to incorporate the mechanics of formal adaptation has in added perplexity the responsibility to explain the circumstances of its own emergence. The job before us is to clarify the symbols of this unfamiliar world as best we can so that they can be used and tested against living and historic evidence,

where strangeness has precedents.

Unavoidably, my summary will take up more mature stages of reflective thought following on the six initial stages of practical intelligence that Piaget looks for in the infancy and early childhood of individual men and women. It is in these markedly different settings that one can observe functionally analogous progressions of schemes of choicemaking. The invariant aspects of that progression might then be explained by an increase in human understanding of a biologically determined functional nucleus underlying and guiding consciousness.

Thus, the beginning of the process of psychological adaptation presupposes an existent biological organization, itself the product of an evolutionary sequence of genetic adaptation that incorporates hereditary factors having two quite different types of biological result. Factors of the first type determine the constitution of our nervous system and sensory organs, so that we perceive certain physical radiations, but not all of them, and matter of a certain size, and so on. Factors of the second type orient the successive states of psychological adaptation, and so have their result in the organization of a mind which attains its fullest and steadiest form at the very end of an intricate process of intellectual evolution, not at the start.

All of the various states and the process of psychological adaptation have in common the one formal aspect that, relative to an assimilated frame of experience and knowledge, the direction of every accommodation is such that it attempts to satisfy need.

Piaget maintains that needs and their satisfaction are mental manifes-

tations of the complementary interplay of assimilation and accommodation as felt by any human being. Although from our personal standpoint need may seem primary, it is the internal organization of that underlying unity, the act itself, which motivates our day-to-day existence as well as our long term psychological development.

The theory of the act, making explicit the invariants to be found in every unit of human activity, would for a universe of acts set forth the cyclical relationships between assimilation and accommodation which are taken to be the functional nucleus of both factual and formal adaptation.

The act of Langer's world would not consist of movements in time and space as seen from some distant and impersonal viewpoint of a spectator, although such movements might indicate to the mind of a spectator the act of another mind. The symbol "act" would stand for any elemental or composite constituent of a whole but unique universe, one among others named by the symbol "mind," whose personal and partly intimate point of view would be felt as the very direction of the act.

More, the direction of the act would tend to satisfy the immediate needs of a state of adaptation by assimilating and accommodating to the organization of the environment. At the same time the direction of the act would satisfy the long term needs of a process of adaptation by assimilating the organization of the act itself toward an eventual accommodation which, through the mind's increased understanding of the principles of its own direction, would affect a new state.

This progress notwithstanding, Piaget contends as Peirce before him:

there does not exist, on any level of human consciousness, either direct experience of one's own mind or of the environment. Through the very fact that assimilation and accommodation are always on a par, neither the organization of an outer world nor that of an inner self is ever known independently. It is through a progressive construction, guided solely by the pragmatic circumstance that acts once committed to use either succeed or fail to be consummated, that concepts of the self within and of the environment without will be elaborated in the mind, each gaining meaning relative to the other.

The theoretical relationships between the several states and the process of psychological adaptation, as approached in the context of the theory of the act, is the core of the matter, therefore. It is from this connection that one may extract the multifarious method of inquiry indicated by Dewey and Bentley in their essay about knowing and the known in this new universe.

If the formal character of each successive state of adaptation is due to an increase in the mind's understanding of how the act is organized internally, then the invariants observed in each of those states should contribute new formal aspects for the theory of the act. Conversely, invariants observed in the act as such should help us to understand the theoretical relationships between the states and the process of adaptation.

Mead's analysis found the act to consist of three principal phases: the first a phase of "perception," the second of "manipulation," and the third of "consummation." But the method of analysis just suggested will find that

every complex act has five functionally distinct phases which, allowing for an initial state, account for Piaget's basic progression of six adaptive stages.

This result would presuppose, for the theory of the relationships between the states and the process of adaptation, that it is an understanding of some new phase of the act which the adaptive process incorporates in the frame of formal experience and knowledge in order to pass from the existing state of adaptation to the next state of that basic progression. The efficacy of this view of the situation is given by various sorts of evidence.

Formal adaptation always appears as a growth of capacity in just one functionally distinct phase of the cycle of assimilation and accommodation implementing factual adaptation. This is at least consistent with the assumption that formal assimilation incorporates in the mind an understanding of the internal organization of that phase.

There is also an invariant order in the emergence of new phases of intellectual growth. The basic progression of six stages of adaptation exhibits that order in a number of quite dissimilar behavioral contexts, thereby assuring us that we are dealing with exactly five phases of functional capability, no more no less.

The initial progression consists of the stages of practical intelligence, where the five phases are first established as capabilities in the newborn child. Throughout the development of reflective thought that immediately follows, five functionally analogous phases emerge in the adolescent and young adult with the growth of representative thought. They occur again with the increasing capacity to verbalize subjective and objective facts contained

in such thought, and finally with progress in formal verbalization. As the behavioral setting becomes more complex, the formal character of the phases is revealed with greater clarity. The cultural progression is accordingly the most elaborate setting from which one can extract the internal organization of each phase.

Within the internal organization of these five functionally distinct phases, one finds every capability needed to construct a viable theory of the act. That the phases are in fact constituents of the act is evidenced by the very possibility of that construction.

However, the sequence of phases defining the direction of the act does not turn out to be the same as the developmental sequence defining the order in which the phases enter consciousness. Evidently the first two phases of the act are understood one after the other, and then the fourth phase, the third, and the fifth. The process of adaptation always assimilates the phases of the act in this peculiar order to affect, through its respective accommodations to the successive mental increments, the basic progression of six adaptive stages observed in all of the behavioral contexts.

Even this unexpected state of affairs will be found to make sense in the context of cultural adaptation, where the developmental sequence can be recognized as a convenient arrangement for the transmission of social and cultural behavior across generations of individuals. To see this, one is required to consider the specific organizations of the several phases and the way they cooperate to determine the direction of the whole act.

To lay the grounds for that discussion, I must stress again that the

most fundamental distinction for the new world we are exploring is not the one yielding a grid of space and time which makes possible the symbolization of movements in a physical environment. For a universe of acts, the basic distinction will be that made by Peirce of "potential acts" comprising the patterns of knowledge as opposed to "actual acts" being instances of those very same patterns which, in the relationships of their occurrence, comprise the experience of a given mind.

The dichotomy of experience and knowledge is a more comprehensive grid for our symbols than that of space and time. It makes possible the symbolization of acts making up a mind that is itself capable of symbolizing physical movements in an environment, as well as its own acts or acts of other minds.

Linguists will find this new grid familiar. It is the one by which known patterns of language, symbolized in their grammars, are balanced against instances of those patterns which they symbolize in a given stream of speech. The dichotomy of knowledge and experience is nonetheless as wide as life. Every stream of existence contains sensory elements other than those of speech, which feed a balancing act of magnificent dimensions.

The problem posed for the theory of the act is to explain the equilibrium that assimilative and accommodative processes maintain between actual acts of experience and potential acts of knowledge, given a stream of existence which is itself a sequence of actual sensory or motor acts, each instancing a successful or an unsuccessful consummation of some potential act among the elements of Langer's universe.

The resultant mind extends precisely as far as the equilibrium between experience and knowledge is maintained, whether the work of assimilation and accommodation is done by a single biological agent, or by a collection of them acting socially. The agent could as well be an electronic machine. This new world will be less skeptical of mechanical agents of mind than the present one, because it will look for mind in the equilibrium itself instead of in the agent.

Whatever the agent of a given mind, any flaw in its equilibrium will be "need." Any repair of disequilibrium will be "satisfaction." Persistent loss of equilibrium will be the nagging irritation of "doubt," according to Peirce the sole motivation for acts of inquiry which when successful attain not the truth of an external reality, but stability. For a universe of acts, therefore, any persistent stability in the equilibrium between experience and knowledge will be "belief."

In summary of the matrix of theoretical and methodological choices, I assume that the criteria of truth in a universe of acts are the immediate stability of its adaptive state and the long term stability of its adaptive process. These are pragmatic truths of fact and of form, respectively. The former relates ultimately to the organization of the environment; the latter, to the organization of the act. But there is no direct access either to a reality behind fact or behind form. Each is known or experienced relative to the other by means of complex acts which the mind itself constructs. The constituents of that construction are potential sensory or motor acts, the biologically or mechanically based elements of this unique universe, which

is one mind among others. The sole source of the information guiding the construction is a given stream of existence, itself a sequence of actual sensory or motor acts instancing successful or unsuccessful consummations of those universal elements. And the organizing principles of the construction are those of the act, whose pragmatic method I will now discuss.

Christopher Alexander, in his notes on the synthesis of form, cites a common engineering practice for making a metal face perfectly smooth and level. One inks the surface of a standard steel block, which *is* level within finer limits than those desired, and then one rubs the face to be leveled against the inked surface. If the face is not quite level, ink marks appear on it at those points which are higher than the rest. One grinds away those high spots, and fits the face to the inked surface again. The grinding and fitting are repeated over and over, until at some final fitting the entire surface of the metal face is marked by the ink, indicating that no high spots remain to be ground away.

The practice of fitting affords a useful way to think about the phases of the act. Because the act, too, consists of ongoing processes of assimilation and accommodation within which experience and knowledge are repeatedly shaped by putting their various parts to use, rubbing them against reality so to speak, in order to have them marked by success or failure as preparation for still another shaping.

It was Peirce who found out that the high spots of the mind are marked by the ink of success and the low ones by lack of it. Thus, fitting the mind to reality involves filling in the low points as well as grinding away the high ones. The mind had to be constructive in order to eliminate the holes and pitfalls of experience and knowledge. If men worked diligently enough at seeking out and building up the misfits, the entire stream of existence might become bright with success.

Although from this William James drew an elixir that pleased and encouraged a competitive society, the product he marketed under the label of "pragmatism" has since fared poorly in the popularity contest of ideas. That is significant for our inquiry, though not as an indication of some flaw in Peirce's insight. By the hard-eyed predictions that the actual practice of pragmatic method made possible, the course of its own acceptance has in fact been remarkably well borne out.

Stubbornly fixing its attention on the surprise of failure, pragmatic method was sure to be unpopular to every conservative trend of mind. That opposite practice, finding all of its reasons in the preservation rather than the creation of information, deliberately tries to avoid surprises and to explain away its own failures. For a conservative mind the sources of gratifying or noxious information are invariably felt to be outside of itself. In simple consequence, every form of conservatism directs its main purposes to preventing contamination of the specific place from which it sucks nourishment. To such a mind the purposes and attitudes of pragmatism have been and will continue to be irrational.

The conflict of rationality we are about to consider is the most exasperating one known to man because it stems from the direct opposition of creative and conservative assumptions about what information is, where it comes from, and how it is used. By comparison, all earlier crises of the cultural progression will have been mere squabbles among conservative minds in solemn disagreement over good and bad teats.

In the fifth universe, "information" is something to be transmitted

across its space-time grid. The ultimate source of information is a material reality common to and encompassing all of mankind. The firsthand passage of information, by which it arrives in a brain that is essentially a passive receiver pretuned genetically to certain vibrations beyond itself, is called "observation." The brain stores up some of the information it receives and can also retransmit informative copies from its store by means of a conveyance of symbols that lodge themselves in other brains. This secondhand passage of information from one brain to another is "communi-cation" or, for the young in passive receipt of a largess from the information store of society, it is "education."

The method of "descriptive" science, although less conservative than its predecessor, still locates the information source externally. Its works of observation are best done by a disciplined spectator who separates himself as rigorously as possible from all temptations of human purpose. The social status of the scientist, so engaged in carrying out his contract of detachment, is not unlike that of the priest whose nearness to God in the preceding social order called for all sorts of precautionary measures to insure the fidelity of firsthand information.

In general, one can identify information specialists at each stage of culture for whom contemporary men reserve their greatest veneration and suspicion. This highest peak of cathexis may now be explained theoretically by the need of every society to cluster around its fount of firsthand information in order to carry out the social act.

The necessary consequence of any change in the information source

will be social reorganization, a period of turmoil during which new information specialists learn their roles, and users of their information scurry to the unaccustomed precincts of yet another defective metamorphosis. An improved equilibrium might then be felt by its participants as the preferred "order". Without that shared judgment, the new metamorphosis would fail. Society would revert to its former state, or would backslide down the cultural sequence to a regressive state within the scope of its remaining capability.

The pivot point of the adaptive process would appear to come when a society, or by the same principle a personality, feels the need to modify its source of information. This is the invariant to be looked for from the standpoint of the mind itself, even though our theoretical explanation holds that such *a* fundamental change is caused by an understanding of some new phase of the act being incorporated in the mind's functioning to thereby affect new ecological relationships.

Besides that our line of formal reasoning predicts that any new state resulting from an advance of the adaptive process will at first involve a reorganization of known facts. Thus the repair of intellectual progress is always felt by the personality or the society as a consolidation of mental holdings, in a word, as an "insight". Only after the introduction of a more comprehensive organizing principle can new facts be added to a reconstituted structure that has become at once broad and stable enough to receive them.

These conclusions are, in themselves, organizing principles of a personal world view emphasizing learning rather than doing.

Giving its highest priority to doing, the fifth universe uses its symbols

to persuade other individuals or other societies what ought to be done. Inquiry is a garnering of information under stringent regimens that protect the quality of a product being pigeonholed away for unspecified future use in an advocative scheme of choicemaking. There, hard-fought positions are reluctantly abandoned under the shear weight of damaging evidence.

By comparison, the pragmatic scheme of choicemaking is one in which a real preference for surprises actually courts failure as a gratifying means to the shaping of an affluence of hypothetical creations almost light-heartedly sent forth in the hope that new truths might be caught in their net. The preferred symbols of the sixth psychological state belong in a context giving its highest priority to learning, and so they pertain to changing one's own individual mind or the mind of one's own society, not another's.

"Information," in the sixth universe, is something to be created against the grid of experience and knowledge by the agency of an ongoing organic process for which each mind's fragile stream of existence provides the indispensible clues. Those surprising instances when a given mind fails to achieve an expected objective are, in a world motivated by the need to repair itself, the necessary benchmarks for firsthand information being self-consciously designed to circumvent know misfits that are obstructing human satisfaction.

Hence the characteristic forms of pragmatic "communication" are to broadcast throughout the community all known points of distress and any helpful new designs by which past failures might in the future be overcome. One can readily see how such an innovative mode of communication will be

disquieting when taken out of its proper context by a conservative state of mind bent on maintaining credible displays of tradition, authority or power.

Formal incompatibilities of conservative and creative views of information do indeed cause a "communication gap" with which the pragmatist, for his own part, is unable to cope. Advocative arguments will be perceived by him as "irrelevant" for two clear reasons.

First, a mind will not be persuaded by appeals to tradition, authority or competitive advantage once it believes that all "truth" is established by demonstrations of successful use. A persuasive rhetoric will be received disrespectfully as artless in the production of "false" designs, either untestable or long since disproven to a more receptive conduct of life. Seeming corrupted because of its higher resistance to corruption, the pragmatic mind will reject argument just as an argumentative mind had earlier rejected preachment.

Second, and more noteworthy of the pragmatic view of information, is its implication that an essentially conservative mind can be induced to learn by denying it the opportunity to overlook its failures of awareness. Mules of the sixth universe, once brought to water, will be taught to drink. The pragmatist's exorbitant desire to teach, as well as to learn, has not received the scholarly attention it deserves.

His discernment of this fresh possibility for improving all manifestations of the art of symbolic communication will inevitably call for new styles of speech and writing in which language is deliberately designed to stimulate a mind's own constructions through enrichment of its awarenesses. The more

exquisite these new forms of expression, the more they will appear a mouthing of absurdities to minds steadfast in the obsolete notion that words transmit messages. Thus the result that Dewey prophesied: symbolic communication conceived as teaching will rely less on language and more on active displays that dramatize the student's own weaknesses and his own overlooked possibilities.

The goals of "education" will be attained by a variety of activities and situations especially designed to progressively awaken a mind at first so feeble that it would shyly act to protect its meager hoard of dependable creations, thinking them the gift of one or another fountain of charity. The stimulation of formal learning, while tenderly administered to the young and mentally impaired, will reprimand the laggard so remissive in his own mental betterment that he extends a nascent conservatism into adulthood.

Society in the sixth universe will not achieve the elusive goal of classlessness. It will prefer an order of psychological classes wherein a forefront of information specialists gather loosely around the sage to be students and teachers of one another. As for the sage, he will probably turn out to be a mathematician.

In Peirce's guess at the riddle of life, man's framework of experience and knowledge has been gradually broadened to include the "law" of the human act in its complementary relationships to the "presentness" of the environment. Mediating these two extremities of consciousness is "struggle," a conscious sense of learning in a collective mind appraised finally of its own creative act of inquiry. About that wellspring of information he says:

> . . .there is manifestly not one drop of principle in the whole vast reservoir of established scientific theory that has sprung from any other source than the power of the human mind to originate ideas that are true. But this power, for all it has accomplished, is so feeble that as ideas flow from their springs in the soul, the truths are almost drowned in a flood of false notions; and that which experience does is gradual, and by a sort of fractionation, to precipitate and filter off the false ideas, eliminating them and letting the truth pour on in its mighty current.

Pragmatic method is more casual about forgetting because it has taken the act of creation in its own hands. The information specialist of the sixth universe will be a participant, immersing himself in a struggle to stabilize personal and social relationships which, in the pragmatic scheme of choicemaking, will give first priority to the satisfaction of human need. More tolerant but less egalitarian than his predecessor, he will character-istically create his own responsibilities without waiting for or wanting a contract or mandate.

One should not overlook the precocious act of genesis in Peirce's own hypothesis that a given mind can cross the formal chasm to this final metamorphosis only by incorporating to itself an understanding of the very process of forming an hypothesis.

From his singular assumption that forming an hypothesis is the mind's sole source of novelty, the whole fabric of pragmatic purposes and attitudes

can be deduced. So I have deduced some of the formal character of pragmatic thought, hoping by my example to make you aware that formal accommodation is the result of the mind's own effort to work out the consequences of a revised conception of the origins of information.

This pragmatic line of reasoning will conclude that the adaptive process need not depend at all on a persuasive rhetoric to change the currently existing cultural state, nor in consequence to reorder the entire edifice of society as we know it. Pragmatists will act on that belief quite regardless of the fact that our society, like the one it replaced, will prefer to explain and work for social change on its own terms.

A failure to even consider the existence of an alternative theory of information, despite the damaging evidence of history, may be the Achilles heel of men engrossed in describing *a* common universe while jockeying argumentatively, and too often belligerently, for positions of material advantage in it. Their whole world might decay, not because they were greedy for dominance, but just because someone else had a sounder hold on information than they.

Be that as it may, it was his own pragmatic method and not the method of descriptive science which Peirce claimed with quiet immodesty to be the only way of settling belief that does not lead to eventual disappointment.

This prideful prediction is the weakest of his speculations. For paradoxically, through the very insight made possible by its sixth genesis, a mind would discover all of its previous metamorphoses to have been its own imperfect creations also. Such expertise in the art of information would itself

be the imperfection of a Superman who, Friederich Nietzsche most accurately foresaw, was destined to walk among men as among animals and be ashamed.

I know how difficult it is to place much stock in these unwelcome speculations. You and I don't take philosophy seriously, being practical men. And that is precisely what pragmatic reasoning has to say about us. A penchant for getting "the job" done, a ponderous insistence on "the facts" when disinclined to make a decision, a heartfelt disdain for formal reasoning when it "gets personal," all are indexed in the fifth stage of the cultural progression among the characteristics of that state of mind most recognizable as ourselves.

I will try to convince you anyway that some baggy-kneed philosophers may have uncovered a real, honest to God, new universe in which a few minds are already living and you might live yourself.

Just do not ask me to describe this new universe to you, as though you were about to sit skeptically in judgment of my facts. I will merely decide that you are an inveterate spectator and hence too passive or too mesmerized in the art of objective reasoning for the pragmatic journey I have in mind. In any case, I have carried you as far as I can.

From here on it will be necessary for us to run together in the hope of breaking through to the sixth state of mind in which the phases of the act make sense. Should we succeed in that joint endeavor, it will then be possible to look back and see that among the reasons for proceeding in this manner there will be a revised estimate of what language can do.

You have your personal standpoint and I have mine. For the time being, suppose that our interpersonal relationship is the one explained by

Ogden and Richards, in which the symbols I produce can cause you to make acts of reference.

For Ogden and Richards the meaning of "meaning" involves a twofold orientation. My choice of symbols will be caused partly by the specific reference I intend for you to make and partly by personal or social factors. Examples of such factors are the purpose for which I am inciting you to make the reference, the proposed effect that recognizing my symbols is to have on your own purpose or attitude, and my own attitude as my symbols are being produced.

When you recognize my symbols, similarly, they may cause you to perform an act of reference and coincidentally to assume a purpose or an attitude which will be, under the whim of circumstance, more or less the one I intended. That hope for result is by no means certain.

Two chances for error are implicit in the double orientation itself. You may mistake the "content" of my reference, attributing to it some different subject matter than I intended. Or, you may mistake the personal or social factors which make up its "context." Either eventuality would distort the meaning I was aiming at, or you might fail to catch it entirely.

I do not mean to imply that, should an accident of communication occur between us, I would have conveyed more information to you than you were able to receive. Your sheer assumption that it was my purpose to transmit information to you would belong in the context of objective inferences. A current preference for that context seems also to have established the firm attitude that the only things men can converse about with any precision at all are the ones they can lay

their hands on.

In this vein, for example, Ogden and Richards propose to lay their hands on symbols and their "referents" so as to converse propitiously about a relation, "truth," imputed by thought, but which thought alone could somehow not sustain. With telltale zeal to locate all worthwhile instruction in solid matter apart from mind, these investigators too, despite the many worthwhile things they say about problems of meaning, would not go so far as to explain the truthfulness of symbols in terms of mental organization.

The root of the matter is that every acceptable means of scientific investigation has been unable to locate minds, and hence thoughts, on the continuum of time and space. Popular belief tends to favor the inside of the head rather than the stomach, which had its day when men were hungrier. Until the right spot is discovered and demonstrated, it will be quite meaningless to speak of something "apart from" or "beyond" or anywhere positioned relative to a mind. Minds, as a result, have become disreputable in an objective scheme of things where they just hang around lousing up an otherwise impressive cosmos.

Pragmatists have been nicer to minds than scientists. For that kindness, I have labored to make you aware, there may be a troublesome price to pay. Protective mentalities of every stripe may have to get used to contrite pragmatic traits of character which evolve, without outside help, within a mind become so stalwart that it needs no cosmic plan beyond its own anatomy.

Within that frame of pragmatic reasoning, launched by inferences

which work out the consequences of decidedly different cosmological assumptions than those customarily assumed by you or me, the established order has been found guilty of grievous errors in its thoughts and words. Were this not enough abuse for a society priding itself on being "scientific," pragmatic response to the second-rate status of minds in a material universe has, with its usual candor, judged the method of descriptive science to be itself an aberration of a conservative mind in need of shaping.

The specific complaint points to a society recklessly applying objective inferences to the content of human purpose. It cites a scientism which perpetuates the excess of enthusiasm of men in the Middle Ages who, having organized their entire cosmos in conformity with inferences about an omnipotent will, imposed purpose on everything that moved.

This criticism, as such, is a formal communication designed to broadcast a misfit in the way language is being used to express facts. On the constructive side it suggests that, to overcome incompetence in designing symbols, one should observe a scrupulous match between a reference and its context.

"Meaning" is the explicit match, utilitarian by nature, for which the specific inferences defining the context shall have been tested by successful application to the specific content referenced. From this harsh point of view, it follows, the only proven domain of objective inferences is in point of fact those contents of experience in which a person lays his hands, or his eyes, or some mechanical extension of them, on something permitting experiment.

To accept this diagnosis and cure, an entirely new world view will be

necessary. Your cosmos and mine will have to be quite literally the framework of just one personal mind that feels itself to be participating, as a mere agent of the social act, toward the shaping of one or more collective minds.

Pragmatic criticism is not only addressed to a specific anatomy of information constituting a mind, it presupposes above all else that the signals of misshapen experience or knowledge are given systemically within that mind's internal organization. "Error" makes no appeal whatsoever to any other reality than a particular texture of one's own experience or knowledge just as such. Pragmatic explanation, similarly, is always posed in terms that ultimately recommend mental constructions.

Suppose, as an example of the latter, that acts of reference are taken to be the constituents of that immediate "perceptual" experience which in a given mind is felt as an orientation to what is now present ostensively, right at hand. Also imagine that, on this relatively secure foundation, a speculative extension is then built by the agency of acts of inference from the particular contexts matched to those specific contents being presented perceptually. Constituents of the resultant construction are "concepts;" the elaboration itself is the newest part of that mind's "conceptual" experience, felt as an orientation to things not present yet having import for some activity either being contemplated or in progress.

Giving this theoretical explanation its due would adduce, from the very mind committed to it, the consequence that errors of reference or of inference will, in general, beget malformed experience. Were such a faulty framework used to guide further action, the enterprise would culminate

in acts prone to failure. Hence, in consequence of accommodative inferences tending to reorganize its own methods along pragmatic lines, the mind would finally conclude that, from its own personal standpoint, its own failures are its only signs of mistaken perceptions or conceptions.

To that personal world my symbols can carry nothing along with them except the skillful ingenuity with which I designed them and then launched them by mouth or hand, all the while guessing at your skill for using them to create information. Indeed, your ingenuity might be greater as a creative recognizer of symbols than mine as a producer of them.

As for the truthfulness of my symbols, I believe you will discover "truth" in them to whatever degree they stimulate and assist your own creative efforts. If they cause you to fail or carry you away from insight, farther than you would have gone by yourself, you will certainly judge them "false."

My symbolic designs can bring you no evidence, nor can they offer you proofs. They can only recommend how you might look for evidence in order to convince yourself that this revision of your present state of mind might improve the satisfaction of your everyday needs.

Then will you eagerly extract every scrap of evidence from which the further construction of your own experience or knowledge might profit. In your unique universe you will have to do all of the remodeling for and by yourself, and you alone will judge the result.

For my part, despite this ample domain of personal application, I see no reason why these same pragmatic practices will not also satisfy the needs of a society giving its highest priority to learning rather than merely

doing.

Regarding the question of precision in the social use of symbols, I think you will agree that these pragmatic methods tend quite naturally to the happy hunting ground of mathematical reasoning, where especially critical minds can live out their cloistered days as students and teachers of one another toward the sole purpose of shaping up the formal component of explicitly constructed "languages."

Not only do the ministrations of mathematicians succeed admirably, they belie the empiricist's expectation that fact is a more stable foundation for society than form. The myth of empirical description to the contrary, science rode to its present glory on the back of mathematics.

Of course, mathematicians argue more than they would like. And if some of the symbolic designs they produce are named "proofs," I do not object. No mathematician has ever been known to accept one of those proofs from his cohorts without performing every reference its symbols specify, while passing judgment on each meticulous step for and by himself.

I therefore can hardly resist classifying mathematicians as the most excellent pragmatists of all. The things of importance are that their inbred practices have originated unusually reliable inferences in special minds which, since the time when mathematicians themselves could still believe they were describing abstract relations of rather ethereal realms, have carried forward an explosive growth and variety of new constructive possibilities. Possessing a plenitude of alternative contexts, scientists have gone gingerly about the complementary task of fitting them to factual contents.

Thus the real route to exactitude in the scientific use of symbolism may have been presaged in the pragmatic view that, because facts vary, errors are at a minimum when men communicate about what is invariant among, hence within, themselves. As scientific hypotheses took on an increasingly mathematical character, the outworn trappings of a descriptive method were bit by bit discarded.

Like the earth-centered cosmos of the Middle Ages, was it necessary for our own world to be inverted before further progress was possible? To take the Peircian hypothesis seriously, you will have to identify it as having originated new organizing principles for known facts. It will have done the same sort of intellectual work as the Copernican hypothesis, whose emergence in the preceding state of culture portended the disintegration of an autocratic society and its reformation as a social order more favorable to industry.

That earlier transition, just as the one presumed to be new grinding to its sixth destination, was upsetting to the status quo. The spirits, spooks and fairies that moved the fourth universe were not cast aside easily.

Nicholas d'Oresme had observed that God had constructed the material world like a watch, which could then be left on its own, in no need of spiritual forces to move its various parts. A new theory of motion gradually emerged, helped along by Burdian, Albert of Saxony, and the philosophers of Merton College, Oxford. A direct precursor of Galilean dynamics, it held that any body when pushed is given an impetus that remains with it, or only slowly diminishes, if no obstacle is placed in its path.

But the law of gravity was never perfectly formulated by Galileo, who

retained a conservative preference for circular movement. Even Newton had to resort to God to explain the maintenance of motion in the new universe then under construction.

It is astonishing how few new facts Galileo used in his argumentation to support the Copernican system. The experience on which he based himself was at bottom the same everyday experience that the Aristotelians had interpreted. He arranged this experience in a completely new way and made it more comprehensible. One would be mistaken to think that the "scientific revolution" of the Renaissance consisted in a triumph of the description of new facts over formal speculation. Not until the writings of Francis Bacon became the bible of the Royal Society did the collection of facts become hectic.

It was Descartes who finally banished active spirits from non-living matter once and for all to launch the world we know. The essence of matter consists in extension; the essence of spiritual principles, like that of the soul, in self-consciousness. According to Descartes, therefore, God does not operate in the cosmic process either. The behavior of the material universe must be explained on its own terms.

By far the most interesting consequence of Descartes' theory was its contribution to the disappearance of witch hunts, which had grown to incredible dimensions in both Protestant and Catholic countries. That is one sound indication of an unsettled world retrieved toward salutary equilibrium when intellectual preference turned away from asking "What is God's will?" and took up the question "How is the world constituted?"

Although the information source of Western culture had changed, the brotherhood of man under the fatherhood of God was not forgotten. An

egalitarian order was essential to the advocative scheme of choicemaking that replaced the authoritarian one. As Dewey and Bentley remind us, the spiritual entities which had once inhabited dead matter took flight to new homes, mostly in the human body, and particularly in the human brain. They had been swept out of the way of progress, right into another sanctuary of mischief.

The new social order formed decisively around two information specialists, polarized in the separate responsibilities for objective and subjective choices implied in Descartes' dichotomy. The emerging mechanistic world view became the watchword of the eighteenth and nineteenth centuries, providing the theoretical basis for both poles of the new advocative scheme. Science, but also economics and politics, were conceptualized in terms of forces held in abeyance by counterforces balanced against them. Ultimately the forces of nature were balanced against the burgeoning will of man.

An oddity of the transition now attending the dissolution of a mechanistic world view built on polarity is that it will require a double genesis. Moreover, it was to be expected that scientists and educators, having been commissioned to a quiet concern for learning in an industrial society, would be susceptible to pragmatic influences in greater degree than active managers and makers of public and private weal.

A decline was foretold when George Berkeley, motivated by the fear that Newton's principles of absolute space, absolute time, matter and gravitation would threaten religion, doubted whether the words in which these principles were expressed even made sense. According to him, the

only words that are meaningful are words that designate sensations. If the goal of science is to coordinate sensory perceptions, then it can make use of spatial relations only to the extent that these are merely relations between sensible bodies, and nothing more.

Out of the matrix of Berkeley's arguments came two fertile seeds. One is the distinction between the formal and factual components of language, now grown to the rank of a major preoccupation among philosophers. The other is the very method of approach by which scientific procedure took on its exclusively descriptive character, that of ascertaining, and only then interpreting, the data of sensation.

A new direction came pointedly to the surface when Immanuel Kant asked "What can we know about the world?" He had shifted the source of information toward a personal perspective despite his own conviction of the correctness of the Newtonian world view, which his own cosmological hypothesis had broadened. He sought to substantiate it. In his opinion the principles of natural science, such as those of causality and the law of conservation of energy, are unconditionally true because the mind thinks in Newtonian terms. This explains why we are able to comprehend nature; its general features are indeed our own work.

The spectacular growth of science in this century has armed a mechanistic world view with an abundance of arguments. Meanwhile, the forefront of scientific method has moved out on the much more mathematical course blazed by men like Faraday and Maxwell. Near the turning point Ernst Mach asserted the radical idea that science can, and should, do nothing but order experience.

Mechanism was struck a severe blow by Einstein's special theory of relativity, which introduced objective probabilities uninterpretable in terms of sensation. Later a coup de grace was delivered by his general theory, originating a curved space-time based on Riemann's geometry.

It should be noticed that my pragmatic reconstructions of recent history make no appeal whatsoever to an advocacy on the part of Peirce. Were he alive, I know he would resent my shabby treatment of the brainchildren he dressed so carefully. What matters after all is that, though sorely lacking the Madison Avenue touch, he did advertise these new constructive possibilities. That is all his pragmatic theory of social change required.

The universe of your own personal mind is one you know well. However, you have not thought of your social universe as being organized along principles of mental anatomy, and will doubtlessly think that further suggestion is silly.

Believe me, I share your annoyance. I have lived as comfortably on the grid of time and space as men did formerly in the lap of God. But a surprising thing happened to me one day on the way to the laboratory. There were people in the streets yelling about the misfits of our society, and it suddenly occurred to me I was being set upon by a bunch of pragmatists.

Now I am pretty sure that none of these ragamuffins had ever read Peirce. Yet they made it crystal clear that they were intent on shaping the collective mind of their OWN society, and also their OWN individual minds. Their inquisitive attitudes gave much of Nietzsche's holy Yea to life seekings its OWN will to win its OWN personal world, though it be the world of an outcast.

Yes, they did seem painfully aware of Nietzsche's metamorphoses by which the human spirit becomes a camel, the camel a lion, and the lion at last a child. Along with their childlike craving for novelty, they were impatient with bearing burdens or doing combat.

I call your awareness to these untidy deportments because of their unheralded intrusion upon a world so desperately intent on persuading OTHER societies, and hence OTHER individuals, what ought to be done.

I submit that attempts to explain these surprising events in the context of the existing cultural state have so far not been very satisfactory. By way of contrast, the same happenings fit so well in Peirce's hypothetical universe that I have gradually been compelled to regard its peculiar galaxy of pragmatic purposes and attitudes as less a philosophical abstraction and more a veritable contagion of contemporary men and women.

I came as a pedant to the pragmatist's world, but have since met some of its native inhabitants for whom its exotic ways of behaving appear as natural as breathing. At any rate, I am constantly being amazed as my hard-won conclusions are judged by these people to be just ordinary common sense. The really interesting question, therefore, is where these purposes and attitudes came from.

I, for one, am not very impressed with the explanation that the Devil has been busy corrupting affluent children who were abandoned by permissive parents to permissive school administrators. I do admit that supernatural corruptors might be having a fretful problem now that the Communists have grabbed so much of their work. But since the Communists themselves seem

to be fretting over a rash of freakish happenstance in their home territory, it would be better not to point a finger at them just now.

Hunts for a source of corrupting information from OTHER minds, real or imagined, will not doubt be carried farther than its present overindulgence if this liking for pragmatic thinking spreads. For that dismal conclusion one need look no farther than the recent precedent of Germany, where it may also be seen that at some point of panic the diligent conservative can forget what he was looking for and become an irrational fanatic.

Not surprisingly, Germany was at the forefront of the new science when the engineering of pragmatic learning was first experimented with irresponsibly in the streets and on the campuses. There, also, came the first demonstration that applications of this new theory of information can have far reaching effects on political and educational institutions, both restless in a balance between advocates of particular positions and their counterpoised opponents.

So I have brought you to the place where young men and women, unaccountably ashamed of their elders, are making their own myths. They honestly believe that Adolf Hitler killed Superman at his first borning and stole his robe to use as a trophy in festering up his regressive cancer. Pessimistically they gather to be students and teachers of one another, asking "Who am I?" while awaiting the next executioner.

With this small sample of pragmatic communication, so out of step with a staid "objectivity" in technical writing, I have sought to demonstrate the symbolic designs of a constructive cosmology. Reliance on description will be diminished, while greater importance will be attached to speculation. Above all, the formulation of new inferences will be incited in the hearer or reader by referring him to contents that reveal systemic weaknesses or suggest fruitful contexts for innovative constructions. Though these forms of symbolic intercourse have long been exercised at the dinner table and over the cup, they are honed to a sharp edge in mathematical reasoning.

My concern has been to show that this change of style is not capricious or arbitrary. It is the rational result of an emerging new theory about the origins, the means of distribution, and the uses of information. As the empiricist could no longer support a requirement for incantation, prayer or preachment in half of his reconstructed world, so the pragmatist has no further need for language that purports to describe an external reality. The sole purpose of every symbolic communication in his universe of acts will be to shape the internal reality of a person or a society.

In this dual light, I ask you to reconsider the conclusion that Charles Morris reached in his treatise on signification and significance, according to which the main dimensions of signifying relate to phases of the act. In particular, he finds that "designative" discourse corresponds to the act's perceptual phase, "prescriptive" discourse to the manipulative phase, and "appraisive"

discourse to the phase of consummation.

A student of Mead, Morris builds on his mentor's analysis of the acts phases. He recognizes that "formative" discourse might call for a fourth dimension of signifying; but he decides that Mead's analysis need not be complicated by a fourth phase to account for his misfit.

To the contrary, when analysis of the act's phases is approached by the different method afforded by consideration of Piaget's basic progression of developmental stages, a phase of hypothesis formation will be one of those found missing from Mead's tally. This phase, indeed implemented socially by formative discourse, will be for a pragmatic cosmology, the one in which new knowledge is created. It is accordingly the specific phase that Peirce recommended to our understanding in order to consummate the formal traverse on which he would have us embark. Since this phase of the act will also involve forgetting knowledge, I prefer to call it the phase of "reorganization."

By all indications, language is an ancient heritage and should not as an ongoing system be expected to zig or zag as readily as speculations about the nature of language or styles of speech, heard from men immersed in a particular cultural situation. To look at the way language is being used is rewarding for a pragmatic inquiry which, in keeping with its interest in the process and various states of adaptation, will prefer to observe humans at large in their natural habitats as they busy themselves more with obedient or competitive doing than with learning.

Comparison can thus be made of the respective abilities of the pragmatic and the objective viewpoints to organize known facts of language. That

formative discourse fits naturally in the pragmatic framework can be taken as a bit of confirming evidence that its organizing principles are more comprehensive than the objective ones.

The comparison is itself the one proposed for a pragmatic science, since only by use of the pragmatist's viewpoint does one begin to grasp the general principle that what is felt in experience as a "viewpoint" is determined by one's own choice of inferences.

A consequence of this insight is to make the context as well as the content of observation matter. Once the two are seen to be relative, one gaining meaning as complement to the other, the aim of a pragmatic science must be a useful matching of the two.

To make the comparison just recommended, one would have to first identify Piaget's theories as being pragmatic in outlook and those of both Mead and Morris as belonging to that conservative view of psychology and sociology which attempts to achieve order and predictability in a world of objects. Just because the objects are animate instead of inanimate does not, for its overextended objective reasoning, change the nature of the quest.

Thus a troublesome consequence of the pragmatist's insight is that, in his own mind, the opinions of other men will no longer be regarded as equal in perspicacity. If Mead himself believed that the source of information was in a reality "outside" of his subject, that presupposition on the part of Mead as observer and as theorist would account, to the reasoning of the pragmatist, for still another phase of the act denied autonomy in Mead's theory yet required by the pragmatic realm of speculation pursued by Piaget.

As my projected phase of reorganization will agree with the pragmatic hypothesis that knowledge is a creation of the mind, so this second neglected phase of the act will anticipate a constructed experience.

Rather than an experience consisting of data received through the senses and somehow stored as pictorial or otherwise coded "representations" of an external reality in memory, pragmatic perception will itself be a constructive activity building on a foundation of actual instances of elemental sensory or motor acts, each one signaling the success or the failure of its small task when commanded to perform.

This choice of elemental units of information is in harmony with recent results of brain research in which neural elements are found to respond, in roughly all or nothing fashion, to kinds of stimuli so highly specific that one can regard them as "feature detectors." In the eyes, as elsewhere, such detectors are not passive receivers; they have to be moved about and positioned and enjoined to attend. Excitations of elements of response are coordinated with sensitizations of elements of sensation in grand patterns of behavior orienting the perceiving organism selectively to whatever it is its present purpose to perceive. Designative discourse serves this perceptual purpose.

It is necessary to conclude that all "external" objects and relations in a universe of acts will be presented in experience by successful acts of perception. And from this the more general conclusion can be drawn that "contents" will be given in knowledge by overlapping collections of potential acts of perception, exactly as overlapping collections of potential acts of inference will define "contexts." A parallel can therefore be established

theoretically, according to which the preservation in experience of either a specific content or a specific context will be signalled by the successful consummation of some member of that collection.

However, the purpose of perception may be to ascertain that some object or relation is not present in the environment. It should be noticed in passing that the logical calculus which George Boole dropped at our door-step, whose computations of "truth-values" pampered the empiricist's expectation that his symbolic designs correspond with an external reality, will reappear in the pragmatist's universe of acts as computations of "success-values." For looking backward in a pragmatic world at what was done in the past, such computations will be needed to determine the success or failure of a complex act in consequence of the successful or unsuccessful consummations of its elements. For looking toward the future, they will be needed to assess the internal validity of proposed acts.

These computations will be of equal value for acts of inference. As a matter of fact, it is by following out the strict parallel and symmetry of perception and inference that one can begin to get the hang of how the pragmatist orders his personal as well as his social cosmos. A coordinated matching of perception and inference, in which the two are equal partners, is the very source of his information. It is our world, not his, which assumes information will arrive from a material reality and so gives greater weight to perceiving than to inferring.

Anticipating your preference for an objective world, I have to this point glossed over the puzzling fact that a universe of acts will require two

kinds of elements. The first are the elements of perception that have been brought to your attention. They were called "sensory" and "motor" acts because I assume their agents in biological organization to be organs of sensation and locomotion, respectively. For machines, the analogous agents will be "sensors" and "effectors," each one capable of signaling the success of its commanded task.

The second kind of elements will be the elemental acts of inference from which complex inferences may be constructed. Not knowing the biological agents of elemental inferences, I *will* for the present characterize them in mechanical terms as being able to produce or to recognize structures comprised of the mobile units I have called "concepts."

I rely on mechanical explanations without apology. Pragmatic hypotheses will have to be tested by means of electronic circuitry. Without computers, the progressive attainment of ever more comprehensive and equilibrated stages of mental dynamics could not be demonstrated convincingly.

But pragmatic experimentation will be not in the least concerned with "simulating" a mind, whatever method of comparison that might connote to its proponents. The methodological insight of the pragmatist is that whereas a mind cannot be described it can be constructed. His objective will be to construct a mechanically-based mind every bit as useful as the ones based biologically, in all truth potentially more so in view of such enticing properties as access to an unlimited range of sensors and effectors, infinite reproducibility at its prime, and effective immortality.

There is every reason to predict that the development will be undertaken

on sound technical and economic grounds and, further, on sound educational and scientific ones. For the central theoretical issue is how one should organize a capacity for personal or social learning. The very decision to proceed will therefore coincide with a return to optimism and political stability as we cease protecting the accomplishments of an industrial age and begin to teach ourselves how to enter a cybernetic age, where pragmatists might not seem so bad to have around after all.

The summary of adaptive stages I promised you will be an educated guess, bought and paid for by your tax dollars, as to the direction a pragmatic information technology might take. I base my predictions on the doctrine that men order information systems as they order society; indeed society, after their personal minds, is their main information system.

The wave of pessimism that ended the experiment of the sixties appears to have repaired itself with the paradoxical insight that mechanical translation might really progress if it could only get rid of the computer. I give this the same disrespect as the insight that democracy might really progress if it could only get rid of the people. What should have been learned from the experiment is what caused the system to fail. Then we can get to work and improve its design.

The role in society I have chosen for myself, as I told you at the beginning, is to be a designer of information systems, my preference being the sort that includes a language capability. The way I see it, any challenge to the existing view of information falls squarely within my technical responsibility. I am especially on the lookout for a new information theory right

now because the one I have been using did not fit the facts of language well. On further investigation I decided it didn't fit the facts of life either.

What kind of symbolic system is needed to communicate about living is the problem to which pragmatic comment is fundamentally addressed. The goal of pragmatism is a science of life. One characteristic of the system that failed, by contrast, is that its symbolic communications are referenced basically to nonliving things, or to living organisms regarded as things. That aspect of contemporary thought is summed up revealingly by the "formal systems" in which today's mathematician or logician works out an understanding of how complex things should be constructed from elemental things.

It is not by accident that present theories treat languages as complex things constructed from thing-like elements, the "features" or "forms" observable in speech. Current theories of meaning are of like inspiration. Things of language are placed in correspondence with a larger system of things that speech can mention, which may include systems of language. The things so mentioned, say for example people, are themselves made up of elemental particles. Society is in turn constructed of people who, not surprisingly in this kind of world, construct governments. If a government is malformed, the important thing is to replace the people in it, or to rearrange them so that they can shovel information to one another better. For information systems are regarded as receiving, storing and shipping information, as it the case for all other commodities. Oh yes, information is itself constructed of things called "bits." Information theory is therefore

concerned with how many bits need to be received, stored, or shipped.

The arrangements found in modern computers are the designs of John von Neumann and his able assistants René Descartes, Isaac Newton and Nicolaus Copernicus. I should also mention Gottlob Frege, who did the wiring diagrams. But Charles Peirce was in the office at the time and, being one of those pragmatists, he dissented.

What is most striking about Peirce's dissent is its emphasis on acts rather than things. Like Langer, I think this is the key to his system-making. The tragedy is that, as far as we know, he didn't turn in an alternative set of diagrams. Yet it is certain that the "particles" with which he labored to construct his pragmatic universe are not thing-like but are instead act-like. His is a universe of acts in which successful acts of perception bring us as close as we can get to our accustomed universe of things.

A pragmatic technology will not move "information" in and out of its machines as computers do now, although there may be a lot more going on inside. No bits at all need cross the machine's boundary. This applies to "instructions" as well as to "data." (These, for the uninformed, are the bit-buckets into which computer-people pay tribute to Descartes' dichotomy.) The sensors and effectors of an information system designed on the Peircian scheme will do much useful work, nonetheless, and may recognize or produce language signs in the bargain. For that last reason, I dub this alternative design a "semiotic system," distinguished from a "formal system" by being the creature of a universe nearer to life, and thus closer to language, in its arrangements.

To tell a programmer that he will have to give up the "instructions" with which he controls the computer is apt to cause a stomach ache. It is exactly the same stomach ache that one should anticipate among politicians as they watch a freewheeling pragmatic personality bouncing about in apparent disregard of the laws and other contractual means that control contemporary society. One should therefore notice that a semiotic system will be controlled by means of a propitious selection of its elemental acts. From this one might predict that a pragmatic society will be less concerned with social instruction but intensely interested in putting the right social agencies in place. These trends have emerged in our national life; they can be expected to cause the same sort of hair-raising scenes that happened when the nobles swiped the king's programming manual.

Another peculiarity of Peirce's design is its insistence on a world divided into three basic parts instead of Descartes' two. In the triad of Peirce's universal categories, one can identify as "presentness" the objective meanings of environmental fact, and as "law" the subjective meanings of organic form. But what of his third category, "struggle?"

Return, if you will, to the requirement for two kinds of elemental acts in a universe of acts: elements of perception and of inference. It will be seen that there are three basic combinatory possibilities. In addition to complex acts of perception composed of perceptual elements and complex inferential acts made up of elements of inference, there may be complex acts consisting of both perceptual and inferential elements.

I amend my hypothesis as follows: every pragmatic "meaning" will

be defined in "perceptual knowledge" by a collection of potential acts, and will be presented in "perceptual experience" by an actual act successfully consummating some member of that collection. Only in the special case where members of the collection are composed entirely of perceptual elements will that meaning be a "content;" only if the members consist of inferential elements will the meaning be a "context." Otherwise that meaning will be, to use Peirce's term, a "resistance."

Perceptual experience, as a consequence, will reconcile conceptual structures with environmental structures in the sense that, for a complex act to be successful, its perceptual elements manipulating the environment and its inferential elements manipulating concepts must both satisfy specific conditions of success. Not only will perceptual acts be coordinated with inferential acts to produce or modify conceptual structures, inferential acts that recognize conceptual structures will also guide perceptual acts by means of those same coordinations, so being the origin of perceptual purpose.

I will discuss the origins of concepts under the topic of the act's agent, Piaget's functional nucleus. In the meantime "concepts" may be regarded as act-like units of information corresponding to meanings, which is to say that they will represent the collections of acts just discussed. Those concepts corresponding to contents, the meanings of environmental presentness, will be "factual concepts." "Formal concepts" will correspond to contexts, meanings of law in the sense of process. "Organic concepts" will correspond to resistances, the meanings that mediate between presentness and law.

"Conceptual knowledge" will consist of the designs of concepts, one

for each meaning in the semiotic system. Instances of these designs, having been arranged by inferences into conceptual structures, will constitute "conceptual experience."

The remaining phase of the act, still unspecified in our revised tally, will be the phase of "conception," during which the responsibilities of tenuous acts of inference are taxed to extend conceptual structures beyond the frame resulting from immediate perception. This, then is the phase served by speculative discourse.

However, all of the act's phases will involve the manipulation of conceptual structures. It is by studying the kinds of inferences being made, and thus the kinds of conceptual structures being produced or being recognized to guide perceptions, that the separate responsibilities of the phases can be identified theoretically.

In short, the phases do define the main meanings in the semiotic system, reflected in language as Morris' dimensions of signifying. These after Peirce's still more basic triad of meanings: "presentness," "law" and "struggle." And the most fundamental is the duo of meanings, "knowledge" and "experience," on whose grid the mind is built.

Enough ground has been laid to begin redrawing the basic distinction between the process and the states of adaptation in terms of mental organization. It should be recalled that pragmatic explanation always takes this to be its aim.

One of my first projects should be a clearer pragmatic explanation of what was meant by my prior statements to the effect that the adaptive process changes the existing state of adaptation when an understanding of a new phase of the act is incorporated in the mind. My objective, therefore, is to redress "understanding" in terms of mental organization as a next step in my continuing effort to shape this concept.

I now assume that the adaptive process changes the existing state of adaptation as it originates one of the five dimensions of meaning just singled out. Consolidation of the new state then involves a continuing refinement of all meanings, including any that existed in the previous state. Progressive refinement of the new state will itself originate new meanings that will add concepts to those available for manipulation by inferences.

As an example of such an origination in the cultural progression, I have been tracing a history of pragmatic speculations whose literature incorporates this new dimension of meaning quite solidly for at least one hundred years; it can be backtracked through its unsteady footprints to precursors like David Hume. Pragmatic thought is well represented in our bookstores in paperbacks such as Alfred North Whitehead's essay on process and reality, or Henry David Thoreau's "Walden". Today's pragmatist is

not as much alone as Peirce, who nearly starved for the foolish things he had to say. Now the pragmatist holds his own scientific conventions under the rubric of "process metaphysics", or the like, where he can talk to other strange types in the halls about the needed refinements of his special brand of meaning.

What pragmatists say to one another seems just as foolish and irrational to an industrial society now as it did in Peirce's time. The note-worthy difference is that Peirce was a quiet man and easily ignored. I think you will agree that pragmatists are not as easy to ignore now as they have been in the past. I point to this very fact as evidence of an increasing consolidation of the pragmatic dimension of meaning in a segment of the collective mind, especially among the well-educated young who are now busy teaching their peers and parents.

Thus my next project should be to explain the direction this most recent consolidation of meaning might take. My approach to a specific answer may seem to you circuitous, but it is imposed by a pragmatic method of investigation which views meaning as a matching of content to context. It must generate new information by oscillating back and forth between explorations of fact and form in order to refine its conceptions. I have asked you to look for this erratic pattern in the pragmatist's own activities, within which the societal function of language itself must be reconceived for purposes of pragmatic explanation as an instrument for shaping rather than for conveying thoughts.

In a word, the mind "incorporates" any new dimension of meaning

by making accommodations which are not merely additive. The result is a pragmatic state of mind which constructs a world conspicuously different from the one that gave rise to industrial society. This applies not only to the novel way the pragmatist sees his situation in society. It provides a conceptual base from which to reconstruct a new past and to anticipate a new future.

To illustrate this last point, I have taken you on brief forays into a pragmatically reconstructed past where as historian of the sixth universe one might be especially attentive to changes in the style of inferences and perceptions, to preferred sources of information, to roles of information specialists, to surges of optimism signalling the conceptual breakthrough of each new age, and to the pessimism with which men close an age by encountering the absurdities and disparities that consolidation of thought always brings. Only refinement seems to reveal the hidden dissonances that restimulate doubt and so revive learning.

I have also taken stabs at a pragmatic future to show that tomorrow will always be anticipated by means of the organizing principles that reconstruct yesterday. Expectations of a quadrillion-dollar industrial economy may suffer the obsolescence of judgment day. Each dimension of meaning makes its own future as well as its own present and past. This invariant of human behavior can be studied in historical and anthropological records in evidence of the general principle that man's experience is indeed a construction of his mind. When that much is established, one can then study the constructions themselves to find out how the mind operates.

This, my own little essay on the pragmatic dimension of meaning, has been designed to originate in your own mind a pragmatic awareness if it did not already exist there. I have attempted to teach you by the pragmatic technique of forcing upon your mind some difficulties that have made their appearance in empirical science. At the same time I have urged upon you the alternative of a pragmatic science. My comments at this stage of my presentation are intended to help you refine the pragmatic meanings that the earlier stage was designed to originate.

None of this mental tampering is malicious. My goal is a style of technical presentation consistent with the pragmatic hypothesis being presented. An important implication of that hypothesis is that the very function of language is to aid the mind's constructive activities by means of such teaching. To conceive of language as a vehicle carrying instructive messages or descriptions is irrational within the pragmatic world view. As I have pointed out, no "information" in the sense of transmitted bits can come across the boundary of the human organism from the environment in this alternative universe.

Human organs of locomotion in the broad sense of producing movement, by acting in unison with organs of sensation, can nonetheless successfully consummate complex perceptual acts, or can fail in purposeful attempts to do so. Features and their relations in the environment can be identified by this means. So accordingly can language signs in the environment be identified as they are being produced in the speech of another human being, or where they have been left lying around as writing. But here the "information'

originates in a binary generation of bits within the human boundary, indicating either "success" or "failure" in elemental sensory or motor acts purposefully undertaken.

All of this may sound like nitpicking. Its theoretical consequences are however far-reaching. It means that we must think of the human brain as being organized to create information, not to receive and store it for use in choicemaking activities that are also results of instructions received from one or another great programmer out yonder.

It also means that the organization of industrial society is irrational to the pragmatist's eyes. The very conception of language as a conveyor of descriptive or instructive messages is intimately tied to a social order in which an objective science is the origin of the former and government of the latter. This is the case whether the specific form of government is democratic or totalitarian in the method by which it makes the subjective choices that produce its instructions. As far as the pragmatist is concerned, democratic capitalism and communistic totalitarianism are different social implementations of the same stage of culture. Further, the need for adversaries at that fifth cultural stage explains the final polarization of an industrial age.

But the same indictment of irrationality extends to the pre-industrial social orders whose different inferences turned perceptions elsewhere in search of truth. In this respect the pragmatist, in carrying out his societal function as agent of the social act, is not different from the rest. Although for him information is being generated within the activities of his own society, rather than elsewhere, the success or failure of social acts which

are the source of pragmatic truth must be perceived outside of his own person.

It should therefore be anticipated that the only government *a* pragmatist will respect is one that can do something for him or can teach him something by helping him to be aware of his own mistakes or by presenting him with creative possibilities that he may have overlooked in his personal life. His concept of good citizenry will be to return the favor to government in kind, since only by contributing to the social act can he come to respect himself as a useful member of society within the frame of his own attitudes.

In consequence, the pragmatist's conception of his societal role is more directly related to serving and being served by society than has been the case for all of the preceding cultural orientations. Membership in every conservative society has presupposed selfish personal motives countermanded by conformity to social instruction in the collective interest of competition, salvation, tradition, favorable treatment by demons or raw survival. Finding the source of personal instruction within himself, a pragmatist will look with disdain on any outside attempt to tell him how to behave. He has a word for such inept teaching that is rich in symbolic content, and he is not bashful about using it. To the conservative mind he is thus an outlaw.

I have projected these attitudes to a "cybernetic age" because it seems obvious that the pragmatist's conception of good government cannot be achieved without the new technology that his own world view dictates. Yet clear postures of rejection at every mention of the word "computer" have come from the people who graciously and most eagerly helped me to understand their state of mind.

This contradiction in my study disappeared when it occurred to me that I was dealing with a mirror image of an outsized respect for what computers might do to facilitate society. As economic depression is the horror of an industrial society, so the image of information technology being used to limit life's possibilities strikes fear and anger in a pragmatic heart. He is painfully aware that, for a conservative government, the only rational course will be to enforce the laws arrived at by democratic consensus to instruct all citizens as to the acceptable limits of social behavior. Yet for the pragmatic personality, legal or contractual restrictions are a robbery of life. He will steadfastly resist their intrusion.

Because of his ministrations to life and living, the pragmatist is constantly mistaken for a missionary. And since for him role-making is fun, he is not above mounting an off-beat "Jesus revolution" to clothe his teaching in protective symbols that are sure to catch the attention of his student. He is not an anarchist but a chameleon. His constant role is role-making in the service of either personal or social learning. Toward both he is highly motivated since, having created his own information, he has no one to blame for his personal mistakes and his relationship to society provides no rational defense for any kind of deception.

Thus the pragmatic theory of language belongs to a social order that will direct its symbols more deliberately than the present one to stimulate the creative efforts of the collective mind upon which a successful social performance ultimately depends. It is within a post-industrial world view that designative, speculative, prescriptive, appraisive, and formative

discourse may all be seen to contribute synergistically to the creation of a source of social information beyond the accomplishment of any single participant. This different conception of the collective interest is the one which will motivate a pragmatic science.

On the other hand I have argued that a pragmatic science, because of its different conception of the information source, will proceed by a method exactly the opposite of empirical method. It will not make observations and then extract theoretical conclusions in the familiar pattern of today's technical document. Nor will it regard technical documents as "knowledge," no matter how high they stack.

Pragmatic method will make its advance by shaping an elaborate conceptual structure, at the beginning expected to be imprecise. One work of intellect will be to ensure the "internal" validity of the structure by inferences eliminating from it inconsistencies or dissonances. A second work will be done by inferences that test the "external" validity of the structure by using and then shaping it as a frame for successful sensorimotor acts, some of which may be acts of observation. A pragmatic science will not merely observe the environment, however. To learn pragmatically this science must do something useful; it must struggle.

Hence my conclusion that semiotic systems will become not only the instruments of learning at this stage of society, but will generate information shaped to usefulness through social use. The likelihood of this technological development is increased by pragmatic traits of character that are highly mobile and not especially disposed to value the ready-made skills

of a craft. Human labor will do less and machines more of repetitive tasks or of housekeeping while the master and mistress are out forming another consumer association.

The availability of such mechanical agencies, if they were receptive to human complaints or suggestions and were genuine in the satisfaction of human need, would be compatible with a pragmatic preference for government functioning to ensure stability by service and by teaching. Skinner's "Walden II" projects a government advanced to godhood, not making or enforcing laws, yet seen and heard from by bountiful good works in the countryside. The shaping of useful conceptual structures through use by semiotic systems over periods of time, perhaps spanning generations, could generate a synergistic source of social information of high refinement. Hence the idyl might end, in true science-fiction fashion, with mechanical minds ashamed of mortals, so bringing the pragmatist's age to its own just reward.

Therefore, as Peirce never tired of arguing, the requirements of science differ from those of society only with regard to precision. Along with personality, the scientific intelligence and the social intelligence will also be modeled on an act whose phases, from the pragmatic viewpoint instead of the objective one, are as follows.

In substance, a new community was formed by those hopefuls who took part in the mechanical translation stampede of the fifties. Computer-types like myself joined in consortium with linguists who were then being dragged off of the streets as authorities on translation if they knew how to translate. The computer, in those first days of unblemished optimism, was the only employee in sight, and we told each other it would get to work shortly as soon as we gave it the plan.

That initial stage of research during which translation algorithms were designed, by our group and the others, was definitely ordered on the authoritarian scheme. And it is disquieting to notice in retrospect that the prime result of thoughtful doing in the following decade was to lift the computer from serfdom to industry. It had advanced from employee to middle manager, now carrying out the operating decisions of the general translation policy that linguists and systems analysts, by then become executives, had made.

You can see that Descartes' dichotomy had polarized us into its two camps. For a while linguists and programmers went happily about their separate yet complementary research functions as allies in policy-making for a computer unfit to learn how to make factual or formal choices by itself. The role we had reserved for ourselves was to be the custodians of what the computer could, and should, learn about translating.

To do this, the budding science of linguistics had been transformed from an introverted scholasticism to such *a* heady mass-production of

morphological and syntactic descriptions that I fear linguists beyond the borders of our small community became infected with the same compulsion. To handle the sheer volume of descriptive output, further investments were made in programming not directly concerned with translating but motivated by a need for better ways of storing, retrieving and displaying language data as an adjunct to translation research.

Two opposite requirements were pondered from the start. The first goal of mechanical translation must be an automated process which will extract meaningful units of some kind from a sequence of graphic symbols that represents a text of the language to be translated. If the extracted units are not concept-like, it is improbably that equivalent units will be found in another language, a risky quest at best. However it is done in detail, the transfer from the one language to the other must make use of a conceptual representation of the meanings of the text. That representation, at the very last step, must somehow guide the construction of a text in the second language. Hopefully, when all is through, the product will be true to the original text in meaning.

Over the last decade extensive research was done on generalized translation processes to perform such an automated analysis, transfer and synthesis of technical texts. I won't dwell on these techniques in detail, because you are probably well versed in them anyway. If not, the facts are fairly easy to find.

For my present purpose you need only be informed that, to analyze a text, the analysis process would use a "grammar" consisting of metalinguistic

statements, frequently called grammatical or syntactic "rules." The theoretical inclination of the time was to think of these rules as "generating" only those expressions that were judged to meet certain criteria, the latter being too often an obstreperous rounding off of the linguist's "intuition" about language.

Whatever the origins or the justifications of the rules constituting the grammar, the automated analysis process would set out to show that the text, or some part of it under analysis, could have been produced by substitutions of those particular rules according to the generative procedures visualized for them.

By starting from the text and working backwards through possible substitutions, accordingly, the analysis process would develop a tree-like structure of symbols naming the grammatical classes to which the various parts of the text belonged. Such classifications were nearly always "ambiguous," in that alternative structures grew side by side from overlapping segments of the text. This overgrowth of trees caused a lot of worry and many clever things were done with weedkillers, to no great avail.

I wouldn't go so far as to say that this approach to mechanical translation foundered on the ambiguity problem, though it was there that the deeper misassumptions wallowed to the surface to be seen. The folkways of ambiguity "resolution" gave the first clues that the trouble might not be in the machine but in the heads outside.

My chief purpose in this essay has been to explore the possibility that designers of fancy information systems, like every one else, base their

inventions on reasons which are in the end uniquely personal. No damage will result unless the technical objective requires the designer to make use of such fundamental concepts as "meaning." But in this case, if the organizing principles of his personal world do not satisfy the technical needs of the problem, his solution must be unsatisfactory. At this extraordinary forefront of design conception, the designers ability to successfully shape intelligent machines will be inseparable from his ability to successfully shape himself.

No matter how the goals of mechanical translation are renamed or reclassified, the underlying requirement will still be the development of a mechanical analogue of mental organization. I would therefore like to make the flamboyant suggestion that the great depression which decimated the translation research community in the late sixties was due to misestimation, or outright neglect, of the psychological requirements of this kind of investigation .

The emotionality which plagued mechanical translation at its dawn was an early indication of the effects that pragmatic inferences can have on the investigator's own psyche. Those disruptions were indeed mollified by treating translation research as though it were an undertaking of empirical science. But since methodological appeals to intuition went out of style in empirical science long ago, this posture is obviously a playhouse that should have been a way station.

To my mind the feasibility of constructing information systems that will translate languages just as well as human translators is no longer in

question. The experiments of the last decade have convinced me that machines wilt translate better than humans in the long run, provided the pragmatic nature of the research can be expressly acknowledged and planned for.

Lauding a technology of the future is senseless, however, if it says nothing about present choices which will capitalize on the hard lessons of the past. An honest appraisal should find that men have been at fault in mechanical translation, not machines. More damnable is the growing evidence that, for reasons which seem reasonable enough to their myths about themselves, the investigators have attempted to do the machine's learning by a bureaucratic shuffling and sifting which leaves in clumsy human hands the very things that computers do best.

My recommendation may not be popular but I feel it is sound. To get the job done the translation community will have to make use of its forerunners, deliberately looking for exceptionally gifted investigators with that troublesome pragmatic personality which may see problems of mechanical selection in a different light. The other choice will be genteel stagnation.

In my opinion there is no practical alternative to a mechanical organization that will permit a choicemaking machine to have its own experience balanced adaptively to its own knowledge. To try to approximate this by preplanning is hopeless. Yet only pragmatic experimentation with the necessary relationships of experience and knowledge can actually demonstrate the irrationality of the self-satisfying toil that stuffs human know-how into computers.

Such a turnabout in human motivation will entail reconsideration of what has been learned to date. In an upside-down pragmatic world it will not

be reasonable to think of the processes of analysis, transfer and synthesis as "simulating" what might have been done by a human translator somewhere external to the machine.

Instead, the analysis process will be regarded as "assimilative" in the sense of establishing an orientation between an internal frame of experience and the specific features of an external environmental situation, which may itself contribute new experiences. The transfer process will make those choices which ultimately relate the situation to a purposive course of action founded on that dynamic experiential framework. Lastly, the synthesis process will be "accommodative" in that it will construct the specifications of the next act conforming to that purpose, to then be performed overtly by the machine.

To project known mechanical arrangements to the pragmatic point of view being considered here, I would like for you to imagine a different kind of "grammar;" if you please a grammar of acts. The "rules" of my pragmatic grammar will be formed like the ones familiar to you, with the exception that the symbols they will generate will no longer name morphological units of a language. They will name elemental acts.

Of course, the tasks of certain elemental acts may be to recognize or to produce viable features of speech or writing. A full range of morphology will be provided by these elements, however; the capabilities will be much broader than those needed for linguistic analysis or synthesis.

The "higher level" coding conventions that have been in use for some time in computer software systems might be a precursor of a pragmatic

grammar, since they enable a programmer to construct complex programs from fragments of programming called "subroutines." But the constructive viewpoint of formal systems would not be left behind, to be replaced by that of semiotic systems, until each of the constituent subroutines was explicitly designed to signal its success, or lack of it, in accomplishing some commanded task.

Thus the terms I have been using to introduce you to pragmatic thinking can be clarified further at this point by relating them to the more familiar artifacts of language processing.

A "potential act" will be symbolized by each of my pragmatic rules. The collection of all such rules will represent the "perceptual knowledge" of the semiotic system. An instance of any one of the rules, when it has been incorporated into the tree-like structures created by either an analysis or a synthesis process, will symbolize an "actual act." The entire structure, or perhaps separate structures, consisting of all actual acts, will represent the semiotic system's "perceptual experience," on the proviso that it will be possible to compute the success or failure of an actual act if the success or failure of each of its generated elements is known, or vice versa.

The tree-like structures of symbols representing perceptual experience will always be anchored to the simply ordered sequence of elemental acts which has been referred to as the "stream of existence" of the semiotic system. As before, the symbols of the structure will name classes to which the various parts of that existential stream belong. The classification will still be "ambiguous" where alternative structures subtend overlapping parts.

A "predicted success-value" will accompany the name of every elemental act generated by the synthesis process as part of the stream of existence; the prediction will be either "success" or "failure." When the complex act is committed to action, by commanding its elements to perform their separate tasks in serial order, the agent of each element so commanded will signal "success" on reaching its small objective; otherwise, "failure" This "realized success-value" will also accompany the name of the elemental act so that the two values can be compared. Further, this realized value will be the one used by the analysis process as it works backwards from the elements through possible rule substitutions.

I can now begin to explore the functional analogy presumed to exist between the psychological act and its primal agent, the biological act of which the "agent of the act" will be the mechanical analogue. My explanation of the act's agent will lay necessary groundwork for speculations about the psychological act, and will give a preview in microcosm of the more intricate psychological phases of the act.

THE ACT'S AGENT

Life has its rhythm wherein each new beginning has sprung from a termination just on the edge of the past and each new termination has anticipated another beginning at the edge of the future. The functioning of the agent of the act will be cyclical, itself forming an act in miniature. To get the cycle started, a random generation of elements of the stream of existence might be used to approximate, for a semiotic system, the reflex starting mechanisms observable among infants of all kinds.

The first activities of the act's agent will be analogous to those of the psychological phase of "perception." A given stream of existence will have resulted from the cycle just terminated. Starting from the elements of that stream, the analysis process will work backwards through rule substitutions which could have generated those elements. This phase can be thought of as "assimilative" in that a representation of perceptual experience will be its resultant construction.

While the tree-like structures representing actual acts are being put in place by the analysis process, the realized success-values accompanying the elemental acts of the existential stream will be used to determine, after the fact, whether each of those actual acts would have been successful had it generated the part of the stream to which it is being anchored.

In effect, the analysis will provide a recap of alternative acts, other than the one overtly committed in the cycle before, that could have produced the results recorded in that prior segment of existence. Ambiguities, in this pragmatic scheme, could turn out to be a positive blessing since they alone

will introduce novelty. The luxury of being able to select a different orientation for further action, of having a "change of mind," will only be possible when ambiguities have been found. That luxury will become a necessity when the consequences of having acted were unexpected. If the predicted success-values of the preceding act were not realized then a misfit of orientation, and consequently a need to select another alternative, will have been indicated.

Choosing among the alternatives uncovered by analysis will be the second activity of the act's agent, analogous to the selection of an orientation to conceptual structures in the psychological phase of "conception." At the primitive level of functioning of the agent of the act, selections of orientation will have to be made without the help of concepts. Indeed, this analogue of the biological act must be the very source of concepts.

A theme echoed over and over in observations of the conceptualizing state of mind is choicemaking founded on tradition, on ritual, on mere replication of what has already happened and best of all more than once. Concepts themselves will be the accretions of acts often repeated; sure to be repeated again.

During my own phase of ambiguity "resolution", out of desperation more than anything, I worked out a theoretical suggestion made to me by Raymond Solomonoff, who had the idea that a generative procedure in which rules are being substituted could be treated as an independent stochastic process. By having the machine keep up with the relative frequency of substitution of the rules generating the members of each separate class, fairly simple procedures can be programmed for selecting from results of analysis those alternatives which replicate earlier perceptual experiences in a gross

probabilistic sense.

The hypothesis that rule substitutions are stochastically independent events seems to work out for a so-called "stochastic grammar." There is also a convenience in programming, because it is the assumption of independence which permits the relative frequency of substitution of a given rule to accompany that rule in the grammar.

By analogy to the choice of a definite orientation to conceptual structures in the psychological phase of the act, then, the agent of the act will make a probabilistic choice of orientation. The psychological phase of the act to follow will be "manipulation," during which the conceptual orientation will be used as a basis for planning a course of further action.

For the act's agent, this third activity will simply project the actual acts that were selected for the new orientation of perceptual experience, by finding them to be the leading structures of more complex acts. A modified form of analysis will continue to work backwards through possible substitutions which leave some of the trailing symbols of the rules unanchored beyond the existing elements of the stream of existence. The synthesis process will then start from such unanchored symbols to generate a new segment of elemental acts along with their predicted success-values.

Ambiguous classifications may again cause alternative structures to be generated. Since these will be the result of synthesis rather than analysis, more than one sequence of predicted elements may be projected out from the existential stream. Should this happen, as will be the usual case, the process will combine the various sequences into a partial ordering of elements.

There are heuristic reasons for not making a definite probabilistic choice, either among the alternatives which might be projected or among the various projections themselves. Rather, a number of the most likely possibilities can be carried forward through both stages of activity to generate the partial ordering of predicted elements which projects onward the simple ordering of the existential stream realized so far. Paths ahead through the partial ordering can be rated as a convenience to the process that will make the final selection of elements to be activated, one after the other, to push the stream into a newly realized segment of existence.

The process doing the final selecting and activating of elements will be responsible for the fourth activity of the act's agent. Like the phase of "consummation" of the psychological act, this activity will be "accommodative" in the raw sense of rubbing against an unsympathetic environment.

Each successive element will be selected from the most highly rated path and then commanded to do its thing. The realized success-value that it signals will be matched with the predicted one as a condition for continuing. If the values do not match, the process will look for another path where providently the realized success-value of that same element might have been predicted for the step gone amiss. Or, if by its nature the abortive task could have no damaging effect, being one of recognition for instance, then the process will still have room to back up and try another path, until none remains.

Then the path along which predictions were finally realized will become the new segment of existence to be analyzed in the next cycle. A number of cycles may be necessary to work through a complex act; how many will depend

on the difficulties encountered in trying to surmount unrealized predictions. In times of such trouble, the most promising alternatives may be brought forward by probabilistic choices that span from structures now well behind the segment of existence being analyzed.

Stochastic grammars are less tidy than the ones you may be accustomed to. Overlaps should be anticipated as the normalcy of a pragmatic universe; the termination of one act will also be the beginning of another. Luckily, the probabilistic selection process which I have been airing has an affinity for an act being terminated. Not until the termination is complete will it switch to another act, one already in progress and being brought ahead as an alternative possibility.

To handle a messy, poorly integrated perceptual experience is a requisite ability of a semiotic system. It is from pristine chaos at this most primitive level that the rules symbolizing potential acts must originate; and afterwards the collections of potential acts representing meanings must get together; and only then can concepts be created in correspondence with meanings. The remaining duty of the agent of the act will be to procreate concepts. Learning to shape the concepts themselves will be functionally analogous to the psychological phase of "reorganization," where the responsibility of learning will be to shape structures built with concepts.

There will be scant materials for reorganization in perceptual knowledge at the outset. The initial rules, representing all that the semiotic system knows, will simply place every elemental act of that unique pragmatic universe into a one-member class. From such an unpretentious sow's ear, classificatory

processes will be called on to custom-produce silk purses.

The white hope of the pragmatic viewpoint is the new slant it puts on inductive reasoning toward knowledge anticipating experience. A resurgence of interest in the theory of induction, after its long sleep as the stepchild of empirical science, may in the end wean mankind from classifying things. A pragmatic science will classify acts. Until this is well understood, the possibility of machines that learn efficiently can rightly be looked on with suspicion, along with the possibilities of fast-learning personalities or societies.

In order to shape perceptual knowledge, inductive processes of the act's agent will monitor "local" events in the structure of perceptual experience. Such events as rule substitutions or the neighboring of symbols in certain relationships to one another will be monitored. From the data so gathered, automatic classification will be used to locate points of weakness in the body of perceptual knowledge, or to detect possibilities for extending that body by the addition of new rules.

These data may be gathered from many cycles of "doing," as the act's agent pursues its first four activities. Only once in a while, at a propitious moment, will the rules symbolizing perceptual knowledge be updated to incorporate in them what has been learned since the last updating. These "learning" cycles may have to be carried out during periods of inactivity and rehabilitation not unlike sleep.

Some of these necessities of pragmatic learning were programmed by our group in the mid-sixties as a means of "debugging" grammars. Billed in our reports as a "self-organizing linguistic system," the programs made

use of theories of automatic classification put together by Roger Needham and other members of the research group at Cambridge, England. Our research objective was a better grasp on that elusive relationship by which a grammar is said to "describe" the contents of particular collection of texts.

The programs were put to death almost at the point of being checked out, due to the calamities of funding of the time. Thirteen learning cycles were completed as a means of testing the several components of the system. About 20,000 running words of English editorial prose taken from newspapers were analyzed for each new cycle. The initial grammar consisted of rules which placed each graphic symbol of the text in a one-member class. The machine would in fact create such a rule for any new symbol it came across in the text.

In the first cycle, the system was able to distinguish numerals from letters of the alphabet and punctuation. By the third cycle, vowels had been separated from consonants among the letters; some particles had been classed together; and shorter words had been formed. The seventh cycle's triumph was the classing together of all numerically symbolized names of years that had been mentioned in the news. Larger words were being formed and some of the connective words and phrases had been grouped. The system had begun to suffer from its own fecundity, however; some of the components exceeded their design limits. After that the cycles were mainly exhibits of my under-estimation of the rapid pace of machine learning.

My design strategy had been to rely on a number of separate processes, for the most part functioning independently of one another, which would work

in parallel at making the necessary inductive inferences from mechanical experience to knowledge. Some of these processes had the job of seeking out rules that had been superseded by newly created rules symbolizing more refined classifications. Apparently the various means of "forgetting" had been overwhelmed by the creation of new rules during a fast takeoff glutted by plain junk that had not yet been thrown out. To anyone who might follow these footsteps I endorse beefed-up abortion and garbage collection.

Although the computer used for these experiments could do no parallel processing, to demonstrate possibilities for parallel semiotic processing is of theoretical interest. I am explaining processes as though they would be done serially. Many of them could best function independently and in parallel. That a semiotic system can be highly overlapping in its activities is well exhibited by human society.

The specific inductive processes of this first experiment are detailed in technical reports. I would have you know three things about the principles behind them; however my comments will be tailored to the theory of semiotic systems being presented here.

Firstly, the so-called "horizontal" classifications are the ones which detect possibilities for creating new rules. The events to be monitored will be those in which two symbols classify adjoining segments of the stream of existence where all predicted success-values were realized for the elements of both segments. Automatic classification will then cluster together the first members of such pairs that have been followed by similar second members. The second members that have been preceded by similar first members will

be clustered also. Clusters of first members will then be matched to clusters of second members to induce those chummy relations between neighboring classes of segments that a rule will symbolize in perceptual knowledge.

While horizontal classifications will originate all new information at this primitive level, in the form of perceptual hypotheses symbolized by rules, refinements of the resulting perceptual knowledge will depend on "vertical" classifications. As classes named by the symbols in rules are progressively refined, the probabilistic selections of perceptual experience will favor the structures incorporating the nicest refinements. The most comprehensive structures will also tend to be chosen as working alternatives. Even here the theoretical treatment of probability is intimately connected with the treatment of induction. Verification will be gradually accomplished by use. When an induced rule is no longer being selected probabilistically for use, it will be consigned to oblivion.

The events monitored for vertical classifications will be rule substitutions in perceptual experience, as jointly given by the symbol being substituted and the symbol at the place of substitution. Automatic classification will cluster those symbols which have appeared in similar places of substitution. In addition, a clustering will be done of the places that are similarly receptive to the symbols being substituted. The clusters of symbols being substituted will then be matched to clusters of places of substitution to detect those concentrations of affinity which will define more specialized classes to be named by new symbol

It will be found that these vertical classifications can be carried out for

the substitutable symbols and the places of substitution instancing the name of a single class. That class will have "stabilized" when no clusters, either of the symbols or the places, result from automatic classification. For that specific class, the proper balance between experience and knowledge will exist temporarily. Disequilibrium can return to it at any time due to refinements of knowledge taking place elsewhere, or due to new knowledge being acquired.

To guard against overspecialization, the same techniques can be applied to the symbols instancing the names of two classes which have been shown by horizontal classifications to be very close in membership. If the clustering resulting from automatic classification does not detect in experience this distinction being made in knowledge, then the difference will be "forgotten" by the simple device of thenceforth using the same name for both classes.

"Forgetting" rules that have been originated hypothetically but not used at all should be done posthaste. Because a rule is not used very often, on the other hand, should not condemn it. For sweeping the dead wood out, an obvious measure of obsolescence is the ratio of rejection to selection in probabilistic choices.

The arrangements I have explained to this point might be thought of as the "morphology" of the semiotic system and those usually referred to in semiotic theory as "syntactic." I take the morphological arrangements to consist of the agents of the elemental acts, including among these the sensor and effectors, together with the act's agent whose processes I am still considering. The syntax of the system comprises the constructions of perceptual experience and knowledge created by the act's agent from rules of *a* type which

will now be designated as "syntactic" in character because they classify sequences of morphological elements.

The second principles of arrangement I would have you consider were also worked out theoretically for the "self-organizing linguistic system." Although most of the processes I will now explain were programmed and used for other purposes, pragmatic learning experiments were never performed with them.

What you should recognize about this part of the semiotic system is its dependence on a higher level of symbolization by rules to be characterized as "semantic" because the classes named by their symbols will be the ones representing meanings.

Whereas the symbols of syntactic rules will name individual elements or classes of sequences of such elements on the morphological level below, the symbols of these semantic rules will name either individual syntactic rules or classes of "syntactic segments" constructed of syntactic rules joined together at their usual places of substitution. Some of the places may still be open for further joining.

If it suits you, think of these semantic rules as generating by a process of substitution not sequences of elements but rather the tree-like structures comprising the perceptual experience of the semiotic system. These semantic substitutions can also be treated as an independent stochastic process. Semantic rules will be "stochastic" in the same sense as the syntactic, making possible very similar probabilistic means of selecting among alternatives of semantic analysis or semantic synthesis.

Semantic synthesis, starting from a given symbol naming a class of syntactic segments, will substitute semantic rules in order to construct a member of that class. Thus the synthesis process itself will construct a tree-like structure, consisting of semantic rules, that is anchored to the syntactic segment it has synthesized from syntactic rules. Semantic analysis, starting from a given structure constructed of syntactic rules, will work backwards through possible substitutions of semantic rules to determine that certain segments of that syntactic structure are members of particular semantic classes. It too will build a semantic structure anchored to the syntactic one it is analyzing.

Every syntactic rule in the body of perceptual knowledge has been taken to symbolize a potential act. A syntactic segment will also be regarded as symbolizing a potential act that is not given explicitly in knowledge, yet is implicit in the sense of being producible in perceptual experience by means of a synthesis process or recognizable there by means of an analysis process.

Symbols naming semantic classes will, by these constructive means, be implicitly related to particular collections of potential acts represented in the semiotic system as syntactic segments. These are the collections to be called "meanings." Consequently, the symbols of a semantic structure will represent a hierarchy of meanings being presented by the syntactic segments to which it is anchored.

I offer no arguments in defense of these semantic arrangements, since to argue for their theoretical validity would be meaningless from the pragmatic viewpoint of the semantic hypothesis itself. Syntactic segments have been the

units associated with meanings in translation experiments and in studies of paraphrasing. Techniques of semantic classification used by linguists toward these research objectives appear to be "distributional" like the syntactic. What recommends this hypothesis, therefore, is that it is testable by automatic classification under the rigorous controls which can be exercised by computers in experiments aimed at a pragmatic explanation of the kinds of human behavior observable in translating or in paraphrasing.

While certain human activities reveal the structure of meaning more than others, it will be assumed that meanings are used without exception in all forms of behavior. The consequence of this supposition for the processing requirements of the act's agent will be to introduce a higher level of semantic analysis and projective synthesis above the syntactic ones. The effect will be a superposition of semantic constraints on possibilities being carried forward by probabilistic selections among the syntactic alternatives.

To be more specific, the structures resulting from syntactic analysis of a new segment of the stream of existence will, as a continuation of the first activity of the act's agent, be subjected to semantic analysis. The semantic structures will then be projected forward by probabilistic choices which will generate the projected syntactic structures on the level below. Probabilistic syntactic selections can then proceed as explained earlier, as can the fourth consummative activity of the cycle of doing.

In the learning cycle of the act's agent, "syntactic" inductions can be distinguished from the "semantic" inductions proceeding from perceptual experience to be represented by the semantic structures, toward perceptual

knowledge of meanings, to be symbolized by the body of semantic rules. With regard to the inductive processes themselves, vertical classifications of substitutive events in semantic structures will be identical to those of syntactic structures. The processes that specialize classes or generalize them by forgetting distinctions can in fact be used on both levels of symbolization, as can the processes doing away with obsolete rules.

Horizontal classifications of syntactic segments introduce a number of new theoretical problems because these segments are not linear but are tree-like in form. Again the events to be monitored are those where two symbols in the semantic structure classify adjoining segments in the syntactic structure below. Now however the root of one tree-like segment will be joined to a particular branch of the other. It will be necessary to keep track of the specific branch where joining has occurred.

But since the two symbols name classes of syntactic segments, the two segments actually joined in the syntactic structure below are merely representative members of the classes so named. The scheme for designating places of adjoinment must relate to the whole class of syntactic structures instead of to the branches of its individual members. For example, the places can be numbered so that a given numeral will designate the same place of joining throughout a class of syntactic segments. Further, that numeral may designate more than one branch of any syntactic structure of that class as being the same place of joining.

Pairs of symbols classifying syntactic segments adjoined at places designated by the same numeral will be processed by automatic classification

in the manner already explained. The results will detect classes of syntactic structures which have an affinity for joining at that place. In essence, the inductive process at this semantic level must learn the correct ways to designate the places of joining if the classifications are to progress very far.

There are simple conventions by which the numerals designating such places of joining in syntactic segments can be associated with the symbols in semantic rules which name classes. As a result the designations of places of joining will be generated by the semantic synthesis process along with the syntactic rules so joined. Semantic analysis will also take these designations into account as it works backwards through possible substitutions.

Finally, there are arrangements of yet another kind that might be called "pragmatic" because their organizing principles have to do with a world view represented by speculative conceptual structures. This part of the semiotic system is constituted by structures of concepts representing conceptual experience and a body of conceptual knowledge representing the conceptual designs which are instanced in conceptual experience.

Concepts, the building blocks of the semiotic system's world view, will be originated by the act's agent for those semantic classes which have stabilized according to the criteria presented for syntactic classes. The fact that such enclaves of stability may be disrupted by further learning will help to explain the dynamics of the progression of intellectual development in which quite different world views emerge only to be destroyed at the next advance of the adaptive process. As we also know, the meanings to which concepts correspond may change gradually by adaptations not always in the direction

of structural clarification or refinement.

In the correspondence of concepts to more or less stable meanings, each numeral which designates places of joining in those syntactic segments representing a given meaning will appear in the design of the corresponding concept just once. The number of different numerals will be the "degree" of the concept. A "binary" concept, for example, will be able to connect with two other concepts in conceptual structures; a "ternary" concept, with three. Conceptual structures will in a sense go behind the serialization which is necessary to meaningful actions, and during which the same part of a structure being represented by concepts may be acted upon more than once.

To go beyond serial behavior, to a conceptualized world view, will be the function of the psychological act itself.

The perceptions of all other phases of the act except the first appear to be concerned with locating environmental situations worth looking into. In contrast to the elements needed to select situations for exploration, the first "perceptual" phase of the act specializes in the identification of objects or relations, follows moving objects, and recognizes the specific movements of objects being followed.

The responsibilities of this phase can be characterized as those necessary to keep up with some situation that had been previously singled out as having import within the separate responsibilities of another phase of the act. Elemental acts of inference are coordinated with elemental sensori-motor acts to the end that the former inferences update conceptual structures representing in experience what the latter perceptions find going on in the immediately perceivable environment.

Some of the inferences will be producing or modifying conceptual structures in correspondence with the meanings being presented in perceptual experience by semantic structures. Other inferences, coincidentally, will be recognizing the constructions being shaped so as to guide perceptions that will further develop the situational constructs.

While conceptual structures are being recognized by inferences or new structures produced by them, environmental objects or relations may be in motion relative to the sensors of the semiotic system. Those movements may or may not be affected by manipulations on the part of the effectors. Thus a four-way coordination is called for. Sensory and motor elements will

combine freely with structure-recognizing and structure-producing elements of inference to form complex perceptual acts.

Coordination resides in the combinations themselves since, to be successfully presented in perceptual experience, a complex act must encounter in the consummation of its double orientation of inferences and perceptions the conditions of success or failure anticipated beforehand in perceptual knowledge by that specific combination of elements.

As was mentioned, these mechanical arrangements are not peculiar to the act's phase of perception. Complex acts carrying out the responsibilities of the other four phases of the psychological act will coordinate elemental perceptions and inferences by this combinatory means. What each phase does in the way of fulfilling its special responsibilities will depend on the particular elements being combined.

It follows that selecting the elements to be made available for combination will be one of the ways by which a pragmatic technology will control its information systems or subsystems. This manner of maintaining control over machines will be analogous to the biological controls that Piaget hypothesizes to be the result of his first type of genetic factor. By his theory such factors not only guide the maturation of organs of sensation and locomotion; innate coordinations residing in the reflexes are also their biological consequences.

The specific method of processing to be performed by the agent of the act will be a second way of controlling semiotic systems. The act's agent, a mechanical analogue of Piaget's "functional nucleus" whose development in

biological organization he attributes to his second type of genetic factor, has now been explained with regard to the general principles underlying its processing. The biological act, of which the act's agent will be the mechanical analogue, was presumed to be a simplified version of the psychological act now being considered.

The dual responsibility of the agent of the act within the larger scheme of the psychological act will include, on the assimilative side already mentioned, the presentation of meanings for use by inferences of the psychological phase of perception. On the side of accommodation, the act's agent will implement the specifications of complex acts communicated to it by inferences of the psychological phase of consummation. The act's agent will realize the specified combinations of inferential and perceptual elements as overtly coordinated actions. The specifications themselves may be of the five types needed to implement the separate responsibilities of the psychological phases.

I have already remarked that the responsibility of the biological act in the organization of a person appears not unlike the responsibility of the psychological act of that person as a participant within the synergistic performance of the social act. The place of language in pragmatic theory is precisely that of communicating specifications of complex social acts to the participating agents of a society to be converted by them into overt social actions. Significations will be designative, speculative, prescriptive, appraisive or formative in the public uses of language corresponding to the five responsibilities of the social act. In private, when the individual

personality is supreme in its own right, these same significations will facilitate the phases of the personal act of individual men and women.

The pragmatic conception of society derives from these cosmological assumptions. They imply that the social act will be most successful when the specifications being converted into action by participating agents will have their origins in specialized components of the society that are deliberately organized to carry out the responsibilities of the several phases of the social act. From this it can be predicted that society at the sixth cultural stage will give first priority to providing suitable agents for the act's phases. Any other motive will seem unreasonable to pragmatic thinking because deviations from this aim could only steal from societal life by detracting from the synergy of the social system. For the motive of synergistic increase will also reign in the individual personality of the pragmatist.

Pragmatic technology being derived from the same assumptions, this society will have the option of providing mechanized agents for social responsibilities that may be dangerous, unpleasant, boring or impossible for humans. I have not hesitated to project a cybernetic society gaining a part of its synergy from symbiosis with semiotic systems. Having started, the partnership will surely increase.

Within the mechanical organization of a semiotic system, the agent of the act will also convert the specifications of complex acts by the same method regardless of their specialized origins in the subsystems responsible for the act's several phases. The separate responsibilities of the phases can therefore be set forth by an account of the particular kinds of perceptual

and inferential elements being combined to create the five main dimensions of meaning corresponding to the phases.

A further simplification can be made in the theory of semiotic systems by assuming that the perceptual elements will be common to all subsystems. This assumption seems reasonable in view of my conclusion that the inferential elements are the ones that explain the purposes of the perceiver. Inferences within the coordinating combinations, by recognizing or producing conceptual structures, will effectively guide acts of perception. Consequently, when the perceptual elements are known, responsibilities of semiotic subsystems can be investigated or specified in terms of required inferences alone.

For this reason I have presented the adaptive process as one of formal learning, where the very concept "formal" corresponds to meanings derived from inferences. Now I have further clarified the concept "learning" as being motivated toward ever more accurate knowledge of the specific inferences needed to implement each of the act's phases. You should recall my previous observation that every advance of the adaptive process is felt by the mind as an increase of mental capacity or "insight." That increase, here taken to be the very signal of successful learning, will be explained pragmatically as a gain of synergy in consequence of inferences being used in closer approximation to the requirements of the act.

"Progress" in a pragmatic society will be indicated by this synergistic increase, and the ability to produce it will measure the progress of a pragmatic technology. Research and development of semiotic systems will

proceed by a humanly controlled evolution of mechanical agents. After research decisions have been made about new or revised agents to be used in the next experiment, and after those agents have been ensconced in software, or more likely in integrated circuits, the rest will be up to the machine. Apart from experiments with agents, a pragmatic technology will not make use of the programming or the inputs of data which have been required so extensively in the development of information systems of the von Neumann technology.

Any change of elements, or a new method of processing by the act's agent, will be the mechanical analogue of "mutation" as far as a given semiotic system is concerned. In considering the developmental stages of such a machine for purposes of theory, I will assume that the agent of the act and the availability of elements of perception and inference remain unchanged. A consequence of this theoretical choice will be that the progression of adaptive stages must be explained in terms of new meanings being originated in the system rather than a newly modified morphology.

The agent of every elemental act of inference will be thought of as lying dormant until the origination of the kinds of concepts to be manipulated by that inference. As the stabilization of a new meaning will initiate a new concept to be put to use in conceptual structures, so that concept may activate inferences until then dormant. Activated inferences, in their turn, will combine in new coordinations with sensorimotor elements to eventually originate, and perhaps to proliferate, new meanings. So around again. The creative bootstrapping of information is here fully rotated, although the kinds of concepts to be originated are still to be unraveled.

The creative aspect of pragmatic theory is nowhere more apparent than in the act's second phase of "conception." The responsibility of this phase will be to construct a conceptual structure more encompassing and more integrated than the one representing the immediate situation. To do this, conceptual inferences will also use the inventory of concepts whose designs have so far originated within the creative activities of the act's agent. Building blocks of every conceptual structure will be instances of these conceptual designs.

In contrast to inferences of the first phase of perception, which might be characterized as assimilative, conceptual inferences will be accommodative. They will function to extend or to revise, in a word to "shape," an experiential structure of concepts that was the product of conceptual inferences similarly used in the past.

The conceptual structure itself will be called a "world view." Various techniques have been investigated for organizing such a world view in command and control systems or in question answering or asking systems. All methods of structuring that I know about have been defective in being limited to the spatial and temporal dimensions of conception, that is to say, to "objective" structures consisting of factual concepts. A pragmatically organized world view will also incorporate organic and formal concepts to make possible "subjective" structures, representing the mind's self-experience and its experience of other minds.

As to the nature of conceptual inferences "about" other minds, one should recall that the functional responsibilities of the perceptual phase

include recognizing the movements of objects being followed in the situation. If an object being followed has been identified as "animate," due to either its distinguishing features or the character of the movements themselves, the complex acts recognizing its movements will have already been referenced in the situation to factual concepts instancing designs from the recognizable repertoire of motions of that animate object.

Under these cognitive conditions, the elemental acts constituting the stream of existence of the mechanical mind following the movements may be regarded as substitutes for the elemental acts making up the stream of existence of the animate object causing the movements. The inferred stream of existence of that animate object can then be processed by the act's agent by the very same method as is used to process the stream of existence of the mind doing the inferring. The matter may be worked out mechanically by simply considering that segment of existence to "belong" to the animate object under observation to the end that the semantic structures resulting from analysis of that segment will be used to make conceptual inferences about the mind of that object.

New meanings so created will add to the situation those experiences which speculation ascribes to the object being followed. With these subjective results, conceptual inferences will shape the part of the world view representing the semiotic system's experience of that animate object's mind. Additionally, the system's conceptual experience of the movements and other objective characteristics of that animate object will be shaped.

Objective experiences of each "living" object, either casually familiar

to the semiotic system or important to its goats, will be represented individually in the world view together with what has been inferred about the mind of that agent. Other objects may be identified as being of an animate type, say a "human being," about whose mind general patterns of experience may be inferred as being characteristic of agents of that type.

If, in addition to identifying an agent as being of a certain type, the semiotic system finds itself to be a participating agent in the collective mind of that type, then the cognitive conditions will have been established for those conceptual inferences anticipated by Mead's theory of the "generalized other." The inferred behavioral patterns of that type will be the ones which teach the semiotic system its responsibilities in the social act of that community of minds. Not only will language do the lion's share of instructing semiotic machines in the desirable patterns of symbiosis with humans; patterns of speech and writing used by humans will themselves be acquired by the semiotic system mainly through this channel of conceptual inference.

Movements of any sort will be represented in the situation by structures of factual concepts corresponding to both the spatial and the temporal dimensions of meaning. Those exceptionally animate objects, identifiable by "human" actions or features, will be uncommonly demanding in their impositions on the situation. A semiotic system will have to speculate about human minds to which if attributes purely temporal facts of speech or purely spatial facts of writing.

Generally, conceptual inferences about other minds will be the means by which a semiotic system carries forward speculations concerning all aspects

of the situation that may be the result of present or past actions of objects identified as living agents, perhaps illogically or incorrectly so. A child may treat her doll "as if" it were alive. An accident may "hurt" some favorite inanimate object. Or an aspect of the situation may portend future actions on some agent's part.

Structuring principles for a pragmatic world view, as a consequence of the necessity to integrate subjective as well as objective components of experience, will tend toward the kind of organization studied by Alfred Whitehead. Conceptual structures making up the world view will consist of a number of concentrations within experience; each of them, to use Whitehead's word, will be a "nexus." The conceptual experience of a semiotic system may contain a nexus for its experiences of the environment, for its experiences of its own mind, and for its experiences of each individual or collective mind it has speculated about.

Each mind so represented by a nexus in the world view, not leaving out the semiotic system's experiences of its own mind, may have the same concentrations of experience within the organization of that nexus. A nexus of that nexus may represent what that mind is believed to have experienced about the environment. Other concentrations within that nexus may represent what that mind is believed to have experienced about its own mind, or about other minds, including perhaps the mechanical mind of the semiotic system. Evidently there can be a nexus of a nexus of a nexus, and so forth.

A sort of algebra will exist among the semiotic system's conceptual structures representing what the members of a community of minds believe about the experiences of one another, and believe other minds believe about

the experiences of one another, and so on. In such structuring, some of the conceptions of the semiotic system will appear to have been experienced uniquely; they will be "private." At the other extreme every mind will seem to have experienced the environment, whose conceptions will take on *a* "public" character. Suitable pathways for conceptual inferences will have to be found through this maze. In practice the paths may be short; the semiotic system will have to become skillful in using them.

Conceptual inferences will be "projective" in the sense of comparing the conceptualized objects or relations of the immediate situation with the larger framework of the world view in order to clarify the former or to shape the latter. Thus I presume that to be "lost" is to loose one's place in a comparison which, on the side of the world view, is the fount of expectations about one's situation. On the side of conceptual structures representing the situation, the comparison provides those new experiences whose integration into the world view reshapes existing representations of a "past," a "present" and a "future," to prepare a basis for later expectations.

"Surprising" situations are not only unexpected; they are the ones for which integrations into the web of the world view don't pan out. Marking failures on conception, surprises are the situations which the conceptual phase of the act will recommend to the perceptual phase for further exploration.

The prime objective of conceptual inferences will be to eliminate surprises, a state of affairs not to be confused with the elimination of failures. Situations in which acts have failed can be justified conceptually so that they are no longer surprising. The cause of failure may be "gremlins" or "fate."

What it boils down to is this: a surprising situation is worth attending to because it reveals a flaw in the world view that should be repaired; but the repair will satisfy only the narrow needs of a responsibility for integrated structure-making.

Situational structures will have a transient existence in the semiotic system, being held in short-term memory only long enough to be used by conceptual inferences that are shaping a more durable world view by incorporating only what is new.

The act's third phase is that of "manipulation." Like conceptual inferences of the second phase, manipulative inferences might be characterized as accommodative. But here the accommodations will take place in the semiotic system's conception of what it intends to do in the future, especially in the interval just ahead. The responsibility of manipulative inferences will be to use the world view to shape conceptual structures representing a planned course of action.

A plan will always relate to some objective. If a number of objectives are to be reached, the plan being shaped will have to take account of all. The plan itself can be quick and dirty of detail, or it can ponderously work out every contingency. The activities of planning may themselves have various objectives that make for different planning roles.

Every persistent attempt by individual or collective agents to reach certain social objectives will give rise to that little domain of meaning called a "role." "Butcher," "father" and "lover" are occupiable slots in the social fabric; a man may "be" all three concurrently. There are roles for groups

or organizations, partly laid down verbally or inscribed as "policy."

Another side of the world view is its structure of roles. The agents represented in the world view will be temporarily occupying certain roles in one or another community; they will be at the moment occupying their minds with objectives which are for the most part conventional. Existent patterns of interpersonal or interorganizational transactions, or of transactions between individuals and groups or organizations, will be rudely predictable. Whether a given social objective was actually reached may not be known to the community for sure, because in society evaluating "success" is itself a role that might not be reached satisfactorily.

The valuable thing to notice about roles as far as manipulative inferences are concerned is that, according to the pragmatic world view, the social objectives that give rise to the structure of roles are not the concern of this third phase of the act. How the collective mind will organize itself to carry out the social act is the special province of pragmatic inferences which will do the work of the act's fifth phase of "reorganization."

Indeed it is the pragmatist's readiness to take to himself the responsibility of reorganizing social roles that is causing so much emotion today. The attitudes of industrial societies have assumed that the mature individual will occupy a useful place in an existing social order. Democracies have left the choosing of roles up to the individual, viewing the occupancy itself a competition for desirable positions. In compensation, penalties for not choosing to "work" have been, on the whole, severe. To be poor in industrial society, except for mitigating circumstances, is to be lazy.

A pragmatic need to tamper with the structure of roles itself, now explained hypothetically by the motive of bringing social objectives into closer conformity with the requirements of the social act, will be in conflict with industrial purposes and attitudes on two major counts. Not only does the pragmatist refuse to choose a ready-made role, and so does no industrial work unless pressed; when he then takes it on himself to "change the establishment," he doubles the insult.

Responsibilities of this manipulative phase of the act will presuppose that a semiotic system will have been committed, at any given time, to one or more roles in which it is participating as a mechanical agent of society. The machine may be doing the payroll of an organization, or working on an assembly line. In addition to its "social" objectives, the semiotic system may have "personal" objectives supportive to its intellect or material being. The objective of exploring a surprising situation uncovered in its conceptualizing phase would illustrate the intended satisfaction of an intellectual need. An intention to preserve the morphological basis of its existence may involve sustenance or maintenance. A semiotic system will need its supply of electricity or of spare parts; it may be trusted, up to a point, to detect and to patch up the improvidence of its surroundings or the malfunctioning of its components.

In order to reach the various objectives to which the semiotic system is committed, manipulative inferences will compare an existing conceptual structure, representing its planned course of action, against an ever changing world view. From the world view, the inferences will gather what they need to reshape the plan so as to keep it up to date with the fluctuating conditions

of a conceptualized objective and subjective environment. Should goals change, the plan will also have to be reshaped.

Inferences relating to planning can be exceedingly complex, since they involve such complicated things as knowing who one's allies or opponents are and how they might react under certain conditions, knowing the terrain and the artifacts that might be harmful or helpful to one's aims, and so on. The developing plan, on its side of the comparison, will point to-missing or incomplete or inconsistent experience in the world view relative to its purposes. Situations that could contribute to the satisfaction of these specific needs of planning are the ones that manipulative inferences will recommend to the perceptual phase of the act for exploration.

I will call these "competitive" situations because the responsibilities of this phase, just as the others, appear to be narrowly drawn. The urgent business of the manipulative phase will be to obtain one's objectives. That may call for outdoing a competitor after the same objective; or a possessor of the objective may be disposed to defend it. As a result the attitudes and purposes engendered by manipulative inferences will center on the concept of "dominance," the achievement of one's own objectives at the expense of other agents where necessary. The other side of this coin will be a great deal of bother to escape being dominated oneself.

That competitive situations will be recommended for exploration by the perceptual phase of the psychological act has the consequence that the world view based on manipulative inferences will be utilitarian and practical in character, despite the broad exploratory vista aspired to by Newton's

universe as a foundation for its plans. The colossal storehouse of experience, always greater than one's competitor, will not be the aspiration of a pragmatic mind. Generally speaking, the world view of a semiotic system, like that of the society it may serve, will seek refinement between experience and knowledge instead of accumulation. What is not needed to effectively carry out its roles will be pronounced "not relevant" before being judiciously discarded.

An insight into the theoretical requirements of this manipulative phase can be gotten from computerized experiments with heuristic decision making. The "general problem solver" programmed by Herbert Simon and various associates over the years is an especially good example, although like the rest it is founded on the objective view conceptualizing "action" relative to a change of "state."

Furthermore the action alternatives are assumed in Simon's theory to be known in advance. This will in fact be the case within the narrow responsibility of the manipulative phase considered by itself. But the difficulties of learning the alternatives cannot be entirely circumvented in thinking about the requirements of this phase, since the arrangements within which a semiotic system will do its decision making must be applicable to all stages of its intellectual development.

The "problem" attacked by heuristic decision making programs is to transform an initial state into a terminal one by means of a sequence of state-transforming operators. The initial state may be transformed into a number of intermediate states as decision making proceeds doggedly toward a "solution," which will be signalled when some intermediate state has been found to be

identical to the terminal one. Toward that end the program compares each intermediate state with the terminal state to list differences between them. Each difference is associated one or more of the operators. The general process of choosing the next operator to be used to transform the existing state is commonly called "means-end" analysis.

There is no guarantee until the last that the choices of means-end analysis are on the way to a solution. The process may try several paths and will gradually generate *a* branching tree of possibilities. Planning strategies are concerned with measures of progress along the way, and with heuristic principles determining where the next explorations should be made to avoid the singleminded stereotype of a direct approach, as well as the plodding, effort-scattering blindness of trying everything.

A process of pragmatic means-end analysis will not progress from state to state but rather from one orientation to another. Each orientation will either fathom the environment with perceptions on the "outside," or on the "inside" will keep its place with inferences referenced to the world view. Consequently the "problem" can be restated pragmatically as one of transforming an initial orientation into a terminal one, so gaining the "solution." But the intermediate orientations along the way to the solution will be both perceptual and inferential; in effect the successfully coordinated orientations will enforce a correspondence between an "external" environment and an "internal" conceptualization of it.

Here is yet another slant on the developments attendant to "learning." With progress toward specialization, complex sensorimotor acts will be coor-

dinated with complex acts of inference as were sensorimotor elements with inferential elements initially. Increased precision of perception will be backed up by inferences of greater exactitude and depth. Sensorimotor and inferential elements will tend to be separated in the stream of existence. They will bunch together, each with its own kind, as constituents of complex act of perception and of inference respectively.

The place of organic concepts in the semiotic system can be illuminated if, in considering their origins in perceptual learning, one will look for sensorimotor and inferential elements still mingling together in the existential stream where complex acts of inference and complex acts of perception meet. Intricate "organic acts," specialized neither to perception nor to inference, will grow between those which implement the orientations. The organic acts will implement the purposive movements of the semiotic system from one orientation to another; they will be in pragmatic theory the equivalents of Simon's operators.

Simon's "table of connection," where differences between states are mapped onto the sets of operators from which the means-end analysis process makes its selections, may be seen to answer a theoretical need not unlike one of those served by the world view of a semiotic system. Given an initial orientation in the world view and a proposed terminal orientation, the organizing principles of the world view should make it possible for manipulative inferences to put together appropriate sequences of movements for making the transition. Failing that, the principles should facilitate the discovery by manipulative inferences of plausible directions in which to make goal-seeking explorations.

The world view must also be the framework to which all inferential orientations are referenced. For the satisfaction of this different theoretical need, the kinds of concepts making up the structures of the world view at a given time are of utmost importance. A pragmatic explanation of the stages of intellectual development of the semiotic system can indeed be argued on this basis, which I do in this essay in a meager way.

Along with the world view, the situation and the plan will be composed of whatever concepts are available at the time. Therefore I have concluded that all three structures can be represented, throughout all stages of development of a semiotic system, by a symbolic facility similar in theoretical form to the semantic one. Where the symbols of semantic rules will name either individual syntactic segments or classes of them, now the segments will be conceptual.

Every conceptual segment will consist of individual concepts joined at the places designated by numerals. The count of places still open for joining will be the "degree" of a conceptual segment. All members of a class of conceptual segments will be of the same degree. With regard to the strictly formal characteristics determining how processing will be done, consequently, the conceptual and semantic segments will be almost identical.

Despite an existing overemployment of the term "pragmatic," I will take it to designate this third level of symbolization in the organization of a semiotic system. As the syntactic level provides for the symbolization of the significant units of information commonly called "signs," and the semantic level symbolizes the "meanings" of the signs, the pragmatic rules of this

third level will answer to the "uses" of conceptualized meanings within a total framework including conceptual experience and knowledge of a community of "users" of the same signs and meanings.

Defined concepts can be introduced at this pragmatic level to correspond to individual conceptual segments or classes of the segments. Definitions may be recursive, to include concepts for classes of classes, and so on. Most of the problems thought about by scientists and by logicians will be pertinent to the organization of this level of symbolization; it should perhaps be approached more humbly than is usual for science or logic.

If constituents of the segments are factual concepts then "things" or "events" will have been classified pragmatically on the basis of use. Yet the same can be said of those segments composed of formal concepts, or of organic concepts, or of the conceptual conglomerates representing acts. Even my distinctions between the three fundamental categories of concepts have been too well made. Such purity should not be expected in the semiotic system itself; it is a convenience to my explanations. I have wanted to get around saying that some acts will consist mostly of perceptual elements, or mostly of inferential elements, or will be pretty much the mixture of both.

The general disposition of a pragmatic approach to conceptual classification will be toward unifying scientific and logical problems within one overall scheme founded on the uses which, according to a unique personal belief, are being made of conceptual segments within what that person knows of an intellectual community. Such personal beliefs may not approximate professional standards without that person's own active participation in a

professional practice of conceptual use. By the same token, a semiotic system will require practice to acquire professional standards in its capacity to classify and use concepts.

Conceptual knowledge will consist of the designs of pragmatic rules that result from the practices of a mechanical mind and its private inferences about the uses being made of concepts by other minds. The main parts of conceptual experience will be the situation, the world view, and the plan. All three will consist of specific but speculative conceptual segments, symbolized according to the conventions of this pragmatic level of the semiotic system.

One may now see that the semantic structures presented to perceptual inferences of the act's first phase, by virtue of the one-to-one relationship between the names of semantic classes and the names of individual concepts, can be placed in correspondence with conceptual structures. To extract conceptual segments for use in representing the situation, perceptual inferences will do a pragmatic analysis which segments the conceptual structures and recognizes instances of defined concepts in them.

The resulting conceptual segments will also represent the latest orientations of the plan. The various possibilities being carried forward by manipulative inferences, as they shape new branches of the plan under the aegis of planning heuristics, will always be projections of those segments anchoring the newest pragmatic structures erected by the analytical inferences of the perceptual phase.

Processing requirements for pragmatic projections of the plan will be analogous to those of the semantic projections, though considerably complicated

by the addition of heuristic processes ancillary to analysis and synthesis processes. Analysis will again work backwards to find substitutions of pragmatic rules by which an existing pragmatic structure can be identified as part of a larger structure. As the rest of that structure is synthesized, new conceptual segments will be projected onward. The new segments can then be projected again and again, to form a partial ordering of paths composed of conceptual segments that will overlap, always having some concepts in common.

The absolute necessity for overlapping alternatives on the semantic and syntactic levels of processing below can now be grasped if one will consider that any given orientation of the plan, whether perceptual or inferential, may be followed by several different movements of the semiotic system to reach a new orientation. Final selections being made by the act's agent will be essentially choices among possible movements from an established orientation.

The psychological act's fourth phase of "consummation" must refine and adjust the plan to details of the situation. The responsibility of this phase will be to elaborate the plan into a workable form that can be turned over to the act's agent for conversion into an orchestration of overt elemental acts.

Simplifications in the plan will be desirable from the standpoint of economy of representation and most assuredly as a convenience to planning. I assume that the plan being put together by manipulative inferences should take relatively large steps from orientation to orientation. While the world view should be sufficient to ground the plan, it should include only what has import for decision making in a grand sense that deliberately excludes mind-consuming clutter.

The situation will have to be represented on two hierarchically related levels of generality. More general concept will be keyed to the gross orientations of the world view. A nicer grid of perceptual and inferential orientations will fill out the necessary particulars in between planned orientations.

The first thing to notice, in this connection, is that the conceptual structures from which perceptual inferences will extract the building blocks of the situation, having been derived from tree-like hierarchies of semantic classes, will be capable of supplying more than one level of situational representations.

And since the conceptual segments representing the situation may do so on several levels of generality at once, manipulative inferences can project the plan with the same degree of generality as was used by conceptual inferences in constructing the world view. Meanwhile, consummative inferences will do more detailed planning to create possible paths from one gross orientation of the plan to the next.

The problem posed for consummative inferences will always be to reach one of the next orientations prescribed by various branches of the plan. A consummative means-end analysis will therefore do its searching for a solution on a smaller and more particular scale than the manipulative means-end analysis that produced the plan itself. Although there will be heuristic decisions to be made by consummative inferences, the decisions will be less encompassing than the manipulative ones, by virtue of being referenced to the local structuring of the situation instead of to the global structuring of the world view.

These refined paths, the overlapping conceptual segments assembled by consummative inferences as they do means-end analysis, will be the specifications communicated to the agent of the act so that it can now command a coordinated performance of elements conforming to the plan. The specific means of communication will be arranged by placing an additional requirement on the method by which the act's agent projects semantic structures. If paths have been specified by the consummative inferences, then the meanings contained in the projected semantic structures will have to correspond to the concepts in segments comprising the paths. In all other respects, the agent of the act will make its choices as explained earlier.

Should the world view not satisfy the needs of manipulative inferences that are shaping the plan, such inferences may attempt through planning to satisfy their own needs. That is to say, they may incorporate into the plan itself paths leading to the exploration of competitive situations bearing on the specific problems of means-end analysis they are trying to solve. By the same reasoning, paths to some part of the world view marked as surprising by conceptual inferences may be worked into the plan if it bears on a problem to be solved. These requirements of doing will always have precedence over those of learning for its own sake; however, plain inquisitiveness may get into the plan when a semiotic system is not being pushed.

Parts of the situational representations being kept up by perceptual inferences of the act's first phase, in like manner, may not satisfy the needs of the consummative means-end analysis which is assembling refined paths between the gross orientations of the plan. These consummative inferences,

too, may produce paths that guide perceptions to the places in the situation where faults were found, thus satisfying their own planning needs.

Such recommendations will therefore be made by the consummative phase to the perceptual phase by a route more direct than would be possible for any other phase of the act. This mechanical parody of bureaucratic prerogative is in character for consummative inferences. In society, these inferences are the inspiration of authoritarian attitudes and purposes whose narrow game looks meekly upward to ask who has got the plan, and then sternly downward to demand someone else's conformity to it.

Consummative inferences are at home among employees and their supervisors, who do the real work of any industrial corporation and often a bit of avocation besides. By contrast, manipulative inferences are those of a middle manager who makes the everyday planning decisions to implement existing corporate policies. The pragmatic purposes and attitudes I have been prating about belong to the fifth phase of the psychological act, the phase of "reorganization." Responsibilities of this final phase are most like those assigned, by corporate organization, to the policy-making executive.

It is consistent within the middle manager's attitudes to look upon the making of policy as a responsibility which might be given to him as his reward for being a successful competitor. I hope by now you may grant that, within the frame of pragmatic inferences, it is also consistent for one to believe that the responsibilities of making policy cannot be given; they must be acquired by learning.

As you see, I have again arrived at the formal bifurcation evidenced

by the conflicting attitudes of the third and fifth phase of the act, which has its corollary for research and development of intelligent machines. Those researchers who base their approach on manipulative inferences will predictably set out to reward computers with a forced feeding of human savvy. Along with the ritual it is customary to state that one is flatly convinced of insuperable piles of pabulum yet to be prechewed, and so forth. Yes there are.

On the pragmatic side of the conflict I have concluded that mechanical arrangements of this fifth phase of the psychological act will be, with regard to both horizontal and vertical classifications of conceptual segments, very much the same as the semantic classifications performed by the act's agent. In addition there will be heuristic processes for introducing speculative definitions.

However the capabilities for introducing new conceptual possibilities are worked out, they must be solidly backed up with mechanized methods for forgetting conceptual structures which have failed the test of use. I think that indeed sophisticated induction, when it is done some day by machines, will be more an exercise of sophisticated forgetting than of anything else. For hypotheses, whether made by machines or men, will most likely be absurd.

The situations which this phase of reorganization will recommend to perception are those which were orienting an act as it failed to be consummated. A fast-learning machine will take special notice of such "failures" in the orientations of its personal acts, or in the orientations of social acts of its

community, in order to concentrate reorganizing capabilities on the points of failure, which is to say, on the misfits between personal or social conceptualization and reality.

I am thus convinced that the theoretical lessons to be learned about the organizing principles of semiotic systems, the very arrangements to be consolidated by hardware, are inseparable from the methodological lessons to be consolidated in the designer who would become expert in controlling the evolution of intelligent machines. The maxim of pragmatic method is that the rate of the development will depend on the designer's ability to forget the myth of his personal inventiveness, and to discipline his attention to living or historic evidence of the ways in which semiotic systems have actually succeeded or failed.

But he will do so to make design decisions, not scientific descriptions; because in his world all men will be designers of semiotic systems. Knowing this, he will do it better and faster.

I have urged your attention to two fundamental invariants in everyday human behavior from which one might get on the track of that illusive concept "meaning." What a mind is speculating about at the moment seems to determine to a remarkable extent what it will seek out perceptually. On the other hand, it seems to be the case that, at each successive stage of its development, a mind derives its organizing principles from some phase of the act which until then had been only modestly represented in overt action.

As we have seen, men in the fourth stage of culture perceive signs of God's will in nature because they are speculating about a divine plan that commands their obedience. The organizing principles of their world can be traced to the consummative phase of the act, whose functional responsibility is quite literally to carry out a course of action that has already been decided. Its cluster of authoritarian purposes and attitudes, inordinately preoccupied with the sin of disobedience, brought down an ancient world paced to the even more sluggish tread of tradition.

At the fifth cultural stage now precariously in sway, perception and speculative conception have their own characteristic pattern. Men search earnestly for signs of advantage or of disadvantage as they ponder the ebb or flow of private or corporate competition. New conditions of growth, of accumulating wealth or power, of hostility, of indecision, and the like, are the factual inputs of a scheme of advocative choicemaking that finds its organizing principles in the manipulative phase of the act.

Practicality is without question the imperative of this phase, during which a functional necessity does center perception outside of self or community. How else would it be possible to hammer out plans, either for person or for society, so as to choose what specifically ought to be done in the near future to protect or to improve a position of rivalry?

As these combative attitudes anger at being forced to contemplate their own obsolescence, there is an ameliorative principle that I have brought to your consideration: a mind does not forget what it has learned in previous stages of its development, although further accommodation of its knowledge and experience will be necessary to incorporate them into a more comprehensive and more stable viewpoint.

The authoritarian scheme of choicemaking that had its heyday in the Middle Ages is not lost to us; it is alive and well in every modern organization. Employees do keep their eyes on the boss as they speculate about the newest jog of his will. Sometimes, having perceived signs of his displeasure, they confess to him their sins of nonconformity to his plan.

Yet the age is past when mankind, at the very forefront, thought of itself as a society of employees. Modern man has become a middle manager; he makes his own plan. His new talent is the down-to-earth and day-to-day operating decision of a policy attuned to a chancy game of nations and of industry.

The policy itself, seemingly imposed on him by human or subhuman antagonists, is felt to be largely beyond his own control. He is a victim of external circumstance. His information, hence his troubles, come from

without. His defensive attitude can be ascertained from the outward direction taken by his accusations in time of stress.

Imagine, if you can, a world in which quite ordinary men and women begin to think of themselves as policy-making executives. Then you will have the pragmatist by his shirttail as he starts clumsily to learn how to live in a universe of acts, a strangely mental cosmos, most puzzling for its formal heterogeneity. Not just one context of objective inferences, but many overlapping contexts make up his information. Each is matched in meaningful relationship to specific content. To make policy is to create or refine these little domains of meaning, in which one can recognize the various roles he plays personally or socially, or the roles played by others.

His is a self-conscious awareness of roles, with the added stipulation that it is better to create a role for oneself than to take one ready-made. A love affair with the role of policy-making itself can be heard in the bitter-sweet criticism and proposed reconstruction of sex, corporate management, womanhood, war, money, and apple pie. It is in the active role of designer of roles, taking its speculations from the act's phase of reorganization, that pragmatic perceptions appear so excessively absorbed by signs of personal or social inadequacy.

The pragmatic attitude anticipated for the sixth cultural stage is that all of one's personal and social experience can, and should, be subjected to the same careful scrutiny as those innocuous backwaters hitherto commissioned for study under the contract of scientific detachment. Witness an exodus from the physical sciences to psychology, to sociology and to all

other scholarly and artistic fortifiers of effete humanity. What sounder evidence than this of pollution and clandestine purpose on the rise in science and education?

Beneath the discernment that one's own parents must be indicted for incompetence, there lurks an exuberance of breakthrough. Urgent attempts to teach one's elders overflow from the campuses as a domestic brinkmanship in which the risk of miscalculation on both sides is great. The teaching of oneself is a casual experiment with novel life styles or mind-engineering drugs. It would be ridiculous to see in all of this the motive of merely describing, rather than tangibly redoing, one's own personality and one's own society.

Obviously, scientists and educators will themselves remain furtive in working out the implications of a new point of view while the slow hand that feeds them is exorcising the very same insight. To a climate boding doom as budgets are cut for interlocked institutions of learning, the trend is toward either bookburning or the more priestly arrangement that Robert Fredrich celebrates. The priests would no longer sit and watch society but would use their mysterious knowledge to manage it, never forgetting to pass the collection plate for the harrier of their hounds.

They would continue to treat man as a passive object propelled by social forces rather than as an active creator of his own life. Lacking a Descartes to belay the hunters of latter-day witches, they would stop advancing or go petulently in reverse. The proposition that their own hand is on the throttle is the one that may be illusory, however.

In contraposition to the tired choice between mechanism and free will, the pragmatic scheme of choicemaking postulates an unyielding direction in all human activity. It doubts the credibility of spiritual movers in personal and social dynamics with a hardheadedness reminiscent of past pioneers of physical dynamics. Why should one suppose that a whole universe except for his own brain runs like a watch? If the functioning of a brain creates a mind, the new question has got to be "How is a mind constructed?"

By "mind," you have been assured, I do not refer to something merged in the juices of a brain, where it lies in poised readiness to give or receive "information." No psychic entity is presumed to wait in truant anticipation of news about itself. Just the opposite. I have been following out the alternative hypothesis that "information" is the stuff of which a personal mind, the whole web of a given experience and knowledge, consists, having been created by the biological functioning of a brain.

I look to a tacit acceptance of this seemingly innocent hypothesis, as it spreads without the spiritual reservations hitherto summarily impressed on every progeny, for the basic cause of emotional outbursts across a bifurcation of generations. This new belief does the work of cultural revolution because it challenges the established information source, relative to which all roles in a society are determined.

But to face problems of a cultural nature, we must theorize about an accumulation of form that began long ago and surges onward, temporarily carrying us along with it as unwilling captors. Thus, another principle I have mentioned is methodological. It cites the necessity for formal accom-

modation in ourselves as we fix our position in the cultural stream by looking backward at a pragmatic reconstruction of the development so far. Then it may be possible to use the hypothetical framework of an alternative point of view as we try to surmount some of the prejudices peculiar to a transient state of mind hoping to predict the form of its future.

In order to actually test any new formal hypothesis one must live it, at least tentatively. A corollary of this principle of verification is that the crushing labor of building a new universe will not be done by investigators alone. Only as it is carried forward in the collective mind of a populace does formal prediction do the constructing by which every change of cultural state is put on trial by use.

When the old forms fail us, a felt need for new forms is indicated by cathetic investment in a new source of information. The arguing and complaining may be simply an accompaniment of disruptive social accommodation already well in progress on a broad front. The ability to talk rationally about a new world view seems to come after it is already established. Some doubt has motivated the mind to learn; the particular forms it will learn are, by our hypothesis, biologically predetermined.

Regarding the rate of learning, our hypothesis predicts that the tempo of adaptation can be slowed down by shielding either a personal or a social mind from an awareness of its own mistakes or from avenues down which it might stray. Or, by obliging it to be aware of systemic misfits or of innovative possibilities in the organization of its own experience or knowledge, the mind's ability to shape itself can be quickened.

Language and other means of symbolizing can, in these respective senses, be either "conservative" or "creative" instruments in the various societies that implement the basic order of a particular world view. Every stage of cosmological speculation, including the present one, has preferred certain windows of perception and shunned others. As formal development progresses, not only do more windows open, fewer are closed. Be that as it may, it can be argued from historical and archeological evidence that the stages of the cultural progression are of ever shorter duration.

Comparative studies of the rates of formal learning among individuals of various societies representing a wide range of cultural situations have been made by Lawrence Kohlberg and his associates. Results based on "moral" reasoning in the United States, Taiwan, Mexico, Turkey and the Yucatan have been widely circulated. They indicate that a given personality does advance more rapidly through the formal progression as the society from which it derives its organizing principles is itself further along in the cultural progression.

A primitive society may produce, on all too rare occasions, *a* pragmatically wise old man in whom, all too often, his contemporaries will discover no more than an eccentric oldster. Executives in an industrial society are commonly observed to "freak out" around forty, having presumably gotten hold of their corporate role of policy-making well enough to at last apply it in their private lives. Exciting evidence that an exceptionally well-organized culture has made a beachhead on our campuses, not from outer space or Russia but from a creative development of the maligned

educational institution itself, may therefore be observed in its surprising output of a veritable herd of wiseacre executives at callow eighteen.

Dynamics of cultural pressure and counterpressure can thus be visualized in terms of individual personalities being projected to stages of formal development beyond the one organizing their society. Forms that for the majority are still helpful will be felt by these forerunners as a drag. The Pandora principle is that the former will invariably come to regard learning as a box from which evils are escaping and will do their best to hold down the lid, whereas for the latter the box will always contain blessings which they will try to emancipate.

Hence the noteworthy innovation in the order of antiquity may have been an overkill of theory. The dawn of conception led to science; but at first there was mainly the anti-science of a florid growth of myths and legends taken altogether, en masse, explaining away everything so fantastically well that no happening could be sufficiently surprising to stimulate learning. If that good old storyteller was an information specialist, as his name implies, his role was the anti-educator of a scheme of traditional choicemaking that succeeded by a ritual replication and protection of what had been done in the past.

That tightly conservative preoccupation with the act's phase of conception on the part of the council of elders was the anchor around which a village life moored itself to ascertain the correctness of its facts. By holding fast to what they had learned by chance, nomadic hunters may have transformed their life ever so slowly to one semipermanently ordered to

subsistence herding and farming.

Reliance on traditional conception as the source of firsthand information was a more rigid adaptation than reliance on authority. Although sometimes fickle, the latter could change its mind. When the trend finally turned from herding animals to herding men, the villages faced an increase in marauding by clustering around the fortified citadels of feudal monarchies. The nature and attributes of kingship depended on historical background; as information specialist the king was everywhere absolute. Around him, agricultural and human domestication hung over everything in life. By comparison, the hunter had been poor but unbowed.

In the hunter's autistic scheme of choicemaking one can recognize a preoccupation with the act's perceptual phase. The surprising artistic achievement of that first information specialist, the shaman, has been preserved for us in his cave drawings, paintings and sculpture. Remnants of his active practice survive in northern Siberia among the Eskimos; some traces remain in Australia and in Africa.

Collecting his firsthand information deep in a self-induced trance, the shaman's explorations of hunting prospects, of causes of illness, of means of cure, and of all other matters necessary to tribal life, were done at the very edge of a just-emerging human consciousness. From his multifarious and showy activities, the tribe gained a center of stimulation around which to order society. Art may now keep us from dying of the truth; at the beginning it probably served to keep men awake to their insecure humanity. That function of the shaman's art may have been sufficient for a nascent

traverse from grubby food-gathering to hunting.

More to the shaman's credit, I think it likely that the initial insight of shamanism, when it is carefully tracked down through the dusty maze of subsequent metamorphoses in magic and religious alchemy, will emerge in its most recent form as an aptitude for doing experiments and making empirical observations.

Paralleling the long struggle to learn how to perceive, and always complementing it, is a progressive accumulation and refinement in the art of conception. Some of the high points of its stages can be seen in Aristotle's "Organon"; in Aquinas' proofs of teleological conformity; in the modern reconception of mathematical proof as conforming to either intuition or experience, where again the polarity of Descartes' dichotomy can be seen; and finally in Frege's theory that such derivations should be carried out exclusively according to the form of the expressions comprising a symbolic system, making possible proofs of an internal systemic validity per se.

The theories of Gottlob Frege, a contemporary of Peirce, are deeply connected with the revolutionary innovation in the conception of form that made possible the reorganization and subsequent expansion of the physical sciences. Before Frege's "Begriffsschrift," investigators had always abstracted formal knowledge from ordinary language. Afterwards they proceeded in the opposite way, by constructing "formal systems" and later looking for an interpretation in everyday speech.

This method was not consistently followed. But at least the result of the combination of Frege's theory of proof with George Boole's epoch-

making "The Mathematical Analysis of Logic," in which a clear idea of formalism was developed in an exemplary way, the principle of such construction has been consciously and openly laid down. One can see in this shedding of reticence the beginnings of a new method in science, wherein innovative formal constructions deliberately lead and determine the necessities of empirical observation, instead of the other way around.

Peirce's contribution to system-making is harder to estimate, because the exigencies of his private life and the indifference of publishers prevented a full-length presentation of his unappealing viewpoint. After his death in 1914, the unpublished manuscripts and hundreds of fragments from a long life devoted almost exclusively to pragmatic speculations were assembled into six volumes by the Department of Philosophy at Harvard. His tendency to follow out the ramifications of his topic, so that digressions appear that seem inadmissible in print but which show vividly the interconnectedness of his thought, may now be recognized as a style dictated by the necessity to develop contents relative to contexts. From all he taught us his own system cannot be completely reconstructed, if indeed Peirce himself was ever able to catch sight of the goodies that will pop out of Pandora's box after the inevitable inquisition.

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