environment as the elevator apartments ultimately ascribable to Newton or Euclid.

We must confess that the ~~account~~ query is well-taken. It is especially so when we learn that the systems of Euclid, Ptolemy, Newton, and Darwin have been destroyed, or modified, or shaken, or at least strongly criticized. Euclid had his Poincaré, Ptolemy his Copernicus, Newton his Einstein, and several are currently contending for the honor with reference to Darwin. We must retreat to our former position and assert that scientific systems are true relative to the use which culture and society may make of them, that they are true relative to their results in giving man control over his environment, that they are true temporarily so long as they form the best means of tying up thousands of discrete findings concerning man and nature, that they are true so long as most workers in their fields are inspired by them to thousands of further studies of the world. Notice, however, that we are not saying truth is relative, but that systems purporting to describe truth are relative. The former question is beyond the scope of this book, but we are mightily interested in discovering systematic variations in political phenomena, institutions, parties, elections, constitutions and others.

Political Science, like the other human sciences, suffers from a plethora of systems and a consequent almost complete unsystematization of most of its data and findings. Both Platonists and Machiavellians are very much alive in the modern area of politics, not to mention other systematic viewpoints. As a result practically every finding in Political Science may be challenged by some influential group as not being intelligible or useful. But more of that later, for we

evolence of some cynic, the inadvertence of some optimist, or the benevolence of some pessimist. I submit that no such discoveries, nor any others that physical science could possibly make, could avail to remedy our condition. I would go further and assert that every step of progress physical science may make in the near future can only add to our dangers and perplexities; for every step of such progress must increase the top-heaviness and the lop-sidedness which are the radical faults of our civilization.

"I have no wish to belittle the achievements of physical science. They are immense and altogether admirable. I am concerned only to bring home to the minds of my readers the indisputable fact that the very successes of physical science, leading, as they have done and inevitably must do, to rapid and violent changes in all our modes of living, are producing a state of affairs that is ever more unstable and dangerous, which urgently needs some large scale corrective such as physical science, no matter how successful, is, in the nature of things, unable to supply."--William McDougall, World Chaos, The Responsibility of Science, pp. 50-51.

Political Science, properly construed, can excite in its disciples the attitudes and skills competent to begin rectifying the imbalance of the sciences.

is to know about the world on a very vague and general level, and also to do little things as well as the next man.

On the most general level, common sense becomes a collection of practically useless or mutually contradictory folk sayings. "A man should look before he leaps", but "he who hesitates is lost." The proof of the truth of the saying or generalization is uncontrolled and ex post facto, and depends on the success of the act. If the man leaped but fell, he should have looked; if he was caught before he leaped, he should not have hesitated so long. To strike closer to home, there is the saying that "nothing is more uncommon than common sense." Whatever the defects of all of these statements or folk laws, we realize a certain truth in the experience they refer back to. If we could get all the exceptions somehow included in the formula, we would not need that contradictory saying and there would be an exact correspondence between a man's successes and his observance of the formula. Then the formula could be passed around and applied everywhere, either by consulting technicians, if it were too complicated, or by ordinary men themselves. But in that case it would be what we call science: an exact ordering of relationships, potentially applicable to achieving man's ends.

Common sense on little things, too, aims ultimately at science. It tries to suppose that all men see all objects in the external world alike and that there is no excuse for differing over sensory data. The phenomena of the world, its rocks, trees, waters, houses, and men, are truly real. Men have been far too successful in mastering their environment to doubt the testimony of their senses. It is easier to doubt every other conceivable thing. Yet we must realize that the so-called five senses might have been ten or fifteen

or only one and in each of those cases we would have ejected angrily any five-sense intruder who saw a different world. He certainly would not have been credited with having common sense.

For many purposes of life and thought, this common sense moves into science and gives it a phenomenological base. The data about man and the world are ordered so as to be intelligible in terms of the senses. Generalizations are related to this "real world". Large elements of common sense, natural science and social science survive and flourish by solving problems on this crutch.

There is, however, a major exception. Most people, while accepting the verdict of their senses absolutely, will, at the same time, hold to the existence of supersense. Religion is the most important manifestation of this belief. In order to understand religion, men must be prepared to reject the claim of common sense to be universally valid, even after it has been transformed into what seems to be a universally applicable science. God and miracles must be known, if they can be known at all, by means other than the senses and the categories thereof. Faith, intuition, and miracles are then the crutch supporting man's need to understand and order the universe. The sensory part of common sense and science may still claim their due in the study of the customs and institutions derived from religious belief - churches, sects, ancestor worship, magic, or architectural styles be they totem-poles, pagodas, or cathedrals.

Science and common sense, therefore, have much in common. Science is more orderly, that is, methodical; it is more self-conscious, that is, aware of its limitations and concrete objectives. Within the sphere of its competence, science gives splendid results

in man's attempt to orient the world. But an enormous stretch of affairs lies beyond science's immediate grasp, and here the art of intelligent guessing remains supreme. Here common sense fumbles over intricate relationships and requires individual aptitudes and art to satisfy the desire to order and control. One here proceeds with scant help from laboratories, tested formulas, repeated experiments, or provable and recorded experiences. He must educate himself to study man and nature and to classify and categorize their data and to allow for expected occurrences, yet the tools of communications have not been perfected enough to allow an exactly equivalent transfer of such knowledge to another man. Such is the situation in almost all of the social or human sciences and much of the natural sciences. Knowledge is scanty, vague, and incommunicable. Yet something may and indeed must be done in this area, for the most important problems of mankind are there included. As Aristotle said, "It is the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits."

Can we not say then, by way of summary, that man has employed universally his common sense to the ordering of the world; that common sense has solved many problems but failed out of vagueness and dogmatism in the solution of many others; that science has taken up the torch and lighted up clearly many of the old areas; that far more remains to be done than has been done, especially in the study of human relationships; and that meanwhile a partial science or an educated intelligence must guide men.

The Ways Scientists Work

How does the scientist go about getting this orderly and precise picture of the world often extending over into an ability to predict

the future behavior of objects and relationships, something which common sense and ordinary study has never been able to do? He does it by a series of procedures called "the scientific method". Those are designed to prevent human frailties from interfering with the correct analysis of a social or physical situation and the communication of the correct analysis to other men. They may be grouped generally into procedures concerning the data being studied, combinations of the data, checking and comparing the relations of the data to the combinations or generalizations, stating the findings precisely and communicably, and generalizing or synthesizing two or more findings. This last process culminates in a "system" of connected, intelligible, and useful relationships, from which other scientists may work down into new materials with a "head start". A field of human or natural relationships is known and new data in the general field will fall into place more easily. Many questions may be asked of the system and their answers given more quickly and with less effort.

The Data

The naive person assumes that the scientific process begins with the raw materials of experience; the facts of life leap out at one and he need only group them logically, test them, report on them in order to complete his ~~test~~ task. No field of science ever develops so simply. True, certain events happen so regularly that they may be predicted and people may adjust to their consequences. Thus, all men are mortal and this social generalization is so true that none but the most fantastic sort of wishful thinking has ever deemed it needful of more controlled investigation. Also, certain

facts of physical geography are perfectly obvious to residents of a local area, what mountains and rivers exist, what crops will and will not grow, when the rains and the snows come usually. Simple and useful generalizations may be made about this type of fact. But with these seemingly simple facts are associated human needs and desires which are not so simple. Are men living longer now? How can life be prolonged? Can life be created? Or when precisely will the rains come? When trees are cut in the mountains to grow the crops, do the rivers flood their banks in the spring? These questions are in the same broad area of facts but require a much closer gathering of the evidence, a much closer scrutiny of the environment and indeed a concern over what is a fact and what is not. Now we see more clearly what science encounters in the gathering of data. Firstly, facts do not stand out of their own accord. They must have some relation to the men which makes them interesting. The census of property and humans waited on the tax needs of the king. Secondly, what are relevant facts depends on the general question which is being asked and how ambitious the question is. Many "irrelevant" facts were ignored about tar oils before perfumeries found them relevant. Thirdly, facts pertaining to the same event may be of all sizes, shapes, and degree of subtility. Mountain-peak snow measurements might be more useful but harder to get than bank measurements, but both would perhaps could be employed to predict floods. Finally, the facts are likely to be so numerous and elusive that procedures must be devised to define them and record them precisely. Election figures must be gathered in detail, election after election, in order to have a field of facts to work over, and as many campaign speeches as possible must be written down to preserve their character as evidence.

The gathering of data then is in most problems that conern science no simple picking of daisies in a field one happens to wander into. There are cultural reasons why one is in the field in the first place and as soon as he is in it to the extent of being active, he is asking questions of it. So one is usually in relationship to his data before he is a scientist. He must only now see his data with new eyes and this very process often means, of course, that new data appear to him and old evidence assumes different form and relationships. It would be foolish to think that he is making notations, counting facts, defining them, tabulating them, translating them into symbols and other short-hand references, looking for new data in all sorts of new places without asking any questions as he goes along and without having some idea how the facts will look afterwards. No, the scientist goes into every field, no matter how abstruse, with a problem and some possible answers. Although at this stage, his mind may be open to all sorts of new data and he may gather in more or less than is necessary to answer the final questions to be asked, his very interest opens up to him certain kinds of data and closes off other kinds and his most elementary ways of tabulating the simple data have reference to a possible answer. He must lift himself by his own bootstraps from the very beginning of his operations.

Later on, when a field has already been established, when questions have been tentatively answered, when something of a system is present in an area of knowledge, he may feel more assured about the collection of data. Vast censuses may be taken of well-defined objects. Telescopes may be trained automatically on the heavens and their views filmed. A crew of men may be left to dig for months on

the site of an ancient city. Thousands of students may be asked the details of their lives. But already the frames of inquiry are taking shape. Already the beginnings of hypothesization are present.

Combining and Checking the Data

From the very beginnings of science in common sense, men have taken for granted vitally important hypotheses. The world is real, and what all agree on is true. In addition, man is so conditioned by his culture that at certain times he is interested in certain problems to the exclusion of others. Or to put it another way, certain needs are felt at one period in history which are not felt in another. Or to put it still another way, his very ways of coping with his needs and interests, his scientific skills, if you will, are a product of a set of historical circumstances which determine whether or not needs and interests will be accompanied by the appropriate skills. This is called cultural determination and is true of all aspects of human affairs, the various fields of science included. Why it is true is beyond relevance to our book and to our powers as well. It is a most important conception, however, in understanding why needs felt at one time in history are not so much in evidence at other times, why political systems come and go, and why scientific progress characterizes certain ages more than others. It is the basic or primitive level of hypothesization. All men, from the most untutored to the most abstract scientist build their ideas in dependence upon it.

The second level of hypothesis is more familiar. Here the use of the word hypothesis is strict. An hypothesis is a tentative answer of a problem to be studied. It is a fact statement about the

world. It is framed in advance in order to make compact and clear the area of study and the nature of the problem, and in order to shape the utility of the study in the direction of other pre-existing, related studies. The small boy with his chemistry set is typical of one who has no clear hypotheses. He simply mixes the chemicals to see what will happen. The scientist tries to know in advance what he is after and then proceeds to test the hypothesis by a variety of accurate, meaningful and controlled observations. If what he observes shows the hypothesis to be false, its tentative answer must be abandoned. If there are indications that the hypothesis was too broadly stated, he must restate it and recheck the evidence. Or he might also be led to make a new hypothesis by certain suggestive combinations of the materials which occurred during the observations.

But already, as this process of verification of the hypothesis is going forward, the scientist is reasoning inductively and deductively. That is, his observations lead him to question the hypothesis, to modify it, to think of other hypotheses. And also, his hypothesis, plus other half-formed hypotheses resulting from past experiences and learning, intrude on his observations and cause him to group them along certain lines and to reject some data in preference to other data. Thus he reasons both from the observations to the principle and from the principle to the observations. As this process occurs, the study gets sharper and more vibrant with meaning. Finally he is ready to warrant to the world that his hypothesis is true and no longer tentative. He is confident that if other men wish to reduplicate his efforts they will come to the same conclusion. Very often, his truth is of such a kind that it

may be used to predict similar events or results even without the benefit of the sort of painstaking labor he employed to prove his single case.

When conditions will allow, and this sort of procedure is uncommon in the social sciences, he will take an hypothesis, partially substantiated by field work on human or natural processes and transport it into the laboratory. Setting up a "duplication" or "model" of the natural process, he will test the hypothesis under more severe controls. This "experimental method", which has had great success in certain areas of physics, chemistry, and animal biology, can often provide a surer measure of the relation of the data to the hypothesis than can the field method.

Reporting the findings

We have already mentioned that the proven hypothesis, the truth, must be valid under exactly comparable standards in another situation. Another man must be able to come up with the same results after going through the same process of study. This means that the finding or truth must be communicable as well as true. Of little value would be a finding if it could not be phrased in such a way that other men could be capable of understanding its meaning, and its limitations. Furthermore, the utility of the finding depends on its capacity to be transferred to other situations; otherwise it does not give other men the short cut or the head start they must have to build any body of science. Partly the problem is one of drafting the finding in words which have exact meaning to other men engaged in similar work. Words and ideas

But partly also the problem becomes a basic one: where scientists do not share similar interests and ideas as to what is important, words themselves will be drowned in the dusty files of scientific periodicals; the scientists conceive the field to be studied differently and select only findings which fit their notions. This fact is not wholly willfulness on the part of some unscientific scientists. It has to do with the nature of systematized knowledge. In order to relate the many parts of a whole field of knowledge such as physics or politics, someone must draw together widely scattered findings and leap over many pertinent but unexplored problems in order to frame the whole field in a common set of objectives and terms. A battle of titans takes place. The winner sets the conditions for scientific progress in the field for some time. Thus did Euclid for Geometry, Ptolemy for Astronomy, Newton for Mechanical Physics, Darwin for Biology. Their "truths" reduced whole areas of reality to a common denominator for long periods of time, and technology and culture of many men felt their effects. In the cases of Newton and Darwin, for example, the meanings their systems had for a particular societies burgeoned into myriad ramifications.

The Systems

The reader may pause here to ask: Why have only natural scientists been named? Where is Plato in Polities, or Machiavelli? Where is Paul in Christianity, Aquinas in Catholicism, Calvin in Puritanism? Where is William James in Psychology? They all had systems which ordered the world or great parts of it. They all had followers by the thousands or millions who worked assiduously according to their methods and erected gigantic movements as important to the

Summer 1948

Chicago and Michigan Beaches

SCIENCE AND MAN'S ENDS

By ALFRED DE GRAZIA

Men are interested in "making sense" out of their relationships with other men and the objects of the non-human world. They feel that their lives will be made easier, their problems lesser, their futures more secure, if only they can bring order to everything. They want to put men and things into their proper places in relation to each other so that they can go about their ordinary affairs in freedom and security, knowing that the world is a stable, controllable thing. But the pursuit of the goal aggravates the same symptoms that cause the pursuit in the first place. For, in trying to make sense out of the world, all phenomena, mental or physical, from God Himself to the stones, become objects of thought and dispute.

During most of history and over most of the world's area, the struggle for understanding has occurred under poor auspices. Few men have emerged from the vast realms of "common sense" to present an intelligible picture of what the world is like and of what the world ought to be. "Common sense", meanwhile, orders the universe for us, and we ought perhaps to have some idea of what it is. This vague phrase, often used in a favorable way in our time, denotes two major ideas, that of folk knowledge which all people are supposed to have, and that of particular, specialized knowledge in whatever operation a man may be interested in performing. A laundryman is accused of lacking common sense when he gives credit to many of his customers and also when he neglects to change the water used to wash socks before washing shirts. And so with the politician who believes he is too righteous to campaign for office and another who puts his innermost thoughts into writing. To have common sense, to

have yet to trace the broad outlines of the history of science and culture.

The Historical Relations of Science and Culture

It would be hard to defend the statement that modern man in Europe and America is a more rational being than man of ten or fifty thousand years ago. In the first place, one would be hard put to say definitely what he means by the word "rational". Do we mean that he knows more about the world in facts? That he has greater control over raw nature? That he has more comforts? That his methods of getting what he wants are more effective? All of these things are true to a certain extent. But if one thinks of some of the most important things in life, they appear not to have benefited very much from these accomplishments: the family, individual and social adjustment, the community, the conciliation of religion and life, universal participation in the arts. Anthropologists have studied societies that seem to give their members more of these values than we give to our own people, although they are most deficient in the first kind of controls.

The problem is indeed very perplexing and perhaps we ought not to worry about the word "rational" too much. Perhaps we may define it and keep the definition in mind as we study political institutions and devices. We will call "rational politics", political activities which seem to be directed, as best we can perceive, towards the maximum adjustment of as many individuals as possible to the ends of their society so far as those ends may be drawn into the future. Except for one small clarification, we will let the definition survive as best it can in the materials to come. We do wish to say, however, that by ends we mean not remote, unattainable goals, which

are set up in sharp contradiction to so-called "means", but rather the many discreet steps by which a community may feel its way towards a large measure of adjustment and virtuous activity for all its members.

Taking such a definition of rational conduct, we can afford a little scepticism over the presumed growth of rationality in history. We can see our own times in a little better perspective. And we can understand a little better the historical relationships among science, religion and politics. It is interesting to note that just about every society of which we have any knowledge has had some specialization in three categories of human affairs centering around science, religion and politics. In primitive communities it is not at all uncommon to encounter the custodian of magic, the custodian of the spirits, and the custodian of the community welfare. The medicine man is expected to control the physical world, the priest the spiritual world, and the chief the tribe's affairs. Thus before the dawn of history, the important work of the community centered around the important needs of the individual. There was no sharp cleavage between the individual and society, something peculiar to branches of modern thought where the individual is supposed to be in direct conflict at all times with the state, a situation, incidentally that has led to excesses on the part of both individual and state.

Perhaps even more important, there was no doubt that the three agencies of the community had definite social functions to perform. There was no pure science, religion or politics, for their own sake. Each had a workaday role to perform, and each was socially responsible

for its functions. We cannot imagine that abuses of functions and excesses of authority were any less common than they are today, but we may believe that the privileges of functional specialization were accompanied by the duty of responsibility to the community.

This condition characterized the early city-states of the Mediterranean world, our first ample source of materials on political affairs. The empires of the Egyptians, Persians, Babylonians, and Assyrians were not comparable to our modern nation states, but were loosely administered congeries of localities, paying tribute in slaves and assessments to distant conquerors. Important scientific discoveries were being made by the Egyptians and Babylonians; geometry, astronomy, and mechanics made their impress on the conduct of business, agriculture and everyday life. They also had their place in the magic and ceremony of the times. From the Near East and Crete magical, religious and political influences moved into the cities of the Greek peninsula and westward to the Phoenecian and Greek settlements in North Africa and Italy.

From the Greeks have come down sophisticated systems of philosophy and knowledge in practically every modern branch of learning. It is difficult to assess the combination of cultural habits which produced the remarkable development of the arts and sciences in this small area several centuries before Christ. Communication with many different cultures at the same time had something to do with it, most probably. Significantly, too, none of the trilogy of magic, religion and politics embraced the other two in iron bonds of prejudice or repression. The market in ideas was exceptionally free.

Science depended on magic, magic on religion and politics. The ends of science were useful (that is, political, for the Greeks considered politics as the whole art of living in a community), and they were religious, designed to give man a better estimate of his future world and the nature of the gods. We find Plato regretting the fact that in the education of the rulers of his Republic, studies of solid geometry cannot yet be used because "no government patronizes them ...That, however, would be otherwise if the whole State became the director of these studies and gave honor to them; then disciples would want to come, and there would be continuous and earnest search, and discoveries would be made; since even now, disregarded as they are by the world, and maimed of their fair proportions, and although none of their votaries can tell the use of them, still these studies force their way by their natural charm..."

Plato is concerned too that the beneficiaries of education in the sciences and philosophy - the skilled in geometry, statecraft, and dialectics - use their skills only for the benefit of the community. Separation of science, religion and politics would be unthinkable to him. His ruling class is at one and the same time scientist and philosopher. Restraints against the abuse of function are provided for through the educational process. No one can achieve his ruling class without self-control over his passions and appetites.

We do not find in the Greeks the separation of power for safety's sake which we find in our own times - where it is widely believed that politics, science, and religion must be kept apart, governing themselves without reference to each other. Nor do we find that insistence upon the isolation of the three elements in

the next great period which is significant for our purposes - the middle ages. There again, science, politics, and religion "cleared" through each other. But here the results were not so pleasing to the ages that followed. For ever since the Renaissance, many men have looked upon the middle ages as the dark ages. Some have pointed the finger of scorn at the times, labeling them the age of militarism. Others have called them the age of dogmatic theology. Others have named them the age of superstition. They have felt that the combination of the three in thought and action meant the abasement of all three. At the same time, the prophets of the new world, first in Italy, then in Germany, Spain, France, the Lowlands, and England, idealized the Greco-Roman period where politics, religion and science walked apace.

Yet, when it came to order modern society, beginning in the Eighteenth Century, the new leaders thought to keep the three forever separate, believing that the corruption of each came from the pernicious influence of the other two. The good society was to be the society free of church and science, the good church was the church separated from society and science, and the true science was the isolated study of nature and man freed from ethical or social considerations.

But culture refuses to be so cut up. If men try to segregate and isolate its essentials elements, it works at deeper, more subtle levels to unify human behavior. Science may still modify the culture but is meanwhile culturally directed; its ends and facilities are provided in large part by its unseen partners of politics and religion. And so it is with the partners. But all the while, the refusal to let any of the partners treat with each other and the

persistent denial of the need for an orientation of the three in terms of each other have precipitated many unwholesome conditions: a politics without ethics, a religion without social effect, a science without balance.

To lay doubts at the feet of the dogma of separation does not lay open all human activity to a naked struggle for supremacy by one activity over all others. Such an accusation would imply that there are only two solutions open to all human adjustment - despotism or anarchy. Rather, speaking on the defensive, one should insist that a great variety of circumstances and events account for the particular malappropriation of authority by any one function in history. The influence of religion on politics or on science, or vice versa, is only one circumstance in the picture. Galileo's physical science researches were received in a friendly manner by high church officials before a veritable social movement lost him their support and almost his life. By contrast, Thomas Hobbes, scientist and political philosopher, regretted the agitation of the democratic preachers of the Great Revolution in 17th Century England, stating: "Had it not been much better that those seditious ministers, which were not perhaps 1000, had been all killed before they had preached?" Popular outcry sent Socrates to his death. The Roman Republic tried but did not succeed in saving the scientist, Archimedes, from perishing in the looting of Syracuse. Tennessee Biblical fundamentalists banished the teaching of Darwin's evolutionary theories. Many French Revolutionaries, some of their leaders scientists, encouraged the massacre of priests. So the total story is a mixed one, hardly capable of being summed up in a slogan to keep the church, the state and science completely separate.

Speaking now more positively, it would seem that the best results would occur if one agrees to the essential integrity of culture and its main parts, and then proceeds to work out a suitable division of labor. To each his own, but to all the function of socially responsible work.

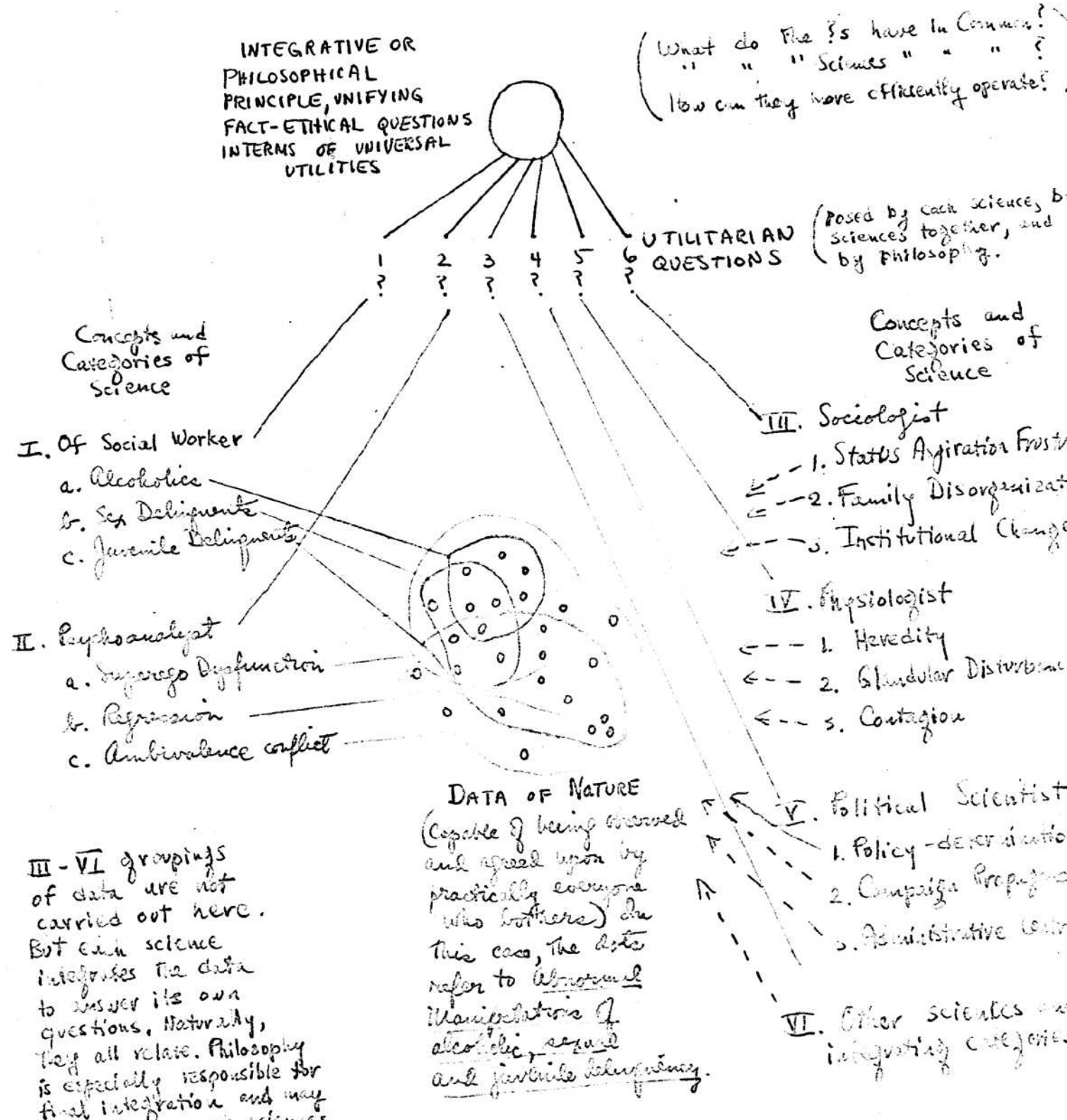
In terms of consequences, this would mean: that the state not deny to religion its custodianship over the spiritual aspirations of men; that science should not deny its responsibilities to the community; and that the state should have community ends as its objects. In more specific terms, so far as science is concerned, both the natural and human sciences should aim at goals consonent with and related to the ends of the community. And, so far as the state is concerned, its own ends are defeated when it employs to the utmost the techniques of the natural sciences, and relegates to the shadows the social sciences. Popular feelings, permeating some of the most influential minds, treat special aspects of the natural sciences like a spoiled daughter, see no faults in her, do not ask her to have any morality, and give her all the party dresses she likes, while the other children are considered to be inherently wicked before they ever utter a word and, by being dressed in rags, are made to feel as if they deserve only rags.

In a book written some years before the descent of an atomic bomb on Hiroshima, a writer declared:

> ". . . . And if some physicist were to realize the brightest dream of his kind and teach us to unlock the energy within the atom, the whole race of man would live under the threat of sudden destruction, through the mal-

Figure x

Relationships of Science, Scientific Method, The Utility Principle, and the Philosophical (or Fact-Ethical) Principle



III - VI groupings of data are not carried out here. But each science integrates the data to answer its own questions. Naturally, they all relate. Philosophy is especially responsible for final integration and may thus influence all sciences.