very promising that the young people who are now in school and those who have already returned to their respective communities after schooling elsewhere are showing restlessness and impatience with the outmoded practices in agriculture, health and education, and even in courtship and marriage. They are also restless because of the delayed progress of their respective communities. To these educated and dedicated youths, the people are pinning their hopes for a more accelerated progress and improved standard of living.

The major problems in agriculture, health, education, housing, social organization, attitudes, and others have been identified in the above discussions. They are not new problems. They are all of common knowledge. They have remained without remedy or with half-baked solutions for many generations, perhaps centuries. They are salient points wherein a program of development can be planned and started. Suggested solutions are not presented here for reasons of brevity. However, our government and people should take the problems of a large minority group such as the Moslem Filipinos seriously and should institute measures for their early solution. The Philippine Republic can not become a strong and stable nation with a large number of its inhabitants staying in isolation, in ignorance, in ill-health, in poverty, and of doubtful loyalty to the constituted authorities.

NOTE: The statistical data in the text are all taken from the Rivera-McMillan Report entitled *Rural Philippines*.

Experimentation and the Scientist*

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Science has been described as a method consisting of asking clear and answerable questions to direct our observations in an unbiased way so that we can actually answer the questions we raise. It is expected that assumptions held before we made our observations will now be changed to conform to the new knowledge we have gained from our observations. Strictly speaking, these observations are called experiments.[1]

The rational experiment arrived on the scene during the Renaissance period, although in earlier history there had been experiments of several types. For example, in India, physiology and its applications to Yoga technique had been the subject of study and in Greece mathematical experiments had been applied to the techniques of war.[2]

Experiments as a principle of research, as knowledge for its own sake, developed as it is known today within the climate of the fourteenth to the seventeenth centuries during the Renaissance.

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[1] James B. Conant, *Science and Common Sense* (New Haven: Yale U. Press, 1951), p. 50.

[2] Max Weber, "Science as a Vocation," reprinted in *The Sociology of Science*, edited by Bernard Barber and Walter Hirsch (New York: Free Press, 1962), 569-589.

It was during this period that man initiated his opposition to the medieval outlook in which the world was seen as an enchanted one, a magical and mysterious world where death was welcomed as an admission to a more orderly and desirable world, and where, in our secular world, natural phenomena were explainable by assertions of faith and dogma.

Copernicus's proposal in 1543 that the sun rather than the earth was the center of our universe led the way for the application of science and experimentation to astronomy and signaled the breakout from the medieval restraints in the pursuit of knowledge about our world. The path had been made, and the scientific method began. Thus, the science of physics in the seventeenth century, chemistry in the eighteenth century, and biology in the nineteenth century all came of age.

We're all aware that these advances from faith to reason did not come about easily. Let us take a most famous example—Galileo. Every history of science relates the trials and tribulations of Galileo, as he ran head-on into direct conflict with church authorities over his acceptance of some of the Copernican theories which began to make sense as an outcome of Galileo's experiments. At the age of sixty-eight, Galileo's publication of *Dialogue on the Two Chief World-Systems* resulted in the Church summoning him to Rome where, the following year in 1633, Galileo was arrested by the Inquisition, threatened with torture, and forced to make the following recantation:

"I bend my knee before the honorable Inquisitor-General, I touch the Holy Gospel and give assurance that I believe, and always will believe, what the Church recognizes and teaches as true. I had been ordered by the Holy Inquisition not to believe nor to teach the false theory of the motion of the Earth and the stationariness of the Sun because it is contrary to Holy Scripture. Nevertheless I wrote and published a book in which I expound this theory and advance strong grounds in its favour. I have consequently been pronounced to be suspect of heresy. Now, in order to remove every Catholic Christian's just suspicion of me, I abjure and curse the stated errors and heresies, and every other error and every opinion that is contrary to the teaching of the Church. I also swear that in the future I will never, whether by written or spoken word, utter anything that may bring me again under suspicion. And I will immediately inform the Holy Tribunal if I see or suspect anything heretical anywhere."[3]

The popular belief maintains that while reciting this humiliating recantation, Galileo was softly saying to himself: "... but the Earth does move." This did not prevent him from devoting himself to science during his remaining years and, five years later at the age of seventy-four, what are said to be his most important contributions in the *Discourses on Two New Sciences* were published, in 1638, in Holland.

We must keep in mind that much of the rigidity concerning the search for knowledge was a legacy the Church received from early Greek thinkers. The Scholastics, led by Socrates and Plato, saw everything as having been conceived to serve some human need. Therefore, explanation consisted of discovering the ends or purposes which things served. Consequently, it followed that the most noble human endeavor was to serve his God through the Church. The views of people like Democritus and others of the so-called Atomist school rejected these teleological explanations. They proposed that explanation is achieved by seeking the causes and conditions which produce things rather

[3] A. Wolf, *A History of Science, Technology, and Philosophy in the 16th and 17th Centuries* (London: George Allen & Unwin Ltd., 1950), p. 37.

than looking to the ends they serve. That this is antithetical to Socrates, Plato, and the views of the Church was readily obvious, and it was therefore a foregone conclusion that scientists like Copernicus, Kepler, Galileo, Bacon, and Newton would have a difficult time. The difficulty lay in the employment of the scientific method in a world which looked at purposes of events rather than causes, a world in which the raising of questions was interpreted as an attack upon Church doctrines.

While this upheaval among the physical sciences was going on, in the sixteenth and seventeenth centuries, the social sciences were also experiencing their birth pains. It was during these centuries that three hypotheses were raised concerning human behavior. One was the view that physical environments influence the behavior of people. A second hypothesis, novel at that time, was the proposal that economic events have some system and order above and beyond governmental manipulations. A third idea which found expression at that time was the notion that applications of statistical methods could help us to better study and understand the behavior of society.

The notion that human nature is influenced by climate and other physical events gained prominence in the sixteenth century through the writings of Bodin, whose main work published in 1577 dealt with problems of government. Bodin proposed that there are differences among various people requiring different types of governments, and that these differences are due to different physical environments. Some of these ideas and notions which we still entertain today are reflected in these early works. For example, Bodin considered people from northern countries to be phlegmatic and chaste, while he saw southern climate inhabitants such as those in the tropics to be melancholy and lustful. These behaviors he attributed to the sun. People of the east, wrote Bodin, are bigger in stature and fairer in complexion than are people in the west because of the "... natural beauty of the air, and of the easterly winds."[4]

The most important physical influence on human behavior, proposed Bodin, was the difference between the hills and valleys. Mountains, often northern and colder, supply a barren soil which forces the people to work hard, to be temperate, and to be resourceful. In contrast, valleys provide lush soil and easy living which produce people who become soft and lazy.

During the seventeenth century there emerged an appreciation of the orderliness and regularity in economic events. Paralleling the recognition of law and order in the developing physical sciences at that time, the statisticians searched for regularities in births, deaths, and diseases while the newly-developing economists asserted that there were many economic occurrences which followed their own laws. This was a novel idea, since until that time the prevailing assumption had been that economic events were the results of manipulations by government. Until the 1600's, economics had been regarded as a part of politics or statecraft in which a country's regulation of industry and trade, particularly of its foreign commerce, was the means through which the country increased its wealth and power. Such concepts as balance of trade, exports, monetary exchange, value, price, labor and production, supply and demand, par value, land value, wages, interest and usury—all emerged into clear focus during the developments of the seventeenth century with its recognition of law and order in the world of economic behavior.

Statistics existed in the seventeenth century where it was known as "political arithmetick". It was developed originally

[4] Ibid, p. 586.

because of a need to obtain reliable figures on such census events as deaths, births, sex ratios, populations of cities, and so on. It is interesting to note that the conclusion presented in the 1650's for the finding that London had almost seventy per cent greater deaths than births was that "... in London the proportion of those subject to die unto those capable of breeding is greater than in the Country."[5] This was said to be because men go to London on business or pleasure leaving their wives in the country, that apprentices marry late, that London contains many sailors who go on long voyages, and that the "smoaks, stinks, and close air" of London must shorten many lives. Further contributory causes suggested were "intemperance in feeding, adulteries and fornications" and business anxieties.[6]

So here we are in the twentieth century, with a 400-year legacy which has seen the development of the scientific method and its use of experimentation—a legacy which has been achieved at considerable cost, as have most things which are worthwhile. What have we learned from these struggles? What advice might one propose for the young scientist—for the person who will be devoting much of his professional life to experimentation and the pursuit of knowledge?

Of all the kinds of advice and admonitions which come to mind, it seems to me that there are a half dozen suggestions which might merit consideration. These thoughts, or perhaps we might call them "pronouncements", are the following:

1. Be informed and knowledgeable about your subject.
2. Be uncomfortable and unsatisfied about what is known in your subject.
3. Be persevering and persistent about your subject.
4. Don't trust yourself to be objective.
5. Don't hesitate to trust others.
6. Don't withdraw from the human race because you're a scientist.

[5] Ibid, p. 596.
[6] Ibid, p. 596.

Be Informed

Why should anyone have to remind us to be informed and knowledgeable about our subject? Perhaps it is because today, more than ever, when almost all of us have a little knowledge about a lot of things, many of us get the impression that we can be experts about almost anything that strikes our fancy. Thus, the physicist who develops atomic weapons may suddenly feel that because of his expertise at developing destructive power, he is automatically qualified to understand, to explain, and to predict the effects of his work upon the behavior of other cultures, societies, and nations. Now I don't mean to say that the physicist isn't exercising his civic responsibility, which he has every right to do, to speak out as a private and concerned citizen in criticism of his country's policies. In fact, my last suggestion that we not withdraw from society simply because we separate ourselves from it occasionally in order to run experiments makes it mandatory that the scientist should speak out when his conscience dictates that he do so. But we must remember that he is speaking out as a layman, not an expert, when it comes to the history, the economics, and the political science of a country's national and international behaviors.

The responsibility to be knowledgeable and informed about our subject means, first, that we are therefore better able to devise experiments which might contribute to further knowledge and, secondly, that with the background of information which we have, we will be more likely to use the outcome of our experiments more efficiently and productively. Since one of our goals in experimentation is to see how our findings support or refute a more general body of assumptions and theories, what we know about the present state of our subject will determine how we relate our fiindings to what is the contemporary state in our field. Any addition or revision of existing theories in light of our new findings on our part will depend upon how much we know about our subject as well as how clever we are. And more often than not, our cleverness is not reflective of some long-standing intellectual capacity but rather the result of a long history of acquiring information and knowledge and experience about our subject.

To plan any kind of experiment takes little skill or ability. Anybody can say to himself, "This looks interesting. I wonder if this will happen when I do that?" We do this kind of experimentation all the time after we get to be about eleven years old and have acquired what Piaget and his fellow psychologists in Switzerland have termed the qualities of formally operational intelligence.[7] But to do the relevant experiment, to do something that counts and to do it efficiently takes a background of knowledge and information from which the relevant variables arise. Otherwise, a whole professional lifetime could easily be spent in asking ourselves interesting questions for which either answers are presently available or for which we are not using the relevant variables to find the appropriate answers.

This is not to say that occasionally someone other than the informed scientist will hit upon a discovery, a serendipitous finding, which will provide a breakthrough in a field hitherto lacking that knowledge. But experience has shown that for every occasion of this kind, ninety-nine other experiments by novices who were uninformed and unknowledgeable amounted to nothing. Perhaps, then, it's not so much a matter that one can never contribute to knowledge if he experiments in a field about which he is uninformed but rather it is a question of efficiency. If one is informed and knowledgeable, then the chances are infinitely greater that he will be better able to develop an appropriate experiment and better able to make use of what he finds out.

Be Uncomfortable

The second proposal is that we be uncomfortable and unsatisfied about what is known about our subject. In other words, be unhappy? Don't be satisfied! Science, by its very nature, implies a built-in dissatisfaction with our knowledge of the world. It is dynamic, it argues against acceptance of the status-quo, and for faith it substitutes reason. According to one view:

"The scientist, if he knows what he is doing, does not have a faith in the order of nature . . . but a determination to discover whatever order there may be in nature, which is a very different matter."[8]

Just as we must approach our subject with feelings of unrest, curiosity, and resistance to any notions that our present theories are unchangeable, we also have to prepare ourselves, in our later years, to prepare our students and followers so that this skepticism and unrest about our findings and our ideas is carefully nurtured among those who follow us.

Max Weber expresses this thought in the following way:

"In science, each of us knows that what he has accomplished will be antiquated in ten, twenty, fifty years. . . . Every scientific 'fulfillment' raises new 'questions'; it asks to be 'surpassed' and outdated. Whoever wishes to serve science has to resign himself to this fact."[9]

[7] Jean Piaget, *The Psychology of Intelligence* (London: Routledge and Kegan Paul, 1950).

[8] Peter Caws, *The Philosophy of Science* (Princeton: Van Nostrand, 1965), p. 254.

[9] Weber, *op. cit.*, p. 572.

In relation to the development of the questioning attitude, there seem to be two major considerations. First, if we've reached adult life with few opportunities to question, to wonder, to be curious—if every time we wanted to find some answers we were punished instead of rewarded — it will be very difficult for us to suddenly develop the feeling of unrest which comes from not knowing. Rather, our passive acceptance of authoritative pronouncements, having in the past led to a more rewarding state of affairs than did our few rebellions and excursions to seek our own conclusions, will result in a scientist whose experiments will most often be oriented to supporting rather than refuting the present body of authoritative knowledge in the field.

The second likelihood is that this scientist will perpetuate this attitude in his relations with his students, who will conformingly follow the authoritative lead, stifling the initiative and unrest from within the individual. Of course, this is rather a far-fetched likelihood in the times of today. Even in such authoritarian societies as Nazi Germany and Soviet Russia, scientific progress did not grind to a halt. But we must keep in mind that it did not, not because of the assistance of the State, but in spite of it. Ultimately, science knows no politics or national boundaries. It is a state of thinking and of feeling which can be taught and learned even in the totalitarian states. The important thing to keep in mind is the present conviction we have that there is a greater likelihood that we can promote and perpetuate, in a free society, those qualities of feeling and thinking which we are convinced are the prerequisites for scientific work—the curiosity, the questioning of contemporary ideas, and the repudiation of the status quo.

Be Persevering

Be persevering and tenacious about your subject. There is little room in the world of experimentation for the dilettante, the person who runs from one thing to another. Why is this? Why can't a scientist who is an expert in one area readily move to another and do equally inspired and creative work? This is mainly a question of efficiency. He probably could do well, given as much time to learn his new subject as he has already devoted to his own area of interest. But for most scientists, this is a life's work in itself—and how many lives do we have available? Cats are said to have nine lives—scientists only one.

Now the admonition I am proposing, that one stick to his own subject, is not an easy one to follow. Why? Because there are so many temptations and blandishments, particularly in the science of our present times. There are scientific "fads" arising daily in every field, often stimulated by government and private grants attempting to direct interest to problems with immediate application to everyday life. Another type of seduction exists within our universities, where there may be certain kinds of research more likely to elicit faculty promotions, additional salary increments, or particular honors in one's professional society. One might say that today the inducements to the scientist to succumb to the very human enticements which reward subject hopping are probably as appealing as the sailor's custom of a girl in every port. However, while the sailor loses very little in his absence, the scientist who leaves his subject for temporary rewards in other fields seldom is able to return to this subject to pick up where he left off. This is because his subject has moved a little beyond him in his absence. This movement, this advance is the essence of science, as we have noted earlier, and the absent scientist does not keep pace with it. The vast numbers of theorists and researchers in one's field all over the world (remember, as we said, science knows no national boundaries) results in an embarrassment of riches, in an abundance of writings and publications so huge that most scientists are able to encompass only very selected portions of this information which are related specifically to his area of specialization within his subject.

What does this mean, then, to stick to one's subject—what are its consequences? One might say that they're pretty much the same as the prices and rewards in marriage. The first consideration is to realize that before you get too involved with a subject, it would be a good thing to evaluate it in your mind to decide whether you think you could be happy living with it for the rest of your life. Thus, the early stages of scientific commitment could be likened to the courtship period in marriage. Preliminary experimentation and trying-out stages are necessary early in the game, but eventually a commitment to something needs to be made, to live with for the future, for better and for worse.

Thus, as the marriage between you and your subject continues and the usual frustrations and difficulties arise as in the case of most long-term arrangements, we need to realize that while the other fellow's pasture may look greener than ours on occasion, jumping the fence will not dispense with future disappointments and disenchantments. Tensions, frustrations, disappointments, and anxieties are simply a part of life. Without them we would not move, change, or grow. And they're part of what the scientist has to learn to live with in his field and to take these in stride as he attempts to relieve and overcome these disappointments—not by running off to another subject, but by coming to grips with his problems in his field. In this way he grows and the field grows.

Up to this point we have discussed the three assertions proposed, namely (1) be informed and knowledgeable about your subject, (2) be unsatisfied with what is known about it, and (3) persevere in it. Let us now discuss the three "don'ts" which were proposed.

Don't Trust Yourself

The first admonition suggested was for the experimenter not to trust himself to be objective. James Conant has expressed this thought in the following way:

"The notion that a scientist is a cool, impartial, detached individual is, of course, absurd. The vehemence of conviction, the pride of authorship burn as fiercely among scientists as among any creative workers. Indeed, if there did not, there would be no advance in science."[10]

Now these strong feelings obviously affect our senses, our receptors for perceiving the world. When we're thirsty, we see water-mirages. When we're hungry, we see food or smell it cooking. To the soldier on duty many miles from his homeland, the local girls seem like Hollywood starlets after awhile. What we perceive is not only the result of what is out there in nature but is, in addition, the result of how our experiences have influenced our interpretations of these sensory stimuli we are receiving. These interpretations reflect our learned behaviors, our personality, our needs, interests, drives.

Thus, when we deduce any hypothesis and subject it to the experimental test, we are really not the disinterested detached objective scientist we purport to be. Hardly! We are very much interested, involved, and subjective in our feelings about the outcome of the experiment. This is human and indeed necessary, as Conant has pointed out. However, the mature scientist knows of this, and he guards

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[10] James B. Conant, *Modern Science and Modern Man* (Garden City, N.Y.: Doubleday, 1953), p. 114.

himself against his feelings affecting his results. He doesn't trust himself but, rather, protects himself from these uncontrollable tendencies to see what he wants to see, to find what he predicts he'll find, by arranging for controls in his experiment—controls which make it impossible for his unconscious wishes and motivations, or anyone else's, to influence the outcome of his experiment.

Most of us are well-acquainted with the discovery of the so-called "personal equation" in the early days of the science of astronomy, where it was suddenly realized that not all scientists looking through telescopes at celestial bodies saw the same thing, even though the heavens were going through identical motions on every occasion. Physics shows us a more recent example in the problem of objectivity a little over a half-century ago, following Roentgen's discovery of x-rays in 1896. It's a very interesting story.

In 1903, a fifty-four year old French professor of physics at the University of Nancy published results of his experiments showing that x-rays were true electromagnetic radiation like light and radio waves. Performing many experiments based upon his original finding that a spark was affected by x-rays and made brighter in their presence, this professor, Dr. Blondlot, found he had isolated new rays, rays which could pass through paper, wood, and metal. He called them "N-rays" after the University of Nancy. Further experimentation showed that these N-rays could be given off by hot bodies or by the sun and also by strained or hardened matter, like a steel file.

During 1904 almost fifteen per cent of the official French scientific journals was devoted to nearly one hundred papers on the N-rays. Later that year the French Academy decided to honor Blondlot, the discoverer of N-rays, with the country's Leconte Prize of 20,000 francs and a gold medal.

However, during the year there were other physicists in Germany, England, and the United States who attempted to reproduce Blondlot's work without success. On the other hand, many French scientists reported results similar to Blondlot's—they also found evidence of N-rays. Finally, in the summer of 1904 in England, physicists got together and asked physics professor Robert W. Wood of John Hopkins University in the United States to personally investigate Professor Blondlot's experiments, since Wood had built up a considerable reputation for exposing unscientific result. Professor Wood went to Nancy, where Professor Blondlot held a hardened steel file near his eyes and made a clock in the shadows visible enough to tell time.

The next day Professor Wood's politely written letter appeared in a weekly paper, *Nature,* in which Wood reported that instead of holding the steel file near Professor Blondlot's eyes, Wood had held instead a wooden ruler near the N-ray discoverer's eyes and yet, although Wood was not supposed to emit N-rays, the experiment had worked again for Blondlot, though Wood himself could not see the clock. Professor Wood's report attributed Blondlot's positive findings of N-rays (and, by implication, the other French physicists as well) to wishful thinking. From that day on, no more N-rays were reported.

Since we've gone this far with the story, you might be interested in the ending. Professor Blondlot appeared in public notice once more three months later at the annual meeting of the French Academy to receive his 20,000 francs prize and his gold medal which the Academy's president diplomatically indicated was for the professor's entire scientific career (which had not been particularly outstanding) rather than for the discovery of N-rays. Professor

Blondlot reached retirement shortly after this and met his end gracefully — and quietly.[11] Perhaps we might say his greatest contribution was as an object lesson to scientists—an object lesson on objectivity!

Let us take a final case study in the problems of objectivity — in the field of psychology, in the 1960's. The study reported here was arranged for the purpose of testing the hypothesis that experimenters are able to obtain from their animal subjects the data they want or expect to obtain. A dozen students enrolled in a senior college course in experimental psychology were assigned their last experiment for the semester. They were told that they were repeating experiments which demonstrated that continuous inbreeding of rats that do well in running through a maze do better than normal rats, and that rats who do poorly in running maze, when subjected to continuous inbreeding, produce rats whose offspring run mazes considerably worse than normal rats do. The students were then told that each of them would be assigned five rats to teach to run through the maze, and that some of them would be given maze-bright rats, while others would be working exclusively with the dull rats. Finally, they were told that those working with the bright rats should find their animals learning to run the maze very rapidly after the first day, while those working with the dull rats would see only very little evidence of learning among their rats.

On the day the course instructor announced these details of the experiment, the laboratory assistant entered the classroom announcing happily that the "Berkeley rats" had arrived. Now since "Berkeley" is associated in student minds with the University of California at Berkeley, these rats were meant to be perceived as the bright ones—college rats! Six pairs of students were formed, in which each member of the pair was assigned a group of rats called "maze-bright" (the Berkeley rats) and the other student received his group of "maze-dull" rats.

The experiment was conducted for five days, and as one would expect, the group of six students with their thirty bright rats was able, right from the first day, to teach their bright rats more correct responses than were their colleagues who were working with the dull rats. By the fifth day, the bright rats were producing almost twice the number of correct responses for their experimenters than were the dull ones.[12]

By this time, I'm sure you've all anticipated the punch-line of this story. There were no bright rats nor dull rats at all! They were all alike—all from the same breeding strain—and equated for age and sex among the groups and then assigned at random.

This problem of objectivity which has just been illustrated is one which precedes errors of perception and observation. Here we have an example of bias and influence in the actual performance, the conduct, of the experiment. Thus, not only do we have problems of observations in experiments but also in our actual conduct of our experiments—in what we do, as well as in how we observe and measure.

In human experimentation there are many cues which we give to others whom we're observing which indicate whether or not we are pleased with their responses. With rats and other animals, a rough toss in the cage after what is to the experimenter an unpredicted response is easily differentiated from the gentle petting and careful return to the cage with which

[11] Derek J. Price, *Science Since Babylon* (New Haven: Yale U. Press, 1961).

[12] Robert Rosenthal and Kermit L. Fode, "The Effect of Experimenter Bias on the Performance of the Albino Rat, "*Behavioral Science*", VIII (1963), 183-189.

the pleased experimenter handles rats who are behaving in conformity with the prediction. Similarly among people it is readily apparent that human subjects in an experiment can easily "read" the changes in the experimenter's voice, body movements, and facial expressions which indicate as graphically as a red neon sign flashing on whenever the subject is behaving the way the experimenter predicts and hopes he will.

Therefore, it is incumbent upon the scientist not to trust himself—and further, to anticipate that his senses and consequently his measurements can be deceived by his feelings. He has to accept the reality of his makeup as a human being and understand that his actions in the conduct of an experiment can be unconsciously directed by his wishes to achieve the predicted outcome. His solution is to build into his experiment the controls necessary to prevent the influence of these extraneous variables, his emotions, upon the outcome of nature.

Don't Hesitate to Trust Others

Our fifth suggestion was, don't hesitate to trust others. By this I mean that once you commit yourself to a life of science and experimentation, you are no longer in business for yourself. Your business is public business — the scientific public. You take your theories, your hypotheses, your experiments, your conclusions —you take them all, and you expose them to the criticism of your colleagues. Of course you need a thick skin for this—sometimes you will look like a fool but that's part of the game. If you don't make some mistakes, obviously you've been so cautious that you've tried only the sure things. So you expose yourself and your ideas to the criticism of others, because it is only by checking and replication, by others taking a fresh approach to your data, can the full worth of your work be extracted. In essence, then, scientific information is not "privileged". It carries no security classification. Rather, the free communication of ideas is a basic cornerstone of the rules of the game which we call "science". Hence, the hue and cry raised by scientists when national and political needs require the temporary restriction upon his free scientific communication cannot be dismissed as an "egghead's" temperamental display of independence. Rather, it is an automatic and required reaction from scientists who realize that if we don't trust one another, we can't help one another to correct our ideas—and ultimately the truth we are seeking will slip through our fingers.

This is quite a different way of thinking about our interpersonal negotiations from many of our other games we play. For example, in business we do keep trade secrets because that's good business. In the United States, for example, when a business trust was being tried before a high court on a charge of engaging in unfair business practices and monopolistic behaviors towards its competitors, it's successful defense was, "Does Macy's tell Gimbel's?" In Manila, we would translate that to, "Does Rustan's tell Aguinaldo's?" Similarly, each fall the car manufacturers cover their new models in shrouds lest their competitors have enough time to copy and incorporate style innovations into their own new car lines. And in Paris, in the fashion shops, the models and their dresses are hidden, like State secrets, lest their new ideas are copied, or, as they put it, stolen, by competitors.

International diplomacy is another game in which openness and free communication is bad business. We are told that the best diplomats are those who can lie with a straight face. While that may be quite far-fetched, certainly the more non-committal and uncommunicative is the diplomat concerning his government's ideas, plans, and intentions, the more discreet he is considered to be and the more likely he is to succeed, as success in that field is measured.

But scientists are a different breed, and this is where the businessman and the diplomats have trouble in trying to understand the scientist's reluctance to accept the premise that what's good for business and for his government is good for science. Because in the long run it isn't. It's a different game, with a different set of rules. And the name of the game, in science, is truth—trust and free and open inspection and criticism and sharing of ideas, theories, experiments and results. Ideas in science are not like merchandise in business, or plans or intentions in diplomacy—they cannot be stolen!

Don't Withdraw from the Human Race

The sixth and final thought which I feel merits the scientist's consideration is the recognition that while he fills multiple roles as a scientist and a citizen, he is in the last analysis a human being whose responsibilities to others are derived from the rules of society and interpersonal relations and not from science. In my opinion, we must not permit ourselves to use our status as scientists as an excuse to withdraw from the human race. The search for truth, while a noble and highly-valued enterprise, need not be pursued at the expense of a person's or a society's rules of conduct, morals, and values. The scientist who says, "This is what we must do to find the truth and to hell with the consequences!" is simply not capable of handling his multiple roles as a scientist and citizen. The mature scientist will say, rather, "This is what we must do to find the truth, and let's get some help to prepare for the consequences."

Max Weber has reminded us that scientific progress represents the process of intellectualization which we have been pursuing for thousands of years. He states:

"It means that principally there are no mysterious incalculable forces that come into play, but rather that one can, in principle, master all things by calculation. This means that the world is disenchanted. One need no longer have recourse to magical means in order to master or implore the spirits, as did the savage, for whom such mysterious powers existed. Technical means and calculations perform the services. This above all is what intellectualization means."[13]

While Weber emphasizes the removal of mystery about our world through intellectualization and scientific progress, it seems to me that too much of the time we continue to delude ourselves into thinking that there remains an enchantment about our human affairs—that if we wait long enough, society will magically find its way to right and good and moral decisions with respect to the findings of our scientific work. It seems at times that it's almost as if the scientific method is seen as a sort of Holy Grail which, when once in our possession, will insure that all our actions are right and honourable.

The fact of the matter is that there is no magic and no mystery about our relationships to one another. However, there is much that we do not know about ourselves. And scientific progress, rather than making things easier in our roles of one human being and one nation in relation to another, is making it more difficult every day by providing us, in their progress, with many more infinitely difficult choices of what to do and what not to do.

In a large sense, perhaps, the social sciences may be seen as an effort to assist us to know what to do by helping us know ourselves better. According to Conant:

[13] Weber, *op. cit.*, p. 573-574.

"All the sciences concerned with human beings that range from the abstractions of economics through sociology to anthropology and psychology are, in part, efforts to lower the degree of empiricism in certain areas; in part they are efforts to organize and systematize empirical procedures."[14]

One might therefore view our concern with experimentation in the social sciences as a final step which has evolved in our process of intellectualization—a step made necessary by our need to know the mysteries of our own human behavior. That it has evolved last, that man has turned his intellectual quests finally to the study of man and his societies after first disenchanting the non-living world and then the living world without man in it suggests an optimistic view to the scientific enterprise. If reflects a sense of consciousness, of awareness, finally, that to seek and to know the truth is not the final goal, in society. In science, it is. But in society, the final goal is to know what to do with the truth, once you have it. Thus, the evolution of the social sciences, arriving on the scene last, can be interpreted as appearing on the scene late not because of its lack of importance but because of it.

The application of the social sciences are pervasive throughout the other sciences because it attempts to provide us with the nature of the truth about ourselves. To the extent that scientific truth calls for choices to be made all along the line, the contributions of the social sciences to our self-understanding as human beings enables us to make better choices and to better live with them.

[14] Conant. 1951, *op. cit.*, p. 129.

The Subgrouping of Philippine Languages

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The Philippine languages belong to a well-known family of languages called the Malayo-Polynesian. The term "Malayo-Polynesian" was first used by the eminent linguist, Wilhelm von Humboldt in 1836 when he tried to establish the relationship of the Indonesian languages to the Polynesian.[1] Later, in 1876, Friedrich Müller called these languages "Austronesian"[2], a term which is now becoming more widely accepted as a term which describes better this vast group of languages (now estimated to be around 500 or 1/8 of the world's languages), whose speakers are spread out from Formosa in the north to New Zealand in the south, from Easter Island in the east to Madagascar in the west. A recent study by Isidore Dyen has also indicated that approximately three-fourths of the Austronesian languages belong to the Malayo-Polynesian subgroup and that the rest are broken down into isolated languages or small language groups chiefly confined to Melanesia.[3]

[1] Wilhelm von Humboldt, *Uber die Kawi-Sprache auf der Insel Java* (3 vols.; Abhandlungen der königlichen Akademie der Wissenchaften zu Berlin, 1836-39).

[2] Friedrich Müller, *Grundriss der Sprachwissenschaft* (4 vols.; Vienna: Alfred Hölder, 1876-88).

[3] Isidore Dyen, *A Lexicostatistical Classification of the Austronesian Languages*, Supplement to *International Journal of American Linguistics,* Vol. 31, No. 1, 1965.