ALFRED KORZYBSKI MEMORIAL LECTURE

POTENTIALS OF GENERAL SEMANTICS IN THE AGE OF SPACE

Russell Meyers, MD, FACS
State University of Iowa College of Medicine

Address given 1 March 1958, Carnegie International Center, New York

Miss Kendig, Chairman Redpath and members and friends of the Institute of General Semantics: I am deeply sensitive of the honor you have conferred in inviting me to present the Seventh Annual Alfred Korzybski Memorial Lecture and in thus adding my name to the company of distinguished students of science and philosophy who have preceded me in previous exercises.

This audience, familiar as it may be assumed to be with the 'time-binding' process, needs no reminding that the Age of Space, about which so much has been said and written during recent weeks, did not spring into being *de novo* in consequence of an international fiat designating 1957-1958 as the International Geophysical Year, nor yet as a result of the appearance of a man-made Russian satellite in the ionosphere on 4 October 1957. However impressive, these events, viewed on a grand scale in their appropriate historical perspective, constitute but two relatively recent occurrences on a continuum consisting of a long antecedent series of events to which countless contributions accumulating at remarkable, exponential rates during the past three hundred years but extending far back into the most obscure past of man's endeavor have played integral, if not compellingly determinative roles in affording us access to space.

It lies beyond the compass of the present paper to attempt to synopsize this sequence, much less to cite and acknowledge our indebtedness to the numerous flights of imagination, creative flashes of insight, logical errors and successes, exploitations of accident, scholarly disputations and cooperative endeavors that necessarily subtended the overt historical events themselves. Our purpose will be sufficiently served if, by alluding briefly to the time-binding process implicit in the sequence, the determinants of a rather different set of evaluations of Sputnik than appears to have moved many of our fellow citizens to action can be exposed for sober contemplation.

As exemplified by the responses of many news and feature writers, political and military leaders, industrial magnates, etc., the initial impact produced by Sputnik was one of amazement and wonder. This was followed almost immediately by perturbation, chagrin and resentment. Clearly recognizable were a deep humiliation that the United States had been 'beaten in a race' by the U.S.S.R. and grave apprehension that this 'defeat' must surely undermine American prestige in the eyes of all peoples who, until that fateful fourth of October, had respected American power and reposed their trust in the invulnerability of the bright shield America had fashioned to protect them against the menacing forces of darkness and evil.

But these were merely the more publicly admissable and 'rational' reactions. Below the surface, bewilderment, anxiety and fear, born of insecurity regarding the real strength of the 'enemy' and dramatically symbolized by this, his newest *tour de force,* were in full operation. In Sputnik and, a few weeks later, in 'Muttnik,' it was asserted, 'The Reds' possessed an instrument for spying on us with impunity. What other diabolical machines had they developed? And how, if at all, might such machines be combatted? The Russians had only recently announced their intention 'to rule by science.' Evidently they were serious about this—more serious than many had thought possible. What might come next?

Such anxieties led some individuals—politicians and military officers as well as laymen—to recommend that belligerent action be taken *at once,* the purpose of which would be nothing less than the complete destruction of the Soviet Union while a chance of succeeding in the venture yet remained. Delay, these earnest patriots warned, would be fatal, for each week would entail more time, and time was more advantageous to the enemy than to us. Fortunately, the persons advocating open warfare on Russia constituted a negligible minority and nothing manifest came of their alarms.

A somewhat less radical, but certainly more widespread reaction prompted both officialdom and the man-in-the-street to contemplate matters that lay beyond Sputnik itself. In the 'race' to get the first satellite into orbit, the United States should, presumably, have been first. Obviously we had not been and the question now arose as to whether it was possible that we were 'behind' in other technologic pursuits. Inquiry among responsible observers in the United States and Britain soon revealed that we were. Thus, on 26 January 1958 President Eric A. Walker of Pennsylvania State University, speaking for several leading American scientists who had just been officially questioned regarding Soviet technology, reported, 'Russia is farther advanced than the free world in some fields of science and is rapidly narrowing the gap in others. They are working harder than we are to discover the laws that govern the world and the universe, and as they learn more about them they will learn more about how to apply them.' The following instances were cited in support of Walker's statement.

Dr. A. V. Astin, Director of the National Bureau of Standards, revealed that two years ago the Russians claimed they could measure accurately temperatures up to 6000° C and that they plan to extend such measurements to 12,000° C by 1960. (Our own best measurements are limited to 2,800° C.) The practical consequences of Russian advances in this regard relate, among other things, to improved technologic development of high energy fuels, blast furnaces and metals (such as are involved in missile programs) capable of withstanding high temperatures.

Drs. Lloyd V. Berkner and Philip H. Abelson asserted that the Russians are in the lead in oceanography and Arctic research, particularly with respect to information on deep currents, water temperature and permafrost. Since, in a war with Russia, the Arctic would promptly become a strategic area and since a precise knowledge of oceanography is of inestimable value in submarine navigation, it is apparent that progress in these basic areas carries a high potential for practical advantages. Dr. Berkner considered also that Soviet astronomy is of the highest order and reported that the Russians already possess several radio telescopes larger than our largest. In a similar way, according to Dr. Abelson, the Russians have implemented a well-coordinated study involving an extensive network of over 60 seismologic stations and have thus acquired a superior understanding of the interior of the earth, especially of distant disturbances. In these and other geologic studies, he stated, the Russians follow a planned program, drilling 200 holes per year—often to a depth of 10,000 feet—at places selected by research geologists. In contrast, the United States Geological Survey depends largely on the casual drillings of private enterprises—not necessarily cooperative—for such information as may be incidentally derived. The depth of the holes drilled for business purposes is usually much less than that drilled by the Russians.

According to Dr. Charles R. Naeser of George Washington University, the Russians lead us in the quantity of work being done in inorganic chemistry, especially in the area of rocket fuels. At Dubna, near Moscow, is located the most powerful atom smasher in the world—the synchrophasotron—which produces 10 billion electron volts as compared with our best instrument (at the University of California) which produces 6.2 billion.

Chairman Isidor I. Rabi of the President's Scientific Advisory Committee stated that all competent observers have been much more impressed by the *rate* at which Soviet science is advancing than by its technologic status as such. Dr. Walker concurred in this statement and warned that, 'Unless we awaken to the enormous implications of Russia's formidable scientific achievements—and soon—we are headed downhill to the status of a second-rate world power.'

These and many similarly provocative revelations constituted sobering challenges to our provincial complacency. For, not only had we not finished first in the race to get a man-made satellite aloft, but, as was now painfully apparent, we had unwittingly fallen behind in races in process in other scientific theaters. And, as the inherent superiority of Americans over all other peoples in respect of intellectual endowment, energy, material, monetary resources, creativity, know-how and track and field athletics is 'well known' and widely acknowledged—at least among Americans—the one general account that seemed reasonable to invoke in the effort to explain these failures was that some among us must have reprehensibly fallen down on their jobs.

This seemingly compelling general conclusion led to a good deal of soul-searching, the manifest aim of which was to identify and rout out the incompetents suspected as being in our midst and to expose their ideational and other ineptitudes so that more successful measures, carrying a high potential for overtaking and surpassing the Russians in the near future, might be adopted. Such soul-searching was destined sooner or later to prompt questions concerning the 'effectiveness' of American education. A short series of articles had recently appeared in the U.S.S.R. Illustrated Monthly (a periodical published in the U.S.A. by the Soviet government) describing the curricula followed in the education of Russian scientists. This revealed that the time given over to mathematics, astronomy, physics, chemistry, biology and geology from the elementary grades on through high school and college appreciably exceeded that spent on these subjects by the average student in the United States. Theory and general laws, as well as laboratory exercises and on-the-scene excursions to laboratories, plants and institutes were described as 'heavily stressed' in the Russian schools. Also described were the close ties planfully maintained between the secondary schools, colleges and scientific institutions. For example, city-wide mathematics contests for high school students are conducted annually by the Moscow State University. These are events of considerable public interest, comparable to our sports events. The contests are preceded by lectures given by nationally known mathematicians and the activities are reported in the public press. Winners are acclaimed and given appropriate prizes. Similar contests and discussions covering a wide range of studies, especially in geography, science and languages, take place in most communities.

At the Tbilisi Engineering Institute, the professors of physics regularly make presentations and laboratory demonstrations pertinent to mechanics, molecular physics, electricity and optics for high school students and encourage lively discussion by the audience. In addition, the colleges, universities and scientific institutes schedule 'open-door days' when the general public is admitted for tour and brought up-to-date on what is in process through talks given by the directors and heads of the various departments.

The magazine account indicated that the aim of such programs and the explicit responsibility of the teachers is preeminently concerned with stimulating every youngster, identifying his latent talents and implementing his potentials through appropriate classroom work and active participation in extracurricular 'circles.' Pupils manifesting high aptitudes are assigned to special teachers and their education is fully subsidized by the state. Regarded as flagrantly wasteful and officially condemned is the expenditure of time, effort, material and money involved in carrying dull and mediocre students in the same classes with those possessing unusual aptitudes.

Here, then, appeared to be some obvious differences between the education of the Russian and that of the American student.

Those who were most excoriated by the advent of Sputnik and in grave earnest to find a scapegoat were prompt to perceive and announce a causal connection between the apparent 'shortcomings' in our own school practices and our 'failure to hold the lead we once so proudly possessed.' By this sequence of events, American education has recently come in for some blistering criticism.

The education of the American pupil was characterized as by and large inferior to that of the Russian, not only in respect to the formal curricula of the primary, secondary and collegiate levels of instruction, but of the pedagogic skills of the teachers and the standards of performance they required their students to meet. At bottom this inferiority was attributed to the change in the philosophy of education induced by John Dewey during the early years of the current century and insidiously propagated by Teachers College of Columbia University during the succeeding decades. Virtually all 'diagnostic' endeavors appeared to point to the deficiencies of our system of education.

Some analyses penetrated into our deeper subcultural attitudinal sets. Thus, D. W. Brogan, professor of Political Science at Cambridge, urged a prompt revision of three illusions stemming from what he called the 'American scientific chauvinism.' The first relates to the complacent, widespread belief that in all or nearly all matters of technology and the application of science, the U.S.A., with its built-in ingenuity and innate mastery of machines and tools, is bound to stay ahead of everyone. The second relates to the conviction that capitalism and free enterprise, motivated by profit and property relations, make for the *only* circumstance under which human achievement can become great. The third relates to the inordinate faith in the American business man and his machines such that, in a showdown war with the Reds, America could not fail to win, just as it has in the past over the Kaiser, Hitler and Mussolini. Dr. Brogan warned that the problems with which we are confronted today are not of a nature that permits solution by more exercise of the old American methods, i.e., energy, money, faith, confidence, ballyhoo and a readiness to adopt whatever appears novel. What is required, he asserted, is a basic revision of our reverence of the American business man and our faith in his omniscience (for he is at best an aide to society and not its boss or strategist). He called also for a revision of the average American's traditional 'pragmatic' attitude toward education.

The American student, said Brogan, needs to be given a more adequate idea of the outside world, its power and potentials, in place of the exclusively American viewpoint derived from his present education. Americans must give up the delusion that everybody should get an 'equal' (ideally, a collegiate) education, for this 'cultivation of the average,' as he calls it, gravely impairs the education of bright boys and girls. Finally, as this world is now a kind in which the scientists the United States so sorely needs do not desire to work, McCarthy-like individuals must be made to pay a penalty for hag-riding scientists.

A somewhat similar view was expressed by C. Wright Mills in his article, 'Program for Peace,' which appeared in The Nation on 7 December 1957. Mr. Mills singled out for prompt abandonment the faulty assumption, exemplified over and again by Secretary Dulles and unrealistically clung to by the 'elite' of the United States, that the Soviet system is in a 'very bad way and politically tottering, so that in the end they will have to seek peace, at which time Washington can serve Moscow its long-overdue ultimatum.' This illusion, said Mills, has prompted us to maintain a broad foreign policy, the chief aim of which is to 'contain' Russia by military encirclement until she totters from her own internal erosions. Mr. Mills holds that, like it or not, we must recognize that an alternative way of industrialization now exists in this world; that it works; and that it has great appeal to peoples of underdeveloped areas who, for quite some time in the epoch of capitalistic ascendancy, have remained gravely handicapped. We must recognize also that a country with skills and resources that could launch a half-ton into the sky will not long remain a second-rate industrial power.

The majority of analysts nevertheless considered our deficiencies to reside in the inferior methods and content of our education systems. Dr. Edward Teller appeared before the Senate Preparedness Subcommittee in December, 1957 and advised a campaign to develop greater respect among the public for the scientist, and Drs. Margaret Mead and Rhoda Metraux lamented the circumstance that we had failed sufficiently to open the eyes of our youth to the wonders of science. In their report, 'The Dangerous Godless Brain,' the latter drew up a sketch of the stereotyped notions regarding scientists discovered in an anthropologic study of 35,000 students representing 118 high schools in the United States. The image of the scientist, they said, 'is overwhelmingly negative' and not infrequently mephistophelian.

Replying to an inquiry raised by the Senate Labor and Public Welfare Committee as to what is wrong with education in the United States, the distingushed biophysicist, Detlev W. Bronk, President of the National Academy of Science and the Rockefeller Institute for Medical Research submitted his opinion that there is too little respect for learning among citizens in general; too much emphasis placed on teaching masses of unrelated fact; too little training implemented in thinking; and an inadequate number of competent teachers, especially in science. He asserted that courses in our schools are not timed to mesh with the students' abilities to learn particular subjects.

The recommendations that followed from these diagnostic reports were simple and sublime: revise the curricula to approximate the course-content and correlative patterns of the U.S.S.R. schools; hire more and better teachers—especially science teachers; raise the standards to which students must attain before being advanced to the next higher grades; motivate pupils more generally toward technologic and scientific pursuits; and adopt measures by which students who happen to exhibit aptitudes for mathematics, the sciences and languages may be early recognized, liberally subsidized and fully developed. To this end, four mediate items appeared to require attention: the man-in-the-street needed to be brought to a new appreciation of intellectual attainment as such; the prestige of the teacher in society needed to be enhanced; teachers' salaries needed to be raised in order to recruit and retain capable persons who might otherwise be drawn into competing vocations; a program for continually improving the quality of teaching needed to be projected; and money needed to be ear-marked to equip and maintain new schools and to subsidize those now operating under handicaps.

With characteristic American dispatch and in the best tradition of big business and military techniques, 'crash programs' were designed, fashioned and moved up to the starting line to meet the urgent needs of the day. Thus, on 8 January 1958, Circular Letter No. 1 of the American Association of Land Grant Colleges and State Universities announced The Eisenhower Program of Increased Funds for Education. This provided one billion dollars to be used by the Department of Health, Education and Welfare during the next four years to strengthen graduate programs throughout the country. Each graduate college might avail itself during this period of funds up to $125,000 to help expand its capacity to accommodate students. A quota of scholarships was to be allotted to each school such that a total of 1,000 new graduate level fellowships might be awarded during 1958 and 1,500 in each of the following three years. Finally, additional funds were set aside 'to improve the quality of training, teaching and research in the sciences.'

Some notion of the magnitude of the current and soon-to-be implemented expenditures can be gained from the fact that approximately 14.5 million dollars of the 40 million dollar budget of the National Science Foundation is now being spent to improve training, teaching and research in the sciences and that the Foundation seeks for 1958 a budget of 150 million dollars, 79 million of which it desires to spend for similar purposes. It appears highly likely that these requests will be honored.

In addition, Senator Lister Hill of the Senate Labor and Public Welfare Committee, backed by 26 fellow Democrats in the Senate, has recently asked for 3 billion dollars federal aid during the next six years to be assigned to primary, high and vocational schools for programs bearing upon 'occupations essential to the national defense' (Bill S 3187). An identical bill (Hr 10381) was simultaneously introduced into the House by Representative Elliott (Dem.).

Not to be outdone, the republican faction in Congress, led by Senator Smith and Representative Kearns, introduced bills intended to authorize over 17 million dollars (to be matched by state funds) for testing, counselling and guiding pupils in the primary and secondary schools and awarding 10,000 scholarships a year to make it possible for high school graduates with strong aptitudes in mathematics and science to pursue collegiate studies.

Representative James White (Dem.) introduced an impressive measure calling for funds necessary to organize 'Future Scientists of America' clubs in the high schools. He urged, in addition, the allocation of 75 million dollars per year (to be matched by the states) for the 'speedy development of secondary school education in the natural sciences.'

Finally, Dr. G. Miles Conrad, Director of the journal, 'Biological Abstracts,' recognizing that 70 percent of the basic and applied scientific literature that appears throughout the world each month is lost to American scientists because it is not routinely translated, abstracted and indexed here as it is in Russia, has recently sought congressional help to bring order out of the current chaos by arranging for a confederation of all existing abstracting and indexing services.

In brief, our public officials and many private entrepreneurs appear determined to show the world that we just can't be outrun by the Russians.

II

Up to this point we have been engaged with synopsizing very recent historical events and noting the trends of public action set in motion throughout our nation by those events. It cannot be denied that we are witnessing the advent of a lively and unprecedented public interest in science and mathematics. This is precisely what has long been advocated by the student of general semantics. It appears in order, then, for us to reflect upon the potentials of general semantics for giving direction to, amplifying and deriving maximal yields from the endeavors that are now being undertaken.

The current century has often been referred to as the Age of Science. Certainly, during the past seventy-five years the labors of the three just antecedent centuries have begun to pay munificent dividends and there is every expectation that more will follow. But if we subscribe at all to the present as the Age of Science, we must recognize that this characterization is too severely limited to those aspects of science that constitute the aggregate of its technical achievements—in a word, its technology. For, in a broad sense, the term 'science' encompasses two other major aspects, viz., *scientific method* and the *ethics of science*—those basic guides for behavior by which the imposing technical results of science have been implemented and in consequence of which the far-reaching impacts we now witness have been brought to bear upon human affairs at every describable level.

Now, if the widespread exploitation of scientific method and the ubiquitous exercise of scientific ethics are envisioned no less than technical achievement as conditions necessarily to be met if the term, 'Age of Science,' is to be considered appropriate, we must acknowledge that, while we may reasonably be said to have begun to move *toward* it, we are as yet a far cry from it. As of the present, science, in the sense referred to above, amounts to but a small subculture. Ours is still a decidedly prescientific culture, and the reactions, diagnoses and recommendations precipitated by Sputnik I must be viewed as products of that culture. To the observer capable of adopting a detached, 'anthropological' view of human activity, these reactions appear to constitute merely the responses that follow easily from the particular set of cultural convictions exemplified by the prescientific assumptions, postulates and theorems quasi-officially embraced in current-day America.

It happens that such responses do not exhaust all possibilities. Among scientists themselves who, insofar as they act *as* scientists, constitute in the aggregate a subculture possessing its own basic assumptions, ethics, postulates and theorems, the reactions to Sputnik I and to the various questions as to what, if anything, needs to be done 'about' it are perceptibly different from those of the prescientific culture that lies roundabout. In general, members of the scientific subculture contemplate events of the sort exemplified by artificial satellites with a good deal of inner satisfaction, for they regard every such achievement as carrying a high potential for putting the entire world of humans at an advantage and, by the same token, for enhancing science as a discipline.

Because their ethical convictions and daily practices characteristically devaluate the *competitive aspects* of human activity and strongly emphasize the overall gains to be realized from genuinely *cooperative efforts*, they tend to be less provincial than their prescientific fellow men. They incline to think in terms of the *individuals* or *group of individuals* who have managed to push back the borders of the unknown at some point, rather than in terms of their national, racial, geographic, religious and similar affiliations. Correspondingly, they do not characteristically think of themselves or their own 'in-groups' as inherently and enduringly 'superior' to others, for their familiarity with the history of science makes them aware that no one, no group, has held or for very long holds a 'corner' on the market of ideas and the means of implementing them. Aware of the fallibility of humans in general, they are not inclined to repose blind faith in the enduring omniscience of any one 'school' of scientific thought and training. Their experience repeatedly indicates that now one person or one 'school' forges a short distance ahead of its fellows and that in a short time another does so; that each manifest advance emerges from and is made by countless humans throughout the ages; and that, in the intriguing game of science, information does not remain private and no one works alone.

Scientists characteristically think of manifest technical advances, such as the fashioning of transistors, the discovery of penicillin and the enunciation of the Relativity Theory, as being merely the most recent, transitory and ongoing events in a long and complicated series of antecedents, the errors and failures of which, no less than the successes, were largely indispensable to the end-result. If we may draw an analogy, they applaud warmly the half-back who catches a pass on the five-yard line and scampers off to make a score; but they are fully mindful of the dynamic antecedents involving all other members of the varsity, the scrub squad, teams of former times and places, coaches, trainers, groundkeepers, ticket takers, the student body, etc., in consequence of whose efforts the touchdown just consummated was 'set up.' Moreover, they recognize that in similar circumstances a considerable number of players other than this particular half-back might have proved equally capable of scoring. Scientists characteristically value the touchdown *for its own sake* and are but negligibly concerned with the name of the institution whose team happens to score and with the local advantages that might accrue from its narrow exploitation by the alumni association and the local Chamber of Commerce. For scientists who live their lives in accord with scientific ethics, the more ubiquitously exploitable the advance, the better.

All this represents a point of view somewhat difficult for persons reared in a largely prescientific, provincial and competitive culture to 'internalize.' The latter incline to characterize it as an 'impractical, ivory-tower ideal.' It is nevertheless widely embraced among members of the scientific culture and, in principle, there is nothing in it which renders it inaccessible to anyone on earth or infeasible of general exercise.

These considerations should make apparent, at least to some degree, why the scientist, *as scientist*, exhibits a different set of reactions to the advent of an artificial satellite than does the prescientist. Stated briefly, he is not resentful and jealous of the achievements of his fellow men and does not permit himself the puerile, short-lived satisfactions that derive from the naive conclusion that American education has hit a 'deplorable low' and must forthwith be brought to a 'proper' standard. This is not to say, however, that he negates the proposition that considerable room for improvement exists in American education. Quite to the contrary. But for him there is nothing particularly novel in the proposition. He was aware of such a need long before Sputnik was launched and has for many years been counted among those most earnestly concerned with the goal of making each new generation better able to cope with its world than any preceding generation. Moreover, he has been more than casually aware that inquiry into the techniques by which this laudable goal may be realized is conspicuous among the vital issues of the day. But he differs from his prescientific fellows in envisioning that the techniques adopted should be implemented with an eye to the overall advantages of every person on earth, rather than to the narrow, vested interests traditionally arrayed under nationalistic, racial and other partisan banners. In short, the scientist of which we have been speaking recognizes a serious public obligation to further the 'time-binding' recognized by Korzybski as the most characteristic feature of human activity and the surest guarantee of humanity.

From what has been said it may be supposed that the difference in attitude between the scientist and the prescientifically-oriented person is fundamentally a matter of ethical philosophy and its behavioral exercise. This is essentially correct. Anatol Rapoport and others have pointed out that no scientist and, for that matter, no person in *any* walk of life can possibly operate without employing some sort of metaphysics and embracing certain rubrics for ethical conduct.

This prompts us to round out the subtopic of the present discussion by briefly synopsizing the ethics of science:

> A preference for truth (measured by the yardstick of predictability),
>
> Reposing authority in the predictive content of statements (rather than in a person or group),
>
> A readiness to share information freely with all interested fellow men (regardless of race, color, creed, nationality or other circumscribed allegiances),
>
> Acceptance of both the right and the responsibility to pursue any investigation that does not violate the civil rights, dignity and overall psychophysiologic integrity of his fellow men, and,
>
> A readiness to alter or surrender current convictions whenever demanded by empirical data that cannot be reconciled therewith.

Although the exercise of these rubrics has played a perceptible role in stocking the storehouse of technical knowledge, it is to be remarked that such exercise is not necessarily integral to it. Technical advances have been made in the past (recall in this connection the experiments performed at Buchenwald and Dachau) and will, without doubt, continue to be made from time to time without reference to scientific ethics. Because this is so, it is in order to point out that, among the provisions stipulated for the implementation of our inspired 'crash programs,' *none spells out a guarantee that scientific ethics as such will be taught to the upcoming generation of students of technology.* Parenthetically, a firm indoctrination of the youth of the world in scientific ethics—particularly in the rubric bearing upon a readiness freely to share information—would *ipso facto* dissolve the need for all programs engendered by provincial, vested interests, 'crash' or otherwise.

At this point it appears desirable to stipulate clearly what is referred to by the term *scientific method*. It represents merely a highly economical and deliberately self-correcting *modus operandi* for checking up on what we assert we 'know' at any particular time and place. Several 'legitimate' varieties and sequences of scientific method are recognizable and those who are most expert in their use certainly do not regard them as immutable. Indeed, since the well-known Pearsonian formulation of scientific method was published in 1892, a number of significant alterations have already been made. In full recognition of these qualifying circumstances, then, the following general outline is offered:

I. Formulation of the question following a 'felt need.'

II. Collection of 'factual' data via (a) observation, (b) experiment, (c) statistic analysis.

III. Tentative ordering, arrangement and classification of data.

IV. Tentative derivation of generalizations (hypothesis, theory, construct, law, etc.).

V. Further collection of 'factual'data.

VI. Rechecking of generalizations *in re* V.

VII. Retention, revision or rejection of generalizations *in re* VI.

VIII. Repeat V - VII *ad infinitum*.

The scientist behaving as such remains fully cognizant of the always-tentative character of his generalizations and 'conclusions,' even when at a given time and place they appear to be firm and enduring. Hence, he does not permit himself to proclaim 'truth' in the archaic sense of eternal verities and absolutes. He speaks only of 'relative truth,' using as his sole, final criterion the *predictive content* of a statement as measured against some non-verbal event. Nor does he speak of 'reality' as if such could possibly be invariant to himself. For him, what is 'real' is that to which individuals have developed relatively adaptive muscular and glandular responses. From this and the fact that the relatively adaptive patterns of response exercised by humans of the past and present are multifarious, the modern scientist, like the modern artist, envisions not one but a literal multitude of 'realities.'

The general semanticist, endorsing the precepts spelled out by Alfred Korzybski in 1933, regards scientific method as the most sane and rewarding technique ever developed in Man's historical endeavor to gain control over himself and his surroundings. It is further his contention that the exercise of scientific method needs in no manner to be confined within the walls of the laboratory; that the method can and should be employed in virtually all human activities in which problem-solving is required—and that is everywhere.

Another important rubric of general semantics proposes that *effective communication,* intra- as well as inter-personal, is indispensable to the making of maximal predictions and therefore to optimal adaptations, 'adjustment' and 'health.' Towards the achievement of these ends the student of general semantics finds it indicated to scrutinize the value-systems that subtend human behavior in its manifold expressions and to press on to the *evaluation of these values,* looking toward the derivation of ever more rewarding designs for living as measured in bio-socio-psychological terms.

As in the case of scientific ethics, the *currently envisioned crash programs appear to have specified no place in the formal indoctrination of our students in scientific method and the essentials of open-ended, progressively-adaptive communication.*

In considering fruitful ways of revising American education, two additional items of interest to the general semanticist appear to merit notice. The first relates to the grave need for training our students in the *skill of asking questions,* as contrasted with that of merely giving answers; and the second, to the need deliberately to *foster creativity*. These valuable 'commodities' are not for sale on any market and cannot be bought with all the gold in Fort Knox. They are, however, indispensable to our survival, adaptation and full health, and as skills they require to be deliberately developed. To develop them requires the *time and sustained efforts* of trained preceptors. Unfortunately, this is not visualized by those who are planning our crash programs.

No doubt we do have preceptors who, if drafted for the job, could train the upcoming generation in the skills of asking questions and foster their innate creativity. But an immediate need is to know *where* they are and *how many* of them are available. Similarly, we need to decide the sorts of program that may be instituted so that currently available preceptors can train new cadres by which their scope and effectiveness can be widened *here and now* and their places taken over *as time goes on.* In short, we need to consider the means by which the time, energy and skills of these valuable persons can be most economically exploited, for our resources in this regard are definitely limited and cannot be immediately enhanced by generously allocating money in the tradition of big business, much less by hiring a battallion of hacks whose facile pens and easy consciences might combine to create delightful illusions for the naive general reader.

We are still a long way from having inculcated our students and other citizens with the detached, anthropologic viewpoint that makes for rewarding analyses of the voiced and unvoiced assumptions that ubiquitously influence our perceptions, decisions and courses of action. Still less do we habitually initiate inquiries into such assumptions when we encounter the behavior of people from other cultures and subcultures. It seems clear that *without the capacity to ask the questions by which we may probe into the basic assumptions of our own cultures and subcultures and those of others, the transmission of ever-increasing masses of technical data to our pupils promises but trivial advantages.* Unfortunately, our teachers appear to be generally satisfied with the jobs they do if only their pupils can re-state in parrot-like manner the disconnected pieces of information with which they themselves were earlier indoctrinated. Training in the asking of questions, in contrast with that in the giving of answers, has not yet become a formal part of our curriculum. On the contrary, in all too many instances the teacher possesses an imposing armament of devices by which the persistently inquisitive and therefore embarrassing pupil can be beaten down. Little wonder that by the time the student reaches adolescence, the habit of asking *how* and *who* and *why* has been extinguished.

Could the presence or absence of this factor—skill in asking questions—make the difference between succeeding or failing to put a satellite into orbit? It would not seem unreasonable to venture an affirmative guess in this connection.

But of all the criticisms that might be levelled at present day education in the United States the most serious relates to our failure deliberately to foster the *creativity* which natively characterizes every pupil who comes under our wing. As emphasized above, we place high premiums on their being able to give back to us the answers pertinent to what we ourselves know—or think we know—and tend to disregard lightly the circumstance that *we do not know much* and that the answers we are prepared to offer our preceptees are not likely to withstand the onslaughts of the next few years.

Then wherein shall we find a solution?

We venture the guess that the potential lies in the creativity of the upcoming generation itself and that our prime job is to adopt such measures as will foster it. The amazing creative propensities of our pupils have for too long been stifled by their preceptors at home, at church and in the schools. If, as Earl Kelley has said, we find our adolescents largely barren of ideas and of the devices by which their ideas may be brought to fulfillment, we must look for a proper account to ourselves and our methods of teaching. Fortunately, the conditions that foster creativity have been spelled out by several authors (Ghiselin, Rogers, Bergson and others) and it only remains for us to implement these in our homes, schools and colleges.

Science, like every culture and subculture, is in large part what it is because of its symbols—its language and jargon. And the effectiveness of every specialized science within the larger and more general scientific culture is susceptible of being facilitated or retarded, even completely inhibited for long periods of time, in accord with the particular symbols adopted by its practitioners. If, as students of the history of science point out, the potentials of mathematics for advanced and efficient calculation were gravely limited for centuries by the clumsy numeral system of the Romans, especially for want of a symbol which should represent 'zero'; and if the potentials of organic chemistry were heavily fettered by linear arrangements of carbon symbols until Kekulé conceived of the benzol ring pattern; it appears warranted to suppose that symbols and word-thing relationships are vital to human survival and, beyond this, are prerequisites to rewarding control of the environment.

All this implies the need for intensive and extensive study of the symbol-users; of the public and private predilections and other evaluative reactions that determine which symbols and rules for symbol-manipulation are adopted at a given time or place; and of the means by which symbols are communicated with greater or smaller degrees of correspondence between what is encoded and what decoded; etc. These constitute proper objects of study in their own right and comprehension of them carries large potentials for accelerating or otherwise modifying the influence of science in the world of human affairs. These are the very areas regarded by the general semanticist as deserving of serious attention. In a certain sense they are *basic* to every other discipline—scientific or otherwise—that man has ever fashioned.

III

Granted the philosophic desirability of a state of affairs in which all humans might enjoy the means of sustaining their biologic integrity, of exercising their native potentials for creative endeavor and of attaining a kind of 'health' such as has never yet been aimed at by medical science; and granted that the hope for implementing such a state of affairs by invoking more science is sufficiently high to justify undertaking the experiment; the important question arises as to whether it is possible by any deliberately adopted means to speed up the evolutionary process from a prescientific to a scientific culture. For if, on the ground that 'nature just can't be hurried,' the answer to this question be cast in the negative, it becomes clear that a laissez-faire policy must be accepted. But if the answer be cast in the affirmative, it becomes our urgent next responsibility to propose mechanisms by which the evolutionary processes may be accelerated.

For the student of general semantics, it is admittedly an article of faith—but one based on certain plausible analogies—that the answer to the question posed above is distinctly, 'Yes.' For him, the proposition that humans *are* an integral part of 'nature' and that men may planfully modify the environment and thus play the role of accelerators of evolution can neither be denied in theory nor long doubted in practice.

Knowledge acquired by human beings keeps changing the ecologic conditions under which we live and, accumulating ever more rapidly along a curve of positive acceleration, inevitably modifies the bio-psycho-social milieu in which humans (and other organisms) operate. As remarked by George Gaylord Simpson, man exhibits an historically new mechanism of heredity—that of the inheritance of acquired characteristics by way of what has been learned. Its exercise necessarily modifies the processes of organic evolution, for psycho-social agents appear to be neither separate nor separable from biologic agents.

The science of genetics has emerged during the past decade or two to a new vista of erudition. More precisely, many biologists have managed during this period to free themselves of the strictures imposed upon genetic study during the closing years of the 19th and the first three decades of the 20th Centuries by the concepts of Weissmann and Morgan. These early investigators evidently looked upon biologic inheritance as a *substance* which, in order to produce a physical characteristic (like black hair, short tails or scalloped petals) only required the lapse of sufficient time to permit the flowering of that 'inner impulse to maturation' they considered to be resident within the chromosome or gene. Of course, students of teratology and general biology had long known that, whether by experimental design or the accidental advent of inimical conditions of temperature, light, humidity, oxygen supply and hydrogen ion concentration, the developing embryo was prone to develop certain abnormal features, e.g an excess or dearth of fingers, a cyclopean eye, hydrocephaly, meningocele and other anomalies. Such observations forced recognition of the circumstance that, under certain conditions, the environment can and does exert influences which ultimately find expression in the structuro-functional makeup of the organism.

Unfortunately, however, the deeper implications of these data were missed. For the most part, geneticists regarded such environmentally-imposed conditions as exceptional, hence, 'unnatural' and 'abnormal.' Until very recently they were apparently unable to break through the conventions of their linguistic habits to arrive at a more consistent, encompassing and parsimonious view—namely, that *if* a precondition of the appearance of 'abnormal' features is the impact of an 'abnormal' environment, then, by analogy, the appearance of 'normal' features requires the impact of a 'normal' environment during embryonic development. Once again, as so often before in the history of science, an essential element had gone undetected for reasons of its universality.

The shift in semantic evaluation resulting from revision of the Weissmanian view carries, as we shall now illustrate, highly salutary potentials for the future of genetics. On the older view, much of that form of mental deficiency known as amentia was imputed to heredity and thus presumed to be genically determined. Short of a dubious program of eugenical sterilization, seemingly little could be done about the situation. However, in the course of time, dependable tests were developed by biochemists for the detection of various sugars in the blood and, somewhat later, other tests were developed for the enzymes which help metabolize these sugars. It now became possible to note that the blood of certain mentally deficient children contained the 12-carbon sugar, galactose, a substance not found in normal subjects. This substance is inimical to the metabolism of brain cells and, when present in sufficient quantities for a sufficient period of time, leads to irreversible damage of the brain and thus feeble-mindedness.

The source of galactose was now apparent, namely, the milk of the diet. This being so, it was necessary to recognize that the appearance of amentia depended in these cases upon an environmentally-derived agent, namely, galactose in milk.

It remained to explain why galactose appeared in the blood of some persons and not in others.

Inquiry soon disclosed that galactose got into the blood stream simply because it was not metabolized by the enzyme, galactase, to the innocuous 6-carbon sugars, lactose and glucose. The mental deficit, then, was evidently conditioned upon the *absence* of the enzyme and presumably this constituted the essential 'inherited' aberration. Note, however, that whatever the outcome of the argument as to the reason for the absence of galactase, it was clear that the 'genotype'—absence of galactase—could not by itself produce the 'phenotype'—mental deficiency. The latter appeared only as a consequence of exposure of the organism-lacking-galactase to an environmental agent, milk. An intellectual 'break-through' was thus accomplished, changing the entire outlook for patients afflicted with galactosemia. Clearly, all that was required to avert mental deficiency in this type of case was to rule milk out of the diet.

Evidence of this sort forced geneticists to abandon the notion that 'heredity' is mediated by a *substance* and to regard it as a dynamic process of action and interaction between protoplasm and its environment.

Current information concerning the flux of energy changes between the intra- and extra-organic moieties makes it further infeasible to draw sharp distinctions between the organism and its surround.

A similar statement can be made regarding the bags-within-bags-within-bags of colloids and electrolytes within a blob of protoplasm. For, any particular bag, including its mitochondria, chromosomes and the hypothetical genes, can be viewed simultaneously as a 'microentity' and/or as a part of the 'environment' of neighboring bags. No bag has ever existed or been cultivated without an environment of some sort or other. This statement can be applied more or less directly to the gene itself.

In short, the appearance of any phenotypical feature, 'normal' or 'abnormal,' evidently requires that a dynamic process of action and interaction be more or less abidingly sustained between the genotypical 'memory,' encoded on the gene, and the intra- and extra-organic surround. If either or both of these change, the phenotype must inevitably be altered.

Genic mutations, which occur without benefit of man's intervention, appear to herald new 'trial patterns' which, over the course of time, determine the course of bio-psycho-social evolution. Such mutations can be evoked by a variety of physical and chemical cosmic agents. Quite recently, man has identified and, by accident (e.g. radium paint poisoning) or design (the experimental production of cancers and congenital malformations by cholanthrene derivations, x-rays, diathermy, ultrasound, dietary deficiencies, oxygen deprivation), has produced mutations that simulate those occurring 'naturally.' In general, the more intense or protracted the 'dose,' the more frequently mutations occur. To this extent, man has begun to accelerate the processes that subtend organic evolution. True, the direction and description of the goals of bio-psycho-social evolution are but dimly perceived as yet, but it is noteworthy that here, in the mid-twentieth century, man *has* begun to influence evolution.

Here, then, is an answer to those who ask, cynically and ironically, whether 'Nature' can be hurried in her evolutionary march. Man is as 'natural' as anything in the universe and his role in the evolutionary process is in principle no different from that of the other 'natural' materials involved in the vast drama of 'Nature.'

It now appears that the issue confronting us is not one of deciding whether or not 'Nature' can be hurried by man, but of arriving at some sort of agreement, even if necessarily tentative, that our goals should include maximal, self-actualizing health for every person on earth. If we concur in this notion, it would appear in order that one of our goals is to emerge from a prescientific to a scientific culture.

The prescription for this was published 25 years ago by Alfred Korzybski.

RUSSELL MEYERS, MD, FACS, a Fellow of the Institute of General Semantics and president of the Board of Trustees, is the chairman of the division of neurosurgery of the University Hospitals, and professor of surgery, State University of Iowa College of Medicine. He was President of the International Society for General Semantics from 1950 to 1953. Dr. Meyers was born in Brooklyn, received the BA and MSc degrees from Brown University and the MD from Cornell University Medical College. His hospital appointments have included Brooklyn, Kings County (N.Y.), Bellevue, Lahey Clinic. He has taught at Brown University, New York University, Cornell Medical College, Columbia University, Long Island College of Medicine, University of Denver, and University of Cincinnati. He was certified by the American Board of Psychiatry and Neurology in 1938, and the American Board of Neurological Surgery 1942. He served with the Army Medical Corps 1942-46 (Lt. Colonel), in Oregon, Ireland, England, France and at the Mayo General Hospital, Illinois, as chief of the neurosurgical center. His academic honors include Phi Beta Kappa, Alpha Omega Alpha and Sigmi Xi. His bibliography includes some one hundred articles in professional and scholarly journals. He joined the Seminar-Workshop faculty in 1955.

Dr. Meyers is a member of some 27 professional and scholarly societies and an examiner of the American Board of Psychiatry and Neurology. He was recently appointed chairman of the Advisory Council on Neurosurgery of the American College of Surgeons. In 1939, Dr. Meyers conceived of and, for the first time, implemented the surgery of the basal ganglia, a group of deep-seated nuclei of the brain, which up to then had been considered technically unapproachable. Since then, he has made numerous contributions to the understanding of the mechanisms underlying abnormal movements and rigidity. His recent work with William J. and Frank J. Fry, using a new ultrasonic stereotactic instrument for the further exploration of these disorders (and others characterized by uncontrollable pain) and looking toward their safe and effective treatment, carries a potential for opening new vistas in all surgical specialties.