

# THE OHIO JOURNAL OF SCIENCE

Vol. 57

JULY, 1957

No. 4

## HUMAN ENGINEERING<sup>1</sup>

ROBERT M. GEIST

*Capital University, Columbus, Ohio*

Recently there has come upon our contemporary scene a binomial expression which is supposed to be concerned with making concepts fit the reactions of people, that is "Human Engineering." In the past the prevalent philosophy was to force the human personality into preset concepts. This supposedly new philosophy is used throughout the industrial world in the form of color shades for appeal, reflectorized paint, design to attract, and endless other methods to further consumer sales. I wish to apply this human engineering concept in a different role, that is, the molding of semimature human beings into full adult personalities with directed purpose of thought and energy. Human engineering then, as used here, may be thought of as the final process in this "cerebral polishing" to obtain this total personality. The educator's role in this all important engineering should and must be paramount.

It might be of value to digress for a moment and consider the engineering which often has occurred in the evolution of an educator. As all of us know, the scientific method postulates at least three major aspects, namely, observation or data collecting, experimentation, and interpretation. A former President of this organization paraphrases these three as follows: pedal, manual, and cerebral. Many of us have, knowingly or unknowingly, carried out this basic concept in our own engineering processes; that is to say, prior to any formal scientific training, we did the pedal part or data collecting as boys in the woods and fields. We spent most of our energetic years with manual scientific work and experimentation and finally we sat back to cerebrated and interpret much as the ancient Greek philosophers. Perhaps, rather, it's just the aging process which puts us into this category, in which the environmental resistance exceeds the biotic potential, and we slip into the philosopher, or educator, or both classes. Your attention is directed to the fact that the word is *educator*, not *educationist*.

Just how or when or why we metamorphose into an educator is not our present concern although it is an interesting topic and should be investigated experimentally. One wonders if perchance the individual, through some chromosomal aberration, has become preadapted such that in a suitable environment he finds a niche he can take over. Judging by the number of individuals in this educator group the niche should be quite full. Could it be that somehow some of these individuals have postadaptations which allow them to rise higher than the others and give the entire group a *raison d'etre*?

Human engineering has become more and more complicated due to our ever increasing knowledge and to the demand for the production of civilian and military

<sup>1</sup>Presidential address delivered at the Annual Meeting of The Ohio Academy of Science at Bowling Green State University, Bowling Green, Ohio, April 19, 1957.

experts. This ever growing mass of knowledge, as well as the rapidly changing social and economic concepts, apparently result from man's enlarged and much convoluted cerebrum. In spite of or because of this large cerebrum our children need more and more education to maintain the standards of our country. This is in extreme discord or perhaps complete accord when compared to animals lower in the evolutionary scale than man. Here the behavior pattern is more or less rigidly fixed, and it is not necessary for these animals to learn much or any of it. For example, in the potter wasp, *Eumenes fraternus*, the adult female emerges from a juglike cell fashioned from mud by its mother, which it has not and never will see, and soon fashions a similar juglike cell of its own, without any previous training in the art of ceramics. Through a small opening in the top of this, she will place lepidopterous and coleopterous larvae, previously paralyzed by stinging them in the exact location which will not kill but only paralyze. On one of these larvae, she will lay an egg before inserting it in the jug, which, after filling, she will seal and then proceed to repeat the process again.

In the vertebrates, the bird, one of the most highly developed automatons, needs no instruction nor even observation to fabricate a nest. There is no need of tools in the sense we think of tools. Have you watched a robin build a nest? After the foundation is laid down, the mud cup must be made and covered with dried grass and then lined. With complete how-to-do-it-yourself instructions we would have great difficulty reproducing a robin's nest even with our tools and our cortical ability.

If one should wish to give a name to the activities just mentioned, would they be called instincts, tropisms, reflexes, or intelligence? It is generally agreed that neither insects nor birds have a neopallium. In the insects the greater part of their behavior is determined by their genes and transmitted by heredity. In the birds a relative increase in the size of the corpus striatum would seem to substitute for the lack of a neopallium and a smooth cerebrum. In fact, some workers believe that the corpus striatum of birds is homologous to the neopallium of higher animals. Man possesses a highly developed neopallium and can by the use of it change, modify, or even displace various aspects of his behavior, even to that of his social heritage. If then, this activity were called intelligence and compared to that called intelligence in man, would it not have to be classified into various orders or levels?

Man claims he is the *ne plus ultra* of living things; yet he must be taught to do practically all the activities which society requires for conformity or he must get them by experience, very often by the trial and error method. We all know that the School of Experience is a most effective educational instrument, but it has been said that the tuition to this school is frightfully high and the time needed for the course too great. It seems that the alternative then is to teach the human individual. To do this someone must be the "Mark Hopkins on the log" to this neophyte educatee. In other words, someone must be the educator. This then is the educator's "reason to be."

It can be said that we have been doing this in America since our forefathers stepped on Plymouth Rock—and doing it well. In fact, perhaps no other nation on this earth has our elaborate public education system. Yet in our progress in all fields of education, and with our vast educational resources, and our huge college and university enrollments, have we not moved with such speed that many basic concepts have been buried in so called Modernism? It would appear that one of our greatest educational problems is directiveness; that is, are we progressing or have we progressed beyond the basic principles of mathematics, science, literature, music, history, etc.? In the past these disciplines were taught in such a manner as to bring out the cultural background as well as the practical. Is it possible we are living too fast? Have we allowed our gadgetry to get too far ahead of our cultural education? Possibly we should return to the more

fundamental and basic education of a generation ago. If education must be adapted to today's needs, it may be well to use some of the principles of years ago. Those principles inculcated a cultural background, which is of as much or more value than the present day evaluation based on dollars and cents. Most of us here tonight are engaged in this field of education. Do you think we would have the same ideas or even similar ideas as to how the job should be done? I'm sure the diversity of thought in this respect would be as great as the problem involved. Perhaps we should give some thought to what we are doing and what we should do. The results of what we have been doing in recent years suggest repeating a few statistics. Comparing the number of college degrees conferred in 1948 with 1956 shows Bachelor's degrees up 20 percent, Master's degrees up 35 percent, and Doctorates up 97 percent.

Those of us connected with the various colleges are aware of the anticipated increase in enrollment facing us in the early 1960's. How they can be handled properly and adequately and financially by the colleges is not in the scope of this paper. That they are not all of college calibre is well recognized.

Even at the present time too much emphasis is placed on the education of the poorly endowed. That these must be trained to live as good citizens is well recognized, but we must face reality and understand that they cannot be trained into future leaders. Should not the well-endowed then receive more of our attention so that we may have well educated and broadly trained leaders? A trite phrase of today is that in order to be privileged one must be one of the underprivileged.

One of my former students in an article in the "Ohio Schools" states that it is time for us to stop working with teenage "drones" who do not want to learn themselves and prevent others from learning. He estimates that ten percent of the older high school pupils care little about getting an education and have thus lowered the standards in the average high school by twenty-five percent or more. Furthermore, he believes that two or three percent of that ten percent account for most of the discipline problems. He believes that our present school laws demand mediocrity and that is just what we are getting.

If then we can get those who genuinely desire a college education and have the native ability to acquire it, we should use our abilities to develop leaders in all fields of endeavor. Human engineering, I believe, is the only way to adequately control and direct the young college student. The student of today, with college qualifications, has the ability, energy, and eagerness, although the directive force and mature guidance are frequently missing. Often college educators feel this type of pampering or spoon feeding should be done in the home. This is quite true if the home is comprised of well informed, mature thinking parents who appreciate the problems of higher education and the impact of these factors on the young college student. Most of us will agree that most homes do not contain a well informed educator who understands both sides of the educational fence. In many cases parental guidance is lacking, inadequate, or even misguided. Nevertheless as educators we can't overlook these factors. The college student needs directiveness which must come more accurately from the experienced educator. Are we doing enough? Or could we do more? If we could do more in this respect, we should concentrate on certain aspects of this problem. I wish to discuss several very important, but frequently overlooked, and neglected phases briefly.

When I mention some of these phases you'll at once say that these should have been covered by the parents prior to school age and by the grade and secondary instructors before these young people come to college. Perhaps so, but as stated previously, we have no way to control this early training and I do not believe we should simply shrug our shoulders and say it's too late and it's too bad and thus wash our hands of the problem.

The first of these phases is reaction to self. Each human individual is a composite of the chance combination of the available genes throughout his ancestry and the impact of his environment since birth on this gene complex. Hence, excepting identical twins, and perhaps not even there, no two persons are exactly alike. The arthropod, or the bird, has a built-in behavior system which is standard equipment on all models of that species. This system is, as mentioned previously, a rigid one, for the most part incapable of modification. By way of an example, some years ago your speaker experimented with a cicada-killer, *Sphecius speciosus*, at her nest. As is generally known, this insect digs an underground nest and provisions it with cicadas, in much the manner of the potter wasp. When bringing her prey to the nest, she places it an inch or so from the nest opening and she then enters the nest; upon returning she picks up the cicada and drags it into the nest. When the cicada was moved to a different location during her inspection tour, the wasp moved about in circles until she located the cicada, whereupon she placed it at a different location and then she entered the nest. This same pattern of behavior was repeated each time the cicada was moved. To test whether this was the peculiar behavior of this individual cicada-killer, it was tried at other nesting sites and a similar pattern of behavior observed.

A human being may have a built in behavior system of inheritance, just as the wasp, but the system is capable of infinite and varied reactions resulting from the environmental impingements on a highly complex nervous system. Thus, this reaction to self is developed slowly but surely from the moment of birth. The mother of any child, if she will but take the time, can see it unfold and develop, change progressively and regressively, be modified and molded by reactions with members of the family and with the child's associates. The process goes through grade school, high school, college, and the rest of life. If, through those years, the molding process has followed the common socially acceptable pattern, we say we have a person well adjusted to our present society. If the molding process has not followed this path, the product is amoral, immoral, or maladjusted.

We, as college instructors, have no opportunity to get into the game of training until the later innings. Many may say that it is too late for us to do anything and in many cases it is. But many a ball game has been won in the last few innings and often we can effect great changes in a person during his college days if we but try. Again the ever present need for human engineering—that is the carefully directed guidance and leadership of the educator. Granted many appear to be rather too far gone before we have a chance to add our environmental impact—this is unavoidable. Yet our responsibility remains. In the classroom of seventy-five to one hundred students it would appear that our only impact is the examination. This is unfortunate and most undesirable. To offer adequate assistance we should know the student, not as the “cute blonde in the front row” or by “seat 31 in the 10 o'clock section,” but as individuals. The instructor must know the person by name, where he is from, his general family background, and his aims and hopes as well as some aspects of his personality. This means personal interest on the part of the instructor, involving frequent conferences, etc.

Many may say that this is all well and good, and can be done easily in a small college but not in the large universities. It is perhaps more difficult in the latter, but that does not mean that it shouldn't be attempted or can't be done. Could not the fact that it isn't done or will not be done mean that the large university is much too large at the undergraduate level? If this part of the training is essential to the proper educational process, and I believe it is, then perhaps we should reorganize our thinking in regard to the distribution of the huge student load anticipated in the 1960's. Since the number of graduate students is increasing greatly, as has been shown, perhaps the large multimillion dollar institutions have a greater challenge to prepare the advanced student in his chosen speciality rather than to increase their numbers at the undergraduate level. The smaller colleges,

where this more personal contact may be made, may be able to exercise a greater choice in selecting their students from among those which show a definite ability to benefit from a college experience.

This concept of human engineering within the framework of the college is not too far from the function of the liberal arts design to develop the cultural side of the student within a wholesome personality. Often the exponents of the so-called arts subjects have implied, if not stated, that there is no culture in science. It is true that some or all the sciences are technical, abstract, detailed, and involved. There is a culture and beauty in the intricate way in which all science fits into an integrated whole. In fact, it is just this perception of the integrated whole which makes the scientist a cultured individual.

The second phase is the sense of responsibility to others. Just as a person must be true to himself, so he must be true to others. If the reaction to self has been properly developed in an individual by means of personal guidance in our human engineering program, then the sense of responsibility to others becomes a corollary of our first phase. There has been growing in the last twenty years an attitude of "it is not mine, so what." This is reflected in the spoiling of parks, natural resources, and the typical American pastime of defacing and destroying. Concomitant with this is the total disregard of the rights and the property of others by many individuals today. It is granted that this attitude is the universal one in nature; however, man has potentialities which allow him to be trained to rise above these baser attitudes; this can be fostered in our human engineering program.

We then, as educators, must train, develop, and inculcate this responsibility to others in all the students with whom we come in contact. It is my belief that it can be done and must be done for an adequate education. Over a period of more than twenty-five years I have tried to instill and develop these ideas in the students who have worked with me even though I got into the game in the last few innings of their formal educative process. The basic concepts which I have tried to weave throughout this paper are those which have been used on hundreds of students during this twenty-five year period in my research problem of human engineering. Success in such a problem is difficult to measure; however, I am quite certain that much of the work has not been in vain.

To the above requirements should be added the obvious phase of our responsibility to train the college student for his or her particular vocation. Generally speaking, we are trying to do this adequately but should we not keep checking on ourselves in this regard or even try ways and means to do the job better? Now and then one hears from the non-scientist that we are not doing the job well. We should take a positive approach to this and start selling science and science teaching to the general public. Industry advertises and continually keeps before the public the results of their work. Let us not hide our light under a bushel. Can't we present new and better methods of training students for their vocations? Obviously one must know some science and its applications not only in order to live but also to live better in this atomic age. In my experience many persons who had not planned on a career in science can be won for science by developing such an interest in them by effective teaching. Effective teaching means that we, as teachers, must have a great interest in our subject, which must carry over to our students. In doing this we must talk to them at the level of their understanding and lead them to think at higher levels. We should not attempt to turn all students toward science but appeal to those who have an interest or who have a potential ability in science. This really needs to be started in the grades and developed until we get these students in college where we may have a closer contact with them. Many may say that the sciences are difficult subjects, but are they any more so than other subjects? It is true that a definite language is necessary for their expression, but should that be any more difficult than learn-

ing any language in order to express our thoughts? Many good students wish to go into scientific work but have failed to take the proper subjects, particularly mathematics, in high school. Those who are in secondary school work should re-evaluate the work at this level and aid in making mathematics as well as the various sciences required courses. Those of us in college work should aid the secondary schools in the planning and carrying out of desirable curricular changes in addition to our training of scientists. Closer liaison between high school and college and university educators would be most desirable to assist each other with ideas and methods in our common responsibilities. High school instructors could be encouraged to take subject matter courses in their field and these courses should be acceptable for graduate credit. These should not be education courses, however. Could seminars be established for the discussion of subject matter and the problems of secondary teachers? This should not be a one way street; however, should not the college instructors visit the high schools to better understand the needs of the high schools and how to better train the undergraduate prospective high school teacher? There might be some excellent results obtained by inter-collegiate visiting on the part of all college instructors in science. Guest lecturers on an exchange basis would go far in stimulating the human engineering project. The National Science Foundation is working extensively on these problems. The Ohio Academy of Science is doing excellent work in one phase of this responsibility. The Junior Division of the Academy is in the hands of very capable men who are doing yeoman service for the potential scientists of our state. All of us should aid them in every possible way. Likewise, Dr. Ronneberg's Committee on high school curricular changes has done some very fine work. Dr. Cunningham's Committee concerned with problems relating to the future of science teaching in Ohio's schools has reported to the Academy at this meeting.

Those of us who are chairmen of the science departments of our Ohio colleges should have time or take time to counsel all students coming into their departments so that they may be aided in the proper choice of courses leading to the vocations they have chosen. Their philosophy of life at this stage of the game and what they think they want out of life should aid us in directing them in the proper channels. Is it possible that too often we spend so much time in research, pure or applied, that we are not stimulating young scientists or we are not doing enough human engineering? Do we share our interest and enthusiasm in research with young persons so that they may be stimulated to undertake such work?

In the process of training these potential scientists for their vocations, we need to add a catalyst to the several phases mentioned in order to produce the all inclusive effect which we must have—it is the ability to live and work with others. It matters not how brilliant, how successful, how noted one is in the work; unless one has this priceless ingredient, the individual is not a completely rounded personality. The undergraduate college is the last chance we have to aid in molding this completely rounded personality which requires individual educator help rather than a multimillion dollar physical plant. All of us know individuals who live as the hermit "in the peace of their self content" rather than "in a house by the side of the road." Perhaps those of us who are college educators have more of an opportunity to do this latter than some of the others. Until the student comes to college he usually lives at home, where there is more or less parental supervision. Often it seems to be mostly less. At college he is on his own for the first time and if the effort is made on our part, much can be done to mold the young person in the proper direction. Some folks believe that college professors climb into their ivy covered ivory towers and dwell there in perfect immunity to the everyday world about them. If one wants a frank statement in this respect, let him ask the man in the street to give his idea of the typical college professor. It is, therefore, especially necessary that we prove by our example that we are *not* ivory tower dwellers but that we are an integral part

of the world about us. In most occupations, even many scientific occupations, people must work in teams or groups. While there is and should be competition among them, for that is the American way, they should be able to live happily with others.

In conclusion, it is my belief that the role of the undergraduate college and our role is to dedicate our institutions and ourselves to human engineering as well as to education, so as to mold an educated, total personality from the eager, energetic rock 'n roll youth of today. This work in human engineering can be most rewarding and can develop an inward feeling of warmth as one looks back over the many young people who are doing excellent work in the many fields of science and in whose preparation one has had perhaps some small part. It would be interesting to know the results of this sort of guidance of students by the individuals in this audience. Such self appraisal might be illuminating—and surprising. It is my hope that in some small way this has and will contribute to the safety and the perpetuation of our American way of life.

---