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Announcement from the Editor

During the past academic year, the Committee on Publications of Kansas State Teachers College, Pittsburg, reviewed and evaluated the College publications program and recommended that several titles be dropped from the list. Among these was THE EDUCATIONAL LEADER. At the same time, however, the Committee recommended the publication of a journal of contemporary thought, somewhat on the order of the LEADER, as it has appeared for the last two years, broadened in scope, and directed by a board of editors representing every major academic department in the College. Plans are now well developed for the appearance of Volume I, Number 1, in October, 1959. The tentative title of this new journal is THE MIDWEST QUARTERLY.

Editor-in-chief of the QUARTERLY will be Dudley T. Cornish, professor of American history, who invites manuscripts dealing broadly with the fields of the humanities, mathematics and the natural sciences, history and the social sciences, education, philosophy, and the fine arts. These manuscripts, not to exceed four thousand words in length and to carry a minimum of documentation, should be directed to a literate and inquiring audience.

Working with Professor Cornish in the organization and production of THE MIDWEST QUARTERLY will be J. D. Haggard, professor of mathematics; Otto Hankammer, professor of industrial education and art; Richard Nuckolls, professor of physics; Rebecca Patterson, associate professor of literature; Theodore Sperry, professor of botany and ecology; and Wray Strowig, professor of education and psychology.

THE EDUCATIONAL LEADER will continue for two more issues, in April and July, before giving place to THE MIDWEST QUARTERLY.

The Seminar in Liberal Education

By Theodore M. Sperry

At the end of an article entitled "Voluntary Committee",* the writer asked, "Will the dynamic force of interest in the free exchange of ideas cause the group to pick up another project—?" The discussions of this voluntary group sometimes tended to get off the topic at hand as a result of interest in learning more about some related idea. This led to the suggestion that some sessions ought to be devoted toward increasing our knowledge about topics concerning which most of us were poorly informed.

In a preliminary discussion it was decided to initiate a monthly seminar for the express purpose of widening our mental horizons. The general plan is for some member of the faculty to present some topic not ordinarily included in undergraduate classes, and to conclude each meeting with a general discussion by those present. Although generally maintained at the graduate level, the meetings are informal and are open to all members of the faculty, adult members of their families, and invited guests from among the student body and townspeople. The meetings are preceded by an informal dinner at the Student Center building on the campus.

Opening in February, 1958, the seminar has included the following topics for its first six meetings:

February: "Polymerization and Genes" by Theodore M. Sperry.

March: "The IGY Program" by J. D. Haggard.

April: "Punctuation of English Sentences" by Robertson Strawn.

May: "Are the Social Sciences Scientific?" by Lewis Bayles.

June: "Statistical Classification of Individuals Into Groups" by Charles Baker.

July: "Twentieth Century Music Making" by Markwood Holmes.

Some of these papers have been collected for this issue of The Educational Leader. It is hoped that additional topics presented at this seminar will be included in future issues of this journal.

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* Sperry, Theodore M., "Voluntary Committee," *The Educational Leader*, XXI (1958), 11-24.

Polymerization and Genes

By Theodore M. Sperry

Several years ago I read a short story in which the plot revolved around the reflections of a young mother while watching her offspring playing on the floor. "You know," she thought to herself, "he has that way of turning his head just like Robert used to. —Robert! —Not John, then!" as the significance of the observation dawned upon her.

These observations of the offspring resembling their parents in appearance or behavior are doubtless as old as the human race, and each of us can probably cite several personal examples of this. The introductory example was used not only to keep it impersonal, but also to emphasize that such characteristics are inherited through the germ plasm of the parents and are not acquired through environment or by imitation. One must constantly be on guard to keep separated those characteristics which are environmentally acquired from those which are genetically inherited.

These latter are manifestations of certain fundamental characteristics which were already present in the sperm or egg which produced the zygote (the initial cell from which the new individual develops). Each such zygote contains hundreds, or more probably thousands, of such unit characteristics, or genes. Each of these produces some particular characteristic of appearance or behavior when located in the proper part of the body (as the iris of the eye, for example), or when the body reaches a certain stage of development (such as the age for the loss of hair from certain parts of the body).

Although we have been more or less glibly talking about these genes for some fifty years now, and have even located some of them rather precisely at specific spots on designated chromosomes in the cells of some of our better known research plants and animals, we still have been quite unable to describe their physical structure, or to offer any explanation as to (1st) why they produce given specific effects, (2nd) why they occasionally mutate to produce a distinctly new characteristic, and especially (3rd) how with each cell division, each one is exactly duplicated in each of the new cells.

In an attempt to explain these mysterious but highly significant properties of the gene, extensive recent research has produced a partial explanation which, while still theoretical, seems to offer us our first significant insight into the fundamental structure of the gene.

This explanation starts with a review of structural chemistry, since some of us may find this a bit rusty after some years of disuse. We recall, of course, that the formula for a molecule of water is H_2O, or more precisely, H-O-H, in which two hydrogen atoms, each with a single valence bond, are chemically united with a single oxygen atom which always has two valence bonds. Similarly, a molecule of methane, CH_4, is represented (perhaps too simply in the light of current chemical concepts) by an atom of carbon, which has four valence bonds, combined with four hydrogen atoms, which always possess only the one bond each (Figure 1).

Larger molecules are elaborations of these same patterns. Thus ethane, with the formula C_2H_6, may be represented by Figure 2, in which it is noted that the carbon atoms each still have the four valence bonds and the hydrogen atoms their single bond. Ethylene, with the formula C_2H_4, differs (Figure 3) in that the two carbon atoms are joined (insofar as the use of conventional symbols indicates) by a double valence bond. Each carbon atom still has its characteristic four valence bonds; but since two of these bonds are on the same side of the carbon atom, an instability exists which permits the molecule to be disrupted whenever ions of the proper type occur near the molecule.

If the chemists will still permit oversimplification, an ion may be defined here as an atom, or a group of atoms, in which one of the valence bonds remains free and unattached to another atom. Thus H- represents a hydrogen ion and -O-H represents a hydroxyl ion. Such ions usually do not remain free in a solution in significant numbers, but will combine with another ion of the proper type to form a molecule, such as the combination of a hydrogen ion (H-) plus a hydroxyl ion (-O-H) to produce a molecule of water (H-O-H), for example. Ions may also disrupt an unstable molecule by breaking a double bond, thereby forming a new molecule (or ion) with a stable single bond.

An example of this latter process might occur if hydroxyl (-O-H) ions were added to a solution of ethylene molecules. (Actually, an undetermined but more complex ion seems to be involved in this reaction). This is indicated by Figure 4, which shows the hypothetical combination of a hydroxyl ion with a double bonded ethylene molecule to produce a single bonded ethylene ion. This ion with its free valence bond will then react with the next ethylene molecule, so as to set up a chain reaction. Figure 5 shows the same hydroxyl ion of Figure 4 and a series of ethylene molecules undergoing such a chain reaction. This will stop when one such

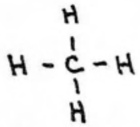


Fig. 1. Methane

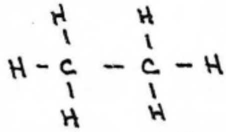


Fig. 2. Ethane

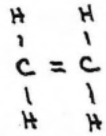


Fig. 3. Ethylene

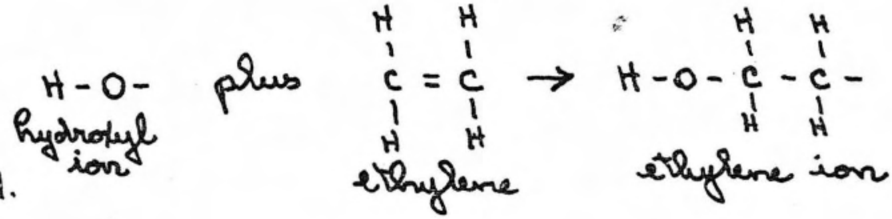


Fig. 4.

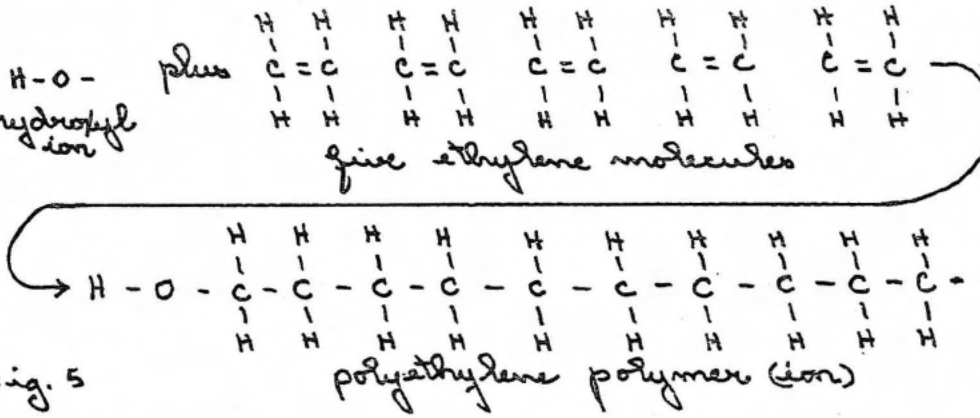


Fig. 5

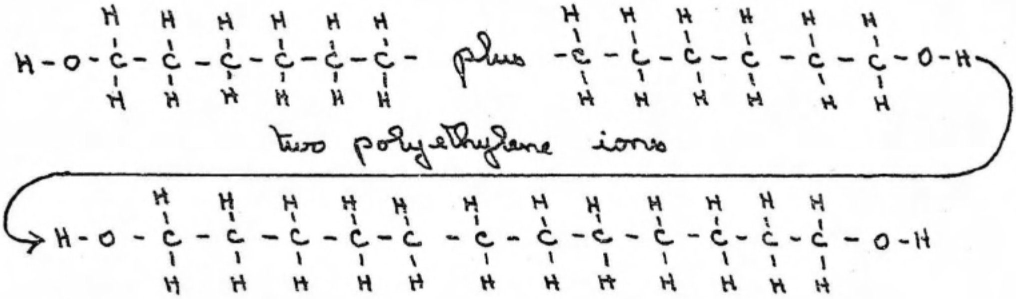


Fig. 6. One straight chain polyethylene molecule

long chain ion meets a second such ion and combines with it, as shown by Figure 6. In such reactions the ethylene molecules are known as monomers, and the resulting long chain molecule is a polymer known as polyethylene. This compound alone has been of tremendous commercial value in the formation of many important industrial and household products.

There is a long list of many such polymers, most of them showing a far greater complexity of structure than we note in the straight chain polyethylene of Figure 6. It is not our object to get involved in polymerization chemistry here, but there are a couple of details we must now note. One of these involves the development of side chains on the main chain of the polymer. Such side chains may be composed of the same units (the chemist calls these units radicals) as the main chain (such as the side chain polyethylene shown by Figure 7), or of one or more entirely different radicals, either uniformly or irregularly arranged on the main chain. One such example is that of the commercial "Neoprene," shown by Figure 8, which includes single bonded chlorine atoms (Cl) in its structure. All of the above polymers may be described as addition polymers, because of the method of their formation.

The second detail involves condensation polymers, in which monomers are combined with each other in a reaction in which a molecule of water is removed. Thus a hydroxyl radical (-OH) from a molecule of glycine might combine with a hydrogen atom (H-) from a molecule of lysine, to form a molecule of water and a molecule of a protein which could be the beginning of a polypeptid chain (Figure 9). Presumably all proteins are enormously long polypeptid chains composed of hundreds or thousands of monomers, all having the same primary peptid unit (Figure 10), but with a variety of side chains, indicated by -R, the conventional symbol for any of a variety of radicals. Some twenty monomers of this type (known as amino acids) are known to occur in nature, and thousands of others are theoretically possible. But even these twenty, joined in all possible combinations, could produce as many different proteins as there are possible words which could be formed from twenty different letters of the alphabet, including words of several thousand letters each!

As a matter of fact, protein chemistry is far more involved than this, due, in part, to the evidence that the chains are not actually straight, but are variously bent or coiled, often in right-handed helixes. Even more involved is the formation of the so-called

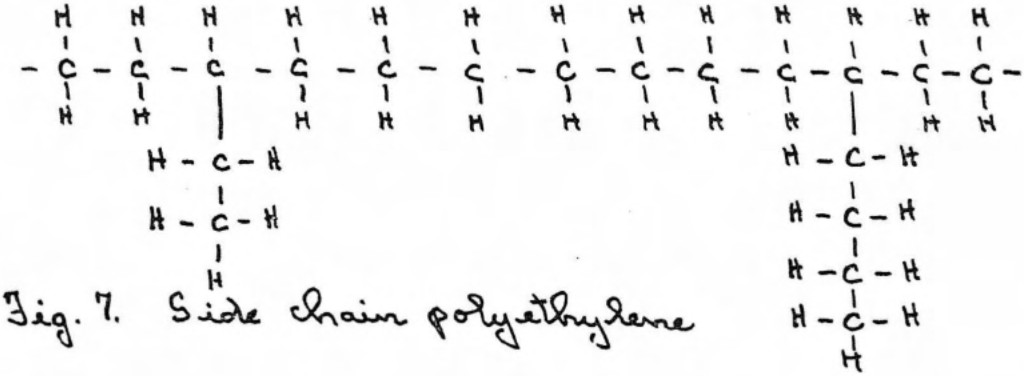


Fig. 7. Side chain polyethylene

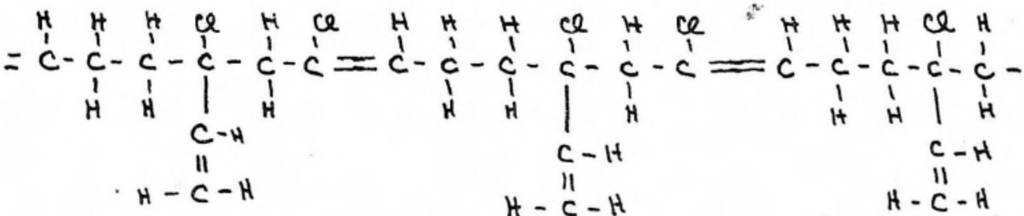


Fig. 8. Polychloroprene or "Neoprene"

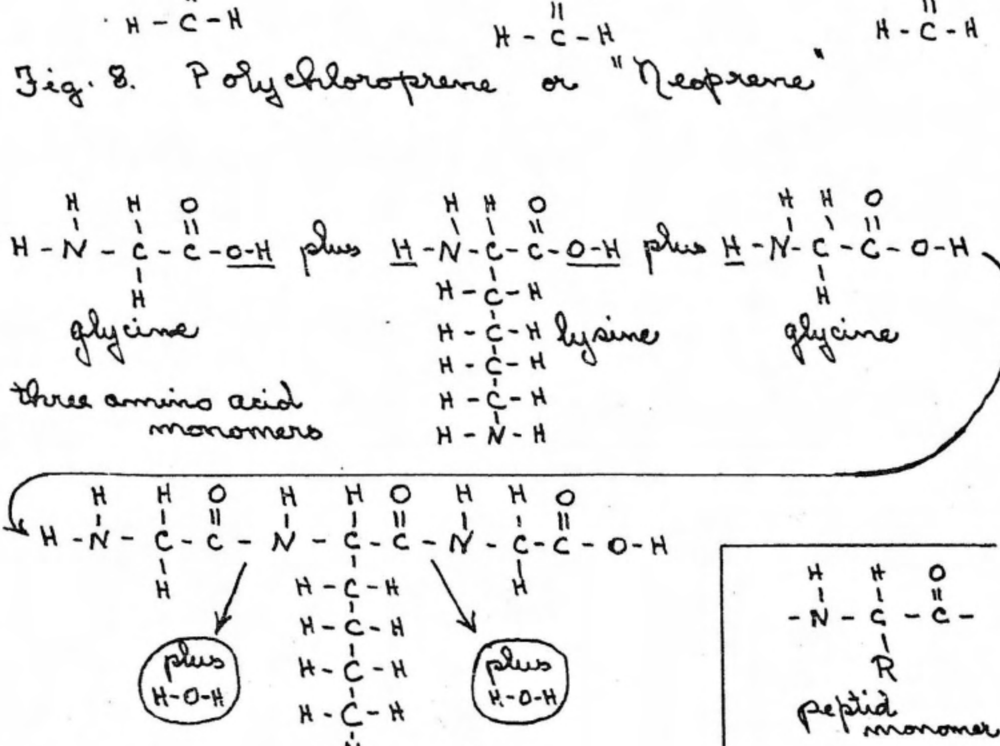


Fig. 9. polypeptid chain

Fig. 10.

"hydrogen bonds" between adjacent and parallel polypeptid chains. The "hydrogen bond" is not a true chemical bond, such as the valence bond discussed in the more elementary parts of this paper, but represents a line of attraction between adjacent atoms which are not chemically joined with each other. The basis of this attraction is the unstable double bonded oxygen of the peptid monomer (Figure 10) and the hydrogen atom attached to the nitrogen of an adjacent peptid radical (also shown by Figure 10). A series of such hydrogen bond attractions is indicated by dashed lines in Figure 11. Although these hydrogen bonds are quite weak, a long series of them between two adjacent molecules serves to hold these molecules in a relatively fixed position with each other. We might compare this with two families, each having a large number of children of both sexes, in which the boys of each family find the corresponding girls of the other family quite attractive. Although there are no marriages, one can well imagine that the two families are closely associated with each other just by the attraction bonds present.

What has all this to do with genes? For this, let us look into the nucleus of the cell.

Among the many kinds of sugars found in nature is a 5-carbon (pentose) *sugar* known as ribose. Its cyclic structure is shown by Figure 12. A very similar *sugar*, which differs from ribose only in that it has lost one atom of oxygen (in the upper right part of Figure 13), is known as deoxyribose. Also found in nature are a number of cyclic organic *bases,* such as cytosine, shown by Figure 14 (above Figure 13). Four other *bases,* somewhat similar but differing in various details and known as adenine, thymine, guanine and uracil, are also important in plant and animal cell structure. For convenience, these bases may be abbreviated simply as C (cytosine), A (adenine), T (thymine), G (guanine), and U (uracil). For our purposes here, we shall drop the uracil (U) at this point. The remaining essential component in this picture is *phosphoric acid,* shown twice by Figure 15. By condensation polymerization, the *sugars* and *phosphoric acid* combine as alternate monomers, with the loss of a molecule of water (HOH) for each condensation, into chains thousands of units long. In another condensation reaction (again with the loss of water), the *bases* attach to the sugars as side chains all along the main chain. By these reactions (which probably do *not* occur in the order mentioned) two very important polymers are produced—*r*ibo*n*ucleic *a*cid (abbreviated RNA) and *d*eoxyribo*n*ucleic *a*cid (DNA). An extremely

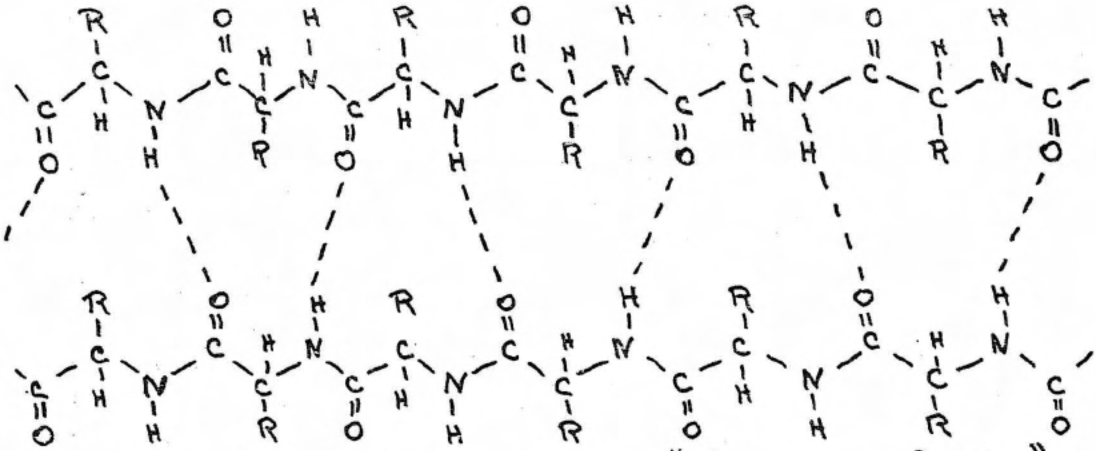


Fig. 11. Broken lines indicate "hydrogen bonds" between polypeptid chains.

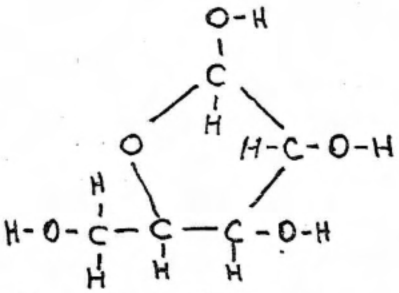


Fig. 12. Ribose

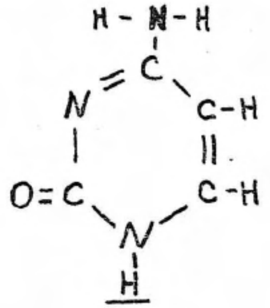


Fig. 14. Cytosine

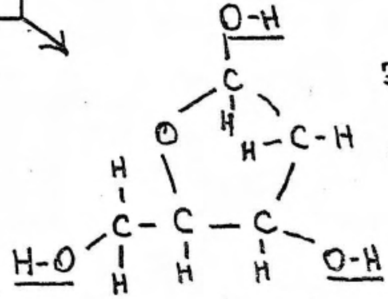
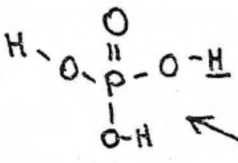


Fig. 13. Deoxyribose.



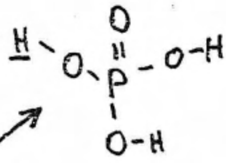


Fig. 15. Phosphoric acid

small portion of the DNA giant molecule is shown by Figure 16, in which side chains of cytosine, thymine and a part of adenine are indicated by C, T and A within the rings. RNA differs in the sugar monomer and in one of the side chain bases.

It is the deoxyribonucleic acid (DNA) which seems to constitute the principal substance of the nucleus of the cell, and hence seems to be involved especially with cell division (or more properly, mitosis) and with the inheritance of genetic characteristics. DNA apparently does not occur in cells outside of the chromosomes, and the chromosome material (*i.e.*, chromatin) is probably composed largely, if not entirely, of DNA. X-ray analysis of DNA shows it to be two parallel chains, and the chemical structure of the side chain bases permits the development of hydrogen bonds between the parallel molecules. It will be noted in Figure 16 that the bases have both double bonded oxygen and double bonded nitrogen atoms. Both of these instabilities are favorable spots for the formation of hydrogen bonds. There are also hydrogen atoms attached to nitrogen atoms of these same bases which also serve, as they did in Figure 11, for the formation of hydrogen bonds. These particular atoms are located in such a way on these bases so that two parallel hydrogen bonds will develop between the cytosine and guanine radicals, and so that a similar pair will develop between the thymine and adenine radicals. However, they are not arranged to permit the bonding between the other bases within this group.

Hence it seems that the two DNA chains are constructed in such a way that for each side chain of cytosine or adenine in one polymer, there is a corresponding guanine or thymine in the opposite polymer. This double "hydrogen bonding" between the bases of parallel DNA molecules is shown by Figure 17. In this figure the square P represents the phosphate monomer, the pentagonal D, the deoxyribose monomer, and the circular C, A, G and T the basic monomers. There is no evidence of any regularity in the arrangement of the different basic radicals on the DNA chain, but there is considerable reason to believe that the particular order in which these radicals are arranged gives a particular characteristic to that molecule, which is different from a molecule having the same radicals in a different order. This is just as the letters CANOE give us an entirely different idea than do the same letters rearranged as OCEAN, or just as the letters CAGT adopted for our bases may be arranged as TAG A GAT or as in GAG A CAT! It is not thought, then, that each basic radical on the DNA chain is a gene, but rather, that it is a particular combina-

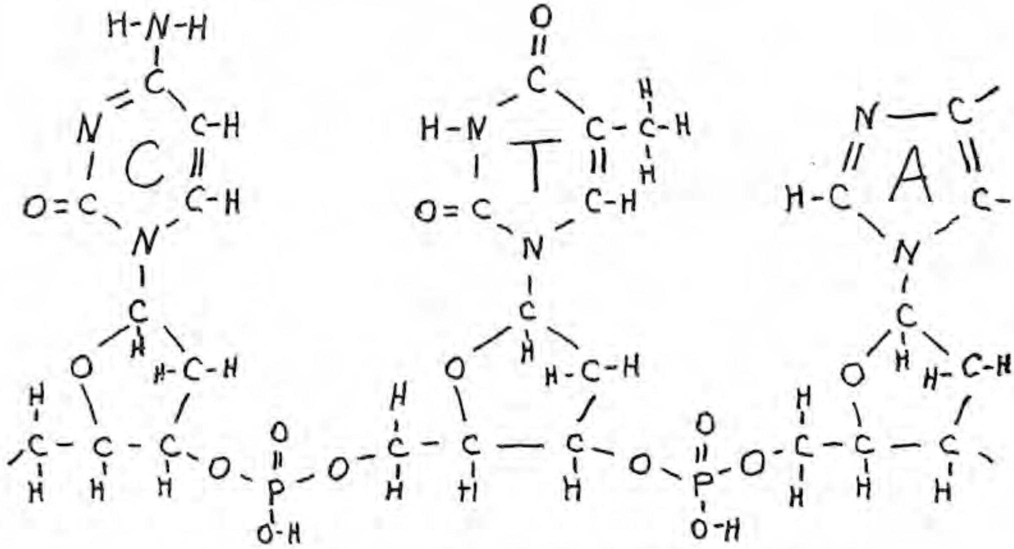


Fig. 16. Deoxyribonucleic acid (DNA) polymer.

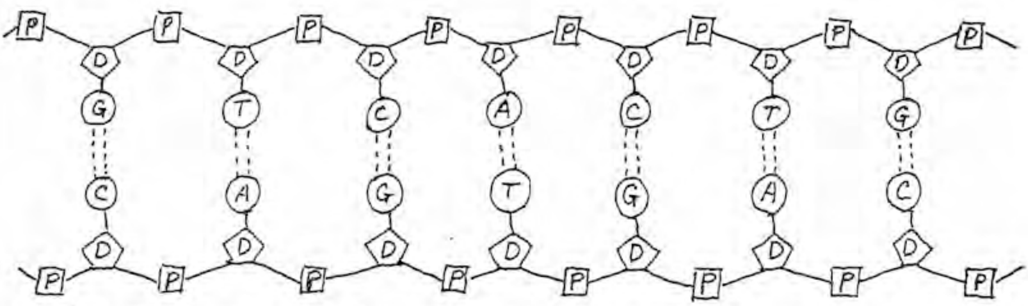


Fig. 17. Hydrogen bonding between DNA polymers.

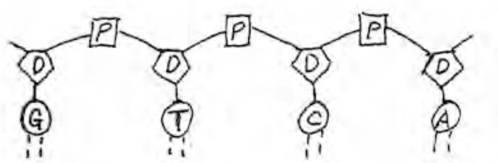


Fig. 18. DNA with hydrogen bonds broken by mitosis.

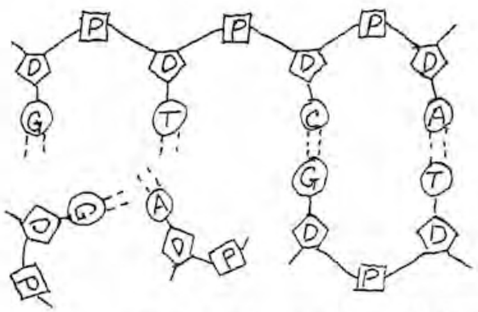


Fig. 19. Replication of DNA.

tion of these radicals with each other which produces the particular genetic characteristic.

This concept of the gene fits our knowledge of the process of mitosis, in which each chromosome splits lengthwise into two identical chromosomes, each of which carries the identical genes to the two new cells. The hypothesis presumes that the weak hydrogen bonds between the paired DNA polymers are broken (how? is anybody's guess) during the early stages of mitosis, leaving each chromosome half (*i.e.*, chromatid) with a single DNA chain, as indicated by Figure 18. Each of these polymers then replicates the missing DNA chain out of isolated nucleic acid units (called nucleotids) in the cytoplasm, by attracting to the new chain only those units which have the proper base to form hydrogen bonds with the bases already present in the original chain. This is shown by Figure 19. Here the upper chain is the same as that of Figure 18. Below this we have shown three different radicals. To the lower right of Figure 19 are thymine and guanine nucleotids which have already polymerized and have formed hydrogen bonds with the corresponding adenine and cytosine radicals above. Next to this is shown an adenine nucleotid which is just about to join the new chain, attracted there by the thymine radical of the upper chain. However, the guanine nucleotid in the lower left of this figure would not join the new chain since it would not be attracted by the guanine radical above. The new chain would be extended only when a free cytosine nucleotid (not shown) became available at this point. Such a hypothesis is supported by several lines of important experimental evidence.

More important, however, is the question as to whether such chemical radicals can actually produce genetic characteristics in an organism. Direct evidence of this has been found in the case of a disease known as sickle-celled anemia of horses—a fatal disease in which the red blood corpuscles have a "sickle" shape. Genetic studies have determined that this disease is due to a single gene in the cell, and chemical studies have shown that the huge hemoglobin molecule of the diseased animals is identical to the hemoglobin of normal animals except for a single radical, in which one monomer of glutamic acid in the normal molecule is replaced by a valine monomer in the "disease" molecule.

While there are several additional items of evidence to support this rather fantastic picture of how we tick, it should be quickly added that there are still some important assumptions which have

not yet been proven, and that there are some complications of this already complicated process which are still very difficult to explain. But in spite of these limitations of this concept, this is still the first theory yet proposed which offers a workable model for protoplasmic dynamics and which presents a reasonable explanation of the fundamental processes of life. We optimistically feel that at least we are on the right track.

Credit for this picture goes to the hundreds of research workers around the earth who have patiently uncovered the countless details involved. These details have been summarized in a series of articles in the September, 1957, issue of *Scientific American*, and the writer has especially drawn on the articles by Mark,[1] Natta,[2] Oster,[3] Doty[4] and Crick[5] in assembling this very much limited and simplified account of polymerization and genes.

Scientific American, September, 1957. Vol. 197, No. 3:

1. Mark, Herman F., "Giant Molecules," pp. 80-89.
2. Natta, Giulio, "How Giant Molecules Are Made," pp. 98-104.
3. Oster, Gerald, "Polyethylene," pp. 139-152.
4. Doty, Paul, "Proteins," pp. 173-184.
5. Crick, F. H. C., "Nucleic Acids," pp. 188-200.

Are the Social Sciences Scientific?

By Lewis A. Bayles

I.

It should be clear from the beginning that the question considered here is not, "*Are* the social sciences scientific?" but "*Can* the social sciences be scientific?" No social scientist believes that at present any of the social sciences constitute a body of tested knowledge as does physics or chemistry. On the other hand the simple fact of scientific progress refutes the idea that the only subject matters which *can* be scientific are those which at present *are* sciences.

The different disciplines vary greatly in the degree to which they have agreed upon bodies of principle. We need to examine, therefore, not specific subject matters but methods of approach and procedure which mark the process of inquiry wherever used. I would reject, however, the idea that a science can exist wherever the scientific method is used. The scientific method can be used—as it is in history—with neither intent nor outcome representing scientific generalization.

The question which we shall consider is simply whether, if the social sciences are to become a body of warrantedly assertable statements, systematically elaborated and of unrestricted generality there are necessary factors in social inquiry which fail to meet the conditions required by scientific method. Scientifically valid knowledge is an ideal. The question for the moment is not whether the ideal has been *attained;* only whether it is *possible.*

II.

Ten years ago this question would have led reputable practitioners of the social sciences into violent disagreement, clear formation of opposing battle lines, and division into schools. Within the past few years, however, continuing interest in philosophy and methodology has involved little elaboration of simple yes-and-no answers, but instead has promoted a great deal of careful examination of problems which arise if one assumes that the answer is yes. The present question, if one consults the academic journals, is not whether the social sciences can be scientific, but what conditions must be met if they are to be made so.

Much of the dispute regarding the status of the social sciences has resulted from changing ideas of what constitutes scientific knowledge in any field. Answers to the basic question have varied

according to what is held as the scientific ideal. Inquiry takes its character from what is being sought and that is a question which is fundamentally philosophical. The first scientific ideal to be used as a guide to social inquiry was that of Newtonian physics. Newton's *Principia* was the culmination of the Cartesian revolution which viewed the universe as a great fixed, mechanical order a mighty machine eternally pursuing the same unchanging round of cyclical processes, understandable only by use of mathematics. Scientific endeavor was a search for the universal laws of nature from which could be derived, by mathematics if possible but by logic if not, the specific facts of experience. A counterpart in the social field of Newtonian mechanics was classical economics. From the fundamental axiom of "economic man," classical economics constructed an elaborate system underlying the policy of *laissez faire.* From the same method came the contrasting ideas of illimitable progress and the "dismal science" of Malthus and David Ricardo. Out of the same wool was cut the pleasure-pain calculus of the utilitarians. Karl Marx, although recognizing that the laws of *laissez faire* were simply those of a capitalistic economy, used similar axioms regarding human nature to derive a theory of history which purported not only to illuminate the present but also to describe the future in terms of the only "scientific" socialism. It is important to note that, despite divergence in conclusions, both Adam Smith and Karl Marx accepted the view of science as discovery of scientific laws.

The same view of science motivated the beginnings of sociology in both Comte's "positivism" and Spencer's *Social Statics* as well as in the writings of other early theorists. The so-called "laws" of society purported not only to explain current facts but also to show the evolution and the future state of society. This prophesy of fixed and inevitable directions, Karl Popper has aptly named "Historicism."

Of major criticisms of this idea of social science, I might mention two. First of all, principles which avowedly were inductively derived, such as the axiom of inherent self-interest, were in fact not so derived. The test of these theories was not the data of experience but logical consistency. Vast edifices of theory were erected on axioms of sand. These principles came secondly, to be treated as descriptive and therefore testable hypotheses but as moral norms, deviation from which was "unnatural" and consequently useless or even evil. The result was either the hands-off policy of Spencer or William Graham Summer or the scientific au-

thoritarianism of Comte or, more recently, of James Burnham. This notion of science led to rigidity of outlook uncongenial to the hypothetical nature of experimental science.

It has been an empiricist reaction to this view of science which has guided most recent American social science research. The excesses of rationalism led, in field after field, to emphasis upon the accumulation of facts pure and simple. Scientific research in this century has been identified with quantification and a study which was not primarily statistical was rejected as unscientific. This movement has led to rapid progress in accumulation of data, development of statistical tools, construction of scales, and interviewing techniques, and has contributed greatly to our knowledge of different cultures through anthropological research. With this empiricist trend, the idea spread that the function of science is simply to collect facts and let them "speak for themselves." Partly as a defense mechanism for those whose findings were critical of the status quo and partly as a reaction against the scientific authoritarianism implied in the previous view, came the view of the ethical neutrality of social science. The most prominent exponent of this view is George A. Lundberg.

Valuable as this trend in social science has been, it has badly disarranged the mutual relationship between facts and theory, and has virtually ignored the function of hypotheses. It should be clear by now that facts cannot speak for themselves. Abstraction is necessary if one experience is to be made relevant to others and this requires many judgments of relevance and propriety. "Pure facts," unrelated to theoretical schemes, are useless. As a matter of fact, the very act of selecting a problem involves value-judgments, and collection of relevant facts is impossible without hypotheses to use in determining relevancy. The idea that facts speak for themselves is nothing more than a blind to hide the motives and beliefs of the one who selects the facts.

The beginning of a reaction against this trend, at least in American social science, can be identified with the publication in 1939 by Robert Lynd of *Knowledge for What?* a criticism of much of current research and a plea for greater awareness of the importance of theory and greater concern with major social problems. Following the suggestion of Einstein that in order to form an idea of scientific method one should study what scientists *do* instead of what they *say* they are doing, Lynd suggested a view of social science which because of its debt to relativism in physics and of its

concern with present problems, might be called experimentalist or pragmatic.* It is on grounds which represent rejection of both extreme rationalism and extreme empiricism that the ideal of modern social science is being built. Modern social science recognizes the need for developing theoretical schemes to make knowledge relevant and to make it fruitful. Induction is more than fact finding: it is a process of evaluation and critical thought. Modern social science seeks warrantedly assertable propositions rather than fixed and final laws. It stresses relevance to human interests while skirting the pitfalls of technocracy. It recognizes the danger of substituting axioms for postulates and essences for constructs, as well as the pitfall of employing wishful thinking in place of precise, descriptive meanings. It is in terms of this modern ideal of scientific endeavor that it seems possible and desirable that the social sciences can be scientific.

III.

With this brief review in mind, let us look at some of the reasons given to support the claim that the social sciences cannot be scientific. One is the argument that human behavior is too complicated ever to be scientifically understood. This argument can be easily refuted, however, on the grounds that any phenomenon which is not understood seems complicated, simply by definition. Any *physical* scientist would consider insulting the idea that the phenomena he studies are simple. Simplicity in science has a technical meaning (reduction in the number of independent variables) referring to present explanatory theories in which the physical sciences are far more advanced than the social. The idea that social generalization is necessarily culture bound, true only in a particular time and place, means only that the basic social science must be a science of culture and cultural change.

We may also reject, on the ground that it misconceives the nature of science itself, the view that human affairs can be understood through the intuitive grasp or *Verstehen* of unique properties, either of individuals, of groups, or of social phenomena. This view holds that social meanings are inherently subjective, and that objective analysis in terms of observed behavior destroys the full significance

* The term "pragmatism" is here used rather imprecisely. The point of view herein presented is a rough, but commonly accepted, compromise between idealism and realism. To explain the pragmatic point of view as presented in the recent writings of Dewey and Bentley requires, I believe, a starting point entirely different from the one we are using and consequent reconstruction of many related concepts. I am presenting not a consistent, technical point of view but a rough outline of widely held principles.

of the phenomena studied. This is true, however, of every science. No science is now thought to explain its data in terms of final causes or inner essences. No one understands "gravity" except as a symbol or a mental construct, denoting sets of relationships among observed or observable events. It may be that at present simple human sympathy is a better guide to understanding another's behavior than are principles of psychology, or that the average boss has a better knowledge of political behavior than does any political scientist. This, however, is a criticism of the present state of the social sciences not a reflection upon the data itself. Every event, social or physical, is in some way unique; "complete explanation" would result in nothing more than a description of the event. It is for this reason that history which purports to represent full understanding of a unique event is not a science, however essential to science it may be. The purpose of science is validation of general propositions, for which abstraction is a *sine qua non.* One may use science to explain a unique event, but science is not forwarded thereby, even if enjoyment might be. Understanding which appears intuitive can be used to suggest hypotheses or to determine relevance, but only that which can be abstracted and tested can contribute to science.

One of the more fundamental grounds for assuming the separation of the physical from the social sciences is the view that scientific determinism is antithetical to what is commonly identified as free will in human affairs. This view is based upon error regarding both the nature of science and the nature of freedom. We must reject the dualism which posits a mechanically determined physical world and a human world of unmoved movers. Although some regularity of nature must be assumed for purposes of scientific prediction, this is far from saying that the universe is fixed in such a way that there are no contingencies—that there is no leeway for chance or choice. Sciences based upon the Newtonian model presumed to be in possession of unalterable laws of behavior to which human beings must conform. In this sense, prediction and control *are* antithetical. That which we can accurately predict—eclipses, for example—human choice cannot control; that which human choice can control, we cannot predict. All modern scientific laws are phrased in the "if-then" form, indicating a course of events which will occur *if* a specified set of conditions is met. In many areas but in human affairs particularly, there is opportunity for human intervention at the "if" clause. Knowledge of the consequences of choice, far from re-

stricting freedom, is in fact essential to it. Choice *without* knowledge of consequences is no choice at all. It is mere habit or blind chance. To illustrate, man's knowledge of the law of gravity enables him to *choose* to commit suicide by jumping off of a tall building. Without such knowledge he might not know how to kill himself, or he might do it accidentally. In no case could he do it deliberately.

It is true that one result of social research has been recognition of cultural limitations upon freedom. Much of human behavior is not the result of rational choice but of custom and habit. Man is not *born* free; he *achieves* freedom. This knowledge should serve as an aid to removing hindrances to freedom, hindrances which were closed to inquiry by the gratuitous assumption of free will. It is only as we become aware of limitations upon freedom that we can attack them, and it is only as we become aware of contingency that we can grasp it and thereby achieve freedom.

A closely related problem is that of value judgments. In its simplest form the argument is that the natural sciences, including any true science, deal only with what *is* and that human affairs necessarily involve value judgments or propositions regarding good and bad, or what ought to be. This apparently simple dichotomy must be subdivided. Speaking of values as objects of inquiry, few would deny that if values are stated in terms of observable behavior, past or projected, they can be studied in the same way as any other observable phenomena.

The more crucial problem is that of the operation of values in the process of inquiry. The problem is whether in relation to human affairs the scientist can retain the attitude of impartiality towards the outcomes of his research which is essential for objectivity. The scientist may study atoms or ants without regard for their feelings in the matter, but he cannot do this to other human beings. I believe that this is logically no more a handicap in one field than in another. In the first place we must reject the myth of the cold and calculating scientist. There is nothing cold about the scientist in the laboratory. The chemist may search for the formula of a hydrocarbon with all the fervor of a rock and rolling teenager. Every true scientific endeavor, furthermore, is guided by a hypothesis which is a preconceived idea determining what data is relevant and what is not. He uses apparatus that does not leave the world as it was before. He is a part of that world and, in the process of inquiry, alters it. A scientist must be involved in the life of any given hypothesis, at least enough to get him to undertake the effort re-

quired to test it. The success or the failure of any experiment may, furthermore, involve success or failure of years of effort, and scientists are not less vain than are other human beings. Every scientist is faced with the temptation to ignore facts which deny a cherished hypothesis; the only difference between natural and social sciences is that, in the latter, relations between facts and cherished beliefs are more direct and observable and we have no tradition or discipline for giving them up. As a matter of fact, the idea of objectivity has nothing to do with the internal state of a researcher. Scientific objectivity is due to communicability of findings and the continuous process of examination and testing and does not depend wholly upon the honesty or the accuracy of any one scientist. It may be true that the social sciences have so far failed in making their theories generally testable, but there is no logical reason why their concepts can not be just as precise as can those in the natural sciences.

A related point regarding the limitations of the social sciences is that of the purported inapplicability of experimentation. "You can't put human beings in test tubes," the argument goes, and, since valid sciences depend upon controlled and repeated experimentation, this source of validation is therefore closed to a social scientist or at least to a humane one. If this were true, it would indeed be a conclusive criticism since our arguments so far have been based upon experimentalist rather than upon rationalist or empiricist views of scientific method. It is quite true that, for the purpose of testing theories of revolution, historical occurrences such as revolutions cannot be repeated in full uniqueness. But, as has been mentioned before, no phenomenon can be repeated *in toto*. What is repeated is the "if" clause of the if-then proposition. This must allow for some variations in non-essential factors, or it loses its essential factor of generality.

On the other hand, to reach full scientific development, it is in controlled action that we shall have to create means for testing social theory. This means that social planning, with a view toward testing ideas, must be undertaken. It is only by using what knowledge we have that we can increase it. Of course, there will be many forms of social experimentation which for moral reasons we would reject and this would exclude total planning of a society. But there are also many forms of social control or planning which at present do go on, without regard for the testing of consequences. Though there are many examples, perhaps the most obvious one is education. A school is an environment, controlled for specific pur-

poses, but most schooling proceeds without benefit of consideration of the theories involved as well as without regard for testing them.

In conclusion, I would like to point out that there are many steps which might be taken toward making the social sciences scientific. But to me the most important step is closer co-operation between social scientists and social practitioners whether the latter are in business, in government, or in the schools. There is so much to be done in man's most important social experiment—education—that it is unfortunate for any time to be wasted on disciplinary bickering.

Twentieth Century Music Making

By Markwood Holmes

There are the contented and there are the discontented. Most of us like to think we are living in a remarkable age of artistic and technological splendor. But there must be those who are convinced they have been short-changed—born too late, or too early.

When I first made serious contact with the musical masterpieces of the great classic and romantic composers I began to wish I had lived in the days of *their* glorious music making—I might have been a part of the turmoil surrounding many of the controversial figures of our musical past. I could have caught a glimpse of one of them as he walked down the street on his way to the barber shop; or joined the small but ardent, vociferous group of Beethoven or Brahms enthusiasts.

But, on second thought, on whose side might I have been had I lived a century and a half ago? Would I have been able to discern, after the first few hearings, the epoch-making grandeur of the Eroica Symphony, or the lasting greatness of the later piano sonatas or string quartets released from the mind and hand of a deaf, irrascible, unapproachable, lonely, and to many, excessively unattractive music maker from Bonn-on-Rhine? I might very well have turned out to be the unfortunate, witless immortal whose record, in the ancient files of a Vienna newspaper, is down in black and white for all posterity to read. He found, and promptly voiced the opinion, that the *Leonora Overture*, for one thing, was no more than an atrocious imposition of such puny musical ideas and such a disorganized conglomeration of strident, unrelated sounds that no cultivated music lover should ever again be subjected to another hearing of this embarrassing piece of music.

So I have gradually become reconciled to living here in our own twentieth century. It took some time for me to be convinced that the real, the great and lovely art of music making was not dead and finished, but that the process goes on all the time. To think that music of an astonishing nature—significant, original and beautiful—perhaps timeless, is a part of the creative output of these very years, is exciting indeed. And just as in the past, when alongside the great works which broke with tradition, there marched the excellent, the good, the fair, the mediocre and the poor expression of musical taste, so now the precious results of daring, original

thinking are cluttered and crowded with cheaper and easier successes—some quite good and fair, to be sure, but the rest of no real consequence whatever.

The twentieth century has revealed composers and their music of all types. Naturally, the change from one musical idiom to another was never achieved at once. The baroque, rococo, classic, romantic, realistic, chromatic, impressionist, neoclassic, expressionist, atonal—all gave way to each other gradually, and *all were contempory* at one time or another. The year 1902 saw the first presentation of Debussy's lovely lyric drama, *Pelleas et Mellisande,* before a most irreverent audience at the Paris Opera Comique. The advent of a really new modernism in music had preceded this premiere with the same composer's string quartet and his *Prelude to L'Apres Midi d'un Faune* some ten years earlier, and this music came to be known as "impressionism" (a term not to Debussy's liking, by the way). None of it was extensively recognized until after the turn of the century, and it may well be considered a truly twentieth century phenomenon.

The yoke of a constantly increasing romantic heaviness—thicker and thicker texture, the demand for a larger and more cumbersome orchestra was broken, and a welcome return to a simpler form of musical expression was achieved mainly through the genius of this one Frenchman, Claude Debussy. Realization that a new era had dawned did not come at once by any means, and for years many composers wrote like mad, in the style of Brahms, Wagner, Richard Strauss or Caesar Franck. Not until this new impressionism had been in turn outmoded and superseded by a still newer expression did the majority of writers begin to imitate Debussy and his younger colleague Maurice Ravel with a frightening fidelity.

It is not that a music is to be abandoned once it is written, or, like our nuclear weapons, considered obsolete even before it is completed. Our old, middle-aged and youthful music of real worth has lasting qualities, and will go on being appreciated indefinitely. But the composer of stature, like the gifted painter, architect or writer, is blessed with a clairvoyance, and an eye and an ear for, and a consciousness of things to come; and if he is to produce anything of significance he will naturally build on the solid footings of the past, but he cannot merely imitate.

A clever mechanic would nowadays succeed very well in building his own radio, television set, telephone or electric toaster, but all he would have to show for his work would be another already

invented useful gadget or two, and the world would be little the richer for them. And a talented musical craftsman can easily turn out any number of acceptable pieces suitable for dinner music, pupils' recitals or night club entertainment, in the style of Chopin, Grieg or Gershwin; but if they are not really "new," the product of a fresh, inventive mind, they will not increase his stature as a composer, although they might help his bank account.

It would be unfair not to mention the names of at least two earlier composers whose influence definitely shaped our music of the early 1900's. The first is Alexis Chabrier, a Frenchman who died in 1894, and whom Ravel, to quote one illustrious example, considered to be the "father of modern music." He is best known for his popular *España Rhapsody* for orchestra, but he has several important operas to his credit. The other composer is the eccentric Eric Satie, a contemporary of Debussy, who not only was responsible for the turn Debussy's music took in the days of an exaggerated romanticism, but may be considered one of the first to break the spell of Debussy's own influence later, and marked the beginning of the end of French impressionism in music. He was a real pioneer in the formation of a style of extreme simplicity, mostly based on his research in Gregorian music. The effect of his counsel on the young French composers of this period led to the formation of a group of revolutionary writers called "The Six," of whom Darius Milhaud, Francois Poulenc and the late Arthur Honegger achieved greatest distinction in their writing. A more linear contrapuntal style, a return at times to a virtual folk song simplicity—yet with full use of such devices as polytonality (several keys simultaneously) and further extension of harmonic possibilities besides the early abandonment of the use of the whole tone scale (a vital characteristic of some of Debussy's music) can be traced to Satie's example. This in spite of the fact that his own personal and composing habits were of such an irregular nature as to preclude a really commanding and prolific musical output from his own pen.

Like many inventions and discoveries in other fields, new writing technics appeared in other widely separated countries at one and the same time, most of them free from the influence of the other. Russia produced one of the greatest musicians of all time in the person of Igor Stravinsky, still living and producing music of far reaching significance. His three monumental ballets, *The Firebird, Petrouchka,* and *The Rite of Spring,* will probably live as long as there is an orchestra to play them. Unlike many artists, Stravinsky was unwilling to develop an original style and stick to it for the

rest of his life. With the completion of the last named ballet, he was well aware that he had gone about as far as possible in the impressionist idiom—for it has come to be realized that the *Rite of Spring* was not the beginning of something actually new, but the termination of the old, beyond which there was no way out save an about face. The abrupt change to a stark, lean neoclassic style of music brought consternation to the band of admirers who had thought they had at last found the ultimate goal in futuristic writing, and had hoped for a perpetual continuation of this style on the part of their hero. Stravinsky's neoclassicism has eventually given way to a neoromanticism with an admitted attempt to imitate nineteenth century opera composers; and more recently he has used elements of the Schoenberg row technic. If there is such a thing as neoatonalism, Stravinsky may well have achieved it by the time this study is completed.

From Hungary emerged another great musical luminary, Bela Bartok, who died about thirteen years ago, and whose music from the year 1907 began to be recognized as a startling innovation of lasting value. He embraced no particular "system" and remained free to continue the exploration of new timbres, new treatment of ancient Roumanian scales, and to develop instrumental combinations which made constantly increasing demands of performers' skills and exploited individual capacities of the instruments to their very fullest.

Germany's contribution to early twentieth century music might best be exemplified by that of Paul Hindenmith, a viola player of international fame and one of the most prolific, scholarly and original composers of our generation. He has been able to combine a remarkable command of counterpoint with an original harmonic style, and has developed such a versatility of output as to be almost unique among today's composers on that score alone.

There is one real revolutionary music maker of our century who stands alone in modern history to date. He was born in Austria as early as 1874, but his music lost its post-romantic qualities at the turn of the century. This is Arnold Schoenberg, ultramodernist, composer of giant intellect and teacher of Alban Berg and Anton Webern; and because of the impact the works of these two illustrious pupils have made on our musical culture, it may be that Schoenberg's *influence* will eventually cast a longer shadow than his *music*. Before 1909 most of his efforts resulted in an over-expansion of the Wagnerian style, displaying a prodigious mastery of technic and a contrapuntal density almost without parallel. Alto-

gether at the age of twenty-six his achievements must be reckoned as nothing short of remarkable—but they seem to have been born too late.

With the completion of his *Three Piano Pieces,* op. 11, however, Schoenberg made a clean break with the past, and from that time on he relentlessly followed his new path with a fixed and unshakable purpose. To him the idea of a single key or tone center imposed a limitation; so he turned to what is known as atonality (again, not a term favored by the composer himself) in which all twelve tones of the chromatic scale are given equal importance and complete independence.

Old laws are no longer obeyed, but if the casual observer should come to the conclusion that this unorthodox writing has thus become a relatively simple matter, it should be pointed out that in place of these familiar rules Schoenberg in his new scheme was guided by an entirely different set of regulations, even more stern and unrelenting than before the advent of his dissonant counterpoint. In fact one might be led to wonder why he struggled so to free music from her traditional fetters only to forge a completely new set more formidable than ever. Some have said that Schoenberg's music displays a mathematical precocity and nothing more; that a new system was developed along this line merely to disguise the fact that the author was without real musical talent. Such a statement can only be made by one who has not seriously studied representative examples of the composer's works, or is not acquainted with his early writing—the lush, sonorous splendor of the tone poems, songs, quartets and other chamber music of his youth. It is true that some of the old pieces display at times a lack of first rate creative ideas, but it is probably due to the wrong (for him) idiom which he at first embraced, and at any rate, to label him as one melodically ungifted or devoid of musical expression can only disclose a superficial understanding of the man and his work.

And now we come to America, the Beautiful, newest of the great new countries. Many peoples blessed with a far older culture have never produced a distinctive music. Not only have they borrowed freely and copiously from their gifted neighbors, but they have never been able to pay them back. Our music making, until the dawn of the twentieth century, was but a mild reflection of Europe's rich past, but we can now claim to have fostered and developed a unique and provocative idiom, with many varied possibilities,

which has captured the imagination of most of the world's famous composers.

It is "jazz," and the "blues," and it could have originated nowhere else. W. C. Handy, for his *St. Louis Blues*, and George Gershwin, for his fabulous folk opera, *Porgy and Bess*, will not soon be forgotten.

Edward MacDowell has been called the first American composer. He was not an innovator; he established no typical American school of writing, and the most American characteristic about his works might be the titles of some of the shorter pieces. But he did prove that an American could manipulate European models with distinction and give them a color all his own. His music, in spite of his European technics, can never be mistaken for that of someone else—MacDowell never travels "incognito."

America did have another composer working away quietly, "on the side," with music as an avocation, and his works are only now in the process of being evaluated. His name is Charles Ives, a New Englander whose death a few years ago came almost too early for him to realize that we had taken any notice of him whatever. His music has a new sound, unlike any other, and long before many first rate composers were aware of the possibilities of dissonant counterpoint, Ives was experimenting with a theory that several musical units of an ensemble may proceed independently of each other. His music is astonishingly free in tonality, rhythm and harmony, and all is highly original and cast in an ingeniously complex technical mold. He has incorporated much homely folk music of early America in his scores, and many titles suggest early New England historical events and places.

I have mentioned only those composers who I feel are mainly responsible for the turn our present day music has taken. In France, Debussy and Ravel seem to have started the impressionist trend. To the familiar musical "do mi sol" triad, the addition of the seventh, ninth, eleventh and thirteenth intervals to form an expanded harmony; veiled sonorities; implied, imaginative shapes; pastel colors and a fragile delicacy might be termed some of its attributes. Stravinsky, with his three Russian ballets, may be said to have finished this movement in a tonal holocaust which resulted in what was probably the most violent and widespread musical upheaval of all time. He had applied his brutal, angular technic to the impressionist style, leaving it sophisticated and decadent.

Stravinsky abruptly announced that he wished to be more of a classicist, and thereupon presented works, which, in his own words,

were in the style of the eighteenth century, viewed from the standpoint of today. He had indeed scaled down his orchestra, abandoned the Russian and pictorial characteristics, and attempted to produce music of a more abstract purity, free from nationalism. This, then, may help to describe "neoclassicism," to which Hindemith subscribed in part as did many present-day writers. The influence of the older styles is evident to some extent in this new classic output, but the dynamite lies in the fact that all twelve tones of our chromatic system are made available, instead of those within a certain tonal limitation; and if the view of this earlier century (according to some listeners) is not clouded and at times downright poor, it is at least very different.

The most distinguished of the French composers, Darious Milhaud, early in his career became conscious of the limitations of the impressionist movement, and, to cite only one of his many interests, experimented extensively with polytonality. Such a technic, allowing more than one key to proceed in independent fashion at one and the same time, may seem to be based on the wrong premise right from the start. But it must be remembered that what to one music lover may appear shocking or ugly, to another would seem perfectly charming. The sounds emanating from a machine shop, annoying as they might be to the average resident next door, could, in the opinion of the owner of the establishment, be considered the most beautiful music in the world.

Milhaud is a most versatile composer, and has experimented with jazz, South American rhythms and an expanded percussion band with a hissing, whispering chorus and declamatory soloist. He has written pieces in two keys, of simple, ingratiating elegance, and he has produced operas with colossal orchestral settings moving in as many as eight tonalities at once. Possibly one of the most astounding works of this century is his unbelievably complex octet, consisting as it does, of two string quartets, his fourteenth and fifteenth, each of which may be played separately with complete success, and then put together to form a sonority of overwhelming power.

No one can say "finally," regarding the arrival of a certain type of music making, for as of this moment, something new and unheard of might be having its first hearing somewhere on this globe. But at any rate, as far as this discussion is concerned, *my* final consideration will be given to a brief examination of the twelve-tone system, as developed by the Austrian-born Schoenberg, a complex technic which is unquestionably responsible for much of the be-

wildering, mystifying, maddening—boring to some, stimulating to others—music of our time. Many people are of the opinion that from the "system" Schoenberg developed his atonal style. The truth is, that his *music came first.* Without the twelve-tone technic Schoenberg's music had already achieved the characteristics which exposed him to the most merciless criticism of our time. And after his system was invented and announced (not by him, but by his pupils) many of these earlier works were pointed to as the result of the twelve-tone technic.

This system was developed as a guide toward the production of music without a tonal center, where each chromatic tone of the twelve (which are all we have to work with unless we go into the realm of quarter tones or some such division) has equal weight and independence. To this end a "row" is formed, and one is not to repeat a figure until the entire row (twelve tones) is exhausted. Thus no one tone receives more attention than another.

The choice of a row is by no means a hit-and-miss matter. Angular, irregular skips are favored rather than those which would imply a consonant or traditional chord relationship. Having finally settled on one, the notes are set down on a staff, one after the other, with no regard for rhythm—let us say all whole notes, for example. This is the *original,* and is labeled "O," and we will apply to it three traditional contrapuntal devices to obtain what are known as derivatives. First it will be *inverted;* that is, note for note, starting with the first, if the original line moves up one half step, down two half steps, up six half steps, up five half steps, etc., our inverted line moves with the same interval relationship, but instead of up, down, up, up, etc., it is down, up, down, down, etc., and it is called the "I" row. Then the original row is turned around backwards, and the last note is written first, and so on until the first is the last to be notated. This is the *retrograde,* represented by the letter "R," and the last change in the row is *retrograde-inversion,* "RI," formed, as would be expected, by the inversion of "R," or the retrograde of "I."

We now have four rows made up of the same tones, but arranged differently: forwards, backwards, up-side-down and backwards-up-side-down. Then for convenience, each one may be transposed, tone for tone, eleven times. Thus each row begins on a different tone of the chromatic twelve-tone scale, and we now have forty-eight rows, ready for immediate use should the need arise.

It is at this point we begin composition, when mathematics must be abandoned temporarily and we must exercise the creative artist's

choice—choice of meter, rhythms, dynamics, register; and building of tensions to be ultimately released in a satisfactory manner. There is all this and much more in the construction of a theme. It may or may not be completed by the time all the tones of the row have been spent, but always, the row returns, in some form or other, perhaps transposed to other degrees of the scale; so until each row has completed its cycle, it is not to start again.

There are exceptions to all rules—the row is upon occasion divided into smaller segments—but it would take too long to dwell upon the list of alternatives very seriously. Briefly, a single tone may be repeated indefinitely, and trills or tremolando effects are admissible, but once the next tone in order is sounded the onward march continues until the whole row is exhausted.

A row is not necessarily always twelve tones in length. Stravinsky has used eight-tone rows as a basis for some composition, and a fairly complete study has been made of the "hexachord" and its relation to the twelve-tone row by Dr. George Rochberg, one of the musical directors of Theodore Presser Publishing Company. This six-tone chord has to do with what is known as mirror inversion. Six tones are arranged on the staff horizontally so that directly underneath them, note for note, can be mirrored (inverted) another row which will produce six *entirely new* tones. A rigorous discipline must be observed in the selection of each tone and the choice of the point of inversion, lest this result in duplications. Once accomplished, the mirror inversion may be placed beside the original, thus completing a twelve-tone row in one horizontal line, and these last new six tones may be in turn subjected to the mirror inversion. Now all four six-tone segments are interchangeable, the first original containing the same notes (differently arranged) as the second mirror inversion; and as would be expected, the second original and the first mirror inversion possess a like similarity.

After a representative composition in twelve-tone technic has been written it would take a musical sleuth with considerable training and patience to ferret out each row, in its myriad forms and transpositions. For the harmony and counterpoint involved in a serious twelve tone-work is based upon the row also. Furthermore, there may be more than one row involved, and remember, they go every which way! Also, they are often spelled differently, musically, but remain the same in sound. That is, A-sharp is tonally the same as B-flat, and it doesn't matter that it is written in a lower or higher octave—it would still count as one of the row and take its place in the designated order.

Many composers are happy to use this technic on occasion—to build a theme free from monotonous reiteration, or to maintain the system for a certain length of time. But they also like to feel free to listen to the whispering of the imagination whenever it should make itself known, and so we often have a work involving a number of technics. Actually, no one cares how a good melody is discovered or by what means it is developed, so long as the end result is satisfactory.

All are aware that the composer and listener do not always see eye to eye. And because of this the composer is often called a fanatic, and either pitied for his alleged lack of talent, or castigated for an apparent lack of sincerity. Maurice Ravel said once that he was not much concerned about a composer's sincerity. Better qualities, in his estimation, are imagination, consciousness of a world of make believe, a vision beyond that of the casual observer and by all means a seriousness of purpose. Such a composer as Massenet, whose operas *Thais*, *Werther*, etc., became so successful, Ravel considered to be too sincere, in that he put down on paper everything he heard, good, bad or indifferent. He was a scholarly, distinguished teacher of composition, and numbered among his pupils some of the greatest composers of his time, but in his sincere effort to record every idea, no matter how slight, he surrounded himself with page after page of trivial, pleasing music which all but engulfed his few significant examples of exalted music making.

The painter has time and again been confronted with the query, "Why don't you paint a dog to look like a dog, or a house a house?" It must be realized that the artist sees things differently. These things are none the less real, and as a matter of fact, he may actually see further, and extract a more significant meaning from what he sees than would a member of the general public. Not every jumbled up mess is valueless. Not so many years ago a form of art called cubism was the butt of a tidal wave of criticism and ridicule. Of course, not all of it was good, but from this and other much maligned art expressions came in part, at least, the clean, simple, distinctive architecture which dominates today's American scene. Many of us cannot abide the abstractions which hang on the walls of the museums of modern art; yet we can admire the same creation incorporated in the design of an exciting modern floor covering. In other words, a complete failure on the wall could be a howling success under foot!

We can say that a camera doesn't lie; for a realistic pictorial document, a photograph couldn't possibly be less than satisfactory.

Yet, a gifted photographer, looking at a benign landscape—nothing more, apparently, than a house, a barn, a clump of trees—might envision, with his discerning mind, factors of a hidden, appalling nature, and by waiting for an eerie dawn to break, or a menacing twilight's veiled, unsettled glow, and by climbing high on a ladder to find a jagged angle of roof or threatening shadow, this artist might produce an almost unrecognizable, awesome composition from this harmless-looking scene; but authentic beyond a shadow of a doubt.

Objection has been raised, from time to time, to so much complexity in a musical composition. We are agreed that, running through a work of some magnitude, there could be found one or more beautiful, thoroughly understandable melodies, which, if left in a simpler, more unadorned frame, could be appreciated and enjoyed by "all." As it is, they are set to an accompaniment containing, for example, a counter melody in one key, an elaborate obligato in another—bass notes, chords in rhythmic profusion until nothing comes through save a bewildering mass of unrelated tones. We must remember that great literature—the lusty, comic, dramatic plots of the Shakespearean plays are "cluttered up," and happily so, with more or less elaborate rhetoric. Many an average citizen has tried to read a great work by one of our foremost novelists, convinced that there is a fine story with a fascinating, satisfactory ending somewhere between the first and last pages, only to find it a frustrating experience, and forced to realize that more than one reading must take place before anything like a full understanding and appreciation can be obtained.

The cultivated musical ear is able to hear clearly many elements in a piece of music all at once—harmony, melody, rhythm, contrapuntal complexity and all. The trained eye of the competent artist sees at a glance a myriad of detail in a fine painting and reaps an inexpressible delight from such an experience. And the well educated literary mind can grasp with pleasure the inner meaning of complex sentence structure and rejoice in the enforced exercise of his mental faculties. Listening to great music, viewing the canvas of a top flight artist or reading a masterful example of works by an enlightened author does not necessarily fall into the realm of entertainment; yet the intelligent participant is often most highly entertained by the rewarding expenditure of his intellectual powers. So the ultimate aim of a performance of a musical composition of large and difficult proportions, or the unveiling of a master painting, or the publishing of a literary effort of unquestioned value

is not foremost a matter of pleasing the public; but rather the sharing of a rich cultural experience.

This one thing we must realize: That the great revolutionary music of the past is no different from the significant music of our time in at least one respect. The old music was no more fully understood by those who listened to it first than is our new music, now, and perhaps we will even be able to evaluate the music of today more quickly. Johann Sebastian Bach's manuscripts lay neglected for one hundred years after his death. Arnold Schoenberg, who pessimistically said of his latest opera: "It will be at least a century before it can be produced, for it is so far in advance of its time," probably did not realize how fast is the pace of our present day living and consumption of new ideas. For within a short six years of his death the opera *was* produced in full—produced, recorded and published as well!

I hope we will not be like the Italian opera composer Rossini, gifted and successful as he was, who said upon hearing a music drama by Richard Wagner, "No one could possibly understand such a complicated piece of music the first hearing—and I certainly have no intention of listening to it again."

Statistical Classification of Individuals Into Groups

By Charles D. Baker

At the outset, it would seem wise to restate some definitions of the terms in this topic:

Group is defined as a category including a number of individuals that can meet some particular criterion unique to that category. Future individuals may also be members of the particular "group" if they can meet the same particular criterion that distinguishes the group from all other groups. In actuality, such a criterion may be a combination of criteria.

Individual is defined as a person, or a thing, or an event having characteristics which can be measured.

Classification is defined as the process of assigning an individual to a particular category.

Statistical is defined as the manipulation of the numerical measures of various characteristics, resulting in some ordering of the chaos often produced in most members of the human species by multiple numerical quantities.

Much of the work in the past directed toward the process of classification of individuals into groups has resulted in perplexity on the part of the worker. Often the process of classification has been attempted by making use of a somewhat sophisticated outgrowth of the widely known, and relatively simple, concept known variously as Pearsonian, or product-moment, correlation. This outgrowth has been termed multiple correlation and regression. When perplexity has resulted following—or during—the use of the multiple correlation and regression method, the occurrence probably has been the result of lack of knowledge—or lack of sufficient knowledge—of a basic characteristic of the concept. This basic characteristic is that the technique is not designed to distinguish between discrete values, but is properly used as a tool for assigning placement of an individual in a continuum of values which represents placement of other individuals and/or other possible individuals.

Thus, when assigning grades to students, if the grading scale is a continuous one, multiple correlation and regression is usually statistically a very appropriate technique, providing certain other assumptions implied for use of the technique are met, and providing that the worker does not mind the work. If, however, the grading scale is discontinuous, such technique is not appropriate. Such a discontinuous scale would be in effect if "A" meant something different than "B," other than merely having—or being able to produce—more or better of the same type of thing. This might be illustrated by thinking momentarily of sand grains, grapefruits, and

beach balls. Among such, if our criterion were size, the items of the types could be scattered along such a continuum of size. If however, other characteristics than size were considered, we would soon find that measuring scales for some characteristics—such as food values, hardness, and the like—would result in at least one of the types of items being classed as unmeasureable, or practically so.

To return briefly to letter grades, it may seem to some of the "students" receiving lower letter grades that the higher letter grades are not units indicating more of a characteristic which the individual may possess in paltry amount. The "students," and some of their instructors, may really believe that the difference is categorical, and not quantitative. It has often seemed to some that the branch of chemistry called qualitative analysis might more properly be called categorical analysis, since the possibilities are discrete and are not merely more or less of a quality.

This problem of lack of appropriateness of multiple correlation and regression to classification of individuals into discrete, noncontinuous groups has been of considerable concern to many. For example, anthropologists can usually identify a fossil bone such as a skull, and can usually determine whether it be reptilian, mammalian, or whatnot. They may not have much trouble distinguishing between human and simian. But the problem of classification of human skulls into racial, or into regional origin, was severely perplexing. In the early part of this century this problem was brought to the attention of Karl Pearson and his associates in England. Some work on this problem resulted in the ground work for the process of multiple discrimination.[1] Multiple discrimination does not mean being "agin" many different groups as might be inferred from another and considerably different use of the word "discrimination." Such uses of the word often neglect to state the implied modifiers such as race, color, religion, etc. In the case of multiple discrimination, no such modifier is implied.

Although the work in England resulted in some basic statements and some indicators of future developments in group classification (multiple discrimination), little further work was done then. Other statistical tools were in the process of development, and major advances in simplification and precision of work with them seemed to overshadow multiple discrimination. As then conceived, multiple discrimination involved extremely extensive arithmetical and algebraic manipulations. This characteristic still holds true. However,

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1. Karl Pearson, *Tables for Statisticians and Biometricians, Part I,* 2nd ed., The Biometric Laboratory, University College, London, 1924, pp. xxiv-xxvi.

TABLE 1. ORIGINAL SCORES AND RESULTING STATISTICAL VALUES

A. Individuals and Sums

Group and Individual	Measures				
	X	Y	X^2	Y^2	XY
Circle 1	15	11	225	121	165
Circle 2	9	0	81	0	0
Circle 3	0	3	0	9	0
Circle 4	47	70	2,209	4,900	3,290
Circle 5	45	70	2,025	4,900	3,150
Circle sums	116	154	4,540	9,930	6,605
Square 1	57	75	3,249	5,625	4,275
Square 2	56	53	3,136	2,809	2,968
Square 3	52	62	2,704	3,844	3,224
Square 4	24	22	576	484	528
Square 5	52	80	2,704	6,400	4,160
Square sums	241	292	12,369	19,162	15,155

B. Summary Data

	Circles		Squares	
	X	Y	X	Y
Mean	23.2	30.8	48.2	58.4
S.D.	19.23	32.20	13.72	20.54
r_{xy}	0.994		0.858	
$\frac{1}{s.d.}$	0.05200	0.03106	0.07289	0.04869

in the earlier work with multiple discrimination, much iterative approximation seemed necessary in order to develop the characteristic equation and roots of any large matrix of data. Such iterative approximations are no longer necessary, due to the work of two investigators working independently. J. G. Bryan [2] of Massachusetts Institute of Technology, working at Harvard University, and C. Radharkishna Rao [3] of India, working there, each reached usable

2. Joseph G. Bryan, "A Method for the Exact Determination of the Characteristic Equation and Latent Vectors of a Matrix with Applications to the Discriminant Function for More Than Two Groups," unpublished doctoral dissertation, Harvard University, 1950.

3. C. Radharkishna Rao, *Advanced Statistical Methods in Biometric Research*, John Wiley and Sons, New York, 1952, pp. 361-364.

and precise mathematical methods of completing the characteristic equation and roots of a matrix, which values previously could be only approximated. These roots are significant in that from them can be developed systems of weights for the data about any individual in order to classify that individual into the group which it (she or he) is most like. "Most like" is not the precise statement here, but—to many—is somewhat clearer than the more precise "least-not-like."

Figure I.
Original Scores

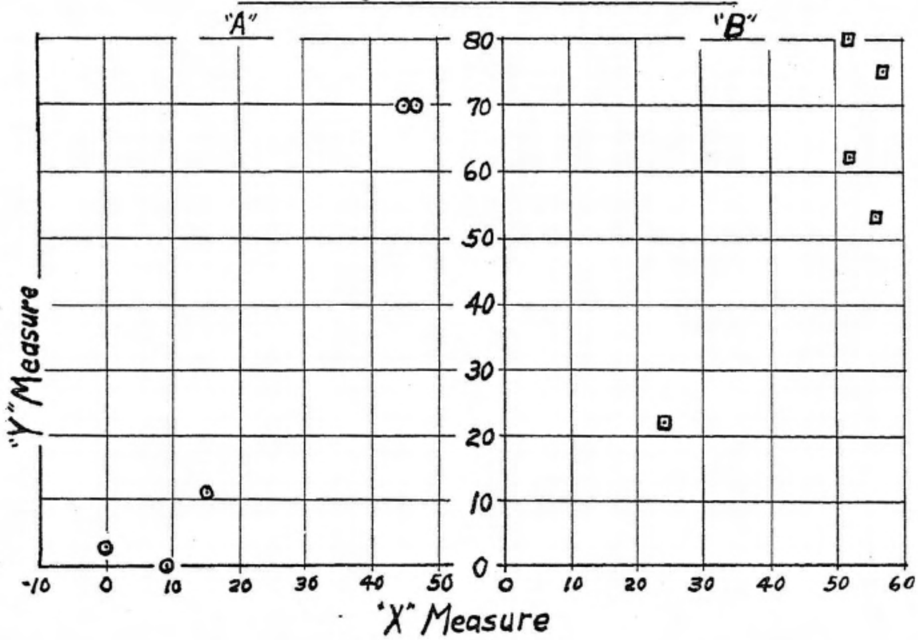
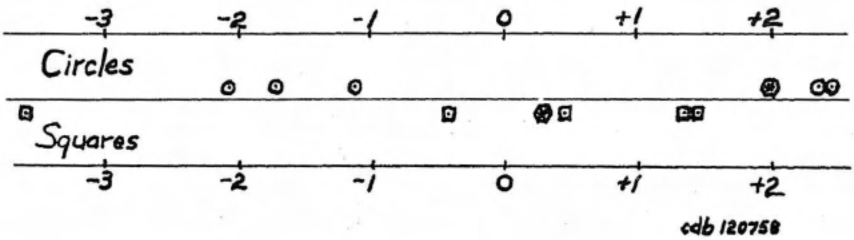


Figure II.

Combinations Resulting From Original Scores



Now to consider briefly an illustrative example. In Table 1 are shown data for ten hypothetical individuals in two groups. Group membership is indicated by "circles" for one group, and by "squares" for the other group, since these individuals are also represented in figures. For each individual the columns of data show measures of two characteristics, squares of these measures, and the product of these two measures.

The lower part of the table shows the results of computation of the arithmetic means and standard deviations of the two measures

TABLE II. CONVERSION AND COMBINATION OF ORIGINAL SCORES

GROUP AND INDIVIDUAL	X	Y	x	y	z_x	z_y	z_x+z_y
Circle 1	15	9	−8.2	−21.8	−0.43	−0.68	−1.11
Circle 2	9	0	−14.2	−30.8	−0.74	−0.96	−1.70
Circle 3	0	3	−23.2	−27.8	−1.21	−0.86	−2.07
Circle 4	47	70	23.8	39.2	1.24	1.22	2.46
Circle 5	45	70	21.8	39.2	1.13	1.22	2.35
Square 1	57	75	8.8	16.6	0.64	0.81	1.45
Square 2	46	53	−2.2	−5.4	−0.16	−0.26	−0.42
Square 3	52	62	3.8	3.6	0.28	0.18	0.46
Square 4	24	22	−24.2	−36.4	−1.76	−1.77	−3.53
Square 5	52	80	3.8	21.6	0.28	1.05	1.33

TABLE III. STANDING OF "ELEVENTH" INDIVIDUAL

CHARACTERISTIC	Group			
	Circles		Squares	
	X	Y	X	Y
Original score	50.0	50.0	50.0	50.0
Deviation score	26.8	19.2	1.8	−8.4
"z" score	1.39	0.60	0.13	−0.41
$z_x \pm z_y$	1.99		0.28	

for these two groups, and the product-moment correlation coefficients for each group on the two measures, plus the reciprocals of the standard deviations for each measure for each group. The data for the groups also are shown plotted by rectilinear co-ordinates (X and Y) in Figures I. A. and I. B.

The original scores in each measure in each group can be converted to deviation scores, and to standard deviation scores, as

shown in Table II. Although rigorous treatment for multiple regression would be somewhat different, for simplicity of illustration these "z" scores can be utilized with practically the same effect as the results of multiple regression analysis. This step is being taken in the interests of simplicity of illustration. Thus, we now add the two "z" scores resulting, and the combined result is utilized in the estimation of quality of standing in each group. The resulting combined scores are shown in last column of Table II., and in diagram fashion in Figure II A. for "circles" and in Figure II. B. for "squares." If another individual is now considered as having scores in measures X and Y of 50 units each, and if there is concern as to whether this individual is more like the "squares" group, or the "circles" group, the system of steps followed earlier for individuals in each group can be applied as shown in Table III. A usual regression interpretation of the results would be that this eleventh individual is more like the high-scoring circles than the high-scoring squares. This is illustrated by Figures II. A. and II. B. in which the eleventh individual is represented by a hexagon.

In considering classifications into groups, the data for the original ten individuals of known group status and for the eleventh individual to-be-classified are combined into one rectilinear co-ordinate plot as shown in Figure III. On the basis of this plot, there seems little evidence to prefer placing the eleventh individual as more like either the "squares" group or the "circles" group.

However, when multiple discrimination (multiple discriminant function) technique is applied, the resultant weights for scores in original measures X and Y are 1.0000 and —0.5268 respectively. The mathematical routine for the determination of these values is more complex by far than the illustration above for correlation and regression. However, the process is not impossibly difficult. When these weights are applied to the original scores for all the eleven individuals, the results are as shown in Table IV. These results can be represented in linear fashion as illustrated in Figure IV.

In contrasting Figure IV with Figure III, the distinction between the results of regression analysis and discriminant analysis may be clearer. In Figure III the eleventh individual seems to fit in somewhere near the middle of either group. In Figure IV there seems definite evidence that the eleventh individual is more like the "squares" group than like the "circles" group.

This basic technique of multiple discrimination has been utilized by very few investigators. A few of the distinctive points of recent uses are summarized below.

Figure III.
Original Scores, All "Eleven"

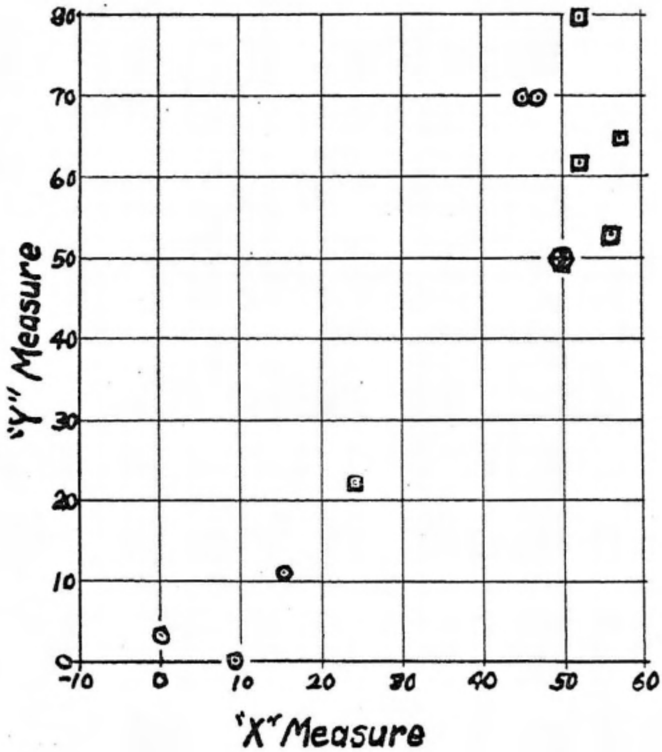


Figure IV.

Resulting Discriminant Scores

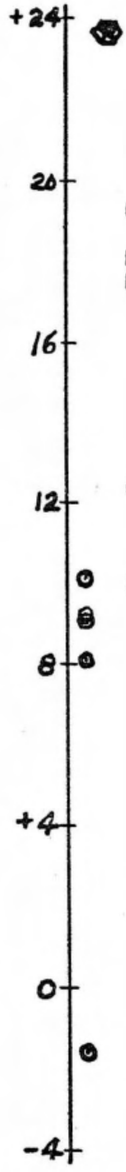


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TABLE IV. CONVERSION OF ORIGINAL SCORES BY DISCRIMINANT WEIGHTS

GROUP AND INDIVIDUAL	Converted			
	X	(Y)	Y	Resultant
Circle 1	15	(11)	−5.8	9.2
Circle 2	9	(0)	0.0	9.0
Circle 3	0	(3)	−1.6	−1.6
Circle 4	47	(70)	−36.9	10.1
Circle 5	45	(70)	−36.9	8.1
Circles resultant mean = 6.96, circles resultant S. D. = 4.84.				
Square 1	57	(75)	−39.5	17.5
Square 2	46	(53)	−27.9	18.1
Square 3	52	(62)	−32.7	19.3
Square 4	24	(22)	−11.6	12.4
Square 5	52	(80)	−42.1	9.9
Squares mean = 15.44, squares S. D. = 4.07.				
Eleventh individual	50	(50)	−26.3	23.7

In 1950, Jackson [4] reported an application of the technique to data for 979 freshmen general chemistry students at Michigan State College (now University) for the purpose of prediction of satisfactory —A, B, or C—grade, or unsatisfactory—D or F—grade. The variables used included decile of ACE total score and scores on arithmetic and reading portions of a locally developed Chemistry pretest. He stated that the

> compound of the three tests distinguishes significantly between students obtaining grades of A, B, or C . . . . and those obtaining grades of D or F.[5]

In 1951, Tiedeman, Bryan, and Rulon [6] reported an application to 6,105 enlisted airmen regarding assignment to one of eight enlisted specialty schools, using seventeen sub-test scores from the Airman Classification Battery. Their report stated little of success, but did provide a complete set of worksheets for the process.

In 1952, Collister [7] reported in his dissertation about an application to the prediction of which division of three of Syracuse Uni-

4. Robert Jackson, "The Selection of Students for Freshmen Chemistry by Means of Discriminant Functions," *Journal of Experimental Education*, 18 (March, 1950), pp. 209-214.

5. *Ibid.*, pp. 211-214.

6. David V. Tiedeman, Joseph G. Bryan, and Phillip J. Rulon, *The Utility of the Airman Classification Battery for Assignment of Airmen to Eight Air Force Specialties*, Educational Research Corporation, Cambridge, Mass., 1951.

7. E. Gordon Collister, "A Comparison of Interest Inventory Scoring Keys Based on Educational and Vocational Groups with Respect to Effectiveness of Classifying Entering College Freshmen Among Alternative Colleges by Multiple Discriminant Analysis," unpublished doctoral dissertation, Syracuse University, 1952.

versity in which students had completed degree. The students were known to be completing a degree in one of the three divisions. Predictive data all resulted from various scoring scales for an interest blank. Success of classification resulting was considerably better than chance.

In 1955, Dunn[8] reported an application of the technique at Brown University in which 1,370 students were statistically classified into fourteen fields of concentration (major) using thirteen variables as predictive data. The variables included entrance tests of scholastic aptitude, English, reading, various other achievements, sex, veteran status, etc. Her study also contrasted multiple discrimination with the most effective use apparently possible of multiple correlation and regression that could be applied for the classifications. Both techniques were significantly successful, and the multiple discriminant technique was significantly more successful than the multiple correlation and regression technique.

The dissertation[9] of the writer reported an application of the multiple discriminant technique to prediction of area of major for 436 male students at Kansas State Teachers College, Pittsburg, Kansas. Each individual was known to be majoring in some one of the five areas. The results slightly exceeded fifty percent success of classification, when—with five groups—chance expectation of correct classification was twenty percent success.

In summary, multiple regression techniques result in the placement of the individual somewhere along a single linear scale of goodness, or along another single linear scale of goodness, with no guarantee that the amounts of goodness on the separate scales are comparable. Multiple discrimination techniques result in sorting the individual into the one of several discrete groups which the individual is most like. For the problem of classification of individuals, the multiple discrimination (multiple discriminant function) techniques are thus most appropriate.

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8. Frances E. Dunn, "Guiding College Students in the Selection of a Field of Concentration," unpublished doctoral dissertation, Harvard University, 1955.

9. Charles D. Baker, "Classification into College Major-Areas of Concentration by Means of Multiple Discriminant Function Weighting of College Entrance Test Scores," unpublished doctoral dissertation, University of Kansas, 1957.

What's Happening in Secondary Mathematics?

By J. D. Haggard

The content of mathematics has long been thought of as representing the ultimate in objectivity and immutability—as certain as two plus two equals four. Apart from the subject matter objectivity, history has placed the various mathematical subjects at well defined positions in the sequence of secondary school work. Algebra is studied in the ninth grade; geometry in the tenth; solid geometry, trigonometry and advanced algebra in the eleventh and twelfth grade. Moreover everyone has come to know just what subjects will be studied in algebra, in geometry, in trigonometry and in the other mathematic courses. No other area of study has enjoyed the status quo quite so long as mathematics.

The traditional high-school curriculum in mathematics was developed during the nineteenth century as a college preparatory sequence. Until very recently the only innovation in that program was the development of general mathematics courses shortly after World War I. This was done to help care for the huge influx of students into high school who had no formal education plans beyond graduation or who would pursue a college curriculum in which mathematics would play no important role.

But alas there is evidence accumulating on the horizon indicating the long established pattern is in jeopardy. There may be something new under the sun. Long before the period of Russian sputniks, mathematics teachers in their various professional organizations were asking serious questions about the traditional material of the secondary school curriculum: Is it consonant with modern theories of learning? Does it represent the real need of a student in our times? Are new developments in science and technology coercing a re-evaluation of the corresponding mathematics? Out of this searching attitude has come a number of research and experimental designs. Considerable sums of money and hours of effort are being expended in an effort to find a valid and reliable answer to what the secondary school mathematics program should be.

We are not now, and perhaps never will or should be, in a position to give final definitive answers concerning the nature of the new mathematics program in the high school. However a number of trends and generalizations are beginning to come into focus. Schools are introducing programs in so-called modern mathematics, wherein

much of the traditional material is being retained but presented in a very diffierent way than in previous years, and even some of the classical content is omitted entirely.

What are the characteristics of this new program in mathematics? What is the nature of its content? What does it try to accomplish that was felt to be neglected in the traditional program?

From a historical perspective the modern point of view in mathematics can be said to have begun with men like Bolyai and Lobachewsky and their phenomenal creation of the non-Euclidean geometries about 1833, and extending to the contemporary work of Godel about 1933 concerning the interdependence of consistency proofs in mathematical systems. The important discovery made by Bolyai was that mathematics is in no way related to the characteristics of the natural world round about us; to inquire about a mathematical system being true in terms of natural phenomena is meaningless. The best one can do is to check its internal consistency; even here we can, as discovered by Godel, have no final answer. The question of whether or not a proposition can be proven both true and false in a given system can be answered only in relative terms; geometry is void of such propositions provided algebra is also free of contradictions; in turn algebra is just as consistent as arithmetic, and arithmetic can be shown to be as consistent as geometry. Since the internal agreement of each system depends on another, we come eventually back to the original system. We have completed a circular action, and the original question of propositions being both true and false is still unanswered.

If mathematical results do not come from nature, then what is the source? Upon what do we build? One of the current objectives in the new program is to examine the dependence of results (theorems) upon the basic assumptions (postulates) of a mathematical system.

> Thus, modern mathematics is a point of view: mathematics is thought of as consisting of the deductive development of certain propositions from a list of assumptions accepted without proof about terms undefined except as limited by the conditions of the accepted assumptions.[1]

The distinction between the geometry of Euclid and that of Bolyai rests in the assumptions used by each writer. The famous "fifth postulate" of Euclid in effect asserts that "Through a point not on a given line one and only one parallel can be drawn." But this assertion is no more true of our physical world than to assume no

1. Albert E. Meder, "Modern Mathematics and its place in the Secondary School," *The Mathematics Teacher*, October, 1957, p. 419.

parallel could be drawn through the point; or what may seem worse yet, two lines through the given point, each parallel to the given line, are possible. The non-Euclidean geometries are indeed constructed upon these latter two alternatives to Euclid's fifth postulate. Once the postulates are clearly stated and the resulting theorems are developed, each of the three geometries, though contradicting each other, are equally applicable to the physical sciences and to nature. The scientist will make use of the theory that affords the best tool for his particular problem.

The traditional mathematics curriculum had its inception in the heyday of the old faculty psychology and its theories of how human beings learn, and was later nourished and nurtured under the influence of the connectionists psychology with all of the emphasis on isolated events. It is both natural and desirable that the content and organization of mathematics should be influenced by the psychological theories of the period, but it is equally important to rethink the program in terms of modern ideas in learning theory. The influence, or at least the relationship, of the Gestalt theory of learning is evident at this point. The current emphasis in secondary mathematics is upon the whole system—the pattern; *i. e.*, postulates, terms, method of proof and results. Rather than memorize and prove one theorem after another, the student is encouraged to examine the postulates and their use in the proof of subsequent theorems, to create new proofs and new theorems, and to examine the matrix and pattern exhibited by the system. Skills, knowledge, and facts are as important as ever; but, whereas we have been inclined to hold them to be the end results of our efforts, we now see them more appropriately as means to an end.

Probably no other concept in all of mathematics has the integrating possibilities and universal application as does the ordinary notion of a set of elements. From high school to the university we have occasion to discuss sets of numbers, triangles, circles and various sets whose elements satisfy certain specific conditions. Here is a means, then, of tying together several branches of mathematics, giving an element of unity and continuity to what has heretofore been handled as discrete units of study. The modern approach is designed to do just this—to develop and study the basic propositions of the theory of sets, both for their own sake as an independent theory, and also as a very important tool in the study of modern algebra, geometry, analysis, and statistics. For example, the construction of graphs has been a common problem in the traditional program of high-school mathematics, and continues to be important

in the new program. But handled within the context of sets of points satisfying a certain condition as contrasted with those points not satisfying that condition, it gives a new insight into an old problem. Inequalities, a topic the traditional program has tended to minimize, are easily handled as a natural extension of equations and their graphs.

Skills, manipulations, and use of formulas in algebra constitute an indispensable area of study; these are no longer to be done as isolated rote learning, but are seen as outcomes of a logical system based on explicitly stated assumptions. We are concerned that the student understand what he is doing; not merely how to do that thing. Using the quadratic formula to solve an equation is a perfectly legitimate concern in algebra; however, of a greater importance would be the examination of the very authority by which the formula was obtained. Short cuts, gadgets, crutches, tricks, and rules are to be avoided insofar as they fail to exhibit a particular case of a general principle or concept.

The Commission on Mathematics of the College Entrance Examination Board has this to say:

> Little change in the actual content of elementary and intermediate algebra is envisaged, but a fundamentally altered point of view is regarded as absolutely essential. Algebra must be treated as a study of mathematical structure, rather than only as the development of manipulative skill in one particular mathematical system. . . . Provision should be made for experience in deductive reasoning in algebra as well as in geometry.
>
> The introduction of the point of view advocated by the Commission will require that teachers familarize themselves with certain concepts not hitherto ordinarily included in their college training, in particular the notions of set, statements, variable, relations and functions, as these are formulated in modern mathematics.[2]

Much of the new emphasis is centered in the process *modi operandi*, where teachers are concerned with the method of solution as much as the answer to the problem. If the fast-moving and ever-changing events of our modern day teach us anything, it is certainly that change and novelty are all about us. Students in school may learn answers to questions and solutions to problems only to find the answers and solutions to be inappropriate for the questions and problems that face them upon completion of formal schooling. Our conscious and controlled efforts should therefore be directed toward emphasizing the "method of learning." Not answers alone, but how to formulate solutions and answers, so that given a novel set

2. Commission on Mathematics of the College Entrance Examination Board, *Modernizing the Mathematics Curriculum.*

of circumstances the student can face the situation with confidence and proceed with the tools of analysis and logic with which he has become acquainted.

That portion of deductive logic appropriate to mathematics is no longer assumed to be obvious to the student, but a segment of the new curriculum will often be devoted to a careful study of the method of arriving at conclusions in mathematics. Very closely allied with the area of logic is the concern for developing initiative and creativity in the students. In the new program he may prove far fewer theorems in plane geometry than usual, but he will be encouraged to formulate new theorems (ones that may not be printed in the textbook) and to work out his own proof. Too often textbooks are so structured that the reader needs to do little else than to memorize the solutions and proofs printed in the book. A part of the new emphasis reverses completely the traditional approach to learning. Instead of following a new definition or formula or concept with illustrations, examples, and drill on that new idea, the modern approach is to turn these two parts around, having the student go through exercise and experimentation until *he* becomes aware of the general principle, law, or formula which applies in the case at hand. Indeed far fewer results are brought to the attention of the student than the older approach permitted, but many teachers feel that the quality of learning in the inductive procedure far outweighs the loss of quantity.

The traditional secondary program in mathematics consists almost entirely of materials developed over 200 years ago. Not only is the subject matter out of step with modern psychology and attitude toward mathematics, but it is lagging badly in its appropriateness to applications in technology and the many new fields in which mathematics affords a very useful tool. In a speech in Kansas City, Missouri, recently, Lawrence Kimpton, president of the University of Chicago, said:

> Mathematics teaching at the high-school level has remained virtually unchanged for decades in spite of the opening of fabulous new fields.
>
> Teaching in high schools in no way reflects the explosion of knowledge that has occurred in the last fifty years. If a man or woman who was in high-school training in the 18th century were to return today, he would find mathematics being taught the same as it was then to a large degree.[3]

Two centuries ago the use of logarithms was a very modern technique of computation, and while there are still other very important uses of logarithms, as calculators they have been replaced

3. *The Kansas City Star*, section A, p. 3, October 12, 1958.

by machines that are much more rapid and accurate. This is only representative of many areas of mathematics. Whole topics are being eliminated or curtailed to provide space and time for what seems more appropriate for our day. The field of statistics and quality control, information theory, and high speed computers will have to be reckoned with in forming the modern high-school curriculum. Moreover, concurrent with the new areas of mathematics *per se*, there is the expanding application of mathematics into many new fields of study, such as social studies, economics, psychology and sociology. Many of these professional groups are holding workshops and seminars in an effort to bring before their people the mathematics needed for their particular area of research and investigation. The needs of the second half of the twentieth century are vastly different with respect to mathematics and its applications than was the case fifty years ago.

Two further points should be made: One is that the material commonly referred to as "modern mathematics" is not really very modern in terms of development. The non-Euclidean geometries are over 100 years old; mathematical logic was explored very carefully by Russell and Whitehead in the early part of this century; topology and statistics, though undergoing some new developments in recent years, are subjects that were studied by our grandfathers.

Rather than containing only mathematics developed in recent years the modern curriculum more nearly represents a new emphasis—a novel arrangement of largely the same subject matter that has been included, with a refreshing touch of new material.

Secondly, the extent to which secondary schools have modified their offering consistent with the above descriptions of modern mathematics is probably rather limited. We are in a period of flux, with each school and teacher seeking new adjustments in content material and method as the opportunities and conditions permit. It is, and will continue to be, a slow evolutionary process. Some are in the midst of real experimentation with the new curriculum; others have already made definite commitments; still others (probably the vast majority) are on the sidelines watching the outcome of the game.

Evolution of European Nationalism

By Ernest Mahan

If nationalism were a part of the dead past it might be left to bury its dead. But coming up out of a rather distant past, it is a part of the living present, and with the lethal weapons now at its command could be the force that would bury us all. For at one and the same time it has been an influence to inspire great people to do great and noble things and yet create a situation in which those same people threaten to do like the Kilkenny Cats.

We are not, then, discussing a subject which has ceased to be of major significance. Nationalism may not be a dominant force determining events in Europe and America to the extent that it did in the nineteenth century, but it certainly continues to be a main movement among mankind, especially in Asia and Africa. Recently in a college class in the history of Modern Europe the observation was made that all periods of time seem to have one or more great movements going on. Sometimes the cause of these movements cannot be discovered and stated completely or adequately, nor can they be stopped or even controlled. They are generated, gain momentum, reach their crest, and then recede, sometimes taking centuries to run their course. The question was raised in this class whether we have such great movements going on in our time. After considerable pondering on the question, it seemed to be generally agreed that we do have, and that nationalism as an important movement in the world is still with us. We hope these preliminary statements are sufficient to persuade you that we are discussing a live subject, perhaps even a fateful issue.

Let us now turn to a consideration of a definition, or the meaning, of a nation and nationalism. In political history a nation has been a body of people having, for one or more reasons, a feeling of homogeneity, a sense of entity, a devotion to a common cause. Sometimes it is a common language as in the case of the Magyars of Hungary; another time it is religion; or it may be a form of government. A state, a central government, a political entity under one flag is not necessarily a nation. One of the best examples in modern history of a state which was not a nation was the Austro-Hungarian Empire. When it finally disintegrated, a number of nations emerged from the ruins. On the other hand a people can be a nation and figure largely in the story of nationalism without being a state. Such was the situation among the Jews until the

State of Israel was created. The United States of America is both a state and a nation and has written largely and indelibly its part of the history of nationalism. Yet it has drawn its population from many language groups and is certainly not a homogeneity in religion. In the first years of the eighteenth century when people of the Tidewater and Piedmont began moving over the folds of the mountains into the valleys of the Alleghenies the first real American was made. There in those valleys running up and down the country a son of New York or New England could meet and marry a daughter of the Old Dominion and their fireside circle could become American. Something new under the sun had been produced which grew to be something new under a new flag.

And so nationalism, in the sense in which we are using it, is a feeling of oneness, a devotion to a common cause, whether because of blood relations, language affinity, religion, or the same political ideals.

In the story of mankind much of the history has been made, not by nations or nation-states, but by empires and dynasties. In the Middle Ages the Christian Church in Europe was, of course, not national but universal, commanding a common loyalty from all peoples and language groups.

The first nation-states to emerge out of the Middle Ages and feudalism were England, France, and Spain. While each of them had consolidated in sufficient measure to be considered both a nation and a state by the fourteenth and fifteenth centuries, most peoples in Europe had to wait for a later time for this development. However, some evidences of an awakening national feeling among these peoples can be found as early as the Renaissance and Reformation. Indeed one of the causes of the Lutheran revolt, some think the major one, was economic. Too much money was flowing out of the Germanies to Rome. For the sake of Germans and Germany it should be kept at home. The trend away from Latin as the universal language and the coming into use of the vernacular may be cited as other evidence, and was a contributing factor in that slow historical process that was changing Europe from Catholicity to national heterogeneity.

The force and the agency that ushered in the era that can really be called the Age of Nationalism was the great French Revolution breaking in 1789, and, in the broadest sense, continuing through the regime of Napoleon Bonaparte. Those earlier precedents, ideas, attitudes, and the influences of the philosophers of the eighteenth century created and nourished a condition that produced the up-

heaval, but the exploding forces of the French Revolution and Napoleon fanned these smoldering fires of national feeling into a flame that became the beacon for so many people for so long. A veritable Pandora's box was opened upon a continental Europe of effete empires and dynasties.

More has been written about the era of the French Revolution than perhaps any other age in human history. Its documents have been examined minutely and research has literally picked it to pieces. Yet its significance can scarcely be overemphasized. The French Revolution did not create them, it inherited them, but it certainly gave a mighty impulse to the two great forces of liberalism and nationalism and released them upon a Europe whose history in the nineteenth and early twentieth centuries was to be largely determined by them.

On the eve of the French Revolution, even in the first months of 1789, France was a land cut up into provinces and other local units divided by such barriers as separate weights and measures, classes with feudal privileges or the lack of them, and local loyalties rather than patriotism for France. The very first step in the Revolution indicated that it was to be a welding process for nationalism when the Estates General was abandoned by the Third Estate and some of the liberals of the First and Second Estate; the fact that when they withdrew and formed a new body they called it the National Assembly. No more representing of classes in a divided France, now everybody represented the nation. On the memorable night of August 4, with this National Assembly aflame with enthusiasm, one erstwhile privileged person after another got up in this Assembly and renounced his special privileges, proud thereafter to be simply a citizen of France. In fact the title citizen took the place of all others and we came to know Citizen Genet or Citizen De Farge. The plebiscite came into use as the method of self-determination by a people of their national affiliation and has been employed many times since then, especially following World War I. In the nooks and corners of France an altar was set up bearing the inscription "The citizen is born, lives and dies for the fatherland." Round these altars citizens would gather and pledge fealty in oath and song to the newborn nation.

The French Revolution brought the first national system of education so that history and patriotism could be taught to the new type of citizenry. The Royal Louvre became the first national museum. Provincial idioms gave way to a nation-wide French language. The clergy and the church were nationalized and church

lands were confiscated by the state to be used as the base for a new money system. The people celebrated in national festivals, and Robespierre, "the dapper little lawyer" of the French Revolution, reporting to the National Convention on these festivals, caught the spirit and exuberance of them and declared that a man should be happy to die for his fatherland.

Plenty of occasion was furnished in the French Revolution for the new citizen to die for the nation. In the first years foreign war threatened its life and called for all and the best that could be mustered in its defense. The first universal conscription system was instituted. This *levee en masse*, to use the French phraseology, really called the nation to total war. Listen to its call for all bodies and souls: "The young men shall go to battle; the married men shall forge arms and transport provisions; the women shall make tents and clothing, and shall serve in the hospitals; the children shall turn old linen into lint; the aged shall betake themselves to the public places in order to rouse the courage of the warriors and preach hatred of kings and the unity of the Republic."

Danton, a leader in the National Convention, declared that "no one can refuse his services without being declared infamous and a traitor to the fatherland. Pronounce the death penalty for every citizen who refuses to march, or who directly or indirectly opposes the measures taken for public safety." This new national call to arms paid off. The invader was defeated and driven back; and the tricolor, the new red, white, and blue flag, was carried through battlefields to the natural boundaries of France, where the *fleur-de-lis* of the Bourbon dynasty could never be carried in so many previous attempts. Hans Kohn observes that "The new French nation-state emerged covered with greater glory than ever in the days of her mightiest kings." [1]

The description of the French Revolution as the dynamo that generated the current that made the next century and a half the Age of Nationalism should include mention of the *Marseillaise*. Composed by Rouget de L'Isle and first sung in 1792 by a band of men who marched from Marseille it became the new national anthem, perhaps the most stirring one ever composed. In the appealing theme it expressed and by its martial music it called powerfully, "Ye sons of freedom, wake to glory, Hark what myriads bid you rise." Coupled with the idea of fraternity, that all French citizens were now brothers under the same flag, expressed in the

1. Hans Kohn, *Nationalism, Its Meaning and History*, New York: D. Van Nostrand, 1955, p. 28.

great watchwords "*Liberté, égalité, fraternité,*" Frenchmen were inspired to go places and do big things.

Napoleon was not a nationalist, but rather an imperialist. However, he sometimes paraded in its name, and pretended to serve its cause with other peoples such as Poles. The effect of his campaigns and conquests, either directly or indirectly, often planted the germ of nationalism in the peoples of Europe or sorely wounded their national pride and made them determined to avenge it and redeem it.

In a sense Napoleon was really a son born of the French Revolution and the agent of its ideas and ideals in Europe. Wherever his conquering armies marched, to Spain, to the Italies, into the Germanies, they seemed to arouse a latent or smoldering spirit of nationalism among the people. If the historian may be permitted to use imagination, one can well imagine how those people looked in awe at those invading armies, bearing so much that was new and different, with their military bands playing the *Marseillaise,* and said to themselves, "Why can't we be like that, too? This is a good idea for us that has blossomed in France." Napoleon's Italian campaigns helped to light the fire that was to burn for Italian unification. He defeated the Germans on the battlefield of Jena, but in so doing his victory and Prussian defeat seemed to teach the Germans a lesson, that strength and greatness could be found in unification. The spirit of nationalism was awakened among the Spaniards and they revolted against Napoleon in 1808 to help wage the Peninsular War against him. The patriotic war for Mother Russia was a reaction against Napoleon's invasion.

The French Revolution caused the flame of nationalism to burn brightly in France. For the first time in history the rank and file of a country became imbued with its spirit. *Fraternité* was the feeling, and spontaneous was the cry of *vive la nation.* But it took the marching armies of Napoleon, soldiers fighting for *la patrie,* to carry the germ to other lands and to demonstrate what a people fired by such a zeal could achieve.

Napoleon was sent to St. Helena. He had brought nationalism up out of the French Revolution and carried it to foreign lands. In these same lands among the conquered peoples his invading armies had aroused a national feeling and resistance which, more than anything else, had sent him back again in defeat. An era had come to an end, an era which had built up and released upon Europe the two great forces of liberalism and nationalism which were to operate powerfully and more than anything else to make the future what it became.

The Congress of Vienna, which gathered in 1815 to remake the map of Europe torn asunder by Napoleon, showed little regard for these forces. The Congress took cognizance of them but for the purpose of suppressing them. Territories and people were disposed of without consideration for national feeling. The guiding principles were to give back to empires and rulers what had been theirs before the wars, or failing that, to compensate them with something else. Thus a power balance was restored. It made no difference if the thin skin of Empires was stretched over many national groups threatening to break out. "Legitimacy" was given to dynasties; the will of language groups was disregarded. A system of alliances was constructed to maintain the status quo. Periodic congresses were to be held to see if a fire wagon, in the form of an army of intervention, needed to be sent anywhere to put out a threatened conflagration.

If one looks upon the map of continental Europe as it was constructed by the architects of reaction in their work at the Congress of Vienna, one observes that it is composed, in general and for the most part, of empires and geographical expressions, not nation-states. The Ottoman Empire held in subjection a number of Christian peoples in the Balkans. The Hapsburg Empire was a great house of cards with many language groups conscious of their own traditions and separate identity. The vast Russian Empire also had within its boundaries language and religious groups who had little feeling of belonging or loyalty. Italy was only a "geographical expression." It was not a Germany but the Germanies, although some consolidation had come out of the Napoleonic wars. Even the Belgians had been joined with the Dutch to make a rather unnatural Netherlands. Such was the situation which a concert of European powers, sometimes known as the Metternich System, tried to maintain against the underground movement and growing pressure of nationalism generated by the French Revolution and released by the wars of Napoleon.

We have said that one thing which has given people a group consciousness and a feeling that they are an entity is an affinity in language. Now that this epidemic of nationalism had been let loose upon Europe at the beginning of the nineteenth century it would seem desirable, even necessary if we are to understand adequately the spread of this epidemic, for us to have a look at the language map. If the geographical location and boundaries of these language groups were coterminous with the boundaries of independent political units, if each language group had a flag and a state, then we would have nation-states and language would give no cause for

the force of nationalism to create a disturbance. But if the boundaries of empires had been drawn without regard for the ethnological factor, then the force of nationalism would operate to change the situation and make these groups into nation-states.

Looking down upon the face of Europe after 1815, we see that the boundaries of states and dynastic empires and the location of language groups were not coterminus. Peoples did not live under the flag of their choice. The doctrine of self-determination must wait a hundred years to be preached and administered widely. In general we see two conditions favorable for the epidemic of the new nationalism. One was a situation where one state had in it many language groups. The Hapsburg Empire was a good illustration. Another kind of condition was where one language group composed a number of states. The Germans were such a people, composing not a Germany but the Germanies.

For one who would understand the history of Europe during the last hundred and fifty years nothing can be more revealing than a study of the linguistic map. To gaze at it intently and carefully, noting the details, is just about the most rewarding thing the student of history can do. One notes that most peoples are included in three great families of languages, the Latin family, the Slavs, and the Teutonic groups. Some people, such as the Magyars and the Finns, are not members of any of these three families. But within each of these three great families are many languages. To try to enumerate them all would grow monotonous. A partial list of Slavs alone might include Czechs, Slovaks, Ruthenians, Poles, Croatians, Serbs, Slovenes and Bulgars, not even to get into Russia proper.

It may seem that we are dwelling too long upon a force released by the French Revolution and Napoleon and the clash of that force, after 1815, with a system in Europe which aimed to repress it. But we have been describing the foundations from which grew the age of nationalism. The great central stream of events that has flowed down through the years since 1815 has had other elements in it. The discoveries of science, the industrial revolution, and the force of political liberalism have been other determining factors. But probably nationalism has been the most important one.

The inspiration had been given, the spirit had been engendered, and the seed had been planted. Literary artists and philosophers cultivated the soil. Only the occasions needed to be created for these language groups to strike against the Empires that held them in subjection, or to move toward unification, and make the dream

of a nation-state come true. In the Empire of the Hapsburgs and in the Ottoman Empire where so many of these subject nationalities were to be found, pressure for independence increased as time passed and a situation developed which one historian has described as a "howling chaos."[2]

The long process of disintegration of the Ottoman Empire began with the Serbs. As early as 1804 they staged an uprising and after years of struggle gained their independence. In 1820 a revolt began among the Greeks. This was a bitter struggle in which many thousands lost their lives. Britain, France, and Russia intervened in behalf of the Greeks. In the naval battle of Navarino Bay the Allied fleet blasted the ships of the Ottoman Empire into kindling wood, and in 1829 Greek independence was recognized.

This same inspiration that flowed out of the French Revolution influenced the Spanish colonies in Latin America. They were also affected by the North American revolution against the British Empire; and imbued with its idea and ideals, under such leaders as Simon Bolivar and San Martin, they revolted against the mother country and by 1823 had completed the separation from Spain and the establishment of national independence.

The Flemings and Walloons of Belgium had been placed in the Kingdom of the Dutch Netherlands by the settlement at the Congress of Vienna, as we have seen. They did not long stay put. In 1830 they revolted and went about in mobs declaring in song that they would give that country liberty which had given life to them. Belgium was declared independent and was finally so recognized in 1839.

Poland made a bid in 1830 for the resurrection of freedom and nationhood but was defeated by the troops of the Russian Empire, and many of its leaders were sent to Siberia. This episode added to the tradition of Polish nationalism and "Poland was proclaimed the Christ among the nations, innocently crucified" and destined to rise again in a time that was auspicious.[3]

The revolutionary movement of 1848 in Europe was the most extensive upheaval since the great French Revolution. In some way it affected practically every country in Europe. Both nationalism and liberalism were usually present as causal factors, and in some instances nationalism appeared to be the more important of the two. The language groups of the Hapsburg Empire, the Magyars of Hungary, the Italians, and the Slavic groups made their

2. Robert Ergang, *Europe Since Waterloo,* (Boston: D. C. Heath, 1954) p. 308.

3. Kohn, *Nationalism: Its Meaning and History,* p. 42.

protest and struggle against subjection. Metternich fell from power. But the time was not yet for the disintegration of this heterogeneous Empire. Revolts were suppressed and in large measure the old order was restored.

In the Germanies, where, as we have said, one language group composed many states, an effort was made in 1848 to make them into one united nation. Delegates to the Frankfort Assembly formulated a constitution to serve as the instrument of government for such a union and offered the crown to the King of Prussia. Had he taken it a Germany might then have been born; but he refused the crown. It would be coming up from below, by authority of the people, and he held to the divine right theory, that crowns must come by grace of God. This effort failed then, but it also added to the dream and established a tradition for German unification.

Returning now to the Ottoman Empire, the defeat of the Turks in the Crimean War set the Rumans, a Latin language group the core of which was in the Provinces of Moldavia and Wallachia, on the road to nationhood. The defeat of Turkey in the Russo-Turkish War of 1877 resulted in the creation of Bulgaria, and a congress of the powers in 1878 at Berlin recognized the independence of Rumania, Bulgaria, and Montenegro. Thus these subject peoples, one after another, as occasion offered, were emerging from the rotten fabric of empire that sought to restrain them.

In the Italies where Napoleon had taught the lesson of unification, the Congress of Vienna had ignored this lesson and had created nine different states with the shadow of the Hapsburgs cast deep over most of the Peninsula. But the Congress of Vienna could not put out the fires of nationalism. The *Carbonari* (Charcoal Burners) literally lighted fires on the hills at night, the *risorgimento* (resurrection) set on the horizon a gleam to be followed, and the Young Italy society, which grew to a membership of many thousand, gave Italians from one end of the Peninsula to the other a feeling of brotherhood and a resolution for freedom and unity.

Outstanding leadership came to the fore. Mazzini became the philosopher, Cavour the statesman, and Garibaldi the soldier of the movement for unification of the Italians into one nation. Italians differed in opinion about the kind of government they should form, but in mass they agreed that they wanted to be one nation.

The Kingdom of Sardinia became the nucleus around which could be joined the other parts of Italy as they could be added. Mazzini and his Young Italy movement had created the spirit. Cavour, the

statesman, took Sardinia into the Crimean war evidently to get her feet under the peace table. He wanted help against Austria and he got it from Napoleon III of France. In a war against Austria in 1859 a victory at Solferino gave Lombardy to the Sardinian Kingdom.

By a deal with Napoleon III, in which Nice and Savoy were surrendered to France, and by a vote of the people, the Duchies of Tuscany, Modena, Parma, and Romagna were united with Sardinia. Garibaldi, the soldier next made his contribution. He led an expedition of the so-called thousand "Red Shirts" to Sicily and Naples and conquered them with little opposition. Meanwhile Sardinian troops had occupied the Papal States. In March, 1861, at Turin the new Kingdom of Italy was proclaimed.

In this Italian unification movement two more steps were to be taken. In 1866 the new Kingdom entered into an alliance with Prussia and participated in the Seven Weeks War against the Hapsburg Empire. At the end of the war Italy gained Venetia as a reward for this aid to Prussia. Italians were defeated on the battlefield, but Prussia won the war and so the Hapsburgs lost Venetia to Italy.

Italians who had dreamed nationalism and leaders who had planned it would not be satisfied until Rome was acquired and made the capital city. When the Papal States had been acquired in 1861 Rome had not been included. French troops were stationed in the City, and so long as they remained there Napoleon III felt obligated to hold it for the Papacy. But in 1870 the outbreak of the Franco-German War caused these troops to be withdrawn. King Victor Emmanuel then moved in, and in 1872 the Eternal City became the capital of the new nation-state. Several hundred thousand Italians were left outside of Italy but contiguous to it. Down through the years until after World War I nationalism caused Italians to complain about *Italia Irredenta* and wait for the opportunity to redeem it.

We now turn to the other nationalistic movement in Europe to unify many states but only one language group. We have seen that the King of Prussia had refused to take a German crown that would come up from the people. But the *Zollverein* had been in operation, co-operation among the Germanies had been promoted, and nationalism had grown. Bismarck became chancellor and proclaimed his "blood and iron" policy. Literally Germany was unified by blood and iron. The Danish War brought the Duchy of Schleswig. The Seven Weeks War with Austria in 1866 not only secured Hol-

stein but led to the formation of the North German Confederation in 1867. Bismarck then arranged treaties with the South German States, which had not come in the Confederation in 1867, ostensibly to protect them against the designs of Napoleon III of France. He then proceeded to engineer a war with France. An appeal to German nationalism had set the stage for war.

This Franco-German War of 1870-1871 was the consummation of Bismarck's "blood and iron" policy by which German unification was hammered out on the anvil of war. The Second Empire of Napoleon III was defeated and the German Empire was born on French soil in the Hall of Mirrors in the Palace of Versailles. It was destined to come back to this same place of its birth to die in 1919, after defeat in World War I. All of the German states were included in this new empire except Austria, which was the German speaking core for the heterogeneous Hapsburg Empire.

The force of nationalism in the nineteenth century had created a number of new nation-states. But a number of language groups were left with only their dream. For the most part, those groups were located in two empires, the Russian and the Hapsburg. They must wait until World War I tore those Empires asunder to have their dreams of becoming nation-states come true.

While nationalism as a force made its contribution to the history of Europe in the intervening years between the end of the Franco-German War and 1914, the next great occasion for the emergence of language groups as new nations developed out of the First World War. As a matter of fact it was a Serbian nationalist agent who carried out the assassination of the Austrian Archduke Ferdinand in June, 1914, and struck the match that ignited the powder keg of war.

From the very first some language groups hoped this war would result in their liberation. During the course of the war the doctrine of self-determination for these peoples was enunciated as one of the guiding principles for making the peace settlement. As it wore on toward the end, the stresses and strains began to tell more and more on the Hapsburg and Romanov Empires, and these discontented and even rebellious language groups were a greatly weakening force.

In defeat the Hapsburg Empire disintegrated. The South Slavic groups joined with Serbia as the nucleus to form the new nation of Jugoslavia. The North Slavic groups became Czechoslovakia. The Magyars declared their independence from the Germans of Austria and set up the nation-state of Hungary. The Rumans of

Transylvania joined their brothers of Rumania. At last much of *Italia Irredenta* was redeemed by Italy.

With the Czar executed at Ekaterinburg and his Empire in ruins, the occasion was created for certain language groups in Russia to get on the bandwagon of nationalism. An independent Poland rose again, resurrected from her crucifixion in 1795. The Finns formed a nation-state. Even the Baltic peoples, small though they might be, emerged as Estonia, Latvia, and Lithuania.

We have seen that the Balkan nations emerged from the Ottoman Empire in the nineteenth century. By the time of World War I not much of this Empire remained in Europe, but that which remained, located in Asia and Africa, was another one of the casualties of the war. It fell apart and in its place came a number of new states and mandates of the League of Nations which have since become Mohammedan nations.

That same nationalistic flame that fired the subjected language groups of Europe spurred the Greeks after this war to strike for a greater Greece, a resurrection of ancient glory. It could only come at the expense of a highly nationalistic new Turkey. A war was fought between the two which was followed by a wholesale exchange of populations, which itself was a part of the nationalistic movement.

Irish nationalism had been burning brightly for a long time before World War I. A home rule bill had been passed by the British Parliament just before World War I, but civil war threatened between the Irish Nationalists and the Protestant Ulsterites. Britain postponed enforcement of the measure with the promise that the question should be considered again after the war. During the course of the war occurred the Easter Rebellion in Ireland. South Ireland became Irish Free State with dominion status in 1921, and the Sinn Fein movement together with *Fianna Fail*, a nationalist party, finally accomplished complete independence. Ireland became the new nation-state of Eire.

We have said the Jews had been a nation but not a state. Their ancient state had been conquered by the Romans and had ceased to exist in 68 A. D. But from that time on through all the centuries and in all the lands to which the Jews wandered they kept the dream alive of re-establishing a Jewish state in Palestine. The anti-Semitic movements in Europe in the nineteenth century, especially the pogroms in Russia, led to the formation of the Zionist organization. The first Zionist Congress was held in Basel, Switzerland, in 1897. Taking its name from the hill of Zion in Palestine, where

once had stood the royal palace of David, this organization through the years campaigned for the migration of Jews to Palestine and the re-establishment there of a national home. In the midst of World War I came the Balfour Declaration by which Great Britain pledged her support for the establishment of a Jewish national home in Palestine. After the war Palestine became a British Mandate. A slow but steady influx of Jews aroused Arab nationalist resentment. As the years passed and persecution of Jews increased in Europe, this influx became a rising stream. As the stream of migrants swelled, Arab nationalist apprehension and resistance increased. Violence erupted in the street between the Jewish Wailing Wall and the Arab Mosque of Omar. War finally resulted and a victory brought the Jews the new nation-state of Israel. This episode in the story of nationalism occurred outside of Europe, but the occasion was mostly created in Europe.

Really, in telling the story of the evolution of European nationalism, the greatest extreme to which it went, and the crest of this great wave of history was reached, with the emergence from the wreckage of World War I of the national socialist movement. In some ways this nationalist movement was different. Whereas, nationalism hitherto had usually been associated with political liberalism, this movement aimed at the totalitarian state. But in other ways it was the same urge and surge. National socialist Germany demanded the redemption of Germans in such places as Sudetenland, Danzig, Memel, Upper Silesia, and especially Austria. Mussolini in Italy not only sounded the call for the resurrection of the glories of ancient Rome but also complained that *Italia Irredenta* still existed in some places and must be redeemed. Not only did this form of nationalism create a new type of state in Germany, Italy, and Phalangist Spain, but it was in evidence in many parts of Central and Western Europe, in the form of political groups, such as the Iron Guard in Rumania and the *Croix de Feu* in France.

The Rome-Berlin Axis joined with Tokyo and this ultranationalist Axis precipitated World War II. With its defeat Nationalism seemed to have spent its main force in Europe and other parts of the Western World. Out of the ruins of this last great explosion has come such movements as Benelux, the Schuman Plan, the North Atlantic Community, and even the United Nations.

But in Asia and Africa the flame burns brightly, in some places even rages, and its devotees feed it with fanaticism. Now that nations have nuclear weapons and can wage biological warfare, what about nationalism? In modern Europe it has been the main

stream. It has inspired peoples to glorious enterprises and to make their finest contributions to civilization. But, as we said in the beginning, with these new lethal weapons, they could end like the Kilkenny Cats.

The historian cannot predict the future. He is more reluctant to try it than most people; although he should be best able to do it. But perhaps he may be permitted to dream of a safer world tomorrow. The most practical and promising plan would seem to be the promotion of the North Atlantic community of nations. These peoples still have much of the world's resources and technological know how, governed, we hope, by the Judeo-Christian attitude and philosophy. This North Atlantic community could present a united front to a fitful world and could probably hold it in awe until such time as world-wide control of weapons can be accomplished.

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