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NOVA UNIVERSITY is a privately endowed institution of higher learning which is starting its first programs at the doctoral and post-doctoral level to insure a strong base of scholarly research in a few specific areas, prior to the establishment of a small, more broadly oriented undergraduate facility. Our goal is to establish a first-rate institution to serve the southeastern region of the United States, sacrificing size and breadth and, initially, concentrating its resources to assure the quality of its programs.

The slowly emerging community of scholars at Nova must have a medium for expressing their views and those general research interests not contiguous with their own professional publication. This JOURNAL will fill that need and we invite others to join with us in contributing to it.

Very few of us are privileged to be part of the creation of a new institution. It is hoped that through this publication readers and contributors can identify themselves with the University and share in the benefits of its development.

Dr. Warren J. Winstead is President of Nova University
I MUST ADMIT that I feel a sense of awe in participating in the birth of a new university oriented to science at a time when our nation, now technically great, cries out for renewed vigor and strength in higher education as our responsibilities in and for the world grow.

A century ago one might have wondered whether the future of our nation really was to be coupled to the cultivation of higher education, and whether we could continue to satisfy most of our needs adequately, particularly in science and technology, by importing European ideas and brains and by sending a significant fraction of the component of our native talent interested in science and engineering abroad for the final stages of higher education. In those days our greatest educational institutions oriented toward civilian life focused on liberal arts, law, and the ministry; most of our engineers received their training at Annapolis and West Point. It is true that Rensselaer Polytechnic Institute was well established in engineering education for civilian life at that time. However, the Massachusetts Institute of Technology was then an infant of still uncertain future; the great state universities were still essentially on the drafting board following the passage of the Morrel Act in 1862. Only a few farsighted idealists in our land, such as Joseph Henry, the first secretary of the Smithsonian Institution and the second president of the National Academy of Sciences, and William Barton Rogers, the founder of MIT, felt that our nation had an

Frederick Seitz is President of the National Academy of Sciences. This paper is an address presented at the dedication of the site of Nova University on December 11, 1965. Dr. Seitz is a membr of Nova University Advisory Board.

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inescapable destiny in higher education in the fields of science and engineering.

Today the picture is entirely different as a result of the wise investment of private and public funds. Ours is not only one of the greatest technologically oriented nations in the world, but that technology now rests squarely upon advances in science which must, in very substantial measure, be generated in laboratories in our own country. Only a small percent of our population completed secondary education a century ago and, in fact, the fraction was only of the order of ten percent when I was born, fifty-odd years ago. We are now in the climactic phase of a very great transition on the educational scene which has had a century of incubation. In another generation half our school-age population will complete college-level education. Half the graduates will undertake postgraduate study. By that time, we will as a nation have gone a long way toward matching the opportunities available for education to the intrinsic capabilities of our entire population, at the highest as well as at the elementary and secondary levels.

There is little doubt that the greatest part of the burden of the cost of education at all levels will be borne increasingly by public funds, provided by the local community, the state, and federal sources. It is particularly imperative that the federal contributions to higher education expand if our national strength in the most crucial aspects of professional education is to be maintained. National survival probably will depend on ever-increasing commitment of federal funds for higher education.

Should this increase in public support come to pass, however, the contributions of farsighted private philanthropy will nonetheless continue to be as important to education as they ever have been in the past, for they play several very important roles. In any institution, public or private, they usually provide the critical degree of flexibility needed to foster imaginative programs as part of the growth of the academic system. In effect, they permit vital mutations during the evolution of the educational system.
Even more important, however, private funds guarantee the preservation of one of the most important constituents of our academic heritage, namely the private university which is free to use its resources without paying undue attention to non-academic pressures that so often inhibit our public institutions.

If we accept the fact that a strong framework of higher education is now vital to our national welfare, then no private philanthropy for public good is more important than that invested in education. This contribution will be indispensable for maintaining quality as well as flexibility in many years to come.

There has been much criticism both inside and outside university walls in recent years because the most creative members of the faculty have focused an increasing fraction of their time and energy on the activities associated with graduate work, particularly on research, which actually is an integral part of graduate education. This matter was, in fact, the subject of a recent series of Congressional hearings. While the question of faculty responsibilities is always a matter of such importance to the public that it merits public discussion, one must recognize that the continual upsurge of advanced professional education so vital for our national welfare must inevitably have its effect on the overall pattern of education in our country.

The overwhelming majority of individuals close to our institutions of higher learning know that the years since the end of the war have brought a vast improvement in the quality as well as the quantity of advanced professional education in our land. This improvement would not have been possible were it not for the increase in both private and public funds directed to all aspects of higher education including graduate research since the war.

If one does decide to examine the distribution of endeavors of our most creative faculty members, one should also re-examine the corresponding endeavors of our students. Traditionally, our system of education beyond the secondary level is built around the four-year undergraduate program, which
occupies a hallowed position in our entire social structure for reasons which I need hardly spell out on this occasion. The mere mention of undergraduate study automatically conjures up a host of associations including homecoming weekend and the senior prom. A century ago the traditional four-year college course was adequate for the most important forms of professional education of that day. This is no longer true. Would it not be wise to re-study the entire sequence of educational steps from secondary school onward, in order to see how the pattern of flow of students into the advanced levels of professional higher education could be placed in greater harmony with the requirement that our most creative faculty members must inevitably focus a larger share of their time on what we now call postgraduate work? Please understand that I am not at all prepared to recommend any rapid or radical change in our existing educational framework, since it has served our national purposes so exceedingly well in the past. I only wish to suggest that it may be healthy for us to take the view that our educational structure should be sufficiently plastic to handle all the needs of our nation in some optimum way, including the requirement that our universities must train many more men and women at the highest professional levels. It is possible that by this time the conventional four-year college degree has gained more social than practical significance in our society. In any event, one should be sure that the relative worth of the bachelor's degree has been maintained before leveling criticism at the very dedicated individuals who are responsible for maintaining the quality of the more advanced aspects of graduate education.

I am impressed with the fact that Nova University is well south of the Mason-Dixon Line and represents a remarkable new venture in education in the southeastern section of our country. It is quite clear that this region of our land is well on the road toward gaining eminence in technology. Moreover, every step that is taken toward advancing higher education in science and engineering in this region is in the national as well as the regional interest.
William Barton Rogers, who, as I mentioned earlier, founded the Massachusetts Institute of Technology in the Boston area, was a son of the South. He was associated both with William and Mary, where his father was a member of the faculty, and with the University of Virginia, where he taught for a number of years. His initial dream was to establish an institute of technology in Virginia in order to accelerate the industrialization of the southern states. Unfortunately, a series of unhappy events in Charlottesville during the period of rising tensions and public emotions before the Civil War convinced him that the atmosphere in the South was not then appropriate for realization of his dream. With some reluctance he turned to New England, whose rocky soil proved more fertile for his goal. A century has changed all this. The time is more than ripe for getting on with the Rogers dream.

To those who may wonder about the time required for a new institution to make its mark, let me emphasize that within a generation after the University of Chicago was formed in 1890 it had not only made a very deep impression on the educational pattern in the Midwest, but it had also so re-oriented national thinking that it quickly acquired one of the most brilliant faculties in the country. Three of the physicists who joined its staff in that period were our nation's first Nobel Prize winners in physics. One of these moved West to propel another new institution into international fame in a short period of time.

Granting money, aspiration, and inspiration, Nova University can go far rapidly. We join in wishing it great success.
Planning A New University Today

RAY PEPINSKY

WHERE DOES one start, in talking about a new university? Perhaps in this way.

I cannot tell you what the political world will be like in 1975, what quarrels will exist between nations, whether the last name of this country's president will be Kennedy, whether our automobiles will again have tail fins, whether the Yankees will be pennant contenders. I can tell you some things, however: how many new campuses with capacities for 27,500 students each there will be in California; how many new junior colleges there will probably be in Florida; that the factory work week will probably be under thirty hours in this country; that the population of southeast Florida will have doubled with respect to its present level; that there will have been men on the moon, and that we will be mining the oceans and some of us living beneath their surfaces; that our farms will be mechanized and our factories largely automated; that our chief social problems will still be unemployment, and what our older citizens can do with the rest of their lives; that we will be training university students for work which has not yet been developed, for operation of systems not yet invented, for research and applications of research results on materials and processes and theories not yet contemplated at the time of this university training; that scholars and specialists will find it even more difficult than it is today, to know what other scholars have done, to talk with one another and to explain their work and thoughts to laymen.

Dr. Ray Pepinsky is Robert O. Law Professor of Physics and Chemistry at Nova University. This article is based on a discussion presented to the Fort Lauderdale Chamber of Commerce, September 17, 1965.
It is a difficult fact to accept, that although the pattern for our universities as we now think of them is some 800 years old, and the roots of our scientific era began to sprout some 350 years ago, yet something like 90 percent of the scientists who have ever lived are still alive! That is a measure of the acceleration of education and knowledge in our time.

Scientific information is growing at a rate greater than is revealed by such figures, and technology races along at dazzling speed. Last year I had occasion to visit the Motorola plant near Phoenix, Arizona. This plant was fabricating complete microscopic electronic circuits by photographic and chemical methods which had not existed two years earlier. Motorola had rapidly become the largest employer in Arizona, at that time already utilizing some 20,000 semiskilled workers and a handful of technologists. Not one worker, and only one technologist, had had any previous experience with these techniques. The new technology had replaced perhaps three times as many workers in factories in other parts of the country; these workers on now-obsolete operations all had to learn something new, or become jobless — and no doubt some are jobless even though they wanted to learn.

A scientist who obtained a doctoral degree five years ago is old-fashioned today if he has not been actively studying and researching since he gained that degree.

This is the actual world for which we must train our students.

Can we plan for a new university, in such a world? Can we think ten years ahead? Universities are designed for generations in the future. (I know of none deserving the name which have disappeared from the academic scene in modern times — despite wars which have utterly destroyed cities and desolated countries.)

There are so many problems to be faced. Some of these arise because, out of the tremendous growth of knowledge and technology, this has become the age of the specialist. How can specialists communicate across boundaries of specialties?
How can society share in knowledge which is esoteric even to the majority of scientists? How can students choose what they wish to study? Does it match their abilities? Can they enter the mad race and grow with it? But this race is, or should be, only part of life. There is far more to life than science and technology. There is the society which encompasses all, and there is wisdom and beauty outside of science for which we should have sensitivity and time to enjoy. How can we prepare for a life of scholarship, wisdom, and beauty? And not less important: how can we build a society, here and world-wide, in which all of us, all humans, can live a good life?

Science is a little corner of life; but it is itself immense. I remember an evening I spent, a few years after World War II, with one of the last — perhaps indeed the last — of the near-universal minds: Professor John von Neumann of Princeton. Von Neumann was a mathematician and theoretical physicist, among whose many contributions to us was the classical treatise on the mathematical foundations of modern atomic theory. He was also one of the creators of our present electronic automatic digital computing machines. He was enormously knowledgeable in mathematics. Despite this fact, he remarked to me that when he attended a mathematical congress he could understand not more than five percent of the papers which were presented.

That was almost twenty years ago. Today the body of mathematics has at least quadrupled. And that is only mathematics!

Permit me to quote from another physicist, one of the most accomplished, wisest and most sensitive of them all: Professor J. Robert Oppenheimer, who until recently was the Director of the Institute of Advanced Study at Princeton:

No man should escape our universities without knowing how little he knows. He must have some sense of the fact that not through his fault, not through his sloth (though he may be lazy and not very bright), but inherently in the nature of things, he is going to be an ignorant man and so is everyone else. It would be nice, however, if this great achievement could be complemented by another great
achievement, which is to make a man, although he may be ignorant of almost everything, not quite ignorant of everything. My own feeling is that for education it is indeed necessary that it accomplishes these two purposes. If I had to advise a young man, to give him some rule to live by, I know that I would be wrong most of the time and that my advice would only be safe if it were ignored. But if I did have to give such advice, I would be inclined to say, “Try to learn something very well indeed. And do not just learn what it is in general terms. Learn it as a practitioner; learn how to do it. And stop while you are doing it long enough to see the beauty of it.” But I would not quite stop with that. I would add, “But learn something else as well that is quite different. Get some sense of the span of the things human, the span of things that the intelligent man can cope with.”

It is within the frame of such problems, which I merely mention and the number of which I could greatly increase, that we must consider the founding of a new university. I want to discuss these problems as we are dealing with them in the development of Nova University. A new university could develop in quite other ways and most of them do. We are subject to special boundary conditions, chief among which are limited funding, a dedication to excellence, and the satisfaction of the particular needs of the area. In order to understand why I sketch certain directions of development these related conditions must always be borne in mind.

The basic design for Nova University was created before I was honored with appointment as its first professor. Many of the concepts which I shall sketch for you came to me from President Winstead. When I want guidance in the responsibilities which he has given to me, to assist in the planning of the Physical Sciences Center, it is always both enriching and enjoyable for me to discuss matters with him.

An essential property of good planning is flexibility, willingness to consider advice and bend to it when it is obviously desirable to do so. There are some immutables in Nova’s plans. We must follow a course which will lead to excellence in faculty and students, in teaching and scholarship, and in facili-

ties for these functions. We cannot develop in every direction of modern science, much less in all of scholarship, at once, and at all university levels. We cannot foresee in what areas we will progress most rapidly. The most important starting material is highest quality in our faculty.

President Winstead's decision was to begin at the graduate level, as did Johns Hopkins almost 90 years ago, and the San Diego branch of the University of California most recently. This is an extremely wise plan, and one recommended by one of our leading university educators, Prof. Bernard Berelson of Columbia, in his treatise on graduate education.°

The first emphasis will be on the development of a strong Physical Sciences Center. Why start here, and at the graduate level? Because the best university scholars are active researchers, interested in training graduate students. Beginning at this level facilitates the attraction of the best staff. One need not have a wide spectrum of areas at the outset; it is possible to develop excellence in a few areas. Strong physical sciences will provide the best support for other sciences, and will be helpful in other ways both within and outside the institution. Federal support for graduate research and training is most available in the physical and biological sciences, and realities require that best advantage be taken of funding sources.

The graduate student body at Nova will grow at a rate dependent upon faculty and facility growth, but will not exceed 1000 students — which is contemplated as its maximum size, perhaps achieved in ten years. The student-to-faculty ratio will not exceed six to one. Only candidates intending to proceed to doctoral degrees will be accepted as degree candidates.

Can we plan now for science as it will be ten years hence? We can anticipate some things with some certainty; and because we will be growing over the entire period, we can adapt to others.

As Robert Maynard Hutchins remarked in an article in the

September 11, 1965 SATURDAY REVIEW, machines are increasingly replacing muscles and minds; job-minded education is increasingly ineffective and indeed obsolete. We must educate students to go on learning, life-long. This is not mere phraseology; it is reality.

The machine which has major influence in our age, and which will only become more important, is the computer. It invades every corner of science and society. It not merely helps to automate our industries, our transportation, our communication and publication methods, but it transforms our commerce and management, our laboratory experiments, our libraries. The library is a university's foremost facility, of course; at the very outset we must consider the use of the most modern and efficient devices for storing and retrieving books, journal articles, reference material, data. Computer techniques must be involved. The second central facility must be the computer itself.

I do not intend to offer a recital of what areas of the sciences and mathematics should be developed, or in what order. I have of course thought much about such matters. The best guarantee, that a new university will be a leader ten years hence, is that it seek from the beginning the most active and original scientists that it can find, and that it provide the right facilities for them and attract the finest students.

It is not necessary to sit back and wait for beautiful buildings to be readied. If a new university graduate training and research program is in operation, it can qualify for federal participation in the costs of the buildings. Prospective staff members will be more attracted by the presence of fine scholars already on the faculty than by immediately-available buildings.

The problem of support for research in the physical sciences is no small one. Good scientists have managed to draw support, as they needed it, in the past two decades. This situation is slowly changing, because science has a cavernous maw and the funding barrel has a bottom. Support for really "basic" research, for which there is likely to be no obvious application
as yet in technology or other applied areas, is in increasingly short supply. There is always a new catchword in Washington. This year it is "relevance". Is a proposed program of research relevant to the mission of a particular funding agency? Might it contribute, eventually, to a new piece of hardware, a new technological advance, a new method for combatting disease, for example?

The relevance of a new idea, the development of which requires the purchase or construction of expensive equipment and materials, the help of technicians or theorists or various laboratory assistants, the collaboration of highly-trained scientists and engineers, and perhaps expensive time on high-speed computers, may be difficult to assess at the outset. "Of what use is a new-born baby" was James Clark Maxwell's reply to someone questioning the practicality of a new theory of electricity and magnetism which he developed about a century ago. Of course his theory soon became the foundation stone for the modern electrical industry, and had far broader influence in physics itself. But that was not foreseen as he worked to develop the theory.

The relevance of research in a university should be the development of new knowledge and the training of new scientists. Once a strong program of research is rolling along, "relevant" results are very likely to fall out of it. This is particularly true in the physical and biological sciences. But the danger in the requirement that a program promise practical results is that quite new ideas may be very difficult to justify on such a basis. This is an old and well-told story, which I need not extend.

I merely emphasize that to build a university's staff only from scholars whose research is of obvious practicality is very dangerous, and would lead very soon to de-emphasis on really new ideas which are at the heart of science's progress. Students must be encouraged to think along new paths, and to work with originality. They will learn this if their mentors have creative and not merely practical minds. I do not deprecate practicality; I do decry it as the chief reason for the support of work on a new scientific idea.
One other problem, in the same direction, lies in a privately-supported university's ability to justify its support locally. It needs such support. To gain it, it must serve as a center where new scholars can be trained. Its inevitable contributions of practical advice to industry and government is important, but secondary, and depends upon the interests and available time of its scholars. Industries congregate in communities rich in universities, and particularly universities with strong graduate programs, because there it is that the source of new research personnel can be found. Furthermore, industries can attract the best young research workers and technicians, and even more mature personnel, if there is a good graduate school nearby where these young people can upgrade their knowledge.

A new university must be prepared to render this service: because the training of students is one of its chief responsibilities, and because scientists in industry must keep abreast of scientific and technological advances; they need continual "retreading". These adjunct students must be qualified to enter a class, to understand the lectures and to participate in discussions; they may or may not eventually be admitted to research programs towards a doctoral degree; such admission must depend upon their qualifications and the seriousness of their intentions with respect to completion of doctoral study and research.

A university will contribute in many other ways to its locality. It is a center of culture, first of all. Its concerts and galleries and museums will of course be available to the public. It will provide lectures and lecturers for the lay public. Its library collection will be available to qualified readers. Special seminars and short courses will be available in many areas of importance to the community.

What a university must not be is what Robert Maynard Hutchins describes as a "service station". It must not undertake research or instructional responsibilities which are not of interest to its scholars. Its excellence must never be diverted or diluted.
Its prime responsibility will always be to its full-time doctoral candidates and the research of choice of its scholars.

There are many problems for which one cannot yet provide a solution, in the design and in the opening stages of this new university. I am not satisfied with the thinking I have done about some of them. Let me discuss just one with you now.

The first problem is: for what is it we want to educate our students? Is it merely for competence, originality, and scholarly dedication in some branch of knowledge? Is it to multiply knowledge, to control nature, to stabilize society, to advance technology? Or is it something more? One answer comes out of sheer practicality. Natural and social scientists are playing an increasingly significant role in our society: not merely as specialists in narrow areas but as molders and managers of government policy. We need natural scientists and technologists who are not illiterates in social and economic matters, and conversely. One does not meet this need by imposing a few course requirements at the undergraduate level, and deprecating the need for further attention to the social science training of natural scientists in the graduate school, or some exposure to newly developing natural science on the part of social scientists: at the very stage in their development when students are really becoming aware of the importance to them of such knowledge.

Not all students have such awareness, nor can one predict at all which of them at later times in their career will be called upon directly for advice and knowledgeability. In an important sense, all citizens in a democracy must be capable of critical and knowledgeable thought in a political world.

President Winstead has been concerned from the outset with these and other needs, outside of areas of specialization; my own thoughts have benefited greatly from his ideas. It will be of little value, simply to require enrollment of graduate physical science students, for example, in additional courses in the social sciences. Probably such requirement would be treated as perfunctory, as are the standard foreign language require-
ments at the graduate level (of which more later!), and resented by faculty and students alike. Scholars will not be enthusiastic in offering undergraduate-level courses in their areas of competence to graduate students from another area. Furthermore, the emphasis at the graduate level should never be on course requirements; rather, it must be on encouragement of learning, discussing, and practicing. The evidence for what is learned is not to be found in a transcript of courses attended and grades received (if any).

The encouragement must come from an atmosphere within the university, generated by faculty and students alike and hence dependent upon the breadth and depth of interests of both. No "system" directed to the broadening of student understanding will produce that result unless faculty members themselves are eager for and capable of inter-cultural interactions.

Intelligent students are more likely than not to have some interest in humanities and the arts. Yet at the graduate level natural and social science students are generally isolated from scholarship in these humane areas, and inter-cultural contacts are at best unguided and haphazard. Their ability to express themselves with voice or pen is very poor. Yet if they can show on a transcript that they have satisfied certain curricular requirements as undergraduates and hence are admissible to graduate standing, they never need demonstrate that they open a good book in a nonscientific area or that they want to do so, or that they can enjoy a string quartet or a Mozart opera, or a recording of a poet, or that they can name, much less appreciate, a few contemporary painters. The graduate foreign language requirements are generally something between a joke and an empty gesture; once a required examination is passed, the meager reading facility can be neglected—and it soon evanesces; and the importance of a language as a road toward the understanding of a foreign people and its cultures is utterly neglected. Scientists are themselves uninformed in the area of modern philosophy, even if, as rarely happens, they have once been exposed to the ancients. For graduate students in
the sciences to spend time and thought on such matters is considered wasteful. There is no time, it is repeatedly said.

It is worse than this. Natural science students, for example, have difficulty developing understanding of one little corner of physics, or chemistry, or biology. Recall the passage from Oppenheimer which I quoted earlier. How rare it is for a physicist to have even a sketchiest knowledge of the problems and methods of organic chemistry. There is “practical” or “applied” mathematics for physical scientists, and scorn for “pure” mathematics, which is deemed useless or nearly so and hence not deserving of consideration.

These barriers between areas of knowledge and culture of course exist for persons on either side of the boundary.

How does one weave together the separated webs of scholarship and enjoyment, to the extent at least that students and masters in one area are aware of and occasionally understand and enjoy something of the scope of one or more others? There are few “educated physicists”, or “educated chemists”; what then can we imply by the term: “an educated person”? Is the epithet obsolete? Is graduate training no more than development of specialists, even more narrow? Is dialogue across disciplines and cultural areas impossible for our most highly-trained minds?

We have at Nova University opportunity to reconsider these matters, from the outset. Since our student-to-faculty ratio will be low, we can know our students; and since our faculty will be comparatively small, we can know one another. Each Ph.D. candidate can have, on his advisory and examining committee, scholars from outside his own area and culture.

He can be required to confer with his committee in toto and with its individual members, on a regular basis and by no means rarely. He should be expected to know something, and be sensitive to some things, outside his field as well as within it. How he attains such knowledge and sensitivity is up to him and his advisors. Every requirement should be meaningful. If he is to learn a language, for example, he should
show that he can use it, and that he does use it; otherwise the requirement is meaningless and should be abandoned. He should read, and want to read, and discuss his reading; he should arrange his ideas logically, and express them well. How he achieves such facility and interest, and when, is a matter for him and his advisors. His qualifications as a potential scholar, his limitations and scope, his sensitivity, his achievements and further potential as a creator of new ideas and new knowledge, his potential for self-learning and self-living, his adaptability to a continually changing world, should be well known long before the day of his final examination.

I can give no rules or schedules or recipes for carrying out such advisory and teaching functions, for the scholars. It is a sort of ad hoc educational plan, to be trimmed to each graduate student. It can only function and succeed if the scholars in this university are well chosen. President Winstead has a fine sieve, a fine eye, and a stubborn intention to build a great new institution of learning. What I am saying here has been inspired by him, and I profit from his conception of what he intends Nova University to be. He knows the importance of first-rate men, and such men will take pleasure in working with him and with their first-rate colleagues.

I close this discussion with a passage from Berelson's volume on graduate education.

In a country as large, as varied, and as rich as this one, a great new university should be founded about every fifty years as an influence, a model, a standard-setter. The last great university was the University of Chicago, which was certainly a pioneering institution in its own right, a national leader of graduate education in every sense, and an important contributor to the strength of the public universities in the Middle West. Since then, seventy years ago, no great new institution has been established, and one is overdue.

In reviewing the history of graduate education, I tried to show how encrusted such a system inevitably becomes, and how difficult it is to move it from within. The sources of important innovation in higher education are four: individual leadership, sharp social change, money—and new institutions. A dramatic experimental model starting de novo without the restrictions of established traditions, established practices, or established personnel would be free to do what operating institutions cannot now try. I shall not suggest what it ought to do,
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since that would be determined by the men who would run it. But I shall say only that there are enough things it could do to warrant the effort. Even if it became nothing but a great graduate university run roughly along the present model, that would in itself be desirable both in process and as outcome.

The graduate enterprise is now so large and so important that a university restricted to it alone is warranted: a super-graduate school for the doctoral and post-doctoral level. Such an institution has failed in the past, but given proper support it could now succeed. Two earlier points against such a project are now inoperative, I think: lack of students in the absence of an undergraduate college to feed them in, and lack of service opportunities to the community. The former should be no problem these years, certainly not if the institution began with the prestige of a distinguished faculty. The latter would be taken care of in its location . . .

Establishing such an institution would probably be strongly opposed by the institutions now at or near the top. Their arguments might be similar to those used against establishing graduate education eighty years ago, e.g., 'why start something new when we cannot support what is already under way.' Most likely such an institution would have to recruit its faculty from several of the top institutions, but on the other hand the 'raiding' point can be put affirmatively, namely, the task of staffing the new university would tend to raise academic salaries and to 'loosen' other places by bringing in new talent there. Thus the new graduate university could have positive effects by its very establishment—even before it had made its own contribution to learning.

A new university of this character could hardly fail: Top-grade people rarely fail. The question is whether it could be a great success or only a moderate one.³

I must confess that I have omitted one paragraph of Berelson’s statement because it interrupted the idea I wanted to convey from him. It would be unscholarly for me to shield you from it; and, furthermore, it is in a sense supportive of our thesis here. In his third paragraph he remarks, as you will recall, that one of the two points formerly made against a graduate university, both of which points are now inoperative, was: lack of service opportunities to the community. This argument would be taken care of in the location of the institution. And he remarks:

... The new university should be located in Washington. The United States is perhaps the only major country in the world without a first-rate university in the nation's capital. Such an institution there would lend tone to the intellectual life of the capital and to the nation as a whole. Its faculty could be available to the government as expert consultants, and government personnel could take refresher courses at the university. In any number of ways, such a faculty could serve the national community. The location in Washington could have one important by-product: the further upgrading of higher education in the South, for which it could serve as supplier and trainer of talent, special consultant, and educational leader in general.4

I think it highly unlikely that the six (or more) universities in the Washington area would permit another graduate institution there; indeed, since Berelson's words were published steps have been taken to forestall the installation of a newcomer at this level. I do agree that it would be well if government officials, some of them at least, could take an occasional refresher course—in Latin American or Asian diplomacy, for example. But they could do this today; and there is some feeling now that there are enough professors in Washington.

What is surely pertinent is Berelson's emphasis on the need for upgrading of higher education in the South. But let us do it from the South itself.

4Ibid.
Science, Process, The Learner: A Synthesis

ABRAHAM S. FISCHLER

RECENTLY I watched a teacher introducing a science lesson. Holding a sealed cardboard box in his hand, he shook the box in order that the students might hear the rattle of an object inside. Then he asked them to try to name what was in the box. All types of guesses were elicited and the names were placed on the chalkboard. After approximately ten minutes, the teacher said, "Let us see who guessed correctly," and then proceeded to open the box. After the lesson I asked the teacher to tell me the purpose of the box in this particular lesson. His reply, "I was trying to get my students to inquire."

Another teacher in a junior high school science class heated a tube containing some small particles. As it was heated, the particles started to move about at a faster rate and rattle against the sides of the tube. The students asked various types of questions which could be answered by "yes" or "no." When asked what he was doing, the teacher again replied, "Teaching scientific inquiry." I know that Dr. Richard Suchman would have curled up in his seat had he been watching the lesson with me. The teacher had no idea of the meaning of scientific inquiry, or of the notions associated with various levels of question-asking.

I cite these two examples because of my concern with the
way "inquiry" is currently being misused in the teaching of science. A second concern is that many individuals do not understand what some of the elementary school science projects are trying to develop through their various curricula. In fact, as you can see from my first illustration, even in the fields of chemistry, physics and biology, some of the teachers do not quite understand why the courses and activities are designed in the particular way that they appear.

As you all know, there are numerous groups involved in the development of science materials for elementary, junior high, and senior high schools. From my point of view, there appears to be one agreement among all the projects—the movement away from science as the accumulation of facts to an emphasis on the "content" of science. The emphasis has changed from the ability of a child to regurgitate scientific facts to the ability of a child to utilize his newly discovered concepts in carefully selected learning situations. (Please note the words "carefully selected learning situations.")

In the literature the dichotomy seems to be between content and process, and I offer for your examination that the dichotomy ought to be between isolated factual teaching and isolated process teaching, as neither one results in a synthesis of ideas or in the development of intellectual models on the part of the child. I view content as the result of the synthesis, in the child's mind, of facts which were so structured as to lead to a conceptual idea taught through a process which engaged the child in observation, analysis and synthesis. The word "science" is looked upon as a verb instead of as a noun. It is associated with Bridgman's term, "sciencing," the search for understanding and relationships which exist in the environment of the child. The emphasis is on the process by which man learns—a process which includes modes of inquiry, experience with reality, and a conceptual structure.

In order to try to clarify the notion of science, inquiry, and the new projects, I will try to organize the balance of this paper handling each of the above separately.
Scientific Enterprise

The futility associated with the teaching of experimentally determined facts alone, without providing a conceptual structure, can be seen by the rapidity with which knowledge is growing within the scientific enterprise. There are approximately 50,000 scientific and technical magazines published in the western world. These publications contain approximately 1,200,000 scientific articles per year; and these figures do not include 100,000 research monographs and 60,000 new books on science published each year. By this time tomorrow, 5,000 new articles will have appeared in print. It is established that our scientific knowledge will double in the next ten years. The children you are teaching now will be adults in the year 2000. Who can predict with any degree of accuracy what scientific "facts" of today will still be true at that time? Why not focus on the major concepts and generalizations of science which have associated with them more longevity? Why not include as part of the focus the intellectual processes by which man learns? Why not give youngsters the opportunity to develop the skills, attitudes, and concept of self which will produce adults intrinsically motivated to pursue knowledge, and also capable of establishing a criteria of excellence for themselves?

For the sake of clarity, let us begin with a scientist making an observation of a phenomenon which raises a question in his mind. It is a discrepant event—an event which does not fit in with the conceptual structure he now has. He gathers information from a variety of sources and formulates a testable hypothesis. Going from the observation to this testable hypothesis is not easy. If possible, he then sets up an experiment which, if he is fortunate, will yield experimental data. This data affirms that under conditions A, B, and C, we observe D. Thus, the experimental fact has certain parameters which are spelled out in great detail.

The nature of the enterprise encourages an individual scientist to publish. He does this not only to gain recognition among his colleagues, but also to add his new knowledge to
the accumulation of other experimental facts in the hope of formulating a concept, generalization, or theory which will enable him to predict what will happen. . . . As soon as his article is published, others have an opportunity to verify the results. Information in the article must be sufficient to enable another investigator, interested in duplicating the experiment, to do so. If his results are the same, this adds to the reliability of the original result. However, if his results are different, he too publishes, and others begin to experiment to try to clear up the differences in their findings. It is this aspect of the scientific community that keeps scientists “honest.” In science, the frauds are usually discovered because of the independent verification of knowledge.

In education and other social sciences, we tend to lack the precision associated with the pure sciences. We tend to word our objectives in non-behavioral terms which then become very difficult to measure. Most of our educational experiments either end up with no significant differences or just fade away. Rarely is enough information given to enable others to duplicate the experiment to see whether in fact they get similar results. Progress is being made, and I realize that in the future we will have much tighter educational designs and will use much better statistical models.

Another occurrence in science is the development of new instruments and techniques which enable us to view phenomena more closely and more accurately. This enables the scientist to formulate new hypotheses and gather new experimental facts which might alter our concepts, generalizations, and even our theories. For example, the use of the electron microscope and newer methods have enabled us to alter our theory of the functions of parts of the cell. Radio astronomy and the use of satellites are altering and changing our knowledge of astronomy and meteorology.

There are many conflicting accounts of the methods used by scientists to make their breakthroughs. Many scientists and philosophers of science have attempted to describe the scien-
SCIENCE, PROCESS, THE LEARNER: A SYNTHESIS

tific method used during a particular series of activities. However, the ability of a scientist to make a discovery or invention does not necessarily mean that he is able to describe accurately the intellectual sequence of what he has done. In my opinion, scientific method is still developing. We know very little about the way people learn and the complexity of "thinking."

Within the enterprise, the tentativeness of the results of scientific inquiry must be stressed. "Truth," as such, in science does not really exist. The search is for closer and closer approximations to the "truth." It is the search for an even higher probability than that previously attained, without expecting certainty. The willingness to regard all scientific statements, from those about discovered data to those of "laws," as subject to possible modifications, correction, or rejection, has had highly useful consequences for scientific inquiry. In the history of mankind, there have been numerous instances in which our failure to question our constructs has had an inhibiting effect on the progress of scientific thought. Methods resolving scientific differences usually occur through the further accumulation of data, and the discarding of outdated ideas.

The usefulness of scientific inquiry may be measured by the extent to which its results facilitate explanation, prediction, and on occasion, the control of events. The self-corrective nature of the scientific enterprise is such that hypotheses are abandoned or modified when their predictions fail.

Ernest Nagel in his book, THE STRUCTURE OF SCIENCE: PROBLEMS IN THE LOGIC OF SCIENTIFIC EXPLANATION, argues that the "distinctive goal of the sciences ... is the organization and classification of knowledge on the basis of explanatory principles." The sciences seek to discover and to formulate in general terms the conditions under which events of various

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sorts occur, the statements of such determining conditions being
the explanations of the corresponding happenings.

Nagel discusses four types of explanations. The first is
deductive; in which what is to be explained is a logical con­
sequence of well-established premises. We observe that when
ice water is poured into a glass and allowed to stand, mois­
ture appears on the outside of the glass. This might be explain­
ed by deduction from the general principle that in specified
circumstances gases condense into liquids when cooled. The
second type is probabilistic and occurs when the behavior of a
member of a class is explained in terms of highly probable state­
ments about the behavior of the class. An example: it is a well­
established fact that heavy drinkers of alcohol get cirrhosis
of the liver. If a person gets cirrhosis of the liver, the illness
might be explained on the ground that he is a heavy drinker.
The third type is functional. Explanations are given in terms of
the role something plays in maintaining the state of a system.
The existence of sweat glands in the human being may be
explained by showing that they operate so as to maintain the
salt balance and temperature balance within the system. The
fourth type is genetic, showing how some phenomenon has
evolved from an earlier stage. Evolutionary change in both
geology and biology is an example of this type of explanation.

In each of the four instances, certain data are accounted for
on the basis of other statements; the data are plausibly linked
through logical implications or experiences to what has already
been established. Scientific explanation avoids that which is
nontestable in principle, is descriptive in the sense that it
refers to things or events, or aspects of things or events, and
the connections among them. The most useful relationship be­
tween theory and data is one in which constant testing and
revision of hypotheses occur based on the most accurate pos­
sible observation of data.

"Inquiry," Discovery, and Problem Solving

Jerome Bruner of Harvard, in his book ON KNOWING hy­
pothesizes that "emphasis on discovery in learning has precisely
the effect on the learner of leading him to be a constructionalist; to organize what he is encountering in a manner not only designed to discover regularities and relatedness, but also to avoid the kind of information drift that fails to keep account of the usage to which the information might be put. Emphasis on discoveries, indeed, helps the child to learn the varieties of problem solving and helps him to go about the very task of learning."

Discovery alone, however, seems to put the emphasis on the satisfaction which is derived from finding the solution to the problem. But certainly there is more than discovery. Inquiry implies that there is a search in one’s environment and to wonder “why” is a necessary additive to “discovery.”

Joseph Schwab makes an important contribution to our discussion of inquiry when he states that it may be of two types: “stable” and “fluid.” Stable inquiry tends to “fill in the blank spaces in the growing body of knowledge. It proceeds down an established path which is governed by the existing principles and generalizations. Stable inquiry is not concerned with new principles.”

Fluid inquiry focuses upon theories. It takes into account the new bits of information discovered by the stable inquirer and tries to discover or invent new relationships, new theories, new constructs which will open up a completely new line of inquiry for the stable inquirer. The fluid inquirer is not searching for the solution to a problem, but rather for the formulation of a theory which will bring about a new series of problems.

This distinction is important. In the field of nuclear physics, for example, many new sub-atomic particles have been discovered. Depending upon the definition of particle, there have been sixty-three particles discovered. What is necessary is the

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invention of a construct which tries to explain the relationship existing between the already discovered particles.

To illustrate this point in another way, let me refer to the discovery of the neutrino. When scientists first studied the decay of the neutron into a proton and an electron, they found that not all of the energy was accounted for by the above reaction. Since they held to the law of conservation of matter and energy, scientists “invented” a particle called the neutrino (little neutron) which has a mass of zero and no electric charge. This particle, they speculated, would account for the difference between the theoretical reaction and the experimental result. It was not until approximately twenty years later that Reines and Cowan actually observed the particle in the laboratory.

Inquiry, then, is not only a technique or a method. It is a way of looking at one’s environment. It encompasses an attitude and an ability. If planned correctly, it results in the acquisition of knowledge as well as the utilization of knowledge as process.

This brings me to another point—that science learning can be viewed as a skill depending upon whether the content is considered as something to be learned or as something to be used as an instrument in the learning of other content. It is possible to view learned concepts as tools which are essential to the solution of new problems.

Reading is an example which comes to mind. Reading itself is a content field; learning to read is an end in itself. Yet reading is an important tool of the scientist since it is used in the acquisition of new knowledge. The better one develops skills in reading, the easier it is to utilize in gaining further knowledge.

The Pupil

I would be negligent if we did not try to bring into this discussion the work of the cognitive psychologists who are concerned with children’s thinking—individuals such as Piaget, Bruner, Smedslund, Peele, and others.
At the University of California in Berkeley, we were fortunate to have Professor Piaget with us for a three-day conference. From this discussion and Piaget's writings, it seems that children go through a number of stages whose order is constant, but not necessarily their time of appearance. The stages are pre-operational, concrete, and formal. We are not concerned here with the child's pre-operational level, since this occurs prior to his arrival in school. However, we should be concerned with the concrete level, inasmuch as this stage occurs approximately at the age of six and continues until about age twelve.

Piaget discusses four factors contributing to intellectual development—nervous maturation, experience, social transmission and equilibration. He maintains that equilibration, where the individual is involved in an active coordination of his own development, is the most important. With the first three factors, something is done to the learner. The fourth factor calls upon the child to become active; it calls for intellectual transformation—series of accommodations, followed by assimilation, followed by the introduction of a new discrepant event which forces accommodation again.

Jan Smedslund of Sweden did an interesting experiment which I think has a great deal of meaning for those of us who are working with children. If you recall, Piaget has shown that children between the ages of seven and eight or thereabouts begin to develop the notion of the conservation of volume and weight. He uses plasticine balls and has youngsters change the shape of a ball into a rod, for example, and then he might ask whether there was more, the same, or less substance now than there was before. And the child will answer either "more" or "less" or "the same". If the child understands the conservation of substance he will, of course, realize that only the shape was changed but nothing was removed and that therefore the quantity (mass) would be the same as before.

Smedslund followed the same format but he tried to convince children who had not attained the conservation principle
that their impressions were false. He started with a population of approximately sixty children and tested each child between the ages of seven and eight for his knowledge of the conservation principle. He ended up with two groups, those who had attained the concept and those who had not. Then he chose to teach the children who had not attained the concept through a series of demonstrations. He had these youngsters predict what would happen, and when he was convinced that they were capable of predicting accurately that changing the shape of a substance did not alter the amount, he was satisfied that he had taught them the conservation principle. When thirty of the youngsters who had not known the concept originally were taught to his satisfaction, he brought all sixty youngsters together. Then he took two plasticine balls of the same mass, and added a little plasticine to one ball which he was rolling into a rod. (Thus, he secretly added more substance.) To test each child he asked what would happen when he put them on a scale. Of course, each one said they would balance. But when in fact Smedslund put them on a scale, since he had cheated just a bit, the scale did not balance. Those children that he taught just seemed to accept it and say, "How interesting." However, the children who had achieved conservation over a longer period of time immediately said, "Something must be wrong," "The scales are not correct," or "You cheated." These individual children believed so strongly in the conservation principle that they would not accept a first impression—what they had observed on the scale.

The outcome of his work appears to have a message for those of us who teach young children. We must be more selective in what we choose to teach, allow time for students to work and give them time to accommodate to new data which must be assimilated by them into conceptual structures. If a pupil has a false equilibrium, perhaps the teacher might set up a situation so the child will correct himself, rather than correct the schema for him.
Examples from Projects

It is impossible to cite examples from all the projects. Therefore, I would like to select three examples at the elementary level and two from the high school. These examples will illustrate what I mean when I speak of leading the child to form a conceptual structure which will have meaning to him and which will enable him to make predictions about what will happen under certain circumstances.

The first example is from Variation and Measurement, produced by the Science Curriculum Improvement Study. The early lesson begins with variation in the shape of leaves—first of different kinds of leaves and then, leaves from the same plant. There is variation not only in shape but also in size. Children are then introduced to the variation of peas in pods. They are asked to count and record the number of peas found in each pod. Through this they learn that there is a variation in the number of peas per pod. Then they are asked to see whether they can draw a histogram summarizing the number of peas of the total class. The histogram is then developed on the board and it has a frequency distribution of the number of peas in each of forty-five pea pods.

Other lessons go on to utilize the histogram as a way of organizing data. You can also use weight charts in relation to age, height charts in relation to age, etc. The youngsters realize that there is a natural variation associated with these items and that once they have organized a histogram, they are in a better position to make a prediction about median, mean, and mode. This begins to give the first grade children an intuitive feeling for probability, a fundamental notion within science. They also learn from this unit that measurement is never exact but always an approximation. The finer the instrument, the closer one comes to the “correct” answer. Pupils learn that there is not one correct answer but that there is a range of acceptability, a plus or minus figure. Thus, through a series of carefully selected activities, children begin to realize
that there is such a thing as variation and they begin to have some intuitive feeling for the notion of probability.

Another unit entitled Animal Coloration was developed by the Elementary School Science Project. The unit sequence is a series of activities where children color various organisms and try to blend the organisms with an environment. Thus in a cardboard box, a background of water might be present and the children will be given a fish-shaped paper which they try to color in such a way as to blend with the water. A light is placed above the box so that the youngsters can see the effect of light shining on the organism. This is continued through various other types of backgrounds until the youngsters realize that animals are more difficult to see when they actually blend in with their environment.

There are other clever activities such as the coloring of various toothpicks and throwing them on a plot of grass. The pupils are given thirty seconds to see how many different toothpicks they can find. After doing this two or three times, they realize the difficulty of finding a toothpick which blends in with the grass.

A third activity is the coloring of various loose-leaf binder page-supporters blue and painting black stripes on fifty percent of them. You might think that the black stripes would make the object easier for the children to find. But when the supporters are shown on the grass outside, pupils find many more of the plain blue ones. Through these activities, the youngsters begin to get a feeling for the notion of natural selection. This is followed by a unit in animal population which will give them some understanding of natural selection, over-population, and the natural struggle for survival.

In both of these units, you will notice the interesting inter-meshing of process and factual outcomes, which encourages the child to develop a conceptual structure to which I refer as the content.

The third illustration I have chosen comes from an early unit developed by Elementary School Science of Educational
Services, Inc. entitled "Mystery Powders." Pupils were given a white powder and asked to identify as many of its properties as they could. They heated the powder, placed it in water, added such things as vinegar, and watched what happened. When they developed some kind of strategy for finding the properties of this particular white powder, they were then given five other powders and asked to try to distinguish their properties. When this was done satisfactorily, two powders were blended together and then pupils were asked to identify which of the vials had two powders, what they were, and the properties associated with them.

After the solids, they turned to liquids and then to gases. What is the fundamental notion? It is the notion of property—that each substance has unique properties and once you have identified the uniqueness of the substance, you are in a better position to predict its behavior if it resembles another substance which behaves the same under certain conditions. It also enables you to begin to classify substances on the basis of their behavior in relation to certain indicators. In addition, this gives the pupils the feeling of how the chemist is involved as he works in the laboratory to identify new elements and compounds, and new molecular structures, on the basis of observable reactions.

In the Physical Science Study Committee Physics course (PSSC), physics is looked at as an explanatory system, a system that extends from the domain inside the atom to the distant galaxies. The sequence of activities tends to encourage youngsters to get an atomic picture of matter, its motions and its relations. The individuals associated with the physics course did not try to teach all of physics but left out a great deal of what had been normally associated with it. This meant that the student had the time to become actively engaged in the laboratory and that the flow between the text and the laboratory experiments moved the students closer to developing a conceptual structure of the atomic structure of matter, its motions and its relations. The laboratory experiments were not
developed to verify that which the student read in the textbook or knew ahead of time, but rather they were designed so that the youngsters could struggle with what they observed and what they were reading in order to build a coherent structure.

The Chemical Bonds Approach (CBA course) attempts to organize the study of chemistry around a central theme: chemical bonds. Many of the properties of materials are best understood by associating their bonds as one imagines them to be present. This course attempts to get students to see the intellectual problem involved in attempting to predict the properties of chemical reactions, chemical products on the basis of their understanding of the bonding energies. The students are encouraged to build mental models and to test constantly their models against what is occurring in the laboratory. When an event that occurs in the laboratory does not fit a model, they must alter the model in order to make it capable of predicting other events.

Although the Chemical Education Materials Study (CHEM) is organized differently, it also attempts to encourage students to accumulate information through observation, to organize this information and to seek regularities in it, to wonder why regularities exist and to communicate their findings to others. Here too, the students are encouraged to build mental pictures and to use them to predict reactions.

Summary

Actually then, the discussion of content versus process is not "real." Content consists of the synthesis of facts and conceptual schemes developed as youngsters are assimilating their observations and their analyses. All of the new programs seem to be moving in this direction. Therefore, it seems necessary that teachers understand the nature of the scientific enterprise, the notion of inquiry, and the cognitive processes through which the learner can develop the conceptual structures which will enable him to look at the world more intelligently.
The Schizophrenia of Modern Culture

CHARLES E. GAUSS

I AM ALWAYS a little suspicious and apprehensive when psychologists ask a philosopher to speak to them, for I am sure they just want to analyze the beast as he performs.

My own philosophical interest has always been the history of ideas. In that vein I want to take a pseudo-psychological romp through the history of western culture. To do this we must be willing to make the questionable assumption that a culture is a giant-size psychological person. The justification for this lies in how much you may think the results are provocative.

At any rate, my theme is that western culture is schizophrenic. Whether other cultures are similar in this respect I do not know. Even if this character of our culture may seem uniquely ours, I shall not claim that it is an abnormality to be abhorred. And I beg indulgence for my interpretation of schizophrenia.

In what respects do I mean our culture has been schizophrenic? The notion of a bifurcation in the patterns of our culture is not a new one. C. P. Snow has talked of the "two cultures", the artistic-humanistic and the scientific, each withdrawn from the other. But this is a recent thing, something that has taken place only since the Renaissance; and though it is a fact, I do not think it is a logical necessity. Actually I think we have made an artificial break, that fundamentally there is no split. The scientific mind is not at war with the humanistic,

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nor are the traits of one incompatible with those of the other. However, I shall not be talking about this dualism.

Another overemphasis has been laid on the difference between the rationalistic and theoretical mental habits of the continental as against the empirical and inductive habits of the British-American mind. I do not mean this.

A third contrast that could be made, which has always intrigued me, is between what I call the Mediterranean and the Gothic mind. The Mediterranean world is one where nature is not hostile, where the sun shines and the sea is blue and the winters are not severe. In the Gothic world nature is not so kind. Man must fight it, protect himself against it. His skies are grey and rainy; his sea is turbulent. Consequently where the Mediterranean man sees himself within a natural setting and as a kind of creature of nature, the Gothic man sees nature as set against himself. The contrast is illustrated in one respect in the difference between the classical imitation theory of art and the Germanic expressionist theory of art. Important, however, as this contrast is, it, too, is not the one I am immediately concerned with here.

What I am talking about is closer to the old idea of the warfare between religion and science, but with a difference. The old conception of the warfare was one between the dogmas of religion and the findings of science. I am not concerned with contents, but with fundamental types of thinking.

Somehow, two incompatibles got joined in our western culture. One is the classical Greek tradition; the other is the Hebraic-Christian tradition. The marriage has always been an uneasy one, but the two parents have somehow stayed together for the sake of the children. What are the antagonistic traits that each exhibit? It is fascinating to analyze these and to see what happened as western culture developed. The story unfolds with the disturbing familiarity of a Greek dramatic trilogy.

The classical habits of thinking are a product of the Greek world. The Greeks were obsessed with curiosity about the
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world and man, and they matched this curiosity with an effort at discovery. Thales, the first man to be mentioned in the histories of philosophy and the histories of science (for the two were one then), shows the temper of the scientific mind. His theory that "all is water" explained the world in the natural terms of a physical substance. And his theory, even if it did turn out to be false, was a good theory, for it proposed an answer to a question in terms that were verifiable, that suggested conditions that might falsify the theory if the theory were wrong. Such answers have the tentativeness that distinguishes them from dogma. They are the products of an open mind. At the same time in the Greek colonies of southern Italy the Pythagorean brotherhood was developing another characteristic of scientific thought. When their founder, Pythagoras, had said that "all is number" he probably meant no more than if one wants to "get a thing's number" he can do so by covering it with stones and counting the number. But as arithmetic developed, the notion of a number as a physical thing, represented by stones, gave way to more sophisticated conceptions, and a number became an abstraction.

So began the notion that scientific explanations are always abstract and that they are expressed in mathematical terms, as we today state them by some mathematical formulae. Plato, developing the notion of abstractions, emphasized that the world as known intellectually is different from the world as perceived, splitting the scientific world of abstractions from the everyday world of the concrete. In this manner the habit of mind of the Greek culture came to maturity. It is characterized by curiosity, the gaining of knowledge through the active employment of a method that is naturalistic, looks to verifiable answers, and is always open-minded, but which is also rationalistic in giving those answers in terms of general abstractions. This is the way of science. In his open-mindedness the Greek saw nothing that was natural as evil. Good or evil was a matter of measure or excess. He thought of the irrational as the chance nature of the individual event that escaped the general explana-
tion. His religion was not dogma, but myth experience transformed into metaphor. Such was the first of the parent cultures of the western modern world. I call it the father-culture.

Contrasted with this is the mother-culture, the Hebraic-Christian tradition, where a different habit of mind prevailed. Here there was no active effort of discovery, but a passive resignation leading to mystical illumination. The authority of tradition or scripture provided a body of thought to be accepted and believed. Knowledge was the exposition of that authority. Religious ideas congealed into infallible dogma. Good and evil were sharply distinguished in the nature of things, and some acts considered evil in themselves. The sense of sin was acute. The irrational in its deeper meaning of the absurd was embraced as wisdom.

No two traditions could be more incompatible, more irreconcilable. But, during the early centuries of the Christian era these two cultures were married, for better or worse. John the Divine and Philo Judaeus performed the wedding. The revealed wisdom of the Hebraic-Christian tradition was spoken in allegorical form, the key to which was Greek Platonism. The quarrel between poetry and philosophy (or science as we might say today) Plato had resolved in favor of philosophy. But his philosophy was transmuted into poetry. This was a deception that the Hellenizing religionist innocently embraced, not realizing that in accepting the poetry he was also introducing the scientific spirit with its rationalism and its abstract mathematicism. The offspring of that marriage is our modern western culture.

No sooner had the Christian-Hebraic culture been married to the Greek culture and been impregnated by it than, as so often happens, the mother withdrew from the father and ritualistically slew him. Irked at the untamed habits of the father, who, in the guise of the old pagan universities, carried on at least the vestige of the spirit of free inquiry, Christianity, in the sixth century of our era, under Justinian, closed these seats of pagan learning and suppressed the older habits of thought.
as much as possible. And so the childhood of our culture during the early Middle Ages was passed under the dominance of its mother.

But, like all children so reared, there grew up a hatred of the mother and a great desire to emulate the father. The remaining scraps of pagan learning were eagerly sought and appropriated. Then, in a great flood, the ways of the father almost conquered the ways of the mother, during the Renaissance. Ever since, the ways of science and the heritage of the Greek father-culture have grown stronger and stronger. Recessive, but unsurrendering, the mother-culture still has kept some grip. Such is the schizophrenia of our culture, the two persons within the one.

For almost two thousand years it has been the pathetic and necessary task of western philosophy to attempt to reconcile these two incompatibles. Over and over again, as conditions varied, the great philosophers have sought to harmonize the split culture in which they lived. Let me mention just a few examples. In the thirteenth century, St. Thomas Aquinas sought to reconcile Christian doctrine and the philosophy of Aristotle. His idea that man, though he must accept by faith the doctrines of Christianity, has not only the right but the duty to discover, if he can, and to explore, these doctrines rationally, independent of his faith, was a magnificent gambit for the sake of free inquiry. In the seventeenth century Kant paralleled the laws of nature, discoverable by the pure reason, with the laws of the moral world, discoverable by the practical reason. In our own century, John Dewey more bravely asserted that the method of intelligence, or what is sometimes called scientific method, should be made amenable to the materials of ethics, religion, and other areas where it was never before considered appropriate. If the methods of science are modulated as they are applied to physics, or to biology, or to archeology, they may also be found to apply to areas where they were never applied before, if only varied in accordance with the nature
of the materials. In such ways in our culture, at least, the philosopher has been its psychiatrist.

In our present-day culture the two incompatibles are stronger than ever. The high degree of abstraction of much of our modern science is a natural outcome of the development of the Greek tradition. The more highly developed a particular science has become the more its conceptual models are difficult or impossible of imaginative visualization. There is very little left in them that can be connected with common experience. This is particularly true of the special theory of relativity, of some of the explanations of sub-atomic behavior, and of much of the newer economics. Even the older idea that the symbolisms and the language in which we state our ideas are pictures of the real has been declared dead. Language is today declared to be a kind of tool. There is no one-to-one correspondence between words and things or between the structure of the language and the structure of things. The use of language is a game in which one manipulates the counters in accordance with the rules of the game itself. The average person is as much befuddled by the claim that the way of words is not the picture of things, as he is by the theories of contemporary science that defy his imagination. Modern science looks to him like a strange game of the symbolic manipulation of abstractions. Here the mother-culture comes in for her revenge. For the average person must accept much of the results of modern science as dogma, given by faith. Though the methodologies of science incorporate techniques of verification, the understanding and practice of these is beyond the scope of the layman. However well a scientific theory may be grounded by a verification process that gives reliability to the resulting knowledge, the layman can usually only accept that knowledge by virtue of the prestige that he attributes to science because he is impressed by the results of its technological applications.

Sometimes even science itself is infected with the virus of dogma. Particular ideas and particular ways that it has developed often become the ways of an Establishment, and it closes
its mind to ways and theories not in accordance with the accepted patterns. We see cases of people who present ideas involving radical breaks with traditional notions in science having difficulty in being allowed to put their ideas to a test simply because they are unorthodox. The Establishment controls the sources of grants-in-aid and sometimes looks askance at radicals. Though often the Establishment may be right, there have been times in the history of science when the radical theory was the beginning of a new and fruitful departure in thinking. One of the hardest things for us to maintain is the open-mindedness of a tentative and fallibilistic attitude. Like so many other cultures we were reared in our formative years by our mother.

Lately the vengeance of the mother-culture has taken strange inversions that only show how strong it is. For instance, we have seen, in Communism, a social theory accepted dogmatically but claimed in the name of science. Or, again, one brand of modern theology declares that God is dead. It probably does so because it realizes the idea of God is no longer efficacious. Though the findings of science and the beliefs of religion are irrelevant to each other, science for its purposes has been able to dispense with God. Yet the theology that declares God is dead is just as religious as the one that declares He exists. Both are assertions of faith. In each an objective uncertainty is held with passionate conviction. And that is the definition that Kierkegaard, the Existentialist, gave to subjective truth. The religious culture is not the content of its dogma but a habit of mind.

As I said, the two incompatibles are strong in our contemporary culture. But, strangely, they have a mingled, paradoxical structure, like the nature of any schizophrenic. This makes for dangerous consequences in our behavior that we must always be on guard against. With all its open-mindedness, curiosity, and potential for change and development, our culture exhibits from time to time and in many segments of it strong tendencies to dogmatic stubbornness, to prejudice, and to resistance to change. I am not so concerned here that these latter traits are
bad, important as that may be. My point is that our culture has often been successful in working out a *modus vivendi* that allows for the two differing sets of traits.

At this point I believe we see a new task for psychology. Lately there has been a branch of musicology that has attained great prominence, ethno-musicology, the study of music as a cultural phenomenon. I believe there should be greater emphasis on what I may call ethno- or cultural psychology, the study of the patterns of thought behavior of different cultures. If it is historical as well as analytical it will trace the basic patterns of thought of a culture from their origins. In tracing our own and analyzing them thoroughly we can come to understanding the dynamism of our western culture; to see, perhaps, not only its weaknesses but its strengths. In studying the patterns in other cultures we may come to understanding those cultures, probably even to communicating with them more successfully. For surely our international troubles today, as always, have come from the lack of communication that stems from misunderstanding of the patterns and ways of thinking of foreign cultures. Our world today is shrinking to such small proportions that such misunderstandings can no longer be tolerated. We must understand other cultures, and even more our own; and as a result of understanding we must all draw together. As surely as racial integration must come, so must general cultural integration, a living together with mutual respect and understanding. An individual cannot be a stranger in his own culture, nor can a culture be a stranger within the world.

And, finally, understanding our own cultural patterns of thought is a necessary basis for understanding the problems of education. For the confusions we find in academia today have their basis in our culture’s schizophrenia.
Editor's Page

WITH this modest issue Nova University presents its new JOURNAL. We thank our friends in the Nova University Association, who have shown their faith in us by subscribing to our quarterly long before its birth, for their patience and support.

We have planned this JOURNAL for those who have varied interests and like the stimulation of ideas. The few articles presented here will give the reader some taste of the quality of materials and the range of subjects we expect. The book review section, which we hope to expand considerably, will call attention principally to books which would not usually come to general public notice.

We invite contributions for our pages: provocative articles on the arts, the sciences, and education in their broader, humane connections rather than in their technical aspects. Nor do we want to exclude poetry of quality.

There are many friends of ideas in this southeastern tip of our country and it is good to have such a quarterly as ours emanate from this area. We invite your participation as subscriber, reader, and contributor. May the NOVA UNIVERSITY JOURNAL grow strong and develop in personality.

C.E.G.
Jean Giradoux was one of the leading dramatists of the French theatre in the second quarter of our century. From 1928 until 1945, the year after the playwright died, his friend, Louis Jouvet, directed thirteen of his plays at the Théâtre de l’Athénée. In translation his works have crossed the Atlantic and have found frequent staging in America. Many of us remember very well AMPHITRYON 38, TIGER AT THE GATES, and MAD WOMAN OF CHAILLOT. His dramas are now part of the standard repertory of most theatrical groups.

Yet, along with their popularity they present some mystification to both theatre goer and critic. The present book is a limited attempt to study a few of Giradoux’s works in their historical and biographical context. Dr. Raymond claims she has found the “Ariadne’s thread” that throws light on the workings of Giradoux’s mind. According to her, his creative work was the result of his reactions to the political events of his times, particularly to the results of France’s victory in World War I and to her defeat and anticipated victory in World War II. His mode of expression was sometimes through erotic metaphor, more often through character as personified symbol, each concealing but replacing a political situation. Giradoux’s plays are approached as dramas of ideas and as capable of rational analysis.

Dr. Raymond’s study is admittedly limited. She restricts herself to just a few of Giradoux’s writings: to the novel SIEGFRIED ET LE LIMOUSIN and the two versions of the play he made from it, to SODOME ET GOMORRHE, to LA FOLLE DE CHAILLOT, and to the booklet LES HOMMES-TIGRES, the latter being revealed as a literary hoax. What she does is sufficient to
BOOK REVIEW

demonstrate how Giraudoux reacts to victory and defeat. Yet the larger issue of how much all his works are capable of analysis and can be approached as political events enigmatically packaged is not amply proven by such selected instances.

Almost one-half of the book is on the Siegfried cycle, tracing the development and changes in the ideas and symbols that Giraudoux made as he worked his original novel into a drama and readied it for production. Siegfried is an amnesiac French soldier leading a new life as a writer and statesman in the post-war world of his German captors. He is the symbol of the post-war German Republic which Giraudoux viewed as a government imposed by the Allies to defeat the uprisings of Bolshevism in Germany and used by the extremists of the right to mask the forces that would be dangerous to Europe in the future. The subject of the drama is thus actually Franco-German relations after World War I and the struggle of extreme right and left, and the subtle warning hint of a possible resurgence of German militarism and right-wing extremism. The drama of victory was an expression of the concern that Giraudoux felt for the future peace of Europe.

SODOME ET GOMORRHE, produced at the Théâtre Hébertot in 1943 and 1944, is a drama of the Occupation. It refutes Petain’s assertion that the fall of France was caused by the moral laxity of its people; and, under the disguise of a quarrel between husband and wife on which the fate of their world hinges, suggests that France fell because a class, the class of “profiteers,” had taken over the government and sold the country into the hands of the enemy.

LA FOLLE DE CHAILLOT, produced posthumously, proposes the remedy for this disease which had overtaken France. Giraudoux believed that the liberation, which he saw impending for the spring of 1945, would be only a detail in the long struggle of the future to rid France of its “exploiters.” The remedy Giraudoux proposed was revolution for free men. In 1944 revolt was the ideal for salvation for France and, though variously understood, was universally embraced.

Such are the serious ideas contained in the whimsies, the
metaphors, the symbols, and the anti-realism of these dramas. To someone who has seen the plays, particularly one on this side of the Atlantic who might be less aware of the involvement of the writer with events in his lifetime, this interpretation of their political meaning opens new perspectives of interest. Though the general reader might find this book somewhat academic in its presentation, this is offset by the interpretative suggestions it offers. And it becomes very fascinating to see how, for Giradoux at least, an artist transmutes his view of reality and his ideals into a work of art.

C.E.G.
CAMP
An Efficiency Engineer Reports on a Symphony Concert

For considerable periods the four oboe players had nothing to do. The number should be reduced and the work spread more evenly over the whole concert, thus eliminating peaks and valleys of activity.

All the twelve violins were playing identical notes; this seems unnecessary duplication. The staff of this section should be drastically cut. If a larger volume of sound is required, it could be obtained by means of electronic apparatus.

Much effort was absorbed in the playing of demi-semiquavers; this seems to be an unnecessary refinement. It is recommended that all notes be rounded up to the nearest semi-quaver. If this were done, it would be possible to use trainees and lower-grade operatives more extensively.

There seems to be too much repetition of some musical passages. Scores should be drastically pruned. No useful purpose is served by repeating on the horns something which has already been handled by strings. It is estimated that if all redundant passages were eliminated the whole concert time of two hours could be reduced to twenty minutes and there would be no need for an intermission.

In many cases the operators were using one hand for holding the instrument, whereas the introduction of a fixture would have rendered the idle hand available for other work. Also, it was noted that excessive effort was being used occasionally by

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the player of wind instruments, whereas one compressor could supply adequate air for all instruments under more accurately controlled conditions.

Finally, obsolescence of equipment is another matter into which it is suggested further investigation could be made, as it was reported in the program that the leading violinist's instrument was already several hundred years old. If normal depreciation schedules had been applied, the value of this instrument would have been reduced to zero and purchase of more modern equipment could then have been considered.
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