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## General

### A WORD OF WELCOME

REV. W. E. O'DONNELL  
*The College of St. Thomas, St. Paul*

### THE SCIENTIST LOOKS AT EDUCATION AND RESEARCH

CHARLES SHEARD  
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It is with some degree of fear and trepidation, and certainly in a spirit of humility and individual insignificance, that I have left a scientific laboratory with its freedom of thought, its doubting Thomas attitude, its search for some crumb or fragment of truth or some contribution to man's knowledge in the light of what we think we know in 1948, and have placed myself on this platform and injected myself into this program concerned with the most stupendous questions of our time—the adequacy or possible inadequacy of our educational systems and the survival of civilization now that science has placed in the hands of the same old savage as of yore such powerful tools as the atomic bomb.

What do we see as we look into the future? For, as the great philosopher Santayana wrote: "It is easier to look into and to foresee the future than to command it, and only those seem to command it who pre-figure it with enthusiasm. Infinitely deeper than the logic of our thoughts is the fertility of our destiny; and circumstances keep us alive by continually defeating us." Is there sanity enough in the world to handle the instrumentalities which science is so fast creating? Is there intelligence enough to enjoy these scientific developments and these systems of education chiefly concerned with man's materialistic welfare, not for destruction but for the building up of a life more abundant for all mankind? Is there time enough to develop a technic of tolerance and self control? What use will we modern savages—we animals with like hungers, passions, desires, intolerances, hatreds and bitterness—make of what we are pleased to call a new civilization?

For the man of today finds himself in a new civilization in which he, somewhat like the lily, toils not, neither doth he spin, and a civilization in which science has so harnessed the visible forces of nature or unlocked and freed her invisible power that, in America, at least, his labors are not arduous struggles; for little of life's supporting substance is earned by the sweat of his brow, and he finds

himself with a leisure and a release for which he has not been trained and which he has not been educated to use. He is still an animal, even though he may complacently and, in general, in ignorance refer to himself as homo sapiens. Like any other animal, he desires and fights for life, food, comfort and perchance today rarely for the necessities of life but rather for its luxuries. His concepts of life and his concern and purpose are largely materialistic; to acquire wealth, to gain power, to take much and to give back little, to think in terms of "gimme" and not in terms of "give." He is concerned with material things, believes but little in the intangibles and in culture, so called, except perchance on occasion for an hour on a Sunday morning or an evening concert of music; is concerned but little about education other than that which is practical and essential to acquire more easily the tokens of exchange; obtains his knowledge, whether it be of science, government or the latest evidence of man's humanness and frailty and infraction of society's commonly accepted mores, from the newspaper or over the radio, and, even though he may be college bred, reads little of anything having any real substance or involving clear, concise, cogent thinking and ability to arrive at any summation or generalization of the fundamentals. Probably he has never read Van Dyke's six line poem, "Four Things," and if so, doubtless considers it only the mutterings of the impractical poet, when he wrote with an inspired pen

"Four things a man must learn to do  
If he would make his title true:  
To think without confusion clearly;  
To love his fellow-men sincerely;  
To act from honest motives purely;  
To trust in Heaven and God securely."

Or as Milton sang so mournfully in "Paradise Lost": "And in confusion, stand." The ability to stand in the midst of confusion and emotionalism in the hour of adversity when all things are now well in a materialistic world; to think without confusion clearly; to love one's fellow men, to act from clean honest unselfish motives, to have ideals and their incarnation as God—these are the eternal verities underlying things of education and of science irrespective of whether the scientist, or this scientist, as he presumes to call himself as he now speaks to you, or the common or average man on the street looks at them.

So, then, nothing perchance is more heroic in the American tradition than the faith in education and the passion to secure it. One finds that faith almost at the beginning of American history and one finds it undiminished at the present day. In past generations at least, Americans have been a serious and a practical people. To expect a nation which wrested civilization from nature to be inter-

ested in education merely for the sake of the play of the mind might well be considered to be folly. Education has not been the training of a gentleman, as was so often true in Europe, but the training of a teacher, a doctor, a clergyman, a lawyer or a business man, who could contribute a practical knowledge of some vocation the importance of which was widely accepted in the new civilization. This is not to say that *education for the decorative use of leisure* (as it has been so pointedly designated by Professor Laski in his *The American Democracy*) has ever been completely absent from the American scene, but it has never been its predominant theme, and it has always had to defend itself from a criticism which has never lacked in vividness. Until recent years, or the beginning of the twentieth century, to say the least, the question: What has he done with his training? has always been a legitimate question to ask of the so-called educated men and women.

American education is set in the background of two principles which it is difficult to reconcile completely. The first, and without doubt historically the older, is a faith in the *social value of the mind disciplined by instruction to understand the world about it*; the second, which was given its main emphasis by the expansion to the West after the Revolution, is the belief that once the *adolescent can read and write and has mastered the simple mysteries of arithmetic, life itself is the best school to which one can be sent*. The second view, represented by the age level of 14 to 18 years, had to give way to the demand for general and compulsory education for all children. On the level of higher education this second view has been weakened, in part, but by no means destroyed, by the growing recognition that a college education can have certain real benefits, both tangible and intangible, and again, in part, by the increasing recognition that certain vocations—medicine, for example, scientific research, and even certain branches of engineering—are practiced better by men and women who have as a background a training of an academically satisfactory and adequate character. In this development and growth of education in America, through public, private and parochial sources and financial support, there has been a constantly changing and, in general, constantly improving attempt to provide schools which will enable those who attend to acquire some knowledge but, even more important, to learn how knowledge is acquired, to understand the tools and the institutions by which man has sought to adapt the world to his needs and wants. For education consists, in the last analysis, of such disciplines and training as will enable each and every one of us to *get the most out of life*, to make the best adjustments to and with all the factors of environment, both animate and inanimate, so that each and every one of us may *put back the most into life*. Therefore our schools of all levels should seek to teach *the art of living together*, the way to evoke the capacity to use one's brains, the building of

character, the grasp of that complicated and many times elusive ideal which we speak of as the American way of life.

In all of these attempts to teach the art of living together, it is obvious that the schools must educate for a changing world, adjust themselves to values which are the outcome of the fact that the cosmos of the generation before 1914 has become something nigh unto a chaos today. Certainly there is hardly a vital element in the American tradition which is set in the perspective it possessed for a man or woman who is now fifty years of age. So we may pause long enough to ask the question: Have the American schools met this challenge with success? In answer, I think I can agree with Professor Laski when he says: "American education has not met the challenge with a success proportionate to its intensity." Wherein may we justly and properly criticize? First of all, we may say with some degree of reservation that the schools have failed to keep up with life. It is apparent that too large a proportion of our youth leaving school has not been made ready for the world they must enter. Furthermore, it is entirely possible that school curricula are not flexible enough for the variety of types with which they have to deal. There is lack of adaptation to new economic and social conditions. There has been far too large a gap between the content of what is being taught and the immense body of new knowledge, both of natural and social science, which has reshaped the contours of our world. But little has been done to make a serious training for citizenship the natural outcome of the environment it attempts to create. Nor, in the age of technology of a mechanical character, has there been sufficient recognition of the fact that preparation for the creative use of leisure in the middle years of life is, in a sense, one of the most important guides to living that our American school can set itself to accomplish.

For the overwhelming majority of American children (estimated at 80 per cent) the high school is the end of their formal training. Since the emphasis has been laid on curricula concerned with preparation for college, it is obvious that training for citizenship is a by-product of school efforts at a time when its urgency was never more striking. It is now widely and rightly held, in the United States as elsewhere, that a new education has become urgent because an environment has emerged for which the old education is somewhat inadequate. There cannot be a new education without a new society to sustain it. A new society needs a new philosophy which evaluates human beings and social institutions on a scale more proportionate to the new world environment. Possibly what is needed is a fundamental change in the spirit by and with which our systems of education are permeated to their very foundations. The destiny of America is still in the melting pot. World history is more likely to be shaped by American history for the next half century than by any other element in its making; and how it is to be shaped

depends on how Americanism is shaped. It is within the United States that the final issue is bound to be decided. If America can so train and educate itself as to save itself, then it may be possible to save mankind from the tragic fate that is staring it in the face. On nothing else perchance does the outcome depend as on our ability to conquer both inertia and fear. As Laski wrote in the closing lines of his volume on American Democracy: "It is in the degree that America's citizens transcend these dangers that the immensity of their power will redeem the greatness of their historic promise."

But look in your own minds and memories  
 And find out what you find and what you'd keep.  
 It's time we did that and it won't be earlier.  
 I don't know what each one of you will find,  
 What memory, what token, what tradition,  
 It may be only half a dozen words  
 Carved on a stone, carved deeper in the heart,  
 It might be all a life, but look and find it —  
 Sun on Key West, snow on New Hampshire hills,  
 Warm rain on Georgia and the Texas wind  
 Blowing across an empire and all part,  
 All one, all indivisible and one —  
 Find it and keep it and hold on to it,  
 For there's a buried thing in all of us,  
 Deeper than all the noise of the parade,  
 The thing the haters never understand  
 And never will, the habit of the free.

Out of the flesh, out of the minds and hearts  
 Of thousand upon thousand common men,  
 Cranks, martyrs, starry-eyed enthusiasts  
 Slow-spoken neighbors, hard to push around,  
 Women whose hands were gentle with their kids  
 And men with a cold passion for mere justice.  
 We made this thing, this dream.  
 This land unsatisfied by little ways,  
 Open to every man who brought good will,  
 This peaceless vision, groping for the stars,  
 Not as a huge devouring machine  
 Rolling and clanking with remorseless force  
 Over submitted bodies and the dead  
 But as live earth where anything could grow,  
 Your crankiness, my notions and his dream,  
 Grow and be looked at, grow and live or die.  
 But get their chance of growing and the sun.  
 We made it and we make it and it's ours.  
 We shall maintain it. It shall be sustained.

— STEPHEN VINCENT BENET  
 from (Listen to the People)  
 — Independence Day, 1941

Twenty-three hundred years ago, a citizen of Greece undertook a very daring enterprise. He tried to bring within the compass of a single analysis the whole sweep of human knowledge. He developed a scientific systematization of information as a basis for the control of life; he tried, by taking thought, to reduce the chaos of human affairs to a rational order. His name was Aristotle, and for twenty-three centuries the world has paid tribute to his memory. And yet Aristotle failed miserably in his attempt. Not only the great Aristotle but all others even to this day have failed. And so, here we are, babes in the woods, children crying in the night and asking for a mighty lever and a fulcrum so that we may turn the world in its course and move and stir the peoples in it. We may feel as did Mr. Britling, in H. G. Wells's inimitable volume "Mr. Britling Sees It Through": "Dear! Dear! Does it sound like rubbish to you? You think I am talking of a dreamland, of an unattainable Utopia? Perhaps I am! This dear, jolly old world of dirt, war, bankruptcy, murder and malice, thwarted lives, wasted lives, tormented lives, general ill-health and a social decadence that spreads and deepens toward a universal smash—how can we hope to turn it back from its course? How priggish and impracticable! How impertinent! how preposterous! I seem to hear a distant hooting" . . . This hooting, this fiendish cry: There will be wars to the end of time. Everlasting peace is for the grave, not for life. The wish for everlasting peace is born of fear and ignorance. This utter hopelessness is part of our materialistic education—an education based on greed, acquisition, money first, in Gold we trust (or as many paper dollars as the gold in them thar hills can be stretched into and for which there is as yet no physical law of elastic limit). But let us not be too pessimistic. In this new generation there seems to be a real capacity for idealism. And it may be that there is too much intelligence to continue to accept our old formulas. Certainly science has accomplished at last that which all the philosophers of all the ages have dreamed of: it has made the world one. This new compactness is based on nothing else but stubborn facts. It is impossible to continue to bring dynamite, TNT, atomic bombs, bacterial death into this unity without blowing the whole of our civilization into oblivion. The first world war was a chemists' war; the second world war was a physicists' war; the third world war, which we may hope and pray may be avoided, must be a psychologists' war; we must all think our way out, "without confusion clearly" and through an acceptance of the doctrine by each and every one of us and an inculcation of it into the very vitals of our educational programs that the acquisition and possession of wealth and material comforts are not the chief aim and purpose of life. Our systems of education and our scientific undertakings must be so modified, motivated and controlled that we may save ourselves and we must dedicate ourselves to much broader viewpoints and make many necessary read-

justments before we can undertake to do what the world now looks to us to do. I said "looks to us." I should have said to us or to Sovietized Russia. A proper degree of independence, freedom of thought and action, competition of a just and proper kind, reasonable property privileges, distribution to all, and with justice, of the products of the hand and of the brain, everybody a profit sharer in all cooperative undertakings, a government which is the servant of the people rather than the people the servants of the government, educational opportunities for all to the limit of their ability to accept and use them, some provision for security in old age and in sickness, millions of comfortably and efficiently living individuals made possible by a distribution of the wealth to the workers, white collars and all, and never accumulated in vast fortunes in the hands of a few: these are the ideals which must be taught and striven for and which must be made in large part realities at home and in our relations with the rest of the world if our present civilization is to be saved. This is practical socialism, being a brother's keeper, and not communism or soviet totalitarianism. This is a doctrine of not only letting live and exist, and struggle hopelessly on, but it is a doctrine of helping to live. This is a doctrine of personal trusteeship; this a doctrine of national and international trusteeship. It is the teaching of this doctrine and its inculcation in our hearts and lives which must provide for us and for the civilized peoples of the world the intangible spiritual development and training so that, with some degree of economic security in the needs of the animal body, there may be finally evolved a democracy with balance—freedom of thought and action looking toward the living of the life more abundant founded and built on the adequacy of economic essentials. Then it may be possible that peace on earth will reign through the ages and man's educational systems may be concerned but in part with the problems of gaining a livelihood and keen economic competition and the release from serfdom and slavery of the struggle for existence may not be converted into demons of warfare and destruction.

Recently as I entered into the inner sanctum of one of our beautifully constructed houses of worship in the East, I paused long enough to read and then to copy these introductory words from a letter tacked to a door and addressed by the bishop to the parishioners:—"We have entered a year which is fraught with solemn significance and, no less, new hope and expectation. Men's hearts, long 'failing them for fear' seek now the sign of promise. Where may it be found?" Yes, indeed, where may it be found? The bishop's words were penned during the period of the depression when the world of material things had tottered and tumbled, and there was weeping and wailing and gnashing of teeth. Where is it to be found today, when the whole world is bankrupt and material tokens of exchange and of business have uncertain and vanishing values? I be-

lieve the answer still lies in the enlightenment of education and the release and freedom from the life of drudgery vouchsafed to us through research if, and only if, there be much greater emphasis placed on the development and educational training of that self which rises above the materialistic and mechanistic and which is the I AM which may reside in each house of clay if it is bidden to enter and abide within. Possibly, as I ventured to suggest subsequent to a three months' sojourn in Europe last summer, we have not been tried and purged; we have not suffered sufficiently; we have not come to believe that it profiteth a man naught if he gain the whole world and lose his own soul.

Allow me to speak for a few moments concerning England. I might speak of, illustrate and reminisce about how rigidly her foods were and still are rationed; of the average low labor wage (\$20 per week for miners); of the lack of clothing and how the yearly individual allotment of less than fifty clothing coupons meant one suit, a shirt or two, a pair or two of socks and one or two handkerchiefs per year; of how darned clothing, even forced on the well-to-do (since rich and poor alike are equal in the eyes of English law but, I judge, quite definitely not so in most of Europe), was fashionable and suits were of ancient vintage for the most part, and of how the English, always possessed of abominable cooking and always a poorly nourished nation, seem so tired, oh, so tired, and yet carry on. But I would speak of how England and Scotland have found educational and spiritual uplift by greater emphasis on the cultural side of life, musical concerts, art exhibits and her literature and through great encouragement to her people to give individualistic expression to their innermost selves through creations of their hands and minds. After my return and as I spoke briefly of the educational and research programs and meetings which I had attended in England, and particularly in Oxford and London, I said: "I have returned to this blessed land, this so unbelievably fortunate and blest land, believing as never before in the survival of that which is the intangible, without money and without price, and that England as a whole and our English educators and scientists and many of us, also, believe that there is something infinitely more worthwhile than the acquisition of the almighty dollar and, as it once was and may in the course of events again become, the almighty pound."

What was and still is the leavening influence and ferment? England's great universities, Oxford and Cambridge most outstanding; the great Clarendon, Cambridge and London presses; the severity of her educational systems if one expects to become one of her lifetime scholars and fellows or to be trained for her diplomatic and governmental agencies and duties. I know but little about the things of either English or American education and I do not wish you to believe that I say that the English systems of education are superior to our own and that we should adopt them. In general, American

education has been for the masses and, perchance of necessity, has been forced to be concerned with training in the practical things of life, the earning of a living, and therefore with the materialistic and utilitarian approaches. In general English and European education, other than of an elementary character, has not been for the masses and it has not adhered to the doctrine of mass education which, like mass production, has been such an inherent concept of American democracy. The English and, in part, the Germans have laid the emphasis on *trained minds*; in America, especially during the Golden Age which I suspect is now passing or has passed, the emphasis has been on *trained fingers*.

It may be well to define what we mean by a *trained mind*. I should say that a trained mind is one that has learned through extensive reading of books dealing with several related subjects, as well as through the guidance of competent teachers, to understand why the subjects are related; to criticize intelligently the statements and opinions encountered in such reading; to distinguish between that which is false and worthless and that which is genuine and worthy; to think, in short, for itself and to go on thinking for itself through life; to speak and write clearly and logically on any subject concerning which it has made a study and on which it has formed an opinion; and to have a sincere appreciation of and respect for intellectual pursuits. I suspect that most of us, whether trained under the American, Continental or English systems or a combination thereof, may well question whether we possess trained minds. My own opinion concerning American education is that it is, as I have already stated, but one aspect of our American system of mass production, that it is chiefly the acquisition of facts and with too little self-thinking and application of the facts. Also, I have reason to believe that English undergraduates and, I am certain, graduate students, as we speak of them, have a high regard for learning, education and the art of teaching. Certainly there is a perpetual effort on the part of teachers in Great Britain to develop in their students sound judgment and a critical sense rather than to stuff them with facts. As I am sure you all know, the two forms of Oxford degrees, as an example, are known as Pass Degrees and Honours Degrees. A student working for a Pass Degree studies a subject somewhat sketchily, takes an examination in that subject when he is ready and speedily forgets all about it. I think I am correct in my statement that the amount of work done by an Oxford undergraduate studying for a Pass Degree is similar to, although a little less tiring than, the amount done by the average American student. An Honours Degree, on the other hand, requires a vast amount of reading in enormous numbers of books and, as some one has said, some of them the heaviest and dullest books ever written in the English language. At any rate, such a student is early trained and educated to do some things which he doesn't want to do and at the time he

doesn't want to do them and to do them well. The basis of all Oxford education is *reading* and the weekly visit to his tutor for his tutorial. At the completion of his week's reading he writes an essay on it and reads the essay to the tutor. The tutor's main duty is to goad the undergraduate into applying his wits to his studies as well as his eyes and his memory, and to make certain that he will not unquestionably accept the statements contained in books, but will critically examine them for truth and falsity. For the moment, then, and to be critical, many of us believe that, in our American universities and colleges, the student does but little reading, rarely writes an essay except as a despicable and so-called "lousy" composition in freshman English, accepts the textbook or professor's statement as infallible proof, expects to be lectured to and that the instructor will use his wits, eyes and memory. If you believe that we are hypercritical, then go into the homes of the graduates of our American institutions and become amazed at the discovery that there is hardly a book, other than the Bible as an air of respectability, in a home. Radios and newspapers are the sources of information and thinking of Joe Blow and Mr. Joe Blow, Bachelor of Science.

Oddly enough, and I doubt if it is to be wondered at, the tendencies in education in Oxford and Cambridge, on the one hand, and of Harvard and Yale, on the other hand, have changed somewhat prior to the war and in the period of depression and since the war. The English public is fully cognizant that it was mass production in America which, for the second time, still left the English speaking peoples as free peoples and their philosophy of life and acceptance of the ideals of democracy as opposed to totalitarianism still dominant and victorious, or at least so for the moment. So, to a degree, English educational systems have been modified with changes in entrance requirements and the establishment of more courses and schools concerned not, fundamentally at least, with trained minds in the sense we previously defined them, but with trained fingers and sensitive finger tips more than mentally sensitive cerebral nerve endings. So the old classical training is being modified and there is some departure from the world of scholasticism and the realm of erudition to a consideration of such materialistic matters as production, training for a livelihood, or perchance a training for national defense and preservation of freedom and peace through mass production and training concerned with the things of mass production. We, in turn, in this country are cognizant of some of the educational weaknesses I have pointed out and begin to fear that the mechanisms of mass production are entering into mass education with the inevitable result that standards are now being and will continue to be lowered and that there is a veritable *tide of mediocrity* sweeping into and over our whole American system of education. Those who go to the senior college should be above average capacity. Parenthetically I might say that I believe we should

have many more junior colleges with specific vocational functions as well as the first two years of fundamental collegiate education. It is asserted that this is undemocratic, aristocratic and smacks of the snobbishness and snootiness of the Oxford, Cambridge and so forth methods. As Doctor Chalmers, president of Kenyon College in Ohio, recently stated: "Such assertions seem to be based on the assumption that there are no degrees of ability and that efforts to establish such degrees are undemocratic." We believe that a student has the right to as good an education as he can be given and is capable of receiving. But that doesn't mean that every man, woman or child should be sent to Harvard. Father Gannon, president of Fordham University, says that "the fraud in the present campaign for educational inflation consists in spreading our national culture perilously thin and calling it democracy of education. It consists in swelling the number of incompetents in American colleges and calling it equality of opportunity." I am sure that a normal condition in an American college finds that about 25 to 33.3 per cent of those registered in such an institution clutter up the place and interfere with other people's intellectual progress. The recent proposal of the President's Commission on Higher Education was to the effect that U. S. colleges and universities double their enrollment by 1960. If 5,000,000 Americans were given a college education at the same time, how good an education would they get? Such ideas and programs threaten to suffocate us with tides of mediocrity. We need more toughness, more severity, less concern about saving the mediocre by so-called higher education, greater demonstration and proof that the education asked for can be accepted and used. We may talk of democracy of opportunity, democracy in material things, but there is no such thing as a democracy of brains. Rather is it an aristocracy, and he who does not have the admittance card has no reason to expect admission.

I said I had no thesis in particular for Oxford and Cambridge universities and similar institutions and also pointed out that changing times and demands, and the exigencies and levelling influences of war, had caused a veer in education somewhat to the left and to the introduction of some Americanisms into English educational systems. Now, then, and interestingly enough do we find one of our oldest institutions of higher learning, Yale University, swinging to the right and introducing some little of the methods and programs of the English and Continental systems. An announcement under date of March 19 of this year states that two major revisions in the requirements for the undergraduate degree at Yale University, which are expected to have a far-reaching influence on that institution, are to be instituted this year. Starting this summer, all students will be required to undertake an extensive reading program during the vacation period. Hence the university will have some degree of year-round supervision over its students. Each stu-

dent will be required to read six books during the summer and from a list prepared by the university. He will then be required to pass an examination on these books at the time of his return to college in the fall. Also, Yale instituted this last year a special *scholars-of-the-house* program. Under this plan, students who are selected will not be required to attend classes. They will be free to select their own studies, subject only to a comprehensive examination at the end of the senior year. The program is intended to encourage a small number of specially qualified undergraduates to assume a more active direction of their own education than is possible under the traditional curriculum. It will provide an opportunity for independent and original work, either academic or creative, on a scale impossible in the ordinary undergraduate program.

Possibly the pursuit of this program at Yale University, should it prove reasonably successful or at least superior to that which now exists, may lead to a more general acceptance of the role of the junior college as it relates to the senior college. I believe that the curriculum of the first two years should be the same in all collegiate institutions, with possibly one elective only in the second year, should be given in junior colleges and small colleges and that it should consist of fundamental and foundation courses in physical and biologic sciences (one of which should be human physiology and hygiene), mathematics, English, sociology, economics and psychology. At the completion of such a course, students would proceed by careful selection into the equivalent program of the Honours Degree course or direct their interest to some semi-professional or artisan course, thereby gaining some background of culture supplemented with a training for a livelihood and some useful service to the country.

In many respects, therefore, this follows closely the methods of Cambridge and Oxford. To my way of thinking, this is an excellent departure and it is to be hoped that this innovation will be the beginning of a movement that will stem the tides of mediocrity that tend to suffocate us educationally. A few giants in the land, with fine physiques, well-trained minds, clean hands and pure hearts, would be worth thousands of these wishy-washy, too lazy to go to work, so-called college students who clutter up our halls of learning, who may be graduated ultimately and for no good reason, who expect to wear white collars, sell some bonds via the telephone, sign big checks and who, since all or none of this life of Riley occurs, become communistically or sovietistically inclined and expect to be cared for by a government that owes them a living.

But I must hasten on. What about science, research, scientific research? As one who calls himself a scientist, I think I rebel more against the shallowness of the concept of what constitutes science and research on the part of the members of a mass-production,

mass-thinking democracy than I do of its inability to understand that facts per se do not constitute education but are the tools to be used by trained minds. Historically we may define science by equating it with the extraordinary activity which arose in Italy in the sixteenth century, for around 1600 there was a change in the point of view among learned men which was truly revolutionary. The leaders of thought of the seventeenth century often spoke of the "new philosophy," or "natural philosophy," meaning experimental and observational science. Science therefore is to be placed within the area of accumulative knowledge. As President Conant of Harvard, in discussing the subject "The Scientist in our Unique Society," said: "Only in very recent times did science emerge from the other human activities which had been accumulating knowledge for thousands of years. The characteristic of the new philosophy of the seventeenth century was that it sought to deal with those ideas or concepts which arise from controlled experiment or observation and in turn lead to further experiment and observation. Science, thus defined, is to be regarded as a series of *interconnected conceptual schemes* which arose originally from experimentation or careful observation and were fruitful of new experiments." The test of a new concept is not only the economy and simplicity with which it can accommodate known observations, but its fruitfulness. When science is viewed as a process of developing conceptual schemes rather than as a practical undertaking, science then has a dynamic quality. So, therefore, it is not the conception of what constitutes science which is held all too frequently by the man on the street—namely, facts and practical undertakings—which is to be considered dynamic, but rather is it largely if not wholly static. Science advances not by the accumulation of new facts (a process which may even conceivably retard scientific progress) but by the continuous development of *new and fruitful concepts*.

Through the past three or four centuries there has been a rapid development of the practical arts which has paralleled the development of science. But it is not until we get into the nineteenth century that we find anything like the practical influence of scientific progress to which Francis Bacon and the new philosophers looked forward. And it has remained to our own century to witness so close an interaction and interrelationship between advance in science and progress in practical arts, with the result that there is much popular misunderstanding about the relation of the two. As Conant stated, "it is as though we are dealing with a continuous spectrum. At one end we may place the changing conceptual schemes arising from experiment and giving rise to experiment (pure science, if you will): at the other end may be placed the improvements in practical arts that have been going on. In the seventeenth century the pure science end of the spectrum appeared; during the next two hundred years the opposite end continues to

grow more and more brightly; the intervening space narrows over the years." The two ends of the spectrum can still be recognized, but the intermediary zone now occupies the main position. Pure science has invaded the practical arts and the practical arts have penetrated deeply into science, and in many regions one cannot distinguish between the technics of the scientist interested only in new conceptual possibilities and those of the practical experimenter who is interested solely in an improved process or machine. This is obvious to most of us in the case of the physical sciences. But it is just as true in the case of the biological sciences and it is difficult to draw the lines between or indicate the confines of pure and applied science in biochemistry, biophysics, physiology and even bacteriology. The application of new ideas and new tools developed by the physicist and chemist to the study of biological problems has been one of the most important and fruitful undertakings of the last three decades. Certainly the interplay, interrelationships, joint investigations of physicists, chemists and biologists have broadened and are still broadening our understanding of certain biological processes. And to again quote President Conant: "Certainly the interplay between those pressing for solution of medical and agricultural problems and those concerned only with fundamental investigations is today very fruitful. There is no room for argument as to which is a superior activity. Neither the clinician nor the fundamental scientist can afford to look down his nose at the other fellow." No, indeed, I might say: they should be too busy cooperating the one with the other.

As we again look backward for the moment and into the middle of the past century, we find that the cleavage between scientists and practitioners or practical men was quite definite. The great Clerk-Maxwell, who gave the world that outstanding conceptual schema of electromagnetic waves, in reviewing in public Alexander Graham Bell's telephone, left no doubt as to who was master or who was supreme in any hierarchy of learning that was worthy of consideration. Even Pasteur might have been, and on occasion was, regarded as a promising young student gone astray.

So in our emphasis on the need today of new and fruitful concepts and the dynamic development of conceptual schemes, we must not be led too far astray by reason of our advocacy of the divorce of theory and practice which characterized the work of Newton, Maxwell and Darwin. But the pendulum has now swung too far, or at least has been swinging rather far toward practical applications and away from fundamental disclosures. For example, investigators concerned with disease rather than with basic concepts in biology are likely to receive popular acclaim, and that acclaim, in turn, to influence unduly large financial support. For it is permitted to a very few, relatively speaking, and then only to those with adequately trained minds, to appreciate or understand

the conceptual schema. The work of Newton, Maxwell, Darwin, Einstein and others like them must, of necessity, remain unknown to the masses of the people, and these names would be unsung had not some practical fellows put the "go" into their theories and concepts.

But without new concepts there will be no advances in the practical arts. We may well ask the question: Is there danger in this union and fusion of pure and applied science, which has occurred in your lifetimes and mine, that the tradition inherited from previous generations of the investigator interested only in the conceptual schemes will be so neglected and so weakened as to disappear? Many of our best trained minds and astute thinkers are inclined to think so. If this happens in any country, then it is obvious that there will be, figuratively speaking, no new blood or new ferment and the effectiveness of physical and biological sciences as applied to practical problems will diminish. Only by a constant development of pure science can there be a constant advance in the practical arts.

As we have indicated, the physical sciences to a very considerable extent and the biological sciences to some degree have made progress through developing conceptual schemes. But those who are concerned with anthropological, sociological and social psychological types of work have no record of success behind them, viewed either as aids to practical-minded men or as a development of conceptual schemes. Surely many of the best minds should be devoted to a study of what must be done to keep society strong and democratic. Studies of society by competent scholars can furnish basic information as an aid to those who struggle with the problems of human relations. Fundamental investigations must be carried on concerning the nature of man and society, as well as a consideration of some of the specific problems at hand. This is the great field of investigation into which should be poured the best physiological and psychological concepts. The closest cooperation should exist between medical men, psychologists and psychiatrists and these, in turn, must be in close touch with and be guided in many respects and on many occasions by those skilled in the accuracy of methods and approaches peculiar to the physical and mathematical sciences.

But the professor and scientist must descend from his ivory tower and return, somewhat reluctantly, to earth and the things of earth as he believes them to be. To be sure, our heads should be in the skies and our feet on solid ground—on the clay but not in the clay. Ideals must be maintained and the least degree of compromise made with these ideals as we live in an everyday world of labor and of struggle for the necessities of life or greedily clutch for and hold to the ever-enticing luxuries and creature comforts. So, as we stand here in this year of our Lord 1948, we know with-

out any shadow of doubt that two great systems of thought, of action, of control, of economies, of social living are now face to face with each other. It means that ultimately there will be a survival of the fittest, possibly determined by the fate of still other wars, but more likely to be determined by our own faith and our own works and whether we believe in not only living and letting live but actually helping the other fellow to live, through the adequacy and richness of our educational and research systems and undertakings in the things of the mind, body and soul. In order to preserve our freedom of thought and action and thereby guarantee to ourselves and the peoples of this world the possibility of economic and social justice, we must protect adequately and be ready at all times to defend without fear, uncertainty or delay this so-called Heartland of ours, North America. Hence we must have at all times adequate and superior air and sea powers and we must support greater developments in theoretical and practical research, pure and applied science.

At the funeral of Jan Masaryk a children's choir sang his father's, Thomas, favorite folk song, a simple ballad with a haunting tune, *Ach synku, synku*:

“Oh, my son, home so soon?  
 Have you been plowing, been plowing?  
 Have you been plowing all afternoon?  
  
 Father, the wheel broke,  
 Father, the wheel broke,  
 We'll have to strengthen each spoke.”

Yes, indeed, “we'll have to strengthen each spoke.”

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## THE SOCIAL SCIENTIST LOOKS AT SCIENCE

CHARLES J. TURCK  
*Macalester College, St. Paul*

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## SCIENCE AND THE PHILOSOPHER

GEORGE P. CONGER  
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