VII

COMMUNICATION, SECRECY, AND SOCIAL POLICY

In the world of affairs, the last few years have been characterized by two opposite, even contradictory, trends. On the one hand, we have a network of communication, intranational and international, more complete than history has ever before seen. On the other hand, under the impetus of Senator McCarthy and his imitators, the blind and excessive classification of military information, and the recent attacks on the State Department, we are approaching a secretive frame of mind paralleled in history only in the Venice of the Renaissance.

There the extraordinarily precise news-gathering services of the Venetian ambassadors (which form one of our chief sources of European history) accompanied a national jealousy of secrets, exaggerated to such an extent that the state ordered the private assassination of emigrant artisans, to maintain the monopoly of certain chosen arts and crafts. The modern game of cops and robbers which seems to characterize both Russia and the United States, the two principal contestants for world power of this century, suggests the old Italian cloak-and-dagger melodrama played on a much larger stage.

The Italy of the Renaissance was also the scene of the birth-pangs of modern science. However, the science of the present day is a much larger undertaking than that of Renaissance Italy. It should be possible to examine all the elements of information and secrecy in

the modern world with a somewhat greater maturity and objectivity than belong to the thought of the times of Machiavelli. This is particularly so in view of the fact that, as we have seen, the study of communication has now reached a degree of independence and authority making it a science in its own right. What does modern science have to say concerning the status and functions of communication and secrecy?

I am writing this book primarily for Americans in whose environment questions of information will be evaluated according to a standard American criterion: a thing is valuable as a commodity for what it will bring in the open market. This is the official doctrine of an orthodoxy which it is becoming more and more perilous for a resident of the United States to question. It is perhaps worth while to point out that it does not represent a universal basis of human values: that it corresponds neither to the doctrine of the Church, which seeks for the salvation of the human soul, nor to that of Marxism, which values a society for its realization of certain specific ideals of human well-being. The fate of information in the typically American world is to become something which can be bought or sold.

It is not my business to cavil whether this mercantile attitude is moral or immoral, crass or subtle. It is my business to show that it leads to the misunderstanding and the mistreatment of information and its associated concepts. I shall take this up in several fields, beginning with that of patent law.

The letters patent granting to an inventor a limited monopoly over the subject matter of his invention are for him what a charter is to a chartered company. Behind our patent law and our patent policy is an implicit philosophy of private property and of the rights thereto. This philosophy represented a fairly close approximation to the actual situation in the now ending period when inventions were generally made

in the shop by skilled handicraftsmen. It does not represent even a passable picture of the inventions of the present day.

The standard philosophy of the patent office presupposes that by a system of trial and error, implying what is generally called mechanical ingenuity, a craftsman has advanced from a given technique to a stage, embodied in a specific apparatus. The law distinguishes the ingenuity which is necessary to make this new combination from the other sort of ingenuity which is necessary to find out scientific facts about the world. This second sort of ingenuity is labeled the *discovery of a law of nature;* and in the United States, as well as in many other countries with similar industrial practices, the legal code denies to the discoverer any property rights in a law of nature which he may have discovered. It will be seen that at one time this distinction was fairly practical, for the shop inventor has one sort of tradition and background, and the man of science has a totally different one.

The Daniel Doyce of Dickens' *Little Dorrit*, is clearly not to be mistaken for the members of the Mudfog Association which Dickens treats elsewhere. The first, Dickens glorifies as the common sense craftsman, with the broad thumb of the hand worker, and the honesty of the man who is always facing facts; whereas the Mudfog Association is nothing but a derogatory alias for the British Association for the Advancement of Science in its early days. Dickens reviles the latter as an assemblage of chimerical and useless dreamers, in language which Swift would not have found inadequate to describe the projectors of Laputa.

Now a modern research laboratory such as that of the Bell Telephone Company, while it retains Doyce's practicality, actually consists of the great-grandchildren of the Mudfog Association. If we take Faraday as an outstanding yet typical member of the early British Association for the Advancement of Science, the chain

to the research men of the Bell Telephone Laboratories of the present day is complete, by way of Maxwell and Heaviside, to Campbell and Shannon.

In the early days of modern invention, science was far ahead of the workman. The locksmith set the level of mechanical competence. A piston was considered to fit an engine-cylinder when, according to Watt, a thin sixpence could just be slipped between the two. Steel was a craftsman's product, for swords and armor; iron was the stringy, slag-filled product of the puddler. Daniel Doyce had a long way indeed to go before so practical a scientist as Faraday could begin to supplant him. It is not strange that the policy of Great Britain, even when expressed through such a purblind organ as Dickens' Circumlocution Office, was directed toward Doyce as the true inventor, rather than to the gentlemen of the Mudfog Society. The Barnacle family of hereditary bureaucrats might wear Doyce to a shadow, before they ceased to refer him from office to office, but they secretly feared him, as the representative of the new industrialism which was displacing them. They neither feared, respected, nor understood the gentlemen of the Mudfog Association.

In the United States, Edison represents the precise transition between the Doyces and the men of the Mudfog Association. He was himself very much of a Doyce, and was even more desirous of appearing to be one. Nevertheless, he chose much of his staff from the Mudfog camp. His greatest invention was that of the industrial research laboratory, turning out inventions as a business. The General Electric Company, the Westinghouse interests, and the Bell Telephone Laboratories followed in his footsteps, employing scientists by hundreds where Edison employed them by tens. Invention came to mean, not the gadget-insight of a shop-worker, but the result of a careful, comprehensive search by a team of competent scientists.

At present, the invention is losing its identity as a

commodity in the face of the general intellectual structure of emergent inventions. What makes a thing a good commodity? Essentially, that it can pass from hand to hand with the substantial retention of its value, and that the pieces of this commodity should combine additively in the same way as the money paid for them. The power to conserve itself is a very convenient property for a good commodity to have. For example, a given amount of electrical energy, except for minute losses, is the same at both ends of a transmission line, and the problem of putting a fair price on electric energy in kilowatt-hours is not too difficult. A similar situation applies to the law of the conservation of matter. Our ordinary standards of value are quantities of gold, which is a particularly stable sort of matter.

Information, on the other hand, cannot be conserved as easily, for as we have already seen the amount of information communicated is related to the non-additive quantity known as entropy and differs from it by its algebraic sign and a possible numerical factor. Just as entropy tends to increase spontaneously in a closed system, so information tends to decrease; just as entropy is a measure of disorder, so information is a measure of order. Information and entropy are not conserved, and are equally unsuited to being commodities.

In considering information or order from the economic point of view, let us take as an example a piece of gold jewelry. The value is composed of two parts: the value of the gold, and that of the "façon," or workmanship. When an old piece of jewelry is taken to the pawnbroker or the appraiser, the firm value of the piece is that of the gold only. Whether a further allowance is made for the façon or not depends on many factors, such as the persistence of the seller, the style in favor when it was made, the purely artistic craftsmanship, the historical value of the piece for museum purposes, and the resistance of the buyer.

Many a fortune has been lost by ignoring the difference between these two types of values, that of the gold and that of the façon. The stamp market, the rare-book market, the market for Sandwich glass and for Duncan Phyfe furniture are all artificial, in the sense that in addition to the real pleasure which the possession of such an object gives to its owner, much of the value of the façon pertains not only to the rarity of the object itself, but to the momentary existence of an active group of buyers competing for it. A depression, which limits the group of possible buyers, may divide it by a factor of four or five, and a great treasure vanishes into nothing just for want of a competitive purchaser. Let another new popular craze supplant the old in the attention of the prospective collectors, and again the bottom may drop out of the market. There is no permanent common denominator of collectors' taste, at least until one approaches the highest level of aesthetic value. Even then the prices paid for great paintings are colossal reflections of the desire of the purchaser for the reputation of wealth and connoisseurdom.

The problem of the work of art as a commodity raises a large number of questions important in the theory of information. In the first place, except in the case of the narrowest sort of collector who keeps all his possessions under permanent lock and key, the physical possession of a work of art is neither sufficient nor necessary for the benefits of appreciation which it conveys. Indeed, there are certain sorts of works of art which are essentially public rather than private in their appeal, and concerning which the problem of possession is almost irrelevant. A great fresco is scarcely a negotiable document, nor for that matter is the building on whose walls it is placed. Whoever is technically the possessor of such works of art must share them at least with the limited public that frequents the buildings, and very often with the world at large. He cannot place them

in a fireproof cabinet and gloat over them at a small dinner for a few connoisseurs, nor shut them up altogether as private possessions. There are very few frescoes which are given the adventitious privacy of the one by Siqueiros which adorns a large wall of the Mexican jail where he served a sentence for a political offense.

So much for the mere physical possession of a work of art. The problems of property in art lie much deeper. Let us consider the matter of the reproduction of artistic works. It is without a doubt true that the finest flower of artistic appreciation is only possible with originals, but it is equally true that a broad and cultivated taste may be built up by a man who has never seen an original of a great work, and that by far the greater part of the aesthetic appeal of an artistic creation is transmitted in competent reproductions. The case of music is similar. While the hearer gains something very important in the appreciation of a musical composition if he is physically present at the performance, nevertheless his preparation for an understanding of this performance will be so greatly enhanced by hearing good records of the composition that it is hard to say which of the two is the larger experience.

From the standpoint of property, reproduction-rights are covered by our copyright law. There are other rights which no copyright law can cover, which almost equally raise the question of the capacity of any man to own an artistic creation in an effective sense. Here the problem of the nature of genuine originality arises. For example, during the period of the high Renaissance, the discovery by the artists of geometric perspective was new, and an artist was able to give great pleasure by the skillful exploitation of this element in the world about him. Dürer, Da Vinci, and their contemporaries exemplify the interest which the leading artistic minds of the time found in this new device. As the art of perspective is one which, once

mastered, rapidly loses its interest, the same thing that was great in the hands of its originators is now at the disposal of every sentimental commercial artist who designs trade calendars.

What has been said before may not be worth saying again; and the informative value of a painting or a piece of literature cannot be judged without knowing what it contains that is not easily available to the public in contemporary or earlier works. It is only independent information which is even approximately additive. The derivative information of the second-rate copyist is far from independent of what has gone before. Thus the conventional love story, the conventional detective story, the average acceptable success tale of the slicks, all are subject to the letter but not the spirit of the law of copyright. There is no form of copyright law that prevents a movie success from being followed by a stream of inferior pictures exploiting the second and third layers of the public's interest in the same emotional situation. Neither is there a way of copyrighting a new mathematical idea, or a new theory such as that of natural selection, or anything except the identical reproduction of the same idea in the same words.

I repeat, the prevalence of clichés is no accident, but inherent in the nature of information. Property rights in information suffer from the necessary disadvantage that a piece of information, in order to contribute to the general information of the community, must say something substantially different from the community's previous common stock of information. Even in the great classics of literature and art, much of the obvious informative value has gone out of them, merely by the fact that the public has become acquainted with their contents. Schoolboys do not like Shakespeare, because he seems to them nothing but a mass of familiar quotations. It is only when the study of such an author has penetrated to a layer deeper than that which has been absorbed into the superficial clichés of the time, that

we can re-establish with him an informative *rapport*, and give him a new and fresh literary value.

It is interesting from this point of view that there are authors and painters who, by their wide exploration of the aesthetic and intellectual avenues open to a given age, have an almost destructive influence on their contemporaries and successors for many years. A painter like Picasso, who runs through many periods and phases, ends up by saying all those things which are on the tip of the tongue of the age to say, and finally sterilizes the originality of his contemporaries and juniors.

The intrinsic limitations of the commodity nature of communication are hardly considered by the public at large. The man in the street considers that Maecenas had as his function the purchase and storage of works of art, rather than the encouragement of their creation by the artists of his own time. In a quite analogous way, he believes that it is possible to store up the military and scientific know-how of the nation in static libraries and laboratories, just as it is possible to store up the military weapons of the last war in the arsenals. Indeed, he goes further, and considers that information which has been developed in the laboratories of his own country is morally the property of that country; and that the use of this information by other nationalities not only may be the result of treason, but intrinsically partakes of the nature of theft. He cannot conceive of a piece of information without an owner.

The idea that information can be stored in a changing world without an overwhelming depreciation in its value is false. It is scarcely less false than the more plausible claim, that after a war we may take our existing weapons, fill their barrels with cylinder oil, and coat their outsides with sprayed rubber film, and let them statically await the next emergency. Now, in view of the changes in the technique of war, rifles store fairly well, tanks poorly, and battleships and submarines not

at all. The fact is that the efficacy of a weapon depends on precisely what other weapons there are to meet it at a given time, and on the whole idea of war at that time. This results—as has been proved more than once—in the existence of excessive stockpiles of stored weapons which are likely to stereotype the military policy in a wrong form, so that there is a very appreciable advantage to approaching a new emergency with the freedom of choosing exactly the right tools to meet it.

On another level, that of economics, this is conspicuously true, as the British example shows. England was the first country to go through a full-scale industrial revolution; and from this early age it inherited the narrow gauge of its railways, the heavy investment of its cotton mills in obsolete equipment, and the limitations of its social system, which have made the cumulative needs of the present day into an overwhelming emergency, only to be met by what amounts to a social and industrial revolution. All this is taking place while the newest countries to industrialize are able to enjoy the latest, most economical equipment; are able to construct an adequate system of railroads to carry their goods on economically-sized cars; and in general, are able to live in the present day rather than in that of a century ago.

What is true of England is true of New England, which has discovered that it is often a far more expensive matter to modernize an industry than to scrap it and to start somewhere else. Quite apart from the difficulties of having a relatively strict industrial law and an advanced labor policy, one of the chief reasons that New England is being deserted by the textile mills is that, frankly, they prefer not to be hampered by a century of traditions. Thus, even in the most material field, production and security are in the long run matters of continued invention and development.

Information is more a matter of process than of storage. That country will have the greatest security whose

informational and scientific situation is adequate to meet the demands that may be put on it—the country in which it is fully realized that information is important as a stage in the continuous process by which we observe the outer world, and act effectively upon it. In other words, no amount of scientific research, carefully recorded in books and papers, and then put into our libraries with labels of secrecy, will be adequate to protect us for any length of time in a world where the effective level of information is perpetually advancing. There is no Maginot Line of the brain.

I repeat, to be alive is to participate in a continuous stream of influences from the outer world and acts on the outer world, in which we are merely the transitional stage. In the figurative sense, to be alive to what is happening in the world, means to participate in a continual development of knowledge and its unhampered exchange. In anything like a normal situation, it is both far more difficult and far more important for us to ensure that we have such an adequate knowledge than to ensure that some possible enemy does *not* have it. The whole arrangement of a military research laboratory is along lines hostile to our own optimum use and development of information.

During the last war an integral equation of a type which I have been to some extent responsible for solving arose, not only in my own work, but in at least two totally unrelated projects. In one of these I was aware that it was bound to arise; and in the other a very slight amount of consultation should have made me so aware. As these three employments of the same idea belonged to three totally different military projects of totally different levels of secrecy and in diverse places, there was no way by which the information of any one of them could penetrate through to the others. The result was that it took the equivalent of three independent discoveries to make the results accessible in all three fields. The delay thus created was a matter of

from some six months to a year, and probably considerably more. From the standpoint of money, which of course is less important in war, it amounted to a large number of man-years at a very expensive level. It would take a considerable valuable employment of this work by an enemy to be as disadvantageous as the need for reproducing all the work on our part. Remember that an enemy unable to participate in that residual discussion which takes place quite illegally, even under our setup of secrecy, would not have been in the position to evaluate and use our results.

The matter of time is essential in all estimates of the value of information. A code or cipher, for example, which will cover any considerable amount of material at high-secrecy level is not only a lock which is hard to force, but also one which takes a considerable time to open legitimately. Tactical information which is useful in the combat of small units will almost certainly be obsolete in an hour or two. It is a matter of very little importance whether it can be broken in three hours; but it is of great importance that an officer receiving the message should be able to read it in something like two minutes. On the other hand, the larger plan of battle is too important a matter to entrust to this limited degree of security. Nevertheless, if it took a whole day for an officer receiving this plan to disentangle it, the delay might well be more serious than any leak. The codes and ciphers for a whole campaign or for a diplomatic policy might and should be still less easy to penetrate; but there are none which cannot be penetrated in any finite period, and which at the same time can carry a significant amount of information rather than a small set of disconnected individual decisions.

The ordinary way of breaking a cipher is to find an example of the use of this cipher sufficiently long so that the pattern of encodement becomes obvious to the skilled investigator. In general, there must be at least a

minimum degree of repetition of patterns, without which the very short passages lacking repetition cannot be deciphered. However, when a number of passages are enciphered in a type of cipher which is common to the whole set, even though the detailed encipherment varies, there may be enough in common between the different passages to lead to a breaking, first of the general type of cipher, and then of the particular ciphers used.

Probably much of the greatest ingenuity which has been shown in the breaking of ciphers appears not in the annals of the various secret services, but in the work of the epigrapher. We all know how the Rosetta Stone was decoded through an interpretation of certain characters in the Egyptian version, which turned out to be the names of the Ptolemies. There is however one act of decoding which is greater still. This greatest single example of the art of decoding is the decoding of the secrets of nature itself and is the province of the scientist.

Scientific discovery consists in the interpretation for our own convenience of a system of existence which has been made with no eye to our convenience at all. The result is that the last thing in the world suitable for the protection of secrecy and elaborate code system is a law of nature. Besides the possibility of breaking the secrecy by a direct attack on the human or documentary vehicles of this secrecy, there is always the possibility of attacking the code upstream of all these. It is perhaps impossible to devise any secondary code as hard to break as the natural code of the atomic nucleus.

In the problem of decoding, the most important information which we can possess is the knowledge that the message which we are reading is not gibberish. A common method of disconcerting codebreakers is to mix in with the legitimate message a message that cannot be decoded; a non-significant message, a mere as-

semblage of characters. In a similar way, when we consider a problem of nature such as that of atomic reactions and atomic explosives, the largest single item of information which we can make public is that they exist. Once a scientist attacks a problem which he knows to have an answer, his entire attitude is changed. He is already some fifty per cent of his way toward that answer.

In view of this, it is perfectly fair to say that the one secret concerning the atomic bomb which might have been kept and which was given to the public and to all potential enemies without the least inhibition, was that of the possibility on its construction. Take a problem of this importance and assure the scientific world that it has an answer; then both the intellectual ability of the scientists and the existing laboratory facilities are so widely distributed that the quasi-independent realization of the task will be a matter of merely a few years anywhere in the world.

There is at present a touching belief in this country that we are the sole possessors of a certain technique called "know-how," which secures for us not only priority on all engineering and scientific developments and all major inventions, but, as we have said, the moral right to that priority. Certainly, this "know-how" has nothing to do with the national origins of those who have worked on such problems as that of the atomic bomb. It would have been impossible throughout most of history to secure the combined services of such scientists as the Dane, Bohr; the Italian, Fermi; the Hungarian, Szilard; and many others involved in the project. What made it possible was the extreme consciousness of emergency and the sense of universal affront excited by the Nazi threat. Something more than inflated propaganda will be necessary to hold such a group together over the long period of rearmament to which we have often seemed to be committed by the policy of the State Department.

Without any doubt, we possess the world's most highly developed technique of combining the efforts of large numbers of scientists and large quantities of money toward the realization of a single project. This should not lead us to any undue complacency concerning our scientific position, for it is equally clear that we are bringing up a generation of young men who cannot think of any scientific project except in terms of large numbers of men and large quantities of money. The skill by which the French and English do great amounts of work with apparatus which an American high-school teacher would scorn as a casual stick-and-string job, is not to be found among any but a vanishingly small minority of our young men. The present vogue of the big laboratory is a new thing in science. There are those of us who wish to think that it may never last to be an old thing, for when the scientific ideas of this generation are exhausted, or at least reveal vastly diminishing returns on their intellectual investment, I do not foresee that the next generation will be able to furnish the colossal ideas on which colossal projects naturally rest.

A clear understanding of the notion of information as applied to scientific work will show that the simple coexistence of two items of information is of relatively small value, unless these two items can be effectively combined in some mind or organ which is able to fertilize one by means of the other. This is the very opposite of the organization in which each member travels a preassigned path, and in which the sentinels of science, when they come to the ends of their beats, present arms, do an about face, and march back in the direction from which they have come. There is a great fertilizing and revivifying value in the contact of two scientists with each other; but this can only come when at least one of the human beings representing the science has penetrated far enough across the frontier to be able to absorb the ideas of his neighbor into an

effective plan of thinking. The natural vehicle for this type of organization is a plan in which the orbit of each scientist is assigned rather by the scope of his interests than as a predetermined beat.

Such loose human organizations do exist even in the United States; but at present they represent the result of the efforts of a few disinterested men, and not the planned frame into which we are being forced by those who imagine they know what is good for us. However, it will not do for the masses of our scientific population to blame their appointed and self-appointed betters for their futility, and for the dangers of the present day. It is the great public which is demanding the utmost of secrecy for modern science in all things which may touch its military uses. This demand for secrecy is scarcely more than the wish of a sick civilization not to learn of the progress of its own disease. So long as we can continue to pretend that all is right with the world, we plug up our ears against the sound of "Ancestral voices prophesying war."

In this new attitude of the masses at large to research, there is a revolution in science far beyond what the public realizes. Indeed the lords of the present science themselves do not foresee the full consequences of what is going on. In the past the direction of research had largely been left to the interest of the individual scholar and to the trend of the times. At present, there is a distinct attempt so to direct research in matters of public security that as far as possible, all significant avenues will be developed with the objective of securing an impenetrable stockade of scientific protection. Now, science is impersonal, and the result of a further pushing forward of the frontiers of science is not merely to show us many weapons which we may employ against possible enemies, but also many dangers of these weapons. These may be due to the fact that they either are precisely those weapons which are more effectively employable against us than against

any enemy of ours, or are dangers, such as that of radioactive poisoning, which are inherent in our very use of such a weapon as the atomic bomb. The hurrying up of the pace of science, owing to our active simultaneous search for all means of attacking our enemies and of protecting ourselves, leads to ever-increasing demands for new research. For example, the concentrated effort of Oak Ridge and Los Alamos in time of war has made the question of the protection of the people of the United States, not only from the possible enemies employing an atomic bomb, but from the atomic radiation of our new industry, a thing which concerns us *now*. Had the war not occurred, these *perils* would probably not have concerned us for twenty years. In our present militaristic frame of mind, this has forced on us the problem of possible countermeasures to a new employment of these agencies on the part of an enemy. This enemy may be Russia at the present moment, but it is even more the reflection of ourselves in a mirage. To defend ourselves against this phantom, we must look to new scientific measures, each more terrible than the last. There is no end to this vast apocalyptic spiral.

We have already depicted litigation as a true game in which the antagonists can and are forced to use the full resources of bluff and thus each to develop a policy which may have to allow for the other player's playing the best possible game. What is true in the limited war of the court is also true in the war to the death of international relations, whether it takes the bloody form of shooting, or the suaver form of diplomacy.

The whole technique of secrecy, message jamming, and bluff, is concerned with insuring that one's own side can make use of the forces and agencies of communication more effectively than the other side. In this combative use of information it is quite as important to keep one's own message channels open as to obstruct the other side in the use of the channels available to it.

An over-all policy in matters of secrecy almost always must involve the consideration of many more things than secrecy itself.

We are in the position of the man who has only two ambitions in life. One is to invent the universal solvent which will dissolve any solid substance, and the second is to invent the universal container which will hold any liquid. Whatever this inventor does, he will be frustrated. Furthermore, as I have already said, no secret will ever be as safe when its protection is a matter of human integrity, as when it was dependent on the difficulties of scientific discovery itself.

I have already said the dissemination of any scientific secret whatever is merely a matter of time, that in this game a decade is a long time, and that in the long run, there is no distinction between arming ourselves and arming our enemies. Thus each terrifying discovery merely increases our subjection to the need of making a new discovery. Barring a new awareness on the part of our leaders, this is bound to go on and on, until the entire intellectual potential of the land is drained from any possible constructive application to the manifold needs of the race, old and new. The effect of these weapons must be to increase the entropy of this planet, until all distinctions of hot and cold, good and bad, man and matter have vanished in the formation of the white furnace of a new star.

Like so many Gadarene swine, we have taken unto us the devils of the age, and the compulsion of scientific warfare is driving us pell-mell, head over heels into the ocean of our own destruction. Or perhaps we may say that among the gentlemen who have made it their business to be our mentors, and who administer the new program of science, many are nothing more than apprentice sorcerers, fascinated with the incantation which starts a devilment that they are totally unable to stop. Even the new psychology of advertising and salesmanship becomes in their hands a way for obliter-

ating the conscientious scruples of the working scientists, and for destroying such inhibitions as they may have against rowing into this maelstrom.

Let these wise men who have summoned a demoniac sanction for their own private purposes remember that in the natural course of events, a conscience which has been bought once will be bought twice. The loyalty to humanity which can be subverted by a skillful distribution of administrative sugar plums will be followed by a loyalty to official superiors lasting just so long as we have the bigger sugar plums to distribute. The day may well come when it constitutes the biggest potential threat to our own security. In that moment in which some other power, be it fascist or communist, is in the position to offer the greater rewards, our good friends who have rushed to our defense per account rendered will rush as quickly to our subjection and annihilation. May those who have summoned from the deep the spirits of atomic warfare remember that for their own sake, if not for ours, they must not wait beyond the first glimmerings of success on the part of our opponents to put to death those whom they have already corrupted!

VIII

ROLE OF THE INTELLECTUAL AND THE SCIENTIST

This book argues that the integrity of the channels of internal communication is essential to the welfare of society. This internal communication is subject at the present time not only to the threats which it has faced at all times, but to certain new and especially serious problems which belong peculiarly to our age. One among these is the growing complexity and cost of communication.

A hundred and fifty years ago or even fifty years ago—it does not matter which—the world and America in particular were full of small journals and presses through which almost any man could obtain a hearing. The country editor was not as he is now limited to boiler plate and local gossip, but could and often did express his individual opinion, not only of local affairs but of world matters. At present this license to express oneself has become so expensive with the increasing cost of presses, paper, and syndicated services, that the newspaper business has come to be the art of saying less and less to more and more.

The movies may be quite inexpensive as far as concerns the cost of showing each show to each spectator, but they are so horribly expensive in the mass that few shows are worth the risk, unless their success is certain in advance. It is not the question whether a show may excite a great interest in a considerable number of people that interests the entrepreneur, but rather the question of whether it will be unacceptable to so few that

he can count on selling it indiscriminately to movie theaters from coast to coast.

What I have said about the newspapers and the movies applies equally to the radio, to television, and even to bookselling. Thus we are in an age where the enormous per capita bulk of communication is met by an ever-thinning stream of total bulk of communication. More and more we must accept a standardized inoffensive and insignificant product which, like the white bread of the bakeries, is made rather for its keeping and selling properties than for its food value.

This is fundamentally an external handicap of modern communication, but it is paralleled by another which gnaws from within. This is the cancer of creative narrowness and feebleness.

In the old days, the young man who wished to enter the creative arts might either have plunged in directly or prepared himself by a general schooling, perhaps irrelevant to the specific tasks he finally undertook, but which was at least a searching discipline of his abilities and taste. Now the channels of apprenticeship are largely silted up. Our elementary and secondary schools are more interested in formal classroom discipline than in the intellectual discipline of learning something thoroughly, and a great deal of the serious preparation for a scientific or a literary course is relegated to some sort of graduate school or other.

Hollywood meanwhile has found that the very standardization of its product has interfered with the natural flow of acting talent from the legitimate stage. The repertory theaters had almost ceased to exist when some of them were reopened as Hollywood talent farms, and even these are dying on the vine. To a considerable extent our young would-be actors have learned their trade, not on the stage, but in university courses on acting. Our writers cannot get very far as young men in competition with syndicate material, and if they do not make a success the first try, they

have no place to go but college courses which are supposed to teach them how to write. Thus the higher degrees, and above all the Ph.D., which have had a long existence as the legitimate preparation of the scientific specialist, are more and more serving as a model for intellectual training in all fields.

Properly speaking the artist, the writer, and the scientist should be moved by such an irresistible impulse to create that, even if they were not being paid for their work, they would be willing to pay to get the chance to do it. However, we are in a period in which forms have largely superseded educational content and one which is moving toward an ever-increasing thinness of educational content. It is now considered perhaps more a matter of social prestige to obtain a higher degree and follow what may be regarded as a cultural career, than a matter of any deep impulse.

In view of this great bulk of semi-mature apprentices who are being put on the market, the problem of giving them some colorable material to work on has assumed an overwhelming importance. Theoretically they should find their own material, but the big business of modern advanced education cannot be operated under this relatively low pressure. Thus the earlier stages of creative work, whether in the arts or in the sciences, which should properly be governed by a great desire on the part of the students to create something and to communicate it to the world at large, are now subject instead to the formal requirements of finding Ph.D. theses or similar apprentice media.

Some of my friends have even asserted that a Ph.D. thesis should be the greatest scientific work a man has ever done and perhaps ever will do, and should wait until he is thoroughly able to state his life work. I do not go along with this. I mean merely that if the thesis is not in fact such an overwhelming task, it should at least be in intention the gateway to vigorous creative work. Lord only knows that there are enough problems

yet to be solved, books to be written, and music to be composed! Yet for all but a very few, the path to these lies through the performance of perfunctory tasks which in nine cases out of ten have no compelling reason to be performed. Heaven save us from the first novels which are written because a young man desires the prestige of being a novelist rather than because he has something to say! Heaven save us likewise from the mathematical papers which are correct and elegant but without body or spirit. Heaven save us above all from the snobbery which not only admits the possibility of this thin and perfunctory work, but which cries out in a spirit of shrinking arrogance against the competition of vigor and ideas, wherever these may be found!

In other words, when there is communication without need for communication, merely so that someone may earn the social and intellectual prestige of becoming a priest of communication, the quality and communicative value of the message drop like a plummet. It is as if a machine should be made from the Rube Goldberg point of view, to show just what recondite ends may be served by an apparatus apparently quite unsuitable for them, rather than to do something. In the arts, the desire to find new things to say and new ways of saying them is the source of all life and interest. Yet every day we meet with examples of painting where, for instance, the artist has bound himself from the new canons of the abstract, and has displayed no intention to use these canons to display an interesting and novel form of beauty, to pursue the uphill fight against the prevailing tendency toward the commonplace and the banal. Not all the artistic pedants are academicians. There are pedantic *avantgardistes*. No school has a monoply on beauty. Beauty, like order, occurs in many places in this world, but only as a local and temporary fight against the Niagara of increasing entropy.

I speak here with feeling which is more intense as far as concerns the scientific artist than the conventional artist, because it is in science that I have first chosen to say something. What sometimes enrages me and always disappoints and grieves me is the preference of great schools of learning for the derivative as opposed to the original, for the conventional and thin which can be duplicated in many copies rather than the new and powerful, and for arid correctness and limitation of scope and method rather than for universal newness and beauty, wherever it may be seen. Moreover, I protest, not only as I have already done against the cutting off of intellectual originality by the difficulties of the means of communication in the modern world, but even more against the ax which has been put to the root of originality because the people who have elected communication as a career so often have nothing more to communicate.