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Challenge to Sigint: Change or Die

Technology advances at ever-increasing speed. Some changes threaten to put us out of business, unless we exploit those other changes that open new doors

There is nothing about the developing state of the world to indicate that Sigint activities will become less important in the future. On the contrary, in a world of increasing hostility and danger there is increasing reason to believe we are stuck with maintaining and developing this kind of activity—with maintaining that eternal vigilance that is the price of liberty. And events occurring both within and without our country indicate that that price may continue to rise even faster than the rate of advancing inflation.

Let's look at some of the technologies that will influence our future operations. We can fairly divide them into two classes. There are those that will complicate our life by making our problems more difficult. There are those that will offer us increased opportunity for success, provided that we learn them, adopt them, and exploit them. The moral of my whole story is: *Change or die.* If we can't move with the new technologies that can help us, the ones that make our job harder will send us the way of the dinosaurs.

By change, I don't mean something simple, like replacing vacuum tubes with transistors and continuing to perform the same old functions. I mean change in strategies, tactics, tools, organization structures, resource allocations, and personnel. The right means of doing the job will change in elusive ways, and the same old methods, carried out by the same old people in the same old ways, won't cut the mustard.

Some of the major technologies that will make our job more confusing in the next ten or twenty years are:

bio-medical and health
public information
agriculture and food
energy conversion
transportation

Some of those that offer us great opportunity are:

materials
information processing and computing
communication

Before getting into a discussion of a few of these items in more detail, I'd like to digress and discuss forecasting a little bit. In many human accomplishments, trends are most easily expressed on an exponential scale rather than a simple linear scale. Things seem to grow each year by some percentage of what they were last year rather than by some fixed amount. We say, for example, that population grows at 2 percent or 3 percent per year. Economists are used to this kind of forecasting. They typically use a graph paper in which the vertical scale is logarithmic rather than linear, because an exponential trend line drawn on that kind of paper is straight. Forecasters who insist on using linear graphing techniques are typically very conservative, simply because they cannot believe the results of an exponential extrapolation if it is carried more than a year or two into the future. The curve rises too steeply. The history of the last 20 years, however, shows that two kinds of trends have been fairly well confirmed. Trends which involve lots of people and multifarious activities tend to follow the simple exponentials. In other cases, there are quantum jumps, which take off on completely different trend lines and make the conservative forecasters look even worse as prophets. Let's look at a few cases.

What Population Growth Means to Us

Since 1365, when the Black Plague reduced the population of the known world by about 25 percent, the growth of bio-medical technologies, mainly in the fields of hygiene and public health, has led to an average rate of

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increase of world population of about 2 percent per year. On an individual area basis, some of the trends carry a more foreboding message. In the "poor world," in which over two-thirds of the people live, the effect in recent years has been to increase the growth rate to 3 percent per year or more, while in the "rich world," where we live, a countervailing, contraceptive technology seems to be bringing the rate down. It may well dip to 1 percent or less within the next few years.

To us, both of these bio-medical effects mean increased problems. We will be attacked (verbally or physically) over the next few decades by larger numbers of dissatisfied people, and we will have relatively fewer from whom to draw troops. Even the military will probably be forced into a comprehension of the need for a labor-saving technology of defense. Our problem will not be to get more people into the service. It will be to move forward in labor-saving tools so that we can do more work with fewer people. And this need applies not only to troops overseas. It applies at home, in industry, and especially in our very wasteful process of "management."

Along with the bio-medical technology, which is upsetting our manpower balances, is the technology of public information which is having dramatic effects on world politics. Every camel driver in Yemen is now equipped with a Japanese-made transistor radio, which he keeps tuned all day long to Radio Egypt. It is no longer possible to keep the poor in ignorance of their situation compared with that of the rich. The movements for independence in Africa and Asia must be taken seriously. There is no universally satisfactory resolution of territorial conflicts such as the one in the Middle East. The number of governments in the world to whose intentions the U.S. must keep alert is growing exponentially, and it is now well over 100.

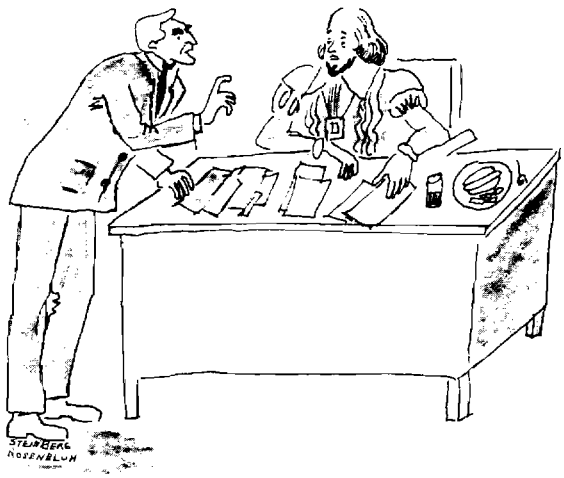
Another Problem—the NSA Population

Within our own Government, the situation continues to become increasingly complex. The number of official organizational elements whose duty requires them to have a "need to know" for part or all of our intelligence output is doubling every 10 years or so. The number of arbitrarily contrived organizational boxes into which we have to divide our effort seems to be increasing without limit. Staffing in NSA has shown a compound rate of growth of more than 8 percent per year since 1955, and there is no sign that any fewer bodies will be needed next year than we have this year. The sheer change in the magnitude of the numbers of people with whom one must communicate to work effectively poses a serious problem in efficiency, which in turn increases the number of people required. It is almost a self-defeating spiral.

Contributing to the fields of weapons and military force, which must continue to interest us a great deal, are the technologies of energy conversion and transportation. Since the Wright brothers delivered their first production airplane to the U. S. Army Signal Corps, where it was intended to replace the horse in courier services, the speeds attained by military aircraft have doubled every 10 years, and there is every indication that this trend will continue for another decade or so. In addition, the rocket vehicle has risen from the status of a battlefield weapon carrier of low accuracy to achieve intercontinental range and speeds about 10 times those of the fast aircraft. It also has an accuracy quite sufficient for the weapons it is designed to deliver. In the amount of energy which can be converted and released in a single bomb, we have seen one of those quantum jumps mentioned earlier. Chemical bombs increased in potency over the first half of this century by a factor of about 10, but in 1945 we witnessed a step increase of a factor of more than 1000, and weapon development took off on an entirely new trend curve. The largest (Soviet) weapon yet exploded is in the 100 million ton class. Theory suggests that another increase by a factor of 1000 to 1,000,000 is not out of reach if anyone wishes to do the job.

Coupling the increased weapon yield with the increased carrier speed, we see that in three decades since 1940 the ability to deliver destruction at a distance for military purposes has increased by approximately 8 orders of magnitude; i.e., 100 million times as many ton-miles per hour as before.

While only a small number of nations currently control such terrible threats, there is little to suggest that the



"No, dammit! *Por favor* means *please*, not *prithee*."

number cannot increase to perhaps 30 or 40 within the next 10 or 20 years. We shall have to be on the lookout in all directions simultaneously.

At the turn of this century, a serious attack by one nation on another involved a very considerable period of time for the assembly of forces, movements into position, and delivery of force. Tactical warning times could be measured in weeks. In 1960, we still felt that we could get a minimum of 15 minutes of tactical warning of attack on the U.S. This year, it appears that five minutes might be a more reasonable estimate for fractional orbiting systems and sea-launched missiles. Our reaction times must decrease accordingly. The transit time for warning messages which was established in the late 1950's is rapidly becoming inadequate, even while the increasing complexity of our DoD structure is making it harder to attain.

A Quantum Jump in our Opportunities

So much for the trends that make our life more challenging and disturb our established notions. What about the trends that offer real opportunities?

The communication of information from point to point on or near the Earth's surface has become incredibly less costly during this century. As the bandwidth of transmission devices has increased, over-all costs of cable, wire, and radio links per bit-mile of transmission has dropped by a factor of the order of 10 for every 20 years. The introduction of communication satellites appears destined to provide a quantum jump of sorts in this arena. Although satellite costs are now comparable to surface costs because of the relatively new state of this art, there is promise that they will fall a factor of 5 or 10 below the projected costs for surface modes by 1980, and that this improvement will continue beyond the end of the century. Systems and methods that are now ruled out because of high data-transmission costs will become eminently practical within the next 10 or 15 years. We should start now to think how to use them effectively in solving our new problems.

Many of the early contributions to the arts of automatic computing had their origin within NSA and its predecessors. We should not let this idea make us feel complacent, however. The commercial and industrial world and the other organs of government appear to be on the verge of outstripping us in the development and application of computer systems for a wide variety of purposes. The cost per unit of output from the "latest model, largest practical" computer system is dropping more than a factor of 10 for every five years. To us this means at least two things. We have an opportunity to do more and more of our work with the help of these amazing machines because the cost of doing this work will continue to drop rapidly. We must stir our cryptologic stumps to make sure that we are keeping our facilities and procedures in this area up with the advancing state of the arts. There are many, many contributors to computation outside our own walls. Perhaps a few of them have good ideas from time to time.

So—here's our challenge. Regard the last 20 years as a period of relative stability. Think about the systems, deployments, hardware, procedures, organizations, and best uses of all of our resources, especially our own personal time. Press forward with vigor, but stay flexible. Don't try to stick too long with an obsolete project. Try to achieve that nice distinction between the visionary and the tried and true, which leads to the efficient, effective, practical. Don't be afraid to beg, borrow, buy or steal an idea. It might be better than one of our own pet brainchildren. Don't overestimate what we can do within the next few months. Don't underestimate what the "industry" will do in the next few years. Learn the capabilities and limitations of what's going on in all of the relevant fields. Don't be held back by yesterday's limitations if we can see that they may reasonably be removed. Don't become wedded to a single technique or a single organization concept or a single procedure. Compare the competitors with a cold, managerial eye and be quick to change direction when the facts indicate. We can create the systems to do the work.