



Address

## **The Past and Future of Agricultural Communications: Part II: Looking Ahead**

**John E. Ross**

Somehow, to me, 1908 seems closer to this moment than does 2058. The year 1908 has a comfortable sound to it. Although we know that things have changed radically since then, we can imagine what life was like after the turn of the century—and that recollection does not seem intolerable.

But 2058 seems very unfamiliar. We know not at all what that year holds for us, perhaps more accurately for our children and theirs.

Predictions about 2058 are problematic, but we can assess some recent dramatic changes and therefore imagine what forces will be at work over the next 75 years.

At this point, I want to state a word about my construct of communication and journalism. Communication is a process. Words and pictures are means to an end. Meaning resides in the content of the communication. It is true, however, that comprehension is a function of both content and style. To understand the role and impact of communication, we must consider both content and style. They are, fundamentally, inseparable.

Therefore if we look ahead to assess the role of communication, we need to consider what is happening substantively in our society—in our civilization—as well as the engineering innovations in communications, as startling as those now are.

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**The opening plenary session of the 1983 National ACE Conference in Madison, Wis., in July took note of the 75th anniversary of the Department of Agricultural Journalism at UW-Madison. Bryant Kearl took a look at the past (Oct-Dec '83 *Quarterly*); John E. Ross, professor of agricultural journalism and environmental communications, addressed what the next 75 years might hold in store for agricultural communicators.**

To lay this foundation, I would like to trace two sets of contemporary phenomena:

One—some social and economic demographics of our time.

Two—some technical discoveries of our time.

I will limit my examples to those I consider the most important.

## **The Shape of Our Times**

I believe that the most singular demographic characteristic of our time—of our century—is world human population growth. The increase in population prescribes most other policies and programs, certainly food production. If it does not immediately prescribe our actions, it refuses to leave even the periphery of our vision—as a fundamental issue.

World population in 1908 was somewhere in the area of 1.5 billion. In 1981 world population reached 4.567 billion, with an annual growth rate of 1.7 percent. As recent as 1975, world population was 4.146 billion, with a growth rate of 2.2 percent. Thus, there is evidence of a decline in the rate of growth. Rates of growth can, however, be deceptive. In 1970 there were 70 million additional people. In 1983 there will be 78 million additional people. The annual increment will continue to increase because of the pyramidal structure of population. In the 1970's global economic growth rates averaged around 1.6 percent, so, in that time period, economic development did not match population growth.

But let's assume that the demographic transition is not a myth, that world development will pick up again, and that the population growth rate will drop by half—to 1 percent, averaged over coming years. That would give us a world population of around 9 billion in our targeted year of 2058.

Whatever happens to the rates of growth, as the decades slide by, we will need to intensify our food production. There are wide variations on the estimates of untapped arable lands. Some say we could increase the land surface in food production by as much as 50 percent. Any new lands in production will require large capital and large energy investments. My feeling is that the pressure will be differentially large on lands currently in production.

It also appears that worldwide we are now losing about 15 billion tons of topsoil from cropland per year, which is about a 5 percent loss per decade. The agriculturally-caused erosion appears to be running at about three times that we would ex-

pect from natural situations. There is disagreement on the yield equivalency of soil erosion. One figure is that an inch of soil equals about a 6 percent loss in wheat.

Whatever pathway to increased food production, it seems that a minimum is to double the output in the next 75 years.

Currently, population growth in the U.S., including migration, is at 1.1 percent a year. At that rate population in the U.S. would be approaching 500 million in 2058. Perhaps that rate will not be sustained here, or it could go higher. It seems inevitable to me that proportionately more of our food production will be consumed at home, unless substantial yield increases lie ahead in our economy. It cannot be ignored that there are about 18 million refugees in the world, that is, individuals who have fled their homelands into another nation.

A second singular characteristic of our time is the recognition that petroleum, here defined as fluid oil, is a finite resource. There is now considerable consensus in the prediction literature that the remaining petroleum resource tops out in the area of 1,660 billion barrels. In 1977 annual petroleum production totaled 21.7 billion barrels. Since 1970 there has been a 12 percent decline in the annual production of petroleum. Most forecasters explain this as a combination of conservation, substitutions, and inflation. Per capita consumption of petroleum in the U.S. is off about 17 percent. But, using the 1977 production figure, if you divide the annual production into the estimates of the resource, petroleum would be gone—all of it—in just over 76 years.

Obviously, it won't happen that way. The petroleum production curve will be skewed, and in the later years, most of it will be used for petrochemicals, at a very high price per barrel. World petroleum production is now estimated to peak in the early 1990's. Of the current remaining stock, some 929 billion barrels, or approximately 56 percent of the total, is in the ground in the Arab countries of the Mideast, plus Russia and China. The U.S. moved over to the back side of its petroleum production curve over 10 years ago.

Predictions for natural gas are somewhat more optimistic. We still appear to be on the upswing in discoveries. However, the online capacity to produce natural gas at least in North America is currently much closer to demand than is oil.

The U.S. energy consumption budget is still nearly 70 percent based in oil and natural gas, in spite of two major price shock waves in the 1970's. Agriculture in the U.S., at this point, is still fundamentally dependent on petroleum and

natural gas. Real costs of these fuels will escalate again after the 1980's plateau. We clearly face a major shift away from petroleum, I think well within this century. And that will happen at the time when we will be trying to double food production.

Petroleum has been very cheap. And it has had the obvious advantage of natural liquidity, making it ideal for fueling moving vehicles, including tractors. But the end of the era of petroleum approaches. Interestingly that era will have closely coincided with the 150 years between 1908 and 2058.

A third characteristic of our time concerns the radical change in the structure of capitalism.

It should be noted that the U.S., Japan, West Germany, France and the United Kingdom now produce half the world's output of goods and services.

Capitalist societies show four lines of change:

First, they have grown from agricultural and commercial economies to industrial ones, and in recent years the service sector of most of them has become more important than the industrial sector. Seventy-five years ago, two thirds of the U.S. labor force was employed in agriculture, forestry and fishing. Today, these three employ 4 percent. Assuming full employment, manufacturing, mining, construction, and transportation now employ 34 percent; services and government—36 percent; trade, finance and real estate—26 percent.

Second, the ownership and control of capital goods have become concentrated in fewer hands. Seventy-five years ago, 35 percent of manufacturing assets were held by the largest 100 manufacturing corporations in the U.S. That figure is now 48 percent. Below this level, concentration also proceeds.

Third, the number of wage earners has risen manifold compared to the number of self-employed. Wage earners have become assembled in ever larger working units. Seventy-five years ago, 40 percent were self-employed. Only 6 percent are now self-employed. There are a number of farmers who at least imagine themselves self-employed. But as capitalism has centralized, self-employed farmers' control over economic forces, and thus their ability to make autonomous decisions, has diminished.

Fourth, central governments have become increasingly implicated in what used to be strictly private affairs of capitalist enterprise. Government actions emerge as monetary policy, as fiscal policy, and as regulatory policy.

John Kenneth Galbraith, in his book, "The New Industrial State," argues that we have entered a stage of capitalism where information and organization are the most important economic goods, replacing, first, control of resources and second, control of capital. In this model the crucial power to make decisions is passing to teams of specialists with great expertise. If Galbraith is correct, this is a most fundamental shift.

In a book titled "Resources and Development," I have argued that the need for information increases as a function of the rate of growth of the capital enterprise. If growth is proceeding at an exponential rate, exponentially increasing information is required to support the organizational structure. Thus, the trend toward information services and professional expertise is not a spontaneous condition of this century. Rather it is woven into and is a response to the changes in the economy.

I see no forces in the near future that would slow or reverse these trends in capitalism, primarily the concentration of resources in larger economic units. For example, recently the U.S. government has removed restrictions on the aggregation of private financial institutions, and we will, in the years immediately ahead, see a rapid concentration of bank ownership. The trend toward larger economy of scale has not, in my judgment, run its course. This emerging capitalism will continue to have profound impact on the economic structure of food production and on energy production.

### **The Shape of Things to Come**

World population growth and its implications for food production, the shifting kaleidoscope of energy supply, and the increasing scale of capitalism are among the important forces that will shape the coming decades. And their momentum, I think, will demand certain kinds of responses from policy makers, educators, and information specialists.

First, there will be a demand for improved forecasts—that is, in our ability to predict future resources supplies, in the basics like minerals, fuels, arable land capacity, and water, and also in forecasting economic trends and the stability of production. A major new thrust in economic forecasting will be risk assessment. There will be increasing concern over possible limitations of natural resources and the extent to

which pollution would act as a limiting factor in development.

Second, there will be a demand for longer periods of advanced planning. There is already considerable evidence of the need to make earlier commitments for specific developmental plans and there is evidence of pressure on the political process to reduce risks well into the future. In other words, pluralism and incrementalism in politics will be increasingly hard to maintain. An example of the increasing demand for long-range planning in all its aspects is the development of the Rocky Mountain coal fields. It is safe to predict that future development of these coal fields will proceed much faster than general economic growth. Hopefully, this development will be anticipated well in advance of crises.

It is important to emphasize again that forecasting and planning have voracious appetites for information, and for expertise in information processing.

There are now before the U.S. Congress three different bills that would strengthen our foresight capability. Some would describe this as planning, but the term foresight capability implies more, that is, an ability to develop scenarios based on phenomena like population, energy, and economic potential. Note that the term also avoids forecasting per se. It seems that we are entering a period of declining confidence in the ability of the market to anticipate the future. It is not just additional information that is sought, but the ability to integrate the information across disciplines and across time. But we still have some doubts about planning and forecasting.

### **Three Key Shapers of the Future**

Now, I would like to turn to some technical discoveries that will shape other issues. To me, three stand above the others: These are (1) the understanding of atomic structure, (2) the understanding of the molecular structure of life, and (3) the microprocessing of information.

It is fascinating that all three of these deal with complexities at the microscopic or submicroscopic level, below the level of direct sensory experience, in worlds not surmised by our grandparents.

These technical developments also have several levels of meaning. The first meaning is in the marvel of the scientific revelation itself.

Second are the economic and social implications of the developments in specific and pragmatic ways.

Third is the potential to control and enhance the environment of humans in general ways that would have seemed utterly impossible 75 years ago.

In the understanding of the atom, the most obvious pragmatic implication is the release of vast amounts of energy, we hope in the sane and safe way. The controlled fusion of hydrogen, for example, could bypass the burning of hydrocarbons with all the environmental negatives that carbon imposes upon us, and could also make unnecessary the fission of the heavy elements with their concomitant dangers. Off in the future lies the answer to whether or not we will solve the technical problems of controlled fusion, and more importantly, whether or not we can achieve a net gain in energy. Fusion optimists say it can happen before 2058. Others urge that we rely on the uncontrolled fusion of hydrogen in the sun and its unrelenting stream of photons.

As bright as these alternatives seem, to achieve the collection and distribution networks of controlled fusion on earth are formidable engineering goals. For example, if the process we adopt is to magnetically contain the fusion reaction, then demand for copper in the magnets could be immense. A major shift to solar energy, 40 or 50 years from now, might result in a dramatic reversal away from large economy of scale, because this form of energy, unlike the hydrocarbons, is uniformly distributed across the earth, and unlike nuclear reaction, does not require multimegawatt fortresses of generation. Manipulated solar energy has immense implications for agriculture.

So does my second example of technical discoveries—the understanding of the molecular structure of life. While there is still much to learn in this area, the foundations of its basic simplicity appear to be well understood. And we are well along in understanding its complexities, that is, the infinity of potential combinations. Further, we expect to be able to understand the switching and control mechanisms.

Implicit in the understanding of DNA, as with understanding of the atom, is the possibility of manipulation of that structure. While that manipulation will affect us in many ways, it is enough to mention a few examples in agriculture.

For example, there is the established fact of cloning, or replicating, already improved strains at the gamete or the zygote level, the improved strains having been developed by more traditional processes of systematic, but still natural selection. While we almost take this for granted in plants, we

are more startled over its application for animals, for example, dairy cows. Given artificial insemination, a high-quality bull can father 250,000 calves. Imagine cloning a super-bull in multiples of two or four, which could generate up to a million offspring. There are now about 11 million dairy cows—total—in the U.S.

There is also the immediate possibility of plagiarizing the expression of genetic material and mass producing various natural chemicals that act as control agents or defense mechanisms—in other words, pharmaceuticals.

We have, at least in one case, introduced specific genes from one species or strain into another, with the genetic trait being transferred to a succeeding generation. We know that viruses and bacteria shuttle genes around under natural conditions from host to host. The pragmatic idea is, of course, to direct this shuttle operation.

It may be possible also to construct and then introduce synthetic traits into living systems. Such traits would then come from the fabrics of our imaginations.

These techniques would perform the function of multiplying quality, of enhancing defenses, or of broadening a natural environmental niche for a strain or species.

Considering information as applied to molecular structure, we deduce two things. First, structure is governed by information. In its most basic form, we have a genetic code. Use of the word code is more than symbolic. It is indeed an information code. Second, while the rudiments of the code are simple, the environment in which life is embedded is very complex. Therefore, to engineer good breeding will require an understanding of the particular code expressed in a trait, but, more importantly, an understanding of the environmental milieu that results in a particular behavior. One could conceive of genetic manipulation that would enhance the process of photosynthesis under less than ideal environmental conditions, such as undesirable light, or temperature, lack of adequate water or nutrients, or the presence of toxins. Basically, we would then be manipulating the efficiency of the use of energy—by living systems, as they trap and store energy from the sun, and consume that energy. This is the fundamental mechanism that makes life possible, along with passing the code to successive generations. Do we dare enhance it?

## For Whom Is the Future?

If the genetic code is dealt out of the deck in increments of four nucleotides, the computer code has only two—positive or negative, on or off, yes or no.

But we are now to the point where a silicon flake a quarter-inch on a side can hold a million electronic components. This prodigy draws the power of a nightlight, and in some versions performs a million calculations a second. Eventually, one billion transistors may be on a single chip. We stand awestruck at the speed, size, and capacity of this yes-no potential, oblivious at that moment to the capacity of our own brains.

Some historian a couple of centuries out may conclude that the period of 1910 to 1985 was characterized by the human use of cheap energy slaves, and that, starting in 1959 and taking off in the 1980's, we massed information slaves. But there is something more lurking in computer technology. Rather than simply slaving harder than humans, they can now work nearly as flexibly and intelligently as humans. Artificial intelligence is now discussable.

We have all read about the things they can or will do so I'd rather comment on what I think are some of their implications in the context of the other things I'm saying.

First, it seems to me that the computer characteristics of memory, decision-making, and self-adjusting controls enhance the ability of the large-scale organizations to make decisions and control the environment, as compared to smaller units or individuals. It's not so much the price of the computer as it is the superstructure that will accompany its adoption. There is already evidence of discrepancy in computer availability in primary and secondary schools, based on the affluence of the school district. Although computers will be available to individuals making individual decisions, they will very likely be used more effectively in big organizations that can bring specialized knowledge in phase with specialized information processes.

Those societies and those individuals that adapt to the integrated circuit will have economic advantages over those that do not. Economic advantages are not new, but these appear potentially more powerful. Furthermore, the integrated circuit is more than the imprint on the chip. It is the integration of the information with the decision-making that is important. And software is more than the floppy disc. It is a pro-

cess of thinking and communicating. So, it is the process and content combined, once again, but this time around in a more powerful mode.

Applied to agriculture, computer awareness could eliminate great gobs of risks that we dirt farmers have dwelt with since neolithic times, but I think in a different economic structure than now exists.

Not all societies and not all individuals will adapt. There is the very real possibility of an increasing gap between the people who move into this brave new world and those who do not. To date, in talking about the haves and the have-nots, we have usually applied the discrepancy to a natural resource, such as food, land, minerals, water, health, energy, or industrial technology. Now we are talking about much more sophisticated technological control of the environment. There is nothing on the political side of life that would guarantee distribution of the benefits of the new technologies evenly among 9 billion people.

Indeed, when we look at the course of the new technologies combined, we see some changes in the basic ways information is shaped and distributed.

First, there is a shift toward specialization in content and in the disciplines. There is a concomitant specialization in the associated information. One who seeks or needs to generalize, such as a contemporary farmer, must perforce rely increasingly on specialists of many different kinds.

Second, highly specialized information has obvious proprietary value. So individuals, commercial concerns, and even governments increase their efforts to keep such information exclusive or secret. Even now, public research institutions are trying to sort out the codes of ethics for the conflicts imposed by the need to publish and disclose and the pecuniary value of the discoveries.

In this setting, information has somewhat broader connotations than either the traditional mass media tuned to news or information, or the open-ended market of ideas characteristic of adult public education. These have been highly effective in the past, and we have made much of the concepts of diffusion of information. But it cannot be taken for granted that in this new setting information will emerge like a clear, cool spring out of the hillside. The risks become too great. Information becomes more tightly programmed and integrated in decision-making. It is far less laissez-faire. Those individuals or groups who feel buffeted by forces over which they have

no control but have access to the new technology will act collectively to reduce the outside forces by increasing the amount of information they process.

Those of us in universities, looking at the growth of such areas as computer sciences and computer engineering are certainly aware of the trends on the technical (hardware) side. And we know where many future students will find employment, that is, in the technical, in-house service teams. We are also keenly aware of the rush with which software is arriving. The training we provide in programs like agricultural communications will inevitably respond to the high technology trends or the programs will fade away.

But the larger question is whether the technological breakthroughs which are, after all, oriented toward process, can really be brought to focus on some of the great substantive issues of our time.

The projected populations will not be sustained without rapid and massive development starting with, but not limited to, increased food production. Essential to this will be replacement of currently dominant energy sources with sources that do not debilitate or exhaust the environment. All the high technology of which we can conceive will not replace the minimum per capita need for natural resources, and we will continue to address the issue of resource limits to growth so abortively attempted by the Club of Rome reports 10 years ago, and the Global 2000 report 2 years ago.

Having said that, it seems to me the great technological breakthroughs of our age do indeed bode well for the future.

There are, I think, some critical conditions that must be met. We must demand that technology does not become an end in itself. That is, specific technologies must be applied to society's problems. It would be easy for them to take off in their own updrafts, or be concentrated in such areas as exotic military hardware. Need we be reminded that there are now nuclear warheads equivalent to 4 tons TNT per capita in the world?

Second, we must work diligently, very diligently, to see that the breakthroughs apply broadly, and particularly to the most disadvantaged, in spite of the fiscal mania they will tend to generate among the more aggressive and more adaptive.

Andrew W. Hopkins, who was chair of agricultural journalism at the University of Wisconsin-Madison for 37 years, wrote a couple of years before his death, "Agricultural experiment stations were created and are supported to carry on

research of value, interest and service both to farmers and the general public. However, during the early years of those institutions, in this and other states, there was no systematic effort to make sure that the findings of the scientists would reach either the farmer or the general public."

Now the stage is larger, the risks are greater, the research is more potent. But the basic social issue is the same. Quoting Hopkins again, "Democracy will live where there is free circulation of dependable information."

I would not place all the future burden of proof for that on one small group of agricultural journalists, but I think this group has some characteristics that make it different from any other communicators. We have not been, and will not be, passive reflectors of events, like mirrors on the wall.

We have understood the relationship between process and content and have dealt with meaning, as well as with comprehension.

We have the talent and the will to proceed.