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SCIENCE, TECHNOLOGY AND THE AUTOMATION EXPLOSION

Richard Bellman

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## SCIENCE, TECHNOLOGY AND THE AUTOMATION EXPLOSION

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### 1. INTRODUCTION

The purpose of this brief paper is to present some of the reasons why I feel that automation is a most serious problem to the economic and political stability of our society at the present time, and why, in my opinion, the problem is becoming more acute with each passing day.

By automation, we shall mean the ability to carry out operations of decision-making and technology with either no human supervision or else greatly reduced manpower requirements. Over the span of recorded history, every society has had to contend with automation and technological change. It is worth emphasizing that these changes have in some cases caused great human suffering, as in the case of the Industrial Revolution in England. It is also worth emphasizing that we cannot depend upon "things taking care of themselves" with "minor readjustments," as some economists and industrial experts are wont to say. This is based upon the tacit assumption that there is only one steady-state behavior which is stable. In a complex system such as ours there are many stable states, not all desirable. It is essential that we look ahead and plan for a desirable one.

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This paper will be delivered at the Conference on Cybernetics and Automation in New York City, June 19-21, 1964.

The various reasons we discuss are, as to be expected, interlinked. We shall, however, divide them into five categories: competition, computers, fashion, simplicity, and availability of trained "efficiency experts."

We shall then say a few words about the equally pressing danger of technological advances, and then conclude with some suggestions as to how to orient our efforts so as to avoid indefinitely the dangers of automation and technology.

## 2. COMPETITION

If, as in the case of the computer, it is true that invention is the mother of necessity, it is also true that the palindromic version is still valid. The military competition with Russia and the intramural economic competition have led to the development of powerful scientific and mathematical tools. Originally created for specific needs and problems, they can now be used in much wider contexts.

In particular, they have been widely and enthusiastically adopted by the Russians, since the tremendous manpower loss in World War II (15,000,000 - 30,000,000) made it imperative, a number one priority, that the USSR automate. Adopted by a society highly trained in mathematics, it is inevitable that they will be adapted and improved. These improvements will in turn, be borrowed back by the United States, themselves improved, and so on.

As the international and domestic markets get tighter, more and more firms will find that their profits are dependent upon their efficiency—more incentive to automate both production and decision-making.

### 3. COMPUTERS

The existence of modern electronic computers makes it particularly easy to automate. Yet the contemporary computer is about the level of a DC-3, if we equate the war-time computers with the Wright Brothers' plane. The newly announced IBM computer is on this scale on the level of a DC-7. Computers can presently be built which are at the jet stage—and we are still in the most rudimentary stages of computer theory and design.

To examine the problem of automation with an eye only on the existing computers is very much like thinking of Civil Defense in World War II terms.

### 4. FASHION

Let us not overlook the influence of fashion on human affairs. It is now considered "modern," "up to date" and "efficient" to automate. Indeed, automation represents carrying the (local) concept of efficiency to its logical limit.

What is needed, of course, is a global concept of efficiency. We must think in terms of the whole society and the welfare of the majority of the citizens.

It is easier, naturally, to use dollar and cents utilities and to avoid the more difficult and important human criteria—which is precisely why it is so dangerous to use the simpler concepts of mathematical economics.

### 5. SIMPLICITY

It is unfortunately true that most technological processes can be improved upon scrutiny by a trained scientist. It is furthermore, and equally unfortunately, true that most of the decision-making involved in the lower and middle echelons of business and industry is of a rather simple nature and thus can readily be automated—with an attendant loss of jobs.

One of the most serious aspects of automation is how far up the totem pole it can reach. The middle class is no longer safe from its effects. This introduces an additional feature of political instability.

#### 6. AVAILABILITY OF EFFICIENCY EXPERTS

Ten years ago, digital computers were rare, but even rarer were people who knew how to take advantage of their peculiar talents. As time went by, computers were installed in universities, in government laboratories, in industrial laboratories; courses were given—summer courses, night courses, extension courses.

Many Ph.D.'s in such abstruse areas as topology, field theory and philosophy took these courses and accepted lucrative positions in industry and government on the basis of their academic polishing. Naturally, they constantly look about for ways of applying operations research, systems analysis, management decision-making, etc., etc., etc. They have the training, they have the computers, they have encouragement from above, they have the incentive. Wherever they look, there is a high probability of jobs disappearing.

Add to these the industrial consultants, the independent operations researchers, the summer visitors, and one has an impressive total of job-destroyers. No such pool of highly trained people was ever available in previous times.

#### 7. TECHNOLOGICAL ADVANCES

We have all heard the stories about the nylon stockings that would wear for years, the electric light bulbs that would burn for years (now available), the razor blades that could be used for months (now available), and so on.

What about car batteries that last for ten years, self-lubricating cars, engines that are sealed and run for 1000 miles on a tank of gasoline, and so on?

The point is that most of these "advances" are either already available (and kept off the market), or can easily be attained if asked for by the right person.

Thus, I maintain, we face equal dangers of industrial unemployment from straightforward improvement of technology and the techniques of mass production. We must look this problem squarely in the face.

#### 8. PARTIAL CONCLUSIONS

I feel that we must accept the fact that the days of mass employment generated by mass industry are over. I also feel that automation will reach far up the scale of middle class activity, e.g., banks, industries, government, and will create extensive unemployment in these areas. Both the lower and middle economic classes will be seriously affected.

#### 9. FURTHER CONCLUSIONS

There is only one area which completely resists automation, the area of personal services. Certainly doctors, nurses, teachers and lawyers will be required for any future society. Similarly, we will also need butchers, bakers, candlestick makers, and secretaries. We can expect a resurgence of the small shopkeeper as people begin to insist once again on better service and the real luxuries of life. In addition, as medical care improves and is extended, we will need people specifically trained to take care of the old; as more leisure time is available, there will be more need for amusements, cultural and educational activities; as we get more civilized, better care will be given to the mentally ill, the criminally ill, retarded children, crippled children.

I maintain that if we look around us and see how desperately so many people need personal care, we will never again worry about whether people can be gainfully and profitably employed. It is not a question of changing the system, it is merely a matter of a shift in emphasis.

We have all of the means available for training people in the necessary areas, for using them and paying them. It is merely a question of bringing the issues clearly before the American people and allowing them to make a choice of what kind of life they really want for themselves.