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The Human Brain is Not Obsolete

MOST of us are only just starting to view automation as being outside the "isn't science wonderful" variety of fiction story. Others, carried away by enthusiasm for the extraordinary machines we use and invent, predict the near approach of a time when robots and "giant brains" will do all the work while human beings recline in cushioned ease. Still others profess to see automation as an agent of doom, trampling upon human intelligence and degrading the human spirit.

All these are unrealistic ways of receiving a reality. Automation is here, and there is no use blinking the fact. It is still in its infancy, as the automobile was in the 1890's, but after a few years of growing pains it will progress rapidly.

There is no denying that a number of thorny questions are raised by the transition, but when we clear away the utopian speculation and the emotional fearfulness, we find that the "push-button" world does not appear very different from the one we have been living in. The danger is not in having push-button machines, but in being content with a push-button type of thinking.

Automation is a step in technological progress. From earliest days we have dreamed up ways to improve our productive skills, tools, and machines. What is automation but fulfilment of Aristotle's forecast 300 years B.C. of a time when every tool, when summoned, or even of its own accord, could do the work that befits it?

The human brain

When we refer to the human brain we mean more than the pinko-grey jelly that fills our skulls. No machine has the imagination that is to be found in even the least-developed human brain. The machine does not have emotions and sentiments, volitions, hopes, aspirations and ideals. The machine does not experiment, or take inventive excursions.

No machine has the human brain's versatility, sensitivity, or power of discrimination. No machine is a self-starter, as the human brain is. And no machine has the power to collect and store bits of incidental information from which to fabricate something new, such as a sonnet, a code of laws, an airplane — or even an automatic machine.

Mental efficiency has been and is and will be (so far as we know) the foundation of every other kind of efficiency. It was the brain that turned the savage into a king, and the workman into a captain of industry.

Our brain is the most complex organ of all creation; the most complicated structural apparatus known to science. It has about ten thousand million nerve cells.

Most of us likely have millions of cells that we don't use. Our output of information may be only one part in a million of our input: our creative flights are only a small fraction of what they could be.

Why is this so? We may go to an ancient philosopher for a poetic answer: "O unhappy mind of thee! of all things alone neglected and untended." We develop our muscles by exercise, and nourish our bodies with food, but too often we feed our brains only on the pap of trivialities and exercise them only under protest.

Machine advantages

Automatic machines have certain advantages over the human body and over machines that must have human attention. Some of them do jobs that men could not do at all, or could not do so effectively. For example, take steering a ship or manipulating an atomic pile, or directing a rocket missile, or controlling rapid chemical reactions.

In a number of industries, automatic controls do not merely cut costs but make possible production processes that otherwise could not be attempted. Automation has contributed to the creation of new products and new industries. Colour television tubes require hundreds of thousands of coloured dots precisely placed: a job that no human being could do.

Automatic sensing devices can operate under conditions deadly to man: in intense heat, in poisonous gases, in an area of atomic radiation. Electronic computing machines surpass human information-handling capabilities. While relieving the worker of brain-fagging detail, they have created new skills and given them value.

What are some of the limitations of automation? In machines, we are dealing with two things: matter and energy. This limitation is quite significant. The machine is merely an electro-mechanical contrivance, no matter how greatly it excels the living brain in speed of calculation or manipulation. You might as well look for a ripple pattern on the surface of the stormy Atlantic as for a point-of-sale advertising brain wave amid the whirling electrons.

A machine may work out the "what" if something goes wrong, and signal the fact, but the "how" and the "why" of it are in man's province. It is clever at answering questions suited to the mechanism that has been built into it, but it does not think up questions to ask. Its programmed questions call for yes or no answers or for sum totals. It does not go behind the answers as humans do, to discover other facts and questions even more complex and subtle. It does not speculate, when it comes to a choice, about how this same problem was handled far away and long ago.

What automation is

In its most simple terms, automation is the use of machines to run machines.

Many homes have furnaces regulated by thermostats: that is automation. The washing-machine that changes water and buzzes when the wash is done; the oven that cooks dinner while the housewife is out: these are automation. The automobile headlight dimmer is a very high type of automation.

Automatic machines must have a source of information supplied in some form of record. This is called programming. The programme tells the machine what to do next. The plan thought out by the designer may be committed to a tape or wire or punched card, and fed into the machine.

Electronics has contributed in two ways to automation: it has extended the range of automatic control and it has increased the speed of the processing of information. Electronic devices respond very quickly to signals. They take measurements and detect faults accurately. They can be placed at a distance from the operation, so that large areas of plant can be centrally controlled.

The idea is not new

People are mistaken who believe that automation descended upon the world a few years ago, just when the word "automation" became widely used. Automation is a fabric of many strands, started long ago and still on the loom.

Insofar as automation replaces human muscle by mechanical power, it continues a process of mechanization that began long before the Industrial Revolution two centuries ago.

There are new developments in automation, as in other areas of human work and skill, but these have been evolutionary, each a logical advance from the one preceding it. Aristotle expressed the idea. In 1496 Leonardo da Vinci planned an ingenious machine for sharpening needles at the rate of 40,000 an hour. A Frenchman, Denis Papin, made the first pressure cooker in 1680, thus originating the steam safety valve, one of the simplest and most widely used of all regulators. In 1725 the French silk industry was using punched records for weaving patterns. Jacquard brought together the best features of the automatic silk-weaving machines in 1801, and the Jacquard loom, essentially as he invented it, is still in use. James Watt designed his centrifugal governor in 1788 to control the speed of his steam engine. A Philadelphia miller, Oliver Evans, put automatic processing together with automatic handling about 1785: he unloaded wheat from boats, and conveyed it through the milling process to barrels and bags which were loaded on wagons and boats, all without human handling. From that it was not much more than a giant step to John Sargrove's electronic circuit-making equipment that was operating in England in 1945 to produce radios.

What about the calculators? Have they had a similarly long period of incubation and growth? Well, the elementary basis of operation of any digital computer, however big and complex it may be, is the same as that of the abacus, invented away back when men found that they needed something better than ten fingers and ten toes on which to reckon. In 1642 a machine to add and subtract was made by Pascal, and thirty years later Leibniz extended the machine so that it could multiply and divide.

Computers are essentially machines that do sums by the "yes" and "no" method. There was one built by Charles Babbage, a professor of mathematics at Cambridge University, in 1822. An investigator reported on it to Sir Robert Peel in this prize understatement: "I cannot but admit the possibility, nay the probability, that important consequences may be ultimately derived from Mr. Babbage's principle."

Today's electronic computers can surpass human beings in speed, accuracy and endurance. They can make calculations that would be otherwise impracticable. Sir Robert Watson-Watt, principal inventor of

radar and now a leader in automation, said of a machine he installed in Montreal last year that it could add or subtract two nine-figure numbers in one one-thousandth of a second, or multiply them in one two-hundredth of a second. Of another machine it is said that it will do at least as much calculating in a minute as a man with a desk machine could do in a year.

This seems a long way from the abacus, on which one counted by moving beads along wires, but the line of descent is obvious. A machine is supplied with certain data which it manipulates according to the instructions it is given and so produces the information desired. It would be better, instead of calling such a machine an "electronic brain" to nickname it "electronic digestive system." It cannot operate outside limits that are closely defined by the system of valves and circuits built into it and the sort of data fed to it.

Employment under automation

Among the important questions raised by automation is that of the place of workers. Will automation raise their standard of living by increasing earnings or reducing working hours? Will more skill be required, or less?

One of the most lively of all economic delusions is the belief that machines create unemployment. It has been destroyed a thousand times, but raises its head with every new step that is made toward improved factory practice.

Increases in output due to mechanization have taken place, starting with the Industrial Revolution, and over the long run employment has increased. There has been a general rise in consumption of goods, and working hours have been reduced. The labour force has been redistributed and re-absorbed.

The industries that are virtually automatic now, such as electric power and oil refining, have plenty of employees. The automobile companies which have been most aggressive in automation had the highest employment in their history in 1955. Growth of the dial system of telephone operation has been accompanied by a sharp rise in employment of telephone operators — more than 80 per cent in the United States, while population increased only 25 per cent. In one department of a big industry thirty young women were employed for manual calculation. After installation of a computer, twenty were employed as before and an additional forty were taken on as programmers for the computer, while fifty male employees analyze and programme problems and operate the night shifts.

A report of the Council for Technological Advancement (Chicago, 1955) declared that automation will help create and save more jobs, companies and industries than it will eliminate. Dr. Elmer W. Engstrom, Vice-President of the Radio Corporation of America, reaffirmed this in a statement published in the Canadian *Labour Gazette* last May: ". . . more jobs will be created than abolished. New industries and new products will come into being."

Greater stability in employment is to be expected. Automation demands long-range planning, and investment in the skill and training of workers will be much too great to allow us to discard employees except under drastically bad conditions.

It seems absurd to fear that workers will be debased by automation. The system will, by its very nature, free human beings from repetitive manual tasks and domination by the machine. It will increase productivity, the primary source of higher living standards. It will, as Gerard Picard told the Canadian and Catholic Confederation of Labour, of which he is president, prove a boon to the working man and his family. In the words of the late Philip Murray, President of the C.I.O.: "I do not know of a single solitary instance where a great technological gain has taken place in the United States of America that has actually thrown people out of work. I do not know of it, I am not aware of it, because the industrial revolution that has taken place in the United States in the past twenty-five years has brought into the employment field an additional 20 million people."

Automation will, said Professor Norbert Wiener, the distinguished mathematician of Massachusetts Institute of Technology, lead to the human use of human beings: that is, to our using man's specifically human qualities, his ability to think, to analyze, to balance and synthesize, to decide and to act purposefully.

All this means taking a step forward from the Machine Age, which in itself produced a higher standard of living for more people than was dreamed of by the utopians of the hand labour centuries.

Wide changes needed

Automation brings with it a demand for wide reappraisal of the industries it affects.

The thoughtful man considering automation will quickly see that tied in with mechanical operations there are questions of marketing, product design, distribution, pricing and timing. As Peter F. Drucker said so neatly in an article in *Harper's Magazine:* "Automation is not a box of tricks or a bagful of gadgets. Automation is a methodology." It is the controlled operation of an entire factory.

What are some of the crucial points to be considered? Automation demands long production runs and an assured or expanding market. The break-even point

moves to a higher level of production. New marketing methods may be needed. It may be uneconomical to produce by machine something that was designed for hand manufacture, so redesign of product may be called for.

Finding men and women with the necessary skills will be another problem. The man who operates the drill press today may not be fitted to service its tape controlled successor tomorrow.

Yesterday's workers were part of the production machine; under automation they will be employed to design, to build, to service and to control. They will require an increasing ability to think, and increased understanding of mathematical and logical methods.

It has been said that North America will need a million programmers in the next ten years. These will not be men and women with high gadgeteering skill, but people trained to use their brains.

Developments in automation present a challenge to both educational systems and employers. A greater degree of literacy will be required of everyone. We can degrade ourselves closer to the machine if we allow ourselves to think of literacy as the ability to read instructions.

It is not enough to prepare a youth for his first job. Jobs will change often and radically as we advance technically. We cannot allow ourselves or our young people to be left in the horse-and-buggy stage of education while our industrial processes emerge into the age of electronics and jet propulsion.

Nor is it enough to be trained in technical skills: we must also keep ahead of social changes, and only liberal education can help us to do that. Sir Robert Watson-Watt remarked on a visit to Montreal: "I have suffered more in the conduct of my business from people who are brilliant and ingenious in their own techniques, but who have not been educated in being human beings."

Management qualities

It is not only workmen who are affected by automation. Management of a department or of a branch or of a great industry by intuition will not stand the test of this age. The day of the lucky guess in replacing a machine, the day of rule-of-thumb selection of foremen and assistants, the day of haphazard methods anywhere — that day was yesterday.

The manager in a business where automation prevails will have to be highly educated in the sense of being able to handle systematic knowledge, though he may have no college degree. He needs to have a broader-than-ever-before understanding of all phases of production, and the wisdom to forecast with some clarity and confidence the direction of events in future.

Given an executive who is sensitive to the fact that a new era in business is already here (or perhaps in his particular line, just over the horizon) what can he do? He needs to ask questions, to conduct research, to obtain more exhaustive knowledge of the environment of his business, and then apply his knowledge to many taken-for-granted policies and plans. Are they true? Are they headed in the right direction? Is the sales plan adequate? Is the pricing policy realistic? Are personnel relations satisfactory? Has he set up a foolproof plan by which he will be informed continuously about changes in all these factors?

It is no disgrace even to the wise to learn and lend an ear to reason. Automation will separate the men from the boys, for example in decision making. Facts will be more quickly available than they are now, and the advantage in business will go to the executive who has assured himself of getting them completely, and who has acquired the ability to analyze them logically and to act upon them speedily.

The age of automation

Far from being puffed up about our present attainments, we have plenty of reason for being modest about what we have discovered and made, because every discovery and invention leads to new horizons over which lies the unknown.

A well-known Scottish writer on evolution, A.Gowans Whyte, said something that should encourage us as humans to remain top dog no matter how our machinery develops. "When we consider how early man was handicapped in the struggle for existence among beasts so much larger and fiercer and more heavily armed than himself, the wonder is that he managed to survive. The secret of his ultimate success lay in his larger and more complex and capable cerebral hemispheres: at this stage in evolution brain won over brute force."

We may allow automatic machines to take over the drudgery of routine and the back breaking jobs, but we must conserve and train ourselves for operations requiring judgment and highly developed skills. The machine will not isolate us from the great problems of nature, but may plunge us more deeply into them. Automation points up the increased need to understand our human environment.

Automation is here, and no one with a sense of history and destiny would wish to arrest a movement that promises to increase the world's goods and reduce human drudgery. We can't get rid of a new day: the sun keeps climbing. But we can push back the frontiers of our understanding, so as to make this new human tool yield the greatest possible benefit.

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