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Science for Pleasure

SOMEONE HAS CALLED SCIENCE "WIGO", which is short for "What Is Going On."

The development of science is the most characteristic feature of the age. Something is happening every day in countless laboratories and research stations where men and women are seeking the answers to "What is going on?" in nature.

These scientists are leading us along strange new paths where we need to understand what science is and what it can do in helping us to live in harmony with our environment.

No matter how far the archaeologist carries us back into prehistoric times, we have not found an age when early man did not observe natural phenomena and speculate on their causes. Today, we can go much further than they, and with greater ease. We have more precise instruments and the experience of all the years. As G. E. Hutchinson remarks in *The Itinerant Ivory Tower*, "Contemporary science can be extremely beautiful though often very exasperating, and at times tremendous fun."

Some people may think it absurd or amusing that they should contemplate adding to all their other occupations a probe into what is going on in the world of science, but the idea has its practical side. The purpose is not to memorize the number of legs a giant water-bug has, or the class of lever of which the wheelbarrow is an example, or the number of nerve cells within the human brain, but to build a fund of the information that is necessary to enable us to judge what developing science means for mankind.

No pill has yet been invented that will make a person capable of becoming an expert in any branch of science, but it is possible for any person to acquire some appreciation of science and its methods, to learn something of its aims and purposes, and thus to provide himself with a sketch map of the territory to guide his thinking.

When we learn something about modern science it will make us less fearful, because we are looking at things directly instead of catching frightening glimpses of them out of the corners of our eyes.

Bridge the gap

Some will ask: "Is it possible for me, with no scientific background, to learn anything worth while?"

One does not need to copy Faust, the subject of Goethe's drama, who sought infinite knowledge. One should rather heed the President of Harvard University, James B. Conant, when he writes in *Science and Common Sense:* "Enough can be accomplished, I believe, to bridge the gap to some degree between those who understand science because science is their profession and intelligent citizens who have only studied the results of scientific inquiry . . . in short, the laymen."

What we read in the newspapers about science is like the part of an iceberg showing above the water. Unless we know about the four-fifths of the iceberg that is below the surface we are misled into thinking that here is merely a chunk of ice floating on the top of the waves.

To learn what is going on below the surface is not difficult. Canada is not backward scientifically, and has attained a respectable place in the world of science. The story up until 1939 is told in *A History of Science in Canada* (Ryerson Press) and it may be followed year by year through publications available from the Queen's Printer.

The National Research Council, established in 1916, has some 45 associate committees studying a wide range of problems. It supports the research of 2,500 university scientists, and awards nearly two thousand scholarships, bursaries and post-doctorate fellowships. A list of its publications may be obtained at any of the Canadian Government bookshops, or from the Queen's Printer, Ottawa.

Science replaces superstition

Science is still young relative to the long ages of mythology and superstition, and the knowledge it provides is largely replacing bigotry, ignorance and prejudice. Observation and controlled experiment are now answering questions which were once decided by the voodoo of witch-doctors. There is an increasing

willingness to take all of the evidence into account so as to arrive at a true answer.

Newly uncovered knowledge sometimes seems to fly in the face of strongly-held opinions of things, but that is the nature of discovery. All the great innovations of the past have involved the rejection of previously accepted beliefs. Science is dispelling mists and teaching us to discriminate between truth and guesswork.

This is not to condemn the past, but to welcome new thoughts which add facts and clarify interpretation of what has already been learned. Science is not a study for people who are disinclined to seek truth, but for those who believe that no branch of knowledge is yet complete, and that to every reasonable question there will some day be found a reasonable answer.

Physical science and research have no answers to many questions which confront this generation, but their methods give some hints about how to go about resolving moral and social problems. To read about the scientific way of reasoning will help toward clarity and toward habitual accuracy of thought. As a philosopher said: "Such as are thy habitual thoughts, such also will be the character of thy mind."

Science encourages open-mindedness, focused vision, honesty, and desire for truth. It requires that we take nothing for granted, that we accept facts however unpalatable, and that we accommodate ourselves without lamentation when long-cherished ideas are proved to be out-of-date.

People talk about "the scientific method" as if it were some magic computer-like method of solving all our thinking problems. There is nothing magical about it, but only a slightly formal kind of common sense: what is the question? shall I seek the answer through experimentation, or reading what different people have discovered? how do my results stack up after considering the negatives as well as the positives? where can I go from this answer so as to evolve my own theory or solution?

This mode of procedure introduces system and order into our thinking and does away with a lot of vagueness; it contributes toward intellectual honesty.

The scientific method teaches us to beware of our certainties, and to admit when we have doubts. Pierre Simon Laplace, the greatest of French mathematicians, once started to read a paper on the speed of travel of gravitational action before the French Academy. After a few sentences he stopped, put the paper in his pocket, said "I must consider this further", and left the platform.

Research

Curiosity is the root of knowledge, but mere wondering about a thing will not accomplish much. There is fun in picking up a thin thread and following it back through a labyrinth until it is found to be part of a strong rope. That is research.

Dr. Hans Selye said in the introduction to *From Dream to Discovery:* "We are at the dawn of what will undoubtedly go down in history as the Age of Basic Research." Just as explorers over the centuries have had fingers itching to draw lines on the blank spaces of the maps, so research people in all the sciences are pressing into the unknown, seeking to illuminate it.

Science devoted to fundamental research and the application of knowledge to peaceful and social ends is capable of bestowing great benefits upon mankind. Through their chosen leaders, democratic people can direct the fruits of research into beneficial channels.

Nothing is too small to engage the attention of someone interested in research, and nothing is unimportant. The person who finds things out is one who has the habit of seeing farther and probing deeper than other people. The scientists who examine material brought from the moon are not only cracking big stones to see what they are made of but are analysing dust motes.

One lesson for everyday use will be learned by anyone who interests himself in science. Before every discovery the discoverer had considered and rejected many previously accepted conclusions and turned away from many seductive suppositions.

The findings of research people are slow but cumulative, not one-jump efforts in which enlightenment and discovery follow one mighty effort. More often they evolve haltingly, circuitously, and with many false starts.

Scientific progress today does not follow a gradual upward curve in the 19th century way. It is exploding all about us because of new findings in every branch of science. Einstein's first paper on relativity, for example, published in 1915, marked a radical change from the old scientific outlook and affected every branch of physics.

The problem apparent to some thoughtful people today recalls the Eastern saying: In making genius the fairies left out one essential gift — the knowledge of when to stop. Toward the end of 1970, a scientist at Columbia University, who later changed his mind, raised a storm of protest from scientists and the public when he proposed detonating a nuclear bomb on the moon to help analyse the moon's interior.

It is often found, sometimes years later, that answers to questions of theoretic interest in science are also of practical importance. When James Clerk-Maxwell disclosed his electromagnetic theory of light in 1873 he had no idea of providing every home with a radio receiving set, although his momentous equations foretold the possibility on purely theoretical grounds.

Advances in technology and applied science play a big part in shaping the form of our lives. It is the function of basic science to enlarge man's pool of knowledge, but not to influence the direction of technological innovation based on this knowledge.

The power to decide what to do with scientific discoveries is in the hands of society. The same network of research that produced nuclear energy led to

the electron microscope and the Salk vaccine in the hands of different developers. Technology applied to scientific discoveries will bring men the things they have the wisdom to want and the incentive to strive for and the energy to produce.

Reading about science

One of the freedoms seldom mentioned in the long list of things we treasure is the freedom to read about science. Some states forbid it in the same way as others disallow freedom of conscience.

Reading in science is an endless process of pleasure and discovery. Sir Arthur Conan Doyle, author of the Sherlock Holmes stories and many others, said this: "If I were advising a young man who was beginning life, I should counsel him to devote one evening a week to scientific reading."

There is not much satisfaction for one's mind in looking at detached fragments of science as they come into view on television or in the newspapers. One needs to consider the systems of patiently constructed knowledge out of which have come these interesting results.

Many a paper written by a scientist is only a few pages in length, and yet these pages are so significant that they mark the end of an era of confusion and groping, and usher in a period of sure-footed, confident advance. The drama of this event is obvious only to the person who knows something about its background.

People who do not learn to read purposefully miss much of the richness to be found in life. They may live and die unfulfilled because they did not make use of their brain power. Estimates of the number of cells in the human brain range all the way from 600 million to 15,000 million. The wisest person who ever lived probably had several million brain cells that were more or less idle.

Reading in science will help a man to grapple with ideas in his own galaxy of brain cells instead of taking his thoughts second-hand. When he is reading about something, and he receives the spark of an idea about it, or frames an hypothesis about it, that is an imaginative exploit that is very pleasing.

To enjoy science, one does not need to probe into all the cautionary qualifications, the modifying details, and the scholarly foot-notes. These are properly used by scientists in their learned papers with regard to things about which they are not absolutely certain, or about which other scientists have different ideas, or to indicate the sources which gave rise to the scientists' findings.

The reader needs a certain firmness of mind to pursue a topic. Cornelia Otis Skinner tells humorously in *Excuse It, Please!* about how she started to look in an encyclopedia for settlement of an argument with her husband. An hour later she had skimmed the "Med to Mum" volume and had found so many interesting things to look at that she had forgotten the subject of her scholarly research. She settled the argument by saying to her husband: "You were right, my dear."

There is a book, published by the University of Toronto in 1948, that contributes to a layman's understanding of physics. It is called *Half-Hours with Great Scientists*, and was written by Dr. Charles G. Fraser. Its 500 pages are filled with interesting and exciting stories of great discoveries through the ages, with some flashes of humour.

The Scientific Monthly, published by the American Association for the Advancement of Science, says of this book: "The lay reader . . . will certainly gain from it a better understanding of the events that he observes in nature, and will be drawn into closer rapport with the scientific age in which he lives."

Observation and experiments

"Science" is a label for our effort to find out how the universe works. It attempts to do this by careful observation and experiment, both of which are also at the service of every person.

The critical observation of science differs from the casual seeing of a wandering eye. It means that one sees what is going on and filters it through a layer of informed common sense. Then one has something to think about, and in addition enjoys the fun of perpetual surprises.

A reader in science learns to look at things not as separate things standing alone, but, as the Greeks did so well, as parts of a whole. The relations of things are just as much facts as are the things themselves, and so we cannot safely shut our eyes to the essential connectedness of things.

As an exercise in observation, not in training of memory, anyone may play the game told about by Rudyard Kipling in his story *Kim*. It consists in getting someone to place twenty small articles on a tray and showing it to you for one minute. Then you write down all that you can remember about what is on the tray. A variation is to look in a store window for a minute, go away, and make a list of as much as you remember of the window's contents.

Everyone has the urge to do things in addition to reading about them, and many experiments and projects can be worked out with bits and pieces available in every home. Professor Wilhelm Röntgen, who discovered X-rays, used in his experiments what he found around him — blackened cardboard, books, playing cards, tinfoil, and wooden blocks — to test the penetrating extent of his vacuum tube.

The UNESCO Source Book for Science Teaching, available at Government bookshops or from the Queen's Printer, describes and pictures hundreds of experiments that anyone can perform with materials and equipment on which he can lay his hands in his kitchen or cellar. These involve astronomy, weather, sound, heat, magnetism, electricity, light, the human body, and water. The book contains useful tables of weights and measures, stars and planets, the elements, and minerals.

As examples: a pattern is given for a "weather

house" built of cardboard, from which little figures emerge to tell whether the weather will be dry or wet: a reflecting telescope can be made with a cardboard tube like the ones used to mail calendars, a shaving mirror, and two lenses.

Something about science

A science is any body of knowledge in a given field so arranged or classified that the phenomena can be understood. Scientists have been able to advance the frontiers of knowledge at many different points so that now science is broken into sections, each specialized but still part of science.

Auguste Comte, the French philosopher, recognized six fundamental sciences: mathematics, astronomy, physics, chemistry, biology, sociology. Of these fundamental and abstract sciences the rest are the concrete developments and applications. The Dominion Bureau of Statistics breaks down the biological sciences into medicine, zoology, botany, pharmacy, agriculture, dentistry, nursing, physio- and occupational therapy.

Besides being pleasurable, the study of science has significance in everyday life. The applicability of a particular science to people's needs and wants today can be illustrated by reference to botany, the branch of biology which deals with the structure, physiology, reproduction, evolution, and other features of plants.

The green leaf pigment, called chlorophyll, is the one link between the sun and life. It is the conduit, as it were, of perpetual energy to man and other creatures.

Consider the Dryad, a dwarf shrubby plant that grows in harsh environment high in the Rocky Mountains. Some people call it Alpine Avens and admire its lovely blossoms. Here is a flower whose rolled leaves prevent rapid evaporation and, being evergreen, convert water, sunlight, and carbon dioxide into food. It possesses root nodules as do legumes, and like this kind of plant it fixes nitrogen and stores it in the soil.

The Dryad is part of the earth's life plan, and there are thousands of other plants similarly serving humanity.

The problem facing people today is how to preserve these growing things. Conservation touches not only the ability of people to live well; it touches their ability to live at all. Dr. Arnold Toynbee stated the issue this way: "We've practically obliterated the natural environment in which the human race came into existence and substituted in its place a very high powered technological environment."

In reading botany and studying plants for pleasure, therefore, we are dipping into the basic principles and laws governing the entire living community. We are becoming acquainted with facts that will guide our footsteps along the treacherous paths of the years immediately ahead. We learn how to behave as members of earth's ecological community.

And so with the other branches of science: every one has things of interest to tell us about ourselves, about what is going on around us, and about our struggle for survival.

Science and society

Today's science is built of the knowledge and ideas provided by thousands of men and women, enlarged and added to and worked into modern form by new thought and new discoveries. We are always re-using the past.

When a tourist looks at the Coliseum in Rome, built in A.D. 72, and asks why there are so many gaps in its structure, he is told that people took the brick and stone and built them into new walls. We do not need to go so far back or so far away to see this thriftiness at work. Stone from the great fortress of Louisbourg in Nova Scotia was taken to Halifax to help build that new city.

Science, using all the building material that the past provides, applying new insights, adding new knowledge, is capable of bringing mankind into a way of life that will be, insofar as its physical properties go, superior to any that has been known in the past.

That is why science holds out so great promise of interest to anyone who will indulge in its study. There are at least three rewards: we develop a scientific mental attitude in the discussion and study of problems; we give ourselves data on which to judge the social repercussions of science, and we dip into an inexhaustible source of enjoyment.

Some people, looking at the human scene, are aware only of wars and threats of polluted death, but others seek to understand and learn to appreciate the progress that is being made toward a better life. Science has placed people of this century on a higher platform than any before reached.

In the short time that man has lived upon the earth he has, by using his brain, progressed from procuring the day's food to the most intricate calculations and discoveries. These revelations by scientists can be channeled by governments and people so as to widen the enjoyment of good health, to provide better food, and to increase the happiness of all people.

To become interested

To become interested in science can be a great event, as dazzling as first love. When a man gets into science for pleasure he satisfies natural curiosity, learns about survival, and finds creative expression through his thoughts about things. Instead of surmises, guesses, suppositions, half-intuitions and dim instincts, he fulfils the urge, hidden away in his make-up, to uncover the truth.

Science is above all else an imaginative and exploratory activity, and the scientist is a man taking part in a great intellectual adventure. He who reads about what is going on becomes, in some part, a fellow-adventurer, questing for the secrets of the universe. He may go on a fishing trip into some aspect of scientific endeavour and come back, not with a big fish, but with a great idea.

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