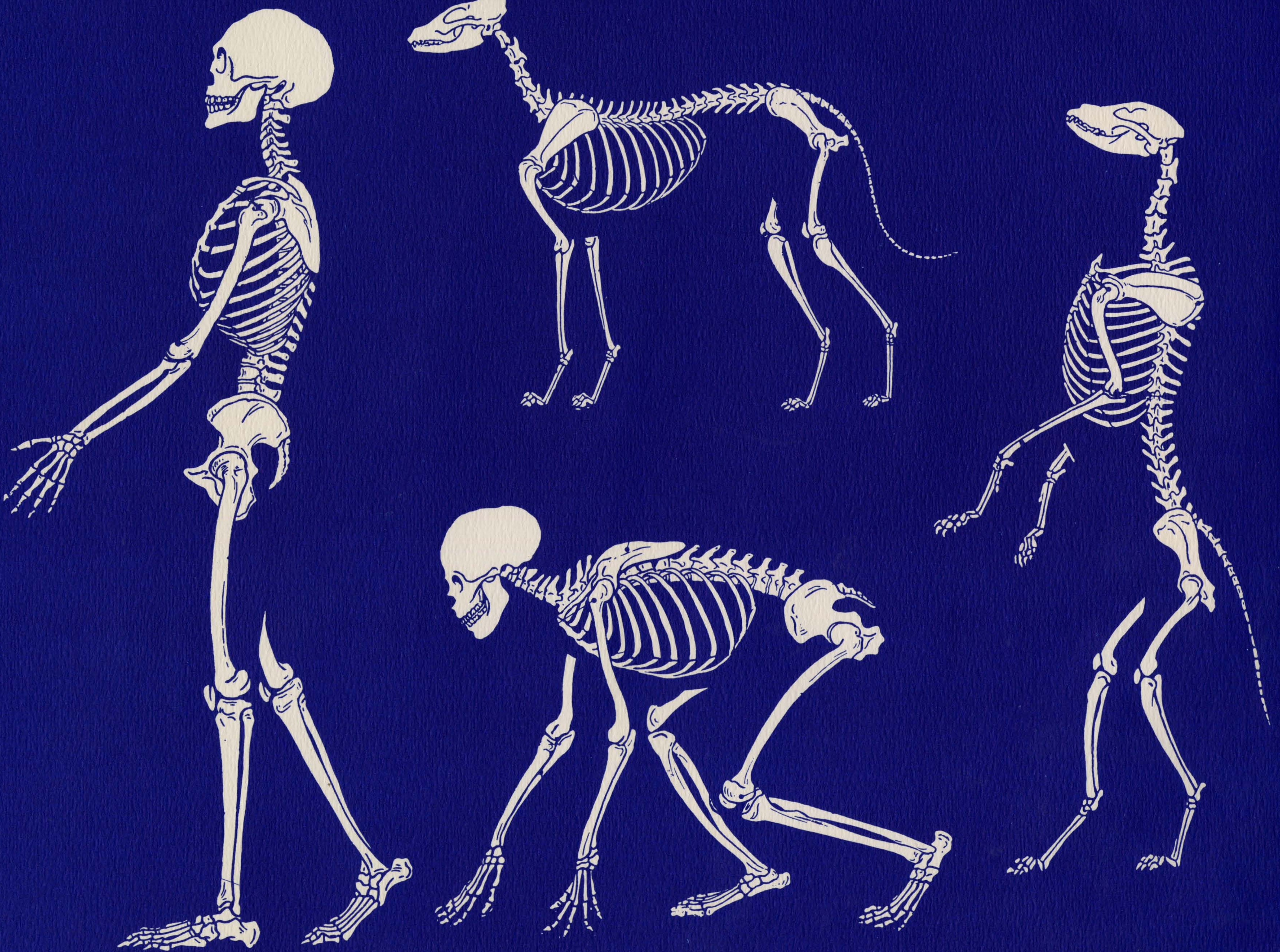
SCIENCE IN OUR LIVES

Narrated by Ritchie Calder / Folkways Records FX 6101



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COVER DESIGN BY RONALD CLYNE

FOLKWAYS FX 6101

FOLKWAYS RECORDS Album No. FX 6101

Science in Our Lives

NARRATED BY **RITCHIE CALDER**

Side I Band 1 SCIENCE BEGAN

SCIENCE began when Man began to observe and make a note of his observations. In the Stone Age, Man lived on the flesh of the animals he could slay. Primitive men were creatures of superstition and probably, like the practitioners of voodoo who make wax models of their enemies and stick pins in them, they made drawings of these animals in the act of being slain in the hope that the wish would be fulfilled. So we have representations of bison in the cavern of Maux, in the south of France, which are faithful anatomical studies, with the arrow penetrating exactly where the heart would be. This, apart from any superstition, showed a useful "know-how" in killing animals.

Then men noticed that the grains in certain grasses were specially good to eat; that from seed they could grow new grasses, that if they chose a suitable bit of ground they could grow lots of such grasses; and that if they scraped the ground, the plants would root better. So they became tillers, applying the science of their observations.

But agriculture depends on the seasons (another observation of the early scientists), and they needed a calendar to help them to sow and reap. They noticed that certain stars had a fixed relationship to the sun, which corresponded with their seasons of growth. And their preoccupation with the stars for this simple purpose of living led them to more—shall we say—academic observations. Five thousand years ago, before, or about the time when Bishop Usher would have us believe Abraham left Ur of the Chaldees, astronomers there could predict an eclipse as recurring at an interval of eighteen years and eleven days. Complete records extending over 360 years have been found at Ur and in them the evidence that a Chaldean, without help of the accurate instruments now at our disposal, had worked out the length of the year as 365 days 6 hours 15 minutes and 41 seconds, only 26 minutes and 26 seconds too long.

Such calendar-making was characteristic of most cultures—the Mayan and Aztec calendars are half a world apart from those of the Middle East, but are just as remarkable in their observations.

When the Nile flooded, it swept away the natural landmarks which might have divided one tiller's ground from another. So some method had to be devised by which the land could be marked out every year. That was the origin of practical geometry. The Egyptians invented a set square to give a right angle by knotting a rope in lengths of three units, four units and five units (the units being based on the length from the tip of the middle finger to the elbow), and pegging it on the ground at the knots. From such practical devices, the Greeks later produced their logical systems of geometry (although Chinese prints of 1000 B.C. show the Orientals anticipated the famous theorem of Pythagoras—that the square on the longest side of a right-angled triangle is the sum of the squares of the other two; and excavations at Tel-el-Harmel near Baghdad showed that much of Euclid was anticipated by two thousand years).

When men began to congregate in communities and to trade, they needed numbers. The handiest way was, like a child at school, counting the fingers. So we have from earliest times had ten-finger, decimal counting. Or men notched sticks, like the bad man of the cowboy films notching his gun to keep tally of his victims. Then they found it was easier to count pebbles. And the next stage was to have the pebbles in a convenient form, so they strung them together as the abacus, or counting frame. The Mexicans and Peruvians were using the abacus before the Spaniards arrived in the New World. The Chinese and Egyptians possessed the abacus a thousand years before the Christian Era. The Romans borrowed it from the Etruscans.

Having tallied up the score, it was necessary to make a note of it. So numerals were introduced. The numerals we use today are derived from the Hindus and probably are the initials of the Hindu words conveying "two," "three," "four," and so on. And zero was probably the unhatched egg.

Band 2 Science Terms

Suppose you are interested in animals and are pretty observant. You keep your eyes open and you notice all sorts of differences between animals—some have long tails and some have short, and some (to wit, human beings) have none at all. Some have toes, some have claws and some have hoofs. Some eat meat and some eat herbage. And so on. But you notice that a whole group of them, including human beings, have one thing in common: they all suckle their young. So you call them "milk-giving animals," or if you know Latin you call them *mammals* (from the Latin word *mamma* meaning "female breast"). You observe them further and something strikes you as significant. None of those animals you have classified as mammals lay eggs. So on your *observations*, or known facts, you say: "Animals which suckle their young do not, apparently, lay eggs." That is a *hypothesis*, a provisional statement, on which you then proceed to do more research (notice the word "re-search" implying search and search again). You go around woods and farms and zoos and wherever you search you find that "animals which suckle their young do not lay eggs." You even find that there are fish or at least swimming animals like whales and seals which, unlike other fish, do not lay eggs but, by the same token, suckle their young. Now you are getting somewhere. Your *hypothesis* can be promoted to a *theory*, which is a *hypothesis* so well established that it has become respectable. You drop the word "apparently." But you are not satisfied. You travel through North America, South America, Europe, Africa and Asia observing and checking. Always it is the same: "Animals which suckle their young do not lay eggs." So now you think you can state it as a universal *law* of nature. You say: "No animals which suckle their young lay eggs." But since no scientific inquiry is ever complete, you go off again to the Australian continent, and there you meet the duck-billed platypus, or duck mole, that curious animal which not only *lays eggs* but also *suckles its young*. All that trouble just to prove yourself wrong in the end! But there is no need to throw yourself in the river. You can restate your *law* as "No animals (with the exception of, etc.) which suckle their young lay eggs." A scientific *law*, like a judicial law, defines the conditions in which it will apply. And, like modern law and unlike that of the Medes and Persians, a scientific law can be amended when new facts are brought to bear upon it.

Band 3 Edison Effect

EDISON HAD OVER A THOUSAND PATENTS to his credit and only one scientific discovery. That one scientific discovery was the *Edison Effect*, which, by force of habit, he patented, but, as he himself said, he "did not have time to continue the experiment."

The discovery came about when he was developing the electric lamp, using a thread of carbon—made from Japanese bamboo—as the filament. Carbon, which is familiar to us as charcoal, graphite or diamond, has the peculiarity that when it is heated it passes into vapor. When, therefore, the filament (shaped like a hairpin) of the Edison lamp was too much heated, or "overrun," by a too high voltage, the carbon evaporated and condensed on the inner side of the tube and blackened it. But there was a clear streak, a "transparent shadow" in the blackening, in line with one of the legs of the carbon-loop of the filament. This showed that the carbon atoms were being shot off from the far leg of the loop and were bypassing the second leg. Edison made a guess at what was happening. He placed a metal plate between the two legs of the loop, connected a platinum wire to it and led the wire to the outside of the bulb. He then found that if he connected this wire, and a lead from the intake terminal, to a sensitive detector (a galvanometer), he got a definite current flowing. But if he attached a lead from the outlet terminal, connected to the leg which was casting the shadow, he got no response. That meant that there was a current flowing in one direction only, like traffic down a one-way street.

Edison never satisfactorily explained the effect, because he was too busy inventing other things, and he, who made such good use of other people's scientific facts, did not realize the significance of his own.

But we do today. Our world-wide communications, our broadcasting systems, our amplifiers, our television, our talkies, all depend on the Edison Effect. It is the explanation of the vacuum tube and of the amplifying tube. But the meaning of Edison's discovery of 1884 was not realized until 1904, when Ambrose Fleming, in Britain, patented the thermionic valve. Notice the word "valve." Fleming gave it that name because here was a device which allowed negative electricity to flow from the filament to the tube, but not the other way. It is like the valves in the veins of our bodies, which allow the blood in them to move only toward the heart, or like the valve in the auto tire which allows the air to go in but not to come out. By inserting a "trap," Fleming found that the effect could be used to rectify and detect radio waves. Lee De Forest, the American, by adding a third factor, the "grid," completed the invention of the modern radio valve.

This story of a great and observant mind which, for once, missed the point, illustrates the essentials of a great discovery. A great discovery depends on three things—*The Method, The Man* and *The Moment. The Method* is what was discussed in Part Two—the observation, followed by the hypothesis or shrewd guess, followed by experiments to test the validity of the guess; the theory, which is the guess now justified by these experiments; and the further tests which keep on confirming the validity of the experiments and the theory. *The Man* implies someone with the gift of acute observation. *The Moment* is that incident in time, or the scientific "climate," in which a whole lot of circumstances combine to make the discovery possible. And in that order, because if *The Man* does not have *The Method,* he will miss *The Moment.*

Edison did not have a scientific training, in the sense of schooling. But you do not have to have a license to use the method. It is a system of thought, a habit of mind, and in Edison's case, largely an intuitive approach. He was a self-taught "methodist." He was certainly "The Man," the gifted individual with shrewd insight, spotting an idea which others had missed and following it through.

The Moment in the case of the Edison Effect had not arrived. It had to wait for J. J. Thomson's discovery of the electron in 1897. Before that, in 1879, Sir William Crookes had shown the existence of cathode rays. Thomson took up their investigation. "I had for a long time been convinced," he wrote later, "that these rays were charged particles, but it was some time before I had any suspicion that they were anything but charged atoms. My first doubts to this being the case were aroused when I measured the deflection of the rays by a magnet, for this was far greater than I could account for by any hypothesis, which seemed at all reasonable if the particles had a mass at all approaching that of the hydrogen atom, the smallest then known."

This experiment showed that his particles must be only about 1/1840th of the mass of hydrogen atoms and that they were traveling with velocities of some 1,500 kilometers a second. He first called them corpuscles," which conveyed the idea that electricity was not a continuous intangible something, but the swarming of infinitesimal specks. In fact, he and Rutherford strained them out by passing them through tubes filled with cotton wool, as the pips are strained out of raspberry jelly by the jelly bag. With this recognition of the nature of electrons, Ambrose Fleming in 1904 reached The Moment when he could explain something which had eluded Edison twenty years before.

Band 4 Atoms

TWENTIETH CENTURY SCIENTISTS are not so cocksure. Science today is much more modest. And one reason derives from the greatest advances which men have ever made —from the studies of the nucleus of the atom, which have produced the release of atomic energy. It is in the atom that we find *uncertainty* in a philosophically insoluble form. It is impossible to predict how an individual electron will behave. And it never will be possible; it is not a question of improving methods or instruments; it is unknowable.

No one, of course, has ever seen an individual atom or an electron. They have seen their effects in a cloud chamber or in the emulsion of a photographic plate—ionized trains. But the whole of the earth-shaking results of nuclear physics has followed from "models" which mean mental conceptions of the atom and its particles. These "models" derive from cause and effect—like Rutherford's deduction that the cause of a beam of alpha particles being bent was the existence of a positively charged nucleus. But even in the early days when Bohr was trying to give theoretical explanations, he was bothered by the fact that Newtonian mechanics would not always fit, and he used them when they did and provided other explanations when they did not. His accommodating theories agreed beautifully with experimental observations. Science, however, does not like improvising laws and gradually new theories were systematized—like wave-mechanics and the quantum theory.

These explained a lot, but experimental evidence still depended on the *average* behavior of large numbers of particles, not on any one. From such statistical behavior, they could get a quite consistent picture and enable nuclear physics to advance to that apocalyptic moment of the explosion at Alamogordo.

That, however, does not satisfy the scientists. They want to know precisely what the position and velocity of any electron is. Only so can they predict what its path is likely to be. But they never can. Heisenberg, the German, who propounded the *Theory of Indeterminacy* reasoned thuswise: if we want to know where an electron is we must illumine it with some kind of light (not necessarily visible ordinary light, but, say, X rays) and use a microscope (not any which we yet possess but one ideal for the purpose) and observe it, not with the unreliable human eye, but with a photographic plate or some other unbiased detector.

This involves using light, but light, with the wave lengths of visibility, would not serve. It would require X rays or even shorter gamma rays from radium. This would give *accuracy of position.* That is not enough; we cannot predict where Mars will be next Thursday unless we know the speed and direction in which it is traveling.

But (Heisenberg reasoned) if you use X rays or other intensive rays, they are so energetic that they will kick the electron forward or sideways. So you have changed its *speed* or its position at any moment and possibly its direction until you cannot be sure where it is going. What *The Theory of Indeterminacy*, or, *The Uncertainty Principle* boils down to is this: in the case of one electron, you can observe its *speed* at any moment, but you cannot know both speed and position simultaneously, which is what matters if you want to predict its future behavior. The mere act of observation changes the behavior.

We can understand that better from ordinary life. A teacher can never know for himself how his class behaves when he is out of the room, because when he comes back to look, the children behave quite differently. Or if someone says to me: "You behaved completely naturally on television last night," I know it is not true, because I knew I was being observed. I had arc lights beating down on me, as I do not normally have. I had a camera leering at me. I had the producer signaling to me. I had cramp from sitting in a prescribed position. I was behaving quite differently from what is normal for me.

SO THE SCIENTIST TODAY, instead of saying like Laplace, that if he knew at one instant the position and velocity of every particle in the universe, he would be able, in principle, to calculate everything that was going to happen, he says that, in principle, it is impossible to know at one instant the position and velocity of even a single particle.

Just as there was a tendency for people to take Laplace literally and reject uncertainty, so nowadays there are some who want to "throw out the baby with the bath water" and say that the Uncertainty Principle discredits Cause and Effect. Nothing of the sort. In the visible world, the physical principles still hold good and give precise, constantly checkable answers. But in the universe of the atom, it is no longer possible to say, "The certain behavior of a particle will be so and so." All that it is possible to say is that "From the observations of millions of particles, the probable behavior will be so and so."

So *Chance* is back. Probability is a perfectly valid scientific principle. And there are those, even among the exact scientists, who are relieved by it. Humility will do science no harm. *"Certainty"* with its sense of inevitability was one of the things which made ordinary people uneasy, if not afraid, of science.

Band 5 Agriculture

Agriculture, however primitive, or however remote in tradition, is in fact the application of science to the problems of living in settled communities. It is not just the use of artificial fertilizers or selective weed killers, or soil conditioning, or the lavish contribution of science to modern, intensive agriculture.

Long before the nineteenth century and the discovery that plants had sex, and before Mendel and his insight into the hereditary factors of plant breeding, Man had successfully bred, and cross-bred, plants for food or flowers for his esthetic satisfaction. He had domesticated his animals most successfully long before Darwin had given him his authority in the theory of evolution.

Flint sickles found at Mount Carmel suggest that cereals were eaten by the Mesolithic cave dwellers probably before 6000 B.C. The first step in agriculture was to get annual crops on prepared ground within a settlement. In the Mediterranean area, two wheats, wild Einkorn and wild Emmer, together with wild barley, were bred for harvesting. Rye and oats, which came much later, began their career as weeds of the wheat and barley fields. It might be said that the civilizations of Western Asia and Europe depended on wheat and barley and that the extension northward into colder latitudes depended on rye and oats.

The domestication of animals for securing food began about the same time. The first domestic animal was probably the dog, which always seems to have had a natural affinity for Man and was his earliest ally in hunting. Cattle, sheep, goats and pigs were brought in early. The use of the horse, ass, ox and camel for transport and haulage came later. Wool, woven into textiles, in place of pelts, originated probably in 4000 B.C. Dairy farming seems to have begun in Mesopotamia about a thousand years later.

Maize and potato agriculture of Central and South America does not seem to have been derived in any way from the evolution of agriculture in the Middle East, and the millet-and-pig economy of China also seems to have been a separate development.

Agriculture was the basis of that civilization which has been called "The Culture of Cities." Settled cultivation could sustain groups twenty times as large as those of the tribal nomad. The means to harvest and conserve food, instead of having to wander in search of it, meant that within settled communities there were opportunities for specialization of labor, beginning with the weaver and the potter and the flint polisher. Out of that grew our complex trades and crafts which depended on the acquisition of farming skill to produce a surplus of food from the soil and not merely a subsistence for those who worked on it.

Side II Band 1 FOOD FROM THE DESERT

The world has awakened to the dangers of erosion and to the destructive effects of mismanagement. Mistakes can be turned to account. What Man did in folly for example, in North Africa and the Middle East, Man, in wisdom, can undo. It means reforestation and revegetation of what are now barren tracts. But it can be done and it can restore the forest complex and check the movement of the advancing desert. In the island of Cyprus, for example, the mere imposition of a law forbidding the free-ranging goat, that destructive animal, meant a resurrection of the cypress forests. In other parts of the Middle East, the introduction of such imported trees as the eucalyptus or the acacia, which can find their own water depth, can help to restore the forest complex in which the indigenous trees and shrubs can again flourish.

This reclamation of desert is likely to be one of the most rewarding campaigns of modern science and technology. There are 18,500,000 square miles of deserts in the world, a third of the land surface. Hundreds of millions of acres of those deserts can become fertile merely by the introduction of water, either from underground sources or by irrigation. For example, under the North Saharan Desert extends the Albienne Nappe, a great water-bearing layer, in places four thousand feet thick. It is a great reservoir, replenished by the rains of the Atlas Mountains. Soundings have been sunk into it, which have proved its extent and its water-bearing capacity. At Zelfana, in Algeria, the layer was reached at about one thousand feet depth and produced a "gusher" one hundred feet high. This water is now supplying a considerable agricultural colony in the desert. That is only a beginning. Similar sinkings are being made over a wide area of the Sahara to establish artificial oases. To quote the French scientist in charge, "Life is being brought to a howling desert."

There are millions of acres of desert in Pakistan and in India which are being brought into fertile production. The Negev in Israel, half the area of the new state, is being developed, and crops have been won from what was only a few years ago a bleak desolation of the Biblical wilderness. It was estimated at a symposium of world experts on deserts held in Jerusalem in 1952 that, without even contemplating the vast areas of remoter deserts which could be made fertile, there were 200 million acres of accessible deserts which could be economically developed by irrigation now.

Extensive studies have been undertaken of the nature of desert plants and how, by transfer and adaptation, plants from one part of the world could be introduced to meet the needs of other parts. New studies have been started on the phenomenon of dew—a factor which has been strangely neglected, when one considers the enormous significance attached to dew by the Ancients and expressed in the Old Testament. It has been found, for instance, by Professor F. Went, of the California Institute of Technology, and by Dr. S. Duvdevani, of Israel, both from field experiments in Israel and laboratory experiments in California, that certain plants, even in a rainless desert, absorb in a night more dew than they need and secrete it into the soil. It should be possible, by selecting such plants, to produce an excess of moisture in the soil to supply other selected plants which have not got this dew-absorbing capacity.

Similarly, a great deal has been learned about the phenomenon which always mystifies desert travelers—the sudden blazing into life of colorful flowers in deserts where there may have been no rain for ten or fifteen years. At the first substantial rain, desert seeds sprout and blossom. The explanation is an "inhibitor," a chemical which prevents their growth. It is a sort of chemical mackintosh. If there is merely a skirmish of rain which would be insufficient to bring the plants to maturity, some of the "inhibitor" may be washed off, but the seed will regenerate it and go to sleep again until there is sufficient rain to make it grow.

Similarly, desert trees and shrubs, once established, exude from their roots an inhibitor into the soil, which will prevent any seeds around from growing. This is the shrubs' way of staking out its catchment area, reserving to itself the moisture necessary for its own growth. But if there is a sufficiently heavy shower which will wash out the inhibitor from the soil, it will be enough both for the established shrub and for the sleeping seeds. And they will come to life.

The nature of these inhibitors is now known, and with knowledge and ingenuity it ought to be possible to treat seeds and disseminate them—if necessary from the air—over areas of the desert. They will lie dormant until there is rain enough for them to root. It is one way of revegetating the wastelands.

Band 2 FOOD FROM THE JUNGLE

ON ANOTHER JOURNEY WHICH I MADE for the United Nations I was concerned with jungle. Tropical vegetation is abundant, but its very abundance may be deceptive if we should recklessly try to clear it for open cultivation. The exposed soil may perish by being dried by the sun or being sluiced by the rains. Nevertheless, it is possible with proper management to bring into cultivation for human benefit vast areas of what are now called jungle. The story of many of these jungles is the story of the Himalayan Terai—once cultivated regions which had to be abandoned owing to malaria. Once the malaria is cleared, as it has been in the Terai and in other parts of India, it is possible to establish food cultivation provided the balance of nature is preserved. This can be done by careful ecological study. For example, in the Terai, although there are 1,700 million acres of jungle now liberated from malaria, the region will never be cultivated to its full extent because large parts of it are being protected as forest—as reserves for wild animals, but also to ensure that the forest acts as a sponge to trap the rain, which might otherwise sluice off the soil, and seep the water into the underground springs.

Even in terms of what has been called "climatic suitability for crop growth," this world of ours is still underdeveloped. It is estimated that 11,000 million acres come within this conservation description—conservative, that is, because by adaptation of plants, difficulties of climate can be overcome. But of that area less than 4,000 million acres, or less than ten per cent of the world's land surface, are at present cultivated. Of this total, the food-producing area represents about one and a half acres per head of our population. But another three and a half acres per head might be brought into cultivation.

HERE, THEN, IS THE GREAT CHALLENGE. The world population problem is now difficult, but in the next fifty years may become catastrophic. The population by 1975 cannot be less than 3,000 million, and may be more. Science, and animal and plant husbandry, combined with the techniques of modern mechanization, could still feed such numbers—and feed them better than is the lot of two-thirds of the population now. It cannot be done by the thoughtless exploitation of nature; that would mean merely destroying the prospects of future generations. It can, however, be done by the wise application of the knowledge we have and the knowledge we are acquiring.

A wise man has said, "Live as if you would die tomorrow; farm as if you would live forever."

Band 3 MILLIONS OF MEN WITH TEASPOONS

THE USUAL CROWD OF ONLOOKERS were gathered round the rim of a city-crater. The giant excavator was scooping out the deep foundations of the building-to-be. Its iron jaws were biting off rocks and rubble by the tons and spewing them into enormous trucks. This was in The Years of the Bread Line.

Said one unemployed man, bitterly: "If it wasn't for that blankety-blank machine, there would be work for hundreds of men with picks and shovels."

Said another bystander: "Or for millions of men with teaspoons."

I recalled this incident when I was in the mountains of Central Java. The scene was vastly different. There, under the equatorial sun, naked brown bodies were sweltering in the heat, cutting a canal, which, eventually, would be forty miles long. They had no equipment except their own muscles, mattocks and scoops, hammers and chisels. In this way, the Babylonian slaves must have cut the Hillah Canal, diverting the Euphrates. With such freaks of muscular effort, the Javanese ancestors of the present-day workers must have built fabulous Borobudur, the great Hindu pyramid temple in this same region.

When they encountered volcanic rocks, they just chiseled their way through. They would chip the rock and then drive in wedges to rive it apart. Then they would break it into pieces small enough for the bearers to carry away on their heads. They filled baskets with spoil and, like copper-colored gnomes in some weird fairy tale, the bearers would scamper up the long, swaying bamboo ladders to tip their few pounds of muck and scurry back again. In a year they had advanced two miles through the volcanic mountains.

Modern science had given them one thing—the health and strength to undertake this strenuous enterprise. For there, in the mountains of Kulumprogo, seven out of every ten people had been afflicted with that dreadful disease, yaws, or frambesia. One injection of penicillin could drive the disease out of their bodies, allow the ulcerous scars tc heal and give them new strength and new purpose. And part of that purpose was to bring rice into those thirsty mountains where the staple diet was cassava and plantains. This canal along the mountains was to bring the water which would cascade down the hillsides flooding the terraces where the rice would grow.

But I thought that modern science ought to give them more than just physical well-being; it ought to give them gelignite to shift, in minutes, the rocks which it took weeks to chisel and break; it might have given them bulldozers to shift that muck and conveyor belts to replace those scurrying bearers. And I protested in those terms to the United Nations officials with whom I was dealing, but one of them, a good scientist and a wise man, scolded me. "Don't even suggest it!" he said. "This is *their* canal. For the first time, they will have something they do not owe to the moneylenders, who have held whole generations in pawn. If you were to make the offer of equipment, they would never believe you were disinterested; they'd think it just another device of the moneylenders. No, let them make it their way. It is their fulfillment."

TO THE WESTERN WORKER ON THE BREAD LINE, the Machine was the first threat to his livelihood; to those Javanese peasants, had they but known it, the Machine could have provided their livelihood and given them, more quickly, the rice they so desperately wanted and needed.

And, of course, the remark about "millions of men with teaspoons" was justified; the relevance of men to the machines is relative. There can be no turning the clock back (or even turning the clock into a sandglass), because a technological civilization has changed its sense of values and its proportionate measurements.

Band 4 RIP VAN WINKLE COMES TO TOWN

CONSIDER THE CHANGES WHICH Rip Van Winkle would see if, having drunk an extra-strong potion in the Catskills a hundred years ago, he were to wake up in the world of today.

When he went to sleep, modern science and nineteenth century technology were barely hinting at the marvels to come. There were "iron horses," the steam locomotives, riding the trails to the West, in spite of the pulpit denunciations of them because they had not been foretold in the Bible. There were steamboats plying the Hudson, a venture once derided as "Fulton's Folly." There was the telegraph, although when Morse ten years before had asked for a government appropriation of $30,000 for an experimental line, he got it by a margin of only eight votes, because some of the opposition wanted to give an allocation to mesmerism instead. There was gaslight in the cities, although William Murdock (another member of The Lunar Society) had been described by Sir Walter Scott as "that madman who is proposing to light the streets of London with smoke!" If Rip used oil lamps in the Catskills, the fuel would be either vegetable oils or whale oil, because kerosene and Drake's oil strike in Pennsylvania were still to come in 1859.

There were no electric generators nor electric lamps; the first skyscraper (Home Insurance Building, Chicago) was still thirty years off, waiting for constructional steel and elevators to be developed; no bicycles; no automobiles; no streetcars; no airplanes; no telephones; no phonographs; no celluloid for film and no movies; no talkies; no television; no X-ray photographs; no general use of anesthetics (doctors were still skeptical about Long, Morton, Warren and Simpson, who had adventured with ether and chloroform in the 1840's); no germs, as far as doctors knew, and so no antiseptics; no proper sewage systems nor purified water; no artificial fibers nor artificial textiles; no plastics, except vulcanized rubber; no refrigerators; no vacuum cleaners; no newsprint from wood; no dynamite; and, of course, no atom bomb.

Imagine Rip Van Winkle being found in a long-forgotten clearing, by a forest ranger, who, of course, has a walkie-talkie radio with which to call the nearest town. "Here's a guy with a long white beard," he says. "Got a keg. I reckon he's a moonshiner. Mighty queer though: he keeps asking how Franklin Pierce is making out as President. . . ." The Associated Press "stringer" in the town would (of course) realize at once that this was Rip Van Winkle. He would flash the news to New York. Within a couple of hours a flock of helicopters are dropping in on that clearing. Only to find that an enterprising television scout has already parachuted from a jet plane and put Rip Van Winkle under contract.

Before Rip is properly awake from his century sleep, he is circling round the Empire State Building in a helicopter and descending on Manhattan.

"And what, Mr. Van Winkle, do you think of our high-speed civilization?" says the television reporter, pointing to the streets of New York with the automobiles jammed, immovably, bumper to bumper.

When they land, he is snatched by a waiting ambulance and rushed, with a siren escort, to the hospital where he, the living proof of hibernation, is "given the works"—but the whole works—the sphygmomanometer, to check his blood pressure; the electroencephalograph to check his brain waves; the electrocardiograph to check his heart; scopolamine and the lie detector to check his story. He is X-rayed and blood-tested. The pathologists, physiologists, endocrinologists, ophthalmologists, bacteriologists, microbiologists, cytologists, gerontologists, hematologists, osteologists, trichologists, and, naturally, the psychiatrists, all want to examine this rare specimen and, if possible, get a bit of it.

Before he is entirely vivisected, Rip Van Winkle is rescued by the attorney of the television company, waving the contract like a writ of *habeas corpus*. Twenty sponsors are already competing, including the Methuselah Vitapill Corporation; the Deepsleep Narcotics Company; Catskill Applejack Inc.; the In-Death-As-In-Life Embalmers; the Samson Hair-Restorer Corp.; and the Delilah Depilatory Corporation.

Having survived the helicopter, the ambulance and the hospital check-over, he barely survives the high-speed elevator to the forty-seventh floor and the shock of seeing and hearing himself on the television playback of the film-and-sound record of his rescue. And when he makes his studio appearance, he is more appalled by the artificial suns, in the form of electric arc lights, than by the cameras and the microphone which mean nothing at all to him. Nor can he conceivably imagine that he is being seen three thousand miles away on a coast-to-coast hookup.

After that, he does The Town. He eats ice cream for the first time, and food cooked by high frequencies or brought out of Deepfreeze. The soda jerk fascinates him even more than the subway, and pressure cooking more than the automatic telephone exchange. He has his beard permanently waved. He sees himself on 3-D, shaking hands with a phenomenon which did not exist a hundred years ago—the glamorous film star. He is taken shopping to buy suits made of artificial wool and socks made of nylon. He does not really believe them when they tell him his transparent raincoat is made of coal. In the stores he sees textiles undreamt of a century ago and colors unconceived (Perkin had not then discovered synthetic dyes). He smells odors which did not exist a hundred years ago—scents rapturously redolent of flowers but from coal just the same, and the lung-rotting fumes from car exhausts.

Plumbing fascinates him. He amuses himself for hours just flushing the toilet or running the hot-and-cold into the bath and making rain with the shower. He does not understand how his hotel room can be hot without a fire, nor the mysteries of air conditioning, nor how, when he presses a button an elevator comes up, nor the radio announcer whose voice comes into his room when he turns a knob. Nor can he understand how electric heat which grills a chop can also produce ice cubes out of a refrigerator.

They take down his Catskill Dutch conversation on a wire recorder and a typist (shameless hussy!) transcribes it on a typewriter. As a "visiting fireman" from another century he, of course, has to see a newspaper office with news being teleprinted every minute from every corner of the world, telephotos arriving from Tokyo, telephone calls from every part of the earth and the thundering rotaries swallowing miles of newsprint. He sees color printing, color movies and color television.

Of course, he is fascinated by the neon signs and moving lights, but the radiation countersignaling the flying particles of the splitting atom impresses him less than a pin-table. A jukebox enthralls him; the electronic computer leaves him cold. (This "brain," they tell him, can do in a few seconds mathematical equations which would take Ph.D.'s months or years, but since Rip could never count anyway. . . .) They fly him—for a stunt—across the Atlantic and back the same day, but he prefers Coney Island Fun-Fair.

They show him machines smashing down buildings and helping to put them up again. There is the grab which scoops up tons of muck at a bite and a bulldozer which (they tell him, but he does not believe them) is pushed by a hundred and fifty invisible horses. He sees pneumatic drills and welding machines and skyscrapers cased in glass.

Twenty million televiewers see him being introduced into the twentieth century home, with its vacuum cleaners, washing machines, launderettes, refrigerators, television, electric sewing machines and meals-in-a-minute out of cans. And hear him being asked what Mrs. Rip Van Winkle would have thought of that. But they do not hear his reply because he is too busy playing with Junior's space-gun.

This strange eventful history of a man who went to sleep in the mid-nineteenth century and woke up in the mid-twentieth could go on indefinitely. We could take him into atom factories and down into submarines and up into the stratosphere. We could, but unfortunately Nature has supervened. Rip Van Winkle could not endure the strains and stresses of this hectic age. So after a month of modern life, supercharged in his case by glandular injections, special diets, vitamin cocktails and the like, he died. The necropsy found that trademark of the twentieth century, the duodenal ulcer, but not far enough gone to account for death. The truth was probably that he died of the shock of Civil Defense rehearsal for an atom-bomb raid.

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