



THE VISITING SCHOLAR PROGRAM, 1977-1978 by Kathy Navascues

When the Visiting Scholar Program was established twenty years ago, five Scholars traveled to 29 colleges and universities which housed chapters of Phi Beta Kappa. After two decades the Visiting Scholar panel has more than doubled in size and the number of visits has increased three-fold, attesting to the enthusiastic response of the chapters to a program which enables students to meet and talk with outstanding men and women in a variety of disciplines.

Each year the United Chapters through its six-member Visiting Scholar Committee invites from ten to fourteen men and women to make a series of two-day engagements. Announcement of the panel is made to the 225 Phi Beta Kappa chapters as well as the department chairman in each Scholar's field. As the chapters' requests are received, Scholars' itineraries are set up in the national office, with priority given to those chapters at institutions not located in major urban centers or where opportunities for visits of this kind are not abundant. Visiting Scholar engagements vary from campus to campus, but the focus of each two-day visit is on formal and informal contact with as many undergraduate students as possible. Typical schedules call for one public lecture and four or five other appearances with an emphasis on classroom and informal discussion. Comments received from the chapters point up the contribution which the Visiting Scholar Program makes to the intellectual life of the entire academic community. It is anticipated that 85 to 90 visits will be made during the 1977-78 academic year.

Thirteen distinguished men and women will participate in the program next year.

CLARENCE R. ALLEN, professor of geology and geophysics at the California Institute of Technology, has served as president of the Geological Society of America and the Seismological Society of America.

HAZEL E. BARNES is the author of *An Existentialist Ethics* and *The*

Meddling Gods: Four Essays on Classical Themes. At the University of Colorado she is professor of classics and integrated studies.

WAYNE C. BOOTH, Distinguished Service Pullman Professor of English at the University of Chicago, is the author of *The Rhetoric of Fiction*, winner of Phi Beta Kappa's 1962 Christian Gauss Award.

E. MARGARET BURBIDGE is president of the American Astronomical Society and professor of astronomy at the University of California, San Diego. She was director of the Royal Greenwich Observatory, England, in 1972-73.

ROSS LEE FINNEY, recipient of the Pulitzer Prize and the Boston Symphony Award, was professor of composition and composer in residence at the University of Michigan from 1948-74.

CHARLES J. HITCH, president of Resources for the Future, was professor of economics at Berkeley and vice president and president of the University of California.

MILTON KATZ is Stimson Professor of Law and director of International Legal Studies at Harvard University.

He is also chairman of the Carnegie Endowment for International Peace.

EDWARD H. LEVI, former U.S. Attorney General, was president of the University of Chicago from 1968-1975, where he is now Lloyd Distinguished Service Professor of Law.

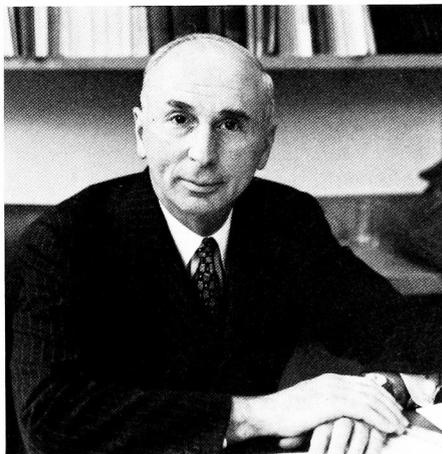
MATTHEW S. MESELSON, who has received the Lilly Award in Microbiology and Immunology, is professor of biochemistry and molecular biology at Harvard University.

J. HILLIS MILLER, who has published widely on 19th and 20th century poetry and fiction, is Hilles Professor of English and chairman of the department at Yale University.

NEWTON N. MINOW, author of *Equal Time: The Private Broadcaster and the Public Interest*, was chairman of the FCC from 1961-63, and is presently a member of the Chicago firm of Sidley & Austin.

LEWIS THOMAS, M.D., is president of the Memorial Sloan-Kettering Cancer Center. His book, *The Lives of a Cell*, won the 1974 National Book Award in Arts and Letters.

WILLIAM B. WILLCOX is professor emeritus of history and editor of *The Papers of Benjamin Franklin* at Yale University.



Milton Katz



E. Margaret Burbidge

THE NEXT INDUSTRIAL REVOLUTION by Freeman J. Dyson

Industrial revolutions are unpopular these days. In the United States many people woke up only recently to the bad effects of industrialization, but in other countries people were aware of these evils earlier. Aimé Césaire, a French black poet, said over twenty-five years ago what so many young Americans are feeling today:

“Mercy, mercy for our naive and omniscient conquerors.
Hurray for those who never invented anything,
Hurray for those who never explored anything,
Hurray for those who never conquered anything,
 Hurray for joy,
 Hurray for love,
Hurray for the pain of incarnate tears.”

I have to confess that I am excluded from the poet's blessing. I did once invent something. I have my name on the patent for a nuclear reactor which I helped to build over twenty years ago. The idea was to design a megawatt reactor which was so inherently safe that you could give it to a group of school children to play with and not worry about them hurting themselves. The reactor actually functioned well. The company I worked for sold fifty of them, which is not bad as the reactor business goes. A few years ago some people at Columbia University announced that they would buy one of these reactors and install it on campus for their nuclear engineering students. Immediately they were faced with massive protests from various indignant citizens of New York City. My name on the patent did not help. The citizens of New York City do not like to live that close to a reactor, even when it is certified harmless and fool-proof by a theoretical physicist from Princeton.

In 1955, when the technology of nuclear reactors was suddenly declassified, scientists like me, who had had nothing to do with the earlier secret work in the bomb projects, were suddenly free to move in. We were invited to come and see if we could help make something peaceful and beneficent out of nuclear energy. That is how I came to partially invent a reactor. It looked like a golden opportunity to help mankind with science. Here was a brand-new, immensely powerful and worldwide source of energy. All we had to

do was to make the production of nuclear energy cheap, safe, and abundant, and the age-old curse of poverty would vanish all over the earth. There was much talk of making deserts bloom and planting wheat over the arctic tundra. It seemed to us scientists at that time that the main problem with nuclear energy in the long run would be the problem of safety. We were not unaware of the shadow of fear that reactors trail behind them. We knew that a major accident in a major reactor would be a catastrophe, not only for thousands of people who might die miserably of radiation sickness but also for the future of the reactor business. So we decided as a matter of first priority to build a hundred-percent safe reactor. I think I have never experienced any greater feeling of satisfaction in any scientific work I have done than I felt in designing that reactor. The safe reactor was a technical success, and even a commercial success too. We felt proud that we had contributed substantially to the second industrial revolution, the nuclear-energy revolution. Clean, silent, safe and inconspicuous, the great power reactors would spread over the earth. With cheap electricity they would also spread prosperity and peace.



What went wrong with these visions? Why has the second industrial revolution not yet happened? Part of the answer is that twenty years or so is too short a time over which to judge a historical development of this magnitude. Reactors are spreading over the earth and are producing important effects whose shape cannot yet be clearly seen. However, even the most enthusiastic believer in reactors has to admit that the effects of nuclear energy have been less spectacular than we hoped. Briefly, the main reason we failed to produce the second industrial revolution is that we were defeated by the laws of economics. We succeeded rather well in making reactors clean and safe. We did not succeed in making them cheap. If they are not cheap they are of little use to a poor society.

So much for dreams. If nuclear energy cannot produce an industrial revolution, is there any other technological force that can do it? I believe there is and that we shall be faced during the next century with a technology which is truly revolutionary. By this I mean that, instead of stumbling against the laws of economics, it will change the rules by which economists think. Instead of stumbling against the laws of ecology, it will operate from the beginning in an ecological frame of reference. The new technology must grow out of an understanding and mastery of the basic processes of biology, just as our existing technology grew out of a mastery of the processes of chemistry and physics.

The idea that the second industrial revolution will be based on biology is not new. Wells and Haldane were saying this fifty years ago, and today our understanding of biological principles already goes far beyond anything that Wells and Haldane imagined. We are now in a position to speculate in some detail about the specific problems that a mastery of biological technology will bring with it. Our understanding of the human situation is grossly inadequate if it does not take such possibilities into account.

The word “scenario” is not the right one for the deliberately oversimplified sketches of future events that I shall describe. The right word is unfortunately familiar only to physicists, and it is “thought-experiment.” The “thought-experiment” was invented by physicists as a device for clarifying their ideas. The purpose is to invent an imaginary situation in which the logical contradictions or absurdities inherent in some proposed theory are revealed as sharply as possible. As theories become more sophisticated, the thought-experiment becomes more and more useful as a tool for weeding out bad theories and for reaching a more profound understanding of good ones. When a thought-experiment shows that generally accepted ideas are logically self-contradictory, it is called a “paradox.” A large part of the progress of physics during this century has resulted from the discovery of paradoxes and their use as a critique of theory. A thought-experiment is often more illuminating than a real experiment, besides being a great deal cheaper. The design of thought-experiments in physics has become a form of art in which Einstein was the supreme master.

The basic idea of my first thought-experiment was published in an article in *Scientific American* over twenty

Professor Dyson, a theoretical physicist at the Institute for Advanced Study at Princeton, was a Φ BK Visiting Scholar in 1975.



years ago by the mathematician Edward Moore. It was called "Artificial Living Plants," but a more exact title would have been "Artificial Protozoa." Edward Moore is however not responsible for the use which I am making of his article in what follows. The thought-experiment begins with the launching of a peculiar-looking flat-bottomed boat from an inconspicuous shipyard belonging to the RUR Company on the north-west coast of Australia. RUR stands for "Rossum's Universal Robots," a company with a long and distinguished history. The boat moves slowly out to sea and out of sight. A month later, somewhere in the Indian Ocean, two boats appear where one was before. The original boat carried within itself a miniature factory with all the necessary equipment, plus a computer program which enables it to construct a complete replica of itself. The replica contains everything that was in the original boat, including the factory and a copy of the computer program. The construction materials are mainly carbon, oxygen, hydrogen and nitrogen, obtained from air and water, and converted into high-strength plastics by the energy of sunlight. Metallic parts are mainly constructed of magnesium which occurs in high abundance in seawater. Other elements which occur in low abundance are used more sparingly as required. It is easy to calculate that after one year there will be a thousand boats, after two years a million, after three years a billion, and so on. It is a population explosion running at a rate several hundred times faster than our own.

The RUR Company did not launch this boat with its expensive cargo just for fun. In addition to the automatic factory, each boat carries a large tank which it gradually fills with fresh water separated by solar energy from the sea. It is also prepared to use rain-water as a bonus when available. The RUR Company has established a number of pumping stations at convenient places around the coast of Australia, each equipped with a radio beacon. Any boat with a full cargo of fresh water is programmed to proceed to the nearest pumping-station, where it is quickly pumped dry and sent on its way. After three years, when the boats are dispersed over all the earth's oceans, the RUR Company invites all maritime cities in need of pure water to make use of its services. Up and down the coasts of California and Africa and Peru, pumping stations are built and royalties flow into the coffers of the RUR Company. Deserts begin to bloom — but I think we have heard that phrase before in connection with

nuclear energy. Where is the catch this time?

Let us now analyze this thought-experiment carefully. It does contain, although in over-simplified form, a genuine paradox. The paradox lies in the fact that the RUR Company builds a finite piece of hardware which costs a finite amount of money, and seems to obtain in a few years an infinite pay-off. This result is in conflict with all the traditional rules of economics and social theory, which tell us that every increase in wealth has to be paid for at a stiff price. Of course the pay-off to the RUR Company is not really infinite, but the rate of growth of their capital investment is so enormous that it seems to contradict all the usual economic limitations. Human experience until now has taught us that a society can at best double its aggregate capital wealth in a period of decades or longer. The mastery of a biological technology which could double our capital in a month would mean that economics as it now exists would become meaningless.



Where is then the catch? There are two obvious snags in this thought-experiment. The first snag is the same one which we encountered in the nuclear energy problem. Artificial plants may provide us with a free supply of pure water, but it still costs money to use it. Just pumping fresh water onto a desert does not create a garden. In most of the desert areas of the world, even an abundance of fresh water will not rapidly produce wealth. To use the water one needs aqueducts, pumps, pipes, houses and farms, skilled farmers and engineers, all the commodities which will still grow with a doubling-time measured in decades rather than in months. The second and more basic snag of the RUR project is the ecological snag. The artificial plants have no natural predators. In the third year of its operation, the RUR Company is involved in lawsuits with several shipping companies whose traffic the RUR boats are impeding. In the fifth year, the RUR boats are spread thick over the surface of almost all the earth's oceans. In the sixth year, the coasts of every continent are piled high with wreckages

of RUR boats destroyed in ocean storms or in collisions. By this time, it is clear to everybody that the RUR project is an ecological disaster, and further experiments with artificial plants are prohibited by international agreement. But fortunately, the prohibition does not extend to thought-experiments.

Let us then try another thought-experiment. The RUR Company has built a small self-reproducing automaton well-adapted to function in terrestrial deserts. It builds itself mainly out of silicon and aluminum which it can extract from ordinary rocks wherever it happens to be. It can extract from the driest desert air sufficient moisture for its internal needs. Its source of energy is again sunlight. Its output is electricity, which it produces with modest efficiency, together with transmission-lines to deliver the electricity wherever you happen to need it. The basic hardware components, the factory and the computer, are more or less the same in the rock-eating automaton as they were in the RUR boats. But the software, the computer program, is now enormously more sophisticated. The software of the RUR boat was like the DNA of a single-celled organism, a bacterium or an amoeba, which provides instructions to the organism only to produce an exact copy of itself. That is why I said the boat should have been called an "artificial protozoa" rather than an artificial living plant. When it is let loose in the ocean it does not know any better than to breed and multiply like a bug in a rotten apple. In contrast to this, the prototype rock-eating automaton is the fertilized egg-cell of a higher organism. The computer program of the rock-eater is like the DNA in a bird's egg. The program instructs the rock-eater to differentiate in a controlled way as it multiplies. It contains the blue-prints for building every one of its descendants, together with an elaborate switching system which ensures that descendants of many different kinds grow and function in a coordinated fashion. The fully developed colony of rock-eaters becomes as well integrated as the cells of a bird. There are automata with specialized functions corresponding to muscle, liver and nerve-cell. There are high-quality sense-organs, and a central battery of computer units performing the functions of a brain.

There is bitter debate in Congress over licensing the prototype rock-eater to proliferate over our Western states. The progeny of this one machine can easily produce a hundred times the present total power output of the

United States, but nobody can claim that it enhances the beauty of the desert landscape. In the end, the debate is won by the anti-pollution lobby. Both of the alternative sources of power, fossil fuels and nuclear energy, are by this time running into severe pollution problems. Quite apart from the chemical and radioactive pollution which they cause, new power-plants of both kinds are adding to the burden of waste heat which becomes increasingly destructive to the environment. Already by the year 2076 the Pacific coast from San Diego to Seattle is lined with power-stations at an average density of two per mile, to take advantage of the heat-absorbing capacity of the ocean. In contrast to all this, the rock-eating automaton generates no waste heat at all. It merely uses the energy which would otherwise heat the desert air and converts some of it into useful form. It also creates no smog and no radioactivity. Legislation is finally passed, authorizing the automaton to multiply, with the proviso that each machine shall retain a memory of the natural landscape at its site, and if for any reason the site is abandoned the machine is programmed to restore it to its original appearance.

Is it reasonable to postulate that a machine with such sophisticated capabilities for differentiation and specialization could reproduce itself in a time as short as a month? Of course, we do not know the answer to this question. We do not know even in principle the complete list of conceptual components which an automaton must contain in order to serve as the germ-cell for a higher organism. All we know is that higher organisms do grow from germ-cells in a remarkably short time. From a bird to an egg to a bird is a generation-time of a year, but this is the time it takes to reproduce a complete bird. From an egg to a bird is thirty or forty generations of cells so that the generation-time for individual cells of a higher organism is at most a few days. It seems that there is no inherent organizational limitation which would compel the generation-time of an artificial self-reproducing automaton to be as long as a month. The generation-time will probably be determined by physical rather than organizational factors. The thing will take time, using a modest input of energy, to process its raw material and fabricate all the parts necessary for its reproduction. The time will be shorter, the more closely its manufacturing processes can mimic biological rather than industrial patterns. I expect that the principles of embryonic development will be understood, both

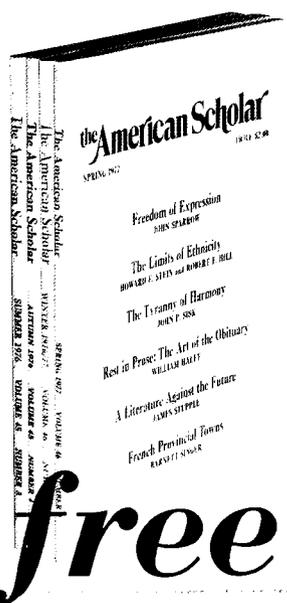
from the experimental and the theoretical side, during the next fifty years. When we have seen how Nature solved the problem of organization of the growth of a higher organism, we shall probably be able to adapt her methods to our purposes. I conclude that it is not absurd in the context of a thought-experiment to think of a month as the generation-time of even the most sophisticated automaton. This would mean that a world-wide system of machines could grow from a prototype egg-machine to full-scale operation within a few years.

My third thought-experiment is merely a generalized version of the second. After its success with the rock-eating automaton in the United States, the RUR Company places on the market an industrial development kit, designed for the needs of developing countries. For a small down payment, a country can buy an egg-machine which will mature within a few years into a complete system of basic industries together with the associated transportation and communication networks. The thing is custom-made to suit the specifications of the purchaser. The vendor's guarantee is conditional only on the purchaser excluding human population from the construction area during the period of growth of the system. After the system is complete, the purchaser is free to interfere with its operation or to modify it as he sees fit.

Another successful venture of the RUR Company is the urban-renewal kit. When a city finds itself in bad shape aesthetically or economically, it needs only to assemble a group of architects and town-planners to work out a design for its rebuilding. The urban-renewal kit will then be programmed to do the job for a fixed fee.

I do not pretend to know what the possibility of such rapid development of industries and reconstruction of cities will do to human values and institutions. On the negative side, the inhuman scale and speed of these operations will still further alienate the majority of the population from the minority which controls the machinery. Urban renewal will remain a hateful thing to people whose homes are displaced by it. On the positive side, the new technology will make most of our present-day economic problems disappear. The majority of the population will not need to concern themselves at all with the production and distribution of material goods. Most people will be glad to leave economic worries to the computer

(continued on back cover)



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natural sciences

FREDERICK J. CROSSON

The Philosophy of Karl Popper. Robert John Ackermann. Massachusetts. \$15. This excellent study of one of the keenest philosophers of science of this century keeps to the narrow path between criticism and appreciation, making its critical points within a possible Popperian framework. The untenability of the positivist criterion of verification as the test of scientific theories led many to follow Popper's theory of falsification as an alternative, but historians of science have come up with enough counter-examples to force either ad hoc reformulations or similar abandonment. Ackermann concedes the weight of the objections but thinks that a more sophisticated falsificationism may be viable. He confronts the difficulties candidly and is unsparing himself on Popper's weak areas, e.g., his social and political philosophy. A couple of chapters are technical, but the whole is readable and rewarding.

The Mind of William Paley. D L. LeMahieu. Nebraska. \$12.95.

Throughout the nineteenth century, Paley's works were second only to Newton's in formative influence on British universities and their progeny. His **Natural Theology**, though written a quarter century after Hume's criticism, formulated the argument from design in a way which made it seem the partner of science. It crystallized and reflected a consensus among British intellectuals which perdured well past Darwin. This felicitous biography of the man and his works makes us realize how long ago and far away that was.

The Restructuring of Social and Political Theory. Richard J. Bernstein. Harcourt Brace Jovanovich. \$17.95.

An important book which ought to be read by any political or social scientist who recognizes the need to understand how we understand social phenomena. Bernstein's aim is to discover how social science can be scientific without being Procrustean. To that end he surveys three approaches which are critical of a behavioral model: the "Anglo-Saxon," phenomenological and critical theory groups. Focusing primarily on Winch, Schutz and Habermas respectively, he extricates from each what he thinks viable and presents a programmatic synthesis by way of conclusion. The exposition and criticism of each position is deft and lucid, and the overall view of the state of the question maps our current situation in bold relief.

Modal Thinking. Alan R. White. Cornell. \$12.50.

As soon as discourse leaves what is simply the case, it begins to modalize, to

add auxiliaries to the verbs in order to say how the predicate is related to the subject. No philosophical problem can be discussed without using modals, and logicians have been working at formalizing them for long now. This solid piece of work takes its bearings from use, correcting grammarians as well as logicians as it palpates the meaning of five basic modals and some related ones. It demands close attention, but it is careful and keen-eyed and no subject is more fundamental for philosophizing.

Religions in Four Dimensions: Existential, Aesthetic, Historical, Comparative. Walter Kaufmann. Readers Digest. \$30.

A guided tour of the higher religions is not the best arena for the critical intelligence and aesthetic sense of Kaufmann. There is just too much encyclopedia-type content necessary for the general reader. Still, he brings his usual fresh and direct approach to texts weighted down by scholarship, and the inclusion of some 250 photographs taken by him (the majority of them in color) provides a moving counterpoint to the words. The pictures are about people as much as icons and temples, and some of them, especially of individual women and children in India, remain in one's mind after the words fade away. Israel and its concern for social justice serves as a recurrent standard of comparison for the other religions, which seem to Kaufmann often to lose themselves in narrow-minded and intolerant divisiveness and to care more for religion than for man. Taken as a whole, this handsome and sometimes sardonic volume—some 500 pages—says as much about its author as about its subject.

RUSSELL B. STEVENS

Appalachian Wilderness: The Great Smoky Mountains. Eliot Porter. Promontory Press. \$12.95.

Potomac: The Nation's River. Frank Graham, Jr. Lippincott. \$15.95.

The Adirondacks. Clyde H. Smith. Viking. \$15.95.

Inside Passage. Bern Keating. Doubleday. \$19.95.

The Desert. Russell D. Butcher. Viking. \$17.50.

These five books — and one could find five more without difficulty — represent a type that is characteristic of the age. In each case, perhaps, the text is less important than the illustrations, and it varies much more in quality. Keating's account of the inland waterway to Alaska is done with a light touch that makes it highly readable; Graham's account of the Potomac provides a number of interesting historical insights, but is marred in my view by too-often bemoaning the events of the past. Eliot Porter provides a rather impressionistic view of the Appalachians,

but an effective one; for my taste Clyde Smith's text on the Adirondacks leans too heavily on a first-person account of adventure. Finally, Butcher encounters a little difficulty in bringing his story of the desert to life.

The Selfish Gene. Richard Dawkins. Oxford. \$8.95.

One need not be a trained geneticist to read this volume with profit and — in light of Dawkins' style — very considerable pleasure. It should be read in its entirety, for the argument builds throughout and cannot fairly be judged from a partial view. Whether one agrees with the central thesis or not, the book will most certainly provoke serious thought and a re-examination of many convictions that may have been comfortably held in the past. In the course of reaffirming Darwinian evolution in a modern context, Dawkins takes issue with more than a few social theories.

The Bluebird. Lawrence Zeleny. Indiana. \$7.95.

For that generation whose childhood was spent in the relatively rural America of the 1910's and 20's, the bluebird has a nostalgic attraction equalled by few wild-life species. Not many of us have even seen one for more than a decade. Zeleny has made a near life-work of fostering the return of the bluebird by writing, lecturing, promoting the erection of nesting boxes, and so on. From that standpoint his small text is a welcome and convenient summary. From a strictly scientific standpoint, however, it is a bit disappointing in that it really fails, in the final analysis, to explain the mystery of the bird's disappearance. Quite possibly, of course, the answers are just not yet available.

Human Experimentation. Ed. Robert L. Bogomolny. Southern Methodist. \$7.95. This is a symposium proceedings containing 11 summary papers addressing many aspects of the very complex and controversial issue of human experimentation — legal, scientific, ethical, and so on. By no means all of the participants are scientists, as indeed must be the case if the subject is to be broadly handled. The writing is just a bit uneven, but is generally of high caliber and thought provoking; it is not a book that can be read quickly, but it is both very timely and very well worth the time.

Man and Natural Resources. Cedric Stanton Hicks. St. Martin's. \$16.95. The author speaks of this short, and very expensive, book as having "an agricultural perspective." And so in a sense it does, revealing a substantial scholarship on the part of Sir Cedric, an emeritus faculty member of the University of Adelaide. The illustrations chosen to document environmental deterioration are persuasive and filled with interesting information. But the potential reader should be warned that the view taken is strongly pessimistic; even beyond that, the author very often adopts an accusatory tone, as though the damage done by human societies in the past were purposeful and malicious.

LEONARD W. DOOB

The Spaceflight Revolution: A Sociological Study. William Sims Bainbridge. Wiley. \$16.95.

A sober, historical account of how the development of rockets, originating in man's imagination and propelled into reality by death-seeking competition during World War II, eventually led to the exciting exploration of space. These achievements have generated lay interest in science (a "subculture") and occult phenomena ("paraphysics" and flying saucers). Why "a sociological study?" Theories concerning social change are needed to embrace the data. Wernher von Braun and his colleagues allegedly believe that because "the stars are out there, they must exist to be visited and brought into man's realm"; if they are not "reached, either the stars are absurd or we are absurd." I wonder.

The Damnable Question: A Study in Anglo-Irish Relations. George Dangerfield. Little, Brown. \$14.95.

A very detailed, gripping description and analysis of the events, persons, and circumstances which finally enabled Ireland, "this most perplexing and damnable country," to achieve independence from Britain. The phrase comes from the British Prime Minister, Mr. Asquith, whose troops did not halt but reinforced the spirit of freedom by quelling the Easter Sunday rebellion in 1916. His successors continue to be plagued by Ulster in the midst of the current economic crisis, even as Lloyd George had to cope with Irish patriots during World War I. Nowadays the evils of colonialism are seriously if glibly acknowledged, but this account is especially noteworthy because it focuses so clearly not only on the political but also on the economic and literary consequences of futile repression.

Lonely in America. Suzanne Gordon. Simon & Schuster. \$8.95.

A journalistic, yet documented description of the anomie and alienation that pervade the lives of many Americans because they are children, adolescents, single, married, divorced, suburbanites, urbanites, aging, or aged — in brief, because they are human beings living in this particular era. The pages are crowded with many anecdotes and a few case histories drawn largely, it seems, from the East and West Coasts of the United States. The pathetic attempts being made to combat such a condition on the individual and commercial levels — for example, bars and communities for swingers and singles — are fully portrayed. The climax of this breezy analysis is an astute critique of extremist encounter and sensitivity-training groups.

Sociology as an Art Form. Robert Nisbet. Oxford. \$8.95.

An elegantly argued essay which suggests that the truly significant concepts of modern sociology (such as power, status, conflict, anomie) as well as the compellingly sociological insights into our milieu and particularly into influential types or persons of any age have been achieved

not rigorously but intuitively and creatively in the manner of the artist. As a result, striking parallels are ingeniously engineered, between the "themes and styles," the "landscapes," the "portraits," and the conceptualization of nature or change which sociologists and artists would depict. Dickens and Marx, for example, are shown to be not too dissimilar. The explanation of a tour de force pointing to the striking interactions between sociology and art must result from the fact that the craftsmen in both intellectual camps compellingly reflect the same Zeitgeist.

Human Behavior and Public Policy: A Political Psychology. Marshall Segall. Pergamon. \$9.50.

A calm, scholarly, honest, above all laudable attempt to salvage from modern psychology the research and theories that seek sincerely to alleviate and to systematize problems associated with the potential capacities of ethnic groups, compensatory education, prejudice and hate, females vs. males, violence, and war. Of course our knowledge is incomplete and panaceas do not exist except in the spinal cords of crusaders. Many of the horrors engulfing us, however, the author views in hopeful perspective: he is temperamentally optimistic and perennially genial, and he believes that truth can set us at least a little freer. Social scientists may possibly feel encouraged when they discover here what they have been accomplishing.

ROBERT B. HEILMAN

Between Paris and St. Petersburg: Selected Diaries of Zinaida Hippus. Ed. & trans. Temira Pachmuss. Illinois. \$12.50.

Hippus, the wife of D. S. Merezhkovsky, was a poet, literary critic, journalist, a religious and political idealist, and later an anti-Communist exile. Charming, sometimes hazy or ambiguous in ideas (those related to sexual and religious feeling), energetic, a cultural leader, she writes fully of inner life and of numerous major Russian figures, 1893-1940.

Journeying. Nikos Kazantzakis. Trans. Themis and Theodora Vasils. Little, Brown. p. \$7.50.

The diaries (written 1927, revised 1955) of travels to religious sites (Pyramids, Sinai, Jerusalem, Paphos in Cyprus) are imaginative, reflective, often moving. They subtly compare Hebraic with Hellenic and Moslem feeling; observe Jewish and Arab modern developments; and predict historic turns in the Near East and in East-West balance.

"Kubla Khan" and "The Fall of Jerusalem": The Mythological School in Biblical Criticism and Secular Literature 1770-1880. E. S. Shaffer. Cambridge. \$25.

Shaffer traces the Orientalizing "higher criticism" (the Bible as myth, as historically conditioned) from Germany to England, especially its impact on Coleridge and Eliot. She condemns J. L. Lowes on "Kubla Khan" and directly attacks the standard denigrations of **Daniel Deronda**, for which she makes a striking new case.

Selected Letters of James Joyce. Ed. Richard Ellmann. Viking \$18.95; p. \$5.95.

This excellent selection of the "best letters," including some love-letters to Nora released for the first time, is admirably edited. Ellmann provides a fine general introduction, biographical sketches for each of the major periods, and full annotations. The most frequent recipients are Nora and Stanislaus Joyce, Frank Budgen, and Harriet Shaw Weaver.

Everybody Who Was Anybody: A Biography of Gertrude Stein. Janet Hobhouse. Putnam. \$17.50.

Over 100 illustrations enhance a biography that is strongest in its account of Stein as critic and lover of art. Drawing mainly on secondary sources, Hobhouse amply portrays a complex self-accepted genius, seeker of fame, confident innovator in literary forms and style, Francophile, befriender of GIs, and patriotic expatriate.

The Oresteia. Aeschylus. Trans. Robert Fagles. Viking. \$15.

This translation of the *one extant Greek trilogy* is the first major one in several decades. It combines a colloquial flow with an Aeschylean compactness and hardness. The apparatus (long essay, notes, glossary) by W. B. Stanford (Dublin) is as useful as it is full.

Oscar Wilde: A Biography. H. Montgomery Hyde. Farrar, Straus, & Giroux. \$15. Hyde's biography is very substantial, complete and readable without being spectacular. It contains some new materials, various quotations from lesser known Wilde works, and two score good illustrations.

The Letter of Charles and Mary Lamb. Ed. Edwin W. Marris, Jr. Vol. 1. Letters of Charles Lamb, 1796-1801. Cornell. \$25. Of these 102 letters (scrupulously edited), 41 are to Coleridge, 29 to Thomas Manning the mathematician, 13 to Southey, 4 to Godwin, one to Wordsworth. They reveal a fascinatingly many-sided Lamb — a devoted brother profoundly depressed by Mary's recurrent insanity, a jolly social companion, a witty and imaginative quipster on many subjects, and an independent critic candidly telling poets of faults as well as successes.

Lewis Carroll: Fragments of a Looking-Glass. Jean Gattégno. Trans. Rosemary Sheed. Crowell. \$8.95.

"Fragments" means that Gattégno pictures Carroll not by a chronological record but by 37 topics, such as "Alice," "Juvenilia," "Oxford," "Sexuality," and "Zeno's Paradox," alphabetically arranged. These glossarial entries do in time jell into a reasonably coherent account of a very interesting personality.

The Bedbug and Selected Poetry. Valdimir Mayakovsky. Trans. Max Hayward and George Reavey. Ed. Patricia Blake. Indiana. \$10.50; p. \$2.95.

Nervous People and Other Satires. Mikhail Zoshchenko. Trans. Maria Gordon and Hugh McLean. Ed. Hugh McLean. Indiana. p. \$4.95.

These recent reprints in the Midland Book series make available representative works by Russian writers disenchanting by the Soviet utopia.

RICHARD BEALE DAVIS

Rebellion and Reconciliation: Satirical Prints on the Revolution at Williamsburg.

Joan D. Dolmetsch. Univ. of Virginia Press for Colonial Williamsburg Foundation. \$12.95.

The American Revolution in the West.

George M. Walker. Nelson-Hall. \$10. The Walker book tells the story of the men and women who fought to defend their homesteads on the frontier and to open the Ohio to eventual American settlement. A popular account with brief sketches of major engagements and useful illustrations. The Dolmetsch volume is a fascinating description and reproduction of many of the fine prints, our first cartoons, illustrating various phases, especially the political, of the Revolutionary years. The prints themselves are principally of European origin. There is a model informative introduction by Ms. Dolmetsch. Each cartoon is accompanied by an interesting commentary.

The Papers of Benjamin Franklin, Vol. 20, January 1 to December 31, 1773. Eds. William B. Wilcox et al. Yale. \$20.

The Papers of Henry Laurens, Vol. V, Sept. 1, 1765-July 31, 1768. Eds. George C. Rogers, Jr. et al. South Carolina. \$27.50.

The Papers of John C. Calhoun, Vol. IX, 1824-1825. Ed. M. Edwin Hemphill. South Carolina. \$27.50.

The Calhoun volume covers the conclusion of the statesman's distinguished career as Secretary of War and his ascension to the Vice-Presidency. The Laurens volume shows the South Carolina merchant and developing political figure during a crucial period, when the Stamp Act and the Navigation Acts furors occurred. Benjamin Franklin appears as his well-known multi-faceted self, along with evidence of the growing impact on him of events in Boston and elsewhere in America.

Adams and Jefferson: A Revolutionary Dialogue. Merrill D. Peterson. Mercer University Lamar Lectures, no. 19. Georgia. \$7.

Elbridge Gerry: Founding Father and Republican Statesman. George A. Billias. McGraw-Hill. \$19.95.

New York: The Centennial Years 1676-1976. Ed. Milton M. Klein. Kennikat. \$9.95.

Peterson's beautifully written analysis and interpretation of the familiar and remarkable founders is fresh and useful, with some new insights even for the historian who has read these men and their correspondence many times. Elbridge Gerry, a second-line founding father, has at last his biographer, who sees him as a more complex and significant figure than has been realized. Klein and his associates, all experts in phases of New York history, present succinctly a city's biography by concentrating on the successive centennials.

"Remember the Ladies" Women in America 1750-1815. Linda Grant De Pauw and Conover Hunt. Viking and Pilgrim Society. \$16.95.

Wind on the Buffalo Grass: The Indians' Own Account of the Battle of the Little Big Horn, & the Death of Their Life on the Plains. Collected and edited by Leslie Tillet. Crowell. \$35.

Visions of a Vanishing Race. Edward S. Curtis. Text Florence Curtis Graybill and Victor Boesen. Photograph prepared by Jean-Antony du Lac. Crowell. \$35. Three handsome documentaries of America's past, each including text and profuse illustrations. The book on early American women is subtly and tastefully compiled, with color and black-and-white reproductions from almost every phase of eighteenth-century feminine history. Delightful and most suggestive. The first Indian book is made up basically of the observations of red men who participated in or saw the last great battle with amazingly appropriate drawings and paintings of events. The second Indian book, a new gathering and commentary on the work of perhaps the greatest photographer of western Indians, reproduces from glass plates over 175 "studies" from two or more generations ago.

The Enlightenment in America. Henry F. May. Oxford. \$15.

The Fledging Province: Social and Cultural Life in Colonial Georgia, 1733-1776. Harold E. Davis. North Carolina for the Institute of Early American History and Culture. \$16.95.

Here are two badly needed studies presented in most satisfactory fashion. One may quarrel with May's arbitrary definitions and classifications of kinds of Enlightenment in America, and one may feel that this is in too many ways a survey of the religious mind of early America, but it must be admitted that it has real significance for the whole eighteenth-century picture. Davis' more limited coverage is a most useful presentation.

ANDREW GYORGY

Adolf Hitler. John Toland. Doubleday. \$14.95.

This new biography by John Toland, eminent British historian and author of various recent books on both Nazi Germany and Japan, can be considered part of the "revisionist" literature on Germany's most frightening dictator. While this reviewer completely disagrees with Mr. Toland's perspective of Hitler as a warm and charming human being, the book does reveal novel and previously unused facets of the dictator's life and of the tortured and complex 30's and 40's in Nazi Germany. Despite the misleading human perspective of Hitler, this book is well worth reading although it cannot be compared with William Shirer's **The Decline and Fall of the Third Reich.**

Russia: The People and the Power.

Robert G. Kaiser. Atheneum. \$12.95. Robert G. Kaiser, eminent *Washington Post* correspondent, lived among Soviet citizens for three years and traveled widely throughout the Soviet Union. His study, including many interviews with Soviet citizens, offers a thorough and up-to-date summary of life in the U.S.S.R. For this reviewer the most useful chapters were those dealing with the Soviet political system, the problem of nationalities, and the fascinating survey of the current status of the Soviet intelligentsia.

Special Envoy to Churchill and Stalin, 1941-1946. W. Averell Harriman and Elie

Abel. Random House. \$15.

This "inside" history of Ambassador Harriman's career focuses particularly on the years 1941-1946. As Harriman explains in the Foreword, this particular book covers his close personal association with Winston Churchill and Joseph Stalin and contributes new facets to the generally familiar period of World War II. Chapters XV and XX, dealing respectively with the Warsaw uprising of 1944 and the surrender of Japan, are particularly useful.

Terrorism: From Robespierre to Arafat.

Albert Parry. Vanguard. \$17.50. In this monumental study on contemporary aspects of terrorism, Parry comprehensively surveys the history of terrorist activities starting with the French Revolution and bringing this terrible story up-to-date through June 1976. While not pleasant or easy reading, the book is a "must" for students of political science and international relations interested in the frightening contemporary escalation of political violence.

The Rebel on the Bridge: A Life of the Decembrist Baron Andrew Rozen, 1800-84. Glynn Barratt. Ohio. \$19.

Professor Barratt, of Carleton University in Ottawa, has produced a distinguished biographical study of the life of a talented and courageous officer of the Imperial Russian Guards. He fought brilliantly against the authoritarianism of the Russian czars, particularly in the 1825 uprising in St. Petersburg. Baron Rozen's tumultuous life presents an interesting insight into early 19th century czarist Russia. The author uses important original materials not readily accessible to Western scholars.

Principles of International Law Concerning Friendly Relations and Cooperation.

Ed. Milan Sahovic. The Institute of International Politics and Economics, Belgrad & Oceana Publications. \$12.95. Professor Milan Sahovic, director of the Institute of International Politics and Economics of Belgrade, Yugoslavia, has edited a comprehensive collection of writings dealing with the basic principles of contemporary international law. The book includes numerous contributions by Dr. Sahovic's colleagues in the Institute and the topics range from the problem of the use of force all the way to detailed studies of the United Nations charter. A well-edited and useful contribution to international law and organizations.

ORATORIO TAPE AVAILABLE

In response to inquiries about additional performances of the Phi Beta Kappa bicentennial oratorio "To Form a More Perfect Union," the authors have prepared an abridged cassette tape of the premiere which interested chapters and associations may borrow. For the tape, and for other information, please write to Drs. Robbins and Yannatos, Music Department, Harvard University, Cambridge, Massachusetts 02138.

The Next Industrial Revolution

(continued from page four)

technicians and will find more amusing ways to spend their time. Again on the positive side, the industrial development kit will rapidly abolish the distinction between developed and developing countries. We will then all alike be living in the post-industrial society.

The basis of the second industrial revolution will be a full understanding of biological processes and the imitation of these processes by means of computer technology. As we understand more about biology, we shall find the distinction between electronic and biological technology becoming increasingly blurred. It was John von Neumann, the mathematician, who first dreamed of this marriage between computers and biology. During World War II, von Neumann was working with great enthusiasm as a consultant to Los Alamos on the design of the atomic bomb. But even then, he understood that nuclear energy was not the main theme in man's future. In 1946, he happened to meet his old friend Gleb Wataghin who had spent the war years in Brazil. "Hello Johnny," said Wataghin, "I suppose you are not interested in mathematics any more. I hear you are now thinking about nothing but bombs." "That is quite wrong," said von Neumann, "I am thinking about something much more important than bombs. I am thinking about computers."

Von Neumann saw very early the profound importance in computer design of the separation between hardware

and software, and he understood that this is exactly analogous in function to the separation between protein and DNA in living organisms. For a machine or an organism to reproduce itself, it is essential that it contain in symbolic form (as software or DNA) a complete description of itself, and in concrete form (hardware or protein) the machinery for translating the symbolic description into an actual copy. Von Neumann also understood that this separation of hardware and software was the key to the possibility of evolution of higher organisms. In evolving from simpler to more complex organisms you do not have to redesign the basic hardware (the biochemical machinery) at every step as you go along. You have only to modify and extend the software, the genetic instructions. Because of this indirect character of the evolutionary process, I am confident that when we have once mastered the art of constructing a practical self-reproducing automaton at the unicellular level, the extension of the technology to produce a complete system of automata coordinated like cells of a higher organism will not be far behind.

I have described what I consider to be the probable shape of the second industrial revolution. But there is nothing inevitable about it. If society decides that there is more evil than good in it, it can be stopped. Politicians can quite easily put a stop to technological developments, if they have the will to do so. But before a decision can be made whether these things are good or evil, one must know

what the technical possibilities are and try to imagine as best one can the human consequences.

Haldane called the book which he wrote in 1924 about the future of science *Daedalus*. He imagined Daedalus, the mythological creator of the Minotaur, hybrid offspring of woman and bull, as the archetype of an experimental biologist. Daedalus is also pictured as the archetype of the deicide, the man who relentlessly destroys illusions and dethrones gods through his uncompromising assertion of scientific truth. Haldane ends his book by saying, "The scientific worker of the future will more and more resemble the lonely figure of Daedalus as he becomes conscious of his ghastly mission and proud of it.

"Black is his robe from top to toe,
His flesh is white and warm below,
All through his silent veins flow free
Hunger and thirst and venery,
But in his eyes a still small flame
Like the first cell from which he came
Burns round and luminous, as he
rides
Singing my song of deicides."

To those who knew von Neumann only through his outward appearance, rotund and smiling, to compare him with Haldane's Daedalus may seem ludicrously inappropriate. But those who knew him a little better, this man who so consciously set mankind moving along the road to the second industrial revolution, understand that from a psychological point of view Haldane's portrait of him was extraordinarily prophetic.



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Consulting Editor: Kenneth M. Greene

Editorial Committee: Irving Dilliard, William F. Hahnert, Robert H. Irrmann, Raymer McQuiston.

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