

ping, then a series of indicator maps can be created from the original map. Thus, individual maps are compiled of soils, lithology, salts, geomorphology, and water conditions. Lastly, these can be variously combined to show potential for agricultural use and the dynamics of salinization of soil-forming rocks.

It is important that these progress reports on geobotanical research in Russia be translated into English so that American geochemists can study them. This volume is, therefore, very valuable to anyone who uses plants as indicators. Unfortunately the translator was not acquainted with botanical jargon, and the translation is, therefore, a literal one. It is difficult to understand the meaning of "coedificator," the bedding groundwater, and similar expressions. The book is not for light reading, but for close study by experts in the fields discussed. It is invaluable in an English-speaking world devoid of comparable plant research.

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Koyré's Newtonian Studies

Alexandre Koyré died on 28 April 1964. Beginning his career in the Paris of Meyerson and Brunschvig, he first studied the religious thinkers of the 16th and 17th centuries; but he later moved more and more into the history of scientific thought, where he made himself probably the most profound, and the most widely respected, scholar of his generation. The first major fruit of this interest was the book *Études Galiléennes* (1939), which gave a new depth and perspective to our understanding of Galileo's true contributions, while making us realize fully for the first time how strong were his intellectual ties to his predecessors—and even to antiquity.

Unlike George Sarton, who took all history, sciences, and civilizations as his province, Koyré placed voluntary limitations on himself. His chosen area was that of cosmology, astronomy, and mechanics from Copernicus to Newton; and in recent years, dividing his time between the *École Pratique des Hautes Études* (Paris) and the Institute for Advanced Study (Princeton), he published a series of notable papers on the ideas of Isaac Newton. Many of these papers arose

from his unfinished collaboration with I. B. Cohen of Harvard on a definitive scholarly edition of the *Principia*, and they have already taught us how far, until our own times, Newton had been deified rather than understood.

The present posthumous collection, *Newtonian Studies* (Harvard University Press, Cambridge, Mass., 1965. 269 pp., \$7.95), by Koyré, comprises six shorter papers from the years 1948 to 1961, all of which have already appeared in the journals, together with one major and extensive essay—not hitherto available, and running (with its appendices) to some 150 pages—on the intellectual affiliations between Descartes and Newton. This study, based on a Horblit Lecture first given at Harvard in 1961, demonstrates convincingly the dominant role of Descartes' work in determining, not merely the "Cartesian" system of physics which Newton's *Principia* was designed to sweep aside (and so its literary layout) but the very form of the questions and concepts with which Newton himself operated in building up his own theories.

In expounding his profound interpretations of past scientific thought, Koyré used all the resources of a perceptive and generous spirit; and he succeeded, more than any other of his contemporaries, in balancing the claims of science, philosophy, and religion against those of "history," more narrowly understood. Those of us who disagreed with him in print on points of detail would be greeted at the next meeting with an affectionate "*Ah, mon cher adversaire*"; we have learned from him some of the secrets of humane scholarship, and we are the losers—personally as well as professionally—by his death.

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Dilemma of Research Strategy

In a prisoner's dilemma each of two players independently selects one of two actions, C (for cooperative) or D (for defecting), and their combined choice determines an outcome for each. Their dilemma is this: no matter which action the other player takes, each prefers his outcome from choosing D to that from choosing C; yet, should both choose D, the outcome is less preferred by each to the

outcome that would have been received if both had chosen C. Such dilemmas are not just pathologies of game theory; they abstract into stark relief the dilemma between individual and social rationality often encountered in unbridled competition. To my knowledge, real dilemmas of this character are only resolved in favor of social rationality by altering the "game" through legal sanctions, subsidies, and the like; and when a suitable external social framework is absent or weak—for example, in an arms race between two sovereign nations—man's inability to find an acceptable resolution is only too grimly apparent. Such social analogies make clear why an investigator might be interested in how people behave in such games and how that behavior can be manipulated.

In *Prisoner's Dilemma* (University of Michigan Press, Ann Arbor, 1965. 270 pp., \$7.50), Anatol Rapoport and Albert M. Chammah report a number of studies with money payoffs; a total of 370 pairs of college students were run, each pair making hundreds of choices in one or more games. Although a good deal of analysis of the protocols is given, the main results seem to be three. First, subjects tended to be initially cooperative, quickly shifted to predominately D choices, and then the pairs gradually fixated on either DD or CC choices, with the latter rather more frequent. The final correlation in behavior within pairs did not stem from strong initial correlations but was rather a result of the interaction. Second, the final split between DD and CC choices varied with the exact payoffs and with the explicitness of the situation (when the payoff matrix was given, the percentage of CC choices was larger than when the matrix had to be inferred from trial-by-trial outcomes). Third, pairs of males ended with CC choices more often than did pairs of females. The authors show that this is not due to any initial differences in their disposition to choose C, but rather reflects the fact that the males were more likely to respond cooperatively to the other's C choices than to retaliate to the other's D choices, whereas the females were somewhat more likely to retaliate to D's than to cooperate to C's. Both tendencies were attenuated when males were paired with females.

These experiments appear to be at least as systematic and convincing as most experiments in social psychol-

ogy, and perhaps they are less subject to the vagaries of procedure and experimenter; but, as with so many studies of human interaction, the results do not seem to generalize much beyond the specific situations studied. We do not learn significant principles of individual behavior that permit us to predict the results for other simple social situations, even for other games. Some mathematical theories are suggested, but no careful attempt is made to test them and no clear understanding emerges of the mechanisms at work. The concluding chapter highlights the resulting quandary. A variety of similar studies is suggested, each as interesting as the next, and it is not difficult to amplify the list 10- or 100-fold; but, lacking a plausible criterion of scientific significance,

where does this end? Detailed studies of specific social situations may be justified when the situations are, themselves, of applied interest; however, when they are at best highly abstracted analogues, some guide other than curiosity is needed. Perhaps it is unfair to fault this book for failing to confront this widespread dilemma of research strategy, especially since the book is good within the terms of the problem formulated. Nonetheless, the question of which interaction studies are worth performing is rapidly becoming acute and, in my opinion, a high degree of scientific acumen is now needed to choose among the myriad possibilities.

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AIBS-AEC Series on Radiation Biology

Although a vast amount of data has accumulated during the past 50 years on the response of mammals to whole-body irradiation and the sensitivity of the target organs that are responsible for the "so-called" lethality syndromes, most of the quantitative information on these key organ systems dates from the adaptation of specific metabolic precursors to biological research, of which one of the most important was tritiated thymidine. Of equal importance to the problem of cell population kinetics and the changes produced by irradiation has been the development and refinement of cell-culture techniques. Scientists at Brookhaven National Laboratory have been in the forefront of the development and utilization of these techniques, and the authors of the volume reviewed here, **Mammalian Radiation Lethality: A Disturbance in Cellular Kinetics** (Academic Press, New York, 1965. 356 pp., \$9.50), Victor P. Bond, Theodore M. Fliedner, and John O. Archambeau, were active participants in many of these experiments—in particular, in the investigations involving hemopoiesis.

In this book they deal with three syndromes—hemopoietic, gastrointestinal (G.I.), and central nervous system (C.N.S.)—but because of the amount and nature of the data they are concerned primarily with the hemopoietic and the G.I. syndromes. Cells of the C.N.S. are highly specialized, nonproliferative cells; therefore, the C.N.S. syndrome occurs (in most ani-

mals) after a high dose and is followed by death within a few hours. In treating the hemopoietic and G.I. syndromes, the authors review and bring into proper perspective most of the information gathered on these two cellular systems for both normal cell kinetics and the changes produced by whole-body irradiation. Death following both syndromes results from the depletion of mature functional cells, but it is the inactivation or destruction of the precursor or stem cells that brings about death. In neither case, bone marrow or intestinal crypt injury, can the stem cells be positively identified, and the current models used to explain the role of the stem cell in regeneration following irradiation are not completely satisfactory. Although the dose-survival curves of these cells resemble those of cells grown in culture, the *in situ* environment and the intricate feedback mechanisms of the whole animal make it somewhat tenuous, if not misleading, to extrapolate from one set of data to the other.

A discussion of animal data precedes the discussion of the effects of whole-body radiation on man. The sources of this information were (i) accidents in industry or laboratories, (ii) the Pacific testing-ground accidents involving exposure to fallout radiations, (iii) the experience at Hiroshima and Nagasaki, and (iv) medical exposure of patients to whole-body (or near whole-body) radiation for therapy of cancer or for other reasons. Although direct

extrapolation from animal data to man (or for that matter, from one animal species to another) may be misleading, the general sequence of events in both the bone marrow and G.I. syndromes is essentially the same in all mammals. It is also clear that death is not the result of damage to a single organ system but that in the lethal range of the syndrome (hemopoietic, G.I., or C.N.S.) death is associated with widespread damage to many organs. Death follows a terminal period that involves hemorrhage, infection, and fluid imbalance.

In general, the authors' treatment of the data shows that the primary consequences leading to the progressive signs and symptoms resulting in death, in days or weeks, to mammals (man or laboratory animals) exposed to large doses of whole-body radiation have their basis in a disturbance of normal cellular kinetics.

This book will be of great value to the advanced radiobiologist as a reference source for use in research and in teaching. It will also provide the clinician with possible guidelines for use in treating persons accidentally exposed to whole-body radiation, in treating cancer, and in making preparation for organ transplants. Heretofore, this information has been widely scattered throughout medical and biological journals and was not available in this form.

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Flora of Turkey

A published flora often dominates our understanding of the vascular plants of its area long after the steady accretion of knowledge has rendered it obsolete. Nowhere has this been more clearly demonstrated than in the Near East, the source of many of our finest garden plants and a number of our most noxious weeds. More than three-quarters of a century has elapsed since the death of the illustrious Swiss botanist Edmond Boissier and the completion of his six-volume *Flora Orientalis* (1867 to 1888). Only in recent years has this classic begun to be superseded by other major works concerned with the plants of this huge region: *Flora U.R.S.S.* (1934–1964) for its northern and northeastern margins; *Flora Iranica* (1963–) for its eastern