Included in the volume are several useful appendixes of data about flights, spacecraft, experiments, schedules, finances, and lunar theory before Ranger, plus a good index. Like other NASA histories, it is profusely illustrated, including good line drawings to elaborate technical descriptions in the text.

From the works of James Killian, George Kistiakowsky, Herbert York, and Philip Morse, to name only a few, we have learned much about how policies for science developed in the executive branch. *Lunar Impact* adds another important dimension to the story by making known some of the discussions among other scientists trying to influence policymaking and by describing some of the problems faced by contractors, such as JPL, that had to implement those policies. Only a few agency histories have achieved this result.

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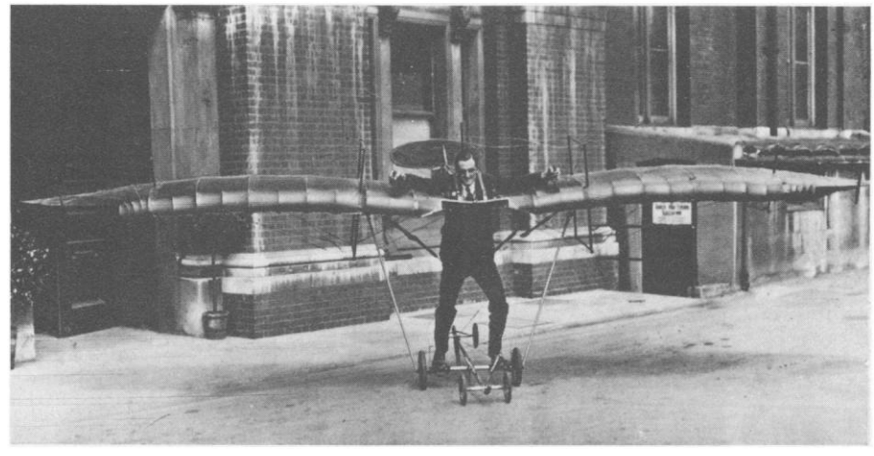
The Icarus Syndrome

The History of Man-Powered Flight. D. A. REAY. Pergamon, New York, 1977. x, 356 pp., illus. $15.

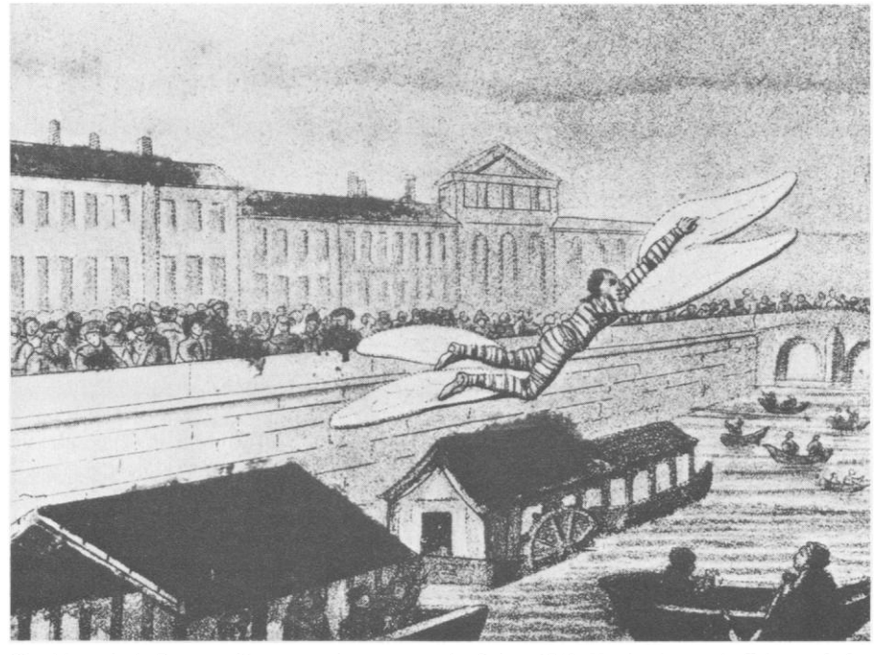
The irony of this account of the development of man-powered flight is that, although it is focused on efforts to win the Kremer Prize and properly gives accounts of the non-British as well as the substantial British contributions, the prize was won while the work was in press by the California team of MacCready and Oldershaw, who, though a hasty postscript on pp. 341–342 notes their accomplishment, are not even mentioned in the text. Yet that should be a reminder that there are still independents outside the normal academic-professional communities who may succeed in meeting a challenge because they start without preconceptions. The man-powered flight aficionados have themselves been divided into two groups—those who believe that professional benefits can accrue and those who are sportsmen. The former now argue that what is learned may be beneficial in energy-saving (if not in pulling in research funds), whereas the latter are simply intrigued by the challenge of success. MacCready, a sometime glider champion, belongs in the purist camp.

Reay, who is an engineer by profession, has long been heavily involved in Britain in the man-powered flight enterprise. And his book falls into the Gibbs-Smith tradition of examination of the minutiae of one aspect of aviation. This is not to belittle the achievement, but to make the point that what he has done is a meticulous (as far as one can tell in the face of the almost complete lack of literature in the field apart from Keith Sherwin's 1971 *Man-Powered Flight*) history of that interesting combination of dreaming and practical experiment with almost no money that is involved in studying flight at bird speeds. As Reay shows, the early designers too often had insufficient aerodynamic knowledge, for until the 1920's the knowledge simply did not exist. The take-off point was the work of the Germans in the '20's and '30's. Efforts accelerated rapidly after World War II both because of the enormous growth of technical knowledge and because of a sort of nostalgic challenge that might be labeled the "Icarus syndrome." Who has not dreamed of flying like a bird without auxiliary power?

Though the book appears, having been printed by photo-offset from typescript, to be merely a research report, it is a sound historical work and deserves a place on the shelves because it provides a survey with illustrations of the work that preceded the successful flight of



"An obscure English attempt at flight in 1920." [From Radio Times Hulton Picture Library, reproduced in *The History of Man-Powered Flight*]



The Marquis de Bacqueville attempting to cross the Seine, 1742. Having jumped off the roof of a house overlooking the riverbank, Bacqueville crashed into a passing barge and broke his legs. "Aviators were not encouraged by the words of William Cowper, who in 1783 wrote: 'If man had been intended to fly, God would have provided him with wings.' This was, of course, not the first time such a sentiment had received publicity, and it was certainly not the last." [From Radio Times Hulton Picture Library, reproduced in *The History of Man-Powered Flight*]

MacCready and Oldham's "Gossamer Condor" on 23 August 1977.

We must end on a footnote. Reay conclusively shows that Icarus could not possibly have flown from Crete to the mainland of Greece. Someone needs to reexamine that legend to see what his real objective might have been or whether he might have been under the influence of hallucinogenic drugs.

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Lightning Discharges

Lightning. R. H. GOLDE, Ed. In two volumes. Vol. 1, Physics of Lightning. xx pp. + pp. 1–496, illus., + index. $41. Vol. 2, Lightning Protection. xx pp. + pp. 497–850, illus., + index. $33.25. Academic Press, New York, 1977.

Modern lightning research began in the early 1900's with C. T. R. Wilson's determination of the cloud charges moved by lightning by measuring the resulting electric field change. Since then, the study of the physical properties of lightning has proceeded at a slow but steady pace, the bulk of the work having been done in South Africa, England, Switzerland, and the United States. Much of the research from the 1920's to the present has been motivated by the problems lightning causes for electric power utilities. Recently the use of vulnerable solid state electronics, both on the ground and in aircraft and space vehicles, has produced renewed interest in (and funding for) lightning research. The field, however, is still a relatively small one. In the last ten years only about 500 journal articles and one monograph (also titled *Lightning*) on lightning physics have been published; there have been considerably fewer journal articles on lightning protection, although monographs have been written on the protection of structures, communication systems, and airplanes.

The two volumes of *Lightning* together comprise chapters by 27 authors. The English is uniform and excellent throughout, despite the disparate national origins of the authors. The two volumes were written, according to the editor, to meet the need for "a comprehensive survey of present knowledge of *all* major aspects of lightning and protection against its effects." The contributors "were requested to start with a brief survey of early work and to present a balanced critical review of present knowledge with clear indications of their own views." The book is largely successful in achieving these goals. The main failings of the book can be laid to a tendency on the part of authors to discussion of their own experience in preference to their appointed subjects and to the use of jargon. One of the shortcomings of almost any collection of this type is that it is difficult for the reader to determine the relative importance of the subjects discussed. For example, in this work there is no consideration of which are the most important unsolved lightning problems and, of these, which are amenable to solution with available technology.

Volume 1, "Physics of Lightning," contains 14 chapters that cover "lightning in history," point discharge, thunderclouds, long laboratory sparks, lightning to earth, lightning in clouds, lightning currents, spectroscopy, radio-frequency radiation, thunder, frequency of lightning discharges, electric-field measuring techniques, and ball lightning. The volume includes more than its subtitle indicates, subjects apparently being relegated to this volume if they are not specifically concerned with protection. Perhaps the best chapter in this volume is "The cloud discharge" by M. Brook and T. Ogawa. It is a balanced, up-to-date review containing a good mix of theory, experiment, results, and appropriately labeled speculation. Most disappointing are the chapter on instrumentation, which does not give the reader what its title implies, and the chapter on ball lightning, which presents an uncritical view of a subject that is badly in need of a critical analysis.

Volume 2, "Lightning Protection," contains 12 chapters covering lightning warning and avoidance, injury and death from lightning, the principles of operation of lightning rods, grounding of lightning, and the protection of structures, underground blasting operations, aircraft, transmission and distribution power systems, telecommunication systems, and trees. The chapters range from equation-filled to equationless, the more technical ones requiring considerable background. One advantage of this volume is that the reader can examine the variety of ways in which engineers concerned with the protection of different types of systems approach similar problems. Perhaps the best chapter in this volume is R. H. Golde's "The lightning conductor," which lives up to the charge he gives his authors. Most of the chapters are quite good; several are disappointing in that the background material necessary to follow the development of ideas is not given.

Lightning will be very important to researchers who are already knowledgeable in the field. Novices will do better to introduce themselves to the subject by first investigating several of the single-author books available on the subject.

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Long-Term Patterns

Climatic Change and Variability. A Southern Perspective. Papers from a conference, Melbourne, Dec. 1975. A. B. PITTOCK, L. A. FRAKES, D. JENSSEN, J. A. PETERSON, and J. W. ZILLMAN, Eds. Cambridge University Press, New York, 1978. xxiv, 456 pp., illus. $37.50.

Climatic Change. JOHN GRIBBIN, Ed. Cambridge University Press, New York, 1978. xii, 280 pp., illus. Cloth, $37.50; paper, $11.95.

That two books on climatic change could be published in the same year by the Cambridge University Press attests to the current high level of interest in the subject. Both books deal with the history of climate over the span of geologic time, as well as with recent and even proximate events. The contributions in both are of generally high quality. Neither compilation is parochial in scope, but the emphasis placed on Australia and the Antarctic Ocean (and to a lesser degree, Antarctica) in the Pittock *et al.* volume is not to be found in Gribbin's book.

The concept of climatic change eludes simple definition, and its diffuseness is parent to the eclectic nature of successful work on the subject. Climate itself must be broadly defined, for to study it involves delineating weather states over a run long enough to characterize the whole assemblage. If climate were stable, then frequencies of given weather types recovered from the world weather record would be repeated with the same frequencies in the future. Although many necessary and useful climate-related works, such as dams for flood control and heating and cooling units for buildings, are based on the assumption of such stability, it is nevertheless true that every year parts of the planet experience weather events not recorded before. Careful examination of the longest series of weather records (the temperature record for Lancashire begins in 1751) fails to reveal one-sided trends of impressive magnitude. What do appear are many irregular variations composed of some variable combination of chance and periodic controls. This state of affairs requires an allowance for drift in climate in