need of any scale change for length and time in the different systems of coordinates involved, the Loedel diagram, still more than the Robert W. Brehme diagram, leads to an important simplification for the understanding of the physics of special relativity.

Yet in spite of its unquestionable superiority over its competitors, the Loedel diagram was not given any attention (probably owing to the fact that the Spanish-American scientific literature is to a great extent unknown in the North) until it was independently discovered by Henri Amar of Lafayette College, Easton, Pennsylvania, in November 1955. Shadowitz's is the first book to make systematic use of the Loedel method in expounding special relativity.

Despite the fact that only elementary mathematics is employed—only the chapter on form invariance (contravariant and covariant tensors, pseudotensors, and the like) makes use of the calculus—the author succeeds in treating virtually all the topics taught even in graduate-level courses in special relativity. The first five chapters deal with the kinematics and optics of relativity and include a discussion of whether the so-called Lorentz contraction is real and a treatment of the shape of moving objects. This section is followed by chapters on relativistic dynamics and on electricity and magnetism which excel in lucidity of explanation.

Since owing to his choice of approach the author did not share Blaise Pascal's difficulty ("The last thing we decide in writing a book is what to put first") but had to start with explaining the Loedel diagram, he was forced to postpone the discussion of the details of the experimental evidence (up to 1964) in support of the theory to the concluding chapter. Each chapter has a biographical section of well-chosen references and a collection of problems commensurate in difficulty with the level of the prospective reader. The book is highly recommended as an introduction to the subject and may be supplemented in breadth by the first book and in depth by the second book under review. Shadowitz's book will certainly also facilitate the work of the instructor who, in this respect, will probably object to the first part, and accept the second part, of the Logan Pearsall Smith apothegm: "I hate having new books forced upon me, but how I love cramthroating other people with them."

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## Early Rocketry

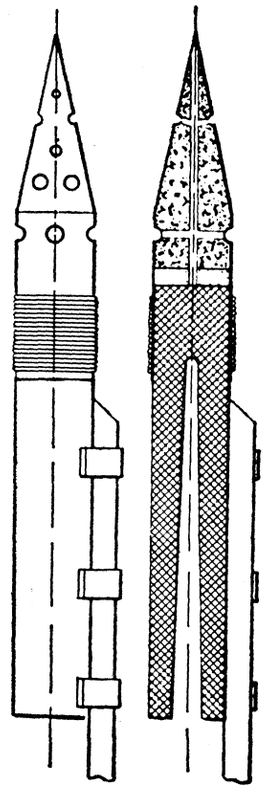
**Russian Solid-Fuel Rockets.** V. N. SOKOL'SKII. S. G. Kozlov, Ed. Translated from the Russian edition (Moscow, 1963) for the Israel Program for Scientific Translations. H. Needler, Transl. and Ed. National Aeronautics and Space Administration and National Science Foundation, Washington, D.C. (available from Clearinghouse for Federal Scientific and Technical Information, Springfield, Va.). iv + 236 pp., illus. Paper, $3.

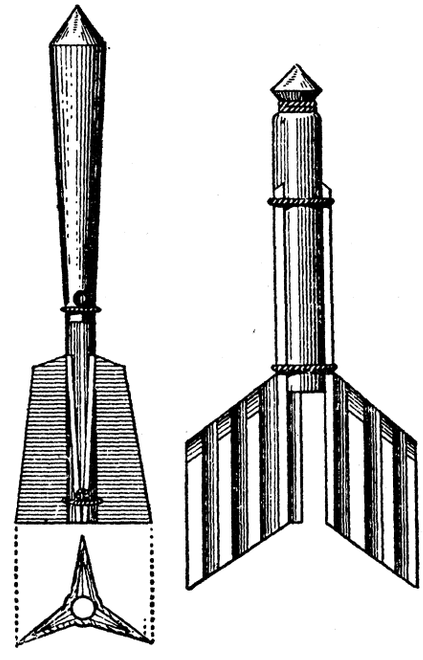
This work fills an almost total gap in one segment of the history of technology—Russian military rocketry. Rocket ordnance and pyrotechnics progressed in occasional spurts for nearly 600 years before Robert H. Goddard and other 20th-century experimenters springboarded from the heritage of 19th-century rocket motor design and ballistics. Yet general histories of the course of early rocket development are rare. There are only two good histories of rocketry in print, the classic work of Willy Ley and the more recent book by von Braun and Ordway.

Only the most scanty references to Russian rocketry have been available until this carefully documented book by historian Viktor N. Sokol'skii. That a translation has been made into English is a measure of the broad historical research activity of the National Aeronautics and Space Administration under the direction of NASA historian E. M. Emme. Translation must have been difficult for lack of suitable reference works to consult, and credit is due translator and editor H. Needler for a painstaking effort.

Sokol'skii has obviously performed an immense amount of research in Soviet archives. Each chapter has dozens of detailed references. The author carefully documents the introduction of pyrotechnic rockets into Russia late in the 17th century. By the early 1700's the writings of Simienowicz and others became available to the court and artillery laboratories. Formulas for block powder variations are given, and their use in fireworks displays is treated.

By 1814 the success of William Congreve's side-stick mount rockets had spread eastward across Europe, and corresponding models were being produced and tested in Russia. Performance results of those built by Kartmazov (up to 1¾ miles for 3.5-inch caliber) were quite respectable. Within a few years, A. D. Zasyadko performed numerous design analyses on rocket shell thickness, ratios of diameter to length, and so on. By 1823 the 1815 center-stick design of Congreve was introduced





Russian rockets of the 19th century. (Left) Military rocket of 1817, designed by A. D. Zasyadko. As in the 1805 British design of Sir William Congreve, the forward end contains incendiary material similar to Greek fire. (Above) Two varieties of fin-stabilized stickless war rockets attributed to Chichinadze and Staff Captain Skripchinskii in the 1860's. [From *Russian Solid-Fuel Rockets*]

by a Britisher, and a few years later the Petersburg Rocket Institute was founded. Thousands of rockets were produced here for troops in the Caucasus. They were widely used in the Russian-Turkish War of 1828–1829, and later in the Balkans.

By midcentury, refinements in fuse design were evident. K. I. Konstantinov laid the groundwork for internal ballistics, empirical knowledge of powder formulations developed, and hydraulic presses capable of 40 tons had been built in France for the new Nikolaev Rocket Plant near Kiev. By the early 1900's, large rocket flares were being produced in quantity, and various wing and tubular stabilized rocket shapes had been tested. Large numbers of rocket flares were manufactured during World War I, although artillery had supplanted bombardment rockets in accuracy and range.

The author concludes with a summary of the history of Russian rocketry, and 16 detailed appendices complete the text. A bibliography and a name index are included.

The care with which Sokol'skii treats historical facts is evident. Statements such as "Until the middle of the 1840's Russian rocket engineering developed very slowly and the poor quality of rockets impeded their widespread use" are refreshingly candid. Russian weights and measures (*pud, sagene, verst,* and the like) are translated into pounds and yards whenever used.

The printing on the whole is clear, although in the review copy there are a few pages where the ink has run through the thin paper. Illustrations are crisp. The price of the book is most reasonable. A better title, however, might have been "A History of Russian Rocketry to 1918."

Highly recommended for students of history of technology, military ordnance, and Russian history and for all rocket engineers interested in learning how rockets were made in the time of their great-great-grandfathers.

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## Land near Water

**River Plains and Sea Coasts.** RICHARD J. RUSSELL. University of California Press, Berkeley, 1967. viii + 173 pp., illus. $8.75. Hitchcock Lectures, Berkeley, 1965.

This short book does not pretend to be a highly technical presentation; it is, rather, a simply and clearly written autobiographical account of the author's important contributions to geomorphology. Russell's research was directed to streams and alluvial morphology before 1956; since then he has been investigating seacoasts and beach processes.

The first half of the book is a lucid survey of the vast accomplishment of Russell, Fisk, and the Mississippi River group. These workers presented a most important challenge to the Davisian system and freed geomorphology from a too intensive preoccupation with erosion to the exclusion of deposition. Their work is certainly now an established part of geomorphology, and their conclusions, especially those dealing with the interaction of a stream with its own alluvium, have been successfully extended to many other streams. With a single unimportant exception, no reference is cited from publications later than 1960, for Russell had by that time become interested in coasts. It is a pity that he has not attempted to combine the important recent work on rivers with his own broad experiences; the results would have been welcome.

The second half of the book, dealing with coastal morphology, beach processes, and problems peculiar to tropical islands, is based on Russell's studies since 1956. The summary here given by Russell is particularly valuable, for the publications are scattered and the studies not generally as widely known as those on rivers. Again Russell's approach was to treat deposition and erosion as halves of a single picture, and he gives a particularly clear account of the many dangers of too naive interpretations of the "evidence" of various Quaternary stands of sea level.

Certainly not all of Russell's conclusions have won wide acceptance, but his contributions to geomorphology are enduring. His obvious love of fieldwork and the excitement of discovery are clearly revealed here; they are contagious. In an assigned reading list for a modern undergraduate course in geomorphology (physical geography) this small book may well be among the most valuable entries.

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## Quaternary Ecosystems

**Quaternary Paleoecology.** Vol. 7 of the Proceedings of the 7th Congress of the International Association for Quaternary Research, Aug.–Sept. 1965. E. J. CUSHING and H. E. WRIGHT, JR., Eds. Yale University Press, New Haven, Conn., 1967. viii + 433 pp., illus. $15.

A new look in paleoecology is exemplified by the varied contributions in this book. Imaginative studies of modern processes and modern biogeography are the basis for some illuminating interpretations of Quaternary biota and climate presented by contributors to the volume. Though much of the material relates to pollen chronology and stratigraphy, the topics are diverse, and include paleoecology based on evidence from mollusks, insects, seeds and other plant megafossils, $C^{14}$-$C^{12}$ ratios in waters of different *p*H, chemical composition of clamshells, and modern pollen rain.

In geographic coverage the work focuses largely on eastern North America, but includes a smattering of studies from different parts of the world. Especially delightful reading is a discussion by Tsukada and Deevey of cyclicity in Mayan agricultural practices and the Mayan economy partly inferred from the pollen record. An example of their light touch is seen in their photograph of modern and ancient "pictographs" along the shores of Lake Guija, El Salvador (see opposite page).

Cushing and Wright's book might well have been entitled "Studies in Late Quaternary Ecology" because of the emphasis on the latter part of the Ice Age and because it is not strictly a book on principles of Ice Age ecology. However, some general papers on methodology and an intriguingly written introduction by the editors add a broad slant to the volume.

The book gives evidence that a good deal of face-lifting is going on in the methodology and ecological interpretation of the Quaternary plant record. An important tool long used in Europe, namely seed stratigraphy in close combination with pollen stratigraphy, is being tried with interesting results in the United States. Aside from the important matter of providing a basis for identifying species, which is not usually possible from pollen grains, plant megafossils such as seeds offer some assurance that the source plant was growing locally—a thing not certain from airborne pollen grains.

American workers are trying new