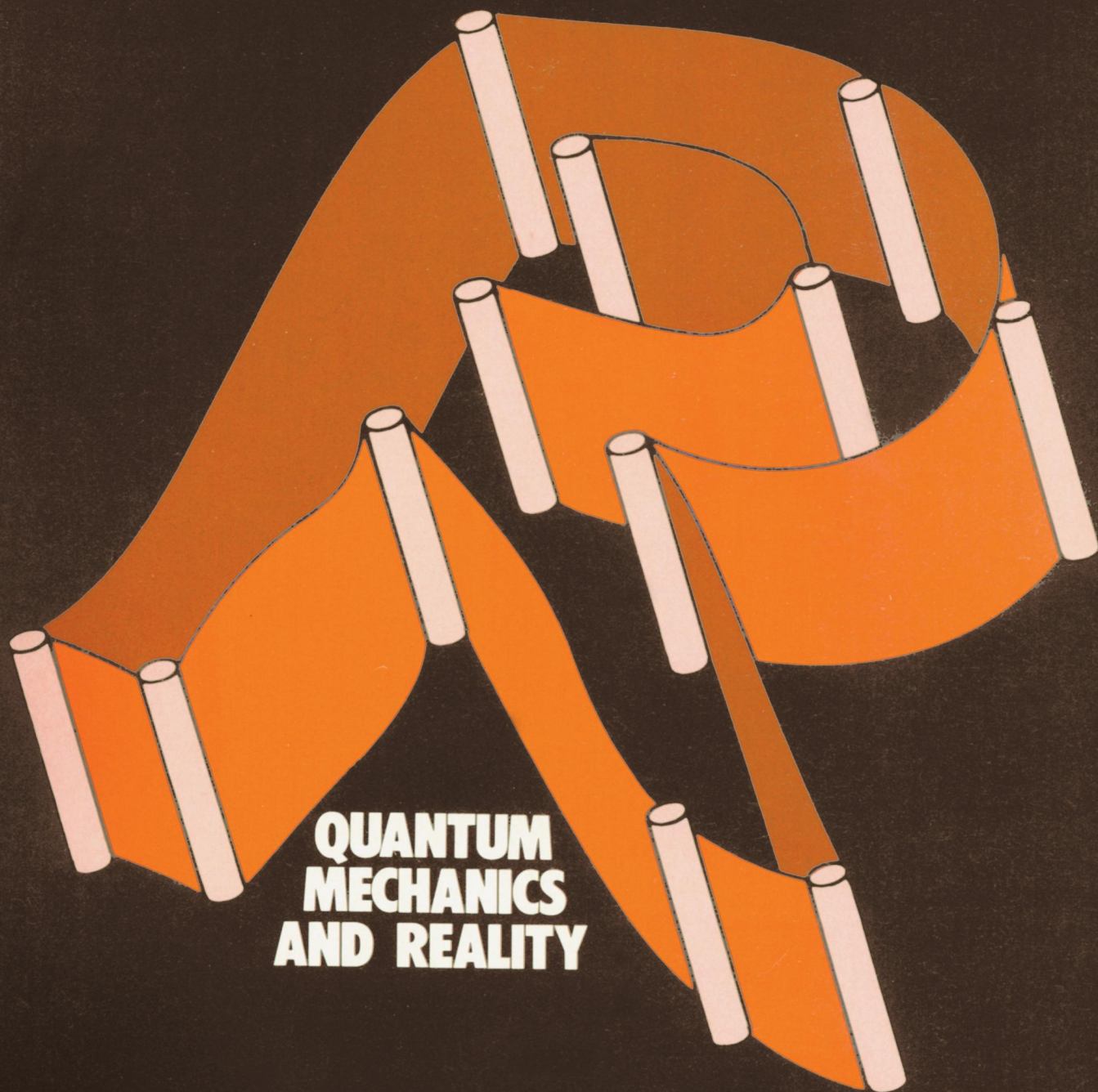


science news

MAY 22, 1976
VOL. 109, NO. 21, 321-336



**QUANTUM
MECHANICS
AND REALITY**

A SPECIAL CHARTER OFFER, A FREE BONUS, AND A CHALLENGE...

EXPLORE & UNDERSTAND THE WONDERS OF SPACE

INTRODUCING POPULAR ASTRONOMY

THE FIRST MAGAZINE TO EXPLAIN THE MYSTERIES OF THE UNIVERSE

If gazing into a star-filled sky—and realizing man has begun to explore space—leaves you in awe, you're not alone.

Aside from the smattering of information in the news magazines and the technical treatises in the scientific press, there are few places you can turn for information on astronomy today.

How to stay up on man's greatest exploration.

Every month Popular Astronomy promises to fill the information void on astronomical developments.

Popular Astronomy is written for you and other intelligent people who are curious about the world around them and the worlds beyond.

It is written by experts—practicing scientists and professionals in astronomy and space technology.

Most important, it is written to be understood.

What you'll learn in Popular Astronomy.

With our distinguished contributors, you'll explore the facts and theories that explain the past and present of our universe—and predict its future.

The Sun: As dependable as day and night now, but what of the future? Will it explode . . . or turn into a cold cinder as it uses its atomic fuels?

The Jovian Planets: Jupiter, Saturn, Uranus, Neptune. Strange worlds where air and earth have no meaning. Will man ever set foot on their "surface"?

The Earth: Is our 24-hour day stable? Will the moon always be in the Earth's sky? Some scientists say no to both questions. Find out why.

The Universe: Did it begin with a "big bang" and will it end that way? Or, can we assume it will always exist?



How to participate in the exploration.

Few have access to observatories or radio telescopes, and fewer still will travel as astronauts in our lifetime.

Still, Popular Astronomy will challenge you to participate in the exploration of our world.

We'll challenge you to build your own telescope. And give you easy-to-follow instructions on how to do it.

We'll challenge you to view the complexities of the galaxies. And provide you with detailed maps to guide you.

We'll tell you not to miss celestial events. And provide you with up-to-the-minute reminders of eclipses, meteor showers and other astronomical events you can view from your own home.

See the heavens as the astronomers do.

Popular Astronomy is as beautiful as the heavens it explores. It is produced on high-quality, coated paper with an abundance of full-color sections.

In our pages, you'll see first-hand the

panoramas viewed through the world's largest photographic telescopes, and you'll see brilliant, scientifically-accurate illustrations of the still-unseen vistas as interpreted by scientists via radio telescopes. Plus, many issues of Popular Astronomy contain full-color center spreads you'll find suitable for framing.

A special offer for Charter Subscribers.

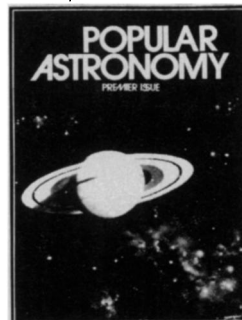
If you've ever gazed at a star-studded sky and wished you knew more about its mysteries, subscribe to Popular Astronomy. Now, while Charter subscription benefits are in effect.

Fill in and return the coupon below and we'll send you the Premier Issue of Popular Astronomy (sure to become a collectors' item), and enter a one-year subscription in your name for just \$10.

Book Club benefits included free.

As a bonus, you will receive free membership in the Popular Astronomy Book Club, a no-obligation club that enables you to purchase astronomy-related books and equipment at substantial savings.

Send in the Charter Subscription coupon today and join Popular Astronomy's scientists/contributors as they explore man's last frontier—space!



© 1976 Popular Astronomy
270 Madison Ave., N.Y.C. 10016



"MAN ON THE MOON"

YOURS ABSOLUTELY FREE!

The Historic Sounds of Man's first Lunar Landing.

You can now receive the historic record album "Man on the Moon" free when you become a Charter Subscriber to Popular Astronomy.

Recorded during the lunar landing and narrated by Walter Cronkite, this timeless record is sure to become a sought-after collectors' item. It is not available in stores and cannot be purchased. It is available only to our Charter Subscribers and only while the supply lasts.

Send your Charter Subscription coupon today and receive your free copy of "Man on the Moon" and the Premier Issue of Popular Astronomy.

YES Please enroll me as a Charter Subscriber to **POPULAR ASTRONOMY**. I understand that as a Charter Subscriber, membership in the no-obligation Popular Astronomy Book Club is included free. I enclose my payment of \$10 for one year, a \$5 savings over regular \$15 rate.

Bill later at \$15.00.

Please check here to start subscription with Premier Issue (if available).

name _____

address _____

apt. no. _____

city _____

state _____

zip _____

Please also send me, FREE, my copy of the historic record of man's first lunar landing, "Man on the Moon," narrated by Walter Cronkite, while the supply is available.

POPULAR ASTRONOMY

DEPT. 6SN5, P.O. Box 2740, Boulder, Colorado 80302

Try Your Choice of these Modern TAB Texts...

MASTER HANDBOOK OF 1001 PRACTICAL ELECTRONIC CIRCUITS

The ideal schematic sourcebook of IC and transistor circuits for practically anything and everything—with ALL the data needed to put them to work...each circuit diagram has every component carefully labeled, and every schematic is accompanied by all the info you need to construct the circuit for use in your own individual application. The circuits included are completely up-to-date, and have been designed, built, tested, reworked as necessary, and perfected. You'll find any circuit you're ever likely to need in the pages of this rich volume. Includes an ultra-complete 22-page Index, plus an Appendix of IC substitutions. 602 pps., over 1250 illus. Hardbound.

Only \$12.95

To order, circle "A" under
TAB books on Reader Service Card.

RADIO ASTRONOMY FOR THE AMATEUR—Heiserman

This one-of-a-kind book combines down-to-earth instruction in astronomy with sensible build-it projects. And once you've built your system, no matter how simple it is, you'll be able to start collecting data from space—you'll even "observe" stars so faint they can't be seen by the 200-inch giant on Mt. Palomar! Projects include a variety of optical devices, radiotelescope antennas, sensitive receivers, radiometers, interferometers, signal-enhancing devices, converters for use with ham-radio equipment and many more. The final Chapters tell how to put the home-built equipment into service, how to build a complete solar radio observatory and a "Jupiter monitor." 252 pps., 88 illus. Hardbound.

Only \$8.95

To order, circle "G" under
TAB books on Reader Service Card.

MICROPROCESSORS/MICROPROGRAMMING HANDBOOK—Ward

An authoritative, practical guide to the construction, operation, programming and applications of perhaps the most significant new technological achievement of our time. Tells what microprocessors are, how they work, where they're used, and how YOU can use them in your own applications! Shows you how to write the necessary programs (called microprograms) to allow your microprocessor to process and manipulate information, simulate control processes, and emulate other machines. Covers every aspect of microprocessors—inside and out, and illustrates basic microprogramming techniques to build up program loops, subroutines, and handle interrupts from other peripheral devices. 294 pps., 176 illus. Hardbound.

Only \$9.95

To order, circle "B" under
TAB books on Reader Service Card.

OP AMP CIRCUIT DESIGN & APPLICATIONS—Carr

An easy-to-read, easy-to-understand, no-frills volume with ALL the applications info you need to put op amps right to work for you...you can design your own functional circuits as well as adapt the author's designs to your own requirements. Presents a straight-talking, practical course that thoroughly covers everything you should know on the subject. Early Chapters explain the operation of op amps; these basics are then applied in following Chapters in computational circuits, measuring instruments, active filters, regulated power supplies, AGC amplifiers, threshold detectors, zero-crossing detectors, and on and on. Not only is operation of each circuit explained, but simple design rules are included so that you can easily design you own—from the ground up! 280 pps., 239 illus. Hardbound.

Only \$9.95

To order, circle "H" under
TAB books on Reader Service Card.

MICROELECTRONICS—Hallmark

All together for the first time: the details on microcircuits—how they're fabricated, how to test them, select them, and even repair them! It's a real theory-and-practice handbook with practical circuit projects along the way to help you apply the principles you learn, among which is the fact that not all integrated circuits are irreparable black boxes—many ICs can be repaired, and you can do it! A sizeable section is devoted to digital logic applications. The elements of binary arithmetic, digital arithmetic and counting are also illustrated. Two Chapters show how op amps work. 22 projects include all sorts of amplifiers, oscillators, logic circuits, an electronic siren, a signal generator, and a precision frequency standard. 266 pps., 248 illus. Hardbound.

Only \$8.95

To order, circle "C" under
TAB books on Reader Service Card.

PRACTICAL CIRCUIT DESIGN FOR THE EXPERIMENTER—Tuite

In plain language, Don Tuite introduces the engineer's tools of analysis and design that are usually presented only in a four-year engineering course. And all you need to assimilate this invaluable data is an ability to work with algebra; all math presented is limited to just what you need to understand the principles of design. Thoroughly explains Kirchoff's laws, phase relationships, the Laplace transform, image parameter filter design, transmission line behavior, and active and passive nonlinear devices. Compares behavior of real components to predicted behavior and ideal components and amplifier models. Invaluable for bridging that technological gap between technician and engineer. 196 pps., 119 illus. Hardbound.

Only \$8.95

To order, circle "I" under
TAB books on Reader Service Card.

DIGITAL/LOGIC ELECTRONICS HANDBOOK—Hunter

Learn digital electronics, number systems, logic, and Boolean algebra while studying modern digital circuits for a clock, calculator, thermometer, multimeter, and interval timer in this down-to-earth book on logic and digital electronics...without the mass of formulas and equations found in many books, but with practical info. You are led step by step through the very basics of logic—from the invention of number systems to their modern applications in everyday events, how logic is applied to addition, subtraction, multiplication, and division. It's all here—basic digital circuitry, logic symbols and their meanings, integrated-circuit logic devices, and digital light-emitting diode circuits. 308 pps., 226 illus. Hardbound.

Only \$9.95

To order, circle "D" under
TAB books on Reader Service Card.

ELECTRONIC CIRCUIT DESIGN HANDBOOK—New 4th Edition

This new fourth edition contains 639 proven circuits for all types of functions, selected from thousands on the basis of originality and practical application. This detailed compilation of practical design data is the answer to the need for an organized gathering of proven circuits that can easily serve as stepping stones to almost any kind of circuit you might want to build...adapted or modified to suit your own specific needs. Here is a giant of a book—an 8½ x 11" hardbound volume of 416 pages, with 19 big sections of tried and tested circuits, which will serve as "imagination triggers" for anyone who has an interest in electronic circuit design and construction. Hardbound.

Only \$17.95

To order, circle "J" under
TAB books on Reader Service Card.

BASIC DIGITAL ELECTRONICS—Ryan

A modern reference offering painless explanations of digital circuits, number systems, Boolean algebra, all popular logic systems (discrete and IC), and a whole trick-bag full of useful digital building blocks. Describes the various types of digital circuits and their features. Covers all types of logic—from relay systems to advanced MOS circuitry—with objective comparisons of the various approaches. Several Chapters explain the basics of logic and introduce the logic diagram and truth table. With this background any digital circuit can be easily analyzed and understood. Contains virtually all the reference material you'll ever need on digital circuits. 210 pps., 117 illus. Hardbound.

Only \$7.95

To order, circle "E" under
TAB books on Reader Service Card.

ELECTRONICS UNRAVELED—A New Commonsense Approach—Kyle

For the first time ever, electronics is truly made simple. Author Kyle effortlessly and interestingly ties together tubes, transistors, and relays in an astoundingly clear exposition of their operational principles. Until now, readers have had to learn tube theory, then augment it with "add-on" theory about transistors. No book on tube theory ever really applied to solid-state electronics...until now. Kyle starts his active-element discussion with a detailed description of the simple relay. By analogy, the concept is applied to transistors, vacuum tubes, and all other active devices. He handles even the toughest concepts with disarming simplicity. Includes ultra simple but useful projects. 228 pps., 96 illus. Hardbound.

Only \$7.95

To order, circle "K" under
TAB books on Reader Service Card.

ELECTRONICS FOR SHUTTERBUGS—Brown & Olsen

The first section of this new volume acquaints photographers with the basic of electronic construction. There's no blue-sky theory here no matter how close you look. The second section, addressed to the seasoned experimenter, covers basic darkroom techniques and offers suggestions for the design of effective photo-processing and working quarters. The balance of the book is a compendium of useful circuits—divided into three categories: easy, intermediate, and advanced circuits. All projects can be easily available, low-cost solid-state components at a fraction of their commercial off-the-shelf cost. 204 pps., 109 ill. Hardbound.

Only \$8.95

To order, circle "F" under
TAB books on Reader Service Card.

COMPUTER TECHNICIAN'S HANDBOOK—Ward

If you have a working knowledge of semiconductors, you'll find in this brand-new, up-to-date volume all the information you need to check, troubleshoot, and maintain computer systems. This giant text—comparable to a 1000-hour course on computer maintenance—contains vital data on number systems, encoding and decoding, basic circuits, circuit blocks, counters, registers, memories, etc. With this book and a few weeks' study, you can be well on your way towards being a knowledgeable computer technician. Explains the similarities in concept and implementation common to all computers, from the smallest to the most complex. 480 pps., over 400 illus. Hardbound.

Only \$12.95

To order, circle "L" under
TAB books on Reader Service Card.

To order any of these books, circle the letter on the reader service card facing this page.

on FREE 10-Day Trial Basis!

BUILD YOUR OWN WORKING ROBOT—Heiserman

This one-of-a-kind book offers complete instructions—plans, schematics, logic circuits, and wiring diagrams—for building Buster, the most lovable (and mischievous) mechanical pet in the world! He'll serve you coffee or bring you the morning papers. He'll forage for his own "food" and scream when he can't find it. His "curiosity" will get him into one plight after another, but Buster has the capacity to get himself out of trouble just as easily as he got into it! Not a project for novices, Buster is a sophisticated experiment in cybernetics. You build him in phases, and watch his personality develop as you add progressively more advanced circuitry to his mainframe. 238 pps., 117 illus. Hardbound.

Only \$8.95

To order, circle "M" under
TAB books on Reader Service Card.

COMPUTER PROGRAMMING HANDBOOK—Stark

A complete guide to computer programming and data processing, with scores of worked-out examples. An extremely comprehensive, informative, and interesting work on digital computer programming, and data processing in general. And, it doesn't require a knowledge of higher mathematics to understand and use! This giant text covers all three types of computer languages—machine, symbolic, and problem-oriented (which focuses on FORTRAN IV—the universal language); each type is covered in detail, complete with worked-out examples which include computer printouts and actual results. If ever there was a one-book course on computer programming, this is it! 518 pps., 114 illus. Hardbound.

Only \$12.95

To order, circle "S" under
TAB books on Reader Service Card.

MOSFET CIRCUITS GUIDEBOOK—WITH 100 TESTED PROJECTS—Turner

Here are practical circuits for test instruments, audio amplifying-processing stages, RF-AF generators, switching devices...in very possibly the best projects book we've ever offered. A compact theory section tells how the MOSFET offers the best of both electronic worlds—vacuum tube and solid state—and shows how to avoid damage from voltage surges, prevent stray pickup, etc. The circuit section contains 100 of the most varied, useful, foolproof, and easy-to-build projects imaginable—basic, general-purpose circuits for technicians, hobbyists, hams, CBers, and audio buffs. All the plans are in the book—all worked out, checked out, and drawn out for fast, sure results. 196 pps., 111 illus. Hardbound.

Only \$7.95

To order, circle "N" under
TAB books on Reader Service Card.

DIGITAL ELECTRONICS: PRINCIPLES AND PRACTICE—Ward

Here is a read-and-do-it type lab-workbench handbook of practical basic theory, plus construction projects and experiments. Theory is followed by experiments which parallel and reinforce the theory. The content begins with the relationship of binary to decimal, octal, hexadecimal and any other numbering system. Convenience of using two-state devices is described. The author shows how to develop gates, devise basic circuits, and assemble counters. Contains complete instructions on parts to use, how to wire up the counter and how to operate it, and describes ready-to-assemble equipment and details for "building from scratch." 288 pps., 168 illus. Hardbound.

Only \$8.95

To order, circle "T" under
TAB books on Reader Service Card.

THE COMPLETE SHORTWAVE LISTENER'S HANDBOOK—Bennet

The most complete and authoritative guide ever published on shortwave listening—all you need to know to get started and become an expert in this exciting field! Thoroughly covers receivers, antennas, frequencies, radio-wave propagation, harmonics, Q codes, where to tune for various type stations, how to keep a logbook, stations of the world by general continental area and frequency, amateur radio, CB radio, FM and TV DXing, utility stations, time and standard frequency stations, FAA stations offering continuous weather broadcasts, worldwide and time chart, amateur and SWL abbreviations, Morse code, Q signals, official NNRC-WDX country list, callsign allocations, etc. 288 pages, 101 illus. Hardbound.

Only \$9.95

To order, circle "O" under
TAB books on Reader Service Card.

INTRODUCTION TO MEDICAL ELECTRONICS—Klein

A practical, modern approach to all phases of medical electronics! Various categories of electromedical equipment are keyed to physiological functions and electronic presentation (diagnostic machines). Many types of equipment are covered, from transducers (pickups), to building blocks such as amplifiers, to data readout, such as galvanometers and oscilloscopes. Includes such areas as proper usage of equipment, plus realistic evaluations of patient and equipment capabilities and limitations. Covers maintenance, evaluations of patient and equipment capabilities and limitations. Covers maintenance, fault serving, fault reporting, equipment management and follow-up for preventive maintenance and servicing. 272 pps., 131 illus. Hardbound.

Only \$9.95

To order, circle "U" under
TAB books on Reader Service Card.

AVIATION ELECTRONICS HANDBOOK—Safford

A complete, simplified guide to aviation electronics—for radio mechanics, avionics technicians, and pilots. Covers all types of complex avionics systems for military, private, and commercial planes. Discusses flight principles, avionics design, aviation communications, autopilots gyros, servos, servoamplifiers, sensors, and actuators, flight instruments, direction finders, navigation systems, radio altimetry, VOR and related systems, localizers, instrument landing, and distance-measuring systems, airborne radar, the use of computers in planes and air traffic control centers, and military electronics. Appendices contain a wealth of material you'll refer to time and again. 406 pps., 249 illus. Hardbound.

Only \$11.95

To order, circle "P" under
TAB books on Reader Service Card.

MODERN APPLICATIONS OF LINEAR ICs United Tech Pub's.

A rich collection of state-of-the-art circuit ideas, complete with descriptions of the latest IC's! Contains a wealth of valuable application rules. Each Chapter describes a specific, currently available IC; then follows with a spectrum of applications for it. Included are suggestions for minimizing such problems as noise, heat transfer, interfacing, and much, much more. Types of linear IC's covered include amplifiers (four Chapters are concerned with op amps, three others deal with non-op-amp amplifiers), multipliers, comparators, phase locked loop IC's, analog switches, voltage regulators, communication IC's, and consumer IC's 276 pps., score of illustrations. Hardbound.

Only \$12.95

To order, circle "V" under
TAB books on Reader Service Card.

GETTING THE MOST OUT OF YOUR ELECTRONIC CALCULATOR—Hunter

A fully indexed volume of never-before-published computation procedures you can put to use every day—to save time, effort, and money in a limitless variety of real-life situations! Dozens of practical examples are solved—using the calculator vs. pencil and paper. Each problem has a detailed solution showing which buttons to press and when to press them. Includes special shortcuts to extend the capabilities of even the simplest calculator. A Chapter on math explains arithmetic, concepts of ratios, averages, angles, percentages, fractions, temperature conversions, etc. Also covers kitchen uses, taxes, interest, unit conversions, unit pricing, mpxing calculations, etc. 204 pps., 28 illus. Hardbound.

Only \$7.95

To order, circle "Q" under
TAB books on Reader Service Card.

TRANSISTOR THEORY FOR TECHNICIANS & ENGINEERS—Veronis

A complete course in semiconductor theory, designed for advanced technicians and practicing engineers. It provides in-depth understanding of semiconductor parameters, device design and fabrication, transistor operation, and modern circuit theory. Diode and transistor action are carefully explained in terms of their most important properties. The internal parameters of transistors are described in relation to their role in determining the ultimate performance of a transistor in a circuit. The second half consists of analyses of transistors in basic circuits—common-emitter, common-base, and common collector—with objective comparisons of the various arrangements. 224 pps., 116 illus. Hardbound.

Only \$8.95

To order, circle "W" under
TAB books on Reader Service Card.

ADVANCED APPLICATIONS FOR POCKET CALCULATORS—Gilbert

Shows you what to do with your calculator after you've performed the simple calculations found in most instruction manuals. Emphasis is on new and unique applications which allow you to tap the full potential of your unit. Shows you how to turn an elementary 4-function calculator into an electronic slipstick and perform "scientific" computations. Completely covers the use and operation of electronic slide rule (scientific) calculators, programmable units, metric calculators, and the most advanced business types. All are fully explained in terms you can easily understand—and illustrated with literally hundreds of tables that show what keys to punch, when to punch them, and what you'll see. 308 pps., illus. Hardbound.

Only \$8.95

To order, circle "R" under
TAB books on Reader Service Card.

MODERN COMMUNICATIONS SWITCHING SYSTEMS—Hobbs

The most exhaustive text ever published on telephone terminal equipment, trunks, switching systems, and signal routing! Tells all about switchboards and electronic switching centers, and everything in between—technologically and chronologically! Whether you want to design switching systems, repair them, or just get to know them, you'll find this an invaluable guidebook. Everything from the local office to the computerized regional center is here in one book—not just the theory, but the hardware as well. Everything from Strowger and crossbar switches to ICs and digital memories is covered in depth. 276 pps., 171 illus. Hardbound.

Only \$17.95

To order, circle "X" under
TAB books on Reader Service Card.

To order any of these books, circle the letter on the reader service card facing this page.