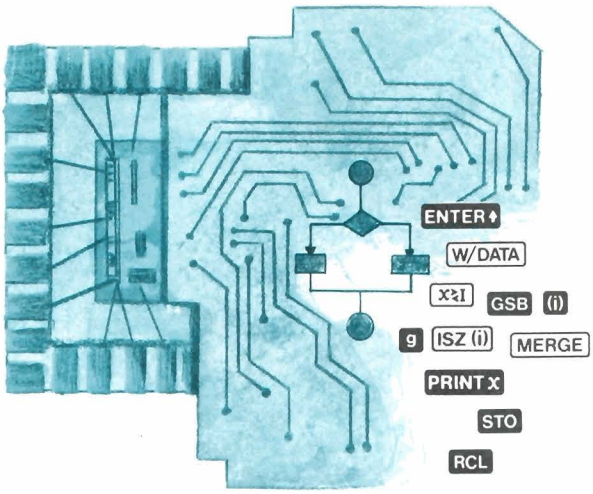


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Computer Museum

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HEWLETT PACKARD

# HP Key Notes

## The Wand You've Been Waiting For!

*Good news!* The **HP 82153A Optical Wand** began shipping in the United States July 1, with international shipments beginning two months later.

The HP 82153A Optical Wand is Hewlett-Packard's newest addition to the HP-41C calculating system. With the Wand, programming the HP-41C takes on yet another dimension. The Wand reads bar code, a quick, convenient, and inexpensive means of inputting HP-41C programs and data. This exciting capability is an important advancement in calculator technology, and it will no doubt contribute to your programming pleasure.

The Wand opens up a world of bar code benefits. By scanning rows of bar code, programs as well as data can be loaded much easier than by key entry—and without errors! Bar code is convenient, too, because it's printed on standard paper. You can store it in a three-ring binder, or send it to a friend as you would a letter. You can duplicate bar code with many office copiers, or with an offset printing machine.

Something you'll all be glad to hear is that all HP-41C Solutions Book and Users' Library programs are now available in bar code form. With The Wand, you can save time and improve accuracy when you load HP or user-contributed software.

Those of you who want to create your own bar code programs can do just that. Pressure-sensitive bar code labels are included with the Wand, allowing you to quickly paste-up short bar code programs with little effort. To help you develop long programs in bar code form, Hewlett-Packard has arranged for inexpensive bar code production with an independent firm, which promises high quality and excellent service. An order form for this service is included with the Wand. You can even produce your own bar code if you have access to a "daisy wheel" or "dot matrix" printer, or a plotter, or Comgraphics system, and purchase the "Creating Your Own Bar Codes" accessory, which will be available in the fall. More about that in your next KEY NOTES.

A great time-saver offered with the Wand is the paper keyboard. All of the HP-41C system functions, including peripheral functions, are printed on a paper keyboard in bar code form. By using the paper keyboard, many HP-41C functions can be entered faster and with fewer errors. As an example of time savings, you can execute the prompt function in one quick pass of the Wand, rather than by executing the nine keystrokes normally required. The paper keyboard is handy for function execution, data entry, and even while programming.

Some of you may want to know more about HP 82153A bar code. The Wand reads bar code formatted in a simple binary design, with narrow bars denoting zeros and wide bars denoting ones. Narrow bars have a minimum width of 15 mils and wide bars are twice the width of narrow bars. Spaces have the same width as narrow bars. Bar size can be larger than 15 mils, but bar and space sizes must increase proportionately. As the Wand scans over bar code, it recognizes alternating areas of low reflectance (bars) and high reflectance (spaces), as well as the differing widths of the bars themselves. You'll be happy to know that the Wand is a speed-reader of sorts, for it scans most effectively at rapid speeds.

By now you're probably saying "Price, price. What about the price?" The HP 82153A Optical Wand, which comes complete with Wand, owner's manual, paper keyboard, and pressure-sensitive labels, has a list price of $125* in the United States. With all of the time and money saving

(Continued on page 2)

*All prices in this newsletter are suggested retail prices excluding applicable state and local taxes—Continental U.S.A., Alaska and Hawaii.*

benefits it offers, many of you will no doubt be visiting your dealers for a closer look at this new addition to the HP-41C system. Once you see it, we're sure you'll agree the HP 82153A is a fantastic product—**"Wand" worth waiting for!**

## Wand Functions

We know you are going to want to see this new marvel at your nearest HP Dealer, so we have included here a bit more data about how it works. Then, when you go to see it, you'll be able to more quickly understand its use.

The Wand functions are contained in the Wand circuitry and become active in the HP-41C system whenever the Wand is plugged into the HP-41C. Wand functions may be executed manually or under program control in the same manner as other HP-41C functions. All can be terminated early by pressing the [←] or [R/S] keys. Following is a review of each Wand function.

The **WNDDTA** (Wand data) function halts a running program to allow you to scan a single row of numeric or alpha bar code. After you scan the row of data bar code, program executing resumes.

The **WNDDTX** (Wand data by X) function also halts a running program to let you scan data bar code. However, under WNDDTX control, you can load an entire set of data directly into one or more of the calculator's memory registers. You specify the registers to be used by placing a value BBB.EEE in the X-register prior to execution of WNDDTX, where BBB is the beginning data storage register address and EEE is the ending data storage register address.

The **WNDLNK** (Wand link) function causes the calculator to halt program execution so that you can use the Wand to load and automatically execute a new subroutine. If the new subroutine ends with a RTN instruction, the HP-41C will then automatically resume execution of the original program.

**WNDSUB** (Wand subroutine) works in a manner similar to WNDLNK, except that after the new subroutine is scanned, program execution resumes with the first instruction in memory after the WNDSUB instruction. The Wand's WNDSUB function is equivalent to the HP 82104A Card Reader's RSUB function.

**WNDSCN** (Wand scan) is a rather complex function intended for use in advanced applications. This function allows you to read nonstandard bar code or to define your own bar code functions. Basically, the function reads any row of bar code that follows HP's specifications for narrow bars, wide bars, and spaces, and then stores in the HP-41C's storage registers the decimal equivalent of the binary number represented by the bars. It does this in eight-bar (1 byte) increments, with a maximum of 16 bytes (128 bars) for any one scan.

The **WNDTST** (Wand test) function allows users to test the quality of their bar code, or if the bar code is in good condition, to identify that their Wand is not working properly. To use this function, execute WNDTST, then scan the bar code row in question. The bar sequence will be displayed eight bars at a time, allowing easy review by the user.

## New HP-41C Power Source Available

In the last issue we said we would tell you about a new power source for the HP-41C. True to our word, here it is: the *HP 82120A Rechargeable Battery Pack.*

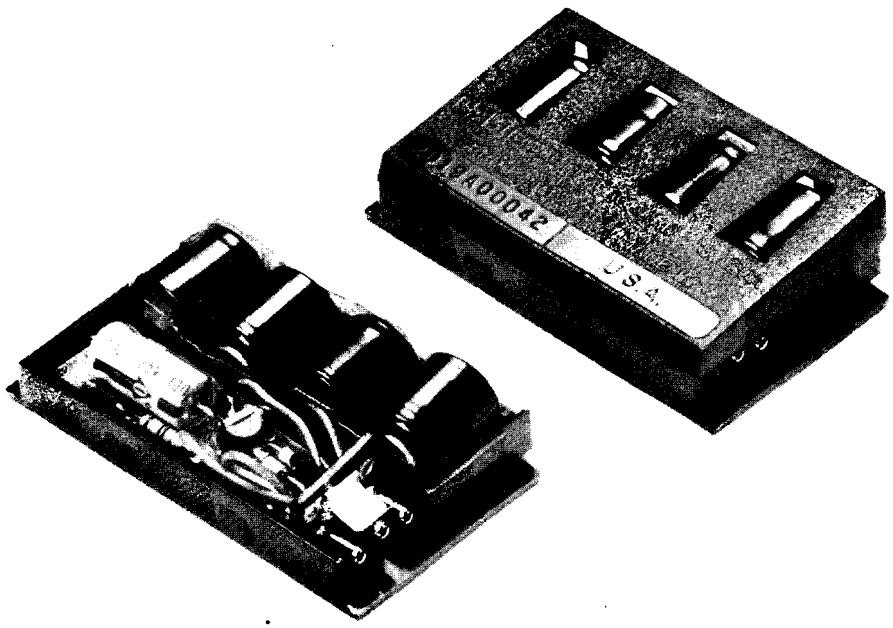
As you can see in the photograph, it is exactly the size and shape of the present battery case assembly, and they are interchangeable. On the right is the complete pack and on the left it is shown with the bottom cover removed. Besides the four nickel-cadmium batteries, there is some circuitry that rectifies and regulates AC to DC and powers the calculator while the batteries are being charged.

Fully charged, the Rechargeable Battery Pack will typically provide 6 to 12 hours of continuous program-running time for the HP-41C, with no plug-in peripherals or accessories. It takes 12 to 16 hours to fully charge the pack. If the pack is fully discharged, it takes about 60 seconds of charging before the first card-read can be accomplished. On a fully charged pack, you can expect about 300 card-reads. Typical nominal lifetime for the new pack is about 500 charge/discharge cycles, which is approximately equal to 50 to 100 alkaline N-cell batteries.

Let's look at the battery life question one more time, because a lot of people are not familiar with rechargeable battery idiosyncrasies. Nickel-cadmium batteries have very long operating "lives," whether you measure by their number of charge/discharge cycles or by the actual number of years they last. Also, these cells can offer long and trouble-free lives whether they are actively used in a repeated charge/discharge mode or maintained by trickle-charge in a ready-to-use condition. They will normally operate for more than 1000 charge/discharge cycles, which allows the user to avoid the inconvenience of replacing primary cells—not to mention the cost of dozens and dozens of primary cells.

Let's also look at life expectancy, which is of special interest to owners of portable electronic machines. The life expectancy of the type of nickel-cadmium cells we use in the HP 82120A Rechargeable Battery Pack, used in a charge/rest/discharge routine, can be considered in terms of the number of charge/discharge cycles required to deplete the available capacity to 50 percent of the rated value. Thus, depending on the variations in the conditions of use, the life expectancy of these cells ranges from 500 cycles to well more than 1000 cycles. Typically, these cells will produce a minimum of 80 percent of their rated capacity for 500 cycles.

Most rechargeable battery packs that fail early are not used in a normal charge/



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discharge manner. They are often used, say, one hour and then recharged. Repeated over and over, this greatly reduces the normal life of the pack. However, if charged, used over long periods, and *then* recharged, the rechargeable packs *do* exhibit very long life. Properly used, rechargeable battery packs will give you long life, reliable service, and very economical operating costs.

The new HP 82120A Rechargeable Battery Pack can be recharged in or out of the calculator, using the same AC adapter/recharger used for the HP-41C printer. The Rechargeable Battery Pack is NOT supplied with a recharger. If you don't have one for the printer, you should order or buy it separately.

Cost of the new battery pack is $40.*

## Library Corner

We have very good news for our European readers: this column will no longer be deleted from the European issue of KEY NOTES. In the past, because of problems involved in selling U.S. Library programs in Europe, we could not include them here. Now, since we have solved those problems, all of the programs you see in KEY NOTES will be available from both Corvallis and Geneva. But, before you order any, *make sure you read the paragraph below*: **"Ordering Programs."**

### GENEVA LIBRARY NEWS

In the next issue, we will start a column of specific news about "Users' Club Europe," for our faithful readers in that part of the world. As you can see, KEY NOTES is becoming a more universal—or world wide—newsletter, and we expect to be able to produce only *one* version in the near future, rather than two, as we now do. That also means that there will be more access to programs in both Libraries, and we are sure that this will please everyone. Making the programs in this issue available in Europe is the first step, and we expect others will soon follow. But, before you order, be sure to read: **"Ordering Programs."**

### CORVALLIS LIBRARY NEWS

There are now over 4400 programs in the HP-67/97 Library and over 450 programs in the HP-41C Library. And, best of all, HP-41C programs are now starting to literally **pour** in! By the time we produce the next KEY NOTES, this mass of programs will have been processed and verified, so we should have some interesting ones to highlight in this column.

### CATALOG UPDATE

A new *Catalog* update for the Corvallis Library is fresh off the press. It is *Addendum #1* to the November 1979 *Catalog*. It was mailed bulk rate to all current subscribers to the Users' Library, so it may take a while to get to you. Please wait until the end of September before contacting the Users' Library.

This update includes 271 new HP-41C programs and 319 HP-67/97 programs. Our Applications Engineers tell us that 95% of the HP-67/97 programs will work in the HP-41C, providing you have at least one Memory Module in your HP-41C. However, if you receive a program that will not work, the Users' Library will either replace it or refund your money.

### ORDER TURNAROUND

The Corvallis Library is excited about a new function that they have undertaken—that of handling the Order Processing of your order. With this new responsibility, they expect to provide better service for you. Since acquiring this function, they have been able to maintain a 48-hour turnaround on subscriptions and program orders. As always, along with cash orders, your credit card and company purchase orders are welcome.

### ORDERING PROGRAMS

HP-67/97 and HP-41C programs mentioned in KEY NOTES are now available from both the Library in Corvallis and the Library in Geneva. Readers in Europe should order from Geneva (address on back cover) to get quicker service. Readers elsewhere should order from Corvallis, where programs cost $6* each, and each program includes documentation and a prerecorded magnetic card. Whenever possible, use the Users' Library Order Form in your *Catalog of Contributed Programs* to place orders for programs you see in KEY NOTES. If you do not have an order form or if you are ordering from Europe or Asia, a plain piece of paper with your name and address and the program numbers you desire is certainly adequate. **Make certain that your address is legible and complete.**

Mail your order and a check or money order to the Corvallis address shown on the back cover of KEY NOTES. Don't forget to include your State or local taxes. Or, in the U.S., you can place your order by calling toll-free: 800-547-3400, except Alaska and Hawaii (in Oregon call 758-1010).

** U.S. dollars. Orders from anywhere outside the U.S. must include a negotiable check (or money order), in U.S. dollars, drawn on a U.S. bank. All orders from anywhere outside the U.S. must include an additional 10% for special handling and air mail postage. (For example, an order for two programs = $6 × 2 = $12 + $1.20 = $13.20 total.) If you live in Europe, you can order directly from Geneva,* but make certain you make payment as required by the Geneva Library; *the above $6 fee is good only for orders to the Corvallis Library.*

### NEW PROGRAMS

Here are some interesting new submittals covering a very wide field of interests. All of the programs in this issue are available worldwide, *but before you order, be sure to read (above)* **"Ordering Programs."**

**(41C) Script Letters (#00099C)**

This program uses the "special-characters" feature of the HP 82143A Printer to form legible script characters. (89 lines, 8 pages.)

Author: **Kenneth E. Newcomer**
Corvallis, Oregon

**(41C) Musical Composer (Complete) (#00312C)**

With *this* program, your calculator can compose music! The program selects an appropriate tempo and then calculates the pitch and duration for each note or rest, which is then displayed, using the alphanumeric capabilities of the HP-41C. You may select any number of beats per measure, and you can vary the length of a note by using the "add-a-beat" feature. *Only the HP-41C is needed to run this program.* (203 lines, 10 pages)

Author: **Richard S. Altman**
Richmond, California

**(41C) Diet Planning (With Output Labeling) (#00316C)**

Most diet plans only count calories for a fixed-calorie input, regardless of an individual's caloric requirements. This program estimates an individual's basal metabolism from height, weight, age, and sex. Then the required calories per day for maintaining (or changing) weight are estimated, using the hours per day spent at each of five activity levels. The program is based on HP-97 Program #01074D. *One Memory Module is necessary.*
(171 lines, 9 pages)

Author: **Richard Altman**
Richmond, California

**(41C) Simplex Algorithm (#00320C)**

This program uses the simplex techniques to optimize the objective function of a set of linear inequalities. Main features of the program are: relatively fast execution, size of matrix (only limitation to the size is number of Memory Modules available), minimize or maximize options, error messages, review and check input data option, and a correctly labeled output. With two Memory Modules up to a 77-element matrix can be handled. *The array size in* this *program requires two Memory Modules.* (401 lines, 13 pages).

Author: **Laurence A. Esterhuizen**
Johannesburg, South Africa

**(41C) Molecular Weight Calculator (#00326C)**

This program calculates molecular weight from the chemical formula for the molecule. For example, to compute the molecular weight of sodium sulphate, $Na_2SO_4$, the user keys in Na, 2, S, 1, O, 4 in response to prompts in the program. The chemical formula is displayed together with the molecular weight. You also can look up the atomic number, given the chemical symbol for an element; and you can look up the

(Continued)

**U.S. dollars. See note at bottom edge of cover.*

atomic weight, given the atomic number. *Requires one Memory Module.* (160 lines, 7 pages)

Author: **Dave Conklin**
Corvallis, Oregon

**(41C) Resistor Color Code Chart (#00328C)**

This program gives the exact value of a resistor when the three color bands are keyed into the calculator. Also, if the fourth color band is keyed in, the program will calculate the high and low tolerance values. *Requires one Memory Module.* (254 lines, 8 pages)

Author: **David D. Walton**
Cincinnati, Ohio

**(41C) LAN Error Minimization (#00347C)**

Given a sequence of sun shots made before, during, and after Local Apparent Noon, the program determines the most likely time of LAN and the sextant altitude of LAN by fitting a parabola to the data, with the mean square error minimized and the slope of the directrix constrained to be infinite. *Requires one Memory Module, and printer is optional.* (180 lines, 9 pages)

Author: **Curtis G. Adams**
Sun Valley, Idaho

**(41C) Gasoline Consumption Analysis (#00372C)**

This programme enables a vehicle operator to keep a tank-by-tank record of gasoline consumption and cost. A record is kept on a magnetic data card, and it is updated for each tankful. A summary programme will display/print totals to date for volume, distance, and cash. It also displays/prints averages, over the period concerned, for consumption, cost per unit volume, and cost per unit distance. There are duplicate routines for Metric/English, an automatic print routine, and fully prompted inputs and labelled outputs. *Requires a card reader, and a printer is optional.* (340 lines, 10 pages)

Author: **Arthur C. Attwell**
Durban, South Africa

**(41C) Print Checkbook Listing (#00375C)**

This program tabulates and prints checkbook balances and items (checks or deposits) from your checkbook listing or bank reconciliation statement. It arranges by column and prints check number, deposit date, "C" or "D" as appropriate, amount of check or deposit, and balance (positive or negative). *Requires a printer.* (142 lines, 7 pages)

Author: **Bob Curry**
Austin, Texas

**(41C) Triangle Solution—Automated (#00392C)**

This program finds the unknown parts of a triangle. You enter the known parts in arbitrary order; the program chooses the proper algorithm and generates the solution. Then you request the output, in any order. After key assignments are cleared, this program will run on an HP-41C without Memory Modules. (230 lines, 8 pages)

Author: **Keith Jarrett**
Manhattan Beach, California

**(41C) PI- and T-Network Calculator With Plot Option (#00415C)**

This program calculates normalized reactances for PI- and T-networks. Inputs are source and load normalized impedances (either series or parallel). Outputs are series/parallel equivalents of source and load; values of JX2, JX3, JX4, and JX5 for the selected network; and relative power response of network, with plot option. *Requires one Memory Module (printer optional).* (334 lines, 17 pages)

Author: **John S. Sutton**
Tucson, Arizona

**(41C) Tissue Blood Flow (#00421C)**

This program solves equations associated with a thermodynamic technique for measuring regional tissue blood flow and heat transfer characteristics. (Also listed below for HP-67/97 as program #04366D.) *Requires one Memory Module.* (238 lines, 9 pages)

Author: **Dr. Thomas Adams, Dr. S. R. Heisey, Dr. M. C. Smith, Mr. M. A. Steinmetz, Mr. J. C. Hartman, and Ms. H. K. Fry**
East Lansing, Michigan

*(This program was originally written as an aid in solving some complex equations in an article written by the above authors. The article, "Thermodynamic Technique for the Quantification of Regional Blood Flow," is copyrighted by the American Physiological Society; Am. J. Physiol. 238 (Heart Circ. Physiol. 7): H682-H696, 1980. The authors are in the Departments of Physiology and Mechanical Engineering at Michigan State University in East Lansing, Michigan. My congratulations to them for their fine work and to Dr. Adams for bringing this to my attention. Ed.)*

**(41C) Foreign Currency Converter (#00432C)**

This program consists of two related routines that enable: (a) conversions between any two of the 52 stored currencies; (b) conversion from 1 to all 51 other currencies. It also provides interconversion between any foreign currency and your "home" currency. Added features are convenient entry and error recovery. *Requires two Memory Modules (three preferable), and a card reader is optional.* (223 lines, 18 pages)

Author: **George G. Sandoval, Jr.**
Caloocan, Philippines

**(41C) Buy and Sell Stock Market Timing (#00449C)**

This program anticipates bull and bear markets using readily available (*The Wall Street Journal*) short sales information of "insiders" activities. This is not a "hot tip" approach, but one used by canny investors who have achieved remarkable success at predicting shifts of 10% or more in stock prices. *Requires no peripherals, but a printer can be used effectively.* (78 lines, 7 pages)

Author: **Norman J. Gordon**
Los Altos Hills, California

*(Before you scoff, check the author's hometown; it has one of the highest per capita income rates—if not* the highest—*in the U.S. If you buy this program and strike it rich, don't forget to mention you "...owe it all to KEY NOTES." Ed.)*

**(67/97) Bode of Ratio of Polynomials in S (#04302D)**

This program provides gain and phase angle plots versus frequency for transfer functions expressed by the ratio of polynomials in S, to the sixth power in the numerator and to the seventh power in the denominator. On entry, term coefficients are tagged by the associated power of S for orderly processing within the program without further consideration by the user. (168 lines, 6 pages)

Author: **Martin H. Oxman**
Malden, Massachusetts

*(The above program came to my attention because the Applications Engineer who reviewed it wrote, "We have received many such programs, but this one is implemented better—in my view, at least—than any other." Congratulations, Mr. Oxman. Ed.)*

**(67/97) Tissue Blood Flow (#04366D)**

This program is the HP-67/97 version of the HP-41C program (#00421C) listed above. (139 lines, 8 pages)

Next, we have for you some *large* program contributions. The first group of four, by **Kenneth R. Dawson**, are newer additions to the Library. (Several other of his programs are listed in your Catalog.) These are excellent examples of what can be done with a card-programmable calculator, and they are exceptionally well annotated, described, and researched. Congratulations, Mr. Dawson!

**(67/97) Curved Beam Loaded Normal to the Plane of Curvature (#04245D)**

This program solves for the transverse shear, bending moment, twisting moment, deflection, bending slope, and roll slope at any point on a curved beam having clamped ends. Load is applied perpendicular to the plane of curvature as a point load, moment, or torque. (Reference: Roark, $5^{th}$ edition, table 19, cases 1E, 2E, 3E.) (409 lines, 12 pages)

Author: **Kenneth R. Dawson**
Alpine, California

**(67/97) Local Crippling of Compressive Elements (#04246D)**

This program will compute the third variable from the other two variables in the crippling equation. It is useful for optimizing

the elements of a beam cross-section for maximum efficiency. The three variables are element length (b), element thickness (t), and crippling stress (fcc). Crippling stress may be for one end free or both ends fixed. The program also will compute crippling stress of a section (fcc). The equations used are applicable to all ductile aircraft alloys at both room and elevated temperatures. (130 lines, 8 pages)

Author: **Kenneth R. Dawson**
Alpine, California

**(67/97) Fastener Reactions—Eccentric Loading (#04258D)**

This program computes the shear load and shear load angle acting on each fastener in an eccentrically loaded joint. A joint may consist of any number of fasteners up to a maximum of 15. Fastener locations are specified by their x and y coordinates relative to any point of origin. The force acting on the joint may be inputted in three different formats. The program then computes and displays the centroid of the fastener pattern as well as fastener number, load, and angle of load for each fastener in the joint. (211 lines, 5 pages)

Author: **Kenneth R. Dawson**
Alpine, California

**(67/97) Cubic Spline Curve Fit With Simpson's Rule Integration (#04294D)**

A curve is generated through 2 to 9 equally spaced points, using the cubic spline method. This method produces a curve fit that is much the same as one would draw freehand. Output options include single point interpolated values or a sweep of values over a user-defined range and increment size. An option is also provided to include numerical integration using Simpson's rule through the sweep. (224 lines, 7 pages)

Author: **Kenneth R. Dawson**
Alpine, California

And last, but not least, here are 27 programs by **Allan T. Seidcheck**, who, at last count, had well over 100 HP-67/97 programs accepted into the Library. Mr. Seidcheck is a retired engineer who lives in Pahoa, Hawaii and, literally, lays on the beach and writes programs with his HP-97.

All of the programs are typed; many have elaborate descriptions and drafting-quality drawings. They cover a broad range of practical, real-world mechanical engineering design problems. They feature consistent input and output formats for ease of use. Sample problems have more than just outputs typed on the page; also included is a discussion of the *significance* of the result, why or why not it is usable, and whether it is consistent with common design practices and off-the-shelf component availability.

No one program is exceptional; however, the *set* certainly provides a broad range of fast, consistent, well-documented solutions. These are sit-down-at-your-desk-and-design-something types of programs. Mr. Seidcheck has contributed a marvelous asset to the world of programmable calculators, and an invaluable tool for engineers—or even teachers—everywhere.

**(#04234D) Size of Pully Setscrew.** Given shaft diameter and speed, and horsepower to be transmitted, program outputs the torque developed in the shaft, and the setscrew diameter required. (49 lines, 4 pages)

**(#04235D) Sizing Steam Engines for Desired Horsepower.** Given the mean effective steam pressure, number of strokes per minute of the piston, the ratio of length of stroke to diameter of cylinder, and the desired horsepower, program outputs the required cylinder diameter and the length of stroke of a steam engine. (42 lines, 4 pages)

**(#0436D) Indicated Horsepower of Steam Engine.** Given the mean effective pressure, piston diameter, length of piston stroke, and engine flywheel speed, program outputs the indicated horsepower of a steam engine. (51 lines, 4 pages)

**(#04237D) Hobbing, Splining, and Serrating Time.** Given the hob diameter, feed, cutting speed, depth of gear tooth, spline, or serration, program outputs the hob rpm, hobbing time per piece, and hourly production rate for hobbing spur or helical gears, splines, or serrations. (103 lines, 5 pages)

**(#04238D) Presswork Force for Piercing, Blanking, and Bending.** Given the length of the cut or bend, the material thickness and its shear strength for punching or its tensile strength and the width of unsupported metal for bending, program outputs the required force for punching, or for 'U' or channel bends, right-angle edge bends, and V bends. (105 lines, 4 pages)

**(#04239D) Square and Flat Plain Keys for Machine Shafts.** Given the shaft diameter and rpm, horsepower transmitted, allowable shear and compressive stresses in the key, and the recommended key size from the table provided, program outputs the torque acting on the shaft, shear force acting on the key, dimension from the bottom of the keyseat to the opposite side of the shaft, and the required length of a square or flat plain parallel machine shaft key. (92 lines, 6 pages)

**(#04240D) Finned-Tube Heat Exchangers for Diesel Engines.** Given the rated brake horsepower of a four-cycle diesel engine and a value from the table provided, program outputs the required heat exchanger surface area and the number of finned tubes required, enabling the designer to select the tube diameter and length for a finned-tube heat exchanger to cool the jacket water. (59 lines, 5 pages)

**(#04241D) Sizing Decanter-Type Separator Tanks.** Given the liquid flow rate, densities of the two liquids and the time required for settling, program outputs the required tank volume (gallons), required tank dimensions (feet), total liquid depth (feet), height of the heavier liquid (feet), and height of the heavy-liquid overflow (feet), for a decanter-type separator tank using gravitational force for continuous separation of two liquids. (97 lines, 5 pages)

**(#04242D) Bank of Highway or Railroad Track for Given Speed.** Given the speed of the vehicle or train, tread or track gage, and the degree of curvature of the highway or track, program outputs the elevation of the outer wheel above the inner wheel of the vehicle or train and the angle of the bank to eliminate side-slip or flange pressure of the wheels. (89 lines, 5 pages)

**(#04243D) Specific Gravity and API Gravity.** Given either the specific gravity or API gravity of any liquid, program outputs the specific gravity, API gravity, Baume gravity, weight, pounds per cubic foot, and pounds per gallon of the liquid. (106 lines, 4 pages)

**(#04244D) Horsepower Required to Adiabatically Compress Air.** Given the number of cubic feet per minute of free air to be compressed and the absolute terminal pressure, this program outputs the horsepower required to adiabatically compress the air for one-, two-, three-, or four-stage compressors. (126 lines, 5 pages)

**(#04247D) Trial Blank Diameters for Round Shells.** Given the dimensions of the shell to be drawn, program outputs the trial blank diameter for twelve configurations of round drawn shells conforming to the sketches provided. (380 lines, 11 pages)

**(#04248D) Equivalent Bending Moment and Ideal Torque for a Shaft.** Given the diameter, maximum allowable bending stress, and the maximum bending moment and torque acting on the shaft, program outputs the equivalent bending moment, section moment of inertia, ideal torque, stress developed in the shaft, and maximum equivalent bending moment of the shaft. (81 lines, 4 pages)

**(#04249D) Cutting Speed for Lowest-Cost Machining.** Given the maximum feed for which an acceptable finish is obtained at a trial rpm, length of cut, labor and overhead cost, tool change cost, and number of pieces produced per tool change, the program outputs the optimization factor and the optimal cutting speed for the operation. (77 lines, 4 pages)

**(#4250D) Wire-Rope Drum Analysis.** Program calculates the combined stresses, bending stresses, and outputs the tread diameter, outside diameter, and inside diameter of a soft-cast iron wire-rope drum for a given load, rope type, and rope diameter. (101 lines, 5 pages)

(Continued)

**(#4251D) Supporting Weight by Rope Wound About Pulley or Drum.** Given the weight suspended, force exerted at free end of rope, and the coefficient of friction of repose from the table provided, program outputs the number of turns of a hemp-or-wire rope about a pully or grooved drum required to support the weight. (37 lines, 5 pages)

**(#04252D) Selection of Roller and Ball Bearings for Reliability.** Given the required operating life in millions of revolutions, the equivalent radial load on the bearing, and the required reliability factor, program outputs the required basic load rating of a roller or ball bearing, using the Weibull equation. (74 lines, 4 pages)

**(#04253D) Toggle-Joint Mechanism Analysis.** Given the lengths of the toggle arms and the force exerted on the toggle joint, program outputs the travel of the slide and the force output at the slide in 5-degree increments for design analysis of a toggle-joint mechanism. (149 lines, 6 pages)

**(#04254D) Compounded Toggle-Joint Mechanism Analysis.** Given the handle length, lengths of the toggle arms, and the force exerted on the handle, program outputs the travel of the slide and the force output at the slide in 5-degree increments, for design analysis of hand-actuated toggle-joint mechanisms. (196 lines, 7 pages)

**(#04255D) Three-Wire Measurement of Screw Threads and Worms.** Given the included angle, lead, number of starts, and the basic pitch diameter of the thread or worm, program outputs the lead angle, exact wire size, the basic measurement over the wires, one-half the included angle of the cutter or grinding wheel, and the included angle of the cutter or grinding wheel, for milled or ground threads or worms, using the Buckingham formula, which includes the effect of the helix angle. (74 lines, 5 pages)

**(#04256D) Selection of a Rigid Flange-Type Shaft Coupling.** Given the bolt-circle diameter, torque to be transmitted, allowable bolt shear stress, allowable hub bearing stress, diameter of the shaft, and the key thickness, program outputs the shear force acting at the bolt-circle radius, bolt diameter, number of bolts, shear stress in the bolts, minimum flange thickness, and minimum hub and key length of a rigid flange-type shaft coupling. (97 lines, 5 pages)

**(#04257D) Universal Joint Power-Coupling Analysis.** Given the input shaft rotative speed, the maximum angular misalignment of the output shaft, and factors from the table provided, program outputs the speed variation and maximum acceleration of the output shaft of a universal joint power-coupling arrangement. (51 lines, 5 pages)

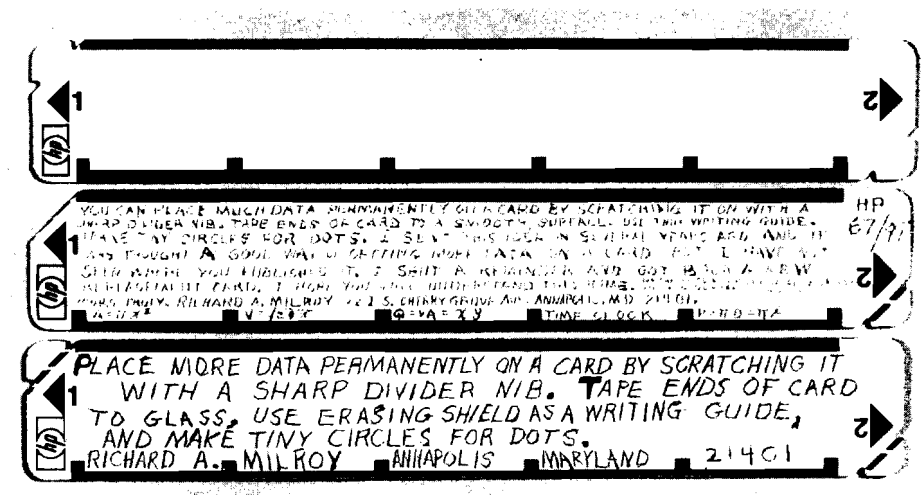
**(#04341D) Cutting Elements of Flat Form Tools.** Given the angles and steps of the workpiece and the clearance angle and top rake—if any—of the form tool, program outputs the angles and step dimensions as measured in a place perpendicular to the front edge of the tool. This program may be used for calculating the elements of skiving tools as well as flat or dovetail tools. (96 lines, 5 pages)

**(#04342D) Cone Clutch Transmission of Power.** Given the horsepower transmitted, the rpm, the angle of the cone contact surfaces with the axis of the clutch, the longitudinal length of engagement of the contact surfaces, and the coefficient of friction between the contact surfaces, program outputs the longitudinal force (spring pressure) required to hold the two faces of a cone friction clutch in contact without slipping. (59 lines, 5 pages)

**(#04346D) Parabolic Cable Tension and Length.** Given the span, cable sag, and uniformly distributed load the cable carries, program outputs the tension in the cable at mid-span and at the supports and the length of the cable. A cable carrying a load uniformly distributed along the horizontal assumes the form of a parabolic arc; for example, a suspension bridge cable. (55 lines, 4 pages)

**(#04347D) Bend Allowances for Sheet Metal.** Given the angle of the bend, inside bend radius, and the material thickness, program outputs the length of material required to make the bend (bend allowance). (40 lines, 5 pages)

**(#04348D) Planetary Gear Mechanisms.** Given either the pitch diameters or the number of teeth of the gears, program outputs the number of turns of the driver to one of the follower and the number of turns of the follower to one of the driver for ten cases of planetary gear mechanisms. Each case is diagrammatically illustrated and explained. (215 lines, 9 pages)




## How Small Can You Write?

At one time or another, we all wonder how to get more information on the face of a magnetic card. And, from time to time, we have published various ways to write small or to use tiny "rub-on" lettering (which *can* come off in the card reader and cause many problems!).

But in all this time, we have not seen anyone surpass **Richard A. Milroy's** method of literally writing a book on a magnetic card. He sent this to us quite a long time ago, but it somehow never got the opportunity to get printed in KEY NOTES. But, as you can see, this method *does* work, and you can squeeze an awful lot of type on the face of a card.

Mr. Milroy uses an "erasing shield," and the sharp pointed end of a divider to scratch the letters on the white face of a magnetic card. To write *really* small, he employs a magnifying glass. And, as you can see, there isn't much doubt about how well this method works.

If you do not have an erasing shield, you can use a small lettering guide or similar device. And there are many sharp-pointed tools and objects that can be substituted for dividers. And to keep the card from moving while you etch the lettering on it, use masking tape on the outer edges of the card(s). Then make sure you clean off any tiny chips, so they do not get into the tiny slot in the head of the card reader.

Thank you, Mr. Milroy, for sharing this neat trick with our readers.

# Efficient Use of HP-41C
## Status, Data, and WALL Cards

The card readers of the HP-67 and HP-97 calculators were improved versions of the one used in the first pocket calculator with a card reader, the HP-65. The added user-convenience features of the HP-67 and HP-97 machines were aptly described by calling these card readers "smart" card readers. The "smart" card reader provided the user with such features as recording either program or data, or even mixing the two on the same card. The reading of additional program steps under program control (automatically reading the card when needed if it was inserted into the card reader) and the ability to merge programs into memory are examples of the increased features of the HP-67/97 card reader. These card readers were especially "smart" because they automatically knew what type of card (data or program) they were reading, and if it was track one or track two.

The HP 82104A Card Reader is one part of the HP-41C Calculator System. The HP-41C card reader, like all HP-41C peripherals, adds more to the capability of the HP-41C than just adding the function of reading and recording cards. This card reader is certainly "smarter" than its predecessors, for its capability goes beyond the flexible reading and recording of programs and data. Table 1 briefly outlines the capabilities of the HP-41C card reader. This article discusses Status cards, Data cards, and WALL cards, with respect to getting the most from magnetic cards when using the HP 82104A Card Reader.

**Table 1. HP-41C Card Reader Functions**

| Function | Remarks |
|---|---|
| a. Read 67/97 data and program cards. | Translates 67/97 contents to 41C compatible instructions, as required. |
| b. Record STATUS. | Angular modes, flags, stack, and alpha registers. |
| c. Record DATA Registers. | All registers, or as specified by WDTAX. |
| d. Record program. | Records local portion of memory. |
| e. Write all programs and data registers. | Records *entire* contents of calculator on cards. |
| f. HP-67/97 features. | Adds functions like RCLΣ and P⇌S. |
| g. Verify. | Confirms valid read; provides track No. read, number of tracks of set, and also identifies if card is HP-67/97 program or data card. |

## STATUS CARDS

The "smart" card reader of the HP-67/97 recorded the flag, the display setting, and the angular mode. But the HP-41C card reader carries this concept further. A separate function, called "Write Status" (WSTS), has been added. When this function is executed, the display will show "RDY kk OF nn," where kk is the number of the next track to be written and nn is the total number of tracks required to record the status information.

**Table 2. Status Card Organization**

| Track | Contents |
|---|---|
| 1 | Flags 00 thru 43.<br>ΣREG location (first of six ΣREG's).<br>SIZE.<br>STACK and ALPHA register contents. |
| 2 | First 32 key assignments. |
| 3 | Next 32 key assignments (if required). |
| 4 | Remaining key assignments (65-68). |

Table 2 implies that the contents of a single track can be read and that the "RDY kk OF nn" prompt can be cleared with the [←] (correction) key. This is indeed true. Suppose, for example, that a group of 32 functions is assigned to unshifted keys, followed by the remaining keys, so that all of these assignments would be recorded as noted in the table. Track 2 would contain the first shifted key assignments, track 3 the unshifted key assignments, and track 4 the remaining (mixed) key assignments. Any track can be read, and further reads can be terminated by pressing the [←] key. This applies to almost any combination of tracks. If all four tracks had been read, and a new read status session is started with only track 4 read, all previous assignments would be cleared and only those on track 4 would be present.

The feature of terminated-key-assignment card-reads clearing all previous assignments suggests a useful technique to avoid clearing each key or performing a "Master Clear." Make up a "Clear Assignments" card as follows:

1. "Master Clear" or remove all key assignments.
2. Assign "ASN" to key 15.
3. [XEQ] WSTS.
4. Feed track 1 in response to RDY 01 of 02.
5. Feed track 1 *again* in response to RDY 02 of 02.

This procedure records only track 2. To use the card, simply read (track 1), press [←], [E], ALPHA, ALPHA [E]. All assignments are cleared. [XEQ] PACK to recover the registers used for the assignments. A fully assigned keyboard could use 34 registers.

Another use for selective reading of Status cards is automatically setting the SIZE of the calculator for a program. Simply make the first track of the program-set a Status card that SIZE's memory. If there are programs in memory and the SIZE can't be set to the value recorded on the Status card, a brief "SZE ERR" message will be displayed and the SIZE will remain unchanged. When this happens, programs will have to be deleted to make room.

An added enhancement to using a Status card to set SIZE is to have an appropriate ALPHA message in the X-register. This six-character message may provide instructions such as "CONT." for continue reading cards, or "ALPHA," to prompt you to press the ALPHA key to read a longer (24 character) message. Possibly the number of additional tracks to be read could be displayed, or the program name. The procedure of using a Status card to set size saves 10 keystrokes. It also offers the advantages of setting flags and locating ΣREG, in addition to filling the stack and the ALPHA register.

The technique of recording only track 2 if 32 or less key assignments are needed makes maximum use of magnetic cards. It is probably a good idea to make a notation on the card to remind you that: "Track 1 is not recorded." Making efficient use of magnetic cards also applies to Program cards. Whenever a program is to be recorded on magnetic cards, it is good practice to [XEQ] PACK prior to recording the program. This procedure removes the NULLS the HP-41C places into program memory during editing. The unpacked NULLS are recorded and may require an additional track if not removed by packing.

The most important consideration in "mixing" tracks of a Status card-set is to not mix track 1 with other tracks unless the complete set is to be read.

## DATA CARDS

The HP-41C card reader stores 16 registers on each track of a magnetic card. A Data card containing 17 registers of data would cause the experienced programmer, as a matter of good programming practice, to reevaluate the register usage to trim one register. This is especially important if the number of tracks for the Program/Data card-set is odd. Saving one register could save one whole card!

In many program usage situations, it is confusing to have both Program and Data cards. Decreased magnetic card usage and simpler user instructions often result if the "data" is entered as part of the program. Flag 11 (auto execution) is set when the program is recorded, and the first part of the program automatically executes to store the data into the registers. This method of combining data and program greatly simplifies program usage. Data cards, like status cards, may be read "as needed," with the

(Continued)

read operation terminated if the remaining track "numbers" are not needed. The data is stored in the registers as recorded on the card.

### WRITE-ALL

Generally, the write-all (WALL) function of the HP-41C is used only when you want to record the entire contents of the calculator. This is most convenient when you interrupt a programming session and you wish to resume with the machine in the exact state it was in when you stopped. However, several characteristics of the WALL function should be kept in mind. Because the whole machine is recorded, all unused registers also are recorded. Therefore, for maximum efficiency of magnetic card usage, remove all unused memory modules before recording on cards. This is done by executing SIZE 064 for each unused module before removing the module. If this is not done, MEMORY LOST will result. Since four magnetic cards are needed to record each memory module, this procedure can significantly reduce magnetic card usage. The WALL card-read **must not** be terminated before all cards are read. (This is not true for Program, Status, and Data cards!) If one WALL card is terminated, the HP-41C will clear memory! For this reason all WALL cards should be clearly marked, because accidently reading one means that anything that was in the HP-41C will be lost without any means of recovery.

The increased memory capacity of the HP-41C naturally requires more magnetic cards to record programs and data. Understanding how the HP-41C card reader records Status, Data, and Program cards can aid in reducing the number of card tracks needed to do a specific task. This saves time, saves cards, reduces wear of the card reader, extends battery life, and makes HP-41C usage a little simpler.

## A Special Program

Every once in a while, we receive a massive "set" of programs that cannot be handled in the usual manner by the Library. This is one of them: **#67000-99967, Electric Vehicle Automotive Performance Models,** and it is priced at $55.50.*

The program—actually a series of 17 interrelated programs—is on 129 pages and 21 magnetic cards. It is the work of **Phil Chapman,** of Pasadena, California, who originally wrote the programs for use at the Jet Propulsion Laboratory (California Institute of Technology) for electric vehicle studies funded by the U.S. Department of Energy. The abstract is as follows:

"This set is a series of automotive simulation programs that predict the performance of electric (and other) vehicles and electric vehicle batteries. Rolling resistance as a function of tire type, pressure, and temperature is considered, along with wind weighted drag coefficients. Simulation can be performed over the SAE J227a type of driving schedules, constant speeds, and wide-open-throttle conditions."

Written for use on the HP-67/97 calculators, these programs were developed over a 3-year period within the Electric Car Project out of necessity and Project requirements. They should provide the user with valuable insight into the performance of electric vehicles and electric vehicle batteries.

Although the programs are not intended as substitutes for the more complex computer-based vehicle performance simulators supported and maintained by the U.S. Department of Energy, some of the models were precursors to these more complex models.

The user should find these calculator programs helpful in research and development work, and casual readers will be able to familiarize themselves with the art of simulation and performance prediction.

Below are a list of the program titles. *Separate programs are not available.*

- Road Load to Single Battery Watts and Power Density
- Battery Models Ragone-to-Curve Fit Data
- Battery Coefficient Generator
- Battery Polynomial Solution
- Temperature-Compensated Battery Polynomial
- Temperature-Compensated $\tau$
- Wind Weighting Factor
- Tire Rolling Resistance
- Motor/Controller Current Limit ($P_D$ Max Determination)
- Electric Vehicle Simulator
- Battery Models Fractional Utilization and Modified 10-Point Power Profile
- Constant-Speed Simulator
- Wide-Open Throttle
- Coast-Down Power and Energy
- Peukert Development
- Battery Limits—Lead Acid EV106
- Percent Gradeability at Speed

We thank **Phil Chapman** for making this work available to the Users' Library and to the many readers of KEY NOTES.

* *U.S. dollars. All orders for this program must be sent to the Users' Library in Corvallis (address on back cover). Orders from anywhere outside the U.S. must include a negotiable check (or money order), in U.S. dollars, drawn on a U.S. bank. Also, please include an additional 10% ($5.55) for special handling and air mail postage. Thus, the total cost for orders outside the U.S. is $61.05.*

## Editorial

Some of you, notably **Leroy Klein** of Corydon, Iowa and **John W. Knight III** of Shreveport, Louisiana, saw an error in a correction (!) in the last issue. On page 3, column 3, in the center of the column, the first entry under "the smaller wire." should have been:

.035 [R/S] (→N) → 19.66 00***
[B] (→$S_s$) → 186.3 03***

Somehow I missed that when I proofread the original copy. Thanks for bringing it to my attention.

If you live outside the United States, don't fail to read the **"Ordering Programs"** paragraph on page 3. All programs in KEY NOTES are now available to readers outside the United States. And in future issues, we hope to improve even that service.

Letters to the editor should be addressed to:

Henry Horn, Editor
HP KEY NOTES
Hewlett-Packard Co.
1000 N.E. Circle Boulevard
Corvallis, Oregon 97330 U.S.A.

We cannot guarantee a reply to every letter, but we do guarantee that every letter will be read by the editor, and as many as possible will be answered either in KEY NOTES or in a personal response. Please be sure to put your return address on the face of your letter. Letters sometimes get separated from envelopes.

## Software Changes

If you have early copies of the following two HP-41C documents, you should make the following corrections in your copy. Later copies have an addendum card, or the corrections have been incorporated in the finished product.

**HP-41C Circuit Analysis Pac**

A note regarding the format of node designations should be added to the GNAP user instructions on page 11, as follows:

Note: The grounded node of a passive branch must be the TO node.

**HP-41C Users' Library Solutions, Heating, Ventilating & Air Conditioning 00041-90140**

The program, "Psychrometric Properties," needs two corrections. On page 40, make a note that two (not one) Memory Modules are required. Then, on page 46, there are four incorrect lines. The correct lines are:

| | |
|---|---|
| 204 | 3.61633 E9 |
| 206 | 5.24506 E8 |
| 261 | 3.61633 E9 |
| 263 | 5.24506 E8 |

Notice that these values were somehow interchanged. We are grateful to the author of this program, **Donald H. Madsen,** for calling this to our attention.

# The Wizard of Programming . . .

Among the most-ordered programs in the Users' Library are "games." And easily one of the most popular of these is "Pinball Wizard (#00321D)." That program, plus another excellent games program called "Bell-Fruit (#00218D)," are the products of none other than **Craig A. Pearce,** a name we're sure you have seen here before.

His "Bell-Fruit" slot-machine game originally was written for the HP-65 and was a very popular game in the HP-65 Library. Then, when the HP-67/97 calculators arrived, Mr. Pearce rewrote and improved "Bell-Fruit" for these later calculations. Not being content with that, he went on to write "Pinball Wizard," which was the seventh most popular program in the Library in 1978. But, the best was yet to come, because his "Wizard of Pinball (#00361C)" for the HP-41C is not just a revised HP-67/97 program; it is entirely new, having been rewritten to take advantage of the HP-41C's many new features.

If you have seen any of the above programs, you can attest to the fact that they are fine examples of the man-machine interface. For example, you can become absorbed for hours with "Wizard of Pinball" and actually experience the feeling of being a decided *part* of the machine in your interaction with the keyboard, the audio tones, and the printed output and/or calculator display.

Mr. Pearce's "Bell-Fruit" game also served as a sort of basis for the "Slot Machine" game that appears in the *Games Pac* for the new HP-85 Personal Computer, although that particular version is radically revised for the computer. But it did take Mr. Pearce to create the concept and, for that, we owe him this recognition.

As a matter of fact, we decided—with his permission—to do a profile on this unique calculator owner because, although his participation is somewhat extreme, he does represent the growing involvement in electronic machines that make life easier, more fun, more profitable, or just plain more interesting.

Mr. Pearce lives in Berwyn, Illinois, is a graduate of Morton West High School and the University of Illinois (Chicago Circle Campus), and is 28 years old. In 1975, while still in college, he went to work as a Remodeling Estimator for Metropolitan Management Company, and the job eventually led to full-time employment. He was recently promoted to Building Superintendent of a new 28-story building that contains about 800,000 square feet of office space. So you might say he has considerable use for some special calculating tools.

And Mr. Pearce *does* have and *does* rely on calculators! His first was the HP-45, which he bought during his second year in college. At that time, he heard about the "Programmable" HP-65 but felt he didn't "need" such a machine. Until he bought the *HP-45 Applications Book,* that is! Then, when he realized what *could* be done with keystroke programming, he succumbed to the temptation of owning the *fully* programmable HP-65. Thus began his long and ongoing relationship with Hewlett-Packard.

In no time at all, Mr. Pearce became member #311 in the "HP-65 Users Club," an independent users group that is now called "PPC," a term he helped to coin.* He was also instrumental in founding the Chicago chapter of that Club, and he contributes articles and columns to the Club newsletter, *PPC CALCULATOR JOURNAL,* as well as to other newsletters such as *The Recreational Programmer.* Mr. Pearce also has authored an excellent article on the HP-67/97 calculators; it was printed in the June 1978 issue of *BYTE* magazine.

The HP-65 also sparked his interest in computers, and he began with the Altair 8800 microcomputer, then moved on to the Health H8, an Apple II, and a Vector MZ system. Tied to these are his DECWriter and SOROC terminal and six disk drives! Plus, in the near future, he hopes to be running a 32K HP-85 Personal Computer both at home and at work.

From the HP-65, Mr. Pearce went on to own the HP-21, HP-25, HP-34C, HP-38C, HP-41C, HP-55, HP-67, and the HP-97 calculators. He also owns an HP-01. He can, and regularly does, program and use all of his calculators, which is an astonishing feat in itself.

Up until he had his first program accepted in the Users' Library, he never realized that what he wrote (programmed) might actually be of interest to anyone else. That first program, "Tug-of-War (#02417A)," for the HP-65, started him on his writing career. Since then he's had at least 18 programs accepted into the HP-65 Library, at least 9 into the HP-67/97 Library, and 2 into the newer HP-41C Library. Not as many as others have done, perhaps, but they *are* contributions to the art. His programs are exquisite examples of organization, clarity and legible documentation. As far as "games" are concerned, his "Bell-Fruit" program was the first one that seemed to duplicate a "real machine." That was not easy to do in the older 100-step HP-65 memory.

There you have Craig Pearce, calculator collector-programmer-user *extraordinaire.* You never can tell what he will do next. In fact, when asked, he said, "What the future holds for me is uncertain, but I can say that I will continue to program all of my systems and hope to bring, through my efforts, some enjoyment to others." And we want to bring some of that to you, by offering these programs to anyone in the world. The abstracts appear below. But, before ordering them in any area outside the U.S., check first the paragraph, **"Ordering Programs,"** that appears on page 3.

**(67/97) Bell-Fruit (Slot Machine) (#00218D)**

This is a much-improved version of the HP-65 "Bell-Fruit" program. This program will simulate a Mills brand, 10-cent slot machine, both in standard payoffs as well as in precisely duplicating the same odds that any particular combination of symbols will occur. It includes automatic recall of winnings by using only one key, delayed-action tumbler display, and prestored seed for quick start-up. (112 lines, 6 pages)

**(67/97) Pinball Wizard (#00321D)**

For either HP-67 or HP-97 use, this program simulates an actual pinball machine, including two flippers, out hole bonus, thumper bumpers, slingshot kickers, special star roll-overs, bonus advance star roll-overs, top roll-overs, kick-out holes, free ball drop targets, free-game scoring, spinner gate, optional tilting possibility, and either conservative (standard) or liberal (easy) scoring options. The calculator keeps track of games, amount spent, number of balls to play, total score, etc. (222 lines, 8 pages)

**(41C) Wizard of Pinball (#00361C)**

This program simulates some of the new electronic pinball games, including 2X, 3X, and 5X outbonus, point-advancing kick-out holes, thumper bumpers, spinner gate, star roll-overs, lane roll-overs, alpha-targets, drop targets, free ball, one to four players, 5 ball games, high-score bonus, 3 free game thresholds, full alpha-display on scoring, and sounds (tones). A bookkeeping routine

(Continued)

keeps track of cash spent on games (25 cents per game). And flippers are included. (534 lines, 7 cards, 23 pages, 3 modules) Notice that a minimum of three memory modules are required for this program. Also, for convenience, a card reader would aid in reloading the program.

** PPC is the acronym for Personal Programmers Club, a volunteer, nonprofit, independent, worldwide group of Hewlett-Packard personal calculator and computer users.* PPC CALCULATOR JOURNAL *is the Club newsletter. PPC is not sponsored nor in any way officially sanctioned by Hewlett-Packard. For information about PPC, send a self-addressed 9" × 12" (23 ×31 cm) envelope with first-class postage for 2 ounces (57 grams) to:*

**PPC CALCULATOR JOURNAL**
**2541 W. Camden Place**
**Santa Ana, CA 92704**

## Book Reviews

One of the rewards of being a member of HP's calculator Division is the ability to get to meet people who are so impressed by our products that they take the time to feature those products in books. The most recent example is **Mortimer Rogoff,** who has written a really impressive book, *Calculator Navigation.*

This book has had an evolution paralleling that of our handheld computing products. Mr. Rogoff first visited us in 1974, when we were still located in California, to talk about writing a book on navigation using the HP-65. Just as he was about to send final copy to his editor, we introduced the HP-25. So Mr. Rogoff revised many of his programs to run on the new HP-25, and was all ready to go again when we introduced yet another calculator, the HP-67 and its printing companion, the HP-97.

When he saw the incredible increase in calculating power represented by the HP-67/97, Mr. Rogoff once again postponed publication of his book and incorporated the new calculators, eventually discarding the HP-25 and HP-65 altogether. The calculators included in the version of *Calculator Navigation* that finally was published are the HP-67, HP-97, and HP-41C, plus some calculators from other manufacturers.

The topics covered in the book are coastwise navigation, sailing, celestial navigation, and Loran. Mr. Rogoff introduces a statistical approach to many of the classical navigational techniques. Thus, the small-boat navigator will be able to greatly improve the quality of his instruments. Many of the statistical techniques have been proposed before, but only the advent of the handheld calculator has made their use practical.

Another significant contribution to the practice of navigation is a rigorous or nearly rigorous solution to the problem of determining one's latitude and longitude from Loran C time differences. This is not a trivial problem, yet Mr. Rogoff's programs can be used to obtain positions that are more accurate than those determined from Coast Guard charts.

If you care at all about navigation, you should track down a copy of this book and look it over. It's hard to believe you won't want it after you see it.

The book contains 417 pages, is hard-bound, and lists at $24.95.* Look for it at your local bookstore or order it directly from:

**W. W. Norton & Company**
**500 5th Avenue**
**New York, NY 10110 U.S.A.**

Next we have a book, *Synthetic Hydrograph Computations on Small Programmable Calculators,* written by **Thomas E. Croley II,** who is with the Iowa Institute of Hydraulic Research, at the University of Iowa. This book presents the computation procedures used in a few of the popular techniques for synthesizing hydrographs. Rather than to attempt a comprehensive coverage of all synthetic hydrograph techniques, a few of the "classical" or more general techniques are dealt with. Those techniques that have already appeared for use on small programmable calculators are not duplicated herein. Programs are presented in each section for the HP-19C, -25, -33E, -65, and -67/97, plus calculators of other manufacturers.

The book contains 236 pages in a unique hard-cover (but loose-leaf!) binding, and it lists at $12.* You probably won't find it at the bookstore, so order it from:

**Institute of Hydraulic Research**
**The University of Iowa**
**Iowa City, Iowa 52242**

Our next review is for *Pocket Programmable Calculators in Biochemistry,* by **John E. Barnes** and **Alan J. Waring.** Both of these authors have excellent credentials, so you can't go wrong on this book if the subject is of interest to you. John Barnes has a Ph.D. in Molecular Biology from Johns Hopkins University and is now a Research Biochemist at E. I. duPont de Nemours, Inc. Alan Waring has a Ph.D. in Biology (plant biochemistry) from the University of California (Los Angeles) and is now an Assistant Professor at Hahnemann Medical College in Philadelphia, Pennsylvania.

The book has 363 pages and lists at $15* for the soft-bound edition or $25* for the hard-bound edition. It was written for the HP-67/97 calculators and for a few from another manufacturer. An appendix at the back of the book presents HP-41C compatibility information. Chapter are:

1. Aqueous Solutions of Small Molecules
2. Macromolecules in Solution
3. Sedimentation
4. Ligand Binding and Kinetics
5. Thermodynamics in Biochemistry
6. Spectroscopy
7. Isotopes in Biochemistry

and there are 5 appendices.

If you can't find this book in the U.S. at your bookstore, you can order it from:

**John Wiley & Sons**
**1 Wiley Drive**
**Somerset, NJ 08873**
**Tel: 201-469-4400**

and in Canada from:

**John Wiley & Sons (Canada)**
**22 Worcester Road**
**Rexdale, Ontario**
**Canada M9W 1L1**

And the last book is one many of you who are not conversant with programming will want. It is *Programmable Pocket Calculators,* by **Henry Mullish** and **Stephen Kochan.** It covers the HP-55, -65, -25, -25C, -19C, -29C, -67, and -33E, plus calculators from other manufacturers. It contains 254 pages, is soft-bound, and lists at $9.95.*

The purpose of the book is to examine in detail these programmable pocket calculators and to point out their architecture, special features, and programming techniques designed to maximize their use. It does not assume that the reader has any previous knowledge of programming. Every program for each calculator is incorporated in a schematic showing *precisely* how to enter the program and to put the calculator to work.

If you can't find it at your bookstore or computer specialty store, order it from:

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## "25 Words" (More or Less!)

There's quite a *smorgasbord* of routines and subroutines in this issue—as you will see. We try to include something for everyone, and for all levels of expertise. If you submitted a contribution and it wasn't printed, don't be dismayed; quite often it will be in the next issue. Of course, there is no practical way to include *all* of them. But we try our best. Maybe an upcoming issue could be 75 percent "25 Words." We'd bet you'd like *that*! Keep your fingers crossed, and we'll see if we can do that for you—neatly segregated by calculator model.

Our first contribution for this issue is from **Nai Chi Lee,** who keeps his HP-41C in Singapore, which also happens to be his hometown.

**(41C)** There are a few points I discovered from my HP-41C that should be of some value to other users. First, according to the Owner's Handbook, the basic HP-41C has 63 registers of program memory. Wrong! It is actually 63 and 4/7 registers. That is, 445 bytes. This is important for those who try to find out the number of bytes in their program by counting the registers and extra bytes left. In my case, I only realized the existence of these 4 "extra" bytes when I tried to save a program that was thought to be exactly 224 bytes, and the calculator asked me for the third side of the card. *(See explanation, below. Ed.)*

**(41C)** Next, the local labels (A to J, a to e) require only 2 program bytes, while other ALPHA labels (K to Z, and special characters) need at least 5 bytes.

**(41C)** And, last, if there are k identical bytes repeated N times throughout the program, the number of bytes saved by a subroutine for the k bytes is

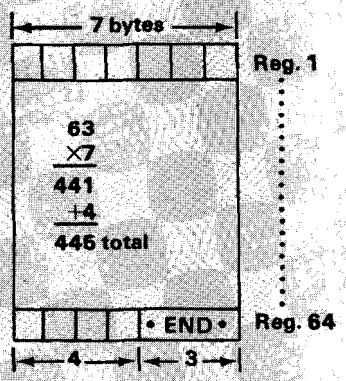
$$(N-1)(k-3)-5$$

For example, if $N = 2$ and $k = 9$ bytes, you save only 1 byte by using a subroutine. This is, of course, assuming that you use a label 00 to 14 for the subroutine. If you use, say, LBL T instead, you will waste exactly 3 bytes.

The following table shows the initial allocation and the maximum number of registers that can be allocated to data storage or to program memory.

| Calculator Plus | Maximum Data Storage Registers | Initial Register Allocation | | Maximum Program Memory Registers |
|---|---|---|---|---|
| | | Data Storage | Program Memory | |
| No Memory Modules | 63 | 17 | 46 | 63 (445 bytes) |
| 1 Memory Module | 127 | 81 | 46 | 127 (893 bytes) |
| 2 Memory Modules | 191 | 145 | 46 | 191 (1341 bytes) |
| 3 Memory Modules | 255 | 209 | 46 | 255 (1789 bytes) |
| 4 Memory Modules | 319 | 273 | 46 | 319 (2237 bytes) |

*(Let's clear up the 441 versus 445 total bytes problem for the last time. There really are 445 bytes available in a basic HP-41C. The diagram shows why. There are actually 64 registers, as you can see, but the last one is not totally usable, because of the permanent END statement. That's why it was stated that there are 63 in a basic HP-41C. The table should also clear up some other questions. Thanks, Mr. Lee. Ed.)*




Many people had problems with **Richard Sperling's** "effective interest" routine in the last issue. This was brought to our attention by a letter from **Roy A. Bitter** of Ft. Wright, Kentucky, and then by more people from all over the Globe! If you change line 013 from ÷ to × and line 016 from × to ÷, you'll find the routine easier to use—or understand. However, on closer examination, we found we could rewrite the routine. So here it is, again, for those who couldn't apply it.

**(67/97/41C)** If you pay an income tax, this routine will calculate the net cost of borrowing, taking into account the amount of interest you can deduct from your income tax.

```
001  *LBLA
002    %
003    -
004   PSE
005    %
006   RTN
007   R/S
```

For example, you want to borrow $950 at 14.35% interest for one year, and your tax bracket is 38%. Key in 950, [ENTER], 14.35, [ENTER], 38, [A]. When you press [A] the display will show "8.9" and, after a pause, "84.52" will appear. The first number is your "effective" interest and the second your net cost of borrowing the $950.

Remember, this is just a quick, handy way to determine approximate costs. It does not accurately calculate for direct reduction loans, compound interest, and so on. But it is far better than nothing, it makes you more aware of net costs, and it is a handy, short routine you can include in financial programs. And we thank all of you who wrote to us about this routine.

Now let's see what is going on in Glasgow, UK, which is the home of **Chilton R. Inglis**—and his HP-41C.

**(41C)** This routine, although longer than the "CHARS" program in the *HP 82143A Printer Owner's Handbook* (page 23), has the advantage of presenting the entire HP-41C character set in a compact tabular form, indexed with the numerical values used by the ACCHR function. Flag 25 is set and tested to exit a loop on the 128th character.

```
01♦LBL "CHARS"          23 X<>Y
02 CF 29                24 INT
03 CF 00                25 ARCL X
04 SF 01                26 ACA
05 SF 25                27 CLX
06 FIX 0                28 LASTX
07 ADV                  29 " "
08 SF 12                30♦LBL 01
09 "**HP-41C**"         31 ACA
10 PRA                  32 ACCHR
11 ADV                  33 FC? 25
12 " STANDARD CHARA"    34 GTO 02
13 "⊢CTER SET"          35 ISG X
14 CF 12                36 ISG Y
15 PRA                  37 GTO 01
16 XEQ 02               38 GTO 00
17 CLA                  39♦LBL 02
18 .127                 40 PRBUF
19♦LBL 00     41 "    0 1 2 3 4 "
20 FC?C 01    42 "⊢5 6 7 8 9"
21 ADV        43 PRA
22 .009       44 .END.
```

```
**HP-41C**

STANDARD CHARACTER SET

     0 1 2 3 4 5 6 7 8 9
   0 ♦ × X̄ ← α β Γ ↓ Δ σ
  10 ♦ λ μ ∡ ↑ ⅟ 8 Ω δ ä
  20 ä ñ ā Ö ö Ü ü £ ¥ ≠
  30 £ ⅟   ! " # $ % & '
  40 ( ) * + , - . / 0 1
  50 2 3 4 5 6 7 8 9 : ;
  60 < = > ? @ A B C D E
  70 F G H I J K L M N O
  80 P Q R S T U V W X Y
  90 Z [ \ ] ↑ _ ` a b c
 100 d e f g h i j k l m
 110 n o p q r s t u v w
 120 x y z ¥ | → Σ ⊢
     0 1 2 3 4 5 6 7 8 9
```

*(Very clever, Mr. Inglis. You'll notice, however, that I added a "CF 29" as line 02. If you don't clear that flag, you will not have the neat tabular form shown here. Try it; you'll see what happens. Refer to pages 230, 231 in the HP-41C handbook for details about flags 28 and 29. Ed.)*

For a change of pace, here is a contribution that does not require pressing keys. It's from **Stanley R. Brockman** of Wheat Ridge, Colorado.

**(41C)** A function and a program both having the same name can be executed from the keyboard if the function is assigned to a key before the program label by the same name is keyed into memory. (See John Gafford's comment, V. 4, No. 1, p. 7 of KEY NOTES). The program can then be assigned to

(Continued)

another key or [XEQ] "...". Actually, the same thing can be done with two or more programs having duplicate names, by simply assigning the labels to separate keys as each label is keyed into memory. The HP-41C keeps the assignments straight. However, I'm not sure why anybody would wish to duplicate names in this manner.

Because the calculator is basically a mathematical tool, we though you'd like an input from someone who uses it as such. He is **J. F. Weaver**, a Professor (Mathematics Education) at the University of Wisconsin in Madison, Wisconsin. Here are two contributions from him.

**(65/67/97)** Given two counting numbers *a* and *b*, Peter Luschny's eight-step routine for finding their greatest common divisor, or gcd (May 1979, Vol. 3, No. 2, p. 10), seems to terminate only when the latter of the two conditions of the Nicomachus algorithm ("continually take the less from the greater until reaching *a unit* or *two equal numbers*") is satisfied. I believe that the routine below, executed on an HP-67/97 as *a* [ENTER] *b* [A], will terminate when either the first or second condition is satisfied, although my routine may "mess up" Mr. Luschny's lcm (least common multiple) routines on pages 10 and 11.

```
001  *LBLA      007   X=Y?
002    -        008   RTN
003  LSTX       009   R↓
004   X⇄Y       010   X≠Y?
005   ABS       011   GTOA
006    1        012   RTN
```

**(41C)** Despite the advent of the handheld calculator and the push toward the metric system of measurement, there are (and will continue to be) times in school mathematics when work is done with "common fractions" rather than "decimals." The following little routine uses the HP-41C's "MOD" to good advantage when changing the form of a common fraction to "lowest terms" (utilizing the Euclidean algorithm to calculate the highest common factor (hcf) of the fraction's terms.)

Given n/d (when n and d are positive integers), change to n'/d' such that n' and d' are relatively prime.

```
01♦LBL "CFLT"     15 GTO 00
02♦LBL "NO"       16 RDN
03 SF 00          17 FC?C 00
04♦LBL "YES"      18 STOP
05 ENTER↑         19 /
06 ENTER↑         20 STOP
07 R↑             21 X<>Y
08 ENTER↑         22 LASTX
09 R↑             23 /
10♦LBL 00         24 STOP
11 MOD            25 LASTX
12 LASTX          26 RTN
13 X<>Y           27 .END.
14 X≠0?
```

To run the program, input n, ENTER, d. If you wish to display the hcf of n and d enroute to calculating n' and d', [XEQ] "YES." Press [R/S] and see n' and press [R/S] again to see d'. If you do not wish to see that, press [XEQ] "NO" and see n'. Then press [R/S] and see d'. But, now, if you change your mind and wish that you *had* displayed the hcf, simply press [R/S] at this point and you'll display the hcf. I leave it to the user to decide upon the program's validity in the event that n or d is not a positive integer.

If the input instructions were changed to n, ENTER, ENTER, d, the routine could be shortened by three lines, by deleting lines 05, 06, and 07.

Note: The routine, of course, covers the condition that in the initial n/d, n and d are relatively prime; in which case, the routine generates:

hcf = 1, n' = n, and d' = d

Although the HP-41C has "alpha" capability, it is a long way from being a typewriter. But you *can* easily write messages on it with this routine submitted by **Hans J. Wüest** of Muri, Switzerland.

**(41C)** This is a short routine to write text with ease. You may enter up to 24 characters a line and as many lines as you need. First, enter the routine, SIZE 000, [XEQ] "TEXT," and see "TEXT?" in the display, then start keying in your message. When 24 characters are keyed, a tone sounds, and you can decide whether to hyphenate the word or delete a letter or two—or just to press [R/S], and print the line you just formed. When finished, exit the loop with one space (after your last [R/S]).

```
01♦LBL "TEXT"     11 ASTO X
02 CLA            12 CLA
03 "TEXT ?"       13 X=Y?
04 AON            14 GTO "EXIT"
05 PROMPT         15 PRBUF
06 ACA            16 GTO "TEXT"
07 AOFF           17 RTN
08 ASTO Y         18♦LBL "EXIT"
09 CLA            19 .END.
10 "├ "
```

## A Day Late? Early?

HP's "Calendar Functions" program in the *HP-41C Standard Applications* book appears to be valid for the period March 1, 1900 through February 28, 2100. I notice that your examples in the book are limited to that span, and that no claim is made for validity as a "perpetual" calendar. However, I also notice the absence of a caution in regard to the period of validity.

In the unlikely event that this is "news," an explanation follows. Your program is written on the assumption that every fourth year is a Leap Year. This assumption is correct for the year 2000, but not correct for 1700, 1800, 1900, 2100, 2200, and 2300. Hence, your program produces an error of 1 day per century, or fraction thereof, outside the 2-century validity span.

Regards, **James E. Sutton**
Redwood City, California

*(You are right, Mr. Sutton. The "Calendar Functions" program should include atop page 14 the note:*

Valid from March 1, 1900 to February 28, 2100. *If this is not in your book, you can write it in just above the title on page 14. Ed.)*


**HP KEY NOTES**
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