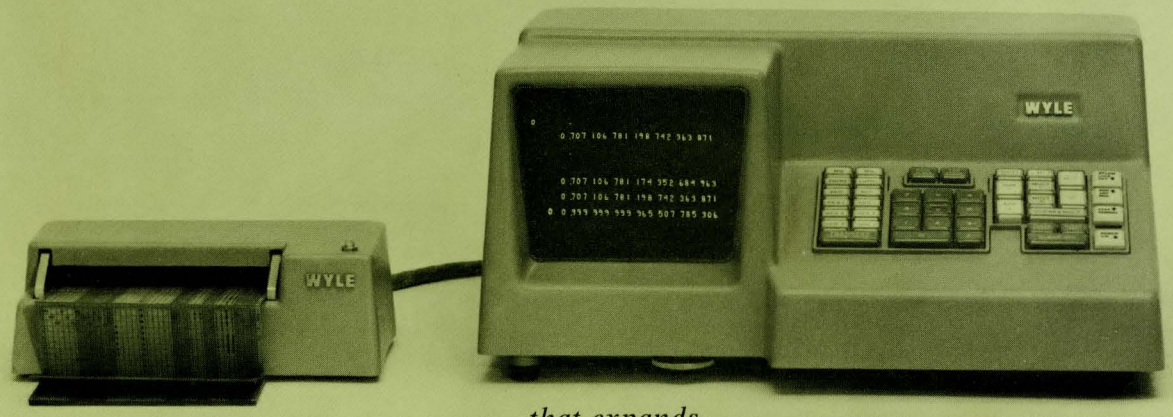
The unit . . .



. . . that expands

. . . and expands.

THE WYLE *Scientific*

WS-02

world's most advanced desk-top computational center—with expandable memory and expandable programming.

THE WYLE *SCIENTIFIC*—world's most advanced desk-top computational center.

It Is Easier To Operate than a Calculator

The Wyle *Scientific* has capabilities for the solution of complex scientific, statistical, and engineering problems far beyond that of any other desk-top machine, yet it is easier to operate than an ordinary desk calculator. Manual operation, programming, and automatic operation are mastered in less than two hours of self instruction.

It Programs with a Ball-point Pen To Operate Automatically

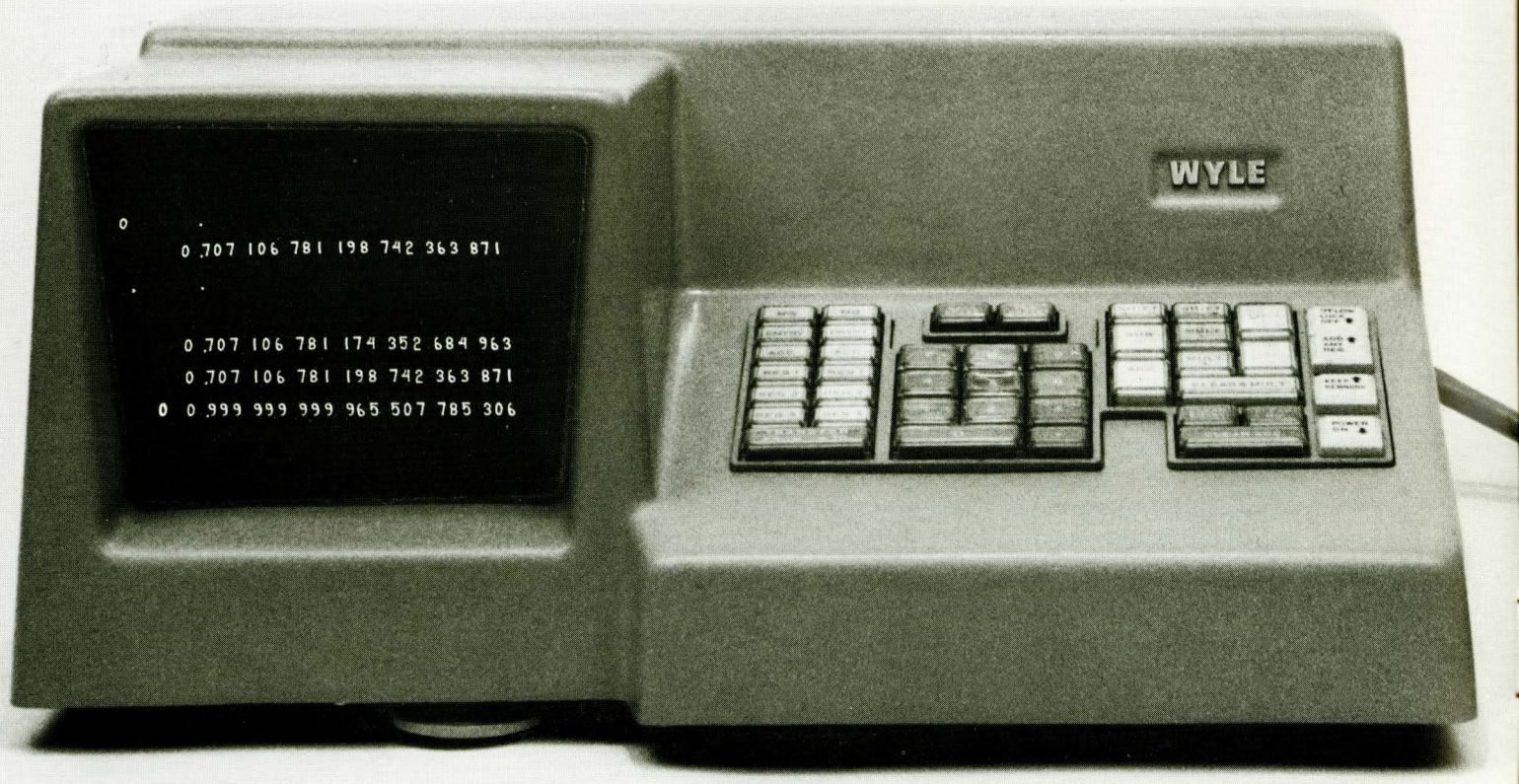
With automated program entry, the Wyle *Scientific* eliminates the tedious, wasted time of multi-step repetitive problem solving. You can prepare your own library of program cards by punching in your instructions with a ball-point pen. Programs are then run through the automatic input card reader with only the variables entered manually.

It is Expandable

For some extremely lengthy and complex repetitive routines, hard-wired programming and additional memory are found to increase speed and efficiency. For such applications, the Wyle *Scientific* can be expanded by addition of PIP Plug-In-Programmer and SAM Scientific Auxiliary Memory units.

And This Is What It Does for You

- Eliminates the drudgery of calculator operation.
- Cuts time (and labor costs) by factors of from 5 to 100.
- Minimizes opportunity for human error.
- Provides extreme numerical precision.
- Eliminates decimal point worry.
- Reduces the line-up for computer time (and frequently the need for it).
- Releases skilled personnel from repetitive problem solving.
- Presents all data visually, for instant proofing.
- Requires no special "language" for programming.
- Has the reliability, speed, and quiet of all-solid-state electronics.
- Amortizes over a three-year period at less than $1 per working hour.



APPLICATIONS

The programming capability is virtually unlimited.

For many simple business calculations, the programmed *Scientific* provides high-speed computation while minimizing operator error.

For scientific and statistical problems, the *Scientific* may replace the need for large computers and highly trained programmers. It completely eliminates the tedious performance of ordinary calculators. The 24-digit capacity provides a precision not possible on ordinary electronic calculators and difficult on most general purpose computers.

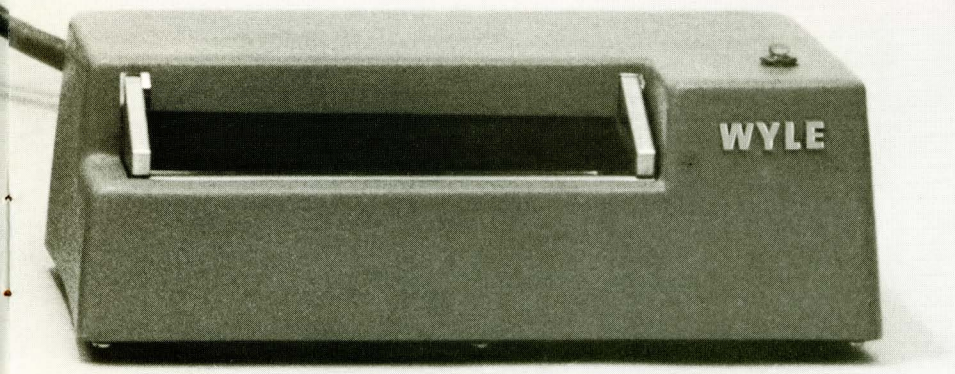
The *Scientific* can be very effectively used in conjunction with large computers—namely, for program formulation and check-out. It is particularly valuable when determining the requirement for double-precision programming.

The total flexibility of the Wyle *Scientific* makes its areas of application almost limitless.

Typical programs that can be run automatically are

- Sine, cosine, and tangent of angles and their inverses
- Statistical analysis
- e^{-x}
- $\text{Log}_e x$ and $\text{Log}_{10} x$
- Antilog x
- Radix conversion, both integer and fractional, including floating exponent
- Roots of equations
- Polynomial evaluation

Essentially, it should be recognized that the Wyle *Scientific* is capable of handling any scientific problem which can be programmed as a power series expansion or summation of series.



CALCULATOR SIMPLICITY

Small

The *Scientific* will take up approximately the same space on your desk as a typewriter, measuring just 10¼″ by 19¾″ by 22½″. Its card reader, which plugs into the back of the *Scientific*, is 4″ by 6″ by 12″.

Portable

Weighing 50 pounds, the *Scientific* can be moved as easily as an electric typewriter from desk to desk. It plugs in anywhere, with power requirements of 160 watts, 115 volts 60 cycles, 230 volts 50 cycle, or 100 volts 50 cycle.

No Complex Programming

No special "language" or code is involved in the operation of the *Scientific*. All numerical input is in ordinary decimal digit numerals, as is all easy-to-read output.

Keyboard Is Simple

Numbers are entered on a standard ten-key board, plus an eleventh key for decimal point. Keys for placing numbers in proper register are plainly labeled, as are the arithmetic function and editing keys.

COMPUTER CAPABILITIES

External Programming

The only desk-top machine with unlimited stored-program automatic input, the *Scientific* can be programmed through its card reader to perform all your recurrent computations automatically, regardless of length. It requires no computer training or any special equipment to develop a complete library covering repetitive formulas. Operating speeds in excess of the card reader's eight steps per second can be achieved by addition of a PIP Plug-In-Programmer.

Six Registers

Three storage registers or "memories," in addition to three arithmetic registers, give the *Scientific* a computational capability far beyond that of any calculator. The contents of any register can be transferred to any other register, so that it is unnecessary to write down intermediate results or recurrent constants even when operating manually. Such numbers are stored and re-entered into a computation wherever needed, eliminating possibilities of transcription error. Up to twenty-four similar storage registers can be added. See descriptions of SAM Scientific Auxiliary Memory units in the Peripheral Equipment section.

24 Digit Registers

24-digit registers permit computations with extreme numerical precision. You can perform problems involving large numbers without worrying about decimal point. Further, the 24-digit registers provide capacity for statistical problems not possible with any other desk-top machine.

Automatic Decimal Point Alignment

Decimal points in all registers are aligned with each other. The decimal point can be positioned in steps of three digits, permitting calculations involving numbers through the range from a 3-digit whole number with a 21-digit fraction to a 21-digit whole number with a 3-digit fraction. When a number is entered, its decimal point is always entered, just as any digit. The number is then automatically aligned with the decimal point in the register. All answers are decimally correct.

Full Display of Registers

All steps of a problem are visible, since the contents of all six registers are displayed on a full 8-inch cathode ray tube "screen" at all times. Each newly entered number appears immediately for verification and can be quickly proofed. There is no need to remember where a number is stored or what the number is. Contents of any SAM Scientific Auxiliary Memory register are displayed at the touch of a key.

Automatic Square Root

Square root is derived instantly with the touch of a single key.

Multiple Entry

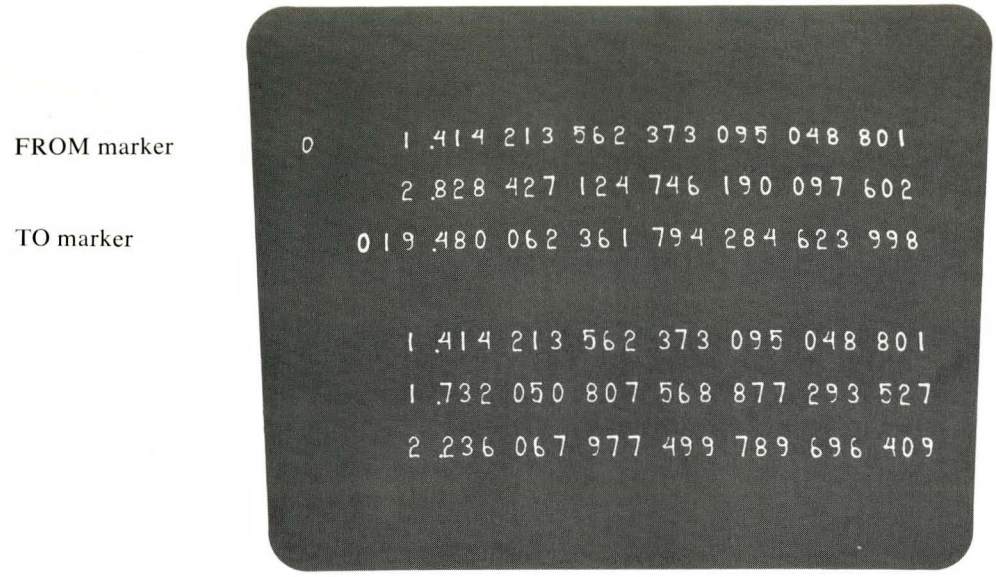
A number can be simultaneously entered or transferred into two, or all three arithmetic registers.

Shift

A number can be shifted left or right around the decimal point.

Correction Capability

Corrections can be made to any digit of any number at any time. This is also useful in editing programs.



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DISPLAY AND KEYBOARD

The 8-inch CRT "screen" displays all steps of a problem. The contents not only of the three active arithmetic registers, but also of the three storage registers are visible at all times. Numbers entered from the keyboard are seen as they are entered and can be verified before use. Corrections can be made to any digit of any number.

In addition to displaying all numerical entries, the display has TO and FROM markers. The TO marker shows the register being entered or transferred to and the point of entry within that register. The FROM marker indicates the register from which transfer is being made. There is no requirement for remembering or transcribing. The keyboard is simple, straightforward, and largely self-explanatory.

Keys are grouped by function. Those grouped at the left control data acceptance and transfer operations, those grouped in the center control data entry, and those grouped at the right control arithmetic and editing operations.

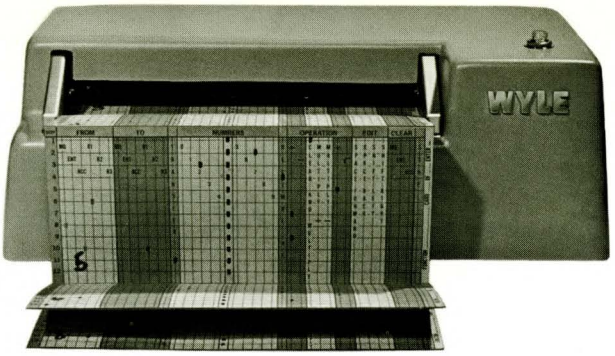
MQ is used for entry of multipliers and it gives quotients and square root answers. ENTRY is used for entering multiplicands, divisors, and numbers for additions and subtraction. ACC (accumulator) is used for entry of dividends and gives sums, subtraction remainders, and products.

The lower registers – REG 1, REG 2, REG 3 – are storage.

Since there are multiple registers, it is necessary to select or "address" registers to be used. To select a register for entry of a number (either by keying in the number or by transferring it from another register), the TO key for that register is depressed. To select a register from which to transfer a number, the appropriate FROM key is depressed. Actual transfer is effected by depressing the TRANSFER key.

These few rules are all you need remember for arithmetic:

Function	*Operation*		*Answer*
Addition	ENTRY + ACC	→	ACC
Subtraction	ACC – ENTRY	→	ACC
Multiplication	MQ × ENTRY	→	ACC
One-step multiplication and addition	ACC + (MQ × ENTRY)	→	ACC
One-step multiplication and subtraction	ACC – (MQ × ENTRY)	→	ACC
Division	ACC ÷ ENTRY	→	MQ
Square Root	$\sqrt{ACC}$	→	MQ



AUTOMATIC INPUT SYSTEM

The Programmed Automatic Card (PAC) input system incorporates a uniquely compact and reliable punch card reader, the model PC-01. When a card is inserted and the start switch on the top of the reader is pressed, the program operates automatically until a STOP command is reached. After a programmed stop, the reader is restarted manually.

The unit can be set to operate one step each time the start switch is pressed. This mode is used principally for checking programs, each program step remaining on the display for as long as may be necessary for verification. This checkout is a simple and straightforward way of verifying the accuracy of the hole punching.

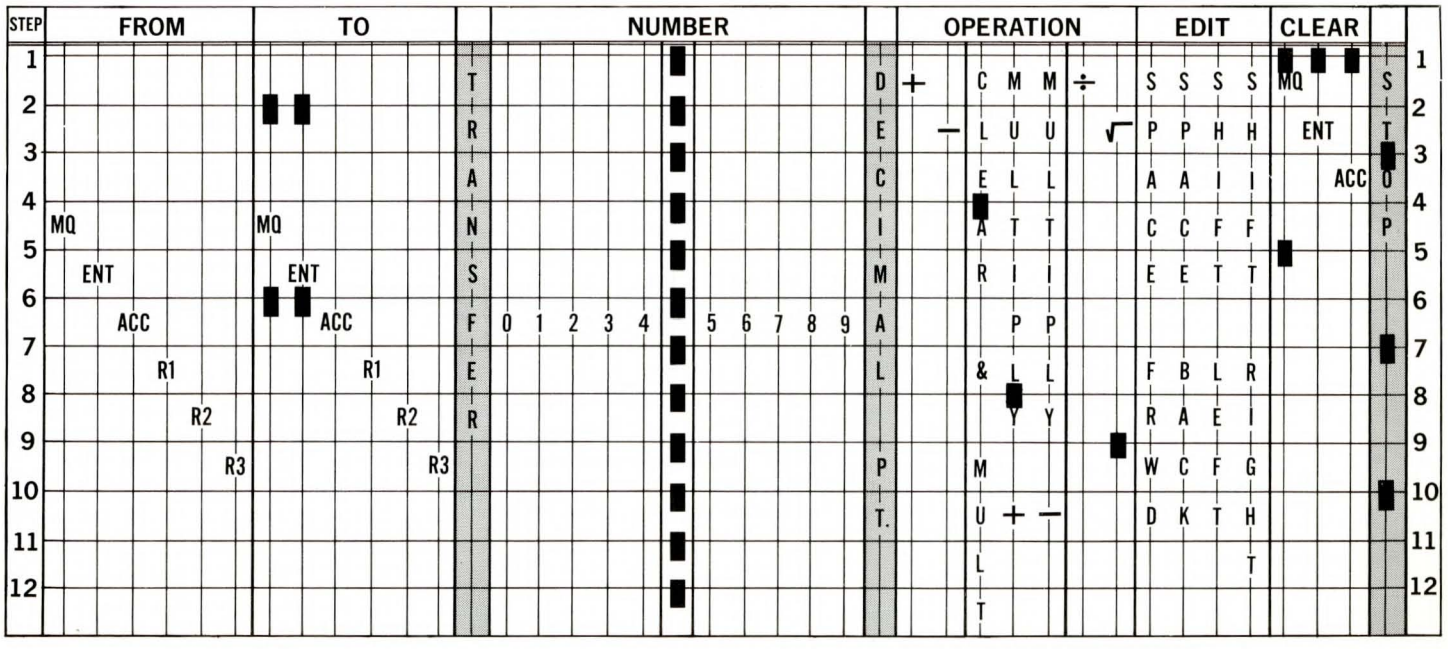
The Wyle program cards are IBM pre-scored cards, printed to correspond to the *Scientific* keyboard functions. Holes are easily punched out with a ball-point pen, or any simple stylus. For added convenience, an IBM Port-A-Punch, costing less than $10, can be used. The cards can be reproduced automatically on conventional keypunch equipment.

Each card provides twelve horizontal lines of pre-scored holes for punching in commands. One program command is punched in per line, with the following exceptions: (a) TO and FROM commands can be combined in one line—for example, FROM MQ and TO R1. (b) Multiple TO commands may be put in one line for arithmetic registers—for example, TO MQ and TO ENTRY (as below). A STOP command is punched in wherever a variable is to be entered and at the end of each program. The holes in the vertical column between the digits 4 and 5 are punched out on all cards, to provide accurate timing strobe for the program holes.

In the example pictured, the card is punched to solve the hypotenuse of a right triangle ($c = \sqrt{a^2 + b^2}$) by executing the following operations, automatically, in less than two seconds:

1. CLEAR MQ, CLEAR ENTRY, CLEAR ACC.
2. TO MQ and TO ENTRY, simultaneously (activates these registers to receive "a").
3. STOP (for manual keying of "a," which enters simultaneously into MQ and ENTRY registers. The PAC input is restarted manually).
4. CLEAR & MULT. (Clears accumulator and squares "a," by multiplying together the contents of MQ and ENTRY, leaving "a^2" in ACC register.)
5. CLEAR MQ. (Otherwise the previous multiplier is maintained.)
6. TO MQ and TO ENTRY simultaneously.
7. STOP (for manual keying of "b," which enters simultaneously into MQ and ENTRY. The PAC input is restarted manually).
8. MULT + (Squares "b," by multiplying together the contents of MQ and ENTRY, and adds result to "a^2" in ACC registers, now giving $a^2 + b^2$).
9. $\sqrt{}$ (Extracts square root of $a^2 + b^2$, root appearing in MQ).
10. STOP. End of program.

The lengthiest computations can be programmed, by using multiple cards taped together for continuous operation.



PERIPHERAL EQUIPMENT

One of the outstanding features of the Wyle *Scientific* is that it can be expanded as needs increase. Circuitry and connections for peripheral equipment are built in. The auxiliary keyboard and junction box used with all peripheral equipment plug directly into the back of the Wyle *Scientific,* Model WS-02.

At the touch of a button, specific calculations and sub-routines such as the sine of an angle or the log of a number can be called out or made part of an integrated program and controlled by the card reader. Up to sixteen such individually interchangeable programs or sub-routines can be added for greatly increased programming speed and convenience. Programs are prepared by Wyle to meet customers' requirements or, they can be prepared by the user. Not only can program steps be controlled from the auxiliary keyboard or through the card reader, but the card reader can be controlled by the programs.

Furthermore, computer techniques such as branching, looping, and conditional skip may be employed. These facilitate computation in areas such as iterative calculation and complex problem solving requiring several different sub-routines.

As additional memory is required, up to twenty-four storage registers can be added, with each register containing twenty-four decimal digits. Information can be displayed from any storage register on demand.

Equipment that enables the *Scientific* to grow as needs increase includes:

PIP—Plug-In-Programmer (Models PB-01 and PB-02)

Model PB-01 accepts up to eight 32-step program modules.

Model PB-02 accepts up to sixteen 32-step program modules.

Both models are compatible with PC-01 Card Reader and SAM units described below.

PIP instructions permit branching, conditional skip, and looping.

Instructions are received from auxiliary keyboard or card reader.

PIP can control card reader—calling for data or sub-routines as required.

PIP programs increase speed and flexibility.

SAM—Scientific Auxiliary Memory (Models SM-01 and SM-02)

Model SM-01 adds eight storage registers plus control electronics. One or two SM-02 units with eight storage registers each can be added to the SM-01.

Information can be transferred flexibly between the *Scientific* and SAM Registers.

Decimal point is automatically aligned.

Registers may be addressed from the auxiliary keyboard and from programs.

All information in the auxiliary storage registers can be displayed.

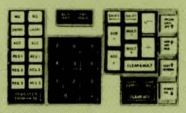
SYSTEM PRODUCTS

The Wyle Arithmetic Processor, Model AP-03, is a rack-mounted, systems-oriented version of the Wyle *Scientific.* It combines the arithmetic capability of the WS-02 with interface electronics which allow input/output connection to a wide variety of data sources and recording devices. The AP-03 is compatible with the PIP and SAM units. Wyle's complete selection of system components includes not only the AP-03, PIP and SAM, but also A/D converters, paper-tape readers, output printers, D/A converters and other equipment. The availability of these standardized "building blocks" reduces the time and cost associated with systems engineering.

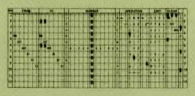
Wyle's system engineering staff is available to assist customers in adding computing capability to existing equipment, or to assume complete systems responsibility if a new system is desired.

IN SUMMARY...

These simple guides are all you need



to operate the Wyle *Scientific*...



or to program it.

To Perform	Press Key (or Punch Hole)	Register Action	Result
1. Entry of numbers into a register	Appropriate TO, Numbers, and Decimal Point	Numbers enter	Selected register
2. Transfer of numbers between registers	Appropriate FROM and TO and TRANSFER	Numbers transfer	Selected register
3. Addition	+	ACC + ENTRY	→ ACC
4. Subtraction	–	ACC – ENTRY	→ ACC
5. Multiplication	CLEAR & MULT	MQ × ENTRY	→ ACC
6. One-step multiplication and addition	MULT +	ACC + (MQ × ENTRY)	→ ACC
7. One-step multiplication and subtraction	MULT –	ACC – (MQ × ENTRY)	→ ACC
8. Division	÷	ACC ÷ ENTRY	→ MQ
9. Square root	$\sqrt{}$	$\sqrt{ACC}$	→ MQ

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