THE UNIVERSITY OF
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USE OF MICROCOMPUTER IN DENTISTRY

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ACKNOWLEDGEMENTS

MY SINCERE APPRECIATION

TO

ASSOCIATE PROFESSOR P. D. BARNARD

M. P. H. (MICHIGAN) . M. D. S. . F. R. S. H.

F. A. C. D. . F. A. C. D. S. . F. A. P. H. A.

MAJOR P. THALER RAMAIC

MY WIFE HALI

MY FAMILY

AND

MALAYSIAN ARMED FORCES

FOR MAKING THIS A REALITY"

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USE OF MICROCOMPUTERS IN DENTISTRY

1:INTRODUCTION

Computers are not new to Dentistry.In the past,dentists have used computers for dental research,dental education,oral pathology,and the business aspect of Dentisty.However dentists do not know much about computers and computer experts do not know enoush about Dentistry.Computers have just(in 1976) celebrated their formal 25th.anniversary.There has been a revolution sinoe its inoeption especially with advanoes in microelectronic technology.Dentistry cannot ignore the implications that computers have become another one of its armamentarium.

This thesis hopes to justify the usefulness that a microcomputer can contribute to Dentistry.The author reokons it to be the"Alladin Lamp" of the 20th.century dentists.

1.1.HISTORY AND DEVELOPMENT OF COMPUTERS

1.1.1.EARLY DEVELOPMENT

In the early days of mankind,man started computing by the use of his fingers and toes (some still do).As counting exceeded 20,he resorted to pebbles and seeds. With time man become more scientific and Marco Polo found the abacus widely used in China.

In the middle ages,Girbert (10th.century,later Pope Silvester II) tried unsuccessfully to introduce Arabic numerals and the type of abacus used by the Moors in Medieval Europe.In the following years,various advances were made.

1614 Development of logarithm by John Napier

1615 Henry Biggs converted Napier's logarithm to the base10

1620 Edmund Gunterinvented slide rule without moving parts based on Napier's logrithm

1642 Blaise Pascal invented the forerunner of the modern day calculator

1694 Gottfried Leibnitz built an adding machine

1799 Charles Mahon invented 2 calculating machines

The weaving industry introduced punched paper tape through Basile Bouchon (1725),Falcon (1728),Jacques de Vaucanson (1745) and Jacques Jacquard (1801).

The father of the computer field was Charles Babbage.He worked on his 'difference engine';the modern day computer equivalence of an 'accumulator mechanism'from 1812 until its abandonment in 1842.In 1833.Babbage devised an automatic general purpose computer called the 'Analytical Engine'.It used punched cards for input and mechanical wheels for computation.Babbage's analytical engine never worked as the parts needed were too complicated to be made then.His ideas were a century and a half too early.

Herman Hollerith was able to complete a census on 62 million within 2 years for the United States Census Bureau with his punched cards and machine(compared with 7.5 years for 50 million in 1880)

Since then,considerable improvements had been achieved.Dorr Felt (1888),William Seward Burroughs,Monroe and Marchant were amongst a few to make their contributions.

1.1.2. 20th.CENTURY

Development towards mechanical digital computers were made in this era.

-Edward Condon used binary numbers for computing

-Derrick Lehmer's number sieve was a form of special purpose digital computer

-Howard Aiken and IBM engineers developed Mark 1

-George Stibitz built at Bell Telephone Laboratories the forerunner of the Mark 1-Mark VI relay computers.

All the above computers were computing on punched card or punched tapes program.

The first all electronic computer was Eniac.developed by Presper Eckert and John W.Mauchly at the University of Pennsylvannia between 1943-1946.The short comings of Eniac in not being able to store much information for manipulation led Von Neumann to devise a method of convertins Eniac's concept of external storage to that of a stored program computer.This led to the subsequent development of Edvac.A paper entitled "Preliminary Discussion of the Logical Design of an Electronic Computing Instrument"by Von Neumann,with Arthur W.Burks and Hermann H.Goldstine,published in 1946,gave the impetus to a change in the design and further development of the digital computer.

1.2.TYPES OF COMPUTERS

1.2.1.ANALOGUE COMPUTERS

Symbolize quantities by the magnitude of a physical quantity e.g. electric voltage.Various physical conditions such as flow,temperature,pressure,mechanical or electrical speeds are translated into mechanical or electrical analogues.Measurements are made continuously and are based on the principle of proportional relations.As such,results must be read off a scale.Accuracy is limited.

1.2.2.DIGITAL COMPUTERS

Represent numbers in precise units,never varying or responding in degrees.Works on the principle of electrical switch (on or off).Boolean algebra and binary system of numbers(a combination of numbers either 0 or1).Accuracy is very high.

1.2.3.HYBRID COMPUTERS

Derive their power from the combination of the above 2 types.They are specifically designed for simulation,process control,signal processing and psychological model building.

1.3.BASIC CONCEPT OF DIGITAL COMPUTERS.

A digital computer processes data under the direction of a sequence of stored instructions.The sequence of instruction words constitute a program.The process of writing a sequence of instruction is called programming.

An instruction is a binary number or bit pattern that is interpreted by the computer as command.Through a program the computer is instructed how to handle data or how to perform a control operation.This ability of processing data under the control of a program stored in memory is referred to as th stored program concept.

Data is information processed by the computer.Data can be in the form of numbers,letters,words or a combination of them (alphanumerics);in contrast to numbers that are being interpreted as program steps.Digital computers can also handle sentences and paragraphs.Processing refers to the infinite number of ways in which data are handled.These include arithmetic operations,data storage and accumulation,editing and sorting.Data can also be inspected or evaluated for use in decision making process.

Both data and programs are stored in memory.The memory is a set of storage locations for binary numbers.

In addition to its processing capabilities,the computer acts as a controller of external circuitry or equipment by controlling sequence,timing and condition.

For engineering reasons,the computer operates on binary numbers,'0' & '1'.A binary digit is called a computer's word size.Different word sizes are used by different computers.Computers with longer word sizes permit faster processing and greater data resolution.

Fig.1.Computer word size

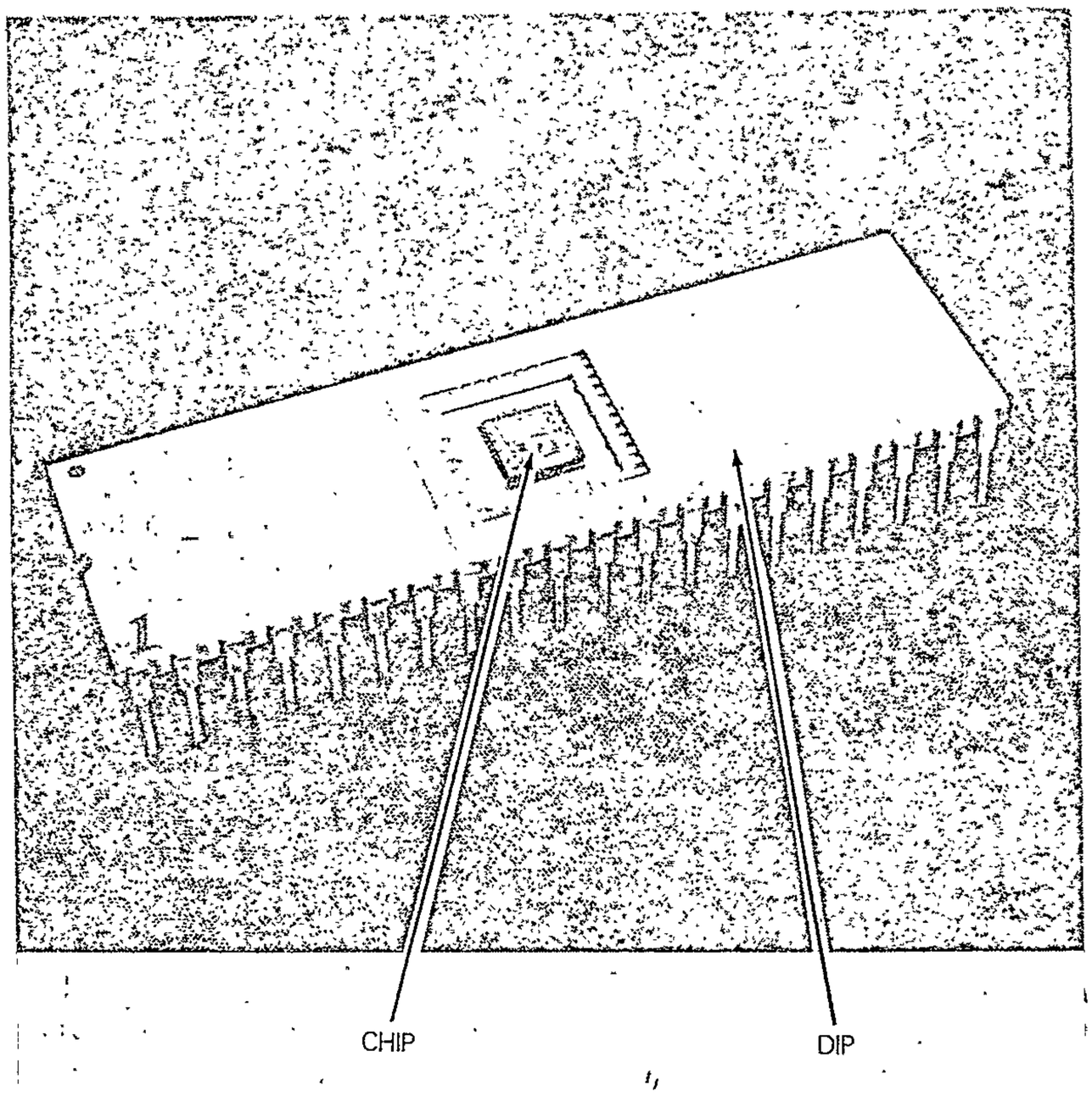
word size	microcomputer
4	Many
6	None
8	Most
12	A Few
16	A Few
18	None
24	None
32	None
64	None

2:MICROCOMPUTERS

2.1.Definition

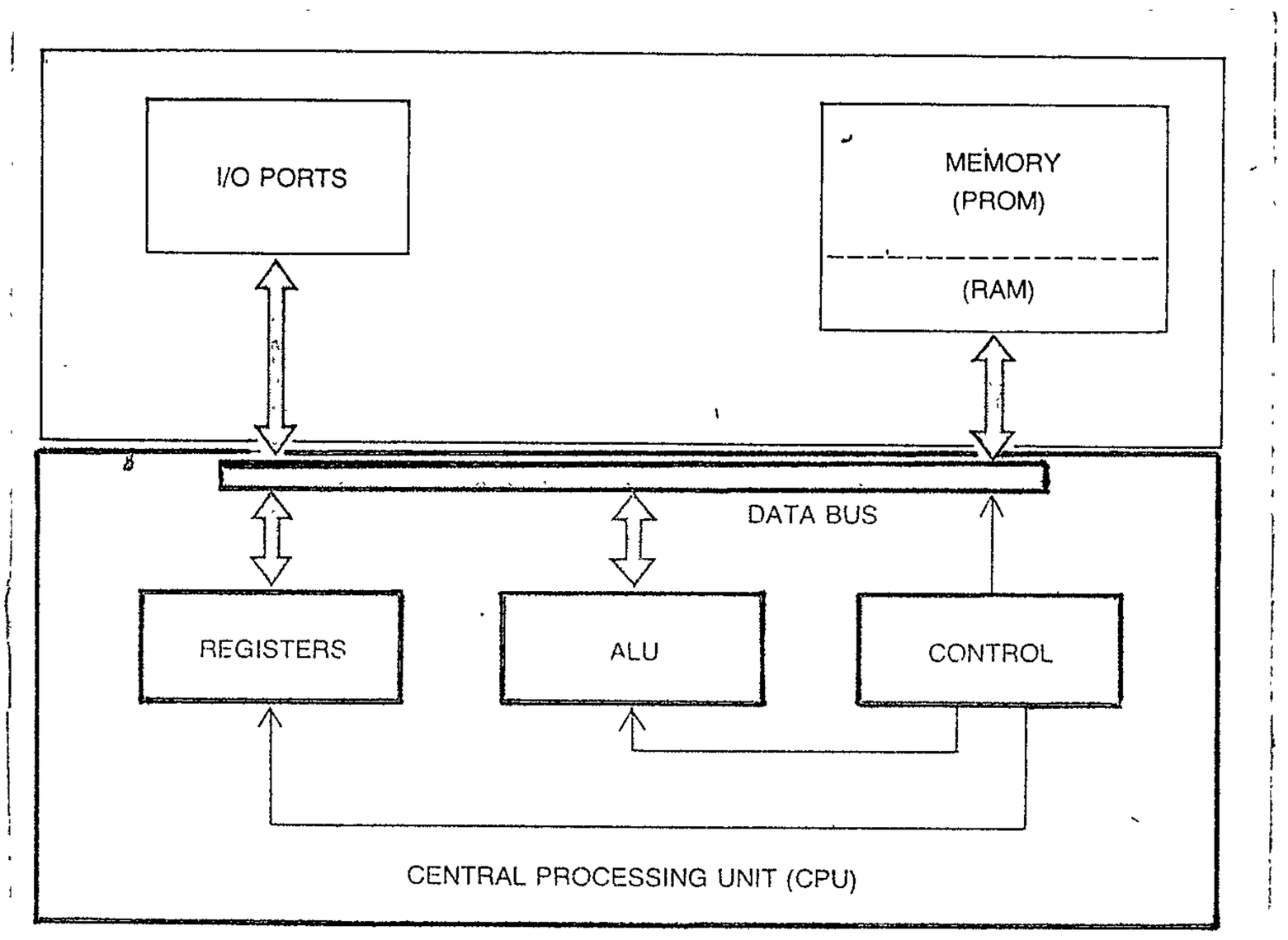
A microcomputer is based on a microprocessor.A microprocessor is the central arithmetic and logic unit of a computer (CPU or CENTRAL PROCESSING UNIT) together with its associated circuitry,scaled down so that it fits on a single chip (sometimes several chips) holding tens of thousands of transistors,resistors and similar circuit elements.It is a member of the family of large scale integrated circuits.A typical microprocessor chip measures half a centimetre on a side.By adding anywhere from 10 to 00 chips to provide timing,program memory,random access memory,interfaces for input and output signals and other ancillary functions,one can assemble a complete computer system on a board.Such an assembly is called a microcomputer.

Fig.2.1.* A Microcomputer Chip And Dip



*From "An Introduction To Microcomputers Vol.1.Basic Concept" by Adam Osborne page xvii.

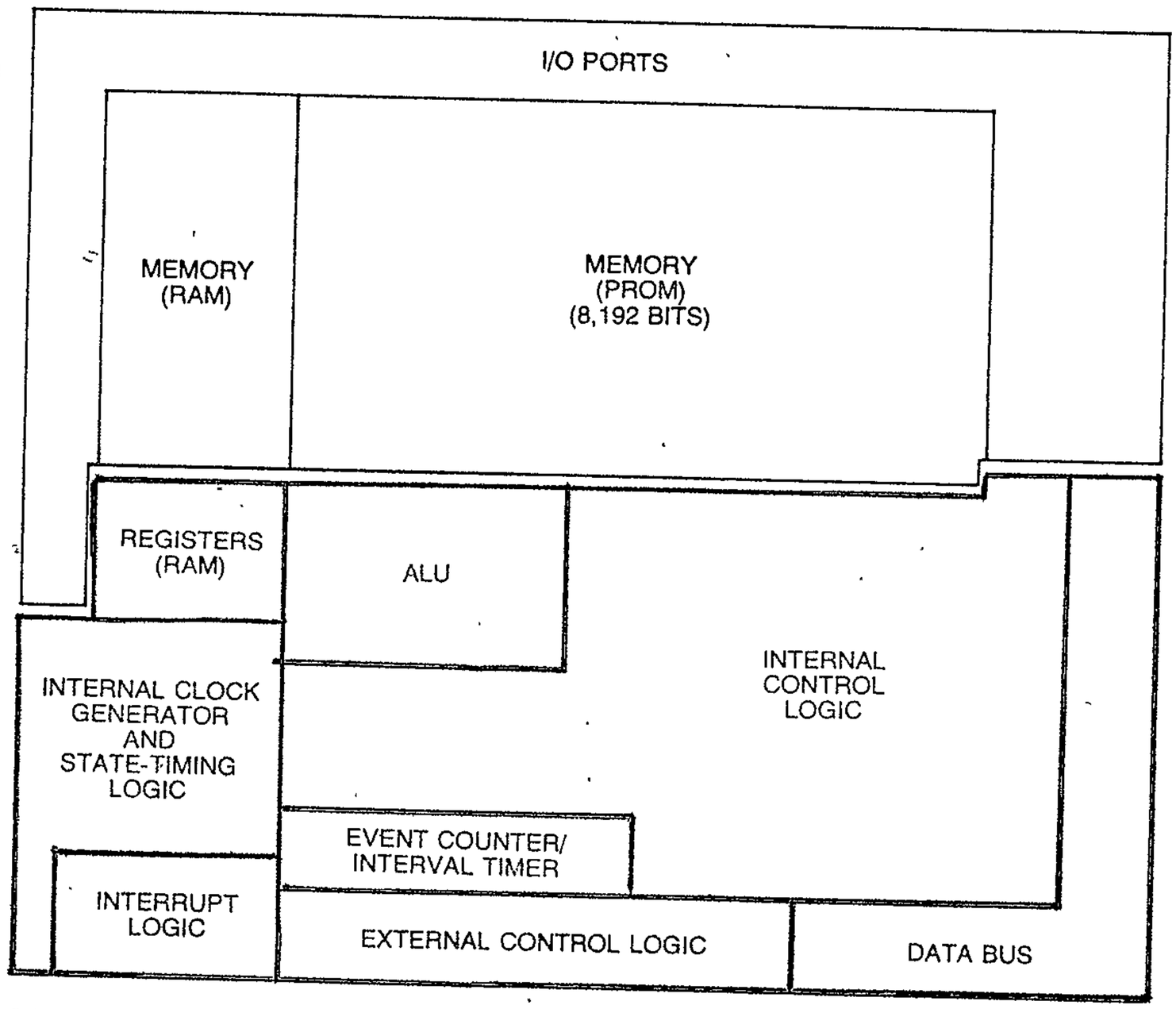
Fig.2.2.* Basic Components of Computer System



BASIC COMPONENTS OF COMPUTER SYSTEM can now be compressed onto a single chip, as in the Intel 8748. In this block diagram "control" includes control logic and instructions for decoding and executing the program stored in "memory." "Registers" provide control with temporary storage in the form of random-access memories (RAM's) and their associated functions. "ALU" (for arithmetic and logic unit) carries out arithmetic and logic operations under supervision of control. "I/O ports" provide access to peripheral devices such as a keyboard, a cathode-ray-tube display terminal, "floppy disk" information storage and a line printer. The functions that are in black convert a microprocessor (*color*) into a complete microcomputer.

*"Microprocessors" by Hoo-Min D.Toong,Scientific American,Sept.1977,page 151.

Fig.2.3.* Map Of 8748 Microcomputer



MAP OF 8748 MICROCOMPUTER identifies the location of the various computer functions. The color scheme used in the preceding illustration is repeated here. Each function can be assigned to one of the five basic functional blocks: control, memory, registers, ALU and I/O ports. The portions of the chip outlined in black represent the functions that transform the 8748 from a simple microprocessor into a microcomputer. Device holds some 20,000 transistors fabricated by *n*-channel silicon-gate metal-oxide-semiconductor (*n*-MOS) technology. Eight-bit central processor responds to 96 instructions in average time of 2.5 microseconds.

*"Microprocessors" by Hoo-Min d.Toong.Scientific American.Sept.1977.page 151.

2.2.ORGANISATION OF A MICROCOMPUTER

There are 5 basic sections within the microcomputer which outline the principles of its mechanism of function.

(i) Memory-stores data,instructions,temporary and final results.

(ii) Control-interpretes instructions from the input and sends signals to other parts of the computer for actions.

(iii) Arithmetic & Logic Unit-manipulates numbers for computation and decisions.

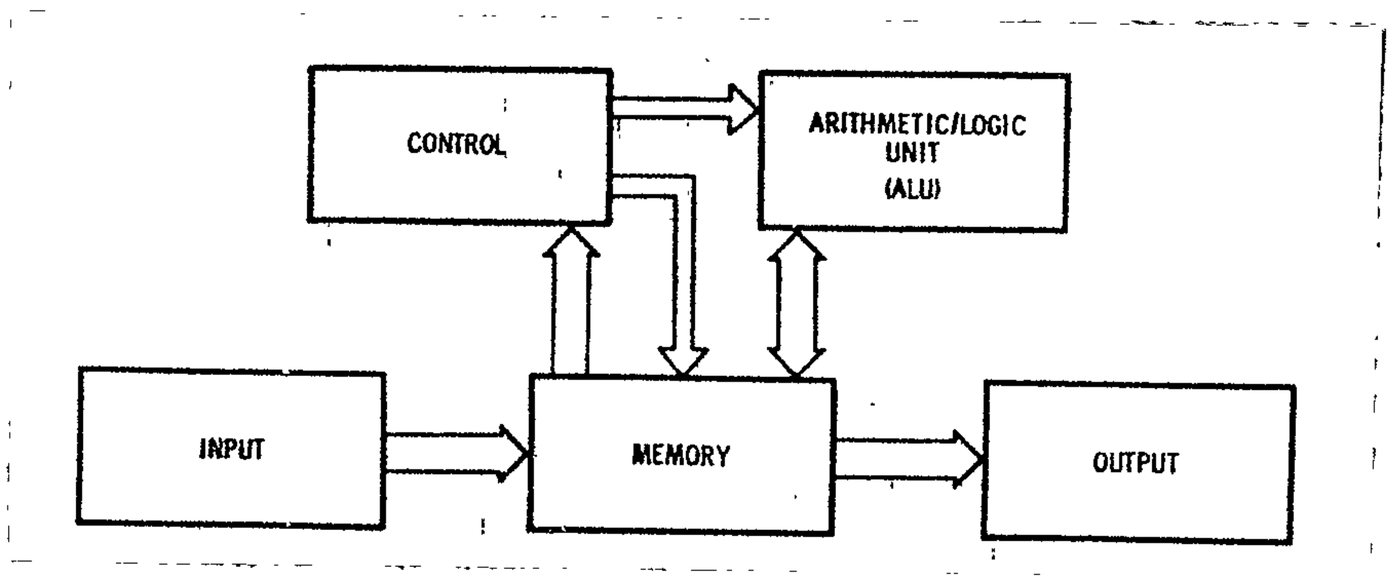
(iv) Input-receives information and instructions from the computer operator or another electronic device(can be another computer.)

(v) Output-passes the results to the operator or another device.

Together,the Control and the Arithmetic & Logic Unit forms the CPU(CENTRAL PROCESSING UNIT)-the nerve centre of the computer.

All the above are interconnected by digital circuitry so that they can communicate with each other through the concept of buses.The 3 buses are the Address Bus,Data Bus and Control Bus.Data Bus is usually bidirectional so that data can be exchanged by the CPU and other elements.The address and control buses are generated by the CPU.

Fig.2.4.*Organization of a typical computer



*"Understanding Digital Computers" by Forest M.Mims,III,page 106.

The 4 sections are now described in detail.

2.2.1.MEMORY

This consists of multiple storage locations of fixed lengths,binary words.Each memory location can be selected for writing or reading.Most microcomputers use semiconductor memory elements.Basically there are 2 types of memory elements:

(i) Static storage circuit-this is usually a flip flop.A flip flop is a simple circuit made from as few as two other simple electronic circuits called gates (or logic circuit based on Boolean Algebra).Gates represent binary numbers like a switch;it is either "on" indicating bit "1" or "off" indicating bit "0".Flip flops enable the computer to count,remember information and shift numbers around for its binary arithmetic operations.Without flip flops,computers would not be able to analyze a problem step by step (sequentially) with perfect rythmn.

(ii)Dynamic memory-this uses a capacitor to store data.The presence of charge represents the storage of binary "1",whilst an absence of charge indicates"0".

The single bit elements or circuits are then combined to form memory locations for the different multibit word sizes eg. 4,8,16 bits.

The memory storage locations are each given an address.Each address when enabled allow data to be written or read from it.The selection of the address is the responsibility of the memory address decoder.

The input for the memory address decoder is received from the address register.This is a multibit register that contains a binary number representing the memory address.

This type of memory is referred to as random access,read/write memory.It allows for direct access to the memory location.Data can be written and read from it.This form of memory structure is called RAM.Information in RAM is volatile-it is lost when electrical power is removed.

Another widely used semiconductor memory is ROM (read only memory).It is also a random access memory.However data has been permanently stored in memory during manufacture.Data in the memory locations can only be read.Fixed programs and data are stored in ROM and thus fixes the application of the computer.Information in ROM are non volatile.It is not lost with loss of electrical power.

PROM is the user (or field) programmable ROM.It is a special ROM which is loaded at the factory with all logical 1s.

RAM and ROM are manufactured with different byte storage capacities.A byte is a unit of information composed of 8 bits.which is treatd by the computer as a single unit.A byte is usually used to represent an alphanumeric character of a number in the range of 0 to 255.Some common examples are:32*8(256 bytes),1024*8(8192 bytes),and 2048*8(16,384 bytes).

Semiconductor memories are usually designated according to the nearest thousand bytes of an even multiple of 2.The symbol used is K(kilo),meaning in computer term,1024 bytes of information.Thus 8192 bytes is called 8K,16384 bytes is 16K and 32K is the sum of 4*8K bytes (32,768 bytes).

The 8 bits(a byte) microprocessor word length is the type predominantly in use today.However,12 bits and 16 bits are currently available and these forms of semiconductor memories can store up to 64K(65,536 bytes).

Data to be read or stored in RAM is generally buffered by the data register.A word read from a memory location is stored in some destination register.A word to be written into a memory location comes from a source register.

2.2.2.CENTRAL PROCESSING UNIT

As outlined previously,the CPU consists of the CONTROL and the ARITHMETIC/LOGIC UNIT.

(i)CONTROL

This can be further subdivided as to be made up of the program counter and the instruction register.

(a)PROGRAM COUNTER

This register contains the memory address of an instruction.Its content is transferred to the address register in memory.The memory address is enabled and the instruction stored there is read into the instruction register.As each instruction is fetched,the program counter is incremented so that it points to the next instruction in sequence.

(b)INSTRUCTION REGISTER

The instruction word is stored here.The word is then decoded by the instruction decoder to determine the function to be performed.

From there,the timing and control circuits within the control section then generate the appropriate control pulses for the other circuits in the computer for the desired actions.

(ii)ARITHMETIC/LOGIC UNIT

This section consists of the main working register called the ACCUMULATOR and the ARITHMETIC LOGIC UNIT (ALU).This section carries out most of the operations desiganted by the computer's instruction set.

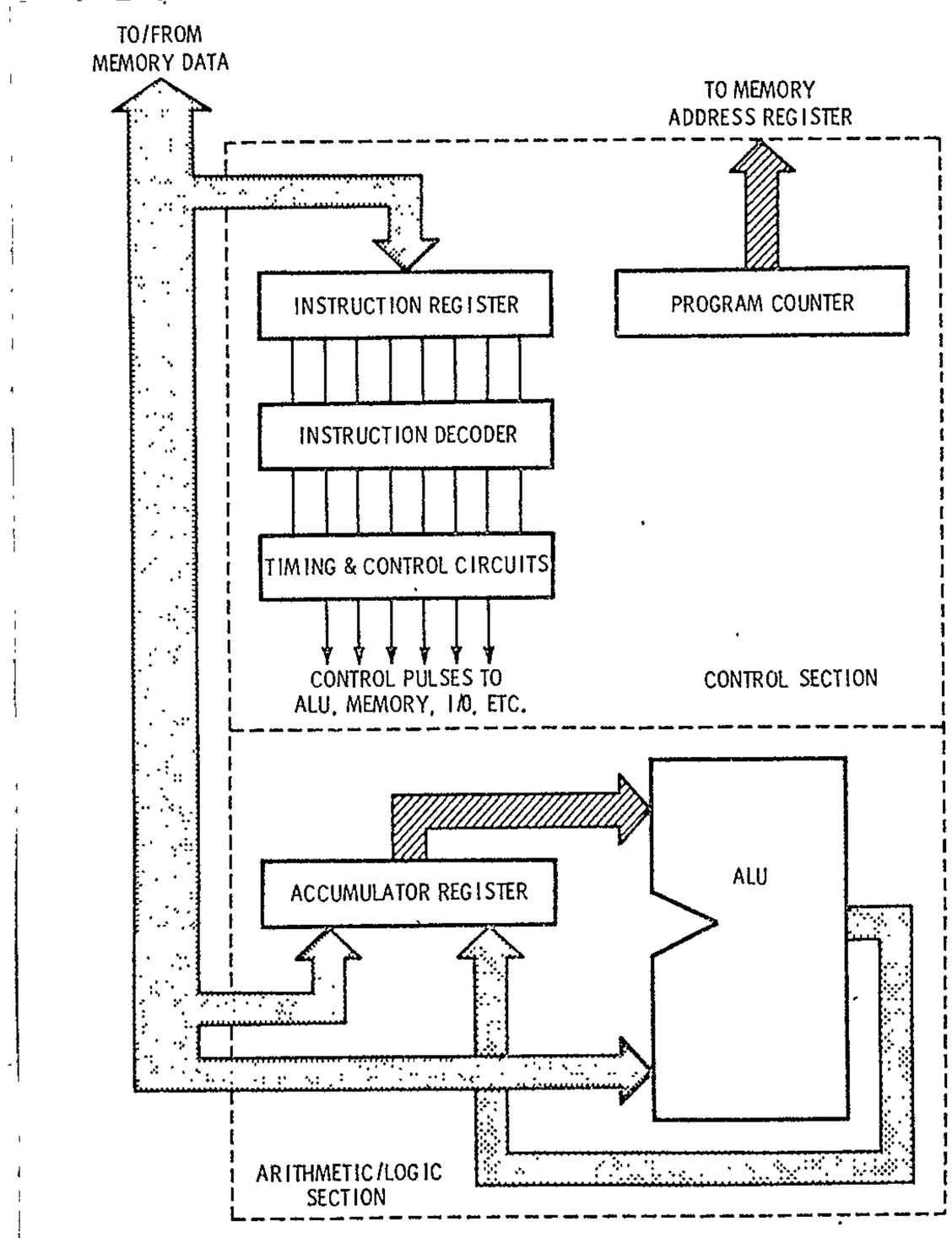
All data transfers and arithmetic/logic operations takes place with one data stored in the accumulator,the other stored in memory.The reult of the computation involving two operands would be stored in the accumulator whilst the data in memory is lost.

The ALU in most microcomputers perform addition,subtraction as well as basic logic operations AND,OR,EXCLUSIVE OR and COMPLEMENT according to the Principles of Boolean Algebra.

2.2.3.INPUT/OUTPUT SECTIONS

These sections interface the computer to the outside world.They handle the transfer of data between the computer and the peripheral units eg computer keyboard,line printers,disk drives etc.The user manipulates these peripheral devices to enter and retrieve results.The input section translates the data into binary and stores the data into the computer's memory.The output section transfers the result from the computer to the peripheral devices where the binary data is converted to a number,a word or a graphic symbol.

Fig.2.5.* Block Diagram Of CPU



* From"Getting Acquainted With Microcomputers"by Louis E.Frenzel,Jr.page 17.

2.2.4.CLASSIFICATION OF MICROCOMPUTERS

Microcomputers can be classified according to :

(i)Type of CPU

(ii)Semiconductor technology used

(iii)Word size

(iv)Size of RAM

2.2.5.TYPES OF MICROCOMPUTER

Various types are available in the market today.Some of the more current popular brands and their specifications are presented below.

Fig.2.6.

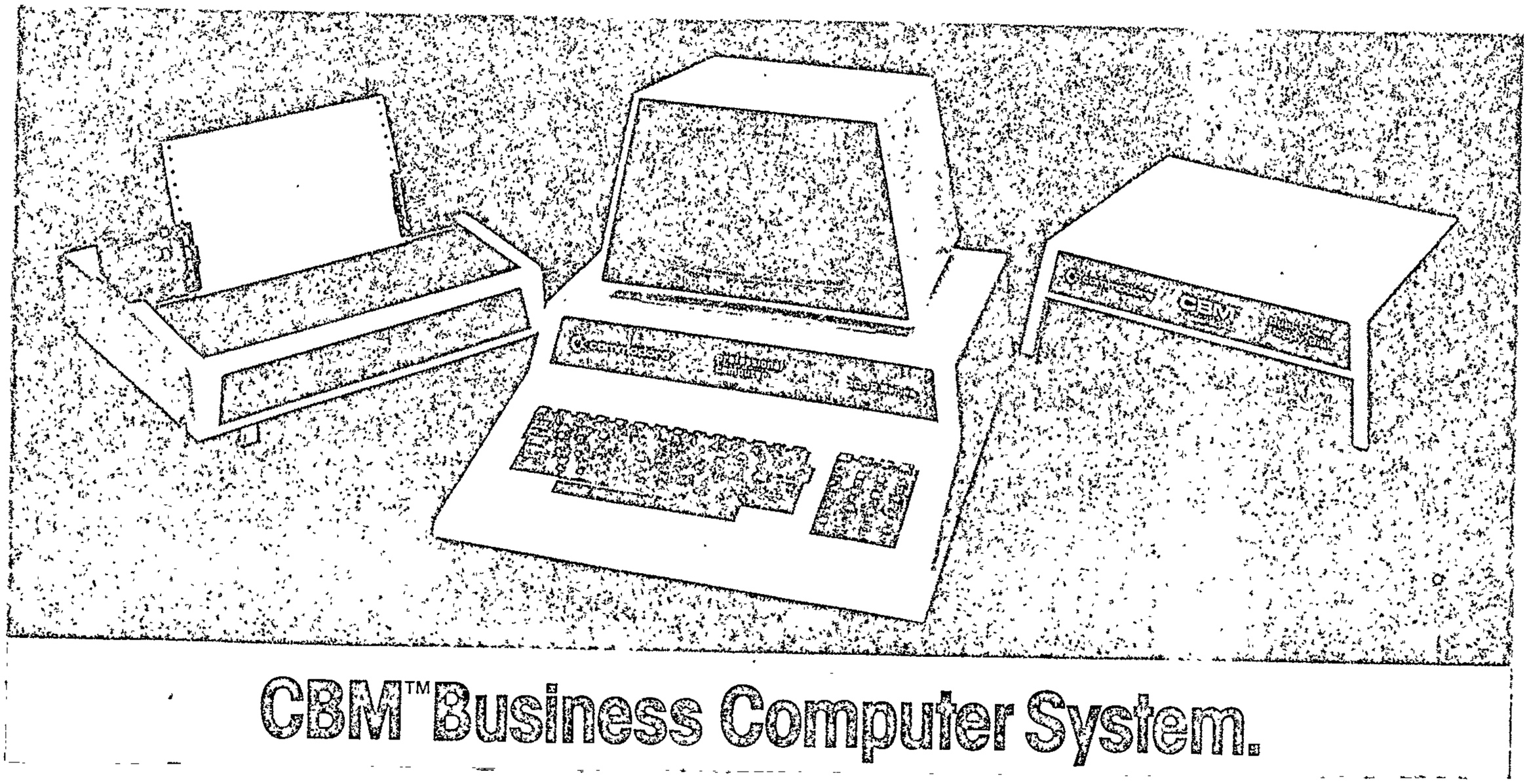


Fig.2.7.

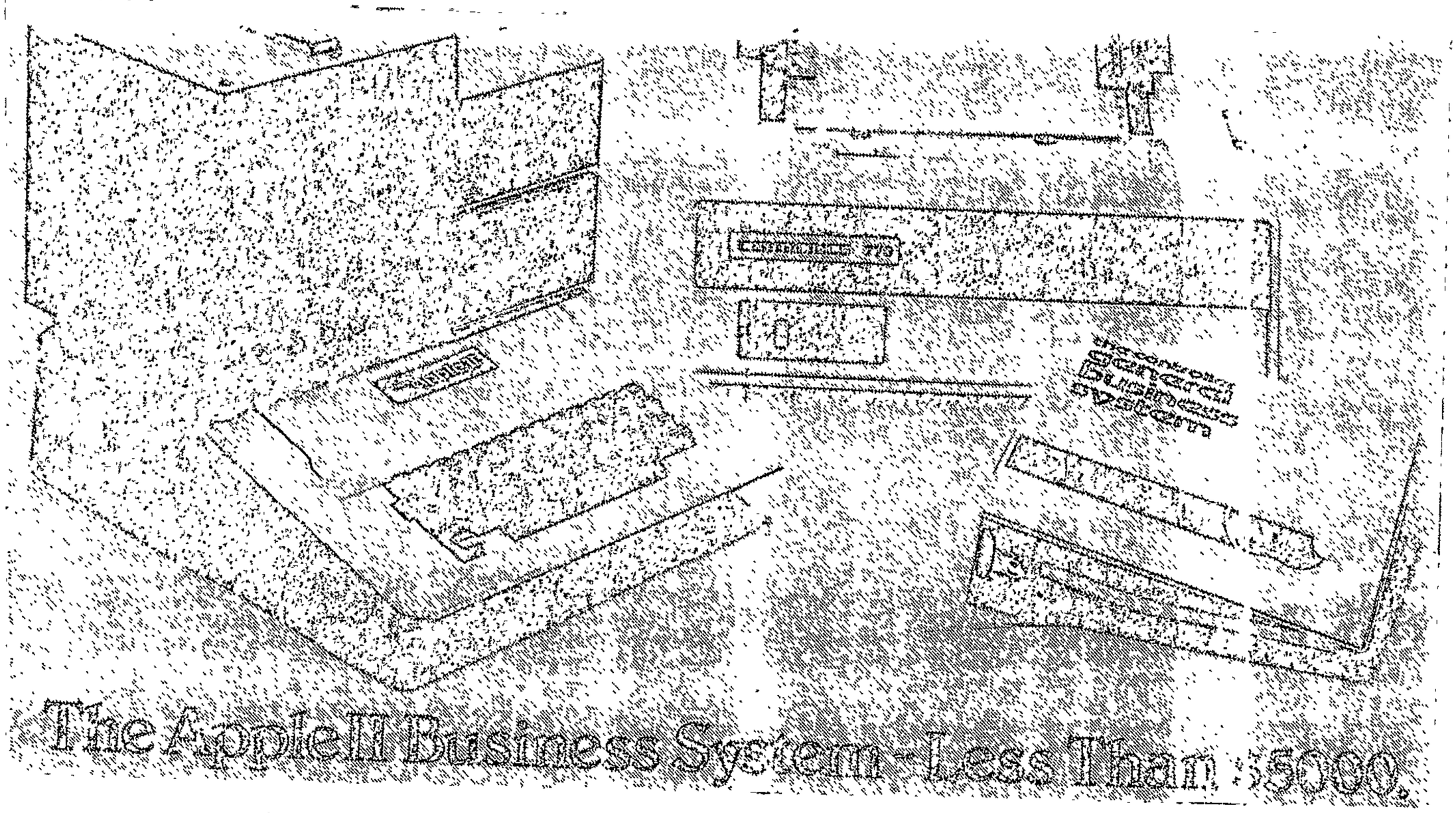

The Apple II Business System - Less Than $5000.

Fig.2.8.

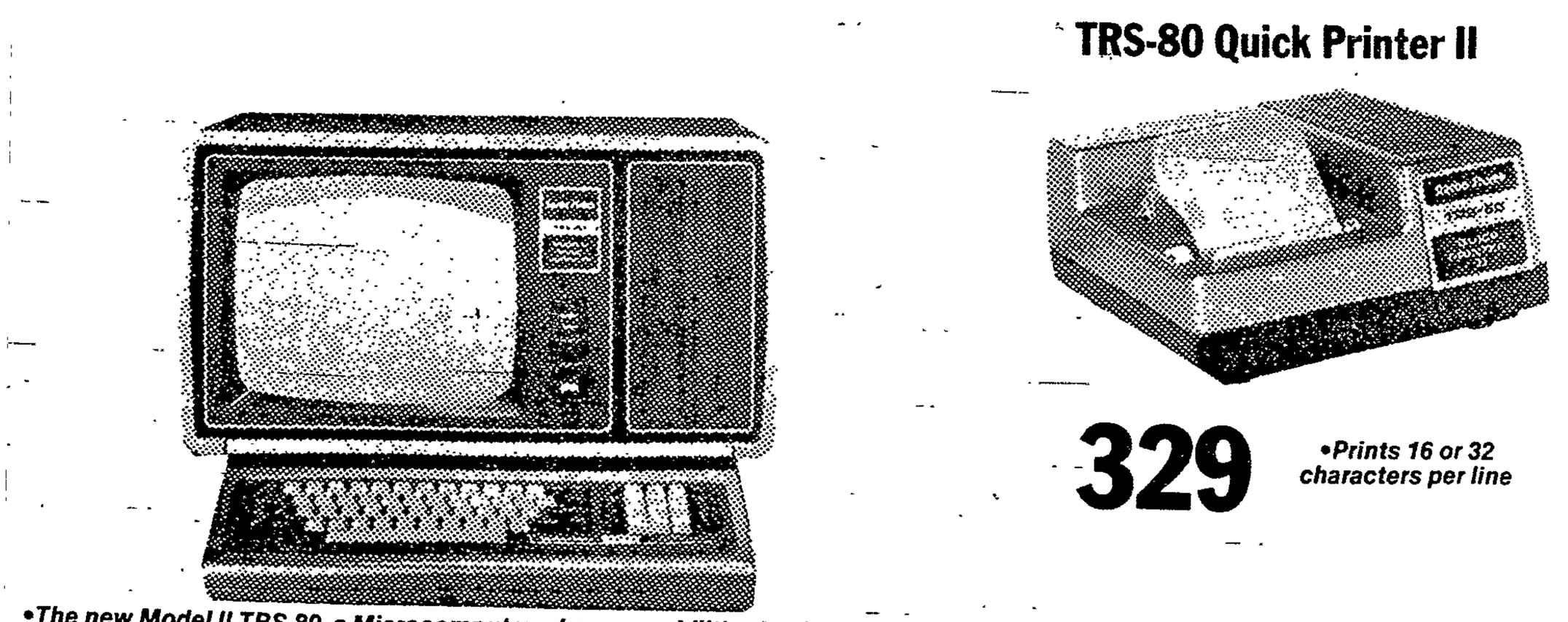
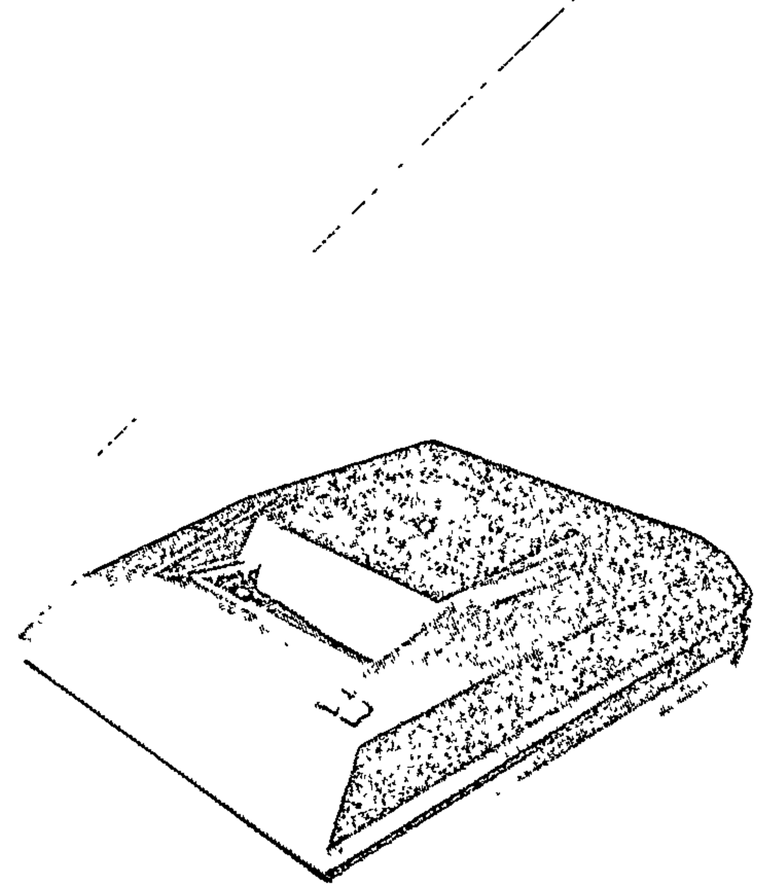
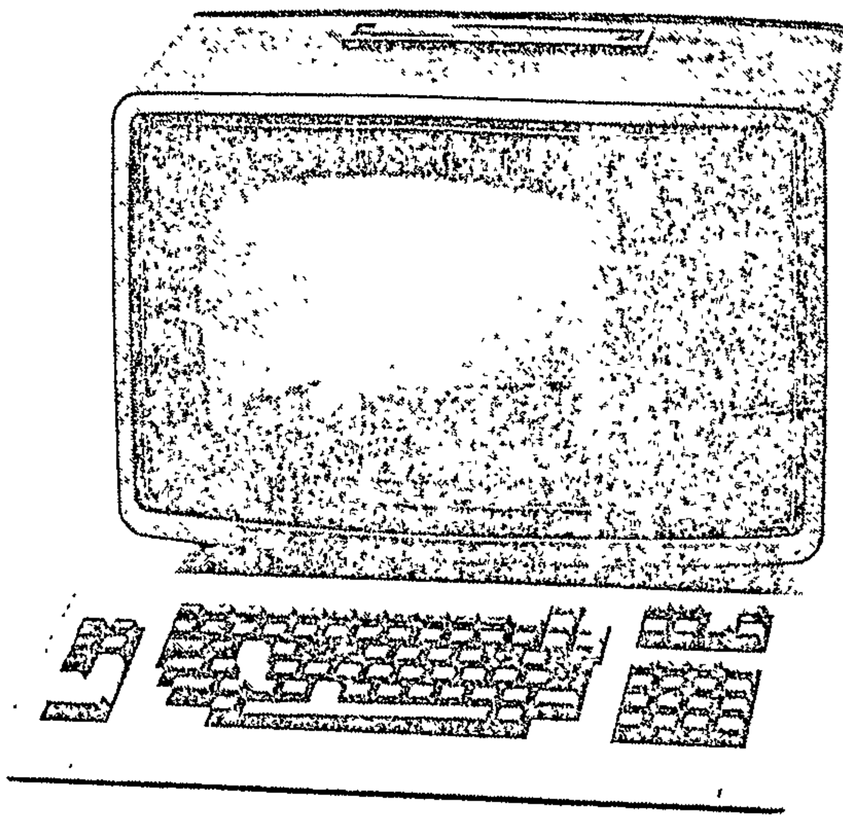

TRS-80 Quick Printer II
329
•Prints 16 or 32 characters per line
•The new Model II TRS-80, a Microcomputer whose capabilities begin where Model I approaches it's upper limits

Fig.2.9.

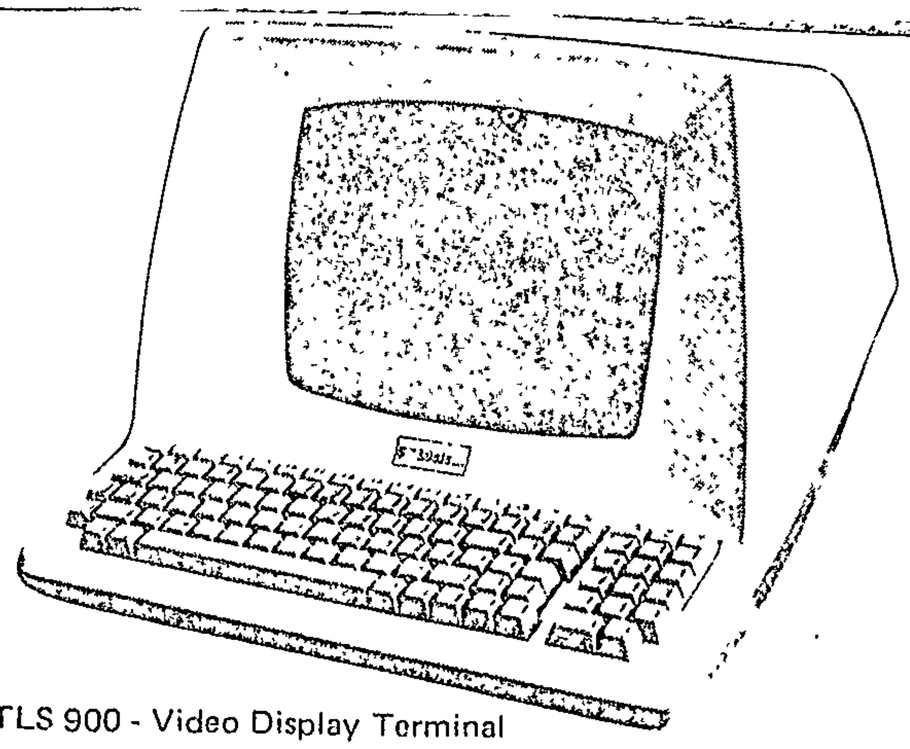


PRINTERM - 80 character col. width receive only printer.



COMPUCOLOR II - Personal desk-top computer

Fig.2.10.



TLS 900 - Video Display Terminal

AUSTRALIA'S MOST UP-TO-DATE BUYER'S GUIDE FOR MICROCOMPUTERS

Month by month, every effort will be made to keep
In Store up-to-date and accurate.
And that means APC will always be happy to hear from its readers
of any errors, and additions that seem worthy of inclusion.

LIST OF ABREVIATIONS

A — Assembler
A/D — Analog to Digital
B/W — Black and White
C — Cassette
cps — Characters per second
Doc — Documentation
E — Extensive
Ed — Editor
Ex — Extended
F/D — Floppy Disc
H — Hardware
I — Introductory
I/O — Input / Output
int — Interface
K/B — Keyboard
M/A — Macroassembler
N/A — Not Available
N/P — Numeric Pad
O/S — Operating System
P/P — Parallel Port
RAM — Random Access Memory
ROM — Read Only Memory
res — Resolution
S — Software
S/P — Serial Port
T/E — Text Editor
U — Utility
VDU — Video Display Unit

All prices shown are exclusive of sales tax, except where indicated by an asterix.

Software items listed in *italics* are not included in the basic price of the equipment.

Name of Machine	Main Distributor & Phone No	Hardware	Software	Doc	Price	Comments
Apple II plus	Computerland (03) 62 5581 (02) 29 3753	16-48K RAM: 6502: colour VDU int.: 81/O slots: games paddles: option 5¼" F/D (116K) and 11 MB disc	O/S: BASIC: *Pascal:* games	E	$1395	280x192 high res colour graphics: Applesoft BASIC in 12K ROM
Century	Abacus Computer Store (03) 429 5844	C100, 48-64K RAM: Z80: 12" VDU: 2x5¼" F/D (2x143K): 112 cps printer: RS232 port: S100 bus: C200 includes 2xF/D (2x315K): hard disc: 4xRS232: 2xP/P	*COBOL: FORTRAN: BASIC*	I	C100–$4950: C200–$5400	Also available: C300
Challenger IP	Systems Automation (02) 439 6477	4-32K RAM: 6502: C int: 24x32 VDU int: RS232 port: option – dual 5¼" F/D (140K)	O/S: BASIC: A: games	I	$448	8K microsoft BASIC in ROM: expansion board available
Challenger 4	Systems Automation (02) 439 6477	8-48K RAM: 6502: colour 32x64 VDU int: RS232 port: P/P: option – 6502C microprocessor; dual 5¼" F/D (140K)	BASIC: *Pascal*	I	$871	BASIC in 8K ROM
Compucolor II	Anderson Digital Equipment (03) 543 2077	8-32K RAM: 8086: 13", 32x64 8 colour VDU: single 5¼" F/D (51K): RS232 port	ExBASIC(ROM):*A*	I	$2095	16K model, $2395: 32K $2695: maintenance manual available
Cromenco System 2, System Z2H, System 3	–	64-512K RAM: Z80A: System 2, dual 5¼" F/D (346K): System Z2H, also Winchester disc (11MB): System 3, 8" dual 1MB: S/P: P/P	CDOS: *BASIC: COBOL: FORTRAN: M/A: ExBASIC: Structured BASIC*	E	System2 $3990 System Z2H $9650 System 3, $6750	All Systems expandable to multi user (2-7 users) $2880–$8825
Exidy Sorcerer Model II	Dick Smith Electronics (02)888 3200	8-48K RAM: Z80: 30x64 VDU int.: RS232 Port: P/P: S100 bus:extra C int.	O/S: ExBASIC (ROM): *M/DOS: CP/M*	I	$1295*	High res graphics capability: 16K version $1395*: 32K version $1525*: 48K version $1655*: User programmable character set

Name of Machine	Main Distributor & Phone No	Hardware	Software	Doc	Price	Comments
HP-85	Hewlett Packard Australia (03)89 6351	16-32K RAM: N/A: 5", 16x32 B/W VDU: C(200K): 64 cps printer: RS232 port: 4 x P/P	BASIC	S	$3550	Full dot matrix graphics: N/P: compact portable unit
IPS-100	Microprocessor Applications (03) 754 5108	32-896K RAM: 8085: 2 RS232 ports: S100 bus: dual 5¼" F/D (630K)	O/S: Ex BASIC: Ed: A: *CP/M: CBASIC: FORTRAN: COBOL*	E	$3750	
Microengine	Daneva Control (03)598 9207	64K RAM: MCP 1600: 2 x RS232 ports: 2xP/P: Options – dual 5¼" F/D (Single or dble density); 8" F/D (single or dble density)	BASIC: Pascal: File Manager: U	E	$2995	Also available as board
North Star Horizon	Melbourne's Byte Shop (03) 568 4022	32-64K RAM: Z80A: 5¼" F/D (170K): 2xS/P: 1P/P: optional – VDU ($1350); Quad density F/D	DOS: BASIC: *COBOL: FORTRAN: Pascal: CP/M: M/A*	E	$2695	
Pet 2001	Hanimex (02) 938 0400	8-32K RAM: 6502: C: 9" 25x40 B/W VDU: extra C Int: IEEE488 port	O/S: BASIC: *A*	I	8K$1199 16K$1859 32K$2249	Options – dual 5¼" F/D (353K), $2329: $109 for disc operating ROM
Sord M100 ACE III	Alliance Digital Corporation (02) 436 1600	48K RAM: Z80: 24x64, 12" VDU: RS232 ports: 2x5¼" F/D (2x143K): S100 bus: 2 octave speaker: A/D Conv.: option–8 colour graphic controller ($1450)	O/S: Ex*BASIC FORTRAN*	I	$4500	M100 ACE IV – 8 colour graphics controller incl.
Sord M223	Alliance Digital Corporation (02) 436 1600	64K RAM: Z80: 12", 24x80 VDU: 2xRS232 port: S100 bus: 5¼" F/D (350K)	O/S: *ExBASIC: FORTRAN: COBOL*	I	$7500	
TRS-80 Level 1	Tandy Electronics (02) 638 6633	4-16K RAM: Z80: C: 12", 16x64 B/W VDU	BASIC: Games: A	I	$699*	BASIC in 4K ROM: upgradable to Level 2
TRS-80 Level 2	Tandy Electronics (02) 638 6633	4-48K RAM: Z80: C:12", 16x64 B/W VDU: RS232 port: P/P	BASIC: *M/A: FORTRAN: COBOL*		$879*	16K machine includes N/P: 4-16K upgrade $320*: ($250* without N/P): max. config. $1169*: option – single 5¼" F/D (78K), (max of 4)
Vector Graphics System B	AJ & JW Dicker (02) 524 5639	64K RAM: Z80: Dual 5¼" F/D (630K): 12", 24x80 B/W VDU: S/P: 2xP/P	DOS: BASIC: A: CP/M: Ed	E	$6350	Graphics and numeric pad.
Versatile 4	Microprocessor Applications (03) 754 5108	32-56K RAM: 8085:9", 24x80 B/W VDU: dual 5¼" F/D (630K): S100 bus: 2xRS232	MBASIC: MDOS (including T/E and A): *Version 4 MDOS AND BASIC: CP/M*	E	$5692	

SINGLE BOARDS

Acorn	Cottage Computers (03) 481 1975	1-8K RAM: 6502: EPROM socket: Hex K/B: C int: 8 digit LED display: up to 16 ports: options – Euro-card 64 way connector; VDU card; Full K/B card	½K monitor: *BASIC*	S& H	System1 $285: SystemII $1224: SystemIII (incl.a5¼" F/D), $2763	Universal interface card available.
Aim 65	Dwell Pty Ltd (02) 487 3111	1-4K RAM: 6502: 8K ROM: full K/B: 20 character LED display: 20 character thermal printer: Cx2 int: 1 P/P	8K monitor in ROM: *A: BASIC*	E	$525*	Case available $75*
SBC100	Microtrix (03) 718 2581	1K RAM: Z80: 8K ROM: S100 bus: 1S/P: 1P/P	1K monitor: DOS in ROM	E	$299	Also available assembled $374

2.2.6.CURRENT STATUS AND LIMITATIONS

At present,microcomputers find greatest application in personal computing.This refers to its use mainly as a hobby and for personal convenience.However,its capabilities in other fields are being exploited.Microcomputers are currently applied in the following fields:

(i) Entertainment-current software available include various games like poker,bridge,star trek etc.

(ii) Learning-it offers learning programs for various subjects such as statistics,mathematics,languages,computer programming etc.

(iii) Data processing and retrieval-data in the form of mailing lists,recipes,telephone numbers,book keeping and accounting functions can be stored.

(iv) Monitoring and control functions-it can be used to control home security system and other home appliances.

(v) Commercial application-the business industry has begun to apply microcomputers in their fields.Microcomputers are in use to perform control functions in factories and by professionals in their everyday work.

2.3.OPERATING A MICROCOMPUTER SYSTEM

A Microcomputer system consists of the hardware and the software.The hardware is made up of the physical units i.e.the computer and its related accessories.The software includes the entire range of non electronic support to the computer.It includes the programs,the user manuals and the design documentation.

2.3.1.OPERATING THE COMMODORE MICROCOMPUTER SYSTEM HARDWARE

The Commodore Microcomputer system to be described is made up of the 2001 Series Professional Computer,the 2040 Series Dual Drive Floppy Disk and the 3022 Tractor Printer.Only the basic to the understanding of the system will be outlined.The user should refer to the Manual for a more complete guide.

2.3.1.1.2001 SERIES PROFESSIONAL COMPUTER

This computer has 32K bytes of Random Access Memory.The Video Display Unit is a 9"monochrome CRT (Cathode Ray Tube) with a screen which displays characters in a format of 40 characters by 25 lines.The screen can display 64 graphic characters and 64 standard ASCII characters (American Standard Code for Information Interchange,the most popular coding scheme used to represent characters).There are 2 character sets stored in the ROM-upper case and lower case.

The microcomputer normally operates in upper case.The upper case characters can be converted to lower case by the direct command "Poke 59468,14".The command "Poke 59468,12" will convert the lower case back to upper case.Graphic characters are displayed by depressing one of the shift keys of the keyboard whilst in upper case.Both upper and lower cases characters can be made to appear in reverse field (characters displayed on a background) by depressing the off/reverse key.

The keyboard consists of 73 keys,made up of 64 ASCII characters,3 shift keys and the functions characters e.g.carriage return,off/reverse,run/stop,insert/delete and cursor (a square of light sitting where the next character will be displayed) controls.

UPPER CASE

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ

lower case

!"#$%&'()*+,-./0123456789:;<=>?@abcdefghijklmnopqrstuvwxyz

The computer operates in 2 modes i.e.the COMMAND MODE and the PROGRAM MODE.During the command mode,instructions are typed in directly from the keyboard;whilst the program mode is when it is operating under instructions from a previously written program.It will not run a program whilst in the command mode and vice versa.Commands however,may be included in program statements.

On powering up the computer,one will see briefly on the screen a variety of strange characters appearing on a greenish rectangle.This reflects the current content of the computer memory.The following will appear on the screen:

```
##COMMODORE BASIC##

31743 BYTES FREE

READY

▒
```

This indicates that 31743 bytes are available in RAM and the square is the cursor.It is now ready to accept a direct command.

e.g.of direct command

Type in:PRINT 30*4

The computer will print 120 followed by a READY and the cursor below it.

At this stage,the computer is ready to accept input of other arithmetic computations or writing of a program.

The other direct commands would be discussed in relation to the operation of the floppy disk drive.

2.3.1.2.DUAL DRIVE FLOPPY DISK

The Dual Disk Drive is an external memory mass storage device for programs and data which the microcomputer are not currently using.It is slower when compared to the semiconductor memory of RAM.The drive to the right of the LED (light emitting diode) error indicator is called Drive 0 and the one to the left is Drive 1.With its 2 Drives,a total of 340K bytes can be stored in two 5 1/4" Floppy Diskettes.

The Disk Drive consists of a read/write head (similar to that of a tape recorder),a stepper motor and a hub assembly (to rotate the diskette).

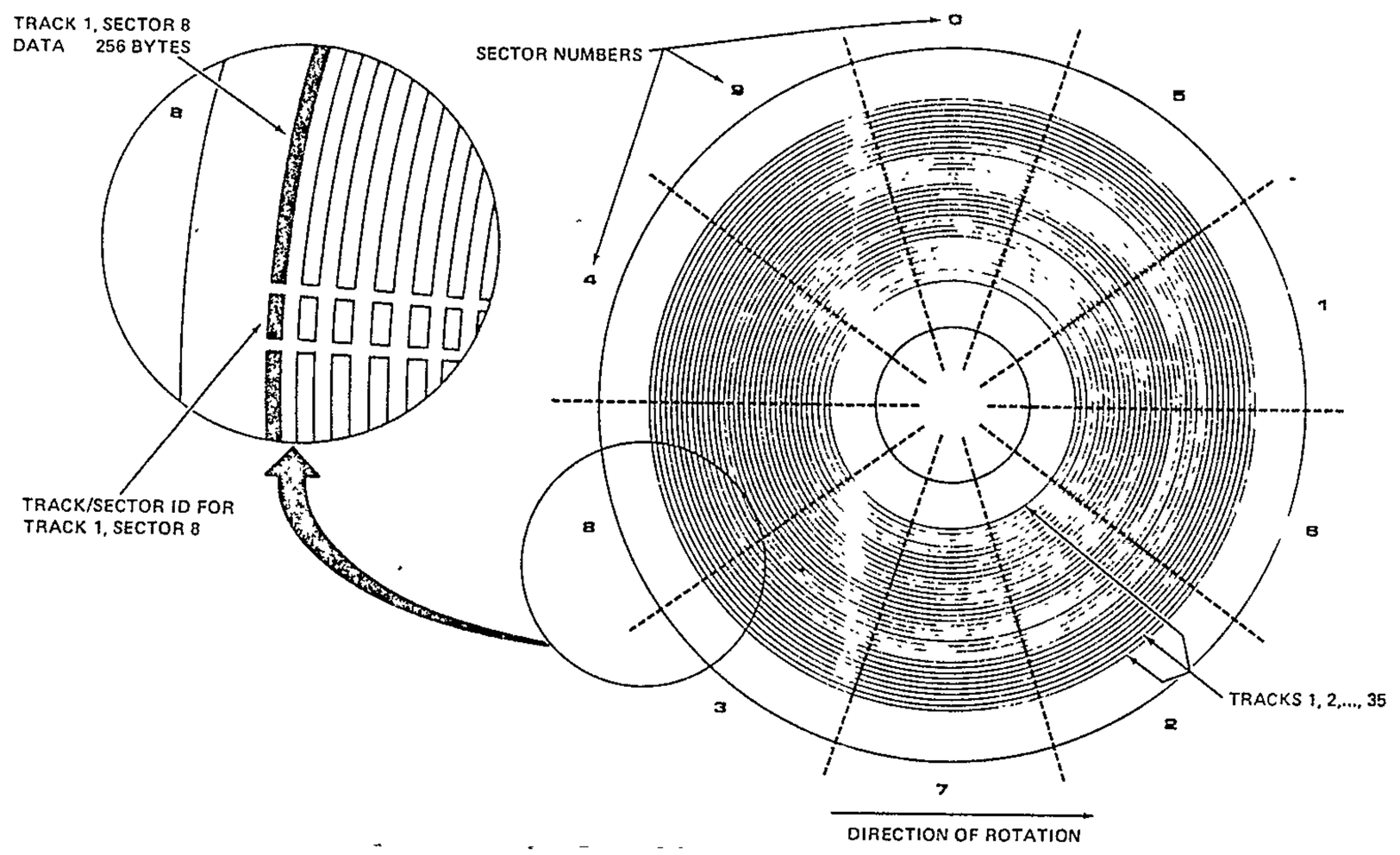
The Disk Drive is an intelligent peripheral and thus uses none of the RAM memory of the computer.

(i) Floppy Diskette

This is the physical unit on which programs and data are stored;as a sequence of magnetic pulses on its smooth ferromagnetic coated surface.A floppy diskette is soft and can easily be bent.It is homed in a square jacket container for rigidity,to prevent scratching and contamination.The jacket also has a special lining which cleans the diskette as it is rotated by the hub assembly of the Disk Drive.

The pulses are recorded alona tracks on the surface of the floppy disk.The diskette is divided into tracks and subtracks called sectors.A miniflappy has 35 tracks.The number of sectors/tracks vary from 17 at the innermost to 21 at the outermost.Each track stores about 128 bytes(128 characters).

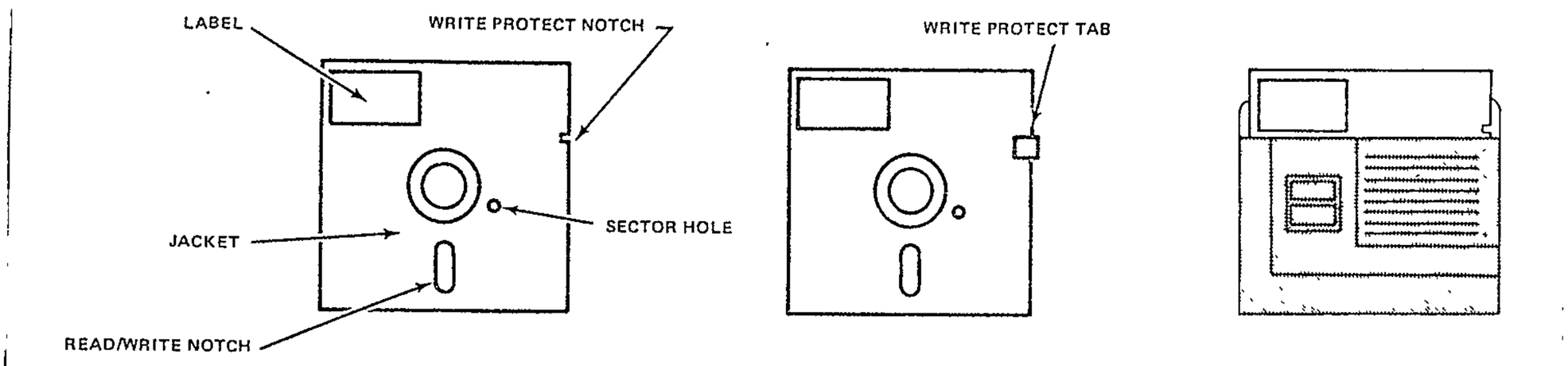
Fig.2.11.* Track/Sector organization on a formatted diskette.



* "TRSDOS & DISK BASIC Reference Manual",Radio Shack,Tandy Corp,page 2-6.

The diskette has a large spindle hole at the centre for the drive hub of the disk drive.There is also a small sector hole which indexes the diskette as it rotates.This is a soft sectored disk.A hard sectored disk has more than one hole in between the sectors.There is a read/write notch and a write protect notch on the jacket.The write protect notch,as the name implies,can be covered with tape to prevent accidental writing of data on a written disk.

Fig.2.12.* A dikette:a write-protected diskette;diskette in envelope.



* "TRSDOS & DISK BASIC Reference Manual",Radio Shack,Tandy Corp.,page 2-7.

Before a diskette can be used,it has to go through a step called FORMATTING.It is during formatting that the Disk Drive designates the tracks and sectors using the appropriate magnetic codes to the diskette.For a comprehensive explanation of the steps in formatting,the user is advised to refer to the 2040 User Manual.

Being a precision recording media,a diskette must be handled carefully to get maximum life from it.The following precautions are advised:

(a)Keep diskette in envelope when not in use.Do not leave diskette in Drive when the system is turned off.

(b)Keep diskette away from magnetic fields as they erased data.

(c)Handle diskette by jacket only.Exposed surfaces are not to be touched,wiped or cleaned as data on the diskette are tampered by the resulting scratches.

(d)Keep diskette away from heat and direct sunlight.Storage temperature is between 12-52 Degrees Centigrade.

(e)Avoid contamination of the disk with cigarette ashes,dust and other contaminants.

(f)Do not write directly on the diskette with pointed tip objects such as ball point pens as the surface will be damaged.Use a felt tip pen.

When inserting the diskette into the drive,take the following precautions:

(a) See that the drive is not running.This is indicated by none of the LED lights being on.

(b) Insert the diskette gently into the slot and make sure that it is seated all the way otherwise it may be damaged.

(c) Do not leave the latch open after insertion as closing the latch causes the hub assembly to grip the disk.

(ii)Disk Drive Commands

The Disk Drive adds to the computer extra storage and file handling capability.It can be controlled directly with basic commands given from the keyboard.The commands are specific to the 2040 and allows one to communicate with and transfer data to and from the Drive.

(a)The OPEN Command.

This command sets up a correspondence between a file number and the 2040.It also opens a specified channel between the computer and the 2040.

e.g.OPEN 1,8,15

where 1 is the logical file number.It can be any value between 1 and 255,8 is the device number(set in the factory for the 2040).15 is the secondary address.This is the channel of communication between the computer and the 2040.In this case,channe 15 is the command and error channel.

(b)The CLOSE Command.

This closes the logical file number opened by the OPEN Command.

e.g.CLOSE 1

There can only be 10 open files in the computer and 5 in the 2040.Closing a file after every open command ensures a maximum number of files available.

(c)The SAVE Command.

Programs written on the computer is transferred to the appropriate disk by this command.

e.g.SAVE"0:PATSY",8

This means to save the program named PATSY to disk in Drive 0.8.is the device number of the 2040.

If PATSY is already on disk and alterations are made in some parts of the program,then to save PATSY again,the syntax of SAVE is:SAVE"@0:PATSY",8.@ means overwrite an existing file on the disk.

(d)The VERIFY Command.

This compares the file just saved on disk with that in RAM.This command is also used to compare a program or data transferred from one disk to another.

e.g.VERIFY"0:PATSY",8

This verifies the program PATSY on Drive 0 of the 2040.A shortform of verify command for a program just saved is :VERIFY"*",8.

(e)The LOAD Command.

This transfers a program on a diskette to RAM of the computer.

e.g.LOAD"1:HALI",8

This instructs the 2040 to transfer a program called HALI on Drive 1 to the computer.When the computer flashes READY.typing the command RUN will cause execution of the program.

(f)The PRINT# Command.

The "Print at" command allows the following diskette commandstring to be transmitted to the 2040:

N-(NEW).This formats(soft sectors)the diskette and initializes it.

I-(INITIALIZE).Aligns the read/write head with track 1 on specified disk,reads the Directory track and loads Disk Data specified during formatting into the Disk Operating System (DOS).

V-(VALIDATE).Creates the Block Availability Map (BAM) according to valid disk data and initializes the Drive.

D-(DUPLICATE).Makes a replica of another diskette.

C-(COPY).Copies and/or merges files from one disk to another or on the same disk.

R-(RENAME).Changes the name of a current file.

S-(SCRATCH).Deletes a file.

e.g.PRINT#1,"I"

1 is the logical file number and the command initializes both Drives of the 2040.

(iii)Diskette Directory

The Directory of the diskette can be displayed by the command:

e.g.LOAD"$0",8

where $ is the shorthand for Directory,0 is the Drive number specified and 8 is the number assigned to the 2040.

The Directory is a listing of all the programs and sequential files on the diskette and the amount of blocks use/free.The NAME and I.D. of the disk is also listed.

Fig.2.13. Directory

```
0    [illegible]
1     "  DISK DATA  "     SEQ
6     "DS"                PRG
27    "MAINT"             PRG
77    "F2"                PRG
62    "F3"                PRG
10    "COPY DISK FILES"   PRG
77    "F1"                PRG
3     "IA"                SEQ
62    "F4"                PRG
3     "IJ"                SEQ
3     "IT"                SEQ
60    "F5"                PRG
3     "I9"                SEQ
276 BLOCKS FREE.
```

Data of many types can also be stored and accessed between the computer and the 2040 Disk Drive.

(a)The PRINT # Command.

This command,not only transmits commandstrings,but also data to the 2040 from the computer.

e.g.PRINT#1,"XXX";CHR$(13);

Unless a semicolon is used as a terminator for each PRINT# statement,the basic interpreter sends a carriage return and and line feed to the diskette.These characters are written to the diskette as part of the data.Thus when data is read from the file,these characters are also transfered.The CHR$(13) is carriage return necessary for the termination of the INPUT# statement.

(b)The INPUT# Command.

This command transfers data from the diskette to the computer.

e.g.INPUT#1,J,T1$

where J can be any simple character to specify numeric input;T1$ is an alphanumeric.More than one numeric or alphanumeric variable may follow the INPUT# Command.

(c)The GET# Command.

This statement transfers one character at a time from disk to the computer.It is useful when one wishes to have immediate access to a character as it is transfered to the computer's memory.

e.g.GET#1,J

The condition is the same as the INPUT# statement.

The use of the 2040-Related Commands can be simplified.The computer can be programmed to perform the disk commands preceded with the BASIC PRINT# commands.The loading and running of programs stored in diskette can be simplified too.

A program called DOS SUPPORT or DS enables the simplification mentioned above.It must be the first program on the disk for it to be implemented.This program is loaded into the computer's protected memory(the highest RAM memory available specified on the memory map) by the command:

LOAD"*",8

This command is given as the first command after power up.It loads DOS SUPPORT,initializes Drive 0 and opens the file.The program is implemented by the command RUN.As it is in protected memory,it is not lost when another program is loaded and executed.It can be recalled at a later stage.This DS program enables the use of the following symbols as shorthand commands:

>

↑ (ARROW UP KEY ON KEYBOARD)

and /.

e.g. >$0-displays Directory on Drive 0.The Directory is printed directly on the screen and does not destroy any program currently in RAM.The usual load command for loading the Directory destroys any program currently in RAM.

>I-both Drives of the 2040 are initialized.

> -Verifies a file on program just saved on disk.

> D1=0-Duplicates disk on Drive 1 to that of drive 0.

/ WHO -Loads a program called WHO.Both Drives are searched if the drive number is not specified.

↑ WHO -Loads and run a program called WHO.Both diskette will be searched if necessary.

The commands outlined so far serve as a skeleton to understanding the operation of the 2040.There are a few other variations which are dealt in greater details in the User Manual.

2.3.1.3.3022 SERIES TRACTOR PRINTER.

The Printer can print hard copy (multiple copies) all the characters on the computer keyboard i.e.Upper Case ASCII,Lower Case ASCII and graphics.

The Control Characters include:

* Enhance printing (double size)
* Automatic line count and paging
* Page eject
* Print Reverse field
* Overprint a line
* Switch to graphics character set
* Switch to graphics character set
* Print programmable character

Through the Secondary Address Commands, the printer has the following capabilities:

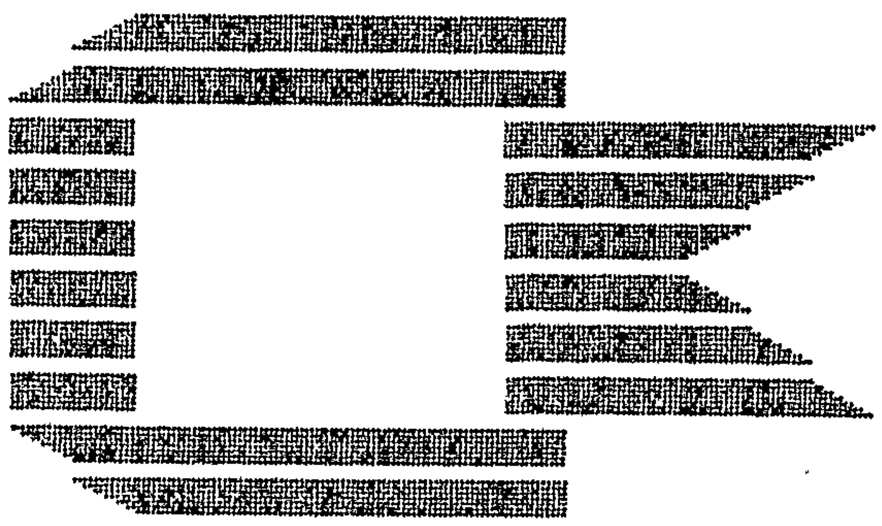
* Print data exactly as received
* Accept characters as a format
* Edit data to format
* Alter number of lines per page
* Enable diagnostic messages to print
* Accept data for programmable character
* Programmable line spacing (permits continuus vertical printing

The Data Formatting Capability includes:

* Field width and decimal position specifed
* Leading or trailing sign
* Fixed or floating dollar sign
* Forced leading zeroes
* Literal characters always printed
* Alha fields left justified

The printer is another intelligent peripheral. It has its own microprocessor and thus is very versatile and it does not use the computer's memory. The various printing capabilities are presented in the following pages.

Fig.2.14



```
  CCC      OO     M     M  M     M    OO    DDD       OO    RRRRR   EEEEEE
 C   C    O  O    MM   MM  MM   MM   O  O   D  D     O  O   R    R  E
C        O    O   M MM M  M MM M  O    O   D   D   O    O  R    R  E
C        O    O   M MM M  M MM M  O    O   D   D   O    O  RRRRR   EEEE
C        O    O   M    M  M    M  O    O   D   D   O    O  R  R    E
 C   C    O  O    M    M  M    M   O  O   D  D     O  O   R   R   E
  CCC      OO     M    M  M    M    OO    DDD       OO    R    R  EEEEEE
```

COMMODORE

BUSINESS

MACHINES

INC.

PRESENTS

THE

MODEL

2022 & 2023

PRINTERS

ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooo

EACH PRINTER HAS FULL GRAPHIC CAPACITY

UPPER CASE

```
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ
```

Lower case

```
 !"#$%&'()*+,-./0123456789:;<=>?@abcdefghijklmnopqrstuvwxyz
```

Fig.2.15

GRAPHICS

[illegible]

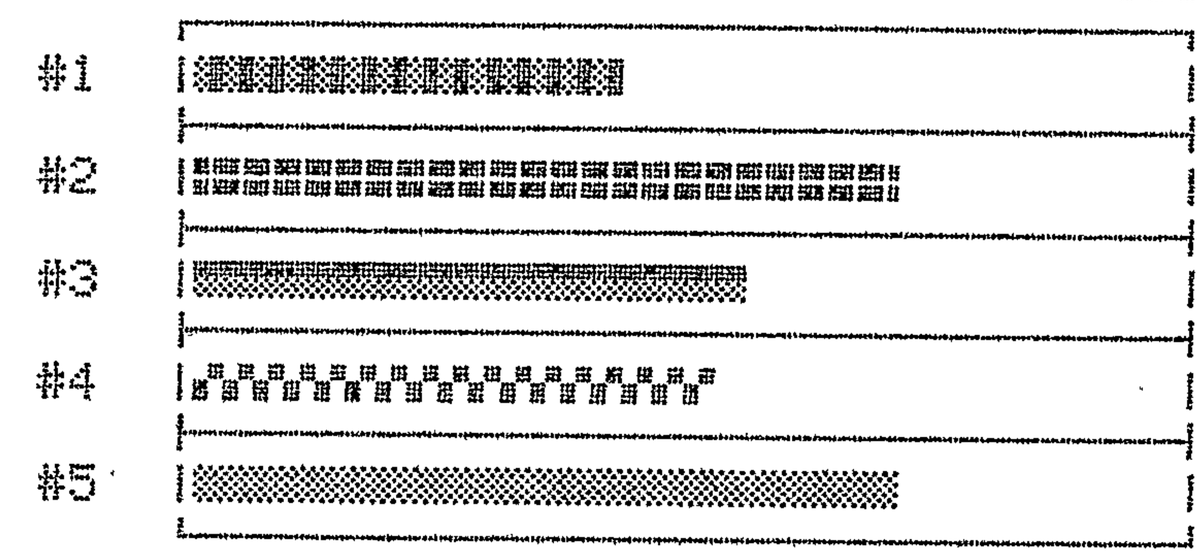
[illegible]

[illegible]

##
YOU CAN EASILY CONSTRUCT GRAPHS

STOCK

0 MILLIONS OF SHARES 100



HORIZONTAL BAR GRAPHS

****

OR FORMAT DATA IN CONCISE CHARTS

MORTGAGE AMORTIZATION TABLE
PRINCIPAL $ 2100 AT 6 % FOR 1.0 YEARS
REGULAR PAYMENT = $ 75

No	Interest	Amoritzation	Balance	Accum Interest
1	$ 10.50	$ 64.50	$2035.50	$ 10.50
2	10.18	64.82	1970.68	20.68
3	9.85	65.15	1905.53	30.53
4	9.53	65.47	1840.06	40.06
5	9.20	65.80	1774.26	49.26
6	8.87	66.13	1708.13	59.13
7	8.54	66.46	1641.67	66.67
8	8.21	66.79	1574.88	74.88
9	7.87	67.13	1507.75	82.75
10	7.54	67.46	1440.29	90.29
11	7.20	67.80	1372.49	97.49
12	6.86	68.14	1304.35	104.35

Fig.2.16

YOU

CAN

PRINT

ENHANCED

CHARACTERS

Ideal for your report headings.

&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&

AND FOR SPECIFIC NEEDS. YOU CAN EVEN
DESIGN AND PRINT YOUR OWN CHARACTERS

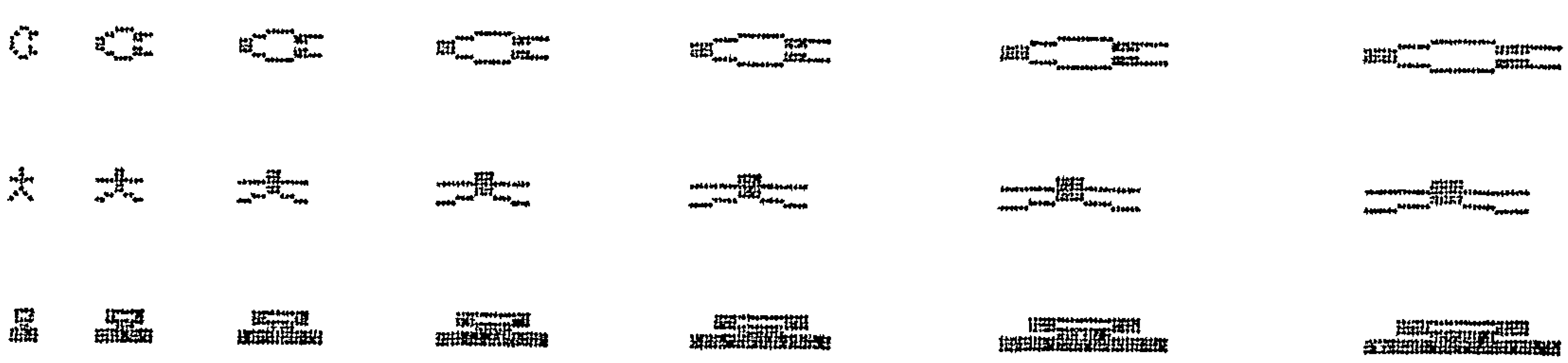


Fig.2.16

YOU

CAN

PRINT

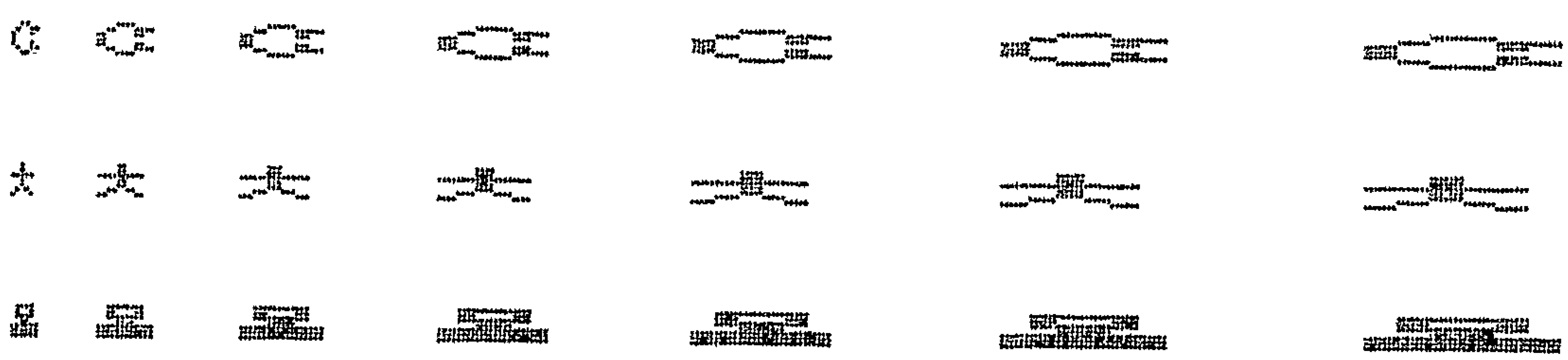
ENHANCED

CHARACTERS

Ideal for your report headings.

&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&

AND FOR SPECIFIC NEEDS, YOU CAN EVEN DESIGN AND PRINT YOUR OWN CHARACTERS



Printing to the printer is done by transferring the video screen function to the printer.The transfer is through the following Basic Commands:

(a)The OPEN Command.

This command sets up a correspondence between a file number and the printer.

e.g.OPEN 7,4,(sa)

where 7 is the logical file number.It can be any value between 1 and 255.

4 is the number assigned to the printer.

(sa) is the secondary address.This number is specified only when formatting is to occur.The secondary addresses are:

0 Print data as received.It is a default value--whether or not it is included,the printer will still prints data as received.

1 Print data according to a previously defined format.

2 Store the formatting data.

3 Set the number of lines per page to be printed.

4 Enable the printer format diagnostic messages.

5 Define a programmable character.

6 Set spacing between lines.

(b)The CMD Command.

This command transfers control from the computer to the printer.The logical file number must be the same as the number used in the OPEN Command.

e.g.CMD 7

where 7 is the same logical file number as in the OPEN command.

(c)The PRINT# Command.

e.g.PRINT#7,data

This command directs output to the printer.The CMD command is to be followed by the PRINT# command in order to close down the connection between the computer and the printer.

(d)The CLOSE Command.

e.g.CLOSE 7.

This command will close the logical file used in the OPEN statement.The same number used in the OPEN Command must be used for the subsequent CMD,PRINT# and CLOSE Commands.

The printer can be operated in the Direct Mode i.e.printing commands at the keyboard or it can be controlled from within a BASIC Program.

For a greater insight to the various programs for formatting capabilities of the computer,the user should refer to the User Manual.

2.4.MICROCOMPUTER SOFTWARE.

The versatility of the computer does not lie in the complexity of its hardware alone.The software available is also important, for in here lies the instructions that the human mind has passed on to the computer for the computer to function in a certain manner.

There are different kinds of software programs available:

(a)APPLICATION PROGRAMS-Software that is specially written to solve some particular problems or for a specific solution or for a sequence of control functions to take place.

(b)SYSTEMS PROGRAMS-Software that usually comes with the computer and is designed to make the creation of applications programs easier.These include Monitor,Editor,Operating System,Assemblers,Compilers and Interpreters.

(c)DOCUMENTATION-Software that shows one how to use the programs and how to modify them for special needs.

The development of software is a big industry and continuous development and improvement are continually taking place.Copyright,patents and all other rights are reserved by the designers.

The following Application and Utility programs (programs or routines which serve limited and specific purposes) help in disk and file management:

2.4.1.DUM 3.4 or MAINT

This program enables the user to do the following:

(a)BACKUP-an exact copy of the original disk is made.

(b)COPY-copies a file.

(c)DIRECTORY-lists the Directory content.

(d)EXIT-takes user out of MAINT program.

(e)HISTORY-reads the disk data on the diskette of the specified Drive.The Disk data include:

DISK NAME

DISK ID

CREATION DATE

LAST BACKUP

DISK TYPE(whether primary or master)

COMMENTS

(f)INITIALISE-initialises the disk Drive specified.

(g)NEW-formats the diskette (soft sectoring).

(h)RENAME-change the name of an existing valid file.

(i)SCRATCH-deletes a file.

(j)VERIFY-performs a byte by byte comparison of the file just written on diskette.

2.4.2.COPY

This program enables the user to copy automatically the wanted programs or all the programs on one disk to another.It also can arrange the copied programs to be in alphabetical order and pattern matched if so desired.The automatic function of this program makes it better than the COPY function of the MAINT program.

The following currently available software are of importance in application to the needs of a dental programmer:

2.4.3.WORD PROCESSING

This refers to computerised typewriter function.where the user can easily change.modify or format text.The text editor allows the creation of text files such as manuscript.

The text is typed on the keyboard and the text will be displayed on the VDU.Deletions and insertions as well as changes can be made to the text material.The positions of words.sentences and paragraphs can be changed.

The finished text is then formatted to be outputted on to another device such as a printer for hard copy.The formatter concerns itself with such things as margins,page length,line spacing,printer feed,right justification and output device number.

There is a comprehensive Instruction Manual on the Commodore Word Processor II which the user should look up for operating the word processing application of the software.This thesis is typed using the format laid down in the "CBM EDITOR" program of Word Processor II.

The word processing capability is possible through a ROM chip.

2.4.4.PROGRAMMER'S TOOLKIT

This software as the name implies, is an aid to the programmer whilst programming.It is a machine language program and comes as a 2 kilobyte ROM.There is an accompanying Manual for its application.The summary of its application will be described in Section III.

2.4.5.LESNIE SOFTWARE UTILITIES

This series of utilities is another aid to programming.The User Manual outlines its use in programming.

The user is advised to survey the market from time to time for the latest software available as this will enable one to operate the Microcomputer System more efficiently.

3:PROGRAMMING OF MICROCOMPUTERS

3.1.TYPES OF COMPUTER LANGUAGE

There are hundreds of programming languages,each with a different set of features and each with their own dedicated users.The most widely used types are:

3.1.1.MACHINE LANGUAGE

This is the final language used by all computers.It is simply a program written in binary code.Though it is the most efficient,it is time consuming,error prone and cumbersome.

3.1.2.ASSEMBLY LANGUAGE

This replaces the binary numbers of machine language with shorthand style phrases called mnemonics (memory aids).The translation of assembly language into machine language is done by the ASSEMBLER,which is a special program residing in the computer memory.It is easy to remember,less prone to errors and much easier to work with.

Both machine code and assembly languages provide the most efficient way to programming since there are minimum number of instructions,which in turn minimizes memory space and execution time.However,knowledge of computer architecture and instruction set is necessary.

In order to extend the use of computer to individuals with no knowledge of computer operations.Higher Level Languages were developed.

3.1.3.HIGHER LEVEL LANGUAGES

These uses English like statements or mathematical expressions that are nearly direct equivalent of the problems to be expressed.The translation of higher level languages to machine language are facilitated by computer programs called COMPILER and INTERPRETER.

A Compiler generates the binary numbers and codes that represent the machine instructions for the various computer functions outlined within the higher level language statement.It works on the SOURCE PROGRAM developed by the programmer which is loaded into memory.One or two passes are required for the computer to generate a machine code or OBJECT PROGRAM.The Object program is then reloaded into the computer for solution output.Compilers are generally used in conjuction with problem orientated languages e.g.FOTRAN,COBOL.Once the Object program is generated,the compiler can be removed from memory.

Fig.3.1.* The use of a Compiler

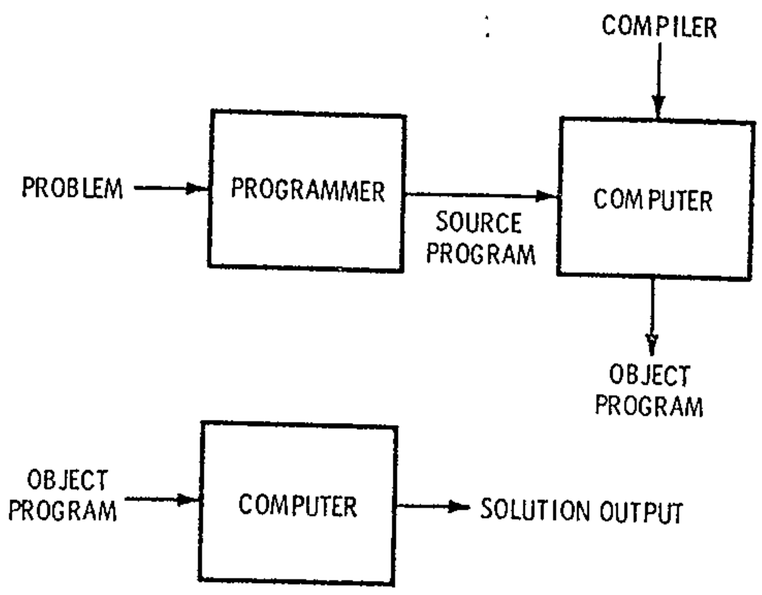
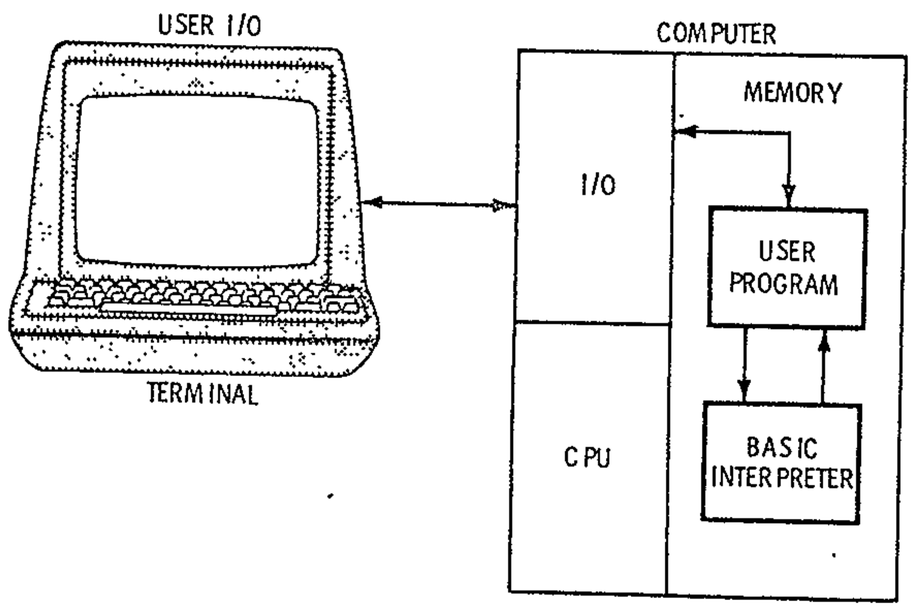


Fig.3.2.+ The use of an Interpreter



*,+ From "Getting Acquainted With Microcomputers"by Louis E.Frenzel,Jr.page 123,125.

An Interpreter is a two part program.The first part identifies the various statements typed into the computer.The second part is a list of the various machine code instructions required to execute each statement.It does not generate an Object program like the Compiler.Instead,each line or statement is translated and executed in sequence as the computer comes to it.As such an Interpreter must always reside in memory.The most popular and widely used Interpreter language is BASIC.This is the language of the Microcomputer.

Interpreters are less efficient than Compilers.They require more memory as they must always reside in memory together with the source program.The sequential translation by the Interpreter results in slower execution time.

The various Higher Level Languages include:

3.1.3.1.FORTRAN

An acronym for Formula Translation was developed by IBM for solving scientific,engineering and mathematical problems.Fortran uses algebric or mathematical statements of the problem.Fortran II was the first programming language to be accepted world wide.Fortran IV contains additional features for input and output statements and specific functions with fewer restrictions.

3.1.3.2.ALGOL

This stands for Algorithmic Language or Algebric Orientated Language.It is the result of International cooperation to obtain a standardised algorithmic language.IAL (International Algorithmic Language) was the forerunner of ALGOL.This language is mainly used in Europe.Principally used in programming of scientific problems,reference and publication language,model for invention of new artificial languages,compiling techniques and mathematical structures.The early version was Algol 60 and later in early 1969,Algol 68 was introduced.

3.1.3.3.JOVIAL

An acronym for Jules Own Version of Algorithmic Language.It is another procedure orientated language derived basically from Algol.This language is derived basically from Algol.It is mainly used by government agencies and military command for control operations.

3.1.3.4.COBOL

This is a procedure orientated language desigmed for commercial and business problems.The name is an acronym for Common Business Orientatd Language.

3.1.3.5.PROGRAM LANGUAGE 1

It is a multipurpose programming language designed for solving both business and scientific problems.It incorporates the advantage of both Fortran and Cobol.

3.1.3.6.SNOBOL

This is an acronym for String Oriented Symbolic Language.It has significant application in program compilation and generation of symbolic equations.

3.1.3.7.PASCAL

This is an Algol like language.It contains the major features of Algol 68.It is designed to be implemented on any reasonably sized computer by Niklaus Wright.

3.1.3.8.BASIC

This stands for Beginner's All Purpose Symbolic Instruction Code.The simple conditions and attributes of the language allow it to be mastered,with practice quite easily.Basic allows conversational statements,free style input, segmenting of complex statements,easy and safe program modification and editing functions.This is currently the widely used hobby and personal computing language.

3.2.UNDERSTANDING BASIC AND PROGRAMMING TECHNIQUES FOR COMMODORE MICROCOMPUTER

3.2.1.LINE NUMBER

Each line of a Basic Program begins with a number.This number is called a line number.It identifies the line and specifies the order in which the statement are to be performed.A line number consists of one to five contisuous decimal digits and can be any number from 0 to 63,999.No spaces are allowed on a line number.The order in which lines of a Basic Program are typed makes no difference because the system will automatically place the lines in ascending order.

Execution starts with the lowest numbered line and proceeds according to the programs structure.Each statement of a line number is executed in sequential order.

When creating a Basic program,one is operating under 2 levels of editor i.e.the SCREEN CHARACTER EDITOR and the BASIC LINE EDITOR.

3.2.2.THE SCREEN EDITOR

Typing on the keyboard with the cursor appearing on the screen,transfers what is typed to the screen memory.Only on typing a carriage RETURN would what is typed transfered to RAM.This feature allows the editing of mistakes by changing characters within a line whilst it is still in screen memory.The CURSOR MOVEMENTS and the INSERT/DELETE keys are mainly used in screen editing.

3.2.2.1.CURSOR RIGHT AND LEFT KEY

The cursor is moved one position to the right by pressing the CURSOR RIGHT/LEFT key.This results in the cursor pointer in memory moving one character to the right.Multiple movements is evoked by pressing the key a couple of times.

To move the cursor to the left,press the SHIFT and the CURSOR RIGHT/LEFT key simultaneously.One character or multiple character movements are feasible depending on the number of times the key is struck.The cursor pointer in screen memory is moved one character less by this action.

3.2.2.2.CURSOR UP AND DOWN KEY

CURSOR UP movement is affected by pressing the appropriate key whilst the CURSOR DOWN move is by pressing the shift key and the appropriate key simultaneously.

3.2.2.3.INSERT/DELETE KEY

This key concerned with the character on a line.When the DELETE key is struck,all the characters,starting from the position of the cursor,to the end of the line,are automatically shifted one chracter to the left,replacing the character preceding the cursor.The cursor can then be moved to the position of the cursor.

INSERT is a shifted DELETE key and is the reverse of the DELETE function.

More than 1 character can be inserted or deleted by striking the key more than once.

3.2.2.4.CLEAR HOME KEY

This key returns the cursor to the top left corner of the screen (the first location of the screen memory).The shift function of this key blanks the screen.

3.2.2.5.SCROLLING

When the cursor reaches the last position of the bottom most line on the screen,typing on would cause the whole screen to move up one line.

3.2.3.LINE EDITOR

The BASIC LINE EDITOR allows one to add new lines and modify and delete old lines.

To delete a program line,type in the line number followed by a carriage RETURN.

To modify a line,list it first on the screen.Then alter as necessary and reenter by striking the RETURN key.

To replace a line,enter the same line number with new text and then type carriage RETURN.

3.2.4.KEY WORDS

Every BASIC STATEMENT begins with a key word.Basic being an interpretive language,executes a command by taking the the last line typed to it and analysing the line working from left to right looking for key words and and expressions which it recognises.Every time it encounters a key word,it interprets this word into a command which means something to it.It executes the key word under the control of a series of subroutines.

3.2.4.1.PRINT STATEMENT

This can also be abbreviated as "?".This statement is an instruction to the computer telling it to display on the screen the instruction that follows.

e.g.10 PRINT "ENAMEL"

All words and sentences must appear within quotes.

If quotes are not used,the computer will calculate what is there and then prints the answer.

3.2.4.2.REMARK

These are placed in a program to help other people understand a listing of the program.Remarks are not printed during a RUN,only during a LIST.

e.g.1 REM PROGRAM TO CALCULATE DMFT.

3.2.4.3.GO TO

This allows unconditional looping.GO TO is written to specify a target line number where execution will always branch and starts execution from that line.

e.g. 20 GOTO 50

Line 50 would be the next executed line.

3.2.4.4.IF THEN

This results in a conditional loop.There are 3 forms:

IF (condition) THEN (statement)

IF (condition) THEN (line no.)

IF (condition) GOTO (line no.)

Conditions are written as two arithmetic expressions separated by relational operator.The six relational operators are:

= equal

<> not equal

> greater than

< less than

>= greater than or equal to

<= less than or equal to

The IF THEN statement allows a computer to decide whether the next statement to be executed is the one right below or the one which the THEN part mentions.

```
e.g.10 I=1
     20 IF I>10 then60
     30 PRINT I*I
     40 I=I+I
     50 GOTO20
     60 END
```

3.2.4.5.GO SUB and RETURN

GO SUB means go to a SUBROUTINE.A subroutine is a short prosram that per-forms some specific operation.It is a frequently used sequence of instructions hat may be referred to several times durins the performance of the main prosram.Rather than writins this sequence each time,the instructions are written just once.The last line of a subroutine must be a RETURN statement.

The RETURN statement is used to tell the computer that the execution of the subroutine is finished and that the prosram shold now resume execution from the next line number of where it left the main prosram.This is where it differs from the GO TO statement.

```
e.g. 10 GOSUB 50000
     20 PRINT "M=";M
     50000 REM **INITIALIZATION**
     50100 RETURN
```

3.2.4.6.FOR NEXT

This statement simplify the writing of programs that do the same kind of things over and over again.In other words,programs that contain loops.The end of the loop is specified by the statement NEXT.

```
e.g.10 FOR I=1 TO 10
    20 PRINT I*I
    30 NEXT
    40 END
```

I starts out as 1.Then I is multiplied by I.I is then incremented by 1.It continues to execute until I reaches 10.Then it stops.

3.2.4.7.READ.DATA.RESTORE

The READ statement specifies the variables whose values are to be entered into the computer via the program.This statement consists of the key word READ followed by a list of variables separated by commas.The list can contain ordinary numeric and/or string,or subscripted variables representing numeric and/or string.

The purpose of the data statement is to assign the appropriate values to the variable listed in the READ statement.The DATA statement consists of the keyword DATA followed by the list of numbers and/or string or subscripted variables separated by commas.Each entry in the DATA statement must correspond to the variable in the READ statement.

For the data to be read again,either some or all of it,the keyword RESTORE is used.

```
e.g. 10 READ J,K,L
     20 ....
     30 RESTORE
     40 READ M,N,P,Q
     50 ....
     60 ....
     70 READ R,S,T
     80 DATA 2,4,6,8,10,12,14
```

In the example,J,K and L are assigned the data 2,4 and 6.With the RESTORE statement in line 30,M,N,P and Q are assigned data 2,4,6 and 8.Otherwise they would assume data values 8,10,12 and 14.

3.2.4.8.PEEK and POKE

PEEK is a function that allows the user to look at any location in the computer memory.However the contents of any address greater than hexadecimal C000 is automatically returned as zero for copyright protection of the manufacturer's BASIC software.

e.g. ? PEEK(25)

This looks at memory location 25.

POKE is not a function but written as a command.It allows the user to deposit a number into RAM.It may range from 0 to 65536.The actual value to be deposited must be between 0 and 255.

e.g.POKE 32768,1

This would put character A at the first location of the screen memory.

3.2.4.9.LET

Assigns a value to a variable.Let is optional in Commodore's Basic.

3.2.4.10.STOP

Causes a program to stop execution and to enter command mode.Typing CONT after a STOP branches to the statement following the STOP.

3.2.4.11.CONT

A command that can be executed only in Direct Mode.It allows the resumption of program execution after STOP,END or use of STOP key.

A program cannot be resumed after error condition,editing,CLR or NEW commands.

3.2.4.12.END

This is optional in Commodore basic.It terminates program execution without printing a BREAK message.Typing CONT after an END statement causes the execution to resume at the statement after the END statement.

3.2.4.13.INPUT

When BASIC encounters the instruction,it prints a question mark to the screen and waits for characters to be typed in until the carriage RETURN is used as a terminator.

e.g.INPUT X,Y,Z

If more characters are typed,BASIC responds with:

? EXTRA IGNORED

If not enough data is typed,it responds as:

??

If an alphabetic field is encountered during interpretation of a numeric field.BASIC responds with:

? REDO FROM START

If INPUT is followed by a carriage RETURN with no other typing.it is considered by BASIC to be a terminator of the program.same as a STOP key.

3.2.4.14.GET

GET is identical in syntax to INPUT.When a numeric value is specified.only numeric keys will be accepted as input.All others cause the message:

? SYNTAX ERROR

Use of numeric value is confusing as if no key has been struck,the value returned is 0.Otherwise it will have a value 1-9 for keys 1-9.

The most desireable way to use GET is with a string variable.If a key has been pressed,the string will have a NULL value(Length=0);otherwise the string will contain the character corresponding to the key that was pressed.

The following example will wait for a key to be pressed and exit only with the value of a key closure:

e.g. 10 GET A$

20 IF A$="" then 10

"" is a literal which contains no character and is a null string.

The GET command will yield one character at a time from the keyboard.

3.2.5.COMMAND WORDS

The difference between key words and command words is that key words are never used alone.It is always part of a BASIC statement that has some other parts to it.They operate within a program mode.Commands on the other hand,are used by themselves.Commands may be used in program statements.LOAD,NEW,SAVE,VERIFY etc. have been discussed in Section 2.CLR(Clear),LIST and RUN will be discussed here.

3.2.5.1.CLR

This deletes all stored references to variables,arrays,functions,GO SUB and FOR statements.

3.2.5.2.LIST

This displays the program starting from the smallest line number and ascending to the largest.The LIST command comes in a few different varieties:

e.g. LIST or LIST-:lists the entire program

LIST10:lists line 10

LIST10-:lists all lines in a program from 10 and > 10

LIST-10:lists all line <10 and including 10

LIST5-10:lists line 5-10 inclusive

3.2.5.3.RUN

Starts execution of a program currently in memory from the lowest numbered statement.RUN restores data.If program is stopped and one wishes to continue,use a GOTO statement to start at desired line.

3.2.6.LITERALS

LITERALS are any value within a set of quotes.They are normally alphanumeric.

Any combination of characters from the pet keyboard may be typed in as a literal and this includes cursor movement and the reverse field.

Cursor movement characters are flagged in reverse field within a literal.REVERSE FIELD looks like an "R".HOME is an "S" and CLEAR is "SHIFTED S" or a "HEART".CURSOR DOWN is a "Q" and CURSOR UP is the "SHIFTED Q" or a "HOLE" graphic character.CURSOR RIGHT is a "RIGHT BRACKET" and CURSOR LEFT looks like a "VERTICAL LINE" through the 5th.column of dots.INSERT is a "SHIFTED T" which looks like a second vertical line.The user should try to see these effects of cursor movements within a literal by trying out on the screen.

One cannot enter a character in reverse field into a literal;but one can turn on reverse field with the control characters before the character is printed.The only characters that are allowed to appear in reverse field between quotes are those that are interpreted as control characters.

DELETE is the only editing character that still works within a literal.Once an odd number of quotes has been typed on a line,the cursor cannot be moved about the screen until a closing quote or a carriage RETURN is typed.

3.2.7.REVERSE FIELDS

This works on the same principle as the the quote mode.Once established,it remains in effect until a REVERSE FIELD OFF or the RETURN keys are struck.

The reverse field on and off characters occupy a space on a program line and they appear in reverse field,but the character one wants to be in reverse field is not in reverse field yet.The effect of the quote is to postpone the action of the control character until the literal is interpreted.

3.2.8.VARIABLES

A function that can have any value is defined both in algebra and in programming as a variable.

3.2.8.1.Numeric variable

Each numeric variable must consist of a letter or a letter followed by an integer or 2 letters.

e.g.A,BB,C7 are different numeric variables.

3.2.8.2.String variable

A string is a sequence of characters (alphanumerics and special characters such as +,-,/,*,!,$ etc).A string variable ends with a "$".

e.g.A$,AA$,A1$

N.B.A sequence of integers in a string does not represent a numeric character.

3.2.8.3.INTEGER VARIABLE

An integer variable is simply a whole number.It ends with a "%".

e.g.A%,A1%

3.2.9.ARRAYS

A collection of computer variables is called an ARRAY.A specific member of the Array can be called by using an Array name followed by a number,letter or formulae in parentheses called the subscript.With lists,only one one subscript is required;with tables,two subscripts are needed to properly identify any given element.

e.g. K(J),H(3),M(1,2),P(INT(X-4),INT(X+4)).

Any time a subscript is larger than 10,a DIMENSION statement must be used.Subscripted variables help the computer to keep track of where things are stored:

e.g. H(3) is the 3rd.member in a list within an Array named H.

M(1,2) points to an item located on the 1st.row and the 2nd.column of a table.

3.2.10.DEF-USER DEFINEABLE FUNCTIONS

When a program section is used as a function,and is used quite often during the main program,one can use the DEF FUNCTION.

The DEF statement consists of the keyword DEF and the FUNCTION DEFINITION.The function definition is the function name followed by an equal sign and then followed bythe appropriate variable,consant or formula.Only numeric function can be define by the DEF statement.

```
e.g. 100 INPUT B
     110 INPUT C
     120 DEF FNA(V)=V/B+C
```

The name of the function is FN followed by any legal variable name.The most severe limitations of User Defined Functions is that they must be contained in their entity on one line.String functions cannot be defined.

The variable in bracket is called a Dummy Variable.A Dummy Variable tells the function in advance that a numeric will be used later on.The actual value of the argument is not required.Other variables used in the expression are considered to be global(have the same value as in the rest of the program),and their current values are used in the evaluation.

After the function definition has been executed,a user defined function can be used:

```
e.g.130 Z=FNA(3)
    140 PRINT Z
```

The User Manual has a list of User Defined Functions which are ready to be used in Commodore Basic.

3.2.11.STR$(expression)

This converts a numeric expression or constant (enclosed in brackets) to a string.

e.g.STR$(A) returns a string equal to the character representation of the value of A.If A is equal to 60,then STR$(A) equals the string "60".POsitive numbers are preceded by a blank in STR$ equivalent.

Negative numbers have a sign in the corresponding position.

While Arithmetic operations may be performed on A,only string operations and functions may be performed on the string "60".

```
e.g.10 A=60.2:B=-60.2
     20 PRINT STR$(A)
     30 PRINT STR$(B)
     40 PRINT STR$(A+B)
     50 PRINT STR$(A)+STR$(B)
     RUN
          60.2
         -60.2
          0
          60.2-60.2
```

3.2.12.VAL$

This performs the inverse of the STR$ function.It returns the number represented by the characters in a string argument.

e.g.If A$="10" and B$="24" then VAL(A$+"."+B$) returns the value of 10.24.

VAL operates a little differently on mixed strings i.e. strings whose values consist of a number followed by alphanumeric characters.In such cases,only the leading number is used in determining VAL;the alphanumeric remainder is ignored.

e.g.VAL(200 DOLLARS) returns 200.

3.2.13.CHR$

Strings may be assigned printable ASCII characters through either literals or direct INPUT,but some devices like the printer require control characters which cannot be produced by normal means.CHR$ allows one to specify such control characters by giving ASCII code numbers.CHR$ is a function to convert a number into internal ASCII representation.

e.g.10 A$=CHR$(88)+CHR$(89)

20 PRINT A$

RUN

XY

The following CHR$ are often mentioned in a program:

CHR$(13) is a carriage RETURN

CHR$(141)is a carriage RETURN with no line feed

CHR$(10)is a line feed

CHR$(145) is UPPER CASE

CHR$(17)is LOWER CASE

CHR$(29)is skip space

CHR$(34)is quote

3.2.14.ASC$

This returns the ASCII Code in decimal for the first character of the specified string.This allows for numerical calculations on strings.

e.g.PRINT ASC("A") displays 65

PRINT ASC("123") displays 49 as ASCII code for "1"is 49.

3.2.15.SEGMENT OF STRING

In most instances it is necessary to access just part of a string.The following functions helps to separate parts of strings and use them in expressions.

3.2.15.1.LEFT$

The function specified as LEFT$(string variable,I) gives the leftmost "I" characters of the string specified.I must be positive,>0 and <255,otherwise an ILLEGAL QUANTITY ERROR is printed.

e.g.IP$="5010"

LEFT$(IP$,2) returns "50".

3.2.15.2.RIGHT$

This function operates on the same principle as the LEFT$ except that it returns the rightmost specified characters.

e.g.AA$="60501A"

RIGHT$(AA$,3) returns "01A".

3.2.15.3.MID$

There are 2 versions:

(i)MID$(STRING VARIABLE,I,J)

This returns a string with J number of characters starting from the "I"th character.

(ii)MID$(STRING VARIABLE,I)

This returns all characters from the "I" position until the end of the string.

For both versions,if "I" is > the length of the screen,this gives a null string.If either "I" or "J" is negative,or >255,an ILLEGAL QUANTITY ERROR is printed.

e.g.HH$=123456789

MID$(HH$,4,4) returns "4567"

MID$(HH$,5) returns "56789"

3.2.15.4.LENGTH OF STRING

The LEN function gives an exact count of the number of characters contained in a string.Non printing characters and blanks are all counted as part of length.

e.g.MM$="TOOTH MORTALITY"

LEN(MM$) returns 15.

3.2.16.THE BASIC PROGRAMMER'S TOOLKIT

This is a machine language program which is provided in a 2 Kilobyte ROM chip.The chip is installed in the computer and when the program is activated by typing SYS 45056 or SYS 11*4096 and pressing RETURN.The computer responds with (C) 1979 PAICS followed by READY.Now the computer BASIC has ten new and very useful commands:

AUTO-Provides new line numbers when one is entering BASIC program lines.

RENUMBER-Renumber BASIC program,including all GOTOs and GOSUBs.

DELETE-Removes groups of BASIC program lines.

FIND-Locates and displays the BASIC program lines that contain a specified string.

APPEND-Adds a previously SAVEd to the one currently in RAM.

DUMP-Displays the names and values of all the variables used by a program(excluding arrays).

HELP-If one's program stops due to an error,HELP displays the offending line and and shows where the computer detected the error.

TRACE-As a program runs,the last six line numbers being executed are shown in the upper right corner of the computer's screen.

STEP-Executes one BASIC line and stops.Pressing SHIFT executes the next line.The line number is displayed in the upper right corner of the screen.

OFF-Turns TRACE or STEP off.

The User Manual should be referred for a complete guide whilst operating the Toolkit during Programming.

4:MICROCOMPUTERS AND DENTISTRY

4.1.USE IN EPIDEMIOLOGICAL SURVEYS

An epidemiolosical survey was conducted for the Australian Reaular Army usina a microcomputer with a proaram developed bu Major P.Thaler,RAADC.

The survey format is based on the WHO Combined Oral Health and Treatment Form with some modification in the Personal and Demoaraphic Information.The Proaram is called F1 and is based on the Random Access Technique.The proaram resides on the Disk in Drive 0 and the Data Disk is Drive 1.

4.1.1.F1-SURVEY PROGRAM

The proaram is started by tupina in the Direct Commands as follows:

```
OPEN1,8,15,"I0"
RETURN
CLOSE1
RETURN
LOAD"0:F1",8
RUN
```

This is then followed bu an INITIALISING routine.The computer then displays the followina messaae on the soreen:

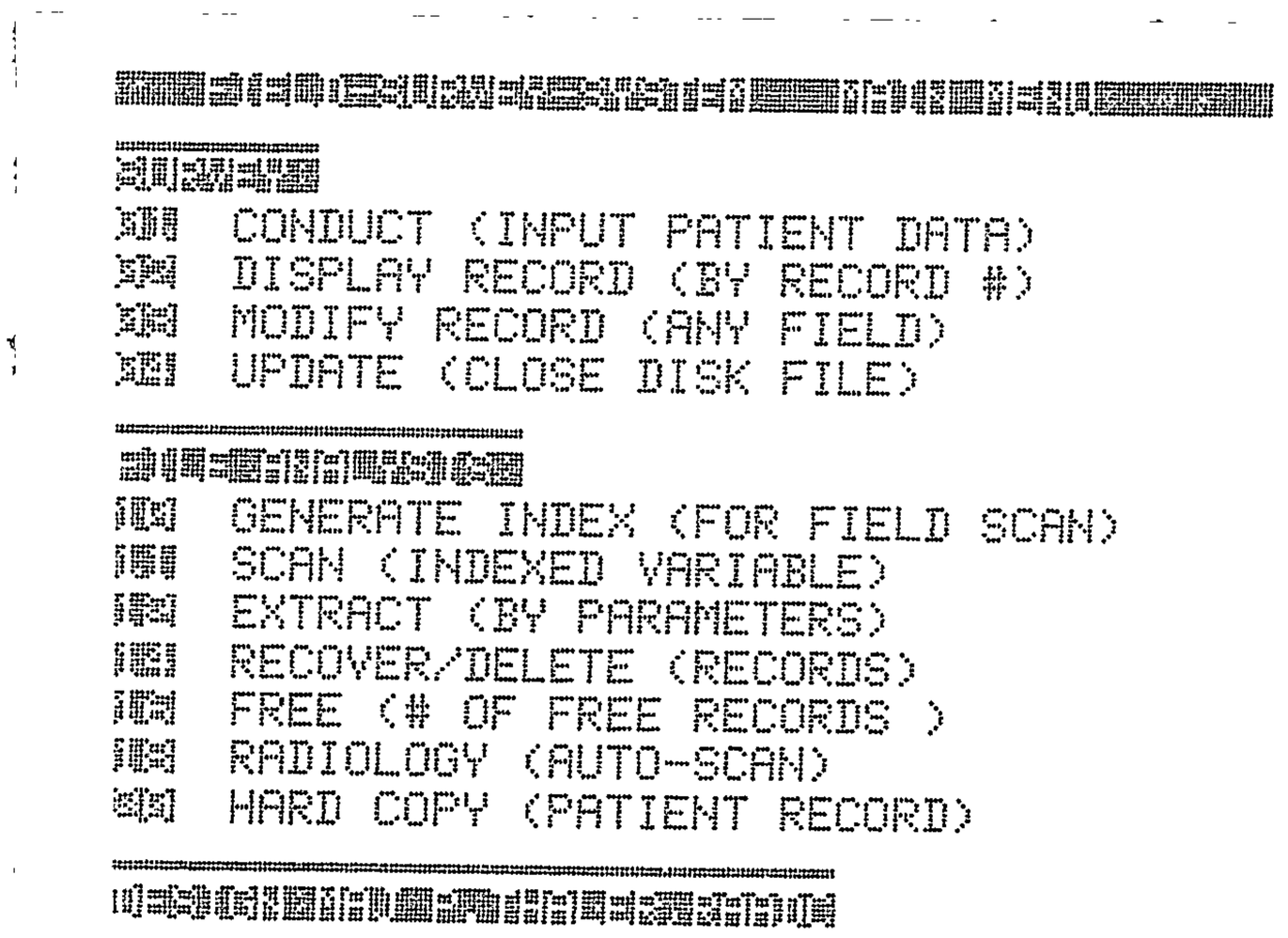
(1)Enter the data Disk ID ▒

The data Disk ID is entered accordinalu bu typina in an alphabet specified in the SEQUENTIAL FILE on the proaram disk.

(2)Openina Information Diskette IJ

The sequential key file determines disk locations to be assessed for data by the program.It flags records as allocated or not,regardless of the actual structure or numbers of records.Thus different key files may be used to perform different searches of data on the same disk,usina common or separate records.

(3)FIELD-SURVEY-SYSTEN MAIN MENU



4.1.1.1.TO CONDUCT SURVEY

At the end of the MENU,the computer asks the user to Enter the function identifier.In order to conduct the survey,the user types in the numeric input "1".

Typing RETURN allows one to go to the next step of the survey whilst the CLR HOME key brinas one back to the previous step.

(i)Insert records and Enter Record Number

The computer keeps count of the number of records already on the data disk and will automatically displays the next available record number.A total of 650 records can be kept on one data disk.

(ii)Skip Service Utilisation

Entering "1" bypass the Service Utilisation Routine.This is done when conducting the Pilot Survey.For the Main Survey procedure "0" is entered.

The Main Data entry routine begins with the heading display of Army #(i.e.number),Record # and Main Sub Titles Heading of the groups of data.

Under the DEMOGRAPHIC title heading:

(1)File-This specifies the file name of the record and is an alphanumeric entry of 4 characters maximum.

(2)Army #-an alphanumeric entry of 8 characters maximum.

(3)Rank-an alphanumeric entry of 6 characters maximum.

(4)Name-an alphanumeric entry of 15 characters maximum.

(5)Unit-an alphanumeric entry of 6 characters maximum.

(6)Status-"1" for officer,"2" for other rank.

(7)Sex-"1" for male,"2" for female.

(8)Age-in years;numeric entry of 2 characters.

(9)FF/Time in-Time in Field Force in years;numeric entry 3 characters maximum.

(10)Md/Time in-Time in Base in years;numeric entry 3 characters maximum.

(11)Last access-Last visit to dentist in years;numeric entry 3 characters maximum.

Under Service Utilisation title heading;

(12)Visit(12)-Visit in the last 12 months;"0" for No,"1" for Yes.

If respond is "0",the computer will skip questions (13) and (14) and proceed to question (15).If respond is "1" the computer will display the next 2 questions in sequence and skip question (15).

(13)Reason-clean=1,hurt=2,
fix=3,check=4,
appt=5,other=6
don't know=9

(14)By whom-den offr=1,hygienist=2
doctor=3,civilian(army)=4,
civilian(own)=5,other=6,

(15)Why not-nil wrong=1,afraid=2,
duty=3,leave=4,
too busy=5,no service=6,
false teeth=7,other=8,
don't know=9,

(16)Problems-teeth=1,gums=2,
teeth+gums=3,
other=4,don't know=9,

(17)Advice/tr—"0" for No,"1" for Yes.On "0",computer skip question (18) and proceed to question (19).For "1",question (19)will be asked.

(18)What a/tr-preventive=0,exam/clean=1,

scaling=2,fill=3,

exo=4,dents=5,ortho=6,

>1 oat=7,other=8,don't know=9

Under Disorders title heading;

(19)&(20)Oral muc.d.-Responds is either "0"(or "RETURN") or "1" for Absence or Presence of a disease condition respectively.On "1",the computer will display "o.m.specify" (20).It allows an alphanumeric input of 15 characters.

The same condition applies to displays (21)&(22) and (23)&(24).

(21)&(22)Def.teeth-Responds as (19)&(20).

(23)&(24)Bone dis.(Def.of bone)-Responds as (19)&(20).

(25)Other condition-15 characters alphanumeric entry.

Under Prosthetics title heading;

(26)Pr.status-This allows for 4 digits entry of all combination of "0","1" and "2".

(27)Dent.Ra.-Similar to (26).

Under Periodontal title heading;

(28)Soft deposit-Responds is either "0" or "1" in all combination of a 6 digits entry.The "RETURN" key is for a case of all zeros.

(29)Caloulus-Similar to (28).

(30)Int.sins.-Similar to (28).

(31)Ad.perio.d.-Similar to (28).

(32)Perio tr.-A numeric entry of 1 digit.Entry range from 0 to 5.The "RETURN" key can be used for "0" entry.

Under WHO criteria title heading;

(33)WHO criteria-A numeric entry of 1 digit.Entry is either "0"or "1" for Absent or Present respectively.The "RETURN" key can be used for "0" entries from questions (33)-(36).

(34)Tr.need.-A numeric entry of 1 digit.Entry range from 0 to 4.

(35)Cond. past(Condition in the past)-A numeric entry of either "0" or "1" for No and Yes respectively.

(36)Tr.past(Treatment in the past)-A numeric entry of either "0" or "1" for No and Yes respectively.

Under Immediate Attention title heading;

(37)Pain/inf-A numeric entry of "0"(or "RETURN") or "1" for No and Yes respond respectively.

(38)Likely p/i(likely pain or infection)-Similar to (37).

(39)Pulp tr.-Similar to (37).

(40)Ia spec.(immediate attention specify)-A 10 alphanumeric entry.For a "nil" entry,the "RETURN" key can be used.

Under Charting title heading;

(41)U/R-Charting is by the FDI System.Coding is as outlined in the WHO Combined Oral Health Treatment Assessment Form.The first entry is for the clinical diagnosis and the next entry is for the treatment recommended by examiner.

A requirement for a pontic of a bridge is coded as "P".

In the case of patients with Prosthetic Status entries of "1010"or "2020",the charting would be automatically done by the computer and the charting of all the four quadrants would be skipped.The computer would assign "50" or "70" for each tooth's clinical diagnosis and treatment recommended depending on whether the patient's age is < 30 > years respectively.

For entries of 1000,2000,0010 and 0020,the corresponding quadrant would be skiped and the appropriate values assign according to the patient's age.

(42)U/L-Similar to (41).

(43)L/L-Similar to (41).

(44)L/R-Similar to (41).

(45)Ant.Endo-A 1 digit numeric entry of either "0"(or "RETURN") or "1" for No and Yes respectively.

(46)Post.Endo-As in (45).

The computer then display the following instructions:

'RETURN' - NEXT RECORD
DISPLAY -CURRENT RECORD
MODIFY -CURRENT RECORD
NEW - NEW RECORD
EXIT - RETURN TO MENU

Thus ends the survey data input routine.

4.1.1.2.DISPLAY RECORD(BY RECORD #)

Going back to the Menu,on typing the function identifier "2",the computer will ask for the record number to be displayed.The "RETURN" key is entered for effect of display as shown below:

```
FILE:FF
ARMY#223681   RANKLT      NAMELOVELL
UNIT8/12   RECORD#  1
SEXMALE          AGE24
DMFT
```

8	1	0	0	0	0	0	0	0	0	1	1	2	4	1
0	1	0	0	0	0	0	0	0	0	1	1	0	1	1

4	2	2	0	0	0	0	0	0	0	0	0	0	2	2	1
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

```
PERIO TR.REQT.  2
PROSTH.STATUS                  DENTURE REQT.
DENTOFACIAL  0000
ANT.ENDO. 0                POST.ENDO. 0
MUCOSA
0
DEFECTS OF TEETH
0
BONE DISORDERS
0
OTHER CONDITIONS
0
T/FF 1/6T/MD 5/0
LAST ACCESS 1/0
IMMED.ATTN. 0LIKELY 0
PULP TR. 0OTHER0
SOFT D. 111111CALC. 111111
INT.GING. 000010ADV.PERIO. 0
DENCARE(12) 1REASON 6
TREATED BY 2WHY NOT0
PROBLEMS 0ADVICE/TR 0
WHAT ADV/TR 0
```

The actual display on the screen is in two parts-the first part is up to the stage of "ENTER".Any key entered on the keyboard will result in the next part of the record entry displayed on the screen.On the screen,all the titles appear within reverse field(in the example,the reverse field has been removed as continuous print in reverse field damage the printer's head).

On entering "2",the same display will come up again.On "1",the computer shows the next record number.If the next record is required then enter "RETURN".If another record is needed instead,then type in the required record followed by a "RETURN".

4.1.1.3.MODIFY RECORDS(ANY FIELD)

On typing the function identifier "3",the computer allows one to modify any fields of the record required.The computer displays:

(1)Enter the Record No.

(2)Field to be changed.

Here the first three letters of the various data entry title heading are entered e.g.sta is for status,ran is for rank,def is for Defect of teeth etc.

(3)Modify>>>>▒

The box will contain the previous data entry.For the modification,type in the new data entry in a box beneath the above display.

4.1.1.4.UPDATE(CLOSE DISK FILE)

On typing the function identifier "4",the computer goes into the Update routine.This is done at the end of each day's data entry.The computer will display "End of input" as a title heading.It then displays "Closing information Diskette I".From here it bring back the program to start at the Initialising routine.

4.1.2.F2

This program is for file analysis.It is chained to the F1 program in order to conserve memory space.It is loaded into RAM when the file analysis part of the Menu is called for.

4.1.2.1.GENERATE INDEX(FOR FIELD SCAN)

On typing 10 as a function identifier,the computer goes into this routine.Here all the records are searched for the data specified.This routine must be executed before the other file analysis is to be done.The computer displays:

(1)Key File

Here the first three letters of the required data entry title heading (e.g.army) is entered.This then appears in full (as army #) beneath (1).

(2)Generating index(approx.7 minutes)

(3)Index generated

(4)Press any key to continue

4.1.2.2.SCAN (INDEXED VARIABLE)

On typing "11" as a function identifier,the computer will scan the records for the records specified.The computer displays on the screen are as follows:

(1)Enter the data

If the army number is the index generated in 4.1.2.1.,then entering the data as "3" will make the computer search all the records with the army number starting with 3.

(2)Scanning

(3)Record no.

Here the record number with the specified data in (1) is displayed.

(4)Press any key to continue

When the Scanning is over,the computer goes back to display the Menu.

4.1.2.3.EXTRACT (BY PARAMETERS)

On typing "12" as a function identifier,the computer goes through the following displays:

(1)Hard copy Y/N

On 'Yes',the following display is shown:

0

1 USER PRINT ROUTINE #1

2 USER PRINT ROUTINE #2

3 USER PRINT ROUTINE #3

At the moment of writing,this part of the program is not refined yet.It is intended to give different hard copies for different needs.

On 'No', the following display will appear:

(1)Select scan field

The field specified is indicated by typing the first three letters of the appropriate field.

(2)Displacement-this indicates starting position of the field specified.

Length-here the field length is specified.

Equality-data to be scanned is indicated to be <,= or > than the length.

Case (U/L)-the field to be scanned has to be indicated whether it is in upper or lower case.

Data-the actual data needed is specified.

(3)Scanning-the records are scanned for the appropriate data specified.

(4)Press any key to continue.

4.1.2.4.RECOVER/DELETE (RECORDS)

The computer will display the following on typing function identifier "14":

(1)Enter Record No.

(2)Recover or Delete(R/D)

A record can be deleted but should it be required again.the recover function would allow the retrieval of the record.A record is only completely deleted if new data are written on the same record number.

4.1.2.5.FREE (# OF FREE RECORDS)

This function is called on typing function identifier "16".The computer displays are as follows:

(1)Print free Records Nos.(Y/N)

On 'Y',further displays include

(i)Ready printer

(ii)Press 'SPACE' to continue

(iii)Checking

(iv)Press any key to continue

It then gives a hard copy of all the available individual record numbers.

(2)On 'N',further displays include

(i)Checking

(ii)Free Records Available=(total number of records available are given)

(iii)Press any key to continue

4.1.2.6.RADIOLOGY(AUTO-SCAN)

This function is called on typing function identifier "18".The computer asks for the data to be entered as specified in the Generate Index routine e.g.army number.It then searched through the records for the appropriate army number data entered.The quadrant to be altered is then specified and the previous entries of the quadrant are displayed.New entries of diagnosis and treatment recommended are then entered over the old entries.Typing a null string allows one to go to another record.

4.1.2.7.HARD COPY(PATIENT RECORD)

This function is called on typing function identifier "20".At the moment,this part of the program still has to be debugged.

This concludes the file analysis part of the program F2.

4.1.2.8.F3

This program gives a printout of the individual patients' records charted during the survey for the local Dental Unit Commanders.The format is based on the Dental Record form used by the Royal Australian Army Dental Corp.

4.1.2.9.F4

This program gives a printout summary of the dental conditions found during the survey for the Unit Commanders.It relates to prevalence of dental conditions and the man hours needed to bring the troops to Class I Dental Fitness.This relates to dental workforce requirement of that particular unit.

4.1.2.10.F5

This program is currently being developed and it is essentially a comprehensive analysis of the survey findings.

4.2.USE IN PRIVATE PRACTICE

A Dental Practitioners System is now available for the Commodore Business Machine 8032 Series Microcomputer System.It is developed by Pittwater Software Pty Ltd.

The minimum system consists of the following configuration:

CBM 8032	Microcomputer
CBM 8050	Dual Floppy Disk Drive
NEC Spinwriter	Letter Quality Printer
	with front feed option
	with tractor feed option

The system can be expanded to include the following peripherals:

4 CBM 8032	Microcomputer
1 CBM 3022	Tractor Feed Dot Matrix Printer

4.2.1.GENERAL SPECIFICATIONS

Up to 7000 patients can be maintained on line at any time.Each patient record can be recalled by name or patient file number.

Each patient record contains:

i.outstanding invoices over 30 days

ii.all current months transactions

iii.clinical records consisting of:

- patient detail
- medical notes
- charting information
- clinical notes

The 'accounts' program has access to all other programs and is operated by the operator on the operator screen. Other screens located in the surgries for 'clinical' program can be connected to the system.

Backup and security is maintained by logging every account transaction, clinical notes and appointment made on the main printer.

The system is designed to provide:

1. Patient Accounting
2. Patient Clinical Notes
3. 12 Months Appointment
4. Patient Recall Letters
5. Practice Management Analysis
6. Word Processing for Correspondence
7. Treatment Planning
8. Forensic Analysis

4.2.1.1. PATIENT ACCOUNTING

This includes: a. Invoices

b. Statements

c. Daily Transaction Summary

d. Monthly Transaction Summaries

e. Banking Summary and Deposit Slip

f. Aged Debtors Listings

g. Account Enquiry

h. Patient Receipts

i. Appointment Slips

a. Invoices

An invoice can be called from any screen but printing is only possible by intervention from the operator's terminal. All accounts are treated as open item invoices and are divided into current and over 30 days. This aging is performed after the printing of statements and printing of the monthly transaction report.

Operator Invoice Generation

The operator can recall an invoice generated by another terminal, print it or generate a new invoice using the standard ADA codes or defined ADA codes. The amount and description of each line cannot be altered from that set on the pricing schedule.

Invoice Generation via Clinical Program

This allows the practitioner to generate an invoice from the surgery whilst viewing the patient's clinical notes. Modifications can be made to the recommended pricing selected by the code, and provision is made to generate a line item with a unique description and price.

Invoice Format:

NAME, ADDRESS & POSTCODE as per patient's details. INVOICE NUMBER generated sequentially by the computer.

ADA CODE DATE OF SERVICE DESCRIPTION AMOUNT

TOTAL DUE _____

Less__% discount for payment within__days

DISCOUNT _____

b.Statements

Statements will show all the details as for the account enquiry,and will be batched printed with optional reprints.Printing will be on 2 parts stationery with one copy for office records.

c.Daily Transaction Summary.

Each transaction entered daily is available as a report for practice management purposes.It will summarise all invoices issued and payments received for that day.This report is protected by password to prevent unauthorised access.This report must be run before the end of the day routine as the file will be reset for the next day of trading.

d.Monthly Transaction Summaries

This is provided as an accounts audit trail.Transactions are limited to a total of 4000 at any time.Transactions are defined as each open invoice and each transaction entered in the current period.If the limit of transactions is exceeded,it will be necessary to perform an'end of month' function to print Statements and age account.

e.Banking Summary and Deposit Slip

This is available at any time to provide bank deposit details and summary of all cash receipts and cheque receipts with cheque details.This report is reset after successful printing.

f. Aged Debtors Listings

A report of debtors are available for analysis.

g. Account Enquiry

This is available from the operator's terminal or any other terminals running the clinical program. Hard copy is only available through the operator's terminal. Information available as follows:

- over 30 days invoices

  date invoice # amount

- current transactions

  date type reference amount

Types of transaction are:

invoice

cash payment

cheque payment

discount allowed

adjustment made

Reference includes:

number

receipt #

cheque #

reference #

h. Patient's Receipts

A hardcopy of the receipt is given as in the reference.

i. Appointment Slips.

An option for an appointment card for the patient is available as part of the 12 Month Appointment System.

4.2.1.2.PATIENT CLINICAL NOTES

The following patient field details and sizes are found on each record:

SURNAME	15	ALPHA	(15)
GIVEN NAMES	25	"	(25)
TITLE	4	"	(4)
ADDRESS	25	"	(25)
SUBURB	15	"	(15)
POSTCODE	4	NUMERIC	(4)
PHONE	10	"	(10)
DATE OF BIRTH	9	ALPHANUMERIC	(5)
DATE OF LAST VISIT	9	ALPHANUMERIC	(5)
MEDICAL ALERT	3	ALPHA	(1)
(TRANS POINTER)			(2)
(CLINICAL NOTES POINTER)			(2)
		TOTAL BYTES	111

Medical Notes

Maximum number of text displayed is 80 characters within 2 lines of 40 characters each.Each line can be inserted and modified as required.

Clinical Notes

The average number of clinical notes per patient is 26.and is averaged over the 500 records stored on that diskette.

Format:

next record	text
2	22 ALPHANUMERIC Characters

At the end of each month a check is made to see if the capacity of the clinical notes is becoming excessive. If so then an option is presented to file away inactive patients and assosciated patients records on another diskette and clean up the patient record diskette.

Charting

Capacity is calculated on the basis of:

32 teeth * 7 surfaces=224 bytes

with one byte to determine the status of each surface variable.

4.2.1.3.12 MONTH APPOINTMENT SYSTEM

Each appointment register is maintained on one diskette. Hence multiple appointment registers can be maintained.

The appointment scheduling is divided into 1/4 hour segments from 8 a.m. to 5 p.m. for 6 days per week of the year, plus 5 p.m. to 9 p.m. for one nominated day.

Details given are: NAME, PHONE, COMMENTS

Single Appointment Entry

After entering the appointment date required, the appointment plan for that day is displayed and the following options offered:

esc	e	to exit
"	a	to add appointment
"	m	to modify appointment
"	d	to delete appointment
"	n	another day
"	p	print appointment page

To add an appointment the following information is requested:

Time		
Length of appointment		
Name	15	ALPHA
Phone	7	NUMERIC
Comment	10	ALPHANUMERIC

An option is then presented to print an appointment card for the patient.

Multiple Appointment Entry

The following information is requested:

# of appointments

Spacing between appointments (days)

Prefered time

Length of each appointment

Name Phone Comment

The computer will search and make appointments within the parameters specified.If no reasonable options are available,the operator will be notified and have to make a manual entry.Any selected appointments that are unsatisfactory will have to be manually adjusted.

An appointment card is printed for the patient on successfull appointment selection.

4.2.1.4.PATIENT RECALL LETTERS

This is available at any time (usually at the end of the month) and will batch recall letters for any patients whose last visit date is 6 months or 12 months previous to the current month.Only 2 reminder notices will be sent to any patient.

4.2.1.5.PRACTICE MANAGEMENT ANALYSIS

This will provide statistics based on each reference to the ADA codes when an invoice is generated.This report is for the current month and the previous 11 months.

4.2.1.6.WORD PROCESSING FOR CORRESPONDENCE

A powerful word processing package is included to allow practice correspondence such as overdue debtors' letters,patient referrals etc.This is based on the WORD PRO 4 Manual.

4.2.1.7.TREATMENT PLANNING

This is available when running the clinical program to provide a quotation and report to the patient on proposed treatment planning.

Printed format

PATIENT NAME FILE #

ADDRESS

Date of Examination

Practitioners Name

General Oral Condition (2 lines)

Oral Hygiene (1 line)

Condition likely to

cause discomfort and/or (1 line)

infection

Treatment Recommended

It is estimated this course of treatment will require attendance at___ number of___ minute appointments.

ITEM DETAIL COST

Total Estimated cost $____

4.2.1.8.FORENSIC ANALYSIS

This allows of patient charting to a given set of charting criteria.The patient file number is printed out when a charting match occurs,and must be manually investigated for further information.

The following programs could also be used in the dental practice:

-General Ledger Accounting

-Creditors Ledger

-Inventory

-Payroll and Mailing List

4.3.APPLICATIONS IN RESEARCH

As up to 1979,microcomputers application to dental research has not been reported in the Index of Dental Literature.However with the present trend of wide use of minicomputers in dental research,it would not be surprising to see microcomputers enroaching into this area in the near future.With the present technological development of microcomputer,the former distinct division of mini and micro is getting less clear.

Microcomputers could be used for clinical trials of preventive agents and other preventive studies in the community.It has enough capability to handle data accumulated from such investigations within limits of its memory size.

It would be ideal in computing cost benefit and cost effectiveness studies of public health programs.

It could also be used to monitor and control other analogue computers used in mandibular movement studies and some orthodontic studies.

It is also possible to use it in fluoride studies,dental workforce analysis,evaluation of clinical procedures,in diagnostic aids of oral pathologies and other similar studies in all disciplines in dentistry.

4.4.USE IN DENTAL TEACHING AND DENTAL EDUCATION

The microcomputer comes in handy as an educational aid.In a private practice situation,it can be used to run programs related to dental health education just like any video tape cassette.The audience would be able to type in queries related to their interests.

With its monitoring and control functions,it could have in line up to 15 peripherals such as television screens.This would be applicable for a teaching institution.Lecture notes,graphs,charts and other teaching materials can be displayed.The result of a "Four Phase Study Of Computer Assisted And Slide Tape Methods Of Simulating Endodontic Problems" conducted at the University of Kentucky College of Dentistry (Mullaney,T.P.et al) goes to show that there is justification for offering both slide tape and computer assisted presentations to students.The study also made use of a computer to simulate clinical situations to develop students data gathering,diagnosis and treatment planning skills.

Professional examinations can be aided by the microcomputer.A data base of examination questions could be collected and drawn at random for an examination.

A detailed analysis of the ability of the student, the question suitability, and most important, the teaching achievement can be obtained as an immediate feedback for staff and students. In this way the ability of the student can be assessed and if necessary, teaching techniques can be changed. New examination questions can be added and the unwanted ones deleted from time to time.

The microcomputer is also suitable for analysis and recording of student's clinical achievement. The grades that a student received over the years could be gathered and analysed. Timely evaluation of quantity and quality of students experience and prompt preparation of clinical grades can be made.

A form of program learning in the article "Computer Aided Instruction In Dental Education: Application To An Introductory Statistics Course" (Freed, J.R. et al) discussed the difficulties associated with teaching statistics to dental students, the potential of computer aided instructions (CAI) in over coming some of the difficulties, and to provide some examples of CAI in use then to run statistic courses. A microcomputer can also be used for such courses.

4.5.CLINICAL APPLICATIONS IN DENTISTRY

Here again,to date,clinical application of microcomputers is limited to the clinical program in the Dental Practitioner System.However there is room for further development in this area.

The word processing capability of the microcomputer can be used to include clinical information as aids to diagnosis and treatment planning.

A data bank of various pharmaceutical drugs,their pharmacological actions,interactions,indications and contraindications could be gathered to assist in writing of prescription.

Normal haematological values and other laboratory investigation values could also be gathered for clinical aids to interpretation of laboratory investigation results.

5:SUMMARY

Computers are not new to dentistry.They have been used in the past.However the microcomputer enables a dentist to personally operate it and do his own programming.

The early development of the computer is traced to give an insight of the road to computerisation.

Through basic concept of digital computers,a general outline of its mode of operation is introduced.

A microcomputer is based on a microprocessor.Its 5 basic sections include memory,control,arithmetic and logic unit,input and output units.Classification of microcomputers can be by their type of CPU,semiconductor technology use,word size or size of RAM.Many different types of microcomputers are currently available.At present,microcomputers find greatest application in personal computing.

Different microcomputers have different capabilities and operating procedures.The operating instructions specified by the manufacturer for a particular system has to be understood in order to operate the system well.

A microcomputer system's hardware consists essentially of the physical units of the computer and its related accessories.

Software includes the entire range of non electronic support for the computer.Various software for different applications are also available commercially.They make the operation of the computer easier.They also help simplify programming.

Basic is the language for a microcomputer.Different microcomputer uses different Basic keywords and commands.They keyboard functions for special controls also differ.

Applications in Dentistry at the moment is confined to data collection and analysis for epidemiological survey and in the administration of a private practice.Other applications in Dentistry needs further attention and development.

6:CONCLUSION

There is a great potential for use of microcomputers in dentistry.Dentists would be able to be involved directly in developing programs to their individual needs.

The compactness of the microcomputer system makes it suitable for use in clinical situation and field work.Gone are the days in which a computer would fill up a whole room.A great amount of information can be kept on one diskette and this minimises the need for big filing cabinets.The life span of a diskette is compatible with most conventional record keeping procedures of 5 years.A diskette can be stored longer than 5 years if necessary.The greatest advantage in field work is the ability to do interim analysis reports on the spot.

The development in microcomputer technology has been rapid since its introduction in 1972.It is predicted that some microcomputers would soon have the processing speed and storage capabilities of the minicomputers.Its low cost in comparison with other computers make it an attractive investment for a private practitioner.

It is relatively simple to learn its operation and characteristics.A computing experience is helpful but not altogether necessary.

Being a general purpose computer,a microcomputer can be applied in other fields as well.It may one day be an item to be found in most homes and clinics.

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