BENCHMARKING THE CLONES

BYTE *ran a variety of* IBM PCs *and work-alikes through benchmark tests*

BY JON R. EDWARDS AND GLENN HARTWIG

BENCHMARKS ARE objective, reproducible measures of performance. Engineers use them to measure precision and to identify poorly performing components or bottlenecks in a system's design. Many users, on the other hand, use benchmarks as a means to determine the speed with which specific systems perform a general class of functions.

The BYTE benchmarks were devised to exercise a computer under review by running it through a series of task-oriented tests. The benchmarks provide reproducible results, they are relatively easy to run and time, and they measure system elements upon which users commonly depend. The Sieve and Calculations tests, for example, are a measure of processor speed, while others time disk access.

Table 1 and table 2 present the results of BYTE's system benchmark tests for the IBM family of personal computers, including the IBM PC, XT, AT, and PCjr, as well as a wide range of MS-DOS work-alikes.

Use the benchmark information to give yourself an introduction to the relative capabilities of a broad selection of equipment. Just as important, do not use this information as the sole basis of your evaluations.

Before running the benchmarks, reviewers adopted a standard configuration with 256K bytes of memory, two 360K-byte disk drives, and PC-DOS 2.0 or MS-DOS 2.0. All tests were run at least three times; the reported time is the average of the trials. When configurations could not be duplicated, reviewers set up the system to be as close as possible to the standard machine. Exceptions are noted below.

We are not attempting to rate the computers competitively, nor can we provide assurances that a computer will be suitable for a specific application. Benchmarks are useful in measuring the time required for specific hardware/software combinations—especially if these combinations reflect the intended use of the system—but benchmarks are imperfect indicators. They provide little or no evidence, for example, regarding ease of use, reliability, compatibility, maintainability, and support. Jerry Houston gave some good advice ("Don't Bench Me In," February 1984 BYTE, page 160) on how to research a product: read reviews, talk with friends and fellow users, and find a reputable dealer. Still, the benchmarks do distinguish time-savers from time-enslavers.

We used readers and national users groups to help perform benchmark tests for those computers we did not have in-house; we could not obtain results for a few machines, including the MAD-1, the Pronto Transportable Solution, and the Sharp PC 5000. No manufacturers or retailers were involved in any

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of the testing. We selected the computers that are listed in table 2 on the basis of figures from Future Computing (8111 LBJ Freeway, Dallas, TX 75251) on the installed base of the computers through the end of 1984.

THE BENCHMARK TESTS

The first four tests to follow are BASIC tests and are written in Microsoft BASIC. "Compatibles" were tested with bundled or recommended versions of GW-BASIC. Certain BASIC interpreters and compilers could not run the programs exactly as written. In those cases, the programs were modified slightly, but with the "spirit" of the test preserved. Disk writing and reading were performed with a blank formatted disk. The last two benchmarks test the most commonly used system functions.

Since June 1984, every system reviewer for BYTE has performed the following benchmark tests.

WRITING TO DISK

The Writing to Disk test measures how long it takes the system/interpreter to

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Table 1: *Comparative benchmark results.*

	BASIC TESTS					
Computer Name	Writing to Disk	Reading from Disk	Sieve of Eratosthenes	Calculations	Format and Copy Disk	File Copy
AT&T PC 6300	32	30	87	27	11	10
Canon A-200	57	29	132	41	11	13
Columbia	31	30	194	59	10	8.8
Compaq Deskpro	57	53	186	59	12	8.4
Compaq Plus	54	51	168	56		7.8
Corona Desktop PC	57	55	201	61	17	11
Data General/One	56	55	229	69	7.8	12
Epson QX-16	58	30	179	54	12	6.9
Ericsson PC	57	31	182	56	12	9.3
Hewlett-Packard HP 150	35	34	148	49		11
Hewlett-Packard HP 110	42	28	114	38		
IBM PC	56	46	191	69	9.6	5.8
IBM PC AT	26	24	80	27		3.9
IBM PCjr	82	55	236	85		8.5
IBM PC XT	59	41	209	70		5.1
ITT XTRA	33	32	185	56	11	8.8
Kaypro 16	56	30	184	56	11	7.3
Leading Edge PC	32	29	153	46	13	9.2
Micromint MPX-16	58	54	216	72	7.7	9.4
Mindset Personal Computer	58	55	301	54	12	12
Morrow Pivot	82	56	313	96	14	11
NCR Plus 4	57	30	182	56	25	13
NEC APC III	30	29	86	29	4.0	6.5
Osborne 3	59	56	273	83	14	15
Otrona Attache	31	30	78	24	11	10
Panasonic Sr. Partner	30	29	184	56	11	5.8
Polo	31	56	448	72	17	9.9
Sanyo MBC-775	31	29	113	35	4.1	8.0
Sanyo MBC-550	32	29	267	93	13	7.7
Scottsdale Systems Inc. Color Fox	59	56	241	73	11	11
Seequa Chameleon Plus	32	29	215	65	24	9.6
Stearns	31	29	76	24	7.2	6.2
STM PC	32	30	79	24	12	7.7
Tandy 1000	56	55	226	68	12	7.9
Tandy 1200 HD	59	55	223	69		7.3
Tandy Model 2000	30	29	79	24	10	9.8
TeleVideo TS 1605	60	57	184	56	15	11
Texas Instruments Professional	31	31	171	52	8.8	9.5
Texas Instruments Pro-Lite	34	33	155	51		11
Visual Commuter	57	45	182	56	9.3	7.0
Zenith Z-150	32	30	193	57	10	8.4

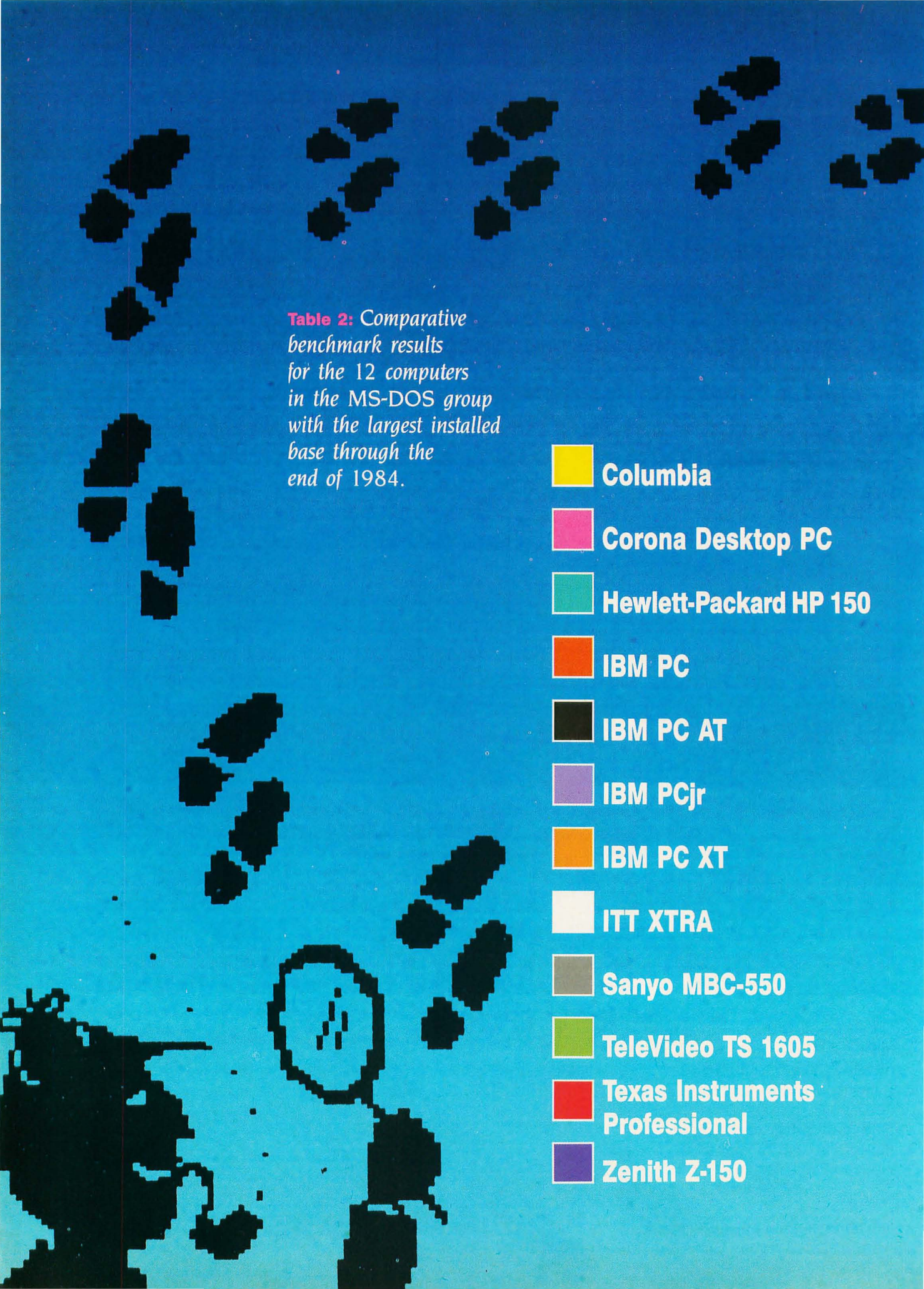


Table 2: *Comparative benchmark results for the 12 computers in the MS-DOS group with the largest installed base through the end of 1984.*

Columbia

Corona Desktop PC

Hewlett-Packard HP 150

IBM PC

IBM PC AT

IBM PCjr

IBM PC XT

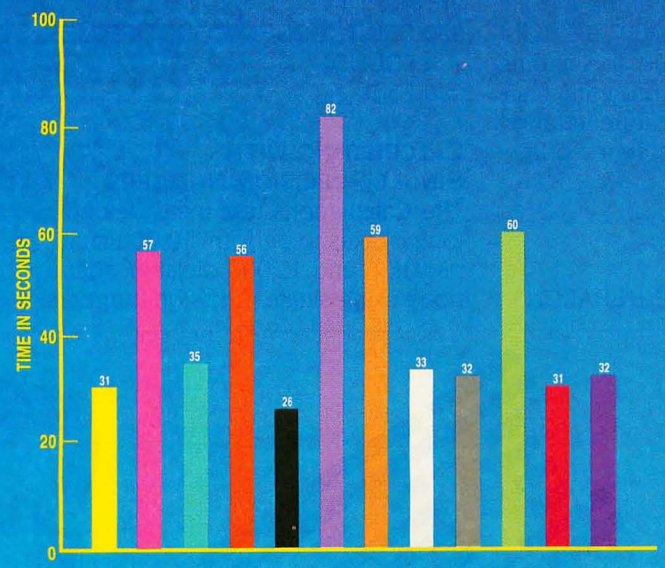
ITT XTRA

Sanyo MBC-550

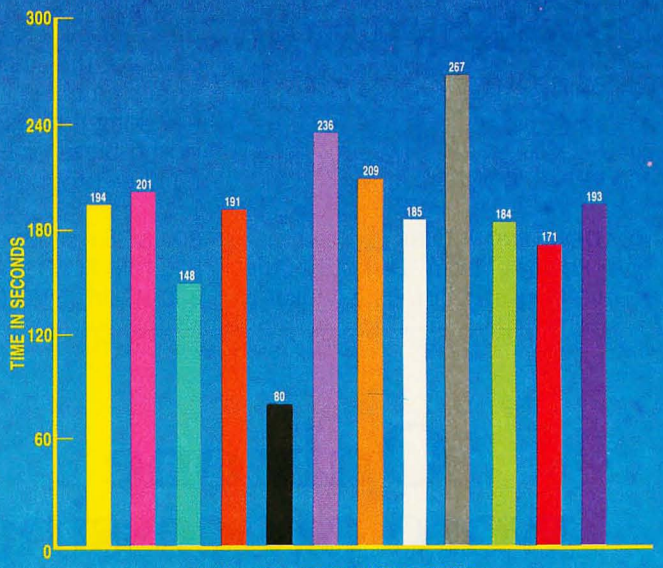
TeleVideo TS 1605

Texas Instruments Professional

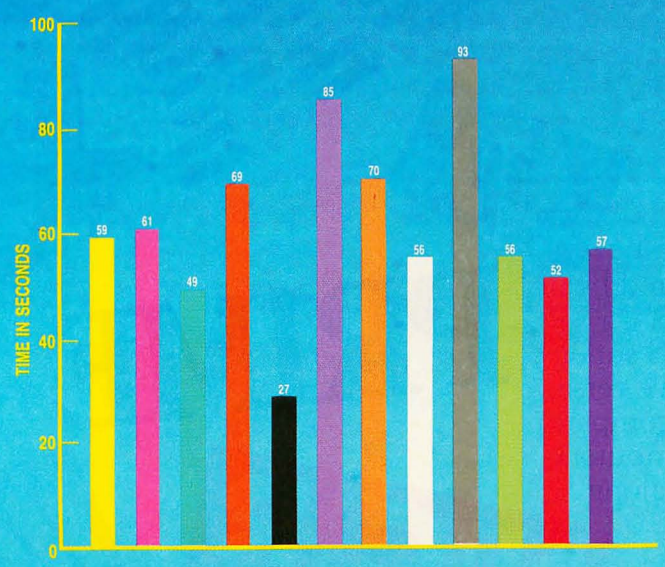
Zenith Z-150



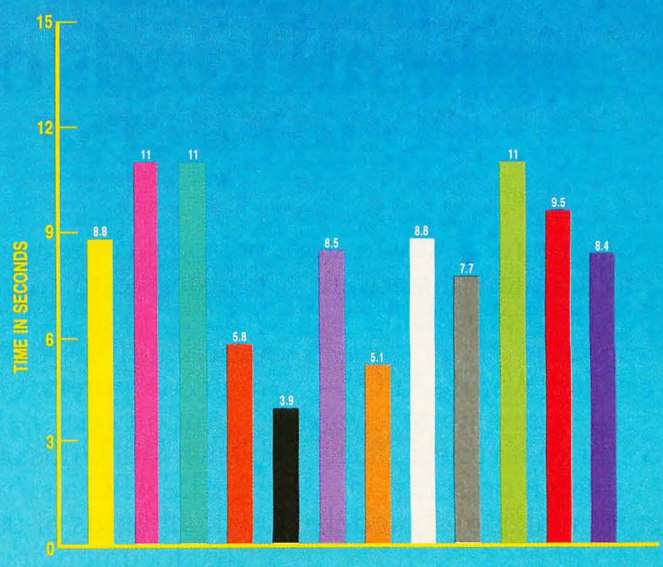
WRITE A 64K-BYTE FILE TO DISK



SIEVE OF ERATOSTHENES PROGRAM



CALCULATING WITH SINGLE-PRECISION NUMBERS



40K-BYTE FILE COPY

write a 64K-byte sequential file onto a disk in 128-byte chunks.

Note that in the tests of BASIC disk access for the Sanyo, the test file was written to and read from the default drive. Sanyo BASIC apparently cannot access other disk drives. The same procedure was used in one-drive systems, like the IBM PCjr.

```
100 A$ = "12345678123456781234567812345678"
120 B$ = A$ + A$ + A$ + A$
140 NR = 512
160 OPEN "B:TEST" FOR OUTPUT AS #1
180 FOR I = 1 TO NR
200 PRINT #1, B$
220 NEXT I
240 CLOSE
260 PRINT "DONE"
```

Reading from Disk

The Reading from Disk test that follows measures how long it takes to read the above sequential 64K-byte file in 128-byte segments.

```
300 NR = 512
320 OPEN "B:TEST" FOR INPUT AS #1
340 FOR I = 1 TO NR
360 B$ = INPUT$(128,1)
380 NEXT I
400 CLOSE
420 PRINT "DONE"
```

The Sieve of Eratosthenes Program

Eratosthenes, the head of the Alexandria library around 200 B.C., discovered this technique for finding prime numbers. The program tests how long it takes to do one iteration of the Sieve of Eratosthenes prime-number program.

```
800 SIZE = 7000
820 DIM FLAGS (7001)
830 PRINT "START ONE ITERATION"
840 COUNT = 0
850 FOR I = 0 TO SIZE
860 FLAGS (I) = 1
870 NEXT I
880 FOR I = 0 TO SIZE
890 IF FLAGS (I) = 0 THEN 970
900 PRIME = I + I + 3
910 K = I + PRIME
920 IF K > SIZE THEN 960
930 FLAGS (K) = 0
940 K = K + PRIME
950 GOTO 920
960 COUNT = COUNT + 1
970 NEXT I
980 PRINT "DONE: ";COUNT;"PRIMES FOUND"
990 END
```

Calculating with Single-Precision Numbers

The Calculations test measures how long it takes to perform 10,000 multiplication and 10,000 division operations using single-precision numbers

and also gives a rough indication of the error involved.

```
500 NR = 5000
520 DEFSNG A – Z
540 A = 2.71828
560 B = 3.14159
580 C = 1
600 FOR I = 1 TO NR
620 C = C*A
640 C = C*B
660 C = C/A
680 C = C/B
700 NEXT I
720 PRINT "DONE"
740 PRINT "ERROR = "; C – 1
```

Format and Copy Disk

The Format and Copy Disk test measures how long it takes to format and copy a disk using the diskcopy command. The test is done only on floppy disks. Copies are made onto previously unformatted disks. Since disk size can vary, the time is adjusted to reflect the number of seconds per 40K bytes of disk space.

The tests on several of the units (STM, Morrow Pivot, Tandy 2000) timed format and diskcopy separately and combined the results. In addition, the STM time includes automatic verification after formatting.

Units with hard-disk drives in their standard configuration (or in the case of the Stearns, for which the review system contained an optional hard disk) will not have results for this test.

Results on this test could not be obtained for the IBM PCjr and the HP 110, which have only one disk drive, or for the HP 150, because the utility diskcopy is not included with the operating system.

File Copy

The File Copy test measures how long it takes to copy a 40K-byte disk file to a blank formatted floppy disk. The tests on units with hard-disk drives measure how long it takes to copy the 40K-byte file from the hard disk to a blank formatted floppy disk. Otherwise, reviewers copied the file to another part of the same disk. There are no results for the HP 110, which had only one disk drive. The results for the IBM PCjr reflect copying to another part of the same disk. ■

The Format and Copy Disk test is done only on floppy disks.

ACKNOWLEDGMENTS

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