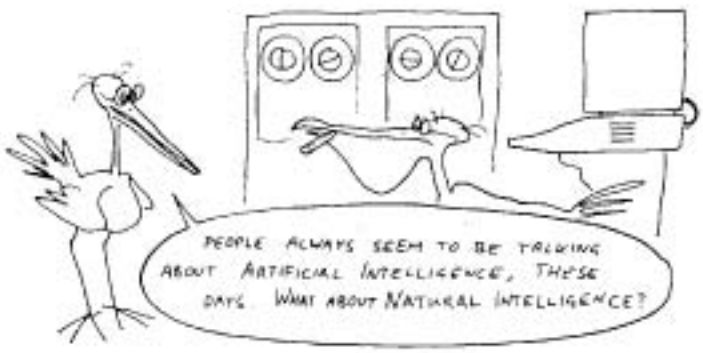
The Adventures of
ARCHIBALD HIGGINS

COMPUTER MAGIC

Jean-Pierre Petit



The Association Knowledge without Borders, founded and chaired by Professor Jean-Pierre Petit, astrophysicist, aims at spreading scientific and technical knowledge in as many countries as possible and in as many languages as possible. To this end, all his popular scientific works, which cover a period of thirty years, and more particularly the illustrated albums he has created, are now freely accessible. Anyone is now free to duplicate the present file, either in digital form or in the form of printed copies and circulate these copies to libraries , within the context of schools or universities or associations whose aims would be the same as the association , provided that they do not derive any profit from this circulation and that they do not have any political, sectarian or confessional connotations. These pdf files may also be put on line in the computer networks of school and university libraries.

Jean-Pierre Petit intends to create numerous other works which will be accessible to a larger audience. Even illiterate people will be able to read them because the written parts will “speak” when the readers click on them. Thus it will be possible to use these works to support literacy schemes. Other albums will be "bilingual" in so far as it will be possible to switch from one language to another selected language with a mere click. Hence another tool made available to develop language skills.

Jean-Pierre Petit was born in 1937. He made his career in French research. He worked as a plasma physicist, he directed a computer science centre, he has created softwares, he has published hundreds of articles in scientific magazines, dealing with subjects ranging from fluid mechanics to theoretical cosmology. He has published about thirty books which have been translated in numerous languages.

The association can be contacted on the following internet site:

http://savoir-sans-frontieres.com

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT COMPUTERS, BUT NEVER DARED ASK ...

SOPHIE - WHEREABOUTS ARE WE ?
A
MMM... HANG ON... I'M IN THE MIDDLE OF A CALCULATION.
BUT WHAT ARE YOU CALCULATING ?
I - OH, LOOK, IT'S TOO COMPLICATED TO EXPLAIN. I'M JUST CALCULATING, / THAT'S ALL .
BLIMEY ! TAKE A LOOK AT THIS !

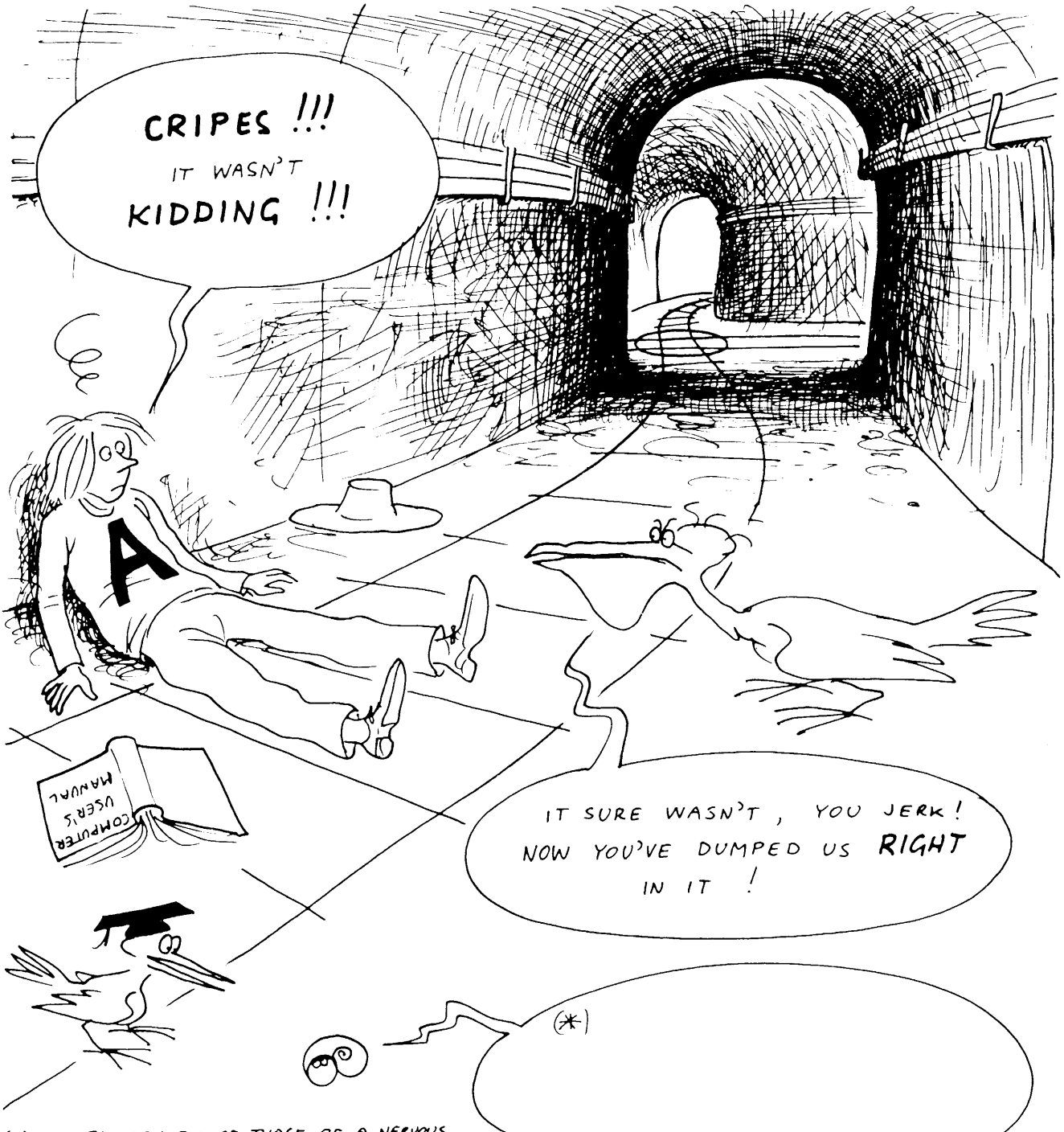
WOW! ALL THESE COLORED BUTTONS!
I WONDER WHAT THEY'RE FOR?
CLICK
CLICKCLICK
HEY — WHAT'S ALL THIS GARBAGE?
ZARKØU5...NNNNN
UU))))
SYNTAX ERROR
???
ZBLUTCHZVVVZZ
55Ø3
SYNTAX ERROR
I DON'T UNDERSTAND A WORD OF IT!

OH, IT'S THAT BLASTED PELICAN MESSING AROUND WITH MY PROGRAM!
ME? WOT'VE I DONE?
LISTEN, SWEETIES - I'VE GOT A JOB TO FINISH. TILL THEN, WHY DON'T YOU TAKE YOURSELVES OFF SOMEWHERE AND BROWSE AROUND THE COMPUTER CENTER? BUT BE CAREFUL - DON'T TOUCH ANYTHING. O.K?

OH, WOW! IT'S COMPLICATED!
COMPUTER USER'S MANUAL
C7 TO D4
BUT NOT AS MUCH AS IT LOOKS. LISTEN: TO PLAY WITH THE COMPUTER, ALL YOU NEED TO DO IS GIVE IT INSTRUCTIONS...
FOR EXAMPLE —
... WHICH YOU TAP OUT ON THIS - SORT OF - KEYBOARD...

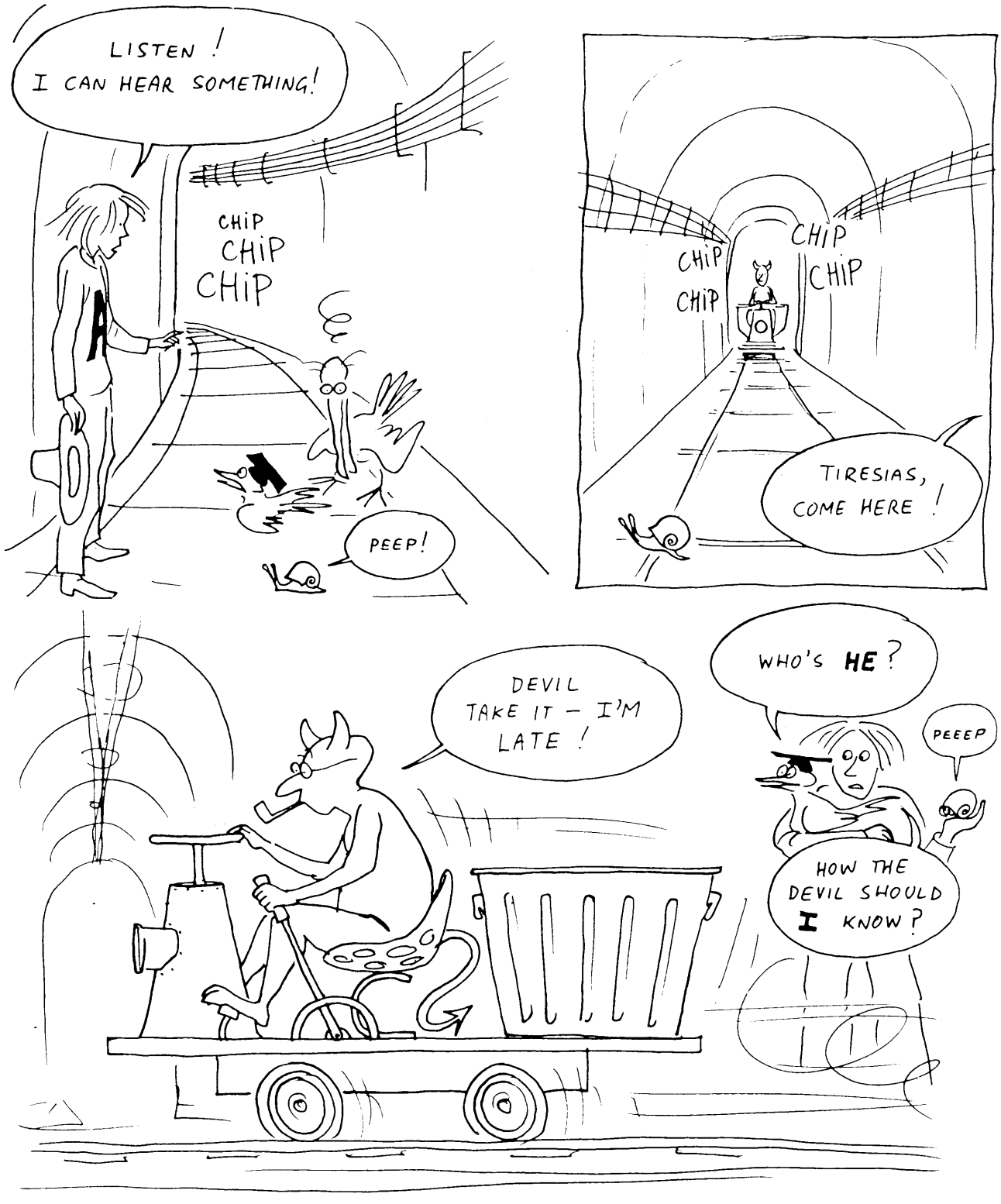
TO MAKE AN ENTRY INTO THE COMPUTER, YOU TYPE A B R A C A D A B R A, AND THEN PUSH THE BUTTON MARKED RETURN.
I SAY, HOLD YOUR HORSES! SOPHIE ISN'T HERE!
I'VE GOT AN 'ORRIBLE FEELIN' I'M GONNA REGRET THIS.
DONCHA FINK IT'D BE BEST TO 'ANG ON TILL SHE COMES BACK, ARCHIE?
BUT SOPHIE TOLD US NOT TO TOUCH ANYTHING!
OH, SOPHIE'S MILES AWAY. ANYWAY, WHAT SHE DOESN'T KNOW WON'T HURT HER, WILL IT?

A-B-R-A-C-A-D-A-B-R-A
NUTS! IT'S NOT WORKING!
OH YES... THE COMPUTER WON'T CARRY OUT AN INSTRUCTION UNTIL YOU PUSH THE RETURN BUTTON.
RETURN - WHERE IS IT? AH, THERE!
CHIP!
COMPUTER USER'S MANUAL

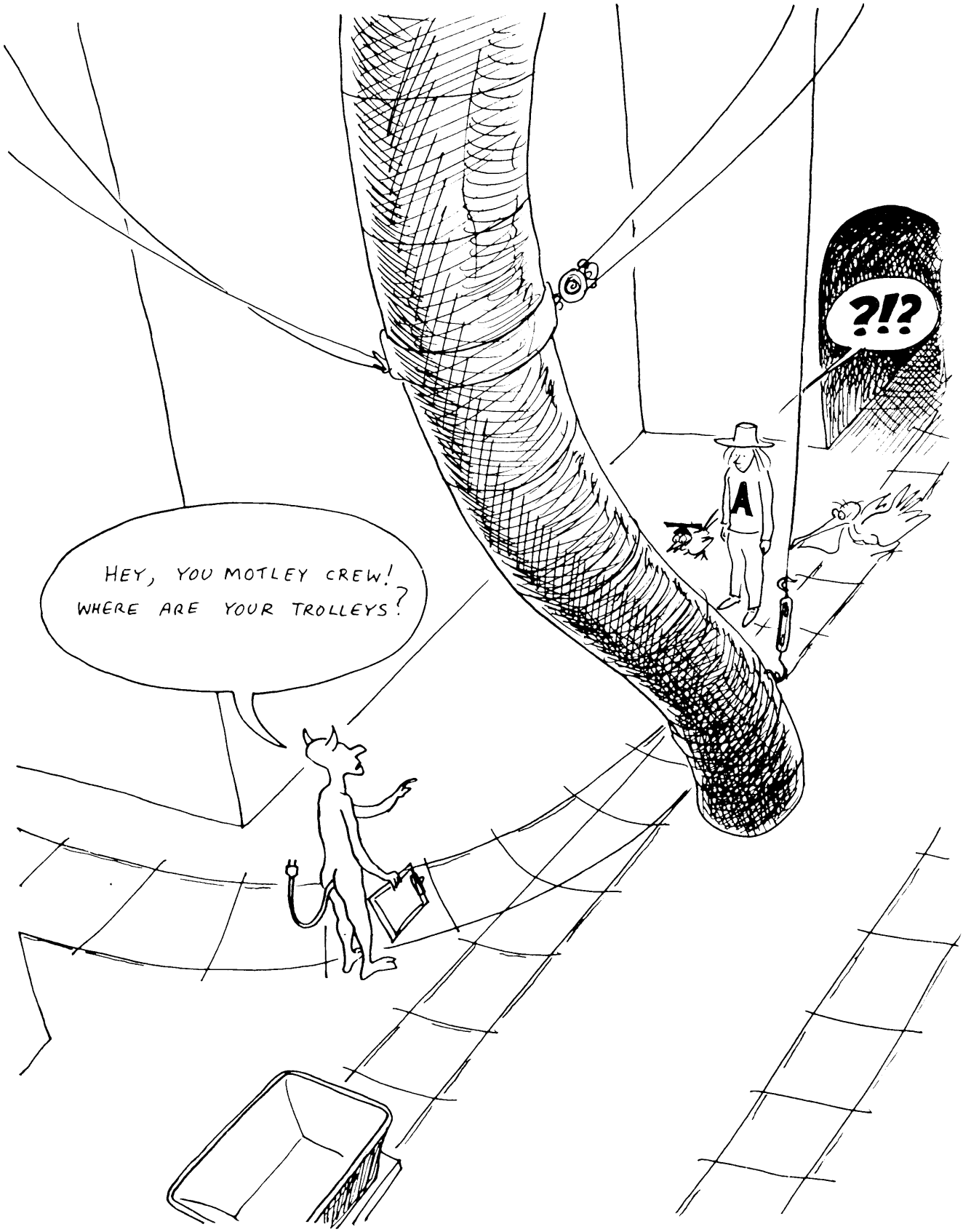


(*) FOR THE BENEFIT OF THOSE OF A NERVOUS DISPOSITION, THIS SPEECH-BALLOON HAS BEEN LEFT TO THE READER'S IMAGINATION.

N.B. ONLY CERTAIN MODELS OF COMPUTER CAN IMPLEMENT THE COMMAND ABRACADABRA. IF IN DOUBT IT IS BEST **NOT** TO TRY...


LISTEN ! I CAN HEAR SOMETHING!
CHIP CHIP CHIP
PEEP!
CHIP CHIP
CHIP CHIP
TIRESIAS, COME HERE !
DEVIL TAKE IT — I'M LATE !
WHO'S HE ?
PEEEP
HOW THE DEVIL SHOULD I KNOW ?

WAIT FOR US !!!
FLOPPITY
FLOPP
FLOP
HANG ON...
HE'S STOPPED.
I WONDER WHAT THESE LOCKERS ARE FOR?
MAN!! COME AN' LOOK AT THIS!


HEY, YOU MOTLEY CREW! WHERE ARE YOUR TROLLEYS?
?!?

I CAN'T FIND YOU FOLKS IN MY PROGRAM AT ALL... IT'S AN ABSOLUTE SHAMBLES TODAY! QUITE DIABOLICAL!
WE'VE COME FROM THE EXTERIOR.
YUS. AN' IF YER COULD JUST POINT US TOWARDS A H' EXIT...
THE EXTERIOR? THAT MUST BE A NEW DEPARTMENT...
I'LL DEAL WITH YOU LATER. I'VE GOT TO ATTEND TO AN INPUT!
DRRRRIIING
THEY CREATE SO MANY INTERFACES THESE DAYS THAT A MAN CAN'T TELL WHETHER HE'S COMING OR GOING...
INTERWHATSITS?

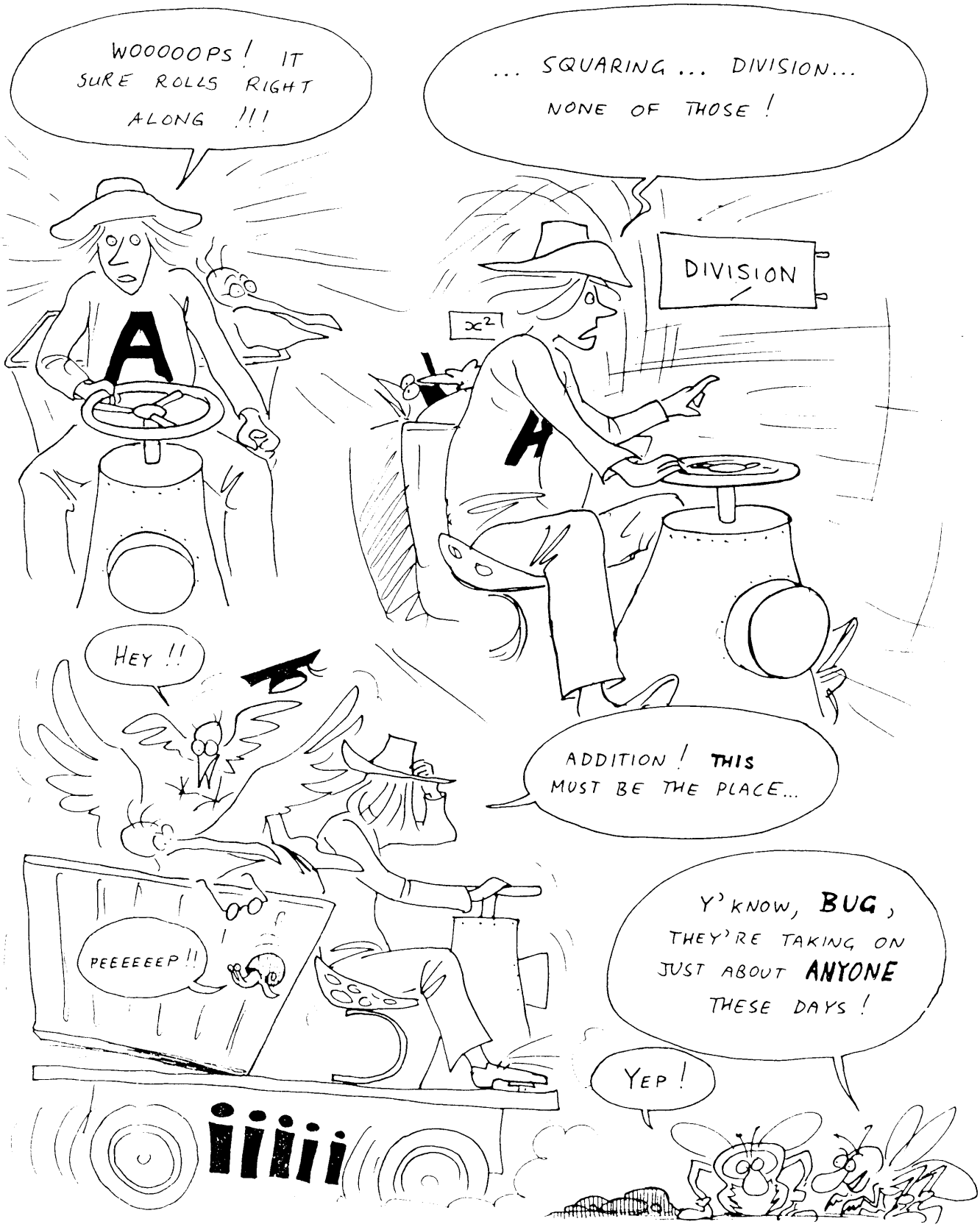
TO YOUR POSTS, MEN!
HOP TO IT !!!
A
PEEK, POKE, BYTE, & RAM!
FRED - FIND ME AN EMPTY MEMORY!
2
X
3
PUT INTO MEMORY A

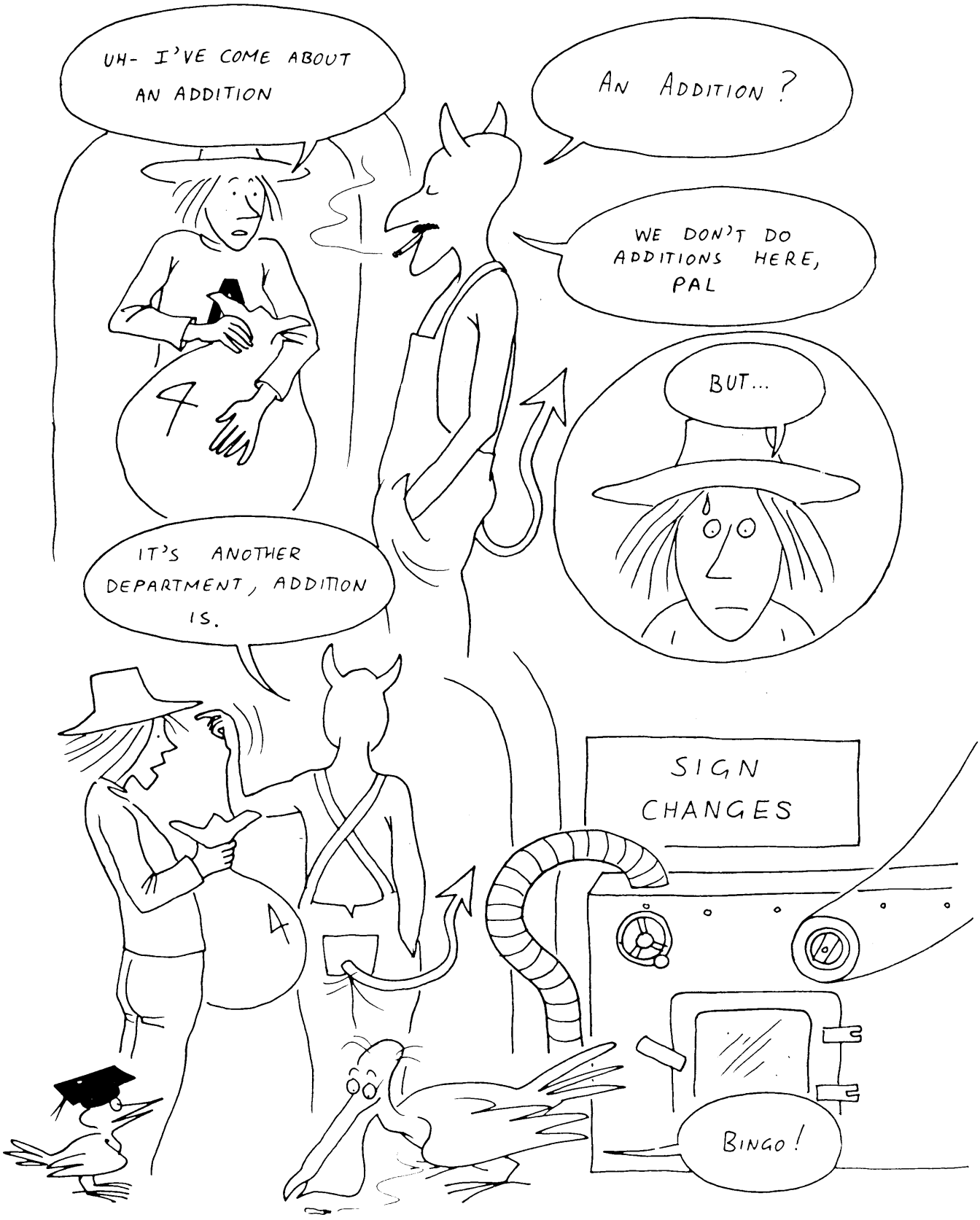
JOE - PUT THAT INTO BINARY CODE!
AND GET ON THE BLOWER TO THE MULTIPLICATION PEOPLE. SNAP TO IT!
RIGHT! CENTRAL MEMORY?
NO PROBLEM. THERE'S PLENTY OF ROOM. THEY'VE RESERVED ENOUGH MEMORY SPACE.
MULTIPLICATION?
READY WHEN YOU ARE!

IS GEORGE READY ? SEND IT OFF ON THE BUS !
SAY WHEN...
DONE !
CLICK
FOUR MICROSECONDS... NOT BAD , NOT BAD AT ALL...

BUT IT COULD HAVE BEEN BETTER!
DRRRIING
GOLLY - ANOTHER INPUT HAS ARRIVED!
BATTLE STATIONS, MEN!
SO THESE ARE INPUTS?
ADD TO THE CONTENTS OF MEMORY A
FRED? JOE?
ALL PRESENT AND CORRECT, SIR!

GEORGE ? WHERE'S GEORGE ? I'LL HAVE HIM SHOT !
WHY ARE YOU STANDING AROUND LIKE A STUFFED DUCK ? GET ON WITH IT – YOU'VE GOT AN ADDITION TO DO !
ME ?
YES, YOU !! I CAN SEE YOU'RE NEW TO THE JOB ...
DRIVE AS IF THE DEVIL WERE AFTER YOU ! MICROSECONDS COST MONEY, YOU KNOW !
CAN'T FIND NO CIGARETTE BUTTS IN THIS DUMP ...
IF YOU INSIST ... WHERE DO I START ?

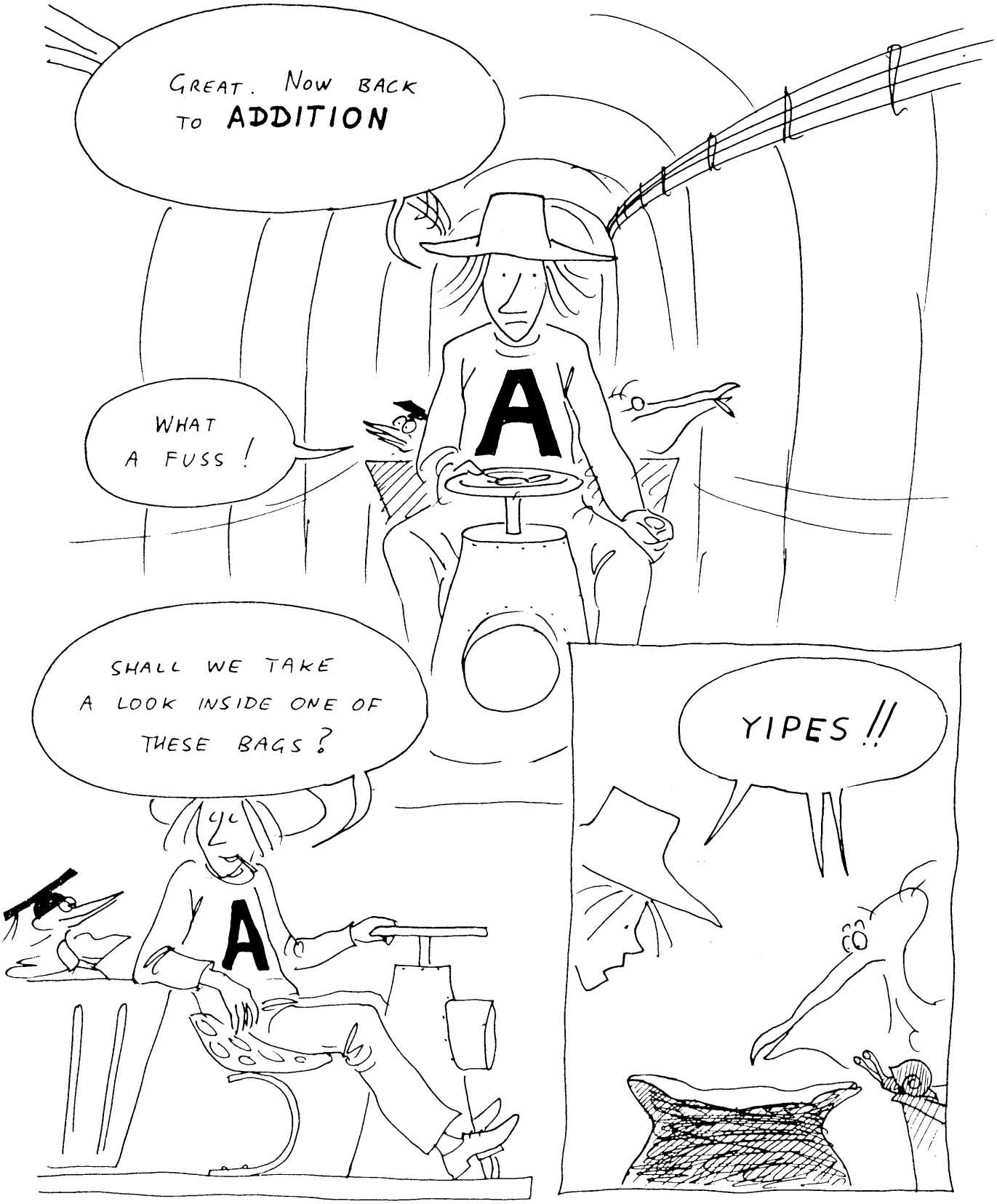

WOOOOOPS! IT SURE ROLLS RIGHT ALONG !!!
A
... SQUARING ... DIVISION... NONE OF THOSE!
DIVISION
x²
A
HEY !!
ADDITION! THIS MUST BE THE PLACE...
PEEEEEEP!!
iiiii
Y'KNOW, BUG, THEY'RE TAKING ON JUST ABOUT ANYONE THESE DAYS!
YEP!


UH- I'VE COME ABOUT AN ADDITION
AN ADDITION ?
WE DON'T DO ADDITIONS HERE, PAL
BUT...
IT'S ANOTHER DEPARTMENT, ADDITION IS.
SIGN CHANGES
BINGO!

OH, IT'S HERE.
ADDITION
I - UH - WELL, GOOD MORNING - UH - THIS HAS TO BE ADDED TO THE CONTENTS OF MEMORY A.
DRAT! IT'S LOW-TAR!
I'D LIKE TO HELP YOU, SON, BUT I HAVEN'T THE FOGGIEST IDEA WHAT'S IN MEMORY A.
OH.
YOU'VE FORGOTTEN TO GET IT FROM CENTRAL MEMORY.

CENTRAL MEMORY
WELL- HERE WE ARE!
HI, YOU DON'T KNOW ME. I'VE BEEN SENT TO GET THE CONTENTS OF MEMORY A.
A
YOU MEAN YOU WANT A COPY, OLD SON
K
I'M NOT ALLOWED TO GIVE YOU THE CONTENTS. ONLY COPIES.
P
N
HERE YOU ARE.
A
A

SOME MEMORY LOCATIONS HAVE LABELS, AND SOME ARE BLANK. WHY?
A
F
K
U
Z
THOSE ARE LOCATIONS THAT HAVEN'T BEEN ASSIGNED YET.
WHAT DOES THAT MEAN?
IT MEANS THAT SINCE THERE'S NOTHING IN THEM WE DON'T PUT NOTHING ON THEM, OF COURSE!
I CAN SEE YOU'RE NEW!


GREAT. NOW BACK TO ADDITION
WHAT A FUSS!
A
SHALL WE TAKE A LOOK INSIDE ONE OF THESE BAGS?
A
YIPES!!

4
BAG 4 CONTAINS THE FOLLOWING: ONE KNOTTED HANDKERCHIEF AND TWO UNKNOTTED ONES. IN THAT ORDER.
NOW FOR BAG A: TWO KNOTTED HANDKERCHIEFS AND ONE UNKNOTTED ONE - IN THAT ORDER!
A
WHAT DO THEY WANT ALL THEM 'ANKIES FOR, MAX?

(*) IN COMPUTING, ZERO IS WRITTEN Ø.

No, no! WHEN YOU GET TO TWO, YOU WRITE 1Ø
... So THREE WORKS OUT AS 11. WHAT DO I DO AFTER THAT ?!?
= 2
= 3
BLIMEY, I'M GETTING THE 'ANG OF THIS!
YOU SHOW HIM, THEN.
= Ø = ZERO
= 1 = ONE
= 1Ø = TWO
= 11 = THREE
= 1ØØ = FOUR
= 1Ø1 = FIVE
= 11Ø = SIX
= 111 = SEVEN
= 1ØØØ = EIGHT
ETC...
WOT 'APPENS IS THAT THE CONTENTS OF MEMORY A IS SIX - WHICH IS WOT YER GET IF YER DOES THE OPERATION WE WAS TALKIN' ABAHT - 2 x 3.
MY WORD, NOW THERE'S A THING!

FINE - BUT WHY NOT STICK TO DECIMAL CODE ?
BECAUSE COMPUTERS ONLY KNOW HOW TO PERFORM OPERATIONS CODED IN BINARY.
ADDITION
HEY! STOP THE BUS! WE'VE REACHED H'ADDITION !
LESSEE, LESSEE... 11Ø + 1ØØ = ?
THE ELEMENTARY OPERATIONS ARE: Ø + Ø = Ø
Ø + 1 = 1 + Ø = 1
AND 1 + 1 = 1Ø
(THAT IS, YOU HAVE TO CARRY ONE.)
THE DEVIL!
1Ø Ø
+ 11Ø
1Ø1Ø
ZERO PLUS ZERO : ZERO.
ZERO PLUS ONE : ONE.
ONE PLUS ONE : I PUT ZERO, AND I CARRY 1. THEN I PUT ONE

= 1ØØØ = EIGHT
= 1ØØ1 = NINE
= 1Ø1Ø = TEN
RIGHTEY! AN' BY CARRYIN' ON THE TABLE ON PAGE 28, THAT GIVES TEN.
IT'S ALL TOO MUCH FOR A HUMBLE SNAIL...
TIRESIAS, OLD BOY - IT'S ALL H'EXCEEDINGLY SIMPLE. IF ONLY YOU'D PAY H'ATTENTION FOR 'ALF A SEC, YOU'D SOON SEE...
PEEP!
WELL, OF COURSE, UH - YOU KNOW. IT'S ALL THE SAME TO ME. I JUST WORK HERE. I SHOVE STUFF INTO MEMORY, AND DELIVER COPIES. I DON'T CONCERN MYSELF WITH WHAT IT'S ALL FOR.
TIRESIAS, YOU'RE A DUNCE!
AND YOU PUT TEN IN MEMORY A.
A
A
I WANT OUT!

AND WHERE HAVE YOU BEEN ALL THIS TIME? THE WHOLE CHAIN OF CALCULATION IS SNARLED UP BECAUSE OF YOU!
IT'S JUST NOT GOOD ENOUGH! I DON'T KNOW WHERE THEY DUG YOU UP FROM - BUT YOU'RE A DISRUPTIVE ELEMENT, YOUNG MAN!
ARCHIE'S BEEN GONE AN AWFULLY LONG TIME... OH WELL, WHILE I'M WAITING I'LL WRITE A LITTLE PROGRAM. START BY INITIALIZING THE VARIABLES...
!!!
BLOUTCH
OH, BOTHER!! IT'S STARTING UP AGAIN! AND HERE I AM WITHOUT A SOUL TO HELP ME!
WHAT'S SHE UP TO NOW?

VERY WELL. YOU THERE! GO BACK TO CENTRAL MEMORY. YOU'VE GOT TO FILE TWO DATA LISTS. EACH ENTRY IN THE LIST IS A STRING OF LETTERS, THAT IS, A WORD.
YER CAN STORE WORDS ?
OF COURSE WE CAN DEAL WITH WORDS !! FIRST WE GIVE THEM A DECIMAL CODE, THEN WE TRANSLATE THAT INTO BINARY.
THE DATA ARE TWO PACKAGES, EACH OF THREE HUNDRED WORDS. WE'LL NUMBER THE FIRST AS A(1), A(2), ... A(300), AND THE SECOND AS B(1), B(2), ..., B(300).
OH, AND WHILE YOU'RE AT IT, YOU CAN RESERVE TWO BATCHES OF THREE HUNDRED MEMORY LOCATIONS.
OK. FIRST GO TO CODING, AND THEN HEAD FOR CENTRAL MEMORY.
WORD LIST A
WORD LIST B

CODING
YOU'VE PICKED A BAD TIME TO EXPECT ME TO DO THAT LOT, PAL!
ASCII CODES
MANE, MANCY, MORPH... WHAT'S THIS BABBLE?
IT'LL BE DONE FASTER IF YOU TAKE LIST B. I'LL LOOK AFTER LIST A.
OK.
A
A(6)
A(5)
B(1) B(2) B(3) B(4) B(5) B(6) B(7) B(8) B(9) B(10) B(11) B(12) B(13) B(14)
B(4)
B(2)
B(1)

COMMAND MODE
I WONDER WHAT THAT NEW BOY'S UP TO NOW ?
SCRRRR
PROGRAM FILE
KLONK!
GOOD HEAVENS, A PROGRAM!
1 GIVE N THE VALUE ONE
1 GIVE N THE VALUE ONE
HERE'S THE FIRST INSTRUCTION IN THE PROGRAM.
NOT SO FAST!
WHAT ARE YOU DOING ?
A

I'M TAKING THE LIST OF INSTRUCTIONS FOR THE PROGRAM THAT'S JUST ARRIVED, AND PUTTING THEM IN ORDER. BECAUSE, NATURALLY, THEY DON'T ALWAYS SEND THEM IN THE RIGHT ORDER!
IN OTHER WORDS, HE'S MAKING A PROGRAM LISTING.
RIGHT, THAT'S IT!
OH NO, NOT ANOTHER ONE!
SHE MUST BE GETTING TIRED OUT THERE...
NOW I'LL HAVE TO DO IT ALL OVER AGAIN!
CANCEL INSTRUCTION 8. (I MADE AN ERROR) REPLACE IT BY: 8 ADD ONE TO N
OM N)26 RETER
NUTS, I'VE MADE AN AWFUL MESS OF THAT!
YOU JUST WOULDN'T REALIZE HOW FRUSTRATING THESE PROGRAM CORRECTIONS ARE TO US HARDWORKING FRONT LINE TROOPS!

I HOPE THEY HAVEN'T GOT INTO ANY KIND OF TROUBLE...
FINE... I'LL CARRY ON
WOULD YOU LIKE A SWEET?
SULPHUR
ER - NO THANKS!
YOU'D BETTER EXPLAIN TO ME WHAT ALL THIS STUFF IS BEING COOKED UP FOR.
A PROGRAM IS RATHER LIKE A RECIPE IN A COOKBOOK, WITH THE DATA ACTING AS THE INGREDIENTS. IT CONSISTS OF LOTS OF INSTRUCTIONS, WHICH ARE NUMBERED AND ARRANGED IN INCREASING ORDER. AS SOON AS I RECEIVE THE COMMAND TO EXECUTE THE PROGRAM, I WILL CARRY OUT THESE INSTRUCTIONS IN ORDER, ONE AFTER THE OTHER.
1 GIVE TO N THE VALUE ONE
AND WHILE YOU'RE WAITING?
WE STORE IT ALL IN THE PROGRAM MEMORY.
A
SO THAT'S WHAT YOU'VE BEEN CARRYING ON ABOUT.

SOPHIE'S PROGRAM

1 GIVE TO N THE VALUE ONE

2 GIVE TO I A VALUE AT RANDOM BETWEEN 1 AND 300

3 GIVE TO J A VALUE AT RANDOM BETWEEN 1 AND 300

4 FIND A(I), THE I^{TH} WORD IN LIST A

5 FIND B(J), THE J^{TH} WORD IN LIST B

6 FORM (BY **CONCATENATION**) M = A(I) + B(J)

7 PRINT N

8 ON THE SAME LINE, PRINT A SPACE AND THEN THE WORD M

9 ADD 1 TO N

10 IF N > 20 THEN STOP. OTHERWISE GO TO 2

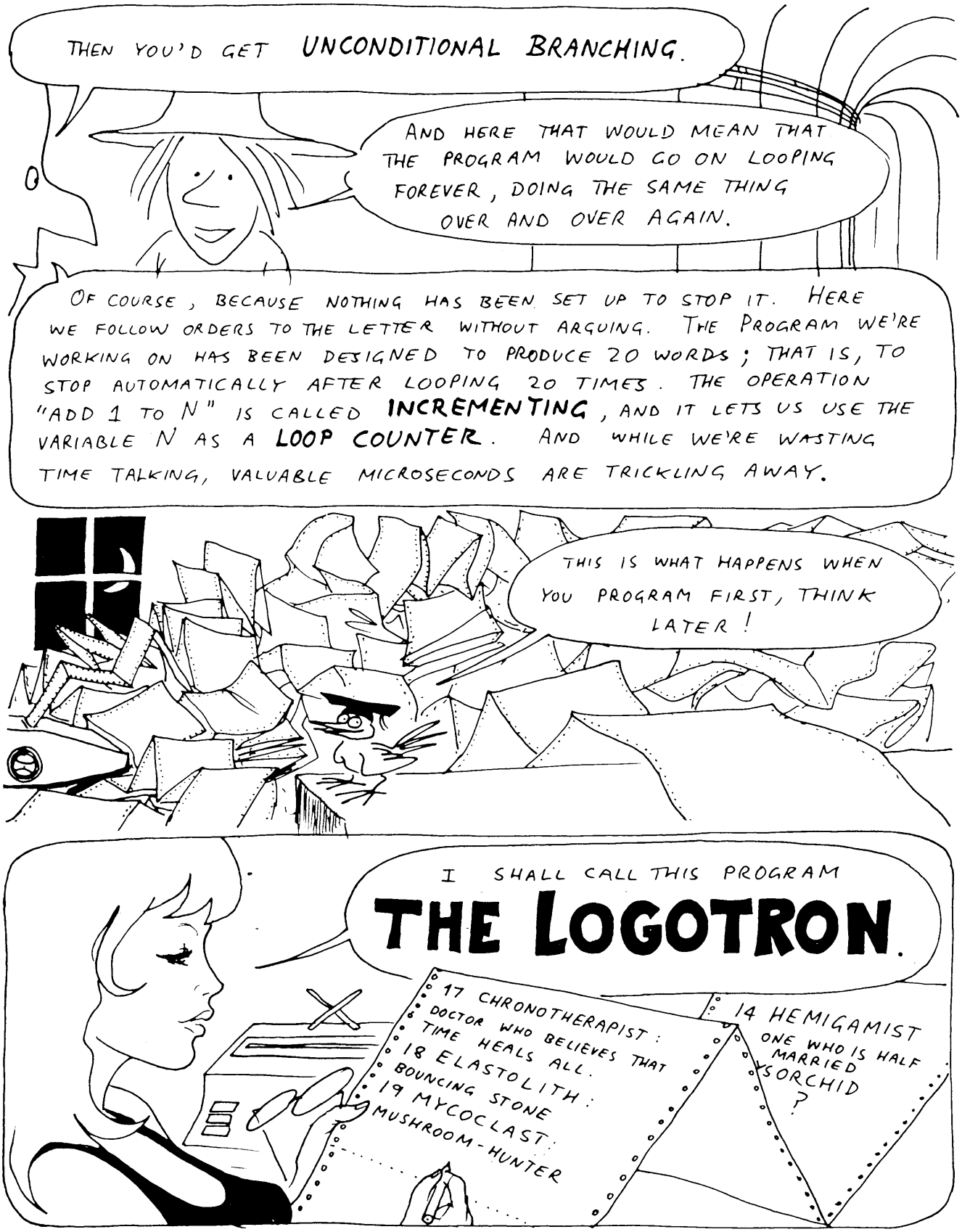
NEXT, GO TO THE RANDOM NUMBER GENERATOR TO CARRY OUT INSTRUCTIONS 2 AND 3.
RANDOM NU
MAY I BE OF ASSISTANCE, SIR?
PATRONS MUST BE PROPERLY DRESSED.
UM... I NEED TWO NUMBERS I AND J, CHOSEN AT RANDOM BETWEEN 1 AND 300.
TUT-TUT... THESE SLOBS
BEFORE YOU ENTER, WOULD YOU PLEASE BE OBLIGING ENOUGH TO PUT ON THIS TIE?
OH. YOUR PARDON, SIR. I REGRET THAT ANIMALS ARE NOT PERMITTED ON THE PREMISES.

I'D LIKE YOU TO PUT THESE INTO MEMORY LOCATIONS, CALLING ONE I AND THE OTHER J.
AS YOU SAY, SIR.
GREAT!
NOW GO TO CENTRAL MEMORY...
BUT I'VE JUST COME FROM THERE!
A
DO NOT QUESTION MY ORDERS! YOU WILL GO AND FIND THE CONTENTS OF I, AND YOU WILL USE THAT TO GET THE I^TH WORD A(I) FROM THE LIST OF WORDS A. YOU WILL DO THE SAME THING WITH J TO GET B(J) FROM THE LIST B.
UP AND DOWN ALL DAY - JUST LIKE A DARNED YO-YO!
HERE'S THE CONTENTS OF I. AS YOU DON'T READ BINARY I'VE ADDED A COPY IN DECIMAL FOR YOU.
96
I
THANKS! NOW, I'M LOOKING FOR THE 96TH ENTRY IN THE LIST OF WORDS A.
A(1) A(2) A(3) A(4) A(5) A(6) A(7) A(8) A(9) A(10) A(11)

EACH OPERATION, IN THE COMPUTER, IS IN EFFECT A MINI-PROGRAM. **ADDITION** AND **MULTIPLICATION**, FOR EXAMPLE, ARE PROGRAMS PERMANENTLY RESIDING IN THE COMPUTER. SUCH STRUCTURES ARE CALLED **SUBROUTINES**. WHAT WE'VE CALLED **CONCATENATION** IS ALSO A SUBROUTINE — ONE OF MANY AVAILABLE TO THE MACHINE. REMEMBER: A(I) AND B(J) ARE **STRINGS** OF LETTERS. CATENA IS LATIN FOR "CHAIN." THIS SUBROUTINE CHAINS TOGETHER TWO STRINGS OF LETTERS INTO A SINGLE WORD, WRITTEN SYMBOLICALLY $M = A(I) + B(J)$.

BUT THESE ARE JUST ANUVVER LOAD OF 'ANKIES WIV KNOTS IN 'EM!
YOU KNOW PERFECTLY WELL THAT EVERYTHING PASSING THROUGH HERE IS CODED IN BINARY – INCLUDING WORDS AND LETTERS.
B(J)
THIS ONE, RIGHT UNDER YOUR - ER - BEAK. IT MEANS COSMO.
A(I)
AND IN BAG B(J) WE HAVE PHOBE.
B(J)
RIGHT. IT'S DONE!
CONCATENATION
A(I)
B(J)
M=A(I)+B(J)
GOOD. THIS HAS TO GO INTO MEMORY M.
ALL THIS TO-ING AND FRO-ING – NO WONDER THEY SAY COMPUTING IS A FEET OF TECHNOLOGY!!

HELLO, HELLO, COME IN PLEASE! AH, BUFFER, INSTRUCTIONS 7 AND 8. PRINT OUT N AND THEN, ON THE SAME LINE, A SPACE, AND THE CONTENTS OF M.
MESSAGE RECEIVED, SIR! ROGER AND OUT!
OH, SUPER! MY PROGRAM IS RUNNING!
PRRRRiiiiiTT
1 COSMOPHOBE
PRINTER
PAPER
STOP
TEST
COSMOPHOBE! THAT'S QUITE FUNNY. I'D BETTER THINK UP A DEFINITION FOR THIS NEW WORD THAT THE COMPUTER HAS "INVENTED". HOW ABOUT "SOMEONE UNABLE TO BEAR THE UNIVERSE"?
AT LINE 10 WE HAVE A CONDITIONAL BRANCH. IT'S BASED ON A TEST: WHETHER THE CONTENTS OF MEMORY N (WHICH ACTS AS A COUNTER) EXCEEDS 20, AND IF SO, TO STOP.
IF NOT, THE PROGRAM GOES BACK TO LINE NUMBER 2 IN THE SERIES OF INSTRUCTIONS, AND CONTINUES - THAT IS, GOES ROUND ANOTHER TIME, DOING ANOTHER LOOP.
10 IF N>20 STOP. IF NOT GO TO 2
WHAT WOULD HAPPEN WITHOUT THAT KIND OF TEST?


THEN YOU'D GET UNCONDITIONAL BRANCHING.
AND HERE THAT WOULD MEAN THAT THE PROGRAM WOULD GO ON LOOPING FOREVER, DOING THE SAME THING OVER AND OVER AGAIN.
OF COURSE, BECAUSE NOTHING HAS BEEN SET UP TO STOP IT. HERE WE FOLLOW ORDERS TO THE LETTER WITHOUT ARGUING. THE PROGRAM WE'RE WORKING ON HAS BEEN DESIGNED TO PRODUCE 20 WORDS; THAT IS, TO STOP AUTOMATICALLY AFTER LOOPING 20 TIMES. THE OPERATION "ADD 1 TO N" IS CALLED INCREMENTING, AND IT LETS US USE THE VARIABLE N AS A LOOP COUNTER. AND WHILE WE'RE WASTING TIME TALKING, VALUABLE MICROSECONDS ARE TRICKLING AWAY.
THIS IS WHAT HAPPENS WHEN YOU PROGRAM FIRST, THINK LATER!
I SHALL CALL THIS PROGRAM
THE LOGOTRON.
17 CHRONOTHERAPIST: DOCTOR WHO BELIEVES THAT TIME HEALS ALL.
18 ELASTOLITH: BOUNCING STONE
19 MYCOCLAST: MUSHROOM-HUNTER
14 HEMIGAMIST ONE WHO IS HALF MARRIED TO ORCHID ?

A COMPUTER POSSESSES A COMPLEX RANGE OF INSTRUCTIONS, AND AN EXTENSIVE LIBRARY OF SUBROUTINES, THANKS TO WHICH YOU CAN COMPOSE A VIRTUALLY LIMITLESS RANGE OF PROGRAMS. HERE WE HAVE AN EXAMPLE OF **WORD-PROCESSING**.

AT THE MOMENT, COMPUTERS HELP US TO MANIPULATE DATA AND MAKE CALCULATIONS QUICKLY. IT IS HOPED THAT SOON IT WILL BE POSSIBLE TO MAKE COMPUTERS THAT POSSESS WHAT IS ALREADY CALLED **ARTIFICIAL INTELLIGENCE**.

THIS COMPUTER HAS STIMULATED SOPHIE'S IMAGINATION, BUT **SHE** IS THE MASTER. IN GENERAL WE CAN SAY THAT "THE COMPUTER CAN ONLY PERFORM THE TASKS THAT A MAN HAS INSTRUCTED IT TO DO, **AND NOTHING MORE**."

BUT SOON, EQUIPPED WITH EYES, EARS, AND HANDS, IT WILL COMMUNICATE WITH THE WORLD **AUTONOMOUSLY**, AND TAKE PART IN ITS OWN EXPERIENCES, BEING ABLE AT THE SAME TIME TO MODIFY ITS PROGRAMS, THAT IS, ITS "WAY OF THINKING," TO IMPROVE ITS PERFORMANCE AND ITS ABILITIES.

PERHAPS IT'S THEN THAT OUR TROUBLES BEGIN...

OMNI

FINANCIAL TIMES

MACHIAVELLI The Prince

TARSKOV MULTIMODAL LOGICS

VON NEUMANN THEORY OF GAMES

KEEP A CLOSE EYE ON THIS CHILD!

LEIBNIZ New essays on the human condition

HYPOLITH:
FOUNDATION STONE
MESOGRAPH: APPARATUS FOR WRITING BETWEEN THE LINES
ELASTOSAUR
ANCESTOR OF THE EARTHWORM
PODOCLAST:
FASHION-BOOT
STATODYNAMICS:
STUDY OF THE EVOLUTION OF STATIONARY STATES
PANSCAPHE:
VEHICLE FOR GOING ANYWHERE
EPISCODROME:
EMERGENCY LANDING STRIP FOR BISHOPS
PSEUDOPATH:
HYPOCHONDRIAC
VERBIPHAGE:
PERSON WHO EATS HIS WORDS
BIBLIOSTAT:
BOOK-PRESS

LOGOTOMY:
MINCING ONE'S WORDS
PANMANIA:
MANIA ABOUT EVERYTHING
PYROTOPE: CHIMNEY
MONOSCOPE:
SMALL CYLINDER OF ARBITRARY MATERIAL PERMITTING THE OBSERVATION OF ONLY ONE THING AT A TIME
PANGAMY:
TENDENCY TO ESPOUSE EVERYTHING
VOLATIPHOBIA:
FEAR OF FLYING
THEOTOPE: PARADISE
LATEROGRADE:
ONE WHO WALKS BESIDE HIS SHOES
LARDIPORT:
ONE WHO BRINGS HOME THE BACON

WHILE SOPHIE CONTINUES QUIETLY AMUSING HERSELF, THINGS ARE BEGINNING TO COME TO A HEAD INSIDE THE COMPUTER...

THEY DON'T ANSWER! I'D BETTER HIT THE PANIC-BUTTON!
WHAT'S UP NOW?
IN CASE OF ERROR
BREAK GLASS
ERROR
I HOPE THEY DIDN'T DO ANYTHING SILLY! I SHOULD NEVER HAVE LEFT THEM ON THEIR OWN...
ERROR
ARCHIE!

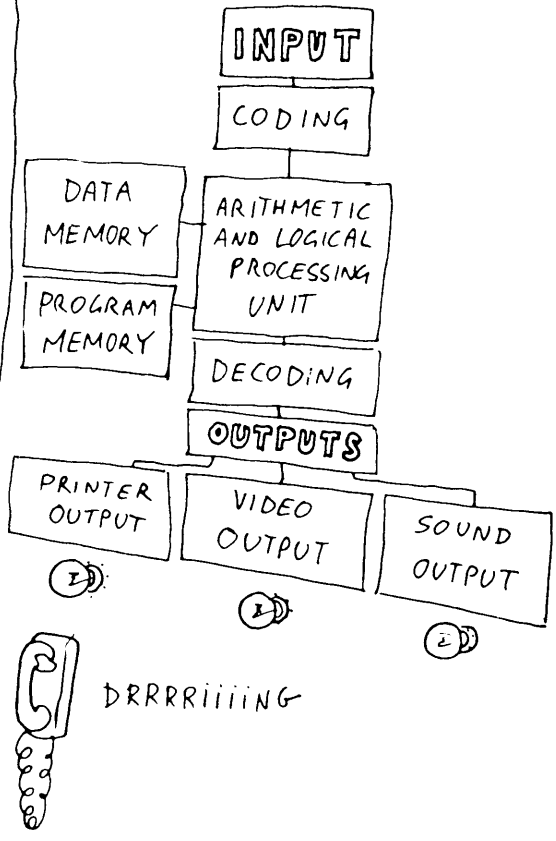
THEY'VE DISAPPEARED! I WONDER IF - MY GOD !!
HELLO, HELLO! CENTRAL MEMORY? WHAT? MEMORY CAPACITY OVERLOAD? THE DEVIL!
HELLO, STOP EVERYTHING. YOU HEARD ME - EVERYTHING !
DRRRRiiiiNG
I'VE NEVER SEEN SUCH AN ABSOLUTE PIG'S BREAKFAST!
WHERE'S TIRESIAS? WHERE'S OUR SNAIL?
A
HE WAS HERE A WHILE AGO...

ARCHIE AND MEGABYTE GO FULL-SPEED-AHEAD IN SEARCH OF THE ERRANT MOLLUSC, TIRESIAS...

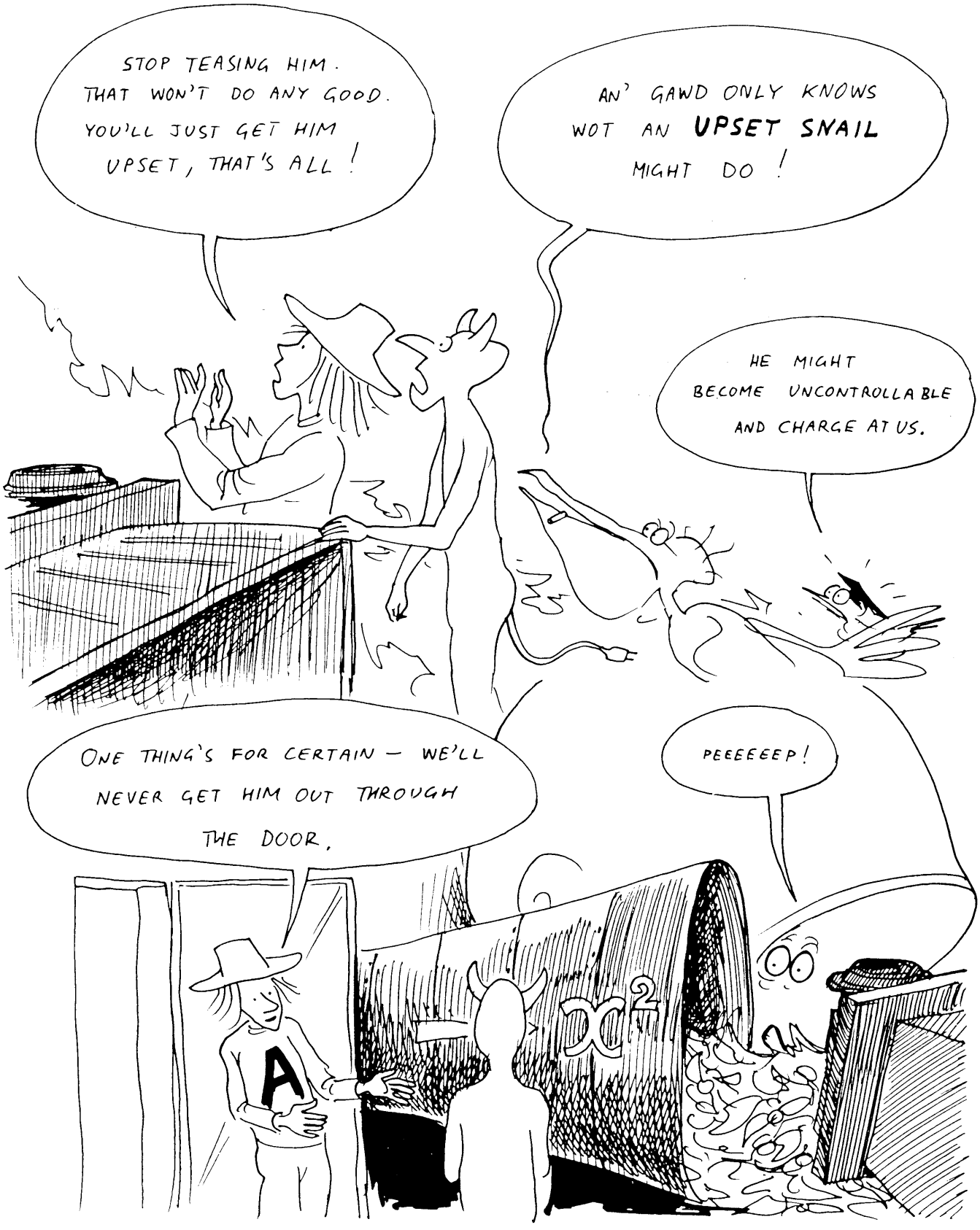
OR HE MIGHT HAVE GONE INTO TRIGONOMETRY, AND GOT HIMSELF TRIANGULATED! HOW WOULD WE GET HIM BACK THEN?
HMM, YES. I WONDER WHAT THE COSINE OF A SNAIL LOOKS LIKE?
H'IT'S ALL VERY WELL, JOKIN' ABAHT IT! 'OW WOULD YER LIKE IT TO 'APPEN TO YOU?
OH DEAR.
THAT ARCHIBALD HIGGINS HAS CRASHED THE LOT!
I'M PRETTY SURE THEY'RE AT THE BOTTOM OF THIS...

IT LOOKS LIKE ALL HELL HAS BROKEN LOOSE!

THERE'S A FLOOR PLAN OF THIS ESTABLISHMENT. TRY TO PIN THAT CONFOUNDED SNAIL DOWN!
A
THE PHONE'S RINGING!


INPUT
CODING
DATA MEMORY
PROGRAM MEMORY
ARITHMETIC AND LOGICAL PROCESSING UNIT
DECODING
OUTPUTS
PRINTER OUTPUT
VIDEO OUTPUT
SOUND OUTPUT
DRRRRiiiiNG

HELLO ? YES, SPEAKING
WHAT ?
TO SQUARING AND STEP ON IT !
SO THAT'S WHAT A SNAIL SQUARED LOOKS LIKE !
$x \rightarrow x^2$
AWAY, YOU MONSTER !

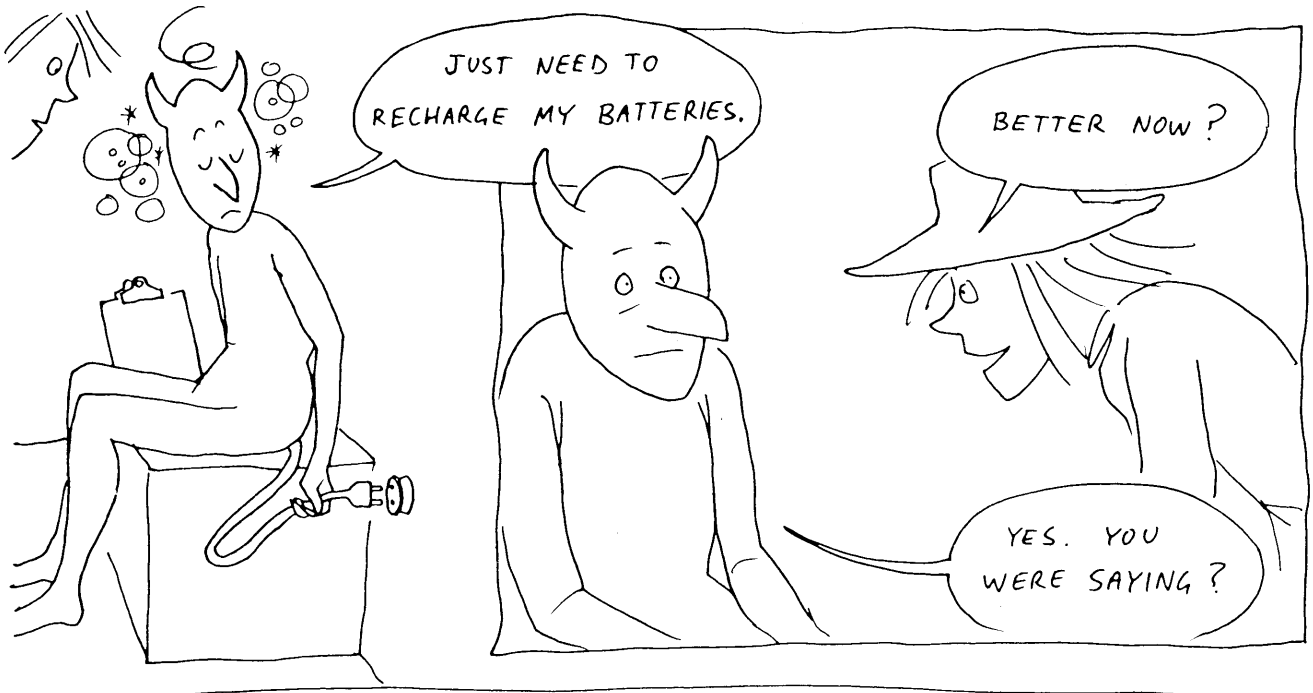

STOP TEASING HIM. THAT WON'T DO ANY GOOD. YOU'LL JUST GET HIM UPSET, THAT'S ALL!
AN' GAWD ONLY KNOWS WOT AN UPSET SNAIL MIGHT DO!
HE MIGHT BECOME UNCONTROLLABLE AND CHARGE AT US.
ONE THING'S FOR CERTAIN — WE'LL NEVER GET HIM OUT THROUGH THE DOOR.
PEEEEEEP!

I CAN ONLY SEE ONE WAY OUT. WE'LL HAVE TO TAKE HIS SQUARE ROOT.
WHAT'S THAT WHEN IT'S AT HOME ?
WE'LL HAVE TO SEND HIM BACK IN THE INVERSE DIRECTION.
KEEP YOUR SHELL ON, TIRESIAS. WE'LL SOON HAVE YOU OUT OF HERE.
HIYOH TIRESIAS AND AWAY !
PEEP !
FIENDISHLY CLEVER !
GO, BABY, GO !!

SQUARING
I WANT OUT!
HEY, IT WORKED!
VERY WELL. IN A CASE LIKE THIS, THE ONLY THING TO DO IS RESET ALL THE MEMORY LOCATIONS TO ZERO.
CLEAR MEMORY
CLOK!
I MIGHT HAVE KNOWN IT!
I WISH THEY'D MAKE UP THEIR MINDS.
ALL THESE HANDKERCHIEFS TO UNKNOT...
N
A

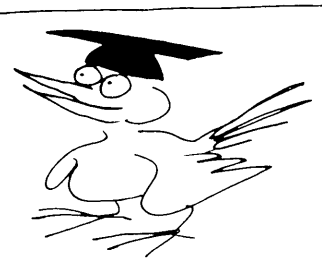
WHAT ARE YOU DOING NOW?
CLEAR MEMORY
WE HAVE RECEIVED ORDERS FROM ABOVE...
I WONDER WHAT SHE'S UP TO?
WHO?
WHY, SOPHIE!
SOPHIE? NEVER HEARD OF IT. MUST BE A NEW SUBROUTINE.

No, Sophie, she's...
Oh, bother! It's all much too complicated to explain!
A
A
Oh dear, I'm feeling tired all of a sudden!
What's the matter?
Your eyes are all red.
It's nothing - I just feel a bit flat
'ardly surprisin' - chargin' abaht like a lunatic all day long!



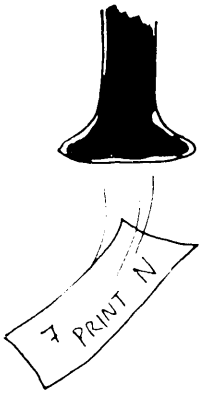
LET'S GET A FEW THINGS STRAIGHT. A COMPUTER, ABOVE ALL, IS AN **INPUT-OUTPUT SYSTEM**. THE ITEMS THAT IT DEALS WITH COME IN AT ONE END AND GO OUT AT THE OTHER. EVERYTHING IS CODED IN BINARY, BECAUSE YOU GUYS ONLY KNOW HOW TO COUNT UP TO **ONE**.

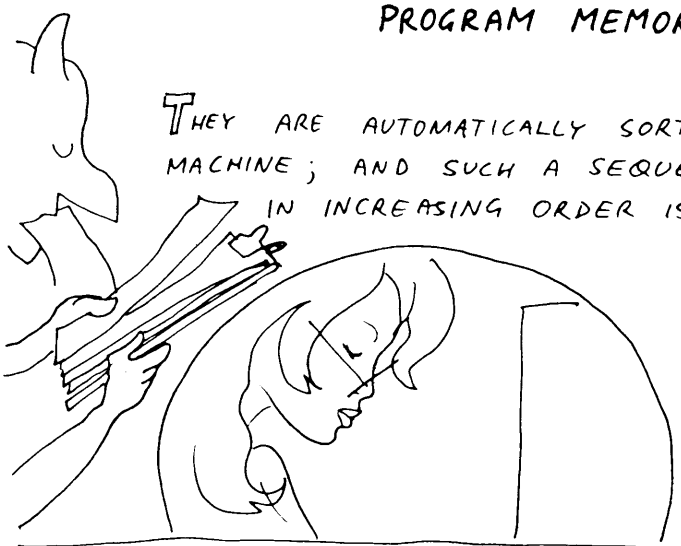
BY **INPUTS** WE MEAN SEQUENCES OF FIGURES AND LETTERS, TYPED OUT ON A KEYBOARD. IN **COMMAND MODE** THE **USER** TYPES INSTRUCTIONS AT THE KEYBOARD, IN HIS OWN TIME. THESE INSTRUCTIONS ARE THEN EXECUTED IMMEDIATELY (PAGES 15-30).



THE WORK IS PERFORMED BY HIGHLY SPECIALIZED **PROCESSING UNITS** WHICH OPERATE ON ITEMS THAT ARE CODED IN **BINARY** (HANDKERCHIEFS); AND THERE IS A NON-STOP FLOW (**BUS**) OF INTERMEDIATE RESULTS INTO MEMORY.

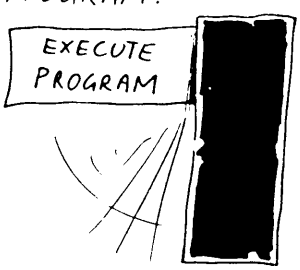
IF THE **INSTRUCTIONS** ARE PRECEDED BY A NUMBER, THE COMPUTER KNOWS AUTOMATICALLY THAT THESE ARE INTENDED FOR **DEFERRED EXECUTION**. THEY ARE THEN STORED IN THE **PROGRAM MEMORY**.





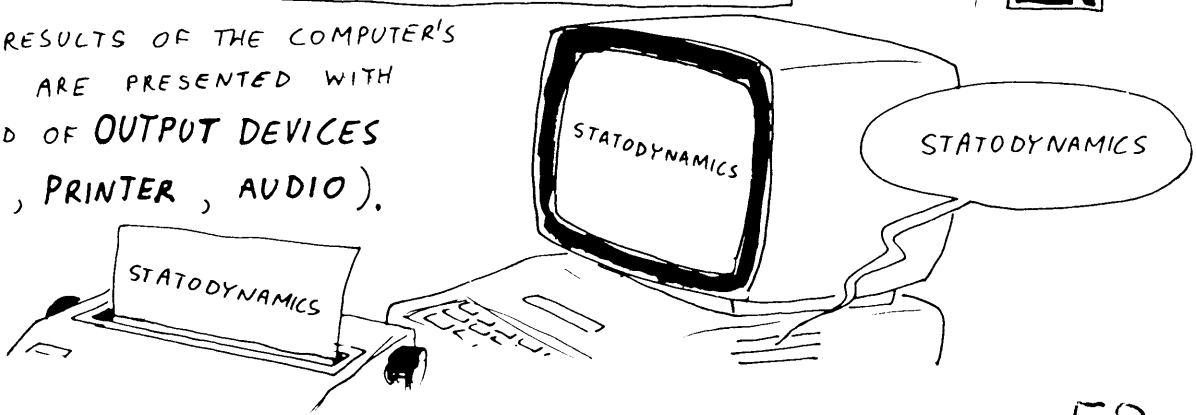
THEY ARE AUTOMATICALLY SORTED BY THE MACHINE; AND SUCH A SEQUENCE OF INSTRUCTIONS ARRANGED IN INCREASING ORDER IS CALLED A **PROGRAM**.

A SPECIAL COMMAND TYPED ON THE KEYBOARD TELLS THE MACHINE TO EXECUTE THIS PROGRAMMED TASK. THIS IS KNOWN AS **RUNNING** THE PROGRAM.

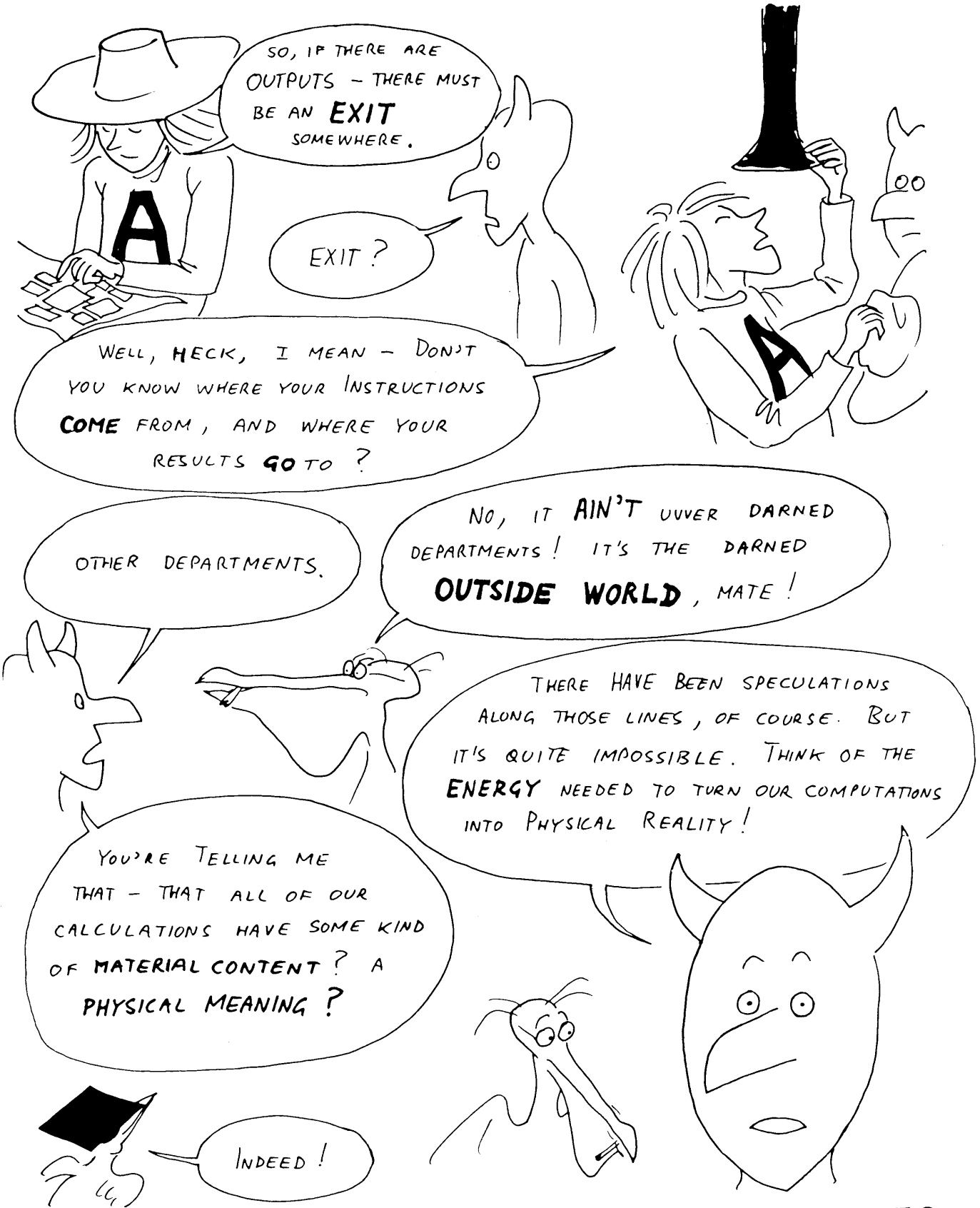


IN PRACTICE THE INSTRUCTIONS ARE NOT WRITTEN AS ON PAGE 37. THEY ARE EXPRESSED IN A **LANGUAGE** APPROPRIATE TO THE PARTICULAR MACHINE.

THE RESULTS OF THE COMPUTER'S LABORS ARE PRESENTED WITH THE AID OF **OUTPUT DEVICES** (VDU*, **PRINTER**, **AUDIO**).



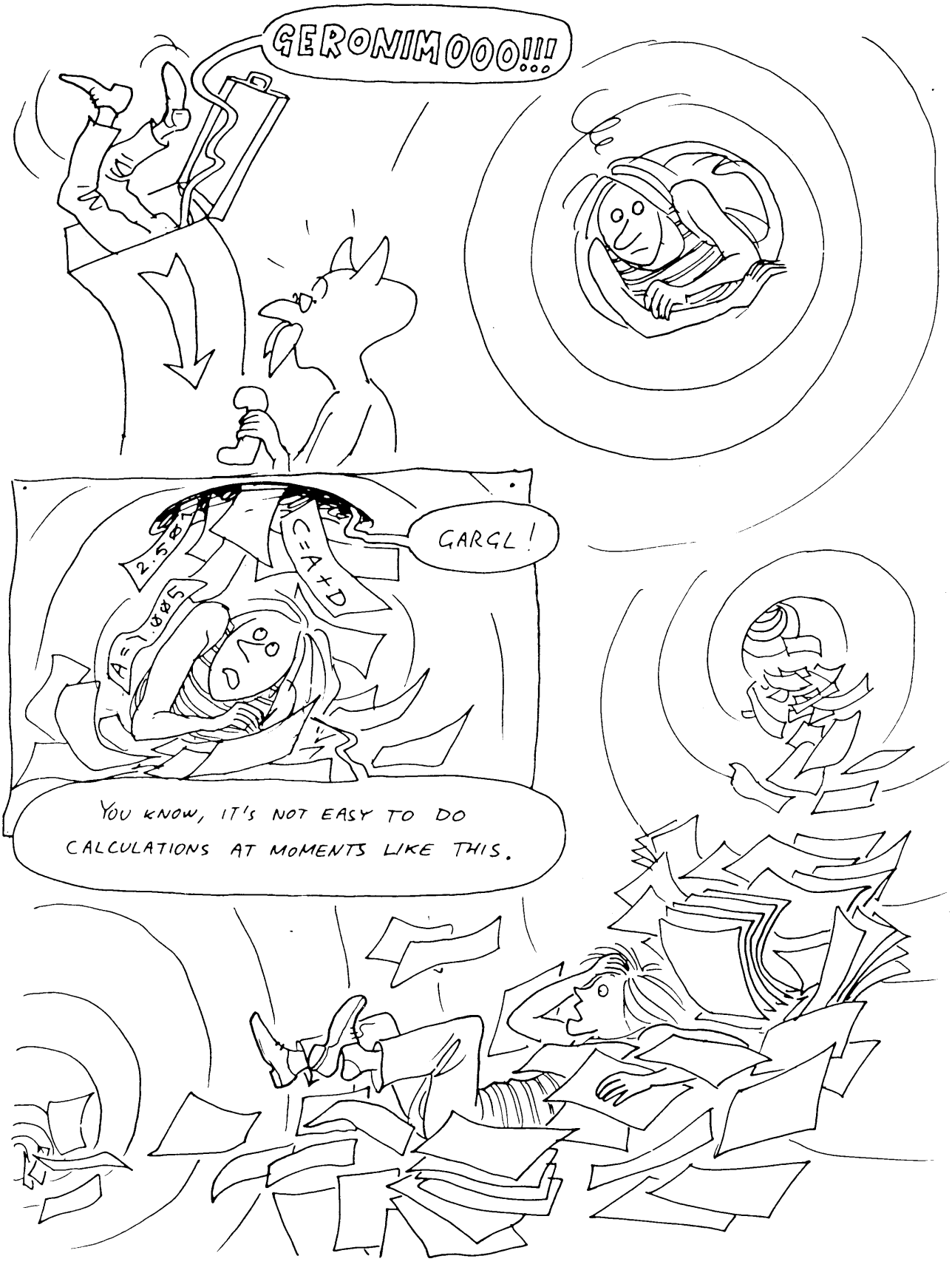
* VISUAL DISPLAY UNIT

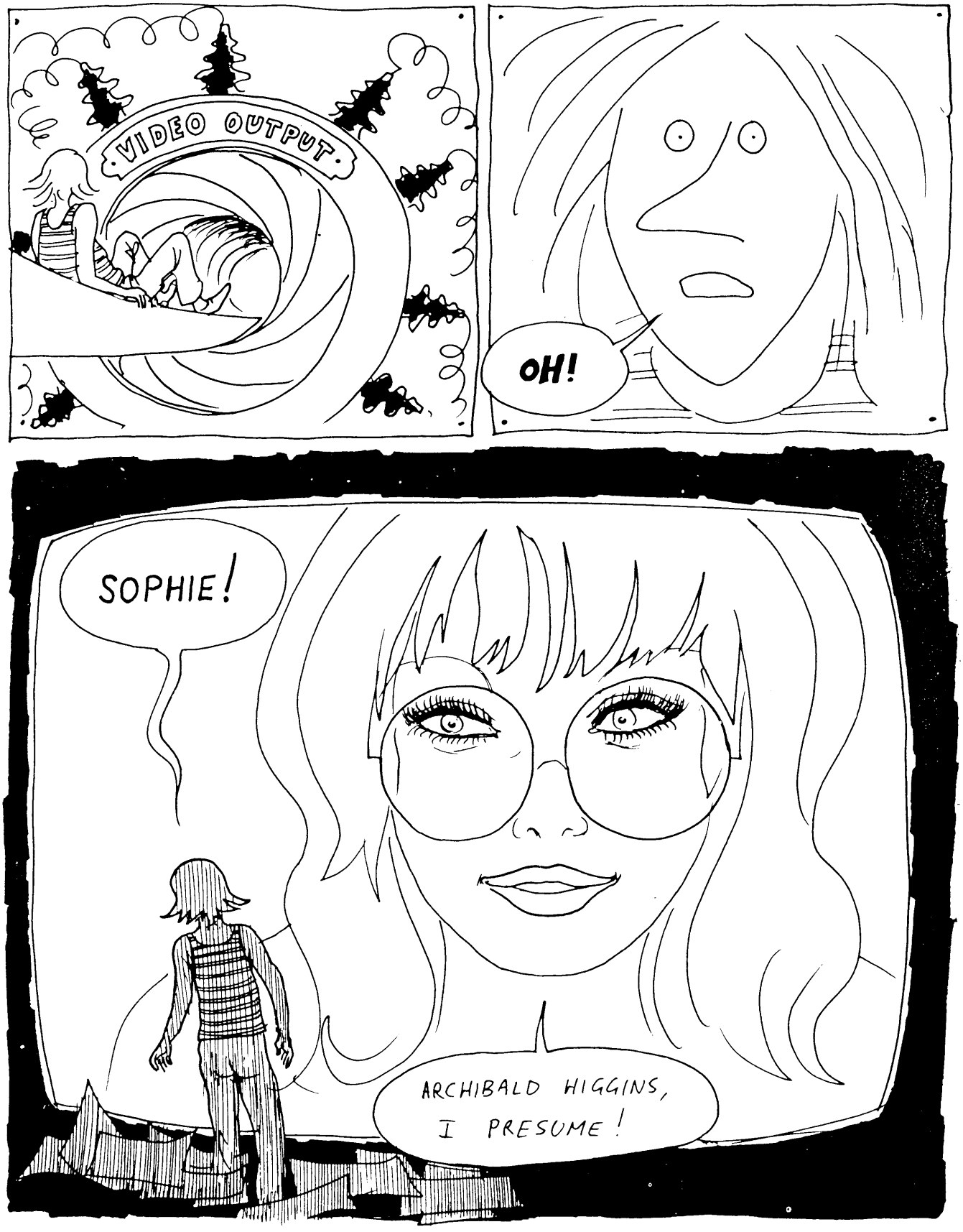

SO, IF THERE ARE OUTPUTS – THERE MUST BE AN EXIT SOMEWHERE.
A
EXIT?
WELL, HECK, I MEAN – DON'T YOU KNOW WHERE YOUR INSTRUCTIONS COME FROM, AND WHERE YOUR RESULTS GO TO?
A
OTHER DEPARTMENTS.
NO, IT AIN'T UUVER DARNED DEPARTMENTS! IT'S THE DARNED OUTSIDE WORLD, MATE!
THERE HAVE BEEN SPECULATIONS ALONG THOSE LINES, OF COURSE. BUT IT'S QUITE IMPOSSIBLE. THINK OF THE ENERGY NEEDED TO TURN OUR COMPUTATIONS INTO PHYSICAL REALITY!
YOU'RE TELLING ME THAT – THAT ALL OF OUR CALCULATIONS HAVE SOME KIND OF MATERIAL CONTENT? A PHYSICAL MEANING?
INDEED!

BUT YOU USE SUCH SILLY LITTLE CURRENTS HERE – OF THE ORDER OF A THOUSANDTH OF AN AMPERE!
LISTEN – ON THE OUTSIDE A STARTER MOTOR FOR A CAR CAN DEVELOP MORE THAN A HUNDRED AMPERES.
ARE YOU TRYING TO BE FUNNY?
A HUNDRED AMPERES? THAT'S DIABOLICAL!
I GET THE FEELING THIS ISN'T A PRACTICABLE WAY OUT.
A
WHERE DO YOU SEND THE RESULTS OF YOUR CALCULATIONS?
DOWN THERE.
HMMM...

TIRESIAS! THAT'S ENOUGH FOOLISHNESS FOR ONE DAY!
I WANT OUT!!
OUTPUT
DOWN THERE? HOLY SMOKE!
A
DECODING
WE'VE GOT AN INPUT!
QUICK!
SOPHIE'S TRYING TO FIND US.
ARCHIE?
HELLO? DO YOU HAVE A MEMORY LOCATION WHOSE NAME IS: A-R-C-H-I-E?
CHIE?
NO, YOU BIG DUMMY! ARCHIE IS ME!

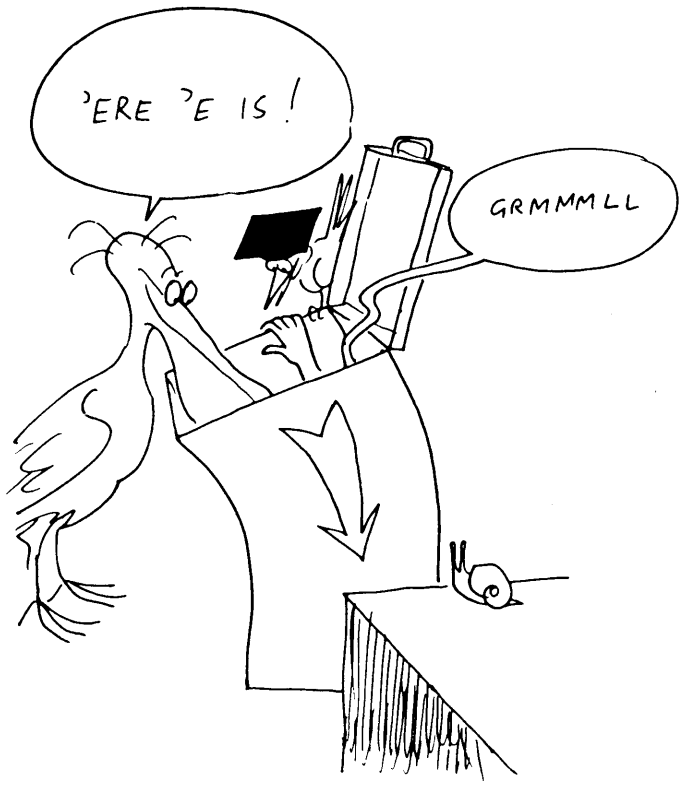
HELLO, CENTRAL MEMORY HERE. WE HAVE NOTHING OF THAT NAME.
LOOK, I'VE ALREADY TOLD YOU — ARCHIE IS ME !!!
YES... OF COURSE... BUT YOU UNDERSTAND... WE HAVE TO GO BY THE BOOK... SORRY...
I'LL HAVE TO FIND MY OWN WAY OUT OF THIS !!
WHEN YOU GOTTA GO, YOU GOTTA GO!
THERE'S NO NEED TO GET WORKED UP ABOUT IT! LOOK AT ME - I'M TAKING IT CALMLY ENOUGH !!
I'LL CALL YOU BACK. THERE'S SOMEONE IN THE OFFICE...


GERONIMOOO!!!
GARGL!
C=A+D
2.5Ø
A=.ØØ5
YOU KNOW, IT'S NOT EASY TO DO CALCULATIONS AT MOMENTS LIKE THIS.


VIDEO OUTPUT
OH!
SOPHIE!
ARCHIBALD HIGGINS, I PRESUME!

GET US OUT OF HERE!
GLAD TO SEE YOU LOOKING SO WELL. BUT I'M AFRAID WE DON'T HAVE THE TECHNOLOGY TO GET YOU OUT THROUGH THIS TV SCREEN.
WHAT HAVE YOU DONE WITH THE USER'S MANUAL?
THE MANUAL?
I'VE LOOKED EVERYWHERE FOR IT.

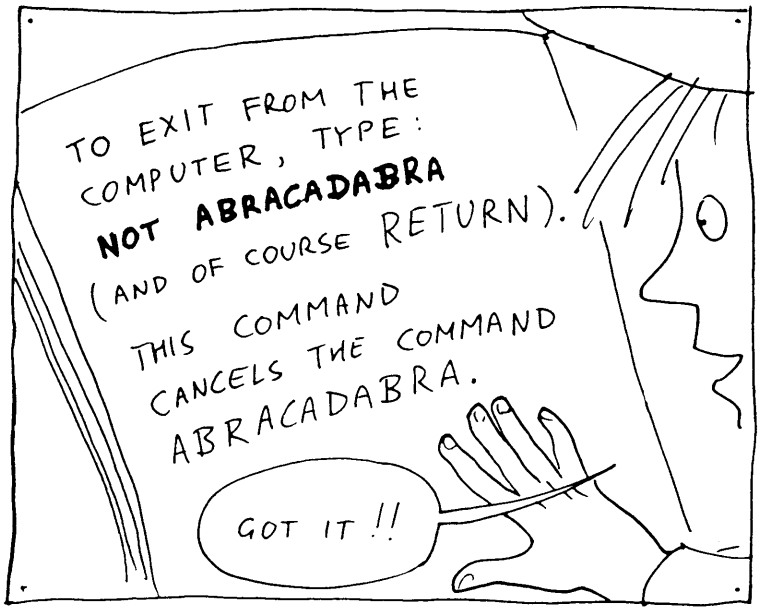
USERS MANUAL
IT MUST HAVE BEEN TRANSFERRED INTO THE COMPUTER ALONG WITH THE REST OF US WHEN I GAVE THE COMMAND ABRACADABRA.
I DON'T KNOW WHAT THE COMMAND IS TO GET YOU OUT OF THERE. IT SHOULD BE IN THE MANUAL. YOU'D BETTER GO AND FIND IT.
O.K!


'ERE 'E IS!
GRMMMLL

I'VE FOUND A WAY OUT.

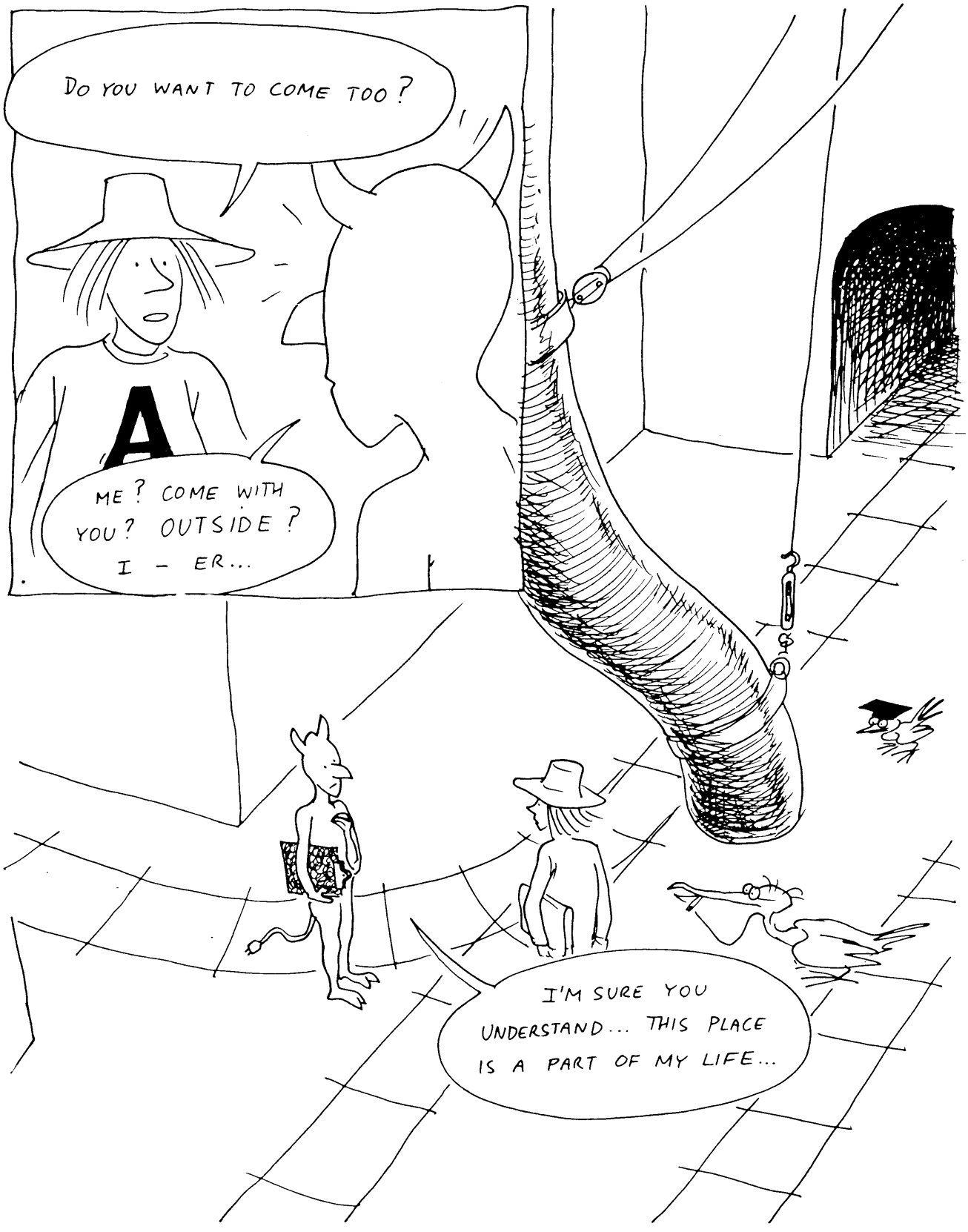
AH, THERE IT IS!
THE MISSING MANUAL!
USER'S MANUAL

LESSEE... LESSEE...
EDITING... DISC HANDLING... MENUS...
THOSE AREN'T IT...
USER'S MANUAL


TO EXIT FROM THE COMPUTER, TYPE: NOT ABRACADABRA (AND OF COURSE RETURN).
THIS COMMAND CANCELS THE COMMAND ABRACADABRA.
GOT IT !!

CAN I OUTPUT A MESSAGE ?
CERTAINLY. WE HAVE AN AUDIO-INTERFACE WHICH WILL DO THAT.

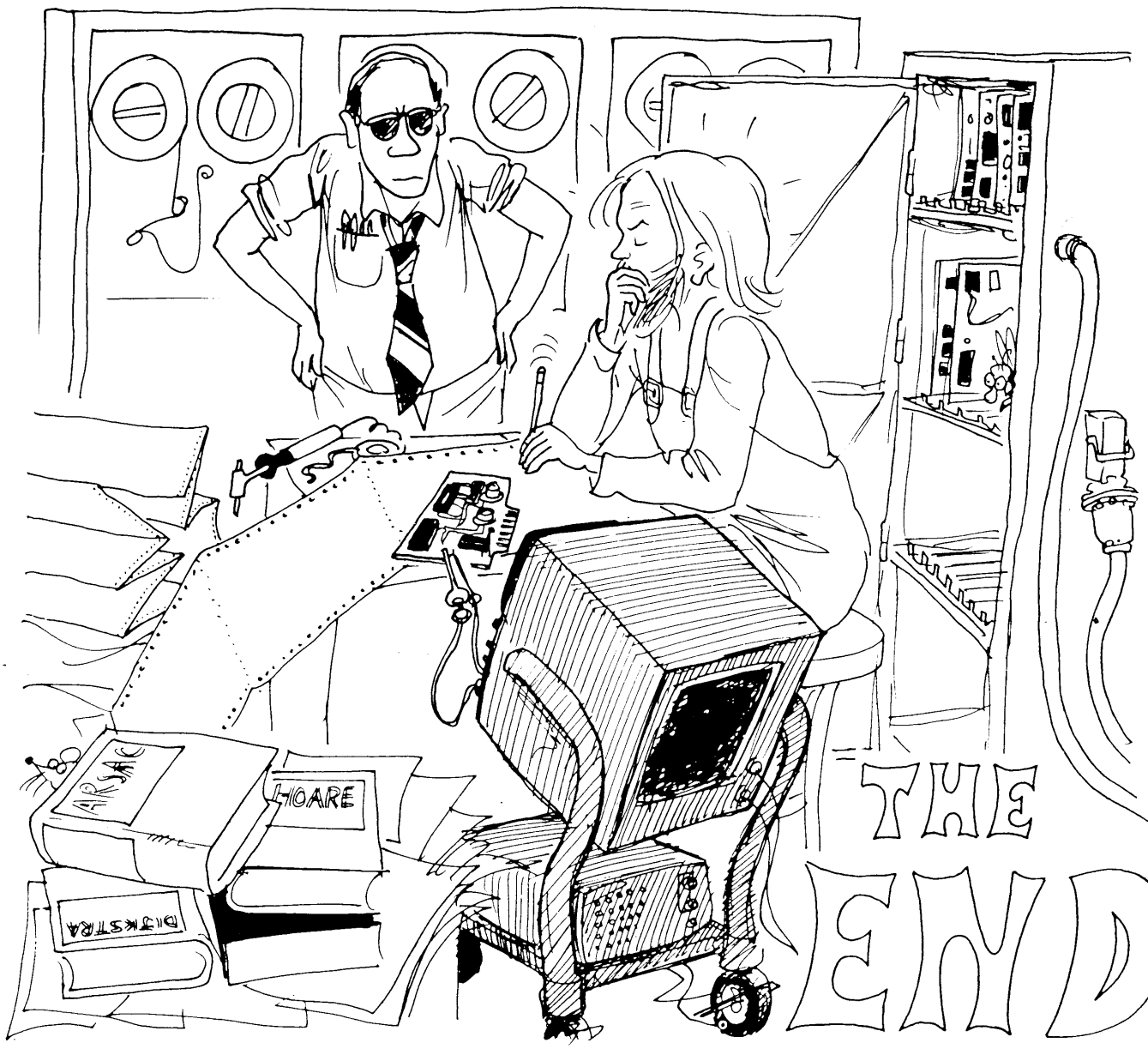
SOPHIE – YOU'VE GOT TO GIVE IT THE COMMAND NOT ABRACADABRA.
O.K!
AND, NATURALLY, RETURN.


DO YOU WANT TO COME TOO?
A
ME? COME WITH YOU? OUTSIDE? I - ER...
I'M SURE YOU UNDERSTAND... THIS PLACE IS A PART OF MY LIFE...

... AND ANYWAY, I HAVE A JOB TO DO. THESE CALCULATIONS...
CALCULATION OF CRITICAL MASS OF A NUCLEAR WARHEAD
characteristic time
dispersion time
ARMOUR PLATING
MISSILE TRAJECTORIES
FILE OF KNOWN SUBVERSIVE
AND NOW THAT YOU'VE MANAGED TO CONVINCE ME ALL OF THIS DOES HAVE A PHYSICAL MEANING, I ASK MYSELF WHETHER THIS OUTSIDE WORLD IS BETTER THAN OURS...
THAT'S TRUE.
HOW AWFUL!

CHiP!
BLASTED BUGS!!
OH, ARCHIE - I WAS SO WORRIED!
PEEP!

BUT FROM THAT DAY FORTH, THE CENTER'S COMPUTER HAS SUFFERED FROM INEXPLICABLE BREAKDOWNS, WHICH NO SPECIALIST HAS BEEN ABLE TO CURE. PERHAPS THIS IS DUE TO ARCHIBALD HIGGINS'S **SHOE**, WHICH REMAINS INSIDE THE MACHINE - IN CONTACT WITH **EVERY PART**...



THE END