From the MICRAL (1972) to the IBM PC (1981) : the first microcomputers as technological products and cultural projects

Loïc Petitgirard – Cnam-HT2S

02/09/2022

A few questions to address

History of a decade of innovation as an opportunity to question :

- Cultural context, cultural biaises, imagination, trainings… what importance ?

$\Rightarrow$ No « neutral » technological product / what it means regarding microcomputers ?

- How are microcomputers related to a growing « deterministic » industry (« performance oriented » computer industry) ?
- Why and how to innovate in the 1970s ? Successes and failures / Constraints and obsolescence in (micro)-computer technology in the 1970s

My talk

1. Overview of the 1970s decade
2. Inventing the Micral at R2E (1971-77)
3. Comparing histories : R2E (France) and the Silicon Valley (USA)

$\Rightarrow$ Answers and insights as it goes along this historical exploration

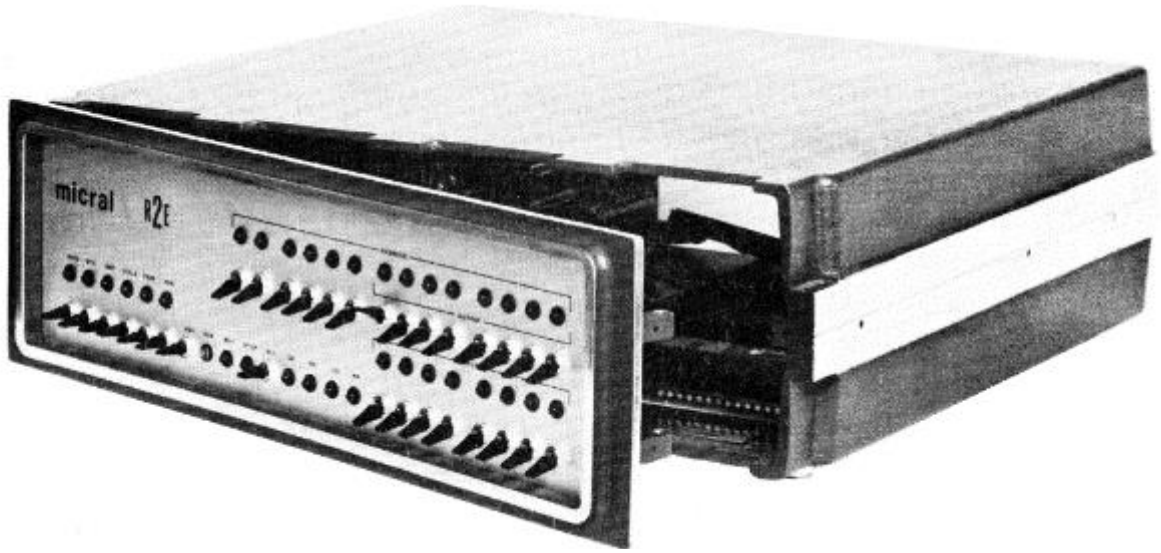
A decisive decade :

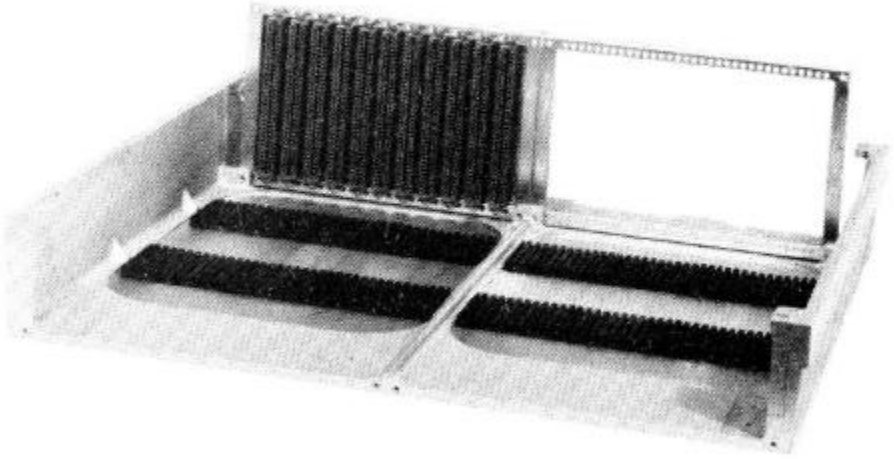
from R2E-Micral (1971) to IBM PC (1981)

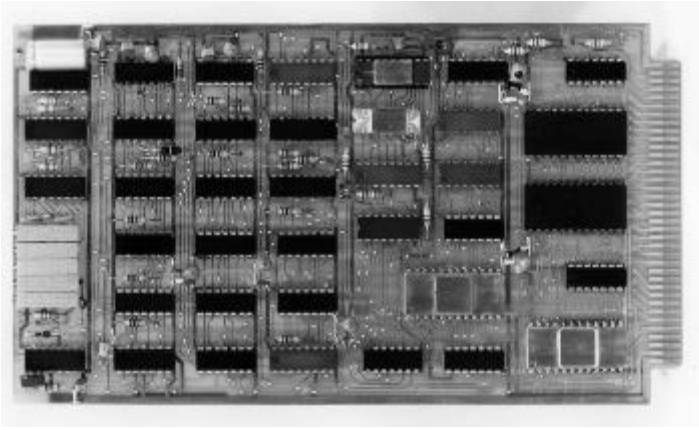
Micral - 1973


micral
AUTO
P/P
INST
CYCLE
PIEGE
SUB
AV
EXEC
PAUSE
ARRET
INIT
OP
LEC
E/S
SCR
ADRESSE
SORTIE

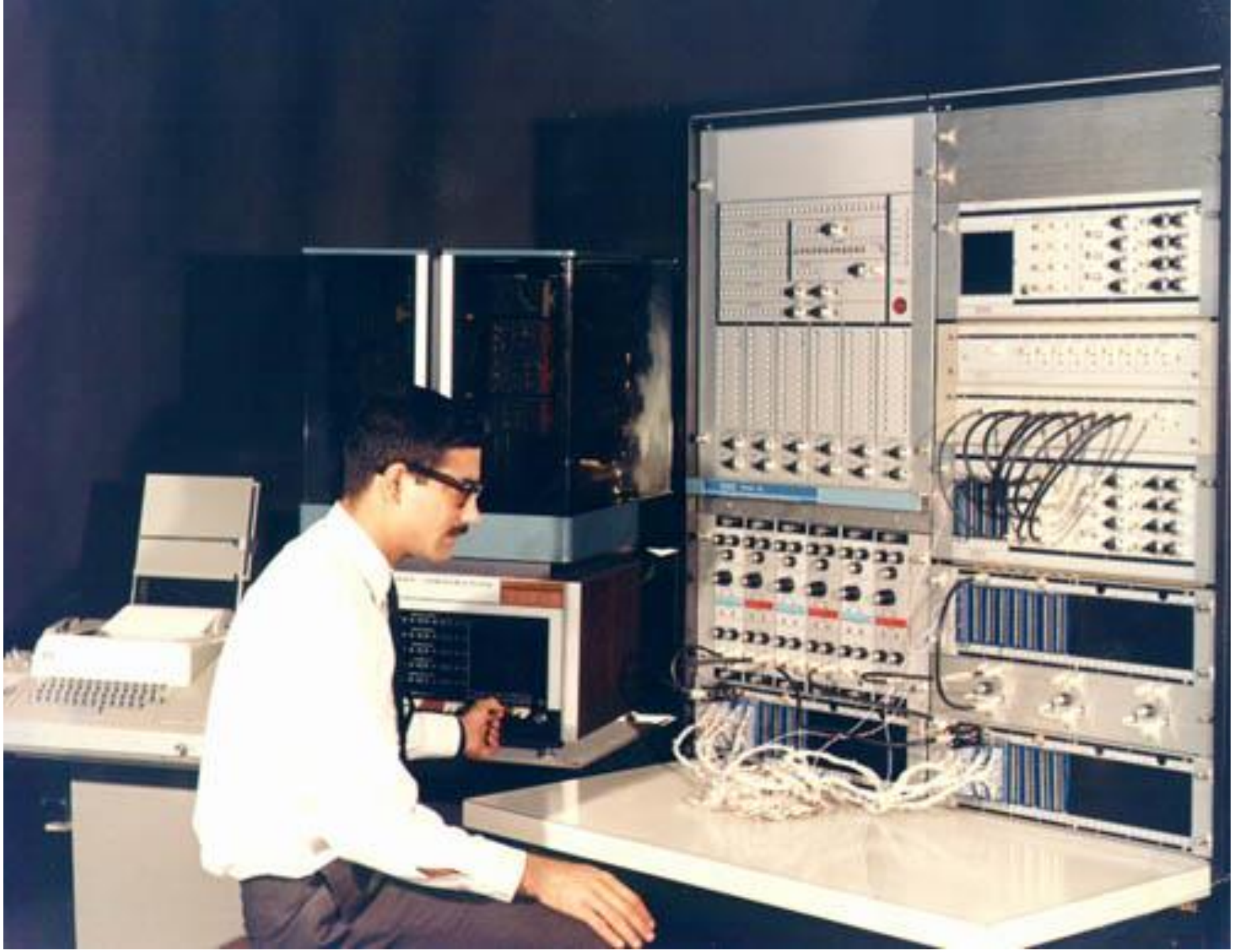
A microcomputer really ?







François GERNELLE (1944 -)

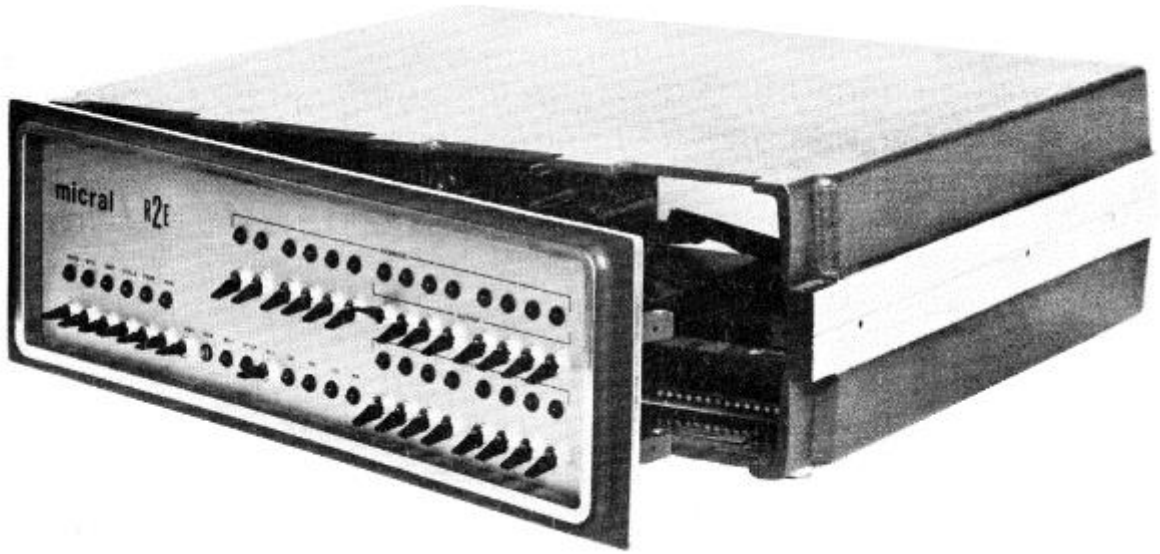


1969

1970-73 : DEC PDP-11
Mini-computers

1964

ENIAC 1945



- The **2 existing categories of that time** : « Mainframes » and « Mini-computers »
- No screen, no keyboard, no on-board memory : just a smaller electronic/computing device ?

The advent of microcomputer business

IBM

MICROSOFT

After 1977

intel

1981 – IBM Personal Computer

- **Computer business turns to « micro » lately**:

⇒ Not on their « roadmap » for the 1970s so to say (not seen as a business opportunity)

⇒ Very difficult for IBM to design and manufacture a « micro »

- **Many other trajectories** : Micral, Apple & co….

⇒ Technological products associated with different cultural perspectives : many products, many intentions…

⇒ They « demonstrated » (unwittingly ?) that it could be a business opportunity

A « classical » narrative : size and performance

1964 – IBM 360

1969 – PDP 9

1970 – PDP 11

1981 – IBM PC

A « classical » narrative : size and performance

1964 – IBM 360

1969 – PDP 9

1970 – PDP 11

What really happened ?

Designing microcomputers from scratch

- **Machines** : Micral, Apple, Alvan… before IBM PC

⇒ From « mini-computers make the job » (1970) … « microcomputers are everywhere » (1980s)

- **Software** : from OS to applicatons

⇒ For the business … the family, video games, etc.

⇒ A lot to invent !!

- **Many different « microcomputers »**
- A matter of **local / global cultures**

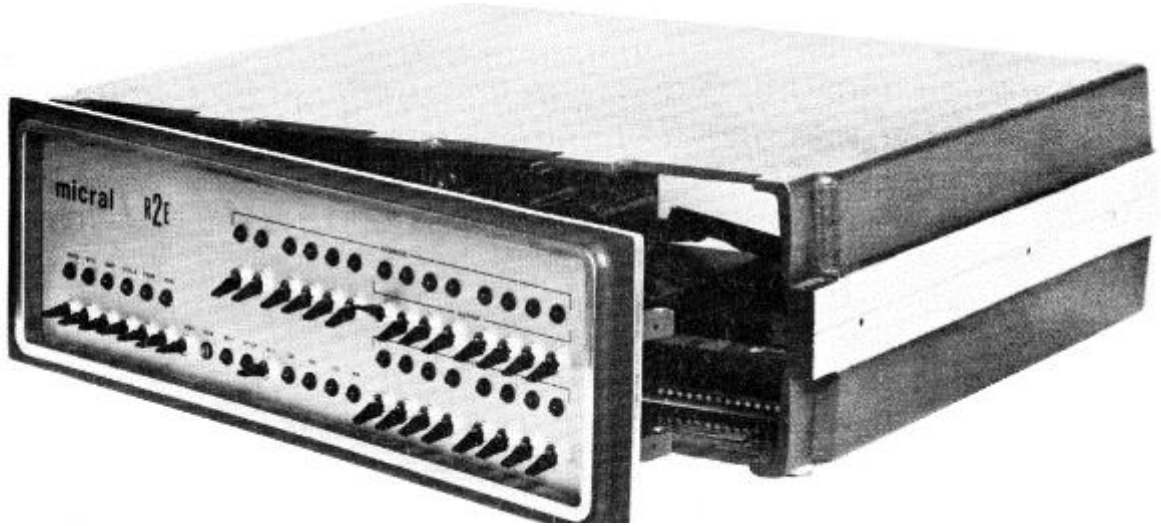
⇒ Expressions of specific cultural contexts of the 1970s

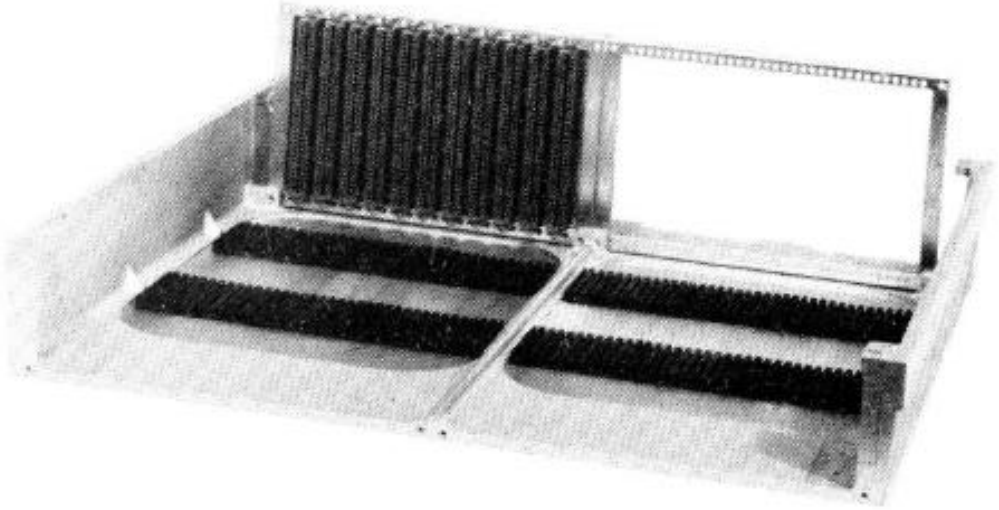
⇒ in a global technological, industrial and cultural turn (post-1968)

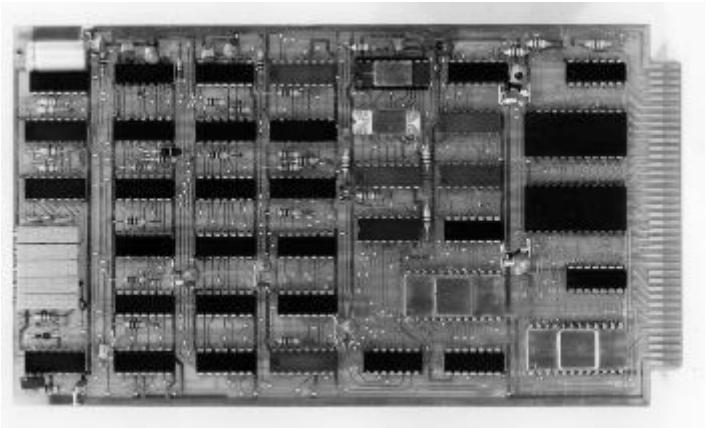
- **R2E-Micral is a milestone**

1972 – inventing the Micral

A scientific instrument and automaton







Inventing the Micral

- **Invented as an instrument** for INRA : automating agronomic measures in the field

$\Rightarrow$ a **« low cost » instrument** (compared to PDP-8 solutions)

$\Rightarrow$ modular, industrialised

$\Rightarrow$ ready to be implemanted « wherever » you need automatisation

- At R2E : « Réalisations Etudes Electroniques »

- Young start-up (created 1970) – as a « spin off » Intertechnique

- « Special systems » team => want to manufacture custom made miniature devices

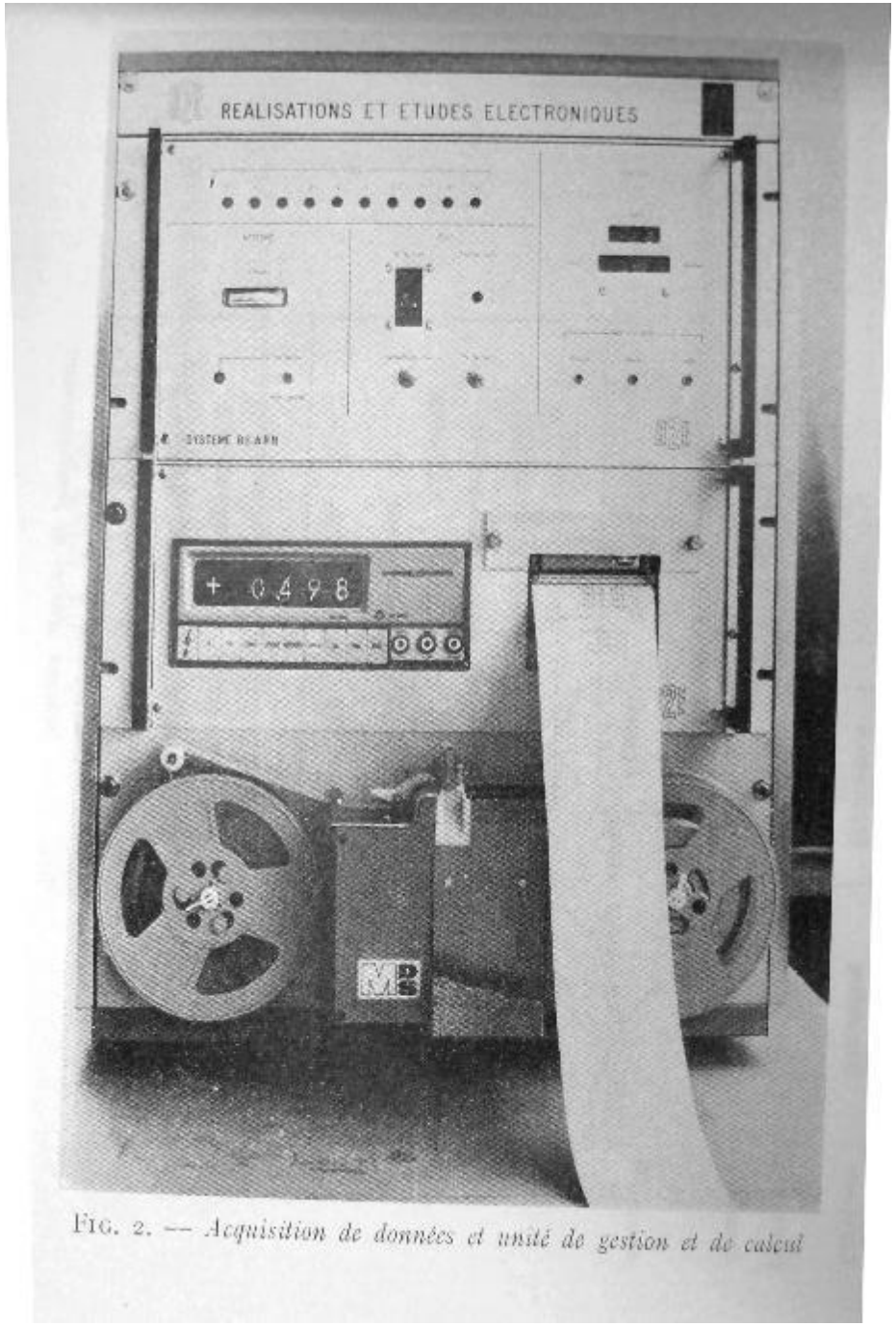


FIG. 2. — *Acquisition de données et unité de gestion et de calcul*

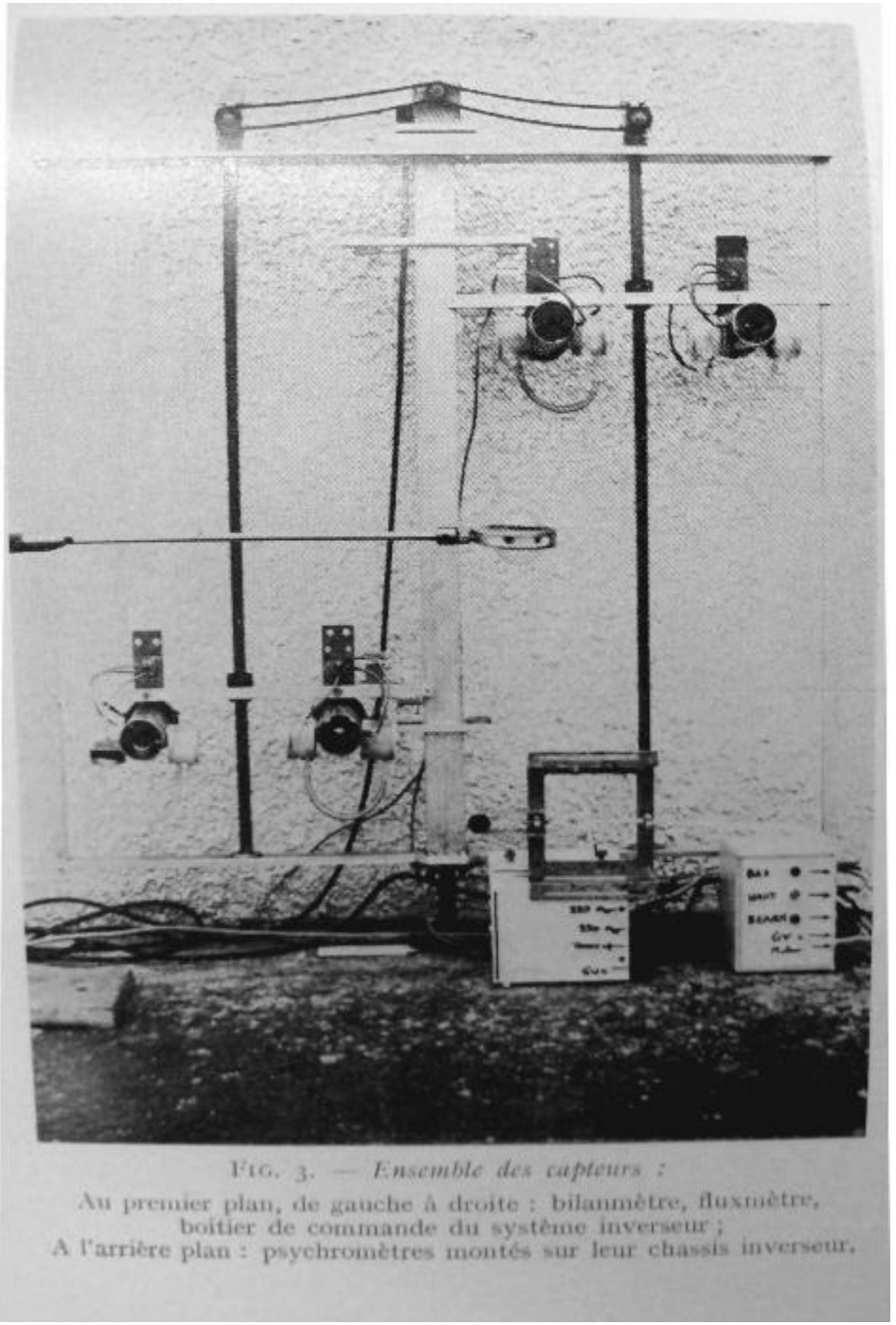
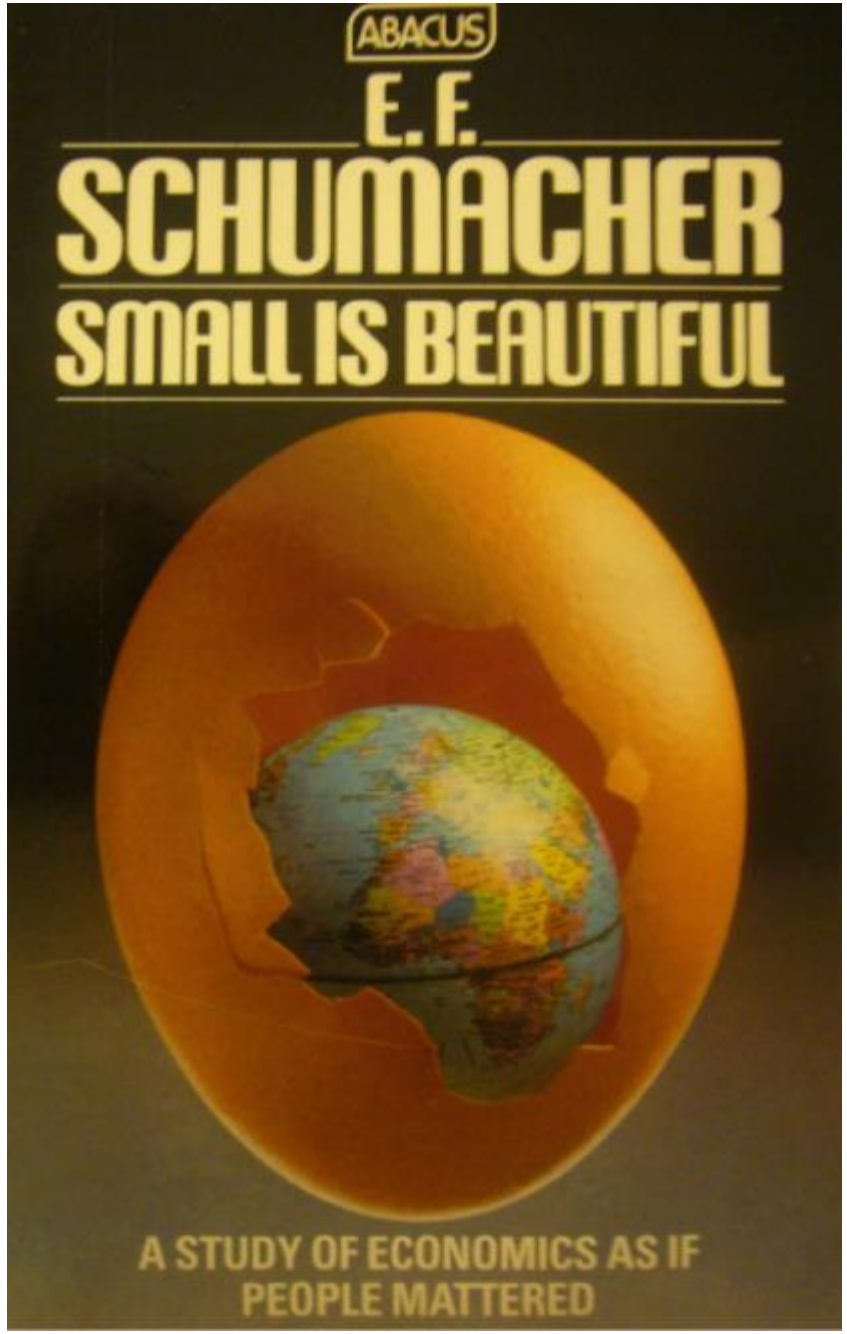


FIG. 3. — *Ensemble des capteurs :*
Au premier plan, de gauche à droite : bilanmètre, fluxmètre, boîtier de commande du système inverseur ;
A l'arrière plan : psychromètres montés sur leur chassis inverseur.

R2E at the crossroad

- R2E : a technological project
  - Automate instruments with electronics
  - Miniaturize systems : following Moore’s law
- R2E : a bold « start-up »
- R2E : gathering skills
  - François Gernelle : leader of the « special systems team » - at the edge of the design of digital electronics devices
  - Hiring « the best » among their network
- R2E in context and post-1968 culture : « Small is beautiful »



Inventing the Micral

- Microprocessor : 1970-71 first Intel 4004 chip on the market (from USA)
- « Know-how » : Gernelle, an expert in electronics, « understands » the spec of the chip

$\Rightarrow$ make it the base for his technological / industrial project

$\Rightarrow$ « Il n'y avait pas d'école qui expliquait comment marchait l'intérieur d'un processeur … C'est sur le tas qu'on l'apprenait »

- A « dream » : the chip that can do « everything » ?

(19) RÉPUBLIQUE FRANÇAISE

INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE

PARIS

(11) N° de publication : **2.216.883**
(A n'utiliser que pour le classement et les commandes de reproduction).

(21) N° d'enregistrement national : **73.03553**
(A utiliser pour les paiements d'annuités, les demandes de copies officielles et toutes autres correspondances avec l'I.N.P.I.)

BREVET D'INVENTION

PREMIÈRE ET UNIQUE PUBLICATION

(22) Date de dépôt ..... 1er février 1973, à 15 h 43 mn.
Date de la décision de délivrance..... 19 août 1974.
(47) Publication de la délivrance ..... B.O.P.I. — «Listes» n. 35 du 30-8-1974.

(51) Classification internationale (Int. Cl.) G 06 f 9/18.

(71) Déposant : Société à responsabilité limitée dite : RÉALISATIONS ET ÉTUDES ÉLECTRONIQUES R.2E., résidant en France.

(73) Titulaire : *Idem* (71)

(74) Mandataire : Office Blétry.

(54) **Ordinateur, en particulier pour des applications en temps réel.**

(72) Invention de : François Gernelle.

(33) (32) (31) Priorité conventionnelle :

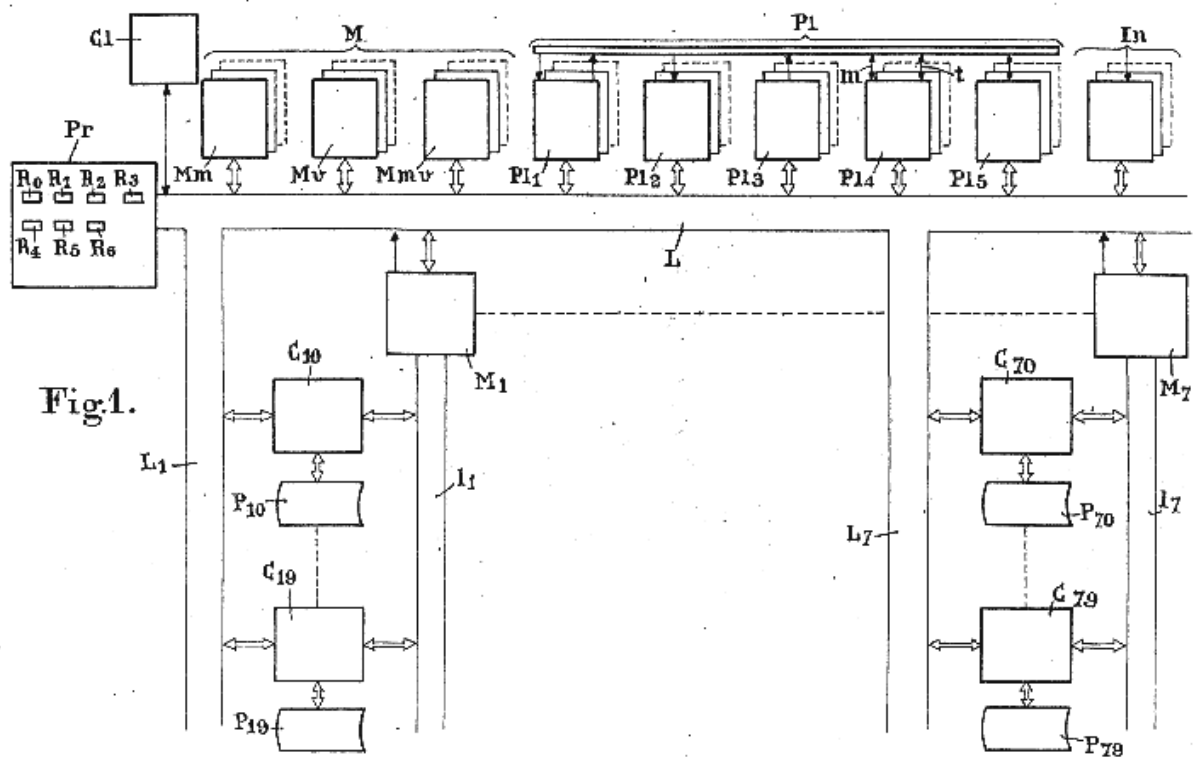
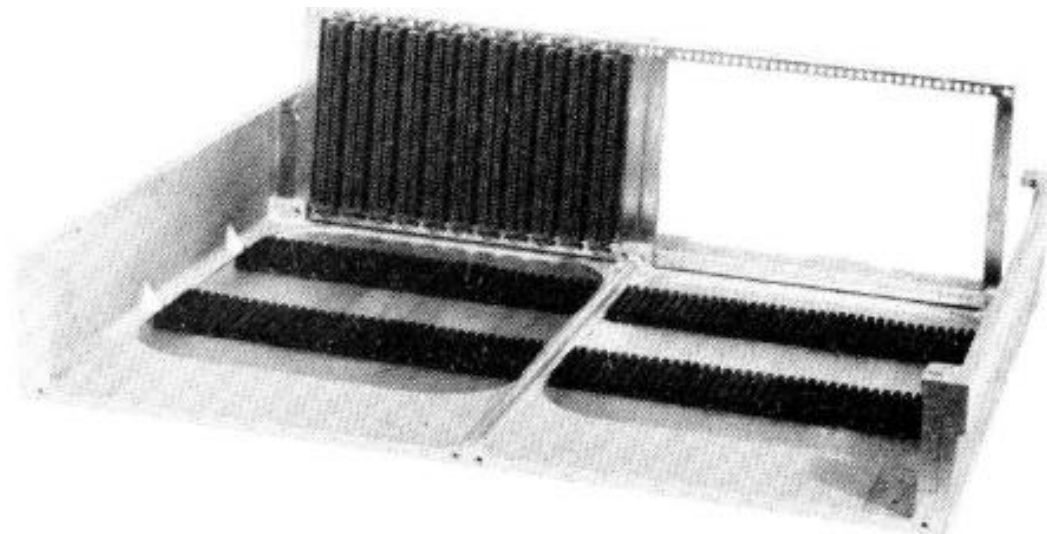


Fig.1.



2216883

Micral : compromising

- **Modularity / genericity**
- **(very) low computational performance**

$\Rightarrow$ **balanced by communication performance**

- Packaging / portability / no need for « air conditionning » (cost saving)
- **Low cost (manufacturing and operating)**

Sobriety (simplicity, austerity) / longevity (sustainability ?) / reliability

Inventing more microcomputers

- Micral-N = first « transgression » from electronics to computer business
- At R2E : every new microprocessor => new microcomputer

Micral-G (Intel 8008) / Micral-S (Intel 8080) / Micral-CZ (Zilog Z80) / Micral-M (operating as a server)

$\Rightarrow$ same basic orientation as Micral-N

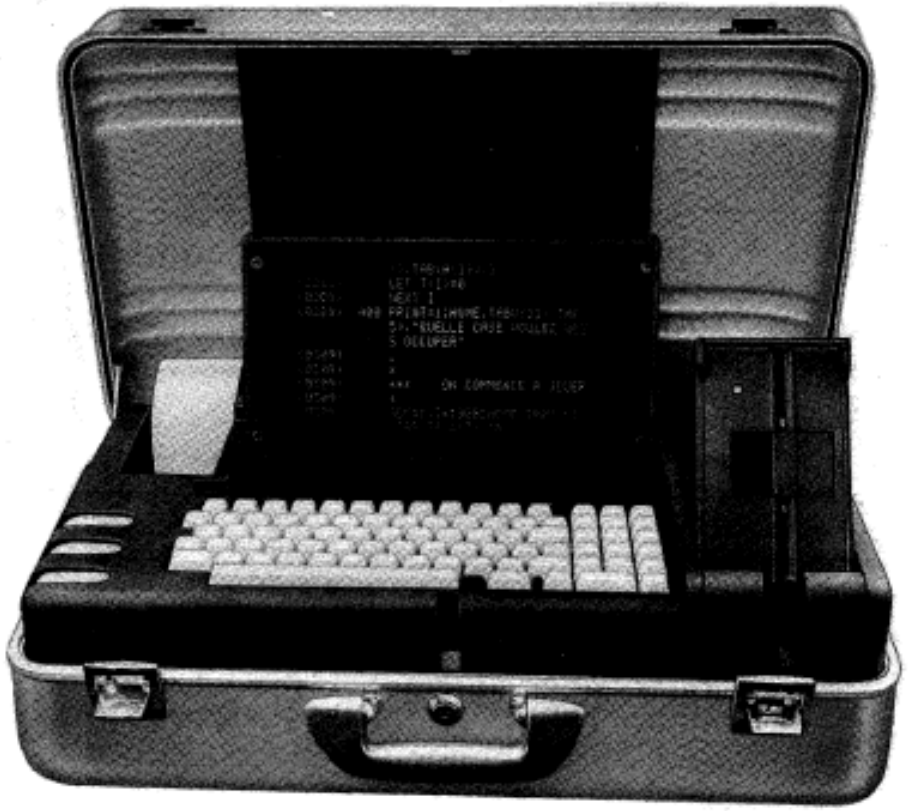
$\Rightarrow$ exceptional creativity !

- **User centered design : specialized (banks, management), multitasking, networking, portability…**

1973 - Micral-N

1974 - Micral-S

1977 -Micral-C



1978- Micral-V : portable computer

1981 - Micral-P2 : Army, Police (*REE/Bull)*

1973

Avec un ordinateur temps réel pour contrôle de processus á 8450 F : LE MICRAL

R2E coupe les prix en 4 !

Pour 8450,00 F

vous avez un ensemble opérationnel, et ce cerveau revolutionnaire est d'une qualité et d'une fiabilité exceptionnelles

Ses domaines d'applications :

la télétransmission, l'instrumentation scientifique, l'enseignement et, d'une façon générale, tous problèmes temps réel.

Pour ce prix, nous vous fournissons :

- ☐ Le processeur (avec 52 instructions)
- ☐ L'horloge temps réel
- ☐ 8 niveaux d'interruption
- ☐ Démarrage automatique
- ☐ Un canal 256 octets (1+1)
- ☐ Coupleur 32 entrées - 32 sorties numériques
- ☐ Mémoire, etc...

L'ensemble de ce calculateur est géré par un seul "PLURIBUS"

Le système Entrée - Sortie est très performant (56 méga-bits/seconde)

Possibilité d'avoir 14336 entrées (bits) et 184 sorties

- ☐ Mémoire VIVE et PROM
- ☐ Technologie la plus moderne telle que LSI, MSI, LOW POWER
- ☐ Coupleurs pour tous périphériques usuels.

R2E

REALISATIONS ET ETUDES ELECTRONIQUES
Siège Social : 18, Avenue du Bois - 92290 CHATENAY-MALABRY Tél. 660.70.00 +
A partir de Juin 75, nouvelle adresse : Zone Industrielle - Courtaboeuf - 91400 ORSAY

1974

pourquoi prendre un marteau pour écraser une mouche!

Quand il existe d'autres solutions !...

Dans beaucoup d'applications informatiques, même un mini-ordinateur fait figure de géant. C'est pourquoi, nous avons construit MICRAL, LE micro-ordinateur à la taille de vos problèmes.

Aussi complet qu'un mini, MICRAL comporte : plusieurs sortes de mémoires à semi-conducteurs (RAM, ROM ou REPROM), pouvant atteindre 64 k octets de capacité ; 56 niveaux d'interruption hardware (8 en standard) ; le PLURIBUS, sur lequel sont connectés le processeur (57 instructions), les mémoires, les périphériques lents et jusqu'à 7 canaux rapides à mémoire tampon (un canal rapide dans la version standard), chacun pouvant recevoir un maximum de 10 périphériques rapides (débit total : 56 mégabits/s).

Aussi efficace qu'un mini, MICRAL dispose de tous les outils software nécessaires à sa mise en œuvre : Assembleur Local ; moniteur d'exploitation Teletype/cassette et floppy-disques ; Cross-Assembleur écrit en Fortran ; bibliothèque flottante ; utilitaires.

Seulement, MICRAL est beaucoup moins cher que n'importe quel mini : 8 500 F (ht)* à l'unité, pour la version de base. Les conditions OEM normales sont, bien entendu, en vigueur chez nous. Nous avons à ce jour enregistré plus de 700 commandes, tant en France qu'à l'étranger.

Un dernier point, MICRAL est français.

* prix au 1/1/74

r2e

Réalisations Etudes Electroniques
Zone d'Activités de Courtaboeuf,
Av. de Scandinavie - 91400 Orsay
Tel : 907.47.77 - Telex r2e 24 014 f.

1977

MICRAL C

Système de gestion compact économique et puissant

A l'heure de l'informatique distribuée et des micro-ordinateurs, R2E va plus loin en présentant le MICRAL C qui, pour un coût nettement plus bas, offre toutes les possibilités et les performances d'un système beaucoup plus important. Le coût du MICRAL C est comparable à celui d'une petite photocopieuse. Son propriétaire pourra en attendre de nombreux services dans les domaines de la gestion, comptabilité, administration et éducation. En outre, il pourra l'utiliser pour tous travaux sur des fichiers de petite et moyenne importance tels que gestion des abonnés et du service lecteur pour une revue, mailings, édition de textes, secrétariat automatique, etc. Il est difficile, au stade actuel, d'établir une liste exhaustive des applications envisageables sur le MICRAL C.

MICRAL C se compose d'une unité centrale puissante dotée d'une importante mémoire interne, d'un poste à écran et clavier dans lequel est intégrée la double unité à minidisquettes. Plusieurs types d'imprimantes peuvent être connectées à cet ensemble très compact.

MICRAL C dispose immédiatement d'un logiciel de base évolué et performant, dont le langage BAL (BASIC orienté gestion) et le système de gestion de fichiers.

R2E – from success … to buyout

- Micral is successful (in France only) for 10 years

~1000 machines sold

⇒ mainly business users (banks, management)

⇒ **a dream / a global (industrial / economical) transformation project in mind**

- Too expensive for a start-up => **BULL buys R2E (1978-81)**

⇒ weaken considerably the R2E team

⇒ a new choice : follow the IBM PC

⇒ a « dramatic turn » for Gernelle & co

Compared histories and contexts

R2E – France

vs.

IBM, Apple - Silicon Valley / USA

IBM Personal Computer - 1981

A « classical » narrative : size and performance

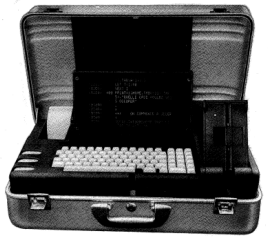
1964 – IBM 360

1969 – PDP 9

1970 – PDP 11

What really happened ?

Deflections in the history



1972 – R2E MICRAL

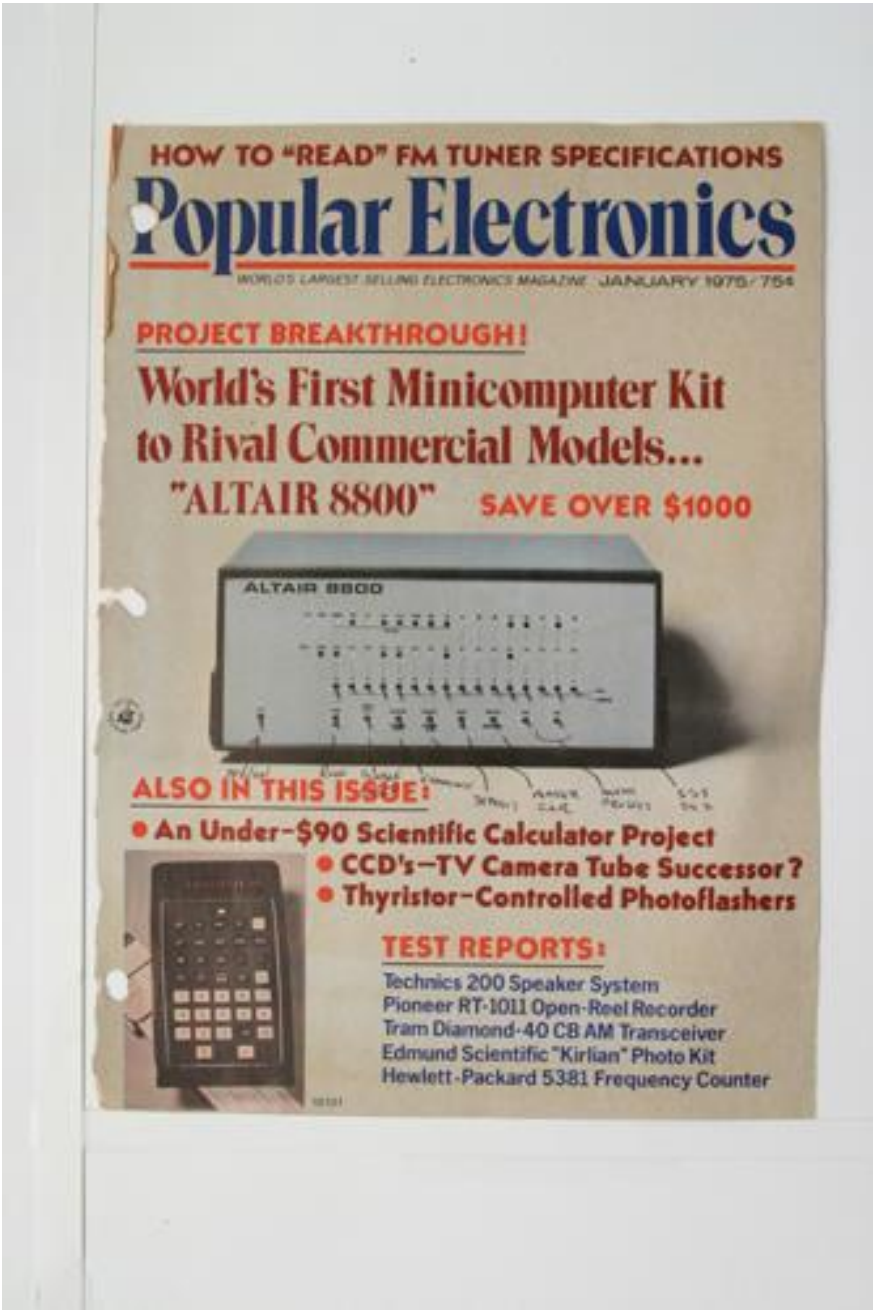
1982 – BULL Micral

1970 – PDP 11

1974 – ALTAIR 8800

Another narrative

A year after the Micral - 1974



Altair 8800 - 1974

- Very similar to Micral :
- MITS = a scientific instrument manufacturer
- Very low brow machine : no interface, no software…
- But :
- A growing community : « Popular electronics »
- A **success « outside the industry and business »** : among hobbyists

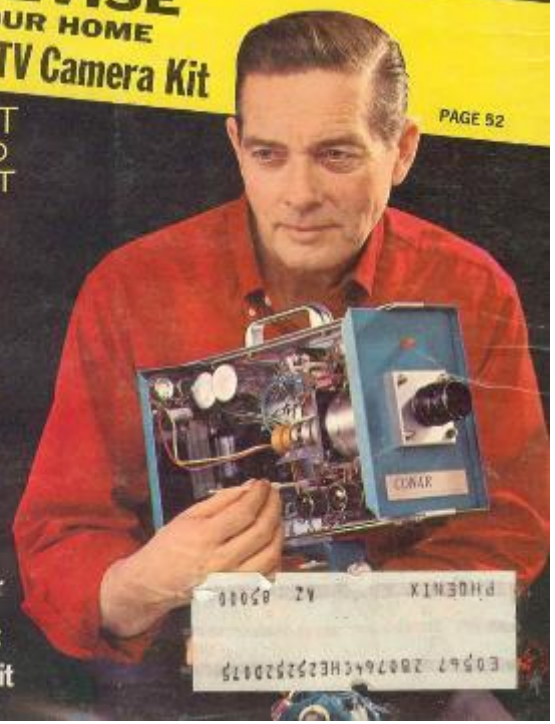
BUILD ANTI-GRAVITY DEMONSTRATOR

POPULAR ELECTRONICS

MAY 1966 50 CENTS

TELEVISE IN YOUR HOME With this TV Camera Kit

PAGE 52



FIND OUT WHAT'S SO DIFFERENT
ABOUT
- CB Antennas

ABOUT
- TV Antennas

ABOUT
- SWL Antennas

BUILD:
- Van de Graaff Machines
- Science Fair Crowd Stopper

REPORT:
- 25" Color TV Kit

JANUARY 1972/FIFTY CENTS

Popular Electronics

INCLUDING Electronics World

JUST HOW GOOD ARE **LABYRINTH SPEAKER SYSTEMS FOR HI-FI?** HERE ARE PROS AND CONS

TEST REPORTS ON:
- 4 Channel Tape Players: Lafayette RK-48 Toyo CH-702
- Pioneer PL-12A Turntable
- SBE Catalina CB Transceiver
- Sencore CG-159 Color Generator
- Bilectro Soldering Pistol
- Eico 239 FET/TVM

BUILD **THE NEGLECTED-BAND TRANSMITTER** (You don't need a license)

ELECTRONICS FOR YOUR **CAR** GM tells what's in their new line.

PC BOARD KITS A roundup of what's available & how you can use them.

CABLE TV It's been on a long, winding road; where it is and where it's going.

Popular Electronics

WORLD'S LARGEST SELLING ELECTRONICS MAGAZINE FEBRUARY 1975 75¢

HOW PHASE-LOCKED LOOPS WORK

A VU Meter with No Moving Parts
Shortwave Newscasts in English
Build a Minicomputer, Part II
"Tug of War" Electronics Game

TEST REPORTS:
Marantz 4270 Receiver
Garrard Zero 100SB Turntable
Ortofon VMS-20E Phono Cartridge
Lafayette Com-Phone 23 CB Transceiver
Data Technology Models 20 & 21 DMMs

Build the first Low-cost ALL-SOLID-STATE TV Camera!

- Uses MOS Sensor
- All Digital

Clubs and hobbyists

NEWSLETTER

Homebrew Computer Club

Robert Reiling, Editor — Post Office Box 636, Mountain View, CA 94042 — Joel Miller, Staff Writer

Typesetting, graphics and editorial services donated by LAIBEL PUBLICATIONS, 17215 Laurel Rd., Los Gatos, CA 95030 (408) 353-3609

random data

by robert reiling

Personal and home computing continue to interest more and more people. The hobbyist clubs are expanding, more computer stores are opening, new products are being announced, magazines devoted to personal computers are increasing in number, and predictions are being made about where we are going. A few months ago, staff reporter of The Wall Street Journal, makes this observation: "The home-computer industry is so new and so fragmented that it hasn't got around to comparing its own program, so nobody knows how many individuals have bought computers. But estimates range from 20,000 to 100,000." There is much more in this article including some quotations from Jim Warren, a member of the Homebrew Computer Club and editor of Dr. Dobbs Journal. Look this article up if you

Computing Microtrek, the computer magazine for the hobbyist, was first published in August of 1976. Its second edition was recently published in December of 1976. Subscribers to Microtrek Magazine will begin receiving Personal Computing Magazine with the upcoming March-April edition.

Apple Computer Inc., 770 Welch Road, Palo Alto, CA 94304, telephone (415) 326-4248, has advance order information for the Apple II. The Apple II consists of

BASIC … beginning of Micro-soft…


APPLE
COMPUTER

Another dynamics in the USA

- « **Ecosystem** » : university campus / hobbyists / some industrials
- **Build the machine yourself => invent new uses**

$\Rightarrow$ uses are defined concurently with the hard/software

$\Rightarrow$ basic shift of the community/ecosystem : emergence of start-up relying on this dynamic

- Major difference (compared to France) : the users

- **« dream » of a democratisation of access to computers**
- **Appropriation of technology (empowerment of users)**

Bill Gates – 1976
Open Letter to Hobbyists

February 3, 1976

An Open Letter to Hobbyists

To me, the most critical thing in the hobby market right now is the lack of good software courses, books and software itself. Without good software and an owner who understands programming, a hobby computer is wasted. Will quality software be written for the hobby market?

Almost a year ago, Paul Allen and myself, expecting the hobby market to expand, hired Monte Davidoff and developed Altair BASIC. Though the initial work took only two months, the three of us have spent most of the last year documenting, improving and adding features to BASIC. Now we have 4K, 8K, EXTENDED, ROM and DISK BASIC. The value of the computer time we have used exceeds $40,000.

The feedback we have gotten from the hundreds of people who say they are using BASIC has all been positive. Two surprising things are apparent, however. 1) Most of these "users" never bought BASIC (less than 10% of all Altair owners have bought BASIC), and 2) The amount of royalties we have received from sales to hobbyists makes the time spent of Altair BASIC worth less than $2 an hour.

Why is this? As the majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid?

Is this fair? One thing you don't do by stealing software is get back at MITS for some problem you may have had. MITS doesn't make money selling software. The royalty paid to us, the manual, the tape and the overhead make it a break-even operation. One thing you do do is prevent good software from being written. Who can afford to do professional work for nothing? What hobbyist can put 3-man years into programming, finding all bugs, documenting his product and distribute for free? The fact is, no one besides us has invested a lot of money in hobby software. We have written 6800 BASIC, and are writing 8080 APL and 6800 APL, but there is very little incentive to make this software available to hobbyists. Most directly, the thing you do is theft.

What about the guys who re-sell Altair BASIC, aren't they making money on hobby software? Yes, but those who have been reported to us may lose in the end. They are the ones who give hobbyists a bad name, and should be kicked out of any club meeting they show up at.

I would appreciate letters from any one who wants to pay up, or has a suggestion or comment. Just write me at 1180 Alvarado SE, #114, Albuquerque, New Mexico, 87108. Nothing would please me more than being able to hire ten programmers and deluge the hobby market with good software.

Bill Gates

Bill Gates
General Partner, Micro-Soft

Complete different context…

Cii

Honeywell Bull

Cii Honeywell Bull

Parallel histories

Professional users

Hobbyists, amators, families, video games, graphic design...

Two parallel histories

- R2E : innovating for a « dream » ; many professional users ; several exceptionnal microcomputers
- USA / others : **toward a « personal computer » for every user** (pro, personal, private, families…)
- IBM « Personal Computer » - 1981 is decisive

$\Rightarrow$ **standardisation**

$\Rightarrow$ a new economy for computers

Standardisation

- IBM strength = **imposing a standard**

$\Rightarrow$ but technically speaking the IBM PC is very poor !

$\Rightarrow$ cannot rival any Micral computer (design, user interface, performance, software…) except for the cost and the « 3 letters IBM on the front »

- Choices : Intel for microprocessor / Microsoft for the OS (no IBM stuff)
- **Major consequences** :

- Everybody in the computer business follows IBM
- With the same machine for everybody

The successfull story of PCs in the 1980s

- 500 000 sold in 1981 / **1 million in 1982**…
- **Microsoft** / **Intel** = winners
- Best-sellers : word processing software + spreadsheets

$\Rightarrow$ microcomputers « everywhere »

- What competitors from the 1970s ? Apple… on a very narrow market
- Before the « clones » of PC (PC compatible)

From R2E Micral … to Bull-Micral (PC type)

Innovation in context

- Of course you need new ideas, skills, organisation…creativity
- **Creativity is everywhere** : R2E, *Homebrew computer Club*…

$\Rightarrow$ But capacity of « trangression » is different :

- Limited to engineers / industry (and new users in this range) ?

- Open to a broader understanding of the computer transforming society ?

$\Rightarrow$ **Related to the understanding of the relation between technology / society**

Technology and society

- **R2E is an engineering projet driven by engineers**

- a very « serious » technological transformation project
- « Small is beautiful » : first dealing with the industrial / economic world
- Technological dreams including their definition of uses / users

⇒ Society « might follow » : a very **« top-down » vision of technology / society**

- At the same time, history of microcomputing takes a « less serious » turn :

- Users and hobbyists : inventors, innovators, consumers, « makers »
- Video games, family use, graphic design…
- A **more « bottom-up » vision**

⇒ R2E never understood that turn (although aware of it) ?

Representations at stake

- Importance of « Evangelisation » in the Silicon Valley = through Clubs (such as Homebrew Computer Club, S. Jobs + S. Wosniak, etc.)
- Also in France (Jean-Louis Gassée, JJ Servan-Schreiber) => **give rise to big techno-political projects !**

⇒ **With no connection with R2E & co**

- Politics in favor of the industry : focused on Networks (Nora-Minc 1978 => Transpac and Minitel)

⇒**Very blind to microcomputers evolution**

- A **dominant representation of computing** in France : 3 letters « IBM » / « mainframes » / « american technology »

⇒ Nobody to believe in R2E

1980s : back to « computer business as usual »

- After a decade of :
- **Overpassing the constraints** of computer industry
- Cultural ambitions, **redefinition of users / consumers**
- « Political » ambitions : **democratization** of the access to computers
- **Outsiders** : R2E, Apple, Clubs, Micro-soft, etc.

- New perspectives, new business or « back to business as usual ? »
- **Moore's Law on the foreground**: from microelectronics to microcomputers
- A decade for IBM + Intel / Microsoft (and newcomers : Dell, Compaq…)

Thank you for your attention