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**Thematic issue**

## **Computing History. Eastern European Scholars. Contributions**

*Issue Editors: Corina Moldovan and Christian Schuster*

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## Coordinators Foreword

The second issue of the *Studia Universitatis Babeş-Bolyai, Digitalia*, offers a selection of papers and projects that were presented on the occasion of the first conference of the Digital Humanities Transylvania Centre, DigiHUBB, titled 'Early digital computing in Eastern-Europe', held on the 28 and the 29th of November 2017 at the Babeş-Bolyai University of Cluj-Napoca. The conference was inaugurated with the key-note speech given by Professor Willard McCarty, one of the first scholars to enthusiastically support the launch and the activities of DigiHUBB, the first digital humanities centre in Romania. In his plenary lecture, professor McCarty underlined the fact that the prospects of a new centre always brings into mind the causes of the disappearance of once brilliant ones, with the main reason being *the lack of an intellectual agenda*. In his paper entitled **The programmer and the scholar: A conversation** which opens the volume, the professor interrogates the meaning of the 'common understanding' that is vital for the resistance of the digital humanities as a field, a common ground understood as 'a fundamentally interdisciplinary and methodological enterprise' that gives value to the field of 'intellectual ecology of the arts and the letters'. For McCarty, the programmer and the scholar are not two different kinds of people but 'two states being in an evolving cognitive resonance'. Thus, the intersection between machine and the enquirer creates an intersection 'where a genuine digital humanities – a practice *of* as well as *in* the human disciplines – takes place.'

The two papers that follow, **The story of the first electronic computer in Hungary** (Balint Domolki) and **Computer Oriented higher education in Hungary – The beginnings** (Edit Sántáné-Tóth) present the stories of the first electronic computer in Hungary, the M-3 which was a medium sized member of one of the first families of Soviet computers and brought to Hungary from Russia around 1957. This computer was successfully used to solve many real-life problems both for scientific-engineering calculations and in mathematical economics, also in educating computer experts: many of the future leading personalities – both on the development and on the application side – got acquainted with computing around it. The second paper continues with the initiatives of the University of Szeged, and also treats the institutes of higher learning offering education in computer studies in the late 1980s; among those the Budapest Technology.

In the study **Past and present of the field of Informatics at „Babeş-Bolyai” University and other institutions in Cluj-Napoca**, professor Grigor Moldovan highlights the pioneering endeavours in the field of informatics in Romania and more specifically

in Cluj-Napoca, spanning from the 50s and all the way up to the 90s and tracing the opening, and transformations, and eventual closure of research centres, laboratories, and various institutional collaborations. A special attention is given to the entity of the Calculus Centre at Babeş-Bolyai University, founded in 1975, as the author himself was its director for 17 years until it was dismantled in 1992.

We were honoured to have as guests to this first edition of the DigiHUBB Days such great personalities that left vibrant marks in the history of computing in Eastern Europe. We add to the names previously mentioned those of Mircea Rusu and Mihai Stanislav Jalobeanu. In **Memories, Recollection, and Landmarks or How I Became a Pioneer**, Mihai Jalobeanu presents, with humour and passion, his realizations in the field of computer graphics, from the joy of having the first plotter to the public debut and the meeting with Herbert Franke, in 1974, in Bucharest. He also references the time he participated at international exhibitions as well as offering the first Romanian course on Computer Graphics at Arad University.

The activity of these Romanian scholars in computing-related research and education is outstanding and has to be underlined for being exceptional in the difficult times of the communist regime. Mircea Rusu, in **A short history of computer use at the Faculty of Physics – University of Bucharest**, selected the main fields of interest that were connected with problem-solving: programmed solutions, simulations and modelling, computer application and software during the time, with examples from computation in tradition physics, to biology, chemistry, astronomy, medicine to data processing and visualization, data management and so on. The fields as nonlinear dynamics, complexity, chaos and fractals, as well as fluid dynamics, atomic, molecular or nuclear physics, earth or stellar physics, connected to improvement of the experiments and devices via artificial intelligence are exemplified.

The last part of the journal presents digital humanities projects accomplished or in progress in Romania. In **Valuable insights into „Albina Bank”, history revealed by the lecture of digital economic journal „Revista economica” (1899 – 1918)**, the group of researchers from the Babes-Bolyai University present a study based on digital resources, in particular, the Economic Review journal “Revista economica” spanning 20 years (1899-1918). Using a qualitative research method based on narrative inquiry and research techniques correlated to the type of data used, the study resorted to documentary research, historiography or the critical review of the business literature, and discourse analysis. The last but not least important are the presentations of Călina Bârză and Andrada Cațavei, two young and passionate researchers, whose projects are new and valuable to digital humanities: **Daguerreobase: Digitizing photographic heritage** and **The study of a project: a collective memory 1950-2000**, two excellent examples of the way in which digital humanities shapes cultural heritage.

*Corina Moldovan and Christian Schuster*

*Editors*

## The programmer and the scholar: A conversation

Willard McCarty

Professor Emeritus,  
King's College London

**Abstract:** The prospects of a new centre for digital humanities brings to mind those once prominent centres that have disappeared, hence the question of what they did or did not do that would have made the difference. Here I suggest that they failed for lack of an intellectual agenda. Drawing from the early history of digital humanities, an ethnographic vignette of my own research, close attention to the machinery of computing and work in the history of the physical sciences, I suggest a beginning to such an agenda.

**Keywords:** Digital humanities; modelling; agenda; collaboration; interdisciplinary research; absolute consistency and complete explicitness; markup

The Transylvanian monarch and scholar Matthias Corvinus, born in Cluj in 1443 ([Figure 1](#)), was regarded by the Florentine Platonist Marsilio Ficino as a true philosopher-king, *potentia simul et sapientia*,<sup>1</sup> a man of both power and wisdom. Inspired by Ficino's lofty prose, I take that great king as allegorical hero in the quite different story of the programmer's *potentia* and the scholar's *sapientia* in our modest domain of digital humanities. This story is perhaps most often of collaboration between individuals, even within teams. But such collaboration depends fundamentally on those individuals coming to understand, indeed to think like each other, and so to converge on

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<sup>1</sup> *Epistolae* IV.121, to Francisco Bandini (Nürnberg: Anton Koberger, 1497). For readers of English Ficino's letters are most conveniently found in the 10-volume edition published by Shephard-Walwyn. On Matthias Corvinus and the Italian Renaissance see Farbaky and Waldman.

the scholar-programmer whose internal, cognitive enactment of action and reason together is my subject here. I will ground what I have to say about that enactment in an ethnographic vignette of a research project from which I learned most of what I know about computing in the humanities.<sup>2</sup> My aim is to bring what I have learned to bear on the historical disciplinary situation in which the fledgling Central Digital Humanities Transilvania finds itself. I begin there, then move on to scholar and programmer.

### 1. Centres and the incunabular period

A new centre for digital humanities is both exciting and gratifying to someone who has been around long enough to witness the struggle for recognition of the field as an intellectual endeavour. But it is not the case that practitioners can now relax, and not only because of the occasional rant against the field, denial that it is one or its mindless popularity. Digital humanities is only about 70 years old and has nothing like an overall sense of direction. It is still feeling around in the dark, its popularity in some places shedding more heat than light. This is not to say that good work isn't being done. Nor is it to say that past efforts have no value for the present – quite the opposite. One big problem is that we have paid too little attention, or none, to the history of those feelings-around in the dark, little or no attention to a history that would help illumine where we might be going. We have not asked, for example, why so many centres of computing in the humanities have disappeared – a topic that has been proposed several times for the annual conference but never taken up as far as I know. Lack of a good answer lessens our ability to build centres that *will* last.

A new one, such as the Transylvania Digital Humanities Centre, has the advantage of being in a position to observe the successes and failures of those who have gone before, learn from them and then plot its own, different, locally shaped, perhaps better trajectory. But in looking to these predecessors the aim has to be to learn from them, not just imitate. Disciplines, after all, even those which have been around for millennia, are not in essence templates for research nor clubs with rules and codes of behaviour. A discipline isn't a thing. It is what students of a subject *do*. It is a starting-point, a living social entity to be shaped and directed.

Among the principal reasons for the failure of many past centres has been, I think, the lack of a distinct intellectual agenda.<sup>3</sup> No field can be a discipline unless it has something like a common understanding of what is to be done. This understanding

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<sup>2</sup> I am indebted to anthropologist Dr Amiria Salmond, who in a long and intense e-mail correspondence suggested I write this vignette as a way of clarifying my ideas.

<sup>3</sup> On agendas, with a focus on computer science, see Mahoney, 165.

is usually tacit, difficult to see from the outside but often demonstrated by the presidential addresses of national and international scholarly associations, acceptance speeches for the awards they bestow, plenary lectures at major conferences and the like. Michael Sperberg-McQueen once said to me that if you want to know what computer science is all about you read the Turing Award Lectures.<sup>4</sup> On that score as well, we are a rather weak lot, having paid very little attention to the fundamental role these occasions and venues play in encouraging the development of the critical thought at the basis of disciplinary life. Alan Liu has complained that we don't have much of it, and he's right (Liu). His is the handwriting on the wall. (Figure 2) Ultimately, there comes a reckoning at which a cogent argument must be made for spending collective resources on the newcomer. Within academia how else is the newcomer to prepare for it except by forging a strong connection with the fundamental purpose of the university, with its agenda, and thus fitting into the society of colleagues?

The centres which have flowered and then withered or been absorbed into service-units, e.g. at Bergen, Oxford and Toronto (where I was for a dozen years) were launched at a time when contact with computing was fatal to a normal academic career for any doctoral student in the humanities and damaging to the reputation of a professor associated with it. Initiatives in digital humanities had to cross-dress, sometimes in the livery of a servant, sometimes in the slick outfit of a salesman, and their budgets had to be protected by deference and salesmanship against collegial piracy. Any talk of an intellectual agenda that did occur tended to be about the research objectives of curious professors who came to such centres for help. As one of those employed to help, I was exposed to research across the disciplines. Although this employment constituted a black mark academically, it gave me invaluable training by affording me the opportunity to see potential for common ground within which an intellectual agenda for computing in the humanities might grow. I took what I thought to be the central problem, formulated a research project of my own and, stealing time from the day-job, pursued it. I will return to this project in a moment.

Disciplinary amnesia has obscured what was going on with computers in those early years, what I call the incunabular period from the 1960s until, in the 1990s, the World Wide Web brought that period to an end. Its history is beyond my scope here; in fact, no proper history of it has been written. But I want to pull from what I know about it a central failure and two sources of insight.

I have pointed to the historical problem of an agenda for the field, but I did not say anything about how to form one. How do we know what needs doing in order to supply a lack others will recognise as a lack, or to fix something they will agree is broken?

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<sup>4</sup> <http://amturing.acm.org/lectures.cfm>. Accessed 29 November 2017.

Incunabular digital humanities failed to gain a foothold in the academy primarily, I think, because practitioners did not develop a theoretical understanding of the field, which for a fundamentally interdisciplinary, methodological enterprise is to say, how the field fits into the intellectual ecology of the arts and letters, what it has to offer of *intellectual* value that others see they need, and what they have to offer that it needs. Having developed no such understanding, practitioners were unable to interest mainstream colleagues, to relate to and learn from them, to persuade them a new field was worth supporting.

Throughout the incunabular period, insiders on both sides of the Atlantic repeatedly sifted for 'evidence of value' to the academy but found little. Matters came to a head at the end of the 1980s and beginning of the 90s, for example in overviews by literary critic Rosanne Potter and by historian of French literature Mark Olsen, who declared the field's major preoccupation, with text-analysis, to be a waste of time.<sup>5</sup> There was much fuss among colleagues; Olsen had constructive suggestions; but no overall theoretical understanding emerged. About that time, in well-informed assessments of the field, the philosopher, historian and classicist Sir Anthony Kenny (who in 1982 had published the standard introduction to statistics for students of the humanities and who had applied computational stylistics to Aristotle) found the harvest of three decades' work disappointing and use of computing in research possibly damaging.<sup>6</sup> To my knowledge, no riposte was offered. Kenny pointed to classicist Robert Connor's question of why, just as the computer was coming into the humanities, scholars were abandoning the kinds of enquiry with which it would have helped. Few if any articulated the connection between the connotations of the technoscientific machine and the sinister machinations of the Cold War. But then in 1991, almost simultaneously, the Web was released to the public and the Soviet Union collapsed. Less than a decade later the Web became visible to the humanities, and Franco Moretti started talking about 'distant reading' (Moretti). But note well: the problems which had retarded the development of our field were not made obsolete or irrelevant by the Web, rather they were temporarily shoved aside by the compelling imperative to stock the virtual shelves.

The incunabular period is worth more than delineation of missed opportunities and certain pregnant questions about the relation between technoscience, the humanities and the lives of ordinary citizens. It is also where we find enthusiasm for the possibilities of computing and great insight. The two best sources of insight from the period are to

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<sup>5</sup> See Potter "Literary Criticism and Literary Computing: The Difficulties of a Synthesis"; "Literary Computing and Literary Criticism: Theoretical and Practical Essays on Theme and Rhetoric" xv-xviii and "Statistical Analysis of Literature" 402-7; Olsen "What can and cannot be done with electronic text" and "Signs, Symbols, and Discourses" (a revised version of the first cited work) which headed a double-issue of *CHum* dedicated to responses.

<sup>6</sup> See esp. Kenny, the clearest statement of his view.

my mind philologist Fr Roberto Busa and literary critic Louis Milic, both of whom argued cogently against the tendency of scholars to apply the machine to what it could most easily do, in other words to treat it as a labour-saving device of automation. Busa's primary emphasis was enabling more scholarly work with more penetrating questions. Envisioning the possibilities in 1976, he asked "Why can the computer do so little?"<sup>7</sup> As others were churning out concordances for print and celebrating the time and labour saved, he argued that "operating on texts only in terms of individual words... [is] a rather poor performance." In 1966 Milic zeroed in on the unexamined nature of the machine. He pointed to understanding of it as the primary goal, somewhat in the manner of an anthropologist's project to understand a profoundly different culture. He wrote that,

The true nature of the machine is unknown to us, but it is neither a human brain nor a mechanical clerk. The computer has a logic of its own, one which the scholar must master if he is to benefit from his relations with it. Its intelligence and ours must be made complementary, not antagonistic or subservient to each other.... The computer can be made an extension of man only if it opens avenues we have not suspected the existence of. Thinking in a new way is not an easy accomplishment. It means re-orientation of all the coordinates of our existence.... What the computer will enable us to do in our humanistic tasks has hardly been imagined yet. (Milic 4f)

He entitled his article "The next step". As I like to say, it's a step we have not yet taken.

## 2. Scholar – programmer (Figure 3)

I have entitled this talk "The scholar and the programmer: A conversation". As I said at the beginning, I don't limit myself to two kinds of people, separated in space, talking and listening to each other. Rather I mean *two states of being in an evolving cognitive resonance*. These two states can exist within the same person or be realised in an external collaboration between quite different people. Nor do I see these as alternatives, rather as simultaneous. The otherness of an other person may be close to essential for developing good research in our field. But without the internal conversation, how can the external one get anywhere at all?

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<sup>7</sup> Busa "Why can a computer do so little?"; see also Busa "The Annals of Humanities Computing".

To explore the relationship between scholar and programmer I want to use the research I did in that forgotten, incunabular period to sketch what a serious problem in the humanities looks within either the internal or external relationship. I offer my own ethnographic vignette not because I think it more insightful than another's but because I don't know of any other to use. More of them would be helpful.

### 3. Modelling

I came on the scene as a doctoral student of English literature in the late 1970s and then as a newly minted PhD in the mid 1980s looking for questions to ask. (I had started with computing, in the form of those legendary mainframes, in the mid 1960s, but that's another story.) I became fascinated with the extravagant claims being made by enthusiastic colleagues and so decided to see for myself. About that time Brian Cantwell Smith made two fundamental observations implicit in the design of the stored-program computer: first, that the machine can do nothing useful without a model of whatever it is to compute; second, that no model can be correct in an unqualified sense: it is necessarily an interpretative simplification of the modelled object or situation (Smith). Even then, in the 1980s, given the slow rhythm of computer-use, it was difficult to impossible for the ordinary user to see that with technical progress true human-computer interaction would become possible, and with it crucial changes would occur: (1) 'model' would come to be understood not as a static design but a momentary state in the process of modelling; (2) the inability of any model to be correct would become the driving force of that process; and (3) as a result, the modeller as participant would, as it were, *move inside the modelling process* as it moves inside him or her. I will come back to that virtual move later.

By the time I wrote *Humanities Computing* in 2005 this change had happened, hence my emphasis on modelling in that book (McCarty Chapter 1). But in the early 1980s I had to learn the hard way. So my focus was on building and perfecting a model of something step by step. Doing that allowed me to bring the logic of the digital into sharp focus.

### 4. The *Onomasticon*

The question I took up was the standard literary one of poetic unity. I asked this question about a poem that had captured me while I was working on the doctorate: the *Metamorphoses* by the Roman poet Ovid – who, by the way, spent his last years not far from Cluj, in exile among the Thracian Getae, in what is now the Romanian city of Constanța on the western shores of the Black Sea.

Ovid's *Metamorphoses* is a large, elusively structured compilation of teasingly interrelated mytho-historical stories in 15 books, amounting to 12,000 lines of classical Latin hexameter. (Figure 4 is a suggestive illustration from George Sandys' 17<sup>th</sup>-century translation and commentary, *Ovid's Metamorphosis Englished, Mythologiz'd And Represented in Figures*.) Since its composition ca. 100CE the poem has had enormous historical, literary and artistic influence, making it fundamental within the European cultural tradition. Nevertheless in modern times it has been poorly understood, often thought to be little more than a convenient miscellany, like Apollodorus' *Library*. When I became interested in it, literary scholarship on the *Met* was largely preoccupied with realising "the immortal dream of a universal key", as one exceptional critic noted of a most ambitious attempt.<sup>8</sup> It and other such attempts did not succeed. I wanted to do better.

My approach as a digitally educated literary scholar was to look for a textual phenomenon distributed throughout the poem whose occurrences could be treated as computationally tractable data but that also was strongly linked to the structural basis of the poem, its stories. The names of persons, a few hundred in number, seemed to fit the bill perfectly. Thus I called the intended tool an *Onomasticon*, a 'book of names'.<sup>9</sup> From the beginning my goal was to provide others with a tool that would allow exploration of structural patterns at the level of narrative without committing the user to any particular idea of how stories might link to each other. The reception-history of the *Met* suggests that readers quite often would begin with a favourite story. What, then, would the whole poem look like from this or that initial perspective? How would the poem as a whole inform the chosen story?

Closer inspection forced me to realise that fixing on proper names alone would miss too much: Ovid's Latin provides an abundance of means for indicating a person without using his or her proper name. Hence I had to expand the category 'name' to all devices of language referring to a person, including pronouns, verbs, personal attributes and effects. In the end there turned out to be ca. 60,000 of them, i.e. an average of 5 per line of poetry, confirming the potential of the *Onomasticon* to embrace the entirety of the *Met* and committing me to far more work than I had anticipated.

Manual tagging followed so that I could say, e.g., 'here is a mention of person *Tereus*, named by lemma *arma auxiliaria* in category attribute'. (Examples are to be found in the online version of the *Onomasticon*.<sup>10</sup>) I began before the Text Encoding

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<sup>8</sup> Due 135, on Otis.

<sup>9</sup> For the ideas and problems involved in constructing the *Onomasticon*, see McCarty "Encoding persons and places 1" and "Encoding persons and places 2".

<sup>10</sup> <http://www.mccarty.org.uk/analyticalonomasticon/>. Accessed 29 November 2017.

Initiative was a force to be reckoned with. But I would have decided to invent my own coding system in any case – to invent it gradually in response to the requirements of the poem – so as to allow the theory of text this system implemented to be as specific to the poem as possible. My objective, as I suggested earlier, was to avoid *all* interpretation, a deliberately naïve stance that I took with two objectives in mind: first, to keep the work as clean of interpretative prejudice *as possible*; second, in order to see up close what computing a cultural object would actually entail – what it would *cost*. (Here is a motto for digital humanists to live by: *there is always a tradeoff*.) To say that resistance to interpretation proved futile is the grossest of understatements. A very large majority of entities to be tagged made interpretation both unavoidable and difficult: not only is ambiguity essential to human language, especially poetry, but the *Metamorphoses* itself also plays on ambiguities to subvert every ontology it tempts the reader to construct. The poet puts forth possibilities of closure only to dodge them. A ‘universal key’ to a defining structure, a different key for each reader or for each interpretative stance – all are impossible in the face of a continual, unresolvable, metamorphic, proliferation of structurings. The poem enacts the poet’s subject, metamorphosis, in such a way that the *Metamorphoses* cannot be wrapped up in a neat taxonomy. As the reading progresses, and scheme after scheme collapses, the frustrating attempt reveals an illimitable, multidimensional process. This process is, I would argue, the poem’s greatest gift and the guarantee of the poet’s final declaration, ... *perque omnia saecula fama, / siquid habent veri vatum praesagia, vivam*, “and if the prophecies of bards are true, through all the ages in fame I will live” (*Met* 15.878-9).

Thanks to a Canadian government grant I was able to hire a research assistant, Burton Wright, whose role was to personify the programmer, I the scholar, but roles became quite blurred. In both cases, otherness of another mind kept us from stultifying fascination with our own coding. We formed a close working relationship, but in time, he left for pastures new, and other research assistants followed. Eventually I abandoned the project, finally realising that no adequate model of the *Metamorphoses* was possible nor was any existing or conceivable tool capable of modelling the poem without embedding deeply, extensively and for all practical purposes ineradicably the prejudicial interpretations of the maker – therefore defeating the purpose of the *Onomasticon*.

## 5. An axiom of digitisation

So where did this leave me? Let me summarise. The *Onomasticon* demonstrated several things, chiefly that metatextual encoding was a powerful instrument for stimulating literary interpretation but wholly inadequate for communicating it; that the unresolvable

polarisation of scholar and programmer was a fundamental theoretical result essential to understanding the creative potential and epistemology of digital research; and that its dynamics is a central problem of the field. I will come back to this problem below.

My experience also led me to formulate what I have come to call the axiom of digitization: that whatever is to be computed must be rendered in a *completely explicit* and *absolutely consistent* form. In consequence, a stark difference between reading and encoding (parallel to the difference between scholar and programmer) emerges. At the time I was unaware that historian of science David Gooding was on course to reach the same conclusion from his work on Michael Faraday's meticulously kept laboratory notebooks. Here is what Gooding wrote in 2003:

To digitalize is to represent features of the world, including relationships between them, in a manner that establishes and fixes unambiguous meaning.... It is a method designed to achieve two things: to preserve the invariance of tokens in a symbol manipulation system and to make the value of the tokens unambiguous. (279 and 283 n. 33)

I had concluded from my own work that the principal benefit of digital computing is a kind of *via negativa*, a 'negative path' that illumines the unknown by showing what algorithms cannot do – much in the spirit of Turing's paper on the *Entscheidungsproblem* (Turing "On computable numbers"). But then computers became faster, more capacious and cheaper, hence personal machines, and so computing ever more of a process, ever less of an event. In consequence modelling became a focus of attention, and so the polarisation of scholar and programmer ever more the precondition of a resonance between them. Gooding depicted the situation as shown in [Figure 5](#).

## 6. Actual computation

So much for the reductive phase with its not inconsiderable gift. But Gooding's diagram illumines two others: the middle phase of actual machine computation, and the final phase at which the enquirer retranslates computational results back into the terms of his or her research. Probing these will take us to the end of this paper.

We may think of operations in this middle phase as mechanical as opposed to human, but since the machine is a human artefact, it is more productive to ask after the model of thought-processing the machine instantiates – its built-in 'theory of mind', if you will. Go back to Turing's 1936 and von Neumann's 1945 papers, and what do we find? Consider the brief snippets shown in [Figure 6](#): first the metaphor of the man doing

his sums, with which Turing begins, second von Neumann's use of neurophysiological vocabulary in his sketch of an architecture for the digital machine – the machine's 'organs', with which it carries out the human mathematical forms of addition, multiplication, subtraction, division, and so on. Between these two documents stands Warren McCulloch's and Walter Pitts' proposal of a model of the brain as a Turing Machine, which von Neumann read.<sup>11</sup>

Many have said, following Lady Ada Lovelace's dictum, that the machine "can do [only] whatever we *know how to order it to perform*" (Lovelace 722), or in the anxious language of the mid 20<sup>th</sup> Century, that it is but a 'fast moron'.<sup>12</sup> In the 1950s IBM made this phrase doctrine to salve public fears of artificial intelligence following the successes of the machine at the game of draughts and the ramping up of publicity for the new 'giant brain' (McCorduck 159). IBM's mantra then went viral. But such is *not* the machine they had or we have, the one von Neumann helped to design, nor the one for which he and Herman Goldstine sketched the basics of programming in their report, "Planning and coding of problems for an electronic computing instrument". They pointed out that the difference in design (which in effect transcends Lady Lovelace's dictum) is the provision allowing a running program, conditional on the outcome of previous operations, to deviate from the linear sequence of instructions or to rewrite those instructions on the fly. They explained – note these words well – that coding "is not a static process of translation, but rather *the technique of providing a dynamic background to control the automatic evolution of a meaning*" as the machine follows unspecified routes in unspecified ways in order to accomplish specified tasks (Goldstine and von Neumann 2). Thus Herbert Simon: "This statement – that computers can only do what they are programmed to do – is intuitively obvious, indubitably true, and supports none of the implications that are commonly drawn from it."<sup>13</sup> The idea of 'machine' behind it is, as Marvin Minsky remarked, "precomputational" (McCorduck 71).

The high level of complications which result from this design, Goldstine and von Neumann went on to note, are "not hypothetical or exceptional... they are indeed the norm"; the power of the machine "is essentially due to them, i.e. to the extensive combinatorial possibilities which they indicate." (Goldstine and von Neumann 2) In essence, as von Neumann suggested four years later, machines "of the digital, all-or-nothing type" work by combining and recombining the data under given constraints until coherent patterns emerge (von Neumann 16). In a nutshell, then, the value-added at this stage is *combinatorial*.

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<sup>11</sup> McCulloch and Pitts; McCulloch 12.

<sup>12</sup> E.g. Soule 173-4; Andree 2, 106; "The Month in Science"; Rathburn 11; Gill 8; Chaplin 16.

<sup>13</sup> Simon 67; see also Feigenbaum and Feldman 3-4.

For an analogy take what happens in a research library, which provides a large number of modular resources in a standard format so that a variety of readers with unforeseen purposes may combine and recombine them *ad lib*. (This scheme goes back at least to the Library of Ashurbanipal, in the 7<sup>th</sup> Century BCE, if I am not mistaken.) On a larger scale, in more recent form, we see more or less the same with the Web, on a smaller scale with a single codex, particularly obvious when it is designed as a reference work, such as a critical edition built to foster recombinatorial liberties. But my point is the familiarity, the humanity of this way of working, though now by the perhaps unfamiliar means of statistical tools for finding patterns in masses of data. Surprises from the process begin to emerge, Turing suggested by analogy to the critical mass of a nuclear reaction, at a quantitative threshold of complexity (Turing “Computing Machinery and Intelligence” 454). The successes of combinatorics in digital humanities are to be found, for example, in stylometric analysis as well as, for example, the many ‘distant reading’ projects of the Stanford Literary Lab.

## 7. Construal

Now for the third phase, at which that retranslation happens.

Modelling is of course iterative. It goes round and round, or more accurately, when it gets somewhere, it goes in a progressive spiral. I often depict the process as in [Figure 7](#). But in such illustrations the modeller’s reasoning is omitted, suggesting (which I think often to be the case) that the result from any state of the model is unproblematically compared to the modelled object and revisions made to the model. For our purposes, the value of Gooding’s work with Faraday’s laboratory notebooks – let’s return to his diagram (Figure 5) – is its illumination of that overlooked point at which the modeller makes sense of results from the modelling apparatus. In other words, Gooding shifts our attention from those results to the modeller’s *making sense* of them, to those “flexible, quasi-linguistic messengers between the perceptual and the conceptual” that go into the making of new knowledge (Gooding “How do scientists reach agreement” 208). We start paying attention to the interchange between digitally mediated and unmediated cognitive processing. The experimental scene moves inside.

I think Aden Evens is basically right when he argues, in his recent book, *The Logic of the Digital*, that this logic extends from the making of digital signals in circuitry and the extravagant engineering which maintains their crisp, discrete form; through the many layers of software; through the representations in the user-interface; to the uses the user makes of whatever digitised resources the interface provides. I argue

that the polarising which the digital effects and the resonance between machine and enquirer that this polarisation enables comprise the intersection where a genuine digital humanities – a practice *of* as well as *in* the humane disciplines – takes place.

Abundant work in human-computer interaction and cognitive psychology thus comes into view. Also artificial intelligence, which we need to take more seriously, for as it progresses it projects into the external world that internal digital voice and so, to some degree, joins the conversation. The situation then becomes anthropological and performative, and so invites the arts back in. I will not spin this out further to suggest an ever-widening circle of disciplines, only ask you to look out for them, and to use their help in building an agenda for digital humanities that will fulfil the promise suggested in [Figure 8](#).

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Figure 1. Matthias Corvinus (1443-1490) ([Back to article](#))



Figure 2. Rembrandt, *Belshazzar's Feast* (1635), from Daniel 5 ([Back to article](#))



Figure 3. Jim Jarmusch, *Coffee and Cigarettes* (2003) ([Back to article](#))

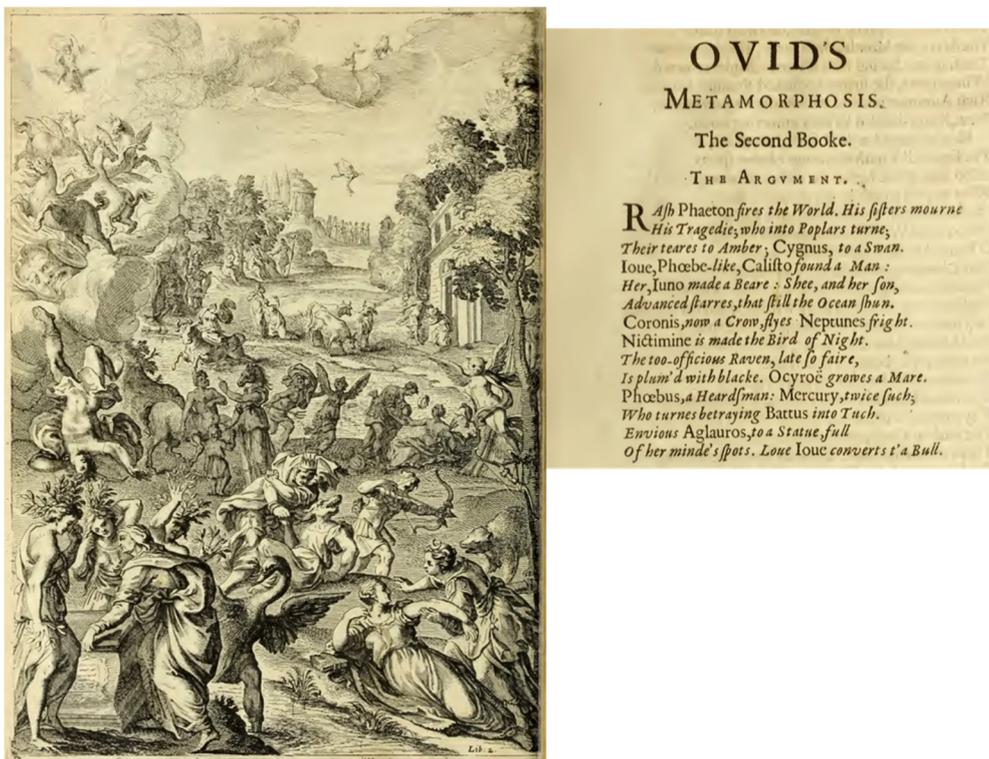


Figure 4. George Sandys, *Ovid's Metamorphosis Englished, Mythologiz'd and Represented in Figures* (1632) ([Back to article](#))

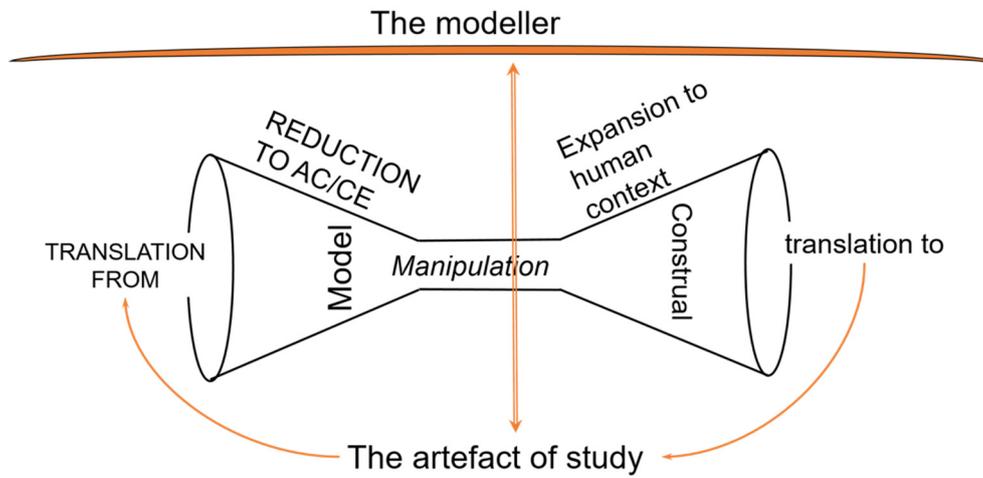


Figure 5. ([Back to article – chapter 4](#)) ([Back to article – chapter 6](#))

We may compare a man in the process of computing a real number to a machine which is only capable of a finite number of conditions  $q_1, q_2, \dots, q_N$  which will be called “ $m$ -configurations”. The machine is supplied with a “tape” (the analogue of paper) running through it and divided into

Alan Turing, “On computable numbers” (1936)

2.6. The three specific parts CA, CC together C and M correspond to the associative neurons in the human nervous system. It remains to discuss the equivalents of the sensory or afferent and the motor or efferent neurons. These are the input and the output organs of the de-

John von Neumann, “First report on the EDVAC” (1945)

Figure 6. ([Back to article](#))

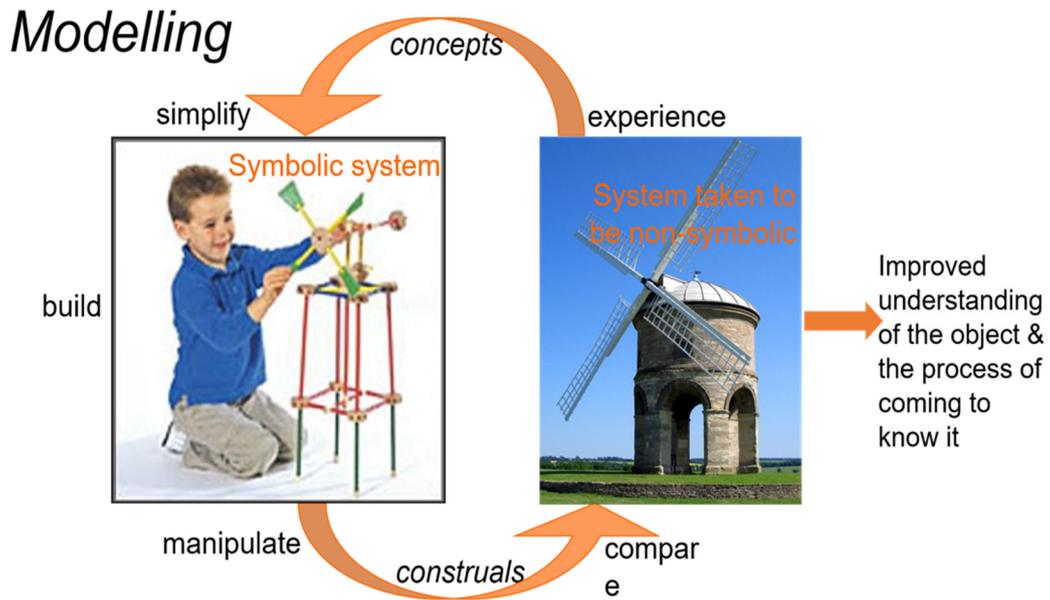


Figure 7. ([Back to article](#))

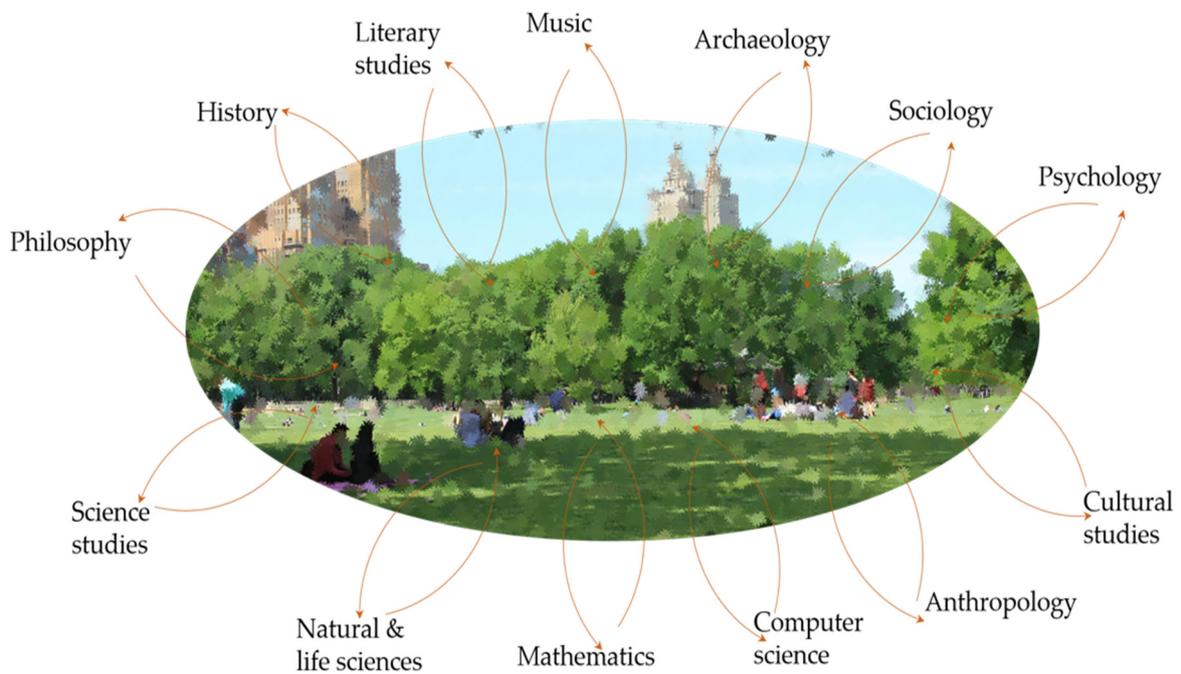


Figure 8. ([Back to article](#))

## **The story of the first electronic computer in Hungary**

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John von Neumann Computer Society  
IT History Forum

**Abstract:** After several preparatory activities in the early 50s, the Hungarian Academy of Sciences decided that it is necessary to have an electronic computer in Hungary. The Research Group for Cybernetics was established in mid-1956 and charged with the task of obtaining one. As commercial solutions proved to be impossible at that time it was decided to build the clone of a recently developed Soviet computer. The M-3 was a medium sized member of one of the first families of Soviet computers. Complete documentation and a package of key components were received in the framework of scientific cooperation. (Similar clones were built in Tallinn, Beijing, Erevan and M-3 was later manufactured in Minsk) Building of the M-3 started late 1957 (with the author's participation). Some life-signs were emerging in 1959, while more-or-less stabile operation was reached in 1960. Several improvements were made over the original design. Magnetic drum memory was exported to Timisoara for MECIPT. Despite its low performance, M-3 was successfully used to solve many real-life problems both for scientific-engineering calculations and in mathematical economics. Applications in other fields, like linguistics started too. The most important contribution of M-3 was its role in educating computer experts: many of the future leading personalities - both on the development and on the application side - got acquainted with computing around the M-3. M-3 served academic computing until 1965, extended with three more years at Szeged University. In the first part of the 60s commercial computers started to arrive to Hungary both from the USSR and the West.

**Keywords:** computing history, computers and education, Hungarian scholars

## 1. Prehistory in Hungary

Computing in Hungary started ... in a prison! In the 50s in Hungary - like in many other countries of the Eastern bloc - many people were put in prison based on fabricated charges. Among these political prisoners, there were many high-level scientists and engineers. Sometimes they were working in an “engineering bureau” within the prison, making translations and even some design work. For this reason, they had a rather good access to Western literature (maybe better, than their colleagues “outside”). So, in late 1953 a group of inmates, having read about the developments of computing in the Western world, convinced the prison management to write a letter to the Hungarian Academy of Sciences, proposing to build a digital electronic computer. They offered to prepare the design and suggested academic institutions, where implementation can be made, with their “remote assistance”. (A photocopy of the letter is published in [1]).

The letter got a politely negative answer, in early 1954, however, the Presidium of the Hungarian Academy of Sciences made a decision to establish within one of the academic research institutions a research unit “to study the building of high capacity computing machines in our country”. Moreover, when in 1955 many political prisoners were rehabilitated, *Rezső Tarján*, one of the authors of the “letter from the prison” became the head of this research unit.



Rezső Tarján  
(1908-1978)

In this capacity *Tarján* made a lot of efforts to promote the idea of electronic computing, by publishing articles, giving lectures, organizing meetings about early experiences with computers in the developed countries. This missionary work was helped by academician *László Kalmár*, who was the first among Hungarian mathematicians to recognize the significance of modern computing.



László Kalmár  
(1905-0976)

In January 1956 came an academic decision about the “necessity of purchasing high-speed digital computers from the Soviet Union”, followed by government approval in September 1956 of the proposal of the Academy to establish Research Group on Cybernetics of the Academy, “with the main task of obtaining and operating an electronic digital computer.” This approval, however, was on condition, that director of the group will be not *Tarján*, but a high-level Party official *Sándor Varga*.

This – seemingly outrageous – decision had some merits, as it turned out later, that *Varga* was an experienced technical manager, with a successful track record in the Soviet (military) industry, and he had very valuable connections in Soviet industrial and academic circles.

The first action of the research group (in the following will be called *KKCS* according to the Hungarian acronym) was to place an order for a Ural computer from the USSR. The order was confirmed by the relevant Soviet foreign trade organization

and delivery was foreseen in the 1957 plan of Soviet-Hungarian commerce. Due to the political situation in Hungary, *KKCS* could not start its actual work in 1956 and in early 1957 received a letter from the Soviet foreign trade organization about withdrawing from the deal, refusing to deliver the Ural computer to Hungary. Now, the connections of *Varga* proved to be useful: he succeeded in arranging to receive – in the framework of scientific cooperation with the Academy of Sciences of the USSR - the complete documentation together with a package of key components of a newly developed Soviet computer, the M-3.

Let us see now what this M-3 computer was about.

## 2. Prehistory in the Soviet Union

Academician *I. S. Bruk* ([2]:pp.61-64 and [3]) was a leading expert of analog computers since the late 30s. After the war his attention turned to digital computers, becoming popular in the West. In early 1948 a young assistant *B. I. Rameev* ([2]: pp.123-134 and [4]) joined his institute, being interested in digital computers. They developed the complete design of an electronic digital computer and submitted an invention application for the “The Automatic Digital Computer” and received notarized Invention Certificate No. 10475 on December 4, 1948 – the first computer invention document in the Soviet Union (Nowadays in Russia the “Day of Informatics” is celebrated on December 4).



I.S. Bruk  
(1902-1974)

Another important early event was in 1949 the creation of the Special Constructor Bureau 245, established as the first (deeply secret) computer development organization (Order signed by J.V. Stalin!). This became the cradle of the Soviet computer industry (Rameev later became one of its key personalities).



B.I. Rameev  
(1918-1994)

In the meantime, the Bruk group continued the implementation of the computer design mentioned above and in 1951 launched the M-1 [5], which is considered the first computer in Russia (practically the same time the computer MESM, developed by the group of S.A. Lebedev, was launched in Kiev, being considered the first computer in the Soviet Union).

The M-1 had several thousand semiconductor devices and only 730 vacuum tubes. This significantly reduced size of the computer, which occupied a room as small as 15 square meters. It used two-address command system, a magnetic drum, widescreen TTY output and transmitter for their input from a punched tape. The number of bits - 25.

Internal memory on electrostatic tubes for 256 words and a magnetic drum for another 256. Performance was 20 operations per second. Operations: addition, subtraction, multiplication, division and several auxiliary operations. Power consumption - 8 kW.

Computer "M-1" was used to calculate operation mode of electrical networks in Moscow, heating of ballistic missiles during the motion in the atmosphere, and for a number of projects of the Institute of Atomic Energy.

As the continuation of the "M" series, the computer M-2 [6] was developed in 1952-53. It had words of 34 bits and a 3-address instruction set, with a speed of 2000 floating point operations/sec. The internal storage devices included the main electrostatic device (standard cathode-ray tubes) that held up to 512 numbers and had regeneration cycle of 25  $\mu$ s, plus an additional magnetic drum that held up to 512 numbers and rotated at 2860 revolutions/min. (A ferrite core memory of 4096 words was added in 1956). The external storage device – a magnetic tape drive – held up to 50 thousand numbers. Data was input from a punched tape reader and output to a teletypewriter. The total number of electronic tubes was 1879, including 203 in the power supply.

M-2 was a real workhorse of early Soviet computing, operating through 15 years performing calculations in atomic energy, missile design and in other scientific areas.

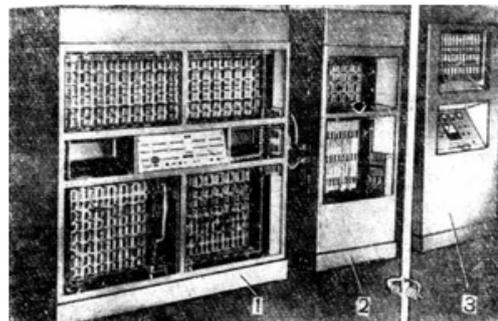
In 1955-1956 *Bruk* created the concept of small computers based on experience in building of the computers "M-1" and "M-2". As a result, the computer M-3 [7] was designed with the following main technical characteristics:

- electronic vacuum tube computer (800 tubes in 3 large cabinets)
- magnetic drum memory storing 1024 words of 31 bits.
- two-address instruction set, with a speed about 30 operations per sec.

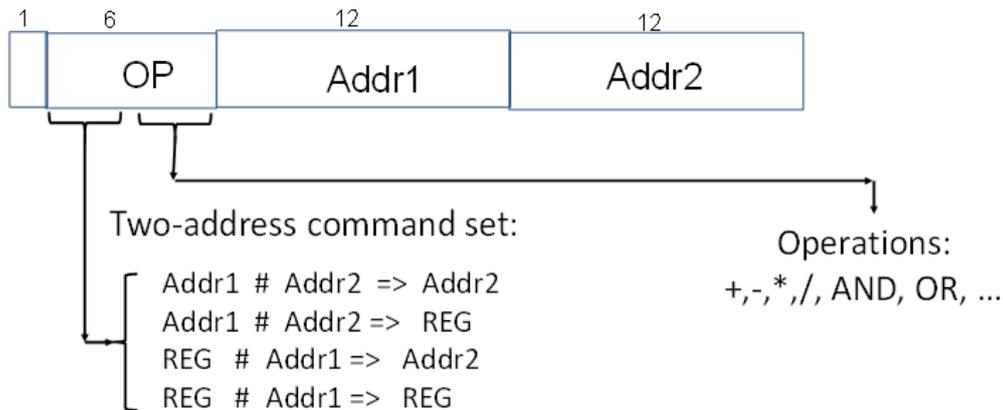
(Later the storage was extended with a ferrite core memory and the speed improved to about 1500 op/sec)

The basic units of M-3 were:

- Arithmetic unit: four registers (31 bit)
- Address register (12 bit)
- Instruction counter (12 bit)
- Code control (6 bit + logical circuits)
- Storage- and i/o controllers



The structure of the two-address commands can be seen in the following diagram:



Development of the M-3 was completed in 1956, led by *N.J. Matyukhin* ([2]:pp.78-84 and [8]). Acceptance test by a state committee followed, passing with success in all technical parameters. Some bureaucratic problems did, however, arise: it turned out that the development of M-3 was performed as a kind of “over the plan” activity, not completely covered by the necessary paperwork. State committee acceptance was therefore delayed, serial production could not begin. The intermediate (“ex-lex”) period was utilized by the developers to distribute the design of M-3 through informal academic channels.



N.J. Matyukhin  
(1927-1984)

This window of opportunity was seized by *Varga* in 1957, making use of his wartime personal contacts in Soviet academic and industrial circles. Apart from Hungary, building of (clones of) M-3 did fertilize early computer life in a few more countries, like China, Estonia and Armenia (where it served as starting point for the design of the successful Razdan family in Erevan). Finally, serial manufacturing started in the newly built computer factory in Minsk (Belorussia) from 1959, followed soon by the rather popular series of Minsk computers.

This - rather adventurous - offspring of the oldest family of Russian computers was the one we started to build in Hungary in 1958.

### 3. Building of the M-3

KKCS started actual work in mid-1957. Received premises in downtown Budapest in an office building of the Hungarian Academy of Sciences.

Recruitment of staff started in the Summer of 1957 with mainly freshly graduated electrical engineers and mathematicians (including the author). There were a few “adults” too, among them a couple of contributors of the “prison letter”. A small number of workers in a mechanical workshop were employed to build the cabinets and the

rather sizable cooling system. Young girls in the electrical workshop were preparing the circuits and did the wiring of the frames. By October 1957 the number of employees of the KKCS was 34.

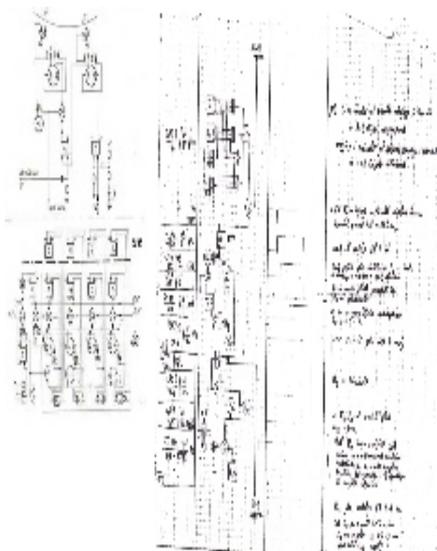
Packets from USSR started to arrive in November-December, containing detailed technical documentation, and a large number of critical components (tubes, diodes etc.). Actual building work started in early 1958 and by the Autumn more or less everything was physically ready and in place.

One of the hardest technical problems was to design and manufacture the magnetic drum, with solving the problem of galvanizing of its surface. This was done so well, that magnetic drums were even exported to Timisoara (Romania) for the MECIPT computer (This was the very first export activity in the history of the computer field in Hungary).

Having a physically complete computer, now we had to “breathe life” into it. This was done first by independently calibrating and debugging the circuits and the basic units. After this, the complex testing of the whole computer would follow.



A big difficulty was, however, experienced here: The purely technical documentation did explain the circuits and wiring only, but not the operation of the computer, the execution of the instructions. So, the (tiresome) activity to discover the “architecture” of the computer had to be performed. As none of the engineers had previous knowledge about computers (this was not yet on the curricula of the universities at that time), one of the young mathematicians (the author) was charged with this task, as a “puzzle solving” activity. As a result, we succeeded to describe the operation of the computer with the help of a specially designed graphic language, showing to the engineers at each measuring point the waveform to appear in case of the correct operation.



This helped debugging and by the end of 1958 some life-signs were shown by the M-3: individual instructions and even short programs were - sometimes - executed. This resulted in a press announcement about readiness of M-3 on January 19, 1959 (with a report in the daily newspaper “Esti Hírlap”).



From left to right:  
*Sándor Podhradzki*,  
*István Ábrahám* (standing)  
 and *Imre Molnár*, *Győző*  
*Kovács*, *László Szanyi*  
 (sitting).  
 In the back: *Bálint Dömölki*  
 (sitting) and *Zsolt Várkonyi*  
 (standing).

In practice, more or less reliable operation was still far away and the whole year of 1959 was spent with testing and with efforts to improve reliability. There were, however, short good periods sometimes, and a few first real applications could have been - with many difficulties - performed.

The main reason for low reliability was the error-prone operation of electronic tubes. So, the goal of the regular testing was to predict which tubes are going to fail in the next period in order to replace them before they actually did fail. One of the methods for this prediction was testing in extreme conditions (e.g. high/low voltages).

In the second half of 1960 the visit of *G.P. Lopato* [9], member of the team designing the M-3 (and chief engineer of the Minsk computer factory), helped the final tuning. Starting from early 1960 M-3 was in normal regular operation.



G.P.Lopato  
 (1924-2003)

#### 4. Operation of the M-3

Despite its low performance, M-3 was successfully used for the solution of many real-life problems both for scientific-engineering calculations (e.g. optical lenses, statics of a bridge) and in mathematical economics (e.g. balance of intersectoral relations, linear programming). When the news about the availability of the first electronic computer spread in Hungary, people from a wide range of professions brought to the KKCS their problems involving many calculations, having been performed earlier by hand or with electromechanical calculators. Some of the problems were even considered hopeless

to solve numerically, because of the huge amount of calculations required (e.g. inversion of large matrices).

Applications in new fields started too, like e.g. linguistics (text analysis, early experiments with machine translation).

As the most important contribution of M-3 to the computer field in Hungary, its role in educating computer experts can be considered: many of the future leading personalities - both on the development and on the application side - got acquainted with computing around the M-3.

M-3 served academic computing until 1965, then it was given to Szeged University, where it was used for educational purposes until 1968.

## 5. After M-3

In the first part of the 60s commercial computers started to arrive in Hungary both from the USSR (Ural 1, 2) and from the West (Bull Gamma, Elliott-803, Gier). Production of computers started in the second half of the 60s, with EMG-830 and the -PDP compatible - TPA series. Later, Hungary participated in the Unified System (Riad) project with its smallest model (R-10) manufactured under French license. More about the history of computing in Hungary, see in [10] and [11].

Some events to commemorate the first electronic computer in Hungary were:

- On the occasion of the 50<sup>th</sup> anniversary of the (official) launch, a memorial session about M-3 was held at the Hungarian Museum of Science, Technology, and Transport in May 2009.
- A mini-conference, devoted to the KKCS, as the cradle of computing in Hungary was organized by the IT History Forum of the John von Neumann Computer Society in October 2014 (video recording available on YouTube, in Hungarian) [12].
- A few remaining parts of M-3 can be seen at the Information Technology History Exhibition of the John von Neumann Computer Society in the Szent-Györgyi Albert Agora, Szeged [13].
- More detailed accounts on the history of M-3 have been published in English by *Győző Kovács*, key person of the M-3 building team [14], [15] and by *Máté Szabó*, a young researcher of Hungarian IT history [16].

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## **Computer oriented higher education in Hungary – the beginnings**

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**Abstract:** The history of computer-oriented higher education in Hungary started in 1957, when Prof. László Kalmár started the education of “applied mathematicians” at the University of Szeged. (The author graduated in the second year of this course, later called the “Szeged School.”) This paper starts with the computing experience around M-3, the first computer made in Hungary, and the use of this experience for educational purposes. It then continues with the initiatives of the University of Szeged, and, after surveying some basic and higher-degree courses, goes on to the institutions of higher learning offering education in computer studies, all the way to the programmer and program developer mathematician courses started in 1972 at three science-universities. However, the institutions of technical education will not be discussed in such detail; although teaching applied computing skills necessary for the technical field had begun quite early, the teaching of professional IT specialists was started only around 1990. The paper contains a table listing the first elective and founding subjects and the first specializations and independent training programmes offered by each university and college. Finally there is a short overview of the connections between contemporary professors and a list of the first conferences organized for IT teachers in Hungary.

The IT History Forum (iTF) within the John von Neumann Computer Society (NJSZT) was founded at the beginning of 2009. At one of its events, it occurred to the author that information about the beginnings should be gathered while the persons in question are still alive. The study took 3 years to prepare and is

the product of a large-scale collaboration: a total of 130 contemporary and present day teachers, researchers, and librarians participated in the work. Typotex published the material in the form of a book in 2012<sup>1</sup>. This study, which provides insight into the everyday lives of 30 institutions, is the source for this paper. (The book includes a name-index containing 300 entries and a list of almost 500 definitive contemporary articles, textbooks and technical books published until 1980.) – The paper is concluded with a brief presentation of the digitalised “Data Archive” (see the iTF website: <http://itf2.njszt.hu>) that serves to preserve the history of computing in Hungary.

**Keywords:** History of informatics; M3; computer oriented education; John von Neumann Computer Society; history of computing in Hungary

## Preface

In Hungary, the history of computer-oriented higher education started in 1957, when László Kalmár launched the *Applied mathematicians course* at the University of Szeged. (Later this course was referred as “Szeged School”; the author herself graduated in the second year of it.)

By that time, work had commenced in Budapest on the first Hungarian-built computer, the M-3, which was put into operation in 1959. Developers and programmers of computer programs, as well as a group of professionals from universities and companies were responsible for setting the wheels in motion that led to the spread of computer skills in Hungary, and later to the institutionalised education of it.

Although there are reports that deal with the beginnings, it is the contemporary participants who can provide us with real detail. (Back then, there was no internet-accessible digitalized storage that would be able to preserve data of events, participants, etc.)

During an event held by the IT History Forum (iTF) – which was founded at the beginning of 2009 within the John von Neumann Computer Society (NJSZT) – the author thought of the idea of clarifying the events of these beginnings, while the persons in question are still alive. The leaders of the iTF embraced the idea and work started immediately on the study entitled “Computer Oriented Higher Education in Hungary –

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<sup>1</sup> Edit Sántáné-Tóth: ‘Computer Oriented Higher Education in Hungary – The Beginnings’. Typotex, Budapest, 2012. p. 366. [http://www.interkonyv.hu/konyvek/santane\\_toth\\_edit\\_a\\_szamitastechnika\\_felsofoku\\_oktatasanak\\_kezdetei](http://www.interkonyv.hu/konyvek/santane_toth_edit_a_szamitastechnika_felsofoku_oktatasanak_kezdetei)

The Beginnings”, which used documents and the (sometimes contradictory) recollections of witnesses to provide an overview of the beginnings as accurately as possible. The iTF held a total of four events in 2010 and 2011 about this history (conveying the words of contemporary participants), during which events the amount of materials, the level of authenticity, and the number of active participants all increased.



Figure 1: Lecturers at the 11 March 2010 event on the institutions that offered computer education by 1971 (from left to right): *Bálint Dömölki, Edit Sántáné-Tóth, János Szelezsán, Péter Gábor Szabó, Péter Hunya, Győző Kovács, János Csépai, Lajos Ivanyos, Dezső Sima, Ferenc Gémes*, and, amongst the attendees: *Sándor Faragó and Gábor Kógelmann*.

At the outset, the aim was to provide a true history of the “Szeged School”, which was naturally followed by work on providing a comprehensive Hungarian overview. However, in the interim, we had to face the fact that the only persons truly capable of providing factual accounts of what happened half a century ago are those who (at least tangentially) participated in the events. This led to intensive correspondence to seek out living witnesses.

Information was compiled first on the beginnings in Hungary, then on the institutions that started independent training in the field of computer sciences by 1971. The collection of materials on education started by 2012 at three science-universities was also commenced, and interviews were made. Sixty enthusiastic persons helped in developing the first version of this study, which was finished by the end of 2009. Its 1st part contains reports on the various institutions in the order of offering independent training. The time-limit of our history is 1980, since by that time computer science (informatics) had generally taken its place in higher education and the basic structure of education of computer studies had taken on its form.

The version of the study finished in February 2010 was uploaded to the NJSZT-iTF website to provide interested professionals with an opportunity to discuss the material (after which the file was updated monthly). The feedback received, and more correspondence allowed us to contact still more contemporary witnesses and people who could help; with them, the study’s message became increasingly diverse and rich.

Intensive work soon commenced to research the histories of the missing higher education institutions. By contacting the friends of friends and writing many letters asking for favours, we managed to find witnesses who undertook to gather together their memories on the beginnings of computer-oriented education. These included people who committed themselves to locate the contemporary documents, accept my participation as editor, and write the contemporary history of their respective institutions. Thus, the second and third parts of the material are about those higher education institutions where we were able to compile histories through intermediaries or from contemporary documents. In order to meet their special educational targets, these institutions included, far before 1972, the computer-related information required for education of the involved fields at the time, though they only launched these specialisations and courses at a later time.

The material prepared after much consultation is *a collective creation: a total of 130 contemporary and present teachers, researchers, and librarians participated in the work*. However, despite of all these endeavours, it still does not provide a complete picture of the beginnings of computer-oriented higher education in Hungary. There are significant higher education institutions (e.g. law and medical universities) that we did not deal with. In absence of substantive information, we therefore do not provide information on their first steps. However, we can definitely say that *the work does provide a good overview of the beginnings in Hungary: the respectable fight of contemporary teachers and their supervisors to introduce new computer-oriented subjects, compile the first curricula, acquire the first computers, and launch the various new sections, specialisations, and courses* (To quote *Gyula J. Obádovics*<sup>2</sup>: “Only try to introduce a new subjects if the gods are on your side.”). In all cases, the authors attempted to provide authentic descriptions to the greatest possible extent.

Meanwhile, the need arose to compile a list of contemporary technical books, higher education textbooks, and notes (published until 1980). A list of 300 people included in the material was also drawn up (even though we realise that only a part of the contemporary actors could be named). Four tables at the end of this paper summarise the first elective and founding subjects and the first specialisations, sections offered by each university and college. The paper also deals with the connections between contemporary teachers of computer sciences (based on correspondence and personal meetings), as well as the first conferences and events they held.

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<sup>2</sup> Gyula J. Obádovics’s book entitled *Mathematics* has been used for generations and is simply referred to as “The obádovics.” Thanks to his textbooks, we consider him to be one of the founders of computer-oriented education in Hungary.

The three parts of the book published by Typotex in 2012 provides insight into the lives of 30 institutions – including a brief history of the various institutions. These institutions naturally include those dealing with holding training courses, postgraduate courses, and other special continuing education. The work summarises the events in computer-oriented/IT education that transpired at universities and colleges in the form of four tables (a brief version of which is also included herein).

The present paper provides a short overview of the beginnings of computer-oriented education in Hungary. Chapter 1 provides an insight into the lives of institutions that launched separate computer-related courses by 1972 – with some more detail provided about the institutions in which the author studied or taught. Chapter 2 presents some interesting solutions and experiments in teaching programming methodology. Chapter 3 gives a short outline of the beginnings of Hungarian technical universities and colleges. Chapter 4 contains the four summary tables mentioned above and the conclusions that can be drawn from them. Chapter 5 deals with the relationships and the first conferences of contemporary lecturers. The conclusion discusses the iTF Data Archive and its Persons section.

## **1. From the cradle to the institutions that launched computer-related courses by 1972**

Two large directions can be found in the development of computing in Hungary: the branches of computer science (as we did say then: cybernetics) and of administrative data processing.

- The first prominent product produced by the *computing branch* was the first Hungarian computer, the M-3, which was built by the Hungarian Academy of Sciences' (MTA) Cybernetics Research Group (KKCS) in 1957. László Kalmár of the University of Szeged took the second step in this direction: with the foundation of the “Szeged School”, he preceded the other higher education institutions in spreading and teaching mathematical logic and computer science in Hungary.

- The *administrative data processing branch* is linked to the Central Statistical Office (KSH), as, starting from 1953, it supervised the distribution of punch card machines that met the data processing needs of the time, as well as the connected training, information, and central purchasing. In the 1960s, the KSH also organised computer training courses, too (since the need arose).

The following is an overview of the lives of the institutions that launched computer science courses by 1972. (The Hungarian acronyms of the English names are provided in parentheses to allow for identification.)

### **a) Cybernetics Research Group of the Hungarian Academy of Sciences' (MTA KKCS)**

The research Group played an important role in *the introduction of computing to Hungary and in its popularisation*. The first programmers were the very people who built the M-3, though many users and teachers who later came into contact with it had their *first computing experiences* thanks to the M-3. Since this was the only operational computer in Hungary at the time, the first students of the Szeged School also spent their technical practice with, and wrote their theses on, the M-3. The training course entitled "*Programming the M-3 electronic computer*" was organised in 1958-59: it consisted of 37 lectures held by the employees of the Research Group. Many of the almost fifty participants of the lecture series became renowned computing experts, leaders, and teachers in Hungary.

The Research Group's employees regularly held informative lectures and seminars for secondary school students. Many colleagues also held regular lectures and seminars in higher education institutions. Thus, we are right to say that the Research Group was *the cradle of Hungarian computing education*.

In 1963, the Researcher Group's employees organised the *Special Department for Information Processing, Cybernetics, and Operational Research* within the *Union of Technical and Natural Science Associations (MTESZ)*. – It should also be noted that this Department was one of the predecessors of the *John von Neumann Computer Society (NJSZT)* established in 1968. – They organised successful conferences with the title "*Computer Technology*" in 1968, 1971 and 1974.

### **b) University of Szeged (SZTE) – later Attila József University (JATE)**

As mentioned earlier, the first computer-oriented education in Hungary was provided in the University of Szeged under the leadership of *László Kalmár*<sup>3</sup> in the first semester of the 1957/58 school year. However, that is not where this story begins. He was first interested in mathematical logic in the 1920s and then turned to computer science in the 1950s. He undertook the fight to introduce these sciences to Hungary.

In 1956, László Kalmár organised his *famous seminar* at the University's Bolyai Institute<sup>4</sup>, targeting the technical and other applications of mathematical logic and cybernetics. During the course of the above, he designed the *Kalmár's logical machine*

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<sup>3</sup> In 1996, László Kalmár's oeuvre was recognised by the Institute of Electrical and Electronic Engineers (IEEE) by the Computer Pioneer Award, given to pioneers in the history of computer sciences. (In 1996, the IEEE broadened its scope to include computer pioneers from Central and Eastern European countries in its award, (posthumously) granting it to 19 prominent figures, including László Kozma – see below.)

<sup>4</sup> The Bolyai Institute in Szeged was awarded the Hungarian Heritage Award in 1997.

in 1957. (The machine was presented at the University on 1 May 1958.) This was the environment in which *László Kalmár's formula-driven machine* and *Dániel Muszka's Electronic Ladybird* were created.<sup>5</sup>



Figure 2: The Kalmár's logical machine



Figure 3: Muszka's Electronic Ladybird

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<sup>5</sup> The Kalmár Logical Machine and Dániel Muszka's Electronic Ladybird were presented at the Budapest Industrial Show in 1960 to resounding success.

The work on the seminar led to the development of a *strong body of teachers*. László Kalmár, the enthusiastic teacher and born propagator of the knowledge, soon realised that the time was ripe to launch the education of experts in applied mathematician and computer programming at the University. He fought to receive the Ministry's approval for 5 percent of the third-year teaching students who were studying two courses "to leave one course and continue more in-depth studies in a special area of their remaining course". For the first time in Hungary, the *Applied (computer) mathematics course* was launched in Szeged in the fall of 1957 – with 3 students. Thus commenced the operation of the "*Szeged School*". At the outset, the in-depth knowledge was imparted upon students in the framework of the *Programming of Automatic Computers* and the *Numerical and Graphical Methods* subjects.

We would also like to note that from the 1963/64 school year, the Szeged School was started from the very first year. However, the number of students never reached 15 in any one year. (The degree to which this failed to satisfy the needs of the market at the time is shown by the fact that the total of 9 students who graduated in the 1968/69 school year could choose from among 61 jobs.) At first, students could only access a computer in Budapest; they wrote programs on chalkboards ("chalk programming") and ran the programs in their heads. Then, in 1963, the *Cybernetics Laboratory* was established under the leadership of László Kalmár. This initially used the M-3 computer and was able to provide the computer background for teaching and research on-site.

### **c) Computing Teaching Centre (Számok)**

The story behind the establishment of the Számok in 1969 is entirely different. By that time, the government had realised that several thousand new computer experts were now required every year. It therefore commissioned the Central Statistical Office, which had experience in the field of administrative data processing, to launch the appropriate trainings and to provide for the details of this task. It ended up creating Számok and entrusted Sándor Faragó with its management. (Besides developing curricula and the examination system, Számok also dealt with the publication of technical books on computing.) Control Data Corporation (CDC), known at the time for its top-of-the-line computers and its training branch, provided the know-how – under a grant from United Nations Development Program (UNDP). As there was no teaching body, a tender was announced for mathematicians, engineers, and economists who spoke English at least at an intermediate level (500 applications were received for the 43 positions). After an intensive two-month English language course, then the selected young people participated in half-year (programming, computer engineering, and systems manager) training at CDC's training centre in Frankfurt.

Számok started the education in the autumn of 1971. Their successful trainings even took them to other (mainly Arabic) countries. As a point of interest, we would like to note that the so called rotation system was launched in 1973 for teachers. First, they created a practical workshop to perform organisation tasks for third-party orders. Then, teachers were required to regularly (once a year) participate in the workshop's activities – to ensure their practical work was founded on experiences.

By way of its various levels of trainings (and courses), Számok was the first to provide an organised format for lifelong learning. For example, they were the first to offer computing-oriented postgraduate courses for experts with university/college degrees. Finally, we would also like to mention the TV-BASIC training series aimed at popularising computing, launched in the beginning of 1980 together the NJSZT and the Hungarian National Television. This training provided a certificate after a successful exam.

#### **d) *Karl Marx University of Economics (MKKE)***

At the initiative of Béla Krekó the Plan-mathematician economist course was launched at the University of Economics starting from the 1960/61 school year. The course aimed to provide experts with thorough macroeconomic skills and experience in the application of mathematical methods and the involved computing skills. About 150 Plan mathematicians had graduated by 1972, and they were highly sought after on the labour market. The Economic mathematician specialisation launched in 1968/69 was a continuation of this training. In addition, the University also introduced a 4-semester computing subjects (and was the first to do so in Hungarian higher education) in the 1971/72 school year, which was compulsory for all first and second year students.

It should be noted that the University Computing Centre was established in 1964 as the basis of University computing education and the institutions' research and development activities. The Centre was housed in the University, and for good reason: Béla Krekó played an essential part in its creation and operation. The Computing Centre was thus available (on-site) for Plan mathematicians.

#### **e) *Kálmán Kandó Electrical Engineering Technical College (KKVMF)***

In 1968, Lajos Ivanyos prepared a recommendation at the College for launching higher education for the computer experts (more specifically, computer operators) required by Hungarian computer centres. After reworking the proposal (and after certain reorganisation at the College), the Computer technician course was launched in the 1970/71 school year with 31 students. Furthermore, starting from the second half of the

1970/71 school year, computer sciences were also taught to all students at the Faculty of Colleges. In 1975, the teaching of the Computer technology tools course was moved from Budapest to the College's Off-Campus Division in Székesfehérvár – all to meet the demand of the Videoton computer manufacturing plant in Székesfehérvár.

It is also important to note that the Engineering informatics course that was launched for the first time at a Hungarian college in the 1988/89 school year by the College's successor (Kálmán Kandó Technical College, KKMf) formed the basis of the Engineering informatics courses introduced at 1988/89 – Hungarian colleges.

#### **f) College of Metallurgy- and Metal-Industry of Dunaújváros (KFFK)<sup>6</sup>**

Ever since its establishment in 1969, the purpose of the College Faculty was to meet the demand of the Danube Iron Works in Dunaújváros. It must first be noted that the Iron Works' Operations Research Group had already been dealing with using computers for metallurgical applications under the leadership of Ferenc Gémes since 1961. (The author herself worked here for 9 years). However, due to a lack of computers in Dunaújváros, the number of persons in the Group decreased after 1971 – several left to research institutions while others went to teach at the College.

The latter experts already had ten years of experience in solving practical problems, and were able to launch a successful System engineer course in the 1971/72 school year. Starting from the same school year, all of the College's students were required to study the basics of computing. They were later provided access to a computer, compatible with computers acquired by the Iron Works that provided both to the College and to the Iron Works a great deal of security. Finally we note that the College established the Engineering informatics course referred to above in the 1992/93 school year.

#### **g) Eötvös Loránd University (ELTE)**

Computing education at the ELTE was commenced from the mid-1960s integrated ("smuggled") into certain subjects (e.g. analysis lectures and the mathematics classes of chemistry and physics students), and regarding which seminars and special classes were held, after which it became an elective and finally a separate subject. The curriculum already had a computer-oriented subject in the first semester of the 1957/58 school year. In the 1971/72 school year, Computer sciences was a compulsory subject for 2 semesters at ELTE's Faculty of Natural Sciences. In the interim, work started and led to the launching of the Programmer mathematician course in the 1971/72 school

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<sup>6</sup> It was then a *Faculty of Heavy-Industry Technology University (NME)*.

year – in accordance with the curriculum agreed on with other universities. The details of this will be discussed below. (It should be noted here the Computational linguistics course was started in the 1962/63 school year at the General Linguistics Department at ELTE's Faculty of Humanities.)

#### ***h) Lajos Kossuth University (KLTE) – in Debrecen***

At the University of Debrecen the head of the Mathematicial Institute, Béla Gyires realised early on that the global surge in the development of computer sciences meant he had an urgent task. In 1963, he sent two of his teachers to the Cybernetics Research Group (mentioned above) to study the operation and programming of the M-3. Upon returning from Budapest, they immediately started developing a computer curriculum and organising education.

For years, teaching took the form of theoretical lectures only (in absence of a computer, they used “chalk programming”, just like in Szeged). In 1967, they finally received an Odra-1013 computer. They organised trainings for university professors and, starting in 1971, even held computer continuing education in the summers for secondary school teachers. Meanwhile, they also joined the works undertaken to prepare for the Programmer mathematician course described below.

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The following is **the history of the development of the *Programmer mathematician (and later the Program developer mathematician) courses*** offered by the three Hungarian science-universities (ELTE, and the universities of Szeged and Debrecen) starting from the 1972/73 school year.

By the 1970s, there was quite a variety of computers in Hungary, and it was becoming increasingly clear that, in addition to operating and programming computers, *the development of computer programs required special technical skills*. People recognised that higher level education had to be provided en masse to professionals with these skills (Számok was not, and could not have been, responsible for this task).

The idea that ELTE could train programmers who were at home in program development and had suitable mathematical modelling foundations came naturally. Towards the end of the 1960s, there were already some attempts at this at the University (though these were vetoed by certain mathematicians).

The Government in 1968 prepared the Central Computer Development Program (SZKFP), which was supervised by the Ministry for Culture. The Ministry requested (instructed) the three Hungarian science-universities to provide basic computer training

to the majority of the students of their Natural Science Faculties and to aid researchers in using computers and computing skills. In connection with these tasks, ELTE established its *Department of Numerical and Computer Mathematics* in 1968.

The Ministry's *commission on mathematics* discussed *the need for launching college-level computer education* several times. Since the Ministry was not opposed to the idea, the experts at the three universities started developing the training program. A committee with four members (*László Kalmár, Imre Kátai, József Mogyoródi, and János Szelezsán*) was quickly set up at ELTE to initiate a *Programmer mathematician* course at ELTE's Faculty of Natural Sciences, which would provide strong modelling skills.

In the beginning of the 1970s, the Ministry then requested the three universities to develop a program for computer oriented higher education. ELTE's Department of Numeric and Computer Mathematician, led by *Imre Kátai*, was given this task. ELTE's representatives in the above committee would have liked to launch a training program similar to that of the Szeged School, but *László Kalmár* stood his ground and protected Szeged's interests. At first, the university of Debrecen (represented by *Béla Gyires*) was also opposed to the initiative, as they did not feel that such experts were guaranteed a possibility of finding jobs. However, *Imre Kátai* devoted his efforts with unheard of dynamism to organise the new course. Meanwhile, the experts at the university of Debrecen processed the computer curricula of universities in neighbouring countries, which led to the harmonised curriculum and the Ministry for Culture's Instruction No 119/1972 (M.K.9) on the introduction of the three-year programmer mathematician training:

*“Starting from the 1972/73 school year, the mathematics courses offered by science-universities will also be host to three-year education courses providing an education as a programmer mathematician. After completing their studies and passing the final State examinations, such students will receive a ‘Programmer mathematician’ college-level degree. This Instruction shall enter into force on the day of its publication. The involved parties shall directly receive the curriculum of the Programmer mathematician course.”*

And so **the Programmer mathematician course was launched** at the three universities in the **1972/73 school year**. This course later (first at ELTE) provided the basis for **a 2-year Program developer mathematician course that provided a university-level degree** – thus implementing a unique, two-tier university-level education that was successfully used for 35 years. Although the Program developer mathematician course was launched in 1979 at the university of Szeged, the Szeged School continued its functions without any manner of transfer between the two. The Program developer mathematician course was started at the university of Debrecen only in 1988.

In response to social pressure, ELTE soon launched the *Program developer mathematician course* in the form of *evening classes*. This meant that the people who started working after receiving their college degree following their 3rd year could get a university degree by taking evening classes.

Starting in 2000, in the spirit of the Bologna process, Hungarian universities carried on with this unique (two-tiered) university level training by introducing a two-tiered system starting with a college-level (not a university-level!) (BSc) and ending with a 2 year university-level (MSc) education.

## 2. Some special Hungarian methods of teaching programming

By 1959 Hungary had two Ural-1 type computers in addition to the M-3. All three computers were located in Budapest, forcing students in Szeged to write programs using paper and pencil or chalk and chalkboard and to run programs in their heads (later called “dry runs”). Since it could be expected that newer types of computers would be purchased, it was not considered expedient to teach computer programming on any one machine. In order to be able to present the various programming steps as clearly as possible, Prof. **László Kalmár** at the university of Szeged taught computer programming methods on the so-called *Kalmár’s fictive computers*. The three-addressed (and later the single- and double-addressed) machines that he defined unified the features of the respective computer types, thus showing what could be the (dis)advantages of any given command. When they were able to access an actual computer, students had to first assess the features of the specific type that were in common with the fictive machine; afterwards, they were able to apply the learned programming techniques relatively quickly.

However, in 1960 he realised that these specific sets of commands used to drive the fictive machine were also limiting his scope. From that time on, *he defined unique commands (add, subtract, move, go to, etc.) that were independent of each other* instead of fictive machines (equipped with command sets). (Moreover, the practical classes gave students the opportunity to learn about all the specific computers that they received specifications for.) A great disadvantage of programming with fictive machines is that the program could not actually be run (which is not a particular setback compared to the fact that – in lack of any computers – students could not run their programs written for any specific computer). This was literally *chalk programming*, which did not give students the experience of running a real program, and the didactic advantages of re-running a program after error correction could also not be utilised.

*The appearance of high-level programming languages* naturally brought about a new situation. Just as in the case of mathematical terms, Kalmár strived to make

teaching as visually stimulating as possible, for example illustrating *cycle commands* with a servant carrying water in a can and the changes in cycle variables with the number of pebbles removed by the servant one by one. He taught ALGOL 60 and later ALGOL 68 with a unique graph method called *flagged figures*. This allowed to provide a better understanding of the given language and the structures and workings of the various programs, thus also helping in checking and debugging the programs.

Finally, we would like to note that László Kalmár *considered it important to teach using tangible objects that helped understand actual practical tasks and gave a life-like approach*. That is why experimental physics (and the accompanying subjects) were not left out of the Szeged School even when the applied mathematics course could be elected as a secondary course starting from the 1st year.

The following is a presentation of the idea of **Ákos Fóthi's**, a professor at ELTE, which led to the founding of a school. He taught the basics of high-level programming (instead of presenting the solutions used by the specific programming languages) by approaching it from the direction of *abstract programming based on relational programming models*. After the *Programmer mathematician course* was set on its way in the 1972/73 school year, he soon developed the characteristic method for teaching the *Programming methodology* (also called *Introduction to programming*) subject, which was consistently followed. The subject dealt with the examination of the theoretical background behind the methods instead of the methods used to create programs: "Programming methodology is a theoretical subject and is part of programming theory: it deals not with the characteristics of various programs, but with *the theory of problem-solving*," – wrote Ákos Fóthi. So the essence is its task-centric nature, i.e. the analysis of the problem to be solved. As a result, he uses the definition of relations, and not the term of functions, as his basis (since the execution of parallel programs is non-deterministic). According to Fóthi, the task is a relation that orders points of a state space to the points of a state space while a program maps a series of points of a state space to the points of a state space. As the end result, the program gives the endpoint(s) of such series, which is 10 called a *program function*. On its basis, it can be determined when a program is a solution to the given task. An important element of the subject is that it provides more than one program (program function) for a task – and also helps prove the correctness of the program.

To quote the opinion of one of Ákos Fóthi's students<sup>7</sup>, "I think that anyone who does not consider the Introduction to programming subject to be important, or considers it outright pointless, is missing the point. It provides students with a number of principles

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<sup>7</sup> <http://www.markmyprofessor.com/tanar/adatlap/8880.html>

that can be used for programming and also helps understand terms that you meet during programming. It also teaches you to think logically and shows you just what it means to prove that a program is correct.”

### 3. On the computing education of technological education institutions

In the 1960s the technical colleges and universities launched application-directed, so-called *applied computing subjects* wishing to meet the demands of the market. The purpose of education was to train students who had the computing skills required for their professions, had a good command of the problem-solving approach specific to their fields of expertise, and were able to apply the computing skills in their problem-solving. These institutions provided technical courses with specialised computer training, called *Engineering informatics* held at the **Budapest Technology University (BME) Faculty of Electrical Engineering** standing out from the crowd by the end of the 1980s, which, following in the footsteps of the **Kálmán Kandó Technical College's (KKMF) Engineering informatics** college-level course (mentioned in Chapter 1), led to the launch and subsequent spreading of *Engineering informatics* education in Hungary. Because of the above (and in order to save space) we will be dealing only with the beginnings of the BME's Faculty of Electrical Engineering; Tables 2-4 in Chapter 4 provide information on the first steps of the remaining technical education institutions.

Organised computer training was launched at **BME's Faculty of Electrical Engineering (VIK)** in the 1960s. By the 1970s, the computer-based approach had become widespread in technical subjects. The purpose of education was focused on teaching the use and programming of computers as well as the skills related to the development and operation of computer tools and equipment.

**László Kozma**<sup>8</sup>, one of the Faculty's founders and the creator of the first programmable computer that used relays, the MESZ-1, should be the first to be mentioned.

Between 1956 and 1958, László Kozma designed and built the MESZ-1, the first Hungarian programmable computer that used relays (see Figure 4.). It was put into operation in 1958. This machine was used in education and for scientific research for ten years. It was found to be quite advantageous for teaching purposes: since it was comparatively slow, its operations could be followed visually.

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<sup>8</sup> In 1996, László Kozma's oeuvre was recognised by the Institute of Electrical and Electronic Engineers (IEEE) by the *Computer Pioneer Award*, given to pioneers in the history of computer sciences. (In addition to the creation of the first Hungarian programmable computer using relays, the reason for the award included the creation of a special computational linguistics computer for the MTA Research Institute for Linguistics. In recognition of his earlier work, they also mention the fact that he worked on developing electric calculators at the Bell Telephone Manufacturing Company's laboratories in Antwerp between 1938 and 1942; ten patents attest the successfulness of his work.)

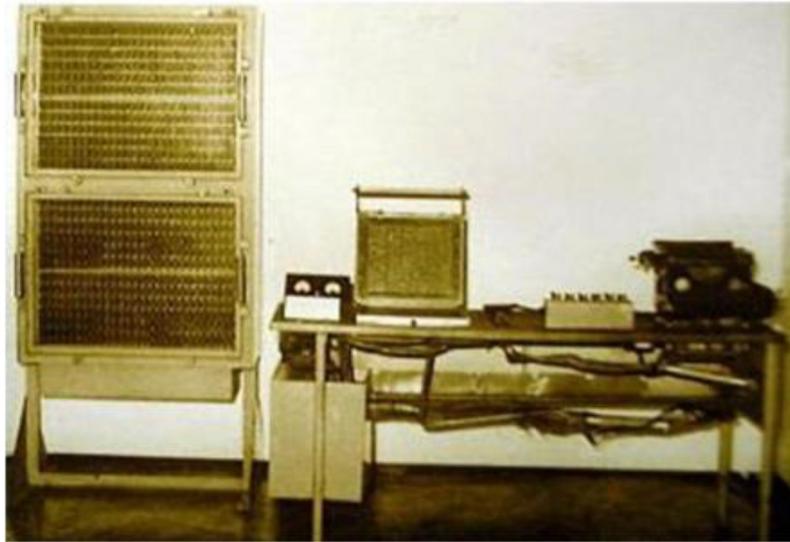


Figure 4: Kozma's MESZ-1

In addition to designing arithmetic circuits, computational circuits, and others, László Kozma's classes on logic circuits and telecommunications networks undoubtedly also discussed computer programming as well, which can thus be considered the first instance of computer education at the Faculty.

The *strict curricular education* used at the University delayed the introduction of computer training at all of its faculties. The rules of the University stated that *the entire curriculum for the whole duration of the course (i.e. five years) had to be prepared by the time the course started*. Thus, when a need arose to implement a change, several years had to pass before an introduced reform affected the entire student body and all courses of the given faculty. However, teachers were driven by the desire to teach students about computing.

Starting from the 1959/60 school year, the **Faculty of Electrical Engineering** provided a possibility for starting institutionalised computer education by announcing *elective subjects and alternative subjects*, which latter were available to certain, typically fifth-year students. (In this case, the alternative subjects meant that one or two had to be selected in the given semester from 2-10 possibilities.) Special subjects of computer science were made compulsory starting from the 1964/65 school year. Afterwards, they launched *six computer-oriented specialisations* in the beginning of the 1970s, which were also applied in the education of computer engineers. Of these six, the subjects found to be useful and worthwhile were then included in the Faculty's regular curriculum after a delay of a few years (within the framework of the rigid curriculum requirements). Computer sciences were naturally included in the various technical subjects quite early on (just as at ELTE).

The industry – and thus the market – set an increasingly strong demand for the education of professionals with a thorough knowledge of informatics and adept at solving the problems incurred in the given sectors. With this *external demand*, the teaching of information technology-oriented subjects at technical education institutions also underwent strong *internal development*. As a result, the Faculty was the first in Hungary to introduce a (university-level) *Informatics course* in the second semester of the 1986/87 school year. The course first had 75 first-year students who had transferred from other courses. Starting from 1987/88, students were accepted based on acceptance scores.

The continuous increase in user requirements regarding informatics education made it necessary to create an independent *Informatics course* that carried the same weight as the aggregate of electrical engineering courses and that could not be thematically linked to electrical engineering but had a separate curricular structure equal in rank to those of electrical, mechanical, chemical, etc. engineering courses.

The first year of the *Engineering informatics course* was launched at the Faculty in September of the 1991/92 school year. (The students who graduated from the Informatics course were already given *Engineering informatics* degrees.) At the same time, the Informatics course was terminated and the electrical engineering education was continued in a new system. As the years passed, the number of students at the Engineering informatics course reached and then exceeded the total number of Electrical engineering students. (12)

#### 4. Characteristic features of Hungarian universities and colleges

The diversity of the composition, interests, technical background, and connections of the respective teaching staff at Hungarian education institutions provided for different topics, even at identical times. The objectives of the computer courses launched at almost identical times, their institutional conditions, the selection of guest lecturers available to hold special lectures and the targeted market were different.

There is even a difference in the method by which the institutions introduced computer education. For example, ELTE and the university of Debrecen started off by integrating it into certain subjects in the form of seminars and special classes from the mid-1960s, after which it became an elective and finally a separate subject. There were numerous such initiatives at the various faculties of the Budapest Technology University (BME) as well; however, the *rigid BME curriculum regulations* discussed in the previous chapter negatively affected incremental development. Here, computer subjects first made their appearance as alternative subjects: those subjects that were deemed successful and

useful were included in the regular curriculum with a delay of several years. The situation was different where *strong personalities* who established schools, were capable of realising their intentions or where *considerable external demand* created a possibility for launching computer education that was independent from the outset – we will discuss some examples later.

The following Figure 5 presents the developed forms of computer education in Hungary according to type, level, and development process. It presents the developed forms of computer education in Hungary according to type, level and development process. (The initiator and one of the elaborators of this 3D state space was Dezső Sima, professor at Óbuda University.) – The X-axis summarizes (in chronological order) the earlier mentioned levels of education. The Y-axis shows the evolving aim of the education – which led to two kinds of courses: the *Program developer mathematician course* (as kind of “Computing major” education) and as the final form of application-direction computing education, the *Engineering informatics course* (as kind of “Computing minor” education). The Z-axis shows the evaluation steps of kinds of education (see below the 2-5 columns of the surveying tables).

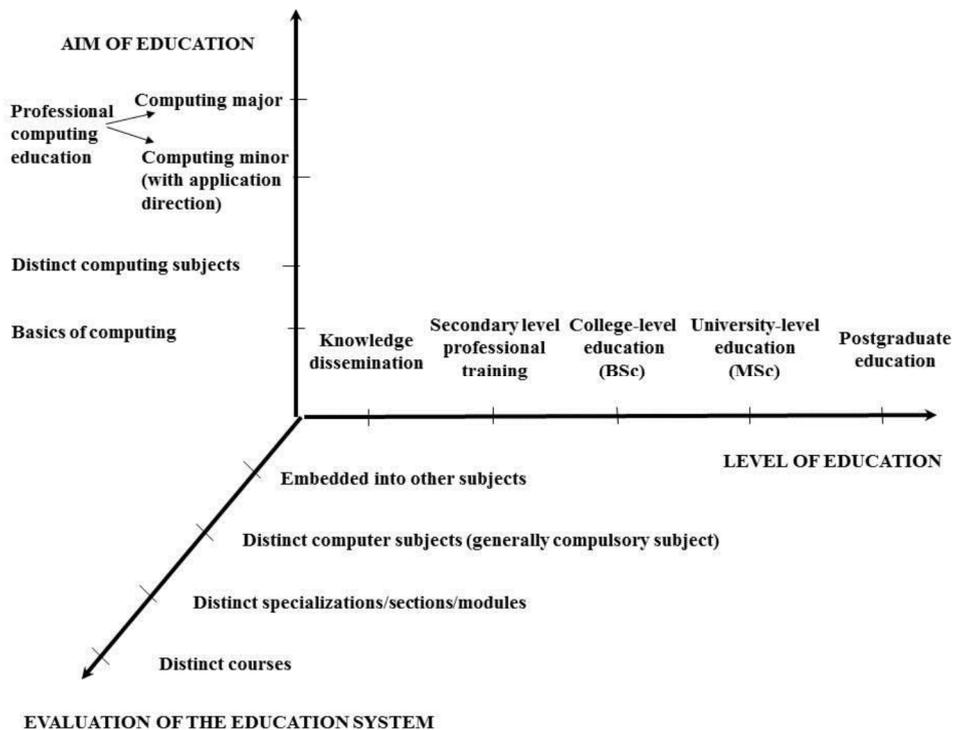


Figure 5: The state-space of the evaluation of forms of education in Hungary

The following tables provide a summary of the data characteristic of Hungarian universities and colleges and the main milestones of the development of computer-oriented education (with dates):

- The first column contains the contemporary names of the various institutions, (in case of two science-universities the well-known direct successors). We also indicate (in parentheses) the present (2017) legal successor, where we use the Hungarian name to facilitate internet searches (websites have English versions); the book also names the earliest successor of each.
- The following columns show the steps in the development of computer-oriented education –from the first, facultative optional objects to the steps shown in the Z-axis of the Figure 5.
- Table 1 contains the data of the universities and colleges presented in Chapter 1 (in course-launching order).
- Table 2 shows data of the faculties of Budapest Technology University (BME) significant from the aspect of computer-oriented education.
- Tables 3 and 4 represent data of other universities and colleges (in alphabetic order).

Table 1: The first independent, computer-oriented university/college-level courses to be launched.

Contemporary name of the institution (with the present successor in Hungarian)	First, facultative optional subjects	First distinct subject (generally compulsory subj.)	First distinct specializations/ sections/ modules	First distinct courses
- 1945-1962: University of Szeged ( <b>SZTE</b> ) - 1962-2000: Attila József University ( <b>JATE</b> ) - (2000-: Szegedi Tudományegyetem, <b>SZTE</b> )	- 1957/58: <i>Programming of automatic computers</i> - 1957/58: <i>Structural elements of computers</i>	- 1971/72: <i>Computer technique</i>		- 1957/58: (III. year): <b>Teacher of mathematics and applied mathematician course</b> - 1972/73: <b>Programmer mathematician course</b> - 1975/76: <b>Program-developer mathematician course</b>
- 1953: Karl Marx University of Economics ( <b>MKKE</b> ) - (2003-: Budapesti Corvinus Egyetem, <b>BCE</b> )		- 1971/72 (2-years): <i>Basics of computing</i> - the first time at universities.	- 1968/69: <b>Economic mathematician specialization</b>	- 1961/62: <b>Plan-mathematician economist course</b>

Contemporary name of the institution (with the present successor in Hungarian)	First, facultative optional subjects	First distinct subject (generally compulsory subj.)	First distinct specializations/ sections/ modules	First distinct courses
			- <b>Business specialization</b>	- 1975/76: <b>Economic planning course</b>
<p>- 1969:Kálmán Kandó Electrical Engineering Technical College (<b>KKVMF</b>)</p> <p>- 1991-2000: Kálmán Kandó Technical College (<b>KKMF</b>)</p> <p>- (2010-: Óbudai Egyetem, <b>OE</b>)</p>		- 1970/71: <i>Computer technique</i>		<p>- 1970/71: <b>Computer technician course</b></p> <p>- 1979/80: <b>Computer technician systems c.</b> (in Budapest, <b>Computer technique tools course</b> (in Székesfehérvár)</p> <p>- 1987/88: <b>Informatics course</b></p> <p>- 1988/89: <b>Engineering informatics course</b></p>
<p>- 1969: NME College Faculty of Metallurgy and Metal-Industry of Dunaújváros (<b>NME KFFK</b>)</p> <p>- (2016-: Dunaújvárosi Egyetem, <b>DUE</b>)</p>		<p>- 1971/72 (1-year): <i>Basics of computing</i></p> <p>- from 1974/75: <i>Computer technique</i></p>	- 1971/72: <b>System engineer section</b>	<p>- 1972/73: <b>System engineer course</b></p> <p>- 1992: <b>Engineering informatics course</b></p>
<p>- 1950-: Eötvös Loránd University (<b>ELTE</b>)</p> <p>- 1950-: Eötvös Loránd Tudományegyetem, (<b>ELTE</b>)</p>	- 1961: <i>Programming of M-3 and Ural-1 computers</i>	<p>- 1957/58: <i>Theory of computers, Information theory</i></p> <p>- (1971/72 (1 year): <i>Computing</i>)</p>	- 1969/70: <b>Numeric and computer mathematician specialization</b> – in the Mathematician course	<p>- 1972/73 (I.-III. years): <b>Programmer mathematician course</b></p> <p>- 1975/76: (IV.-V. years) <b>Program developer mathematician course</b></p>
<p>- 1949: University of Debrecen (<b>DE</b>)</p> <p>- 1952-2000: Lajos Kossuth University (<b>KLTE</b>)</p> <p>- (2000-: Debreceni Egyetem, <b>DE</b>)</p>		<p>- From about 1965: <i>Programming of M-3 computer</i></p> <p>- (1972 in Faculty level): <i>Basics of computing</i>)</p>		<p>- 1972/73 (I.-III. years): <b>Programmer mathematician course</b></p> <p>- 1988/89 (IV.-V. years) <b>Program developer mathematician course</b></p>

Table 2: The development of computer education at BME's various faculties.

Contemporary name of the institution (with the present successor in Hungarian)	First, facultative optional subjects	First distinct subject (generally compulsory subj.)	First distinct specializations/ sections/modules	First distinct courses
- 1949: Budapest Technology University ( <b>BME</b> ) - (2000-: Budapesti Műszaki és Gazdaságtudományi Egyetem, <b>BME</b> )				
- 1949: BME Faculty of Electrical Engineering ( <b>BME VIK</b> ) - (1992-: BME Villamosmérnöki és Informatikai Kar, <b>BME VIK</b> )	- 1959/60: <i>Computing</i> - 1959/60: <i>Math. problems of analogous computers</i> - 1964/65: <i>Development of digital systems</i>	- 1964/65: <i>Automation and computer</i> - 1969/70: <i>Programming of computers</i> - (1971/72: <i>Basics of computing</i> )	- 1969/70: <b>Digital computing section</b> - in the Telecommunications course	- 1963/64: <b>Control engineering specialist – post-graduate course</b> - 1986/87: <b>Informatics course</b> (diploma: <b>Engineering informatics</b> ) - 1991/92: <b>Engineering informatics course</b>
- 1873: BME Faculty of Architecture ( <b>BME ÉPK</b> ) - (1973-: BME Építészmérnöki Kar, <b>BME ÉPK</b> )	- 1961: <i>ALGOL 60 instruction study – for teachers, too</i>	- (1972/72: <i>Computing – for all students</i> )		
- 1782: BME Faculty of Civil Engineering ( <b>BME ÉMK</b> ) - (1782-: BME Építőmérnöki Kar, <b>BME ÉMK</b> )	- 1977/78: <i>Computers in the hydrology and hydraulics, Computer-controlled systems</i>	- 1961/1962: (5. y.) <i>Electronics and cybernetics</i> - (1963/64: <i>Electronic computers</i> - (1965/66: <i>Basics of computing</i> )	- 1965/66: <b>Geodesic automations training for lectures</b> - 1971/72: <b>Applications of computers specialization</b> - 1972/73: <b>Computer technique section</b>	
- 1871: BME Faculty of Mechanical Engineering ( <b>BME GPK</b> ) - (1871-: BME Gépészmérnöki Kar, <b>BME GPK</b> )	- 1970/71: <i>Computer programming</i>	- (1971/72 (1 year): <i>Programming of computers</i> )	- 1972/73: <b>Computer technique section</b>	
- 1955: BME Faculty of Transport Engineering ( <b>KMK</b> ) - (BME Közlekedés-mérnöki és Járműmérnöki. Kar, <b>KSK</b> )		- (1969/70: <i>Computer technique</i> )	- 1971: <b>Transport system analysis section – in the Transport course</b>	
- 1873: BME Faculty of Chemical Engineering ( <b>VEK</b> ) - (2006: BME Vegyészmérnöki és Biomérnöki Kar, <b>BME VBK</b> )	- 1968: <i>ALGOL 60 programming</i>	- 1970: <i>Basics of computing –only for teachers</i> - (1972/73: <i>Computer technique</i> )		

Table 3: The development of computer education at other Hungarian universities.

Contemporary name of the institution (with the present successor in Hungarian)	First, facultative optional subjects	First distinct subject (generally compulsory subj.)	First distinct specializations/ sections/modules	First distinct courses
- 1962: Academy of Mining and Forestry ( <b>EFE</b> ) - (2008: Nyugat-magyarországi Egyetem, <b>NYME</b> )	- 1975/76: <i>Computer technique</i>	- (1977/78: <i>Computer technique</i> )		
- 1957: Gödöllő University of Agriculture ( <b>GATE</b> ) - (2000: Szent István Egyetem, <b>SZIE</b> )		- 1973/74: <i>Computer techn. (in Mech. eng.)</i> - (1979/80 (1 year): <i>Computer techn.</i> )		
- 1982: Janus Pannonius University ( <b>JPTE</b> ) - (2000: Pécsi Tudományegyetem, <b>PTE</b> )		- (1972/73: <i>Computer technique</i> - for layers)		
- 1949: Heavy-Industry Technology University, <b>NME</b> - (1990: Miskolci Egyetem, <b>ME</b> )	- 1962/63: <i>Numerical methods, Practical mathematics</i>	- (1964: (4,5 year) <i>Technical mathematics</i> – for mining engineers)	- 1966: <b>Applied Mathematics specialization.</b> - 1971: <b>System analysis section</b>	- 1993: <b>Engineering informatics course</b>
- 1951: Veszprém University of Chemical Engineering ( <b>VVE</b> ) - (2006: Pannon Egyetem, <b>PE</b> )		- 1967/68: <i>Computer technique</i> - (1970-1974 years: <i>Comp. technique</i> – for all students)	- 1971/72 (2 year): <b>Chemical system engineer section</b> - 1971/72 (3 year): <b>Chemical system engineer section</b>	- 1973: <b>Organizing chemical engineering course</b> - 1988: <b>Automation engineering course</b> - 1991: <b>Engineering informatics course</b>
- 1955: Miklós Zrínyi Military Academy ( <b>ZMKA</b> ) - (2012: Nemzeti Közszolgálati Egyetem, <b>NKE</b> )	- 1960: <i>Automation, Information theory</i> – in air defence training	- 1965/66: <i>Military cybernetics</i> - (1967: <i>Basics of military management</i> )	- 1968/69: <b>Operation research lectures – technique section</b>	- 1982: <b>REVA (System organiser, mechanization of management and automation) course</b>

Table 4: The development of computer training at other Hungarian colleges.

Contemporary name of the institution (with the present successor in Hungarian)	First, facultative optional subjects	First distinct subject (generally compulsory subj.)	First distinct specializations/ sections/modules	First distinct courses
- 1969: Donát Bánki Technical College ( <b>BDGMF</b> ) - (2010: Óbudai Egyetem, <b>OE</b> )	- 1971/72 <i>Programming languages</i>	- 1972/73: <i>Computer technique</i>	- 1972/73: <i>Computer technique</i>	- 1992: <b>Engineering informatics course</b>
- 1948: Teachers' Training College of Eger ( <b>ETF</b> ) - (1989: Eszterházy Károly Főiskola, <b>EKF</b> )	- 1972: computing - special lectures	- (1972: <i>Numerical and computing technologies</i> ) - (1989: <i>Basics of computing</i> )		- (1987–89: development of Hungarian curriculum and program for training of teachers)
- 1969: Technology College of Engineering Industry and Automation ( <b>GAMF</b> ) - (2017: Neumann János Egyetem, <b>NJE</b> )		- (1971/72: (1 year) <i>Basics of computer technique</i> )	- 1971/72: <b>Computers – technical section</b> - 1971/72: <b>System organiser section</b>	- 1991: <b>Engineering informatics course</b>
- 1972: Technical College of Light Industry ( <b>KMF</b> ) - (2010: Óbudai Egyetem, <b>OE</b> )		- 1970/71: <i>Controlling and computing</i> - 1971/72: <i>Computer technique</i>		
- 1968: Transportation and Telecommunication College ( <b>KTMF</b> ) - (2002: Széchenyi István Egyetem, <b>SZE</b> )		- (1971/72: <i>Computer technique</i> ) - (1974/75: <i>Basics of computing and programming</i> )	- 1971: <b>Transport technologies section and Transport system organiser section</b> - 1987: <b>Computer technique section</b>	- 1970: <b>Transport-cybernetics specialists course</b> - 1992: <b>Engineering informatics course</b>
- 1970: Financial and Accounting College ( <b>PSZF</b> ) - (2016: Budapesti Gazdasági Egyetem, <b>BGE</b> )	- 1967 basics of computing – special lectures	- 1965/66: <i>Application of organizing tools</i> - (1967: <i>Computer technique</i> )		- 1971/72: <b>System organiser course</b>
- 1970: Mihály Pollack Technical College ( <b>PMMF</b> ) - (2004: Pécsi Tudományegyetem, <b>PTE</b> )		- (1971: <i>Computer technique</i> )	- 1987: <b>Computer engineering – with mechanical engineering. and building industrial sections</b>	- 1992: <b>Engineering informatics course – with different specializations</b>
- 1972: Miklós Ybl Technical College ( <b>YMÉMF</b> ) - (2016: Szent István Egyetem, <b>SZIE</b> )	- before 1972: <i>Computer technique</i>	- (1972: <i>Computer technique</i> )		

The above tables can provide us with interesting information regarding the introduction of courses.

Table 1 is about those higher education institutions that were the first to introduce independent computer-oriented courses by 1972. To reiterate the above, we can establish the following:

- *Strong personalities capable of establishing schools* launched computer-oriented courses quite early on: *László Kalmár* introduced the *Applied mathematician course* at the University of Szeged in 1957 and *Béla Krekó* introduced the *Plan-mathematician economist course* at the Karl Marx University of Economics in 1960.
- Two different examples are about *external compelling demands*. The *Computer technician course* launched at the Kálmán Kandó Technical College in 1970 was a response to the strong demand for professionals shown by computer centres. The *System engineer course* launched at the NME College Faculty of Dunaújváros in 1971 was primarily aimed at providing professionals for the local Danube Iron Works.
- In 1972, as a result of the increased *external demand* for computer experts with university degrees, the *Programmer mathematician course* launched by ELTE and the science-universities of Szeged and Debrecen were the result of the internal crystallisation of their respective curricula. The Ministry of Culture even required these universities to provide this form of education, and they soon launched courses with harmonized curricula. Later on, these universities (again with harmonised curricula) based their university-level *Program developer mathematician courses* on this first initiative. (This created a 5-year university level training that functioned for 35 years; as opposed to the Bologna system, where the first three years provide only a college-level (cf. the *university-level Programmer mathematician course*). In both cases students had the possibility to exit after 3 years with a college degree).

The technical-oriented education institutions figuring in Tables 2-4 initially taught the *applied computer sciences* required by their respective profiles. The industry (and the market) had an increasingly intensive demand for the education of professionals with a thorough knowledge of informatics and adept at solving the problems incurred in the given sectors. With this *external demand*, the modernisation and specialisation of information technology-oriented subjects at technological education institutions also underwent strong *internal development* at a high rate. This led to the creation of the *reference curricula of Engineering informatics courses*:

- The *Informatics course* launched at the BME's Faculty of Electrical Engineering in the 1986/87 school year, together with the *Engineering informatics course* that it developed into by 1991, was the national *university standard*, and
- The *Engineering informatics course* launched by the Kálmán Kandó Technical College in the 1988/89 school year was the *college-level sample*.

As shown by the above tables, the *Engineering informatics course* was taught at all universities and colleges by 1993 on the basis of the above college and university examples, taking into account the unique features of the various technological institutions.

## **5. The similarities and differences of the histories, the connections between professors**

The information on the beginnings of computer-oriented education has a lot to teach us. Although all histories are unique, they have similar strains and content and the connections between the actors tie them all together.

*The initial periods of the education institutions that started teaching computer sciences at different times* are quite different from each other. On the one hand, the material to be taught continuously expanded as computer sciences developed and the availability of computers and software in Hungary (and its accessibility to students) was constantly expanding. On the other hand, teachers and the experts in the field of applied computer sciences *published* an increasing amount of useful materials, meaning that those who started teaching the subject at a later time were helped along in developing their topics by targeted technical books. Moreover, *the demands of the ever broadening and selective market* also underwent significant changes, and the diversity of the composition, interests, technical background, and connections of the respective teaching staff at the various education institutions provided for different topics, even at identical times. *There is even a difference in the method by which the institutions introduced the teaching of various computer-related subjects*. ELTE and the university of Debrecen started off by applying the *principle of gradualism* starting from the mid-1960s: they integrated it into certain other subjects and held seminars and special classes, after which it became an elective and finally a separate subject. (There were similar examples of this practice elsewhere as well.) However, as mentioned above, the BME's *rigid curriculum* made it quite difficult to introduce new courses.

It is also interesting to work out, at least in theory, *the relationships between the contemporary Hungarian institutions and their teachers*. Nobody doubts that the roots of the network of computer-oriented education in Hungary stem from Hungarian Academy

of Sciences' Cybernetics Research Group. Many of the people who built the M-3 also had teaching positions and/or held lectures in higher education institutions. In addition, the computer sciences professors from many education institutions also came into contact with the M-3. It must also be noted that during the development of the various programs for the M-3, the Research Group's employees launched research in areas of computer application (e.g. economic applications, operations research, computational linguistics) where the results were subsequently used in the material taught by the colleges and universities.

*László Kalmár*, who organised his legendary seminary in 1956 by involving teachers, students, and aspiring talents from Szeged, played a prominent role in the network of personal relationships. Although both he, his colleagues, and his first students ran their first programs in Budapest (on the M-3), the spirit of the "Szeged School" was unequivocally defined by Kalmár's interests, knowledge, and personality. His professional aura could not be constrained by the walls of any one institution. He was also a frequent guest at the Cybernetics Research Group, which was like a second home for him. But he also frequented ELTE and the university of Debrecen. Every half-year he would also look up the Számok centre. Furthermore, his contribution to spreading computer application in a wide variety of areas in Hungary – from linguistics through biology and medical professions to industry – is also great. His helpfulness, wide range of interests, and legendary ability to see the essence of things also helped him find the solutions to numerous, non-mathematical related problems. *László Kalmár was a living catalyst between disciples of the science and the professors and users of computer sciences.* We mentioned earlier that he visited the Danube Iron Works several times in search of application-related tasks. It is no accident that the first of his students to graduate ended up at the Iron Works and then at the College in Dunaújváros. We naturally also met students of his at other universities<sup>9</sup>. He is thus a root with a multitude of branches in the network of actors involved in the teaching of computer sciences.

The oft-times intertwined history of the early predecessors of today's higher education institutions also acted as a catalyst for pervading the spirit of the original institution. For example, the book mentioned the fact that many Hungarian education institutions consider the *Banská Štiavnica Mining Institution* or the *University of Trnava* as their earliest predecessors. We must also mention the predecessor to the University of Szeged, the *University of Cluj-Napoca* (established in 1872), from where the majority of

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<sup>9</sup> The author (as a student of László Kalmár) actively participated in teaching topics of Artificial Intelligence at universities and colleges for 25 years, starting from 1993. She was a guest lecturer at ELTE; a lecturer at the *Óbudai Egyetem and its predecessors*; and taught at the *predecessor of the Dunaújvárosi Egyetem*. She was moreover a contracted lecturer also at *other institutions* and held two 2-week lecture series at the *Babes-Bolyai University in Cluj-Napoca*.

Hungarian teachers and students left in 1919 – generally carrying the spirit of the University with them to other Hungarian universities. Hungarian educators also worked at more than one institution, which added colour to the palette of education and contributed to the unification of teaching materials. – Moreover an increasing number of guest lecturers could be included in the courses and the students could perform practical training at more and more factories and institutions.

Finally, mention must be made of the professors' contemporary meetings and conferences that were very important venues for the exchange of ideas in the world without internet. Starting from 1972, the representatives of Hungarian universities met regularly every year to harmonise their topics. *The first Hungarian computer education conferences* were held in Visegrád (1974), Pécs (1978), and Siófok (1981). The NJSZT then organised national conferences entitled *Programming Systems* in 1972, 1975, 1978, 1980, and 1984. Starting in 1993, the *Informatics in Higher Education* (IF) conference series has been held every three years in Debrecen; from the very beginning, it has been a useful forum for all IT lecturers (the last one was held in August 2017).

### Closing thoughts

The previous chapters provided a look at the special history of computer-oriented higher education in Hungary. The author would again like to thank the work of those 130 collaborators who enthusiastically helped in collecting the materials used for preparing the document that forms the basis of this paper, even undertaking to work on entire (or parts of) chapters. (Sadly, a number of them have since passed away.) – Here the author expresses her thanks to Bálint Dömölki for revising both the book and this paper.

We must finally mention that the IT History Forum has been compiling a **Data Archive** since 2013, which is accessible at the website <http://itf2.njszt.hu>. The Data Archive is a “digitalized collection of information that is continuously growing and which includes the information, facts, and documents worthy of mention in the Hungarian history of informatics, pertaining to important figures, products, institutions, events, and published materials. With its help, users can look up the biographies, writings, and creations of prominent personalities. In fact, some of the elder persons talk about their lives in the form of video reports. We can find information on the types of IT products that were developed in Hungary prior to 1990 and can get a taste of the Hungarian conferences...” (Our source book titled ‘*A számítástechnika felsőfokú oktatásának kezdetei*’ is also available in the Archive: <http://itf2.njszt.hu/324rtr4/uploads/Sztech164x233-1.pdf>.)

As the person responsible for the Persons [*Személyek*] section of the Data Archive [*Adattár*], the author is proud to note that of 300 persons figuring in the list of names included in the source book, almost half can be found under the “Who is Who” [*Ki kicsoda*] or the “Who aren’t with us” [*Akik már...*] subsection. – The Data Archive allows both the contemporary actors and the younger generations to use its basic information as they look to the future of computing.

## **Past and present of the field of informatics at “Babeş-Bolyai” University and other institutions in Cluj-Napoca<sup>1</sup>**

Grigor Moldovan

Babeş-Bolyai University Cluj-Napoca

**Abstract:** This article is centered on the story of the pioneering endeavors in the field of informatics in Romania and more specifically in Cluj-Napoca. Stemming from personal experience and reverence towards the very first professors and specialists that opened up this vast and formidable domain, this article which reads as a history of Romanian informatics, has the added benefit of filling in a noticeable gap in texts that take into account this interesting subject. Spanning from the 50s and all the way up to the 90s and tracing the opening, and transformations, and eventual closure of research centers, laboratories, and various institutional collaborations, this article brings a better understanding of the efforts and challenges that are always seem to be intertwined with progress, but which were eventually overcome through the persistence of brilliant scholars, and sometimes even the occasional favorable policy. Special attention is given to the entity of the Calculus Centre at Babeş-Bolyai University, founded in 1975, as the author himself was its director for 17 years until it was dismantled in 1992. This too however did not mark an end, but rather a new beginning, a different model of institution that was meant to tackle the ever-changing issues informatics face today.

**Keywords:** Informatics; history of informatics; institutional transformation

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<sup>1</sup> Translation by Voica Puşcaşiu

The words “informatics” and “computer” are today part of people’s vocabulary, especially for the younger generation, along the most-used words. Further on, we are so accustomed to using a phone, eventually even a mobile device which allows us to communicate everywhere in the world and with anyone we desire almost instantaneously, we then flip through the television channels from the comfort of our armchairs using a remote control and many, many others. Today’s world has become dependent on computers, a fact which was unimaginable years ago. The *Internet* phenomenon has a fantastic social, economic, and perhaps even cultural impact in the world we live in that is not to be understated. Let us think about how much the communication distance between people has been reduced by the internet, as compared to the time it took for a letter to travel to a destination carrying a message. What wonderful transformations flow from this from a human perspective, which we might not even register at this moment! Everything happens naturally, as if these things were here since the dawn of time.

All the technical conquests of today are influencing people’s lives, it is sufficient to take into considerations the afore-mentioned ones to be utterly convinced of this fact. In the domain of human relations, even on a sentimental level there have been important changes. Everything happens in a much too short time span and with a much larger reaction time. Let us remark that for child today, all these things seem usual and normal.

What is the price of this high-impact modernization, which reduces distances, compresses time, speeds up the reaction time, the speed of dissemination, adds new pleasures, modifies feelings and human psychologies? There surely is a price, for example stress, but perhaps even others in the medical field and beyond. Some consequences will be noticed shortly, while others might not, in any case the unwanted ones we will be able to prevent, attenuate, and eventually even eliminate.

We mentioned some of these truly revolutionary things that have taken place in the last few years in order to convince every beneficiary of these technical and scientific successes that every once in a while we should at least mention some of those who contributed with their minds and knowledge to their existence, namely their pioneers. I believe that these pioneers are many. The distinction between them lies in the fact that some knew and were able to gain a certain popularity, while others were not interested in this aspect, perhaps being overwhelmed by work, or they were simply not allowed to present their outcomes, perhaps even due to others’ envy. There is nothing normal in any of this. The essence lies in the fact that there are pioneers in every domain we have mentioned. There are thus pioneers in the field of informatics on the local scene, on the national one, and evidently on an international level.

In our country, it is quite remarkable the high receptivity with which the majority of ideas and conquests of advance sciences and technology have been adopted. In the domain of informatics and computers, the interest in this sense was notable in the main

university centers: Cluj-Napoca, Timișoara, and Iași. In the universities, polytechnic institutes, and research institutes there have been enthusiastic specialists, which have dedicated themselves to pioneering activities in the field of informatics.

I will take into account in a few words the activities of the university centre of Cluj, where there has been research and questions about developing large-scale programs in computing and informatics.

I have to mention that the first of these have taken place in the Calculus Institute of the Romanian Academy, under the directorship of the academician Tiberiu Popoviciu. The mentioned nomenclature of the institute dates from 1951, while initially, in 1948 it was named the Mathematics Institute of the Romanian Academy, Branch of Cluj-Napoca. This institute was drastically reorganized in 1974. It was here where many of the professors of the Faculty of Mathematics in Cluj were active. Obviously, the institute had its own personal research organized into sections and laboratories. One of them was the Calculus Laboratory where mathematicians such as Liviu Negrescu, Emil Munteanu, and Teodor Rus worked together with engineers like Manfred Rosmann, Gheorghe Farkas, and Ionela Juhasz among other specialists. In 1959, under the leadership of Manfred Rosmann the relay and other automatic devices calculus machine has been built in laboratory conditions. It has been named MARICA (Automatic Relay Machine of the Calculus Institute of the Academia) and it constituted a fine technical and mathematical exercise into how an automatic calculator should look like, despite the fact that this arithmetic calculus machine has never worked. This achievement has been announced in an Italian journal and a real school has taken shape in this field. This was followed in 1959-63 by the building, in the same institute, of the computer DACICC-1 (Automatic Dispositive of Calculus of the Calculus Institute of Cluj), which has as construction elements electronic tubes and transistors and effectively worked, being able to roll programs in machine language that were introduced in its internal memory through perforated bands or through the keyboard of a console. The next computer created in this institute during 1964-68, based on a commission was DACICC-200.

In the country, the first computer with parallel electronic tubes was built in 1957 at the Institute of Atomic Physics, under the supervision of engineer Victor Toma and is named CIFA-1. In 1961 at the Polytechnic Institute in Timișoara an electric tube computer has been built, MECIPT-1. Other computers built in the country of which we must mention the series FELIX C-256 etc., INDEPENDET, CORAL and some types of personal computers, then followed it. Construction of computers has been done starting 1970 at the Electronic Computer Factory in Bucharest.



*Computer DACICC-1*

At the university in Cluj-Napoca, in the Faculty of Mathematics the concerns started later on but many mathematics students have participated in scientific circles organized by the Department of Mathematical Analysis, that were run by the academician Tiberiu Popoviciu and which introduced computer themes. A proper activity in the field of computers begins only when the section of calculus machine has been founded, there classes in this field were being taught. One in year IV named Calculus Machines, taught by Kiss Ernest and another one Programming in FORTRAN language taught by Professor D.D. Stancu, after his return from the United States of America in 1962.

In 1963, Professor D.D. Stancu opens the Department of Numerical and Statistical Calculus which brings together many educators with interest in this new field (D.D. Stancu, I. Marușciac, M. Rădulescu, E. Virag, F. Oancea, Gh. Coman, Gr. Moldovan, and others). At the start of 1964, the Calculus Laboratory is also opened, under the care of the youngest of the colleagues, Gr. Moldovan. This was followed by concerns of equipping the laboratory and in trying to create something with the help of the students of the Faculty of Mathematics and those from the Faculty of Physics. The success was building a binary parallel sumator, in lab conditions, and of student level (the main contribution was that of I. Urs, student of calculus machines and V. Sgorcea, under the supervision of Gr. Moldovan). It became clear at that time that the university is unable to engage in the building of hardware, but that its focus should stand in software and programming. Also the academician T. Popoviciu wished that research in the domain of calculus machines to be

solely done in the institute he was running, this combined with uncertainties on the behalf of the university's rector makes the efforts of D.D. Stancu to put together a collective of specialist even more notable.

Among other specialists throughout the country, D.D. Stancu and later on Gr. Moldovan, participate at the proceedings of the GAMS group constituted from the socialist bloc states and which was centered on issues of automatic programming of computers.

During this time, we should mention some important contributions in universities on informatics. For example in 1962 at the University of Bucharest, academician Gr. C. Moisil – one of the most important disseminators of informatics and the creator of the school of theory of algebra for automatic machines – founds the very first Calculus Centre in the country which is endowed with an IBM-360 computer. In Cluj, Professor D.D. Stancu, a fine exponent of the school of numerical analysis, publishes in 1965 for the first time in Romania, in the *Mathematical Gazette*, A series, a group of articles on automatic programming and the ALGOL 60 language. In the same year and the same journal vol. 65(5), the first program in the FORTRAN language appears in an article by Gr. Moldovan. Also in the same year D.D. Stancu and Gr. Moldovan publish: *Romanian Terminology Project of the ALGOL-60 Language Comprising the Proper Terminology in English, French, German, and Russian*, printed at the University of Cluj. I then should mention that in a paper by yours truly, published at *Studia Univ. Babeş-Bolyai, Math-Physica Series* in 1967, there is a first mention of an algorithm for solving a problem in the numerical analysis sector in the ALGOL-60 language. I must confess that the effective validation of this program was done in 1968 on the MINSK-22 computer while doing a specializing semester abroad at the Calculus Centre of the University of Prague. The first collection of problems referring *Logical Schemes and FORTRAN Programs* is published in 1973 at UBB Cluj-Napoca, and then in 1976 at the Educational and Pedagogical Publishing House in Bucharest by Gr. Moldovan. This was a real success as it was printed in large numbers (35.000 copies). Also in Cluj, the first collection of problems for COBOL language is published, authored by a collective from CTCE Cluj-Napoca. A mention must also be made of *Theory of Algorithms*, by I. Maruşciac, which develops on theoretical concepts of the Russian school.

A special place is also taken by the Calculus Technical Institute (ITC), Cluj branch under Emil Munteanu, and The Territorial Centre for Electronic Calculus (founded in 1968 and endowed with FELIX C computers in 1971) under the directorship of Vasile Petreanu. The two important exponents of informatics on the local and national stage are graduates of the Faculty of Mathematics and also come from the Calculus Institute of the Romanian Academy, Cluj-Napoca branch.

After 1965, a collective of educators from the Technical University of Cluj-Napoca also showed an interest in computers, among them the professors: Ioan Dancea, Kalman Pusztai, Ioan Alfred Leția, Ignat Iosif, Olimpiu Negru, iar după 1982, Sergiu Nedevschi, Ioan Salomie, Dorian Gorgan, Vasile Dădârlat etc.

Also at the Cluj-Napoca branch of the Institute of Atomic Physics (IFA) the interests in informatics of M. Jalobeanu are notable especially in graphics and imagistic.

Promoting informatics through creating and implementing systems and important applications, for the most diverse fields at that time, necessitated the elaboration of a national organizational plan of informatics and calculus technique endowment. This finally takes shape in 1971, when after long and strenuous debates between economists, mathematicians, electronic engineers, and engineers from the field of automatics, the conclusion is reached that we needed to purchase a French license IRIS-50 (in its turn an American license IBM-360) for building the computers in the FELIX C 256 series etc. The contribution of academicians Manea Mănescu, Grigore C. Moisil (1906-1973), Nicolae Teodorescu (1908- 1998), Tiberiu Popoviciu (1906-1975), and Mihai Drăgănescu (1929-2010) are notable in this sense.

Parallel to this plan there was the obvious need to create another plan of preparing high school graduates and superior studies recipients with informatics knowledge. In the university environment the former name of the department of calculus machines, which was initially inspired by the Russian system and was compulsory, was replaced by a specialization in informatics, inspired by the French and which is still in use today. For this is it important to note the consistent contribution of Mihai Varia, once a employee of the Technical Publishing House, and then bought by Mihai Drăgănescu into the governmental committee tasked with endowing institutions with calculus technology. 1971 sees the foundations of informatics departments at various Faculties of Mathematics throughout the country, thus in Cluj as well, and they are meant to prepare informaticians for future calculus centers that were supposed to be organized in every county. At the polytechnic institutes the department of Automatics and Computers are opened, and at the Faculties of Economy, special departments for Economic Informatics are also created. Curricula and analytical programs specific for the field of informatics are established and the number of students is rather large.

In the summer of 1970 at the Cluj University, with the support of the rector Ștefan Pascu, in collaboration with the local ITC, the first classes for preparing educators are organized with the added help of specialists from *Compagnie Internationale pour l'Informatique* – C.I.I. These were followed by classes to prepare the specialists in the calculus centers through professional reconversion of some of the graduates of the faculties

of mathematics, physics, economical sciences, and those with electric profiles from the polytechnic universities. Cluj was one such center and this organizational task was put upon the territorial calculus centers.

In 1971, the first year of university studies for the new Department of Informatics was under two teachers who hailed from the Department of Numerical and Statistical Calculus: 1) Cornel Tarțea, who recently returned from his studies in the former U.S.S.R. on calculus machines, and 2) Grigor Moldovan, from the first series of graduates in 1963 of the department of calculus machines. In the same year the Faculty of Mathematics, Department of Department of Numerical and Statistical Calculus run by prof. Stancu, who was also pro-dean, received under placement 5 young graduates from various domains: mathematics (calculus machines) – Blaga Petru, Kasa Zoltan; electronics (computers) - Lupșa Nicolae, and economics – Oprean Dumitru, Mârza Ion, which are all send for specialization courses (educators) at ICI Bucharest. During the next year people have also been brought in through placement into the collective of informatics: Țâmbulea Leon (calculus machines department), Dumitrescu Dan, Landa Frederic (Physics graduates). This was a hard situation for the department as the informatics was only done on paper, without the presence of proper hardware.

A governmental decree from August 1973 marked the founding of the Central Institute for Conduct and Informatics (ICI), subordinated to the Council for Social-Economical Organization, and which in turn had under it the territorial centers for electronic calculus and supervised informatics all around the country.

In the same year territorial centers for electronic calculus are opened in most counties, in Cluj-Napoca and Timișoara they were already functioning since 1968. In the university years 1973/74 and 1974/75 the students roll their programs in these centers and even for a while at the territorial center for calculus in Pitești. The conditions for the students were very hard. Most of their difficulties were due to the use of perforated cardboard and the writing paper for the printing machine in order to create and adjust a program written in a programming language. In order to correct a simple one-character mistake in a program, they had to wait even for several days and the “serving” order was generally done on a first-come-first-served basis.

At the end of 1974, just before retirement, from what he recounts in his writings, through favorable circumstances he manages to obtain the placement of three computers for the university centers in Iași (Ioan-Cuza University), Cluj-Napoca (Babeş-Bolyai University, the P35 system), and Timișoara (Polytechnic Institute). Thus, less than one year after my return from the University of Grenoble in France, after a specialization in informatics, I was appointed as the first director of the Calculus Centre of the University

in Cluj-Napoca, a position I filled from 1975 to 1992 (17 years). The tasks of the center, as a self-financing unity were many. We were obliged to offer our services for free to the institutions of superior education in Cluj-Napoca (Babeş-Bolyai University, Polytechnic Institute, etc.), but the self-financing also made us look for monetary sources elsewhere.

The beginnings of informatics at the Babeş-Bolyai University (UBB) in Cluj-Napoca could be invoked in different modes and context by the various leaders and scientific personalities of this prestigious educational institution. I believe that the most important “stone” in the foundation of this modern building that is being build through permanent reforms in UBB – using the services provided by computers – is represented by the creation in 1975 of the Calculus Centre of UBB, the only unit of its kind at the time in the important university center that is Cluj-Napoca in Romania. The inauguration of the computer FELIX-C-256 marked an important achievement for UBB, because in December 1975, the Prime-Minister of the government himself, academician Manea Mănescu was present at the event. It started with enthusiasm from the behalf of some, and skepticism from others. There were obviously many hardships, specific for beginnings, especially due to the self-financing regime. However, the important thing is that it offered the possibility of shaping a modern spirit for the students, teachers, and the rest of the University’s staff, by using a computer in order to solve issues in various domains.

Self-financing from sources outside UBB, prompted a collaboration with research units and enterprises around Cluj, and these collaborations were always beneficial (the centre gained extra-budget sums in one year that were the equivalent of the one-month salaries of the entire university personnel; and all of this without counting the services it offered to the educational process, which was not highlighted in the University’s accountancy). Some important collaboration connections were through the research contracts and conventions for exploitations services with the ITC, Cluj branch, its director was prof. E. Munteanu, but which did not have a FELIX-type computer for which they were creating the software. Certain collaboration also existed with the CTCE, especially for organizing one of the most important scientific manifestations in the country in the domain of informatics, namely the CONDIF Symposium.

A special collaboration was one with the prof. Marian Papahagi, a close beneficiary of the Calculus Centre of UBB in the realization of scientific research contracts. We have influenced him in taking some crucial decisions regarding the necessary endowment with PCs of the universities around the country, and especially for supporting the educational process when he was state secretary for the Ministry of National Education and responsible for the higher education. This national PC endowment plan was also accomplished.

As the director of this center from 1975 to 1992, I have benefited from a strong collaboration and support from the deans of the Faculties of Mathematics and Informatics, as well as the rectors of UBB: Acad. Ştefan Pascu, prof.univ.dr. Ion Vlad, prof.univ.dr. Aurel Negucioiu, and Acad. Ionel Haiduc. Especially during the initial period of arranging and actually building the Centre we had the full support of the rector Ştefan Pascu.

The Calculus Centre of UBB was a representative unit in the superior education network in Romania. This institution was eventually disbanded due to the progress in calculus technology and the technology of informatics, but informatics is everywhere and in everything, mostly through specialists, which were formed at this Calculus Centre. It suffices to mention the teaching staff, which originates from the Center: prof.dr. F. Boian - PhD coordinator in informatics and department director, prof.dr. B. Pârv – PhD coordinator in informatics, cathedra director, prof.dr. I. Parpucea – collective director, conf.dr. I. Chiorean, conf.dr. A. Diaconu, lector dr.ing. D. Chiorean – informatics laboratory director, lector dr. S. Damian. We should then mention their other colleagues: P. Pop, L. Munteanu, Gh. Mureşan, L. Săceleanu, L. Cobzaş, S. Petrişor, M. Topliceanu, L.F. Labo, R. Costin, ing. G. Ciplea, ec. R. Lazăr, ec. R. Pop.

Calculus technology has evolved immensely. At the time of birth of the microcomputers (PCs) and the creation of the first computer networks, which brought on the development of the Internet, the shape of the organization in calculus centers from 1975-1994 was no longer justified. Thus, there is a serious reorganization and eventual dissolution of these organizational structures. The Communications Center is founded in 1996, with a specific communication-oriented task set out, namely Internet. This new unit of informatics in the University was set up by prof.dr. F. Boian. Also a few years later, in 2002, the Center for Informatics Systems is opened. The two new informatics units on the university level are now financed from the national budget, are functioning in the frameworks of the Direction for Information and Communication Technology (DTIC), which was run at first by conf.dr. A. Andreica, and currently by prof.dr. Horia Pop.

There are many pioneering activities in informatics at UBB in which the director of the Calculus Centre - author of these lines – along with other specialists from the center were directly involved. It would be difficult to name them all. Still at least those of general interest need to be mentioned. I believe that the personal support of the Informatics Symposium and its applications in the frameworks of the Days of Cluj Academia in all its editions are a noteworthy action. The support and creation of many informatics applications of national and local interest is also quite important. Here are some of these interests. The creation of a database with the entire staff in the educational network of MEI, for which the Calculus Center of UBB was a zonal calculus center (Gr. Moldovan director), encompassing the counties of Cluj, Alba, Bistriţa, Oradea, Satu-Mare,

Maramureș, Sălaj. This database was then exploited with our own programs in order to obtain certain statistics, evidence of didactics personnel, etc. Now these programs have been taken over by the County School Inspectorates and by the Human Resources Services of the universities, which all have their own microcomputers. There have been created programs to help with admission, programs to help with calculating the staff's salaries, and to keep the evidence of students throughout the university. All of which were in use at UBB far before any other university in the country. They were first initiated at the Calculus Center and then they were extended and re-mastered by colleagues, especially those from the Faculty of Mathematics and Informatics, which took into account the new calculus technology available in the University.

Accomplishments in informatics are numerous, but I am now confident that the most precious product of the Department of Informatics of the Faculty of Mathematics and Informatics are the few thousand graduates that are now working in important institutions and enterprises both at home and abroad. Our pride stems from them and we rejoice, I rejoice personally when I get to meet with them and they are willing to share their own important accomplishments.

## **Memories, Recollections, and Landmarks Or How I Became a Pioneer**

Mihai Stanislav Jalobeanu

INCDTIM Cluj-Napoca and  
„Vasile Goldis” Western University of Arad, Romania

**Abstract:** The paper presents a pioneering period (68-76) in the context and with the difficulties of those years remembered all of a sudden in 2006 on the occasion of the celebration of Herbert Francke in Bremen. This led without further explanations to a partial restart of the educational activity in the ‘graphic-imagery’.

**Keywords:** Herbert Franke; computer graphics; computer graphics exhibitions; pioneer; computer art

### **Instead of an Introduction**

This text has its ‘roots’ in an incident from October 2006. When I received a peculiar message, which I opened almost accidentally only because it included (in the *Subject:* line) a name which sounded familiar: “*Herbert Franke*”.

The message came from Barbara Nierhoff, the director of the Museum of Arts in Bremen. And in this message I was asked if it was I, Mihai Jalobeanu, who once had been preoccupied with graphic arts using computers. How lucky am I that my name is not Popescu?

In Herbert Franke’s archive, among hundreds of drawings, archive which was taken over by the museum and which was prepared to be exhibited, they had found two of my drawings, with dedication and signature.

Afterwards, in order to refresh my memory, they sent me an image of both drawings... And then came an avalanche of messages and questions: how did they come in the possession of Herbert Franke, what could I say about the way they had been made,

which was my trajectory in this domain, whether I still work in this field, and, what was most amusing, why was the inscription “Worth 1 leu” on the back of one of the papers and what did that mean...

That’s how the chapter closed around 1978-79 was reopened, a chapter which I considered forgotten, passed... I had to recall those years, from around 1970 to around ’78-’79... that is:

- the joy of the first plotter, in the configuration of the programmable office computer HP 9100B [1], and of the graphics which I could draw with it;
- my public debut with my drawings, at the Institute of Computers, then the various exhibitions in Arad, Timișoara, București, Satu-Mare...;
- attending a conference in West Berlin and presenting some of the drawings made with the plotter and transposed into slides; followed by a visit to Erlangen, to the Siemens Computer Center, and a meeting with Georg Nees (the first European to set out in this domain in the ’60s);
- the meeting with Herbert Franke, in 1974, in Bucharest, at the itinerant exhibition of the Goethe-Institute, in which he toured across Europe, explaining and promoting art made with the help of computers... On that occasion I met Professor Mocanu, the one who then succeeded in arranging my exhibition in Bucharest, in January-February of the year 1976, at the New Gallery.

Set in motion by our messages exchanged with the Director of the Museum from Bremen, I retrieved my forgotten and faded drawings from closets, photographed them and uploaded the images to my Web server from INCDTIM.

Moreover, at the university in Arad, giving account of this in the department, I found myself faced with the following cue: “Would you mind taking the ‘Computer Graphics’ course, as it is part of the syllabus and there is no one to teach it?”

But what is even more important is that after a quite dense correspondence with the team from Bremen, I arrived, in June 2007, at the opening of the exhibition and inaugural event called *Ex Machina - Fruhe Computergraphik bis 1979* (<http://www.kunsthalle-bremen.de/Ausstellungen>), an outstanding exhibition opened from the 17th of June to the 26th of August, at Kunsthalle Bremen, a majestic building in the old port city of Northern Germany.

Kunsthalle -Bremen holds probably the amplest- collection of works of this type, and the team working on it had started a few years back a cycle of retrospective and “salvaging” expositions, with the works of the pioneers in this particular domain (Manfred Mohr, Georg Nees, Frieder Nake ...).

The retrospective “Manfred Mohr” had still not been closed and almost simultaneously with the *Ex Machina*, between the 10th of July and the 31st of August, they organized the instructive exhibition called “Schule macht Kunst und macht Schule” as well.

We met there, on the 16th of June, only 8 of us “pioneers” in the domain from the ‘70s (coming from Canada, Australia, UK, Romania...). At the head of us, of course, was our celebrated personality, Dr. Herbert W. Franke, lucid, modest, having a good sense of humor, in his eighties for which he was celebrated. In fact, he was the only one present there of all true pioneers who introduced art made by computers in the ‘60 and -’70s.

The organizers, led by Barbara Nierhoff, edited a catalog - an impressive and elegant bilingual volume of above 500 pages, published at Deutscher Kunstverlag, with the history and biography of the “pioneers”, as well as a lot of reproductions... Book entitled *Ex Machina - Frühe Computergraphik bis 1979*, and having as a subtitle *Die Sammlungen Franke und weitere Stiftungen in der Kunsthalle Bremen. Herbert Franke zum 80 Geburtstag* (See the cover in figure 3).

But why only until 1979? Because, with the emergence of personal computers accompanied with graphic design monitors a new phase has started, graphics with the assistance of computers becoming a more and more uncomplicated, accessible to all PC users.



Fig. 1. The group of the “Pioneers of Computer Graphics” present in Bremen in 2007

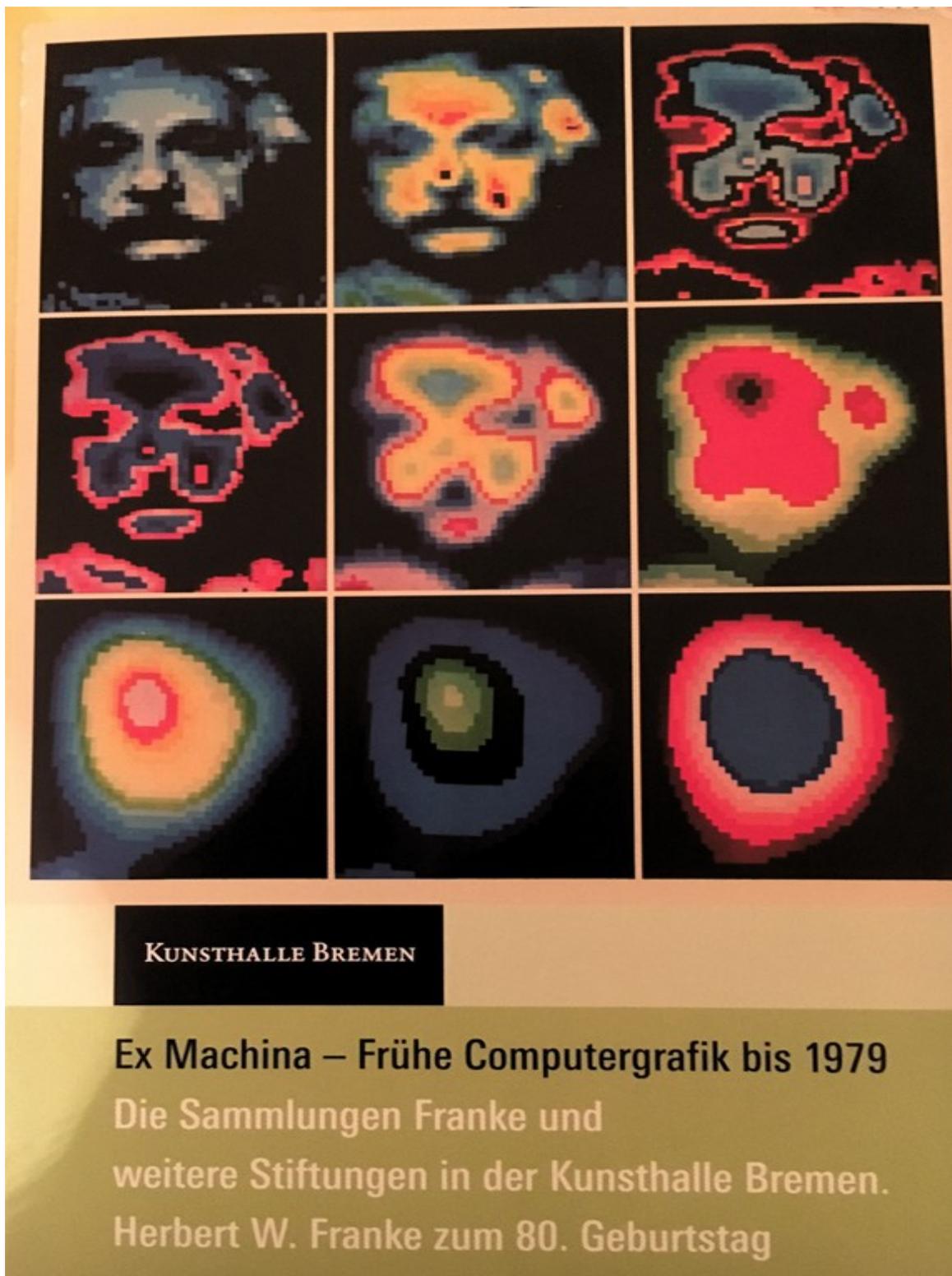


Fig. 2. The poster of the exhibition, including several reproductions of H. Franke's works



Fig. 3. The cover of the bilingual volume of 503 pages, elegant and dense, reproducing and explaining the context and the details of the drawings - the images featured in the exhibition as well as the few “poems” made with the help of computers in the same period (until 1979).

Note: to the dissatisfaction of the organizers, several drawings (the drawings from Franke's archive) were untitled, thus they appear accompanied by "ohne Titel".

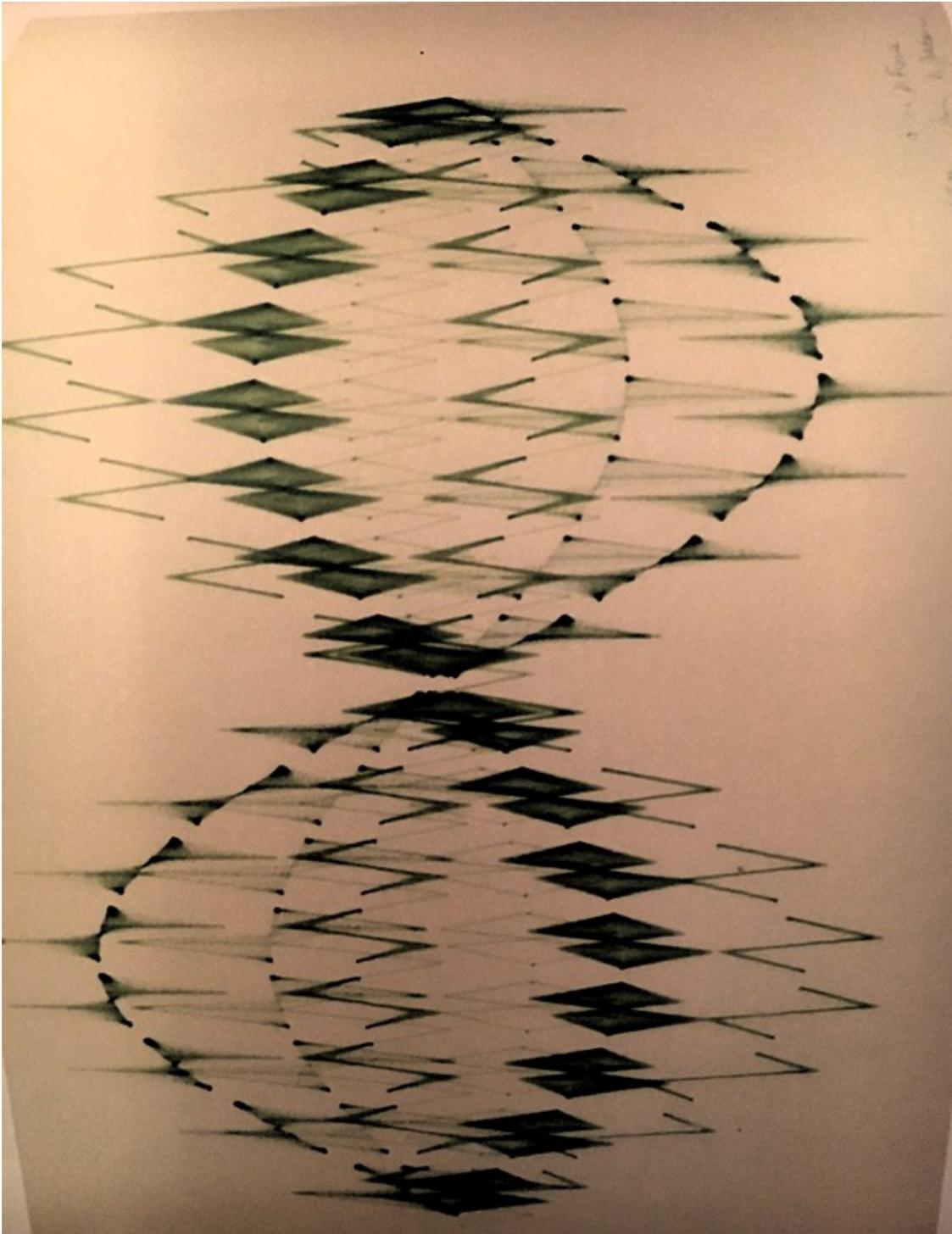


Fig. 4. Drawing which appears in the catalog (p. 196. Mihail Jalobeanu, *Ohne Titel*, 1974)

During those years, to separate my artistic activity from the scientific one, I turned to this subterfuge, I signed Mihail in those kind of texts which represented my “artistic” activity, this way disassociating myself a little from the mathematician/researcher Mihai Jalobeanu.

### **What Was the Beginning Like?**

There have been several attempts to outline the chronology of this domain, either from the point of art critique, or from that of informatics, having as context the history of computers, of informatics and of the applications in projection, publicity, film, entertainment... Some of the protagonists themselves, Herbert Franke among them, have explained and presented the appearance and the stages of the study of means in which computers could be used in art. Wayne E. Carlson designed and upheld a chronology on the Web - *An Historical Timeline of Computer Graphics and Animation*, replaced/ completed during the last few years through a course entitled *A Critical History of Computer Graphics and Animation*. Also, at the [DAM::Home](#) (Digital Art Museum), even the conclusions of the exhibition in Bremen are accessible as well, starting with Herbert Franke’s “The New Visual Age: The Influence of Computer Graphics on Art and Society”.

The year 1950 can be considered the starting point in the history of Computer Graphics, when the Norbert Wiener’s book entitled *Cybernetics and Society* (at the MIT), and when Ben Laposky, with his oscilloscope, displays some wave patterns (generated with analogical procedures) which were photographed and promoted as artistic images.

The first graphics display device (vectorscope) to the Whirlwind computer, only appeared and was presented to the public one year later.

In the years that followed, numeric computer systems are developed, the first programming languages appear, video tapes appear as well as colored television... Influenced by the *oscillations* of Ben Laposky, which he admired, Herbert Franke, previously specialized in photo techniques, designs his own set of images: “Lightforms” (in cooperation with Andreas Huebner) between 1953-1955, “Oscillogramm” in 1956.

Several critics of art, starting with Jasia Reichardt, consider 1956 to be the year of the birth of Computer Graphics - at that time analog (Jasia Reichardt was the Director of The Institute of Contemporary Art in London, and, in this position organized the exhibition called *Cybernetic Serendipity* in 1968).

The first plotters were manufactured only in 1958, drawing instruments for paper, numeric controllers, such as the CalComp 565 drum plotter... In the same year integrated circuits were invented and, independently, on an analog computer, John Whitney Senior designs his first artistic images.

In 1959, the Museum of Modern Art in Vienna presented the exhibition “Experimentale Asthetik” which included photographs featuring Laposki’s oscillations among other works made using analog computers.

### **Graphics with the Digital Computer**

The term “computer graphics” appears only in 1960, brought to light by William Fetter, at Boeing, for his drawings that analyze the position of the pilots in the cockpit of the plane. 1960 is the year when John McCarthy enhances the LISP language and the DEC firm build-generates the first mini-computer, the PDP-1.

The year 1961 gives rise to Spacewar, the first ever digital computer game to be available outside a single research institute, created by Steve Russell at MIT, especially for PDP-1.

In 1963, Charles Csuri and Michael Noll, independently, engage in the first artistic works with the digital computer (computer generated artwork), mainly printer graphics. At MIT, Robert already starts the study of hidden line algorithms. Also, Edward E. Zajac, from Bell Labs, USA, performs the first movie ever commenced by a computer. Soon after, the Computers and Automation Journal establishes the leading art competition with a computer, which was won by Michael Noll in 1965, and by Frieder Nake, in 1966.

Also in 1963 Ivan Sutherland, an MIT programmer, and one of the pioneers of the Internet, concludes in his doctoral thesis (lead by Claude Shannon) the Sketchpad program- a system of graphic communication coupled with the computer- a very first version of graphical interfaces (a system he was working on since 1961) - achievement which was awarded in 1988 the Turing award. It is said that his work was inspired by the Memex from “As We May Think” by Vannevar Bush.

In 1968, Ivan Sutherland in association with his student Bob Sproull at Harvard, put together the pristine system of virtual reality. On the strength of this system, Sutherland is considered to be a “parent” of this innovative computer graphics. Even though the mouse- a common input method for most modern computers- was also invented in 1963 (by Doug Englebart), Sketchpad, and most other innovations of that time did not use it.

### **The First Exhibitions**

In February 1965, George Nees coordinates the first computer graphic exhibition “Generative Computergrafik” at Technische Hochschule in Stuttgart, Germany. Born in 1926, George Nees studied mathematics, physics, and philosophy in Erlangen and Stuttgart, with his leading doctorate called “Generative Computer Graphics” under Max

Bense. Nees was a professor at the Erlangen University and worked at Siemens Research and Calculation Center in Erlangen.

Similarly, in 1965 between 6-24 April the first art exhibition takes place in the United States, at Howard Wise Gallery in New York, "Computer generated Pictures" where Bela Jules and Michael Noll bring their work to light. Between 5-26 November, "Computergrafik" exhibition is being unfolded, presented by Max Bense.

George Nees, Herbert Franke and Frieder Nake are nevertheless the first ones in Europe - the European pioneers of computerized art.

In 1967, plastic surgeon Robert Rauschenberg and engineer Billy Kluever (from Bell Labs) establish a work group called "Experiments in Art and Technology" in New York (E.A.T.).

## **Organizations and Publications**

The first Computer Graphics Chair was set up in 1968 at the University of Utah in the Computer Science department. 1969 marks the establishment of the SIGGRAPH professional organization, and Alan Kay's creation of Xerox's first Graphical User Interface (GUI).

In 1970 Lillian Schwartz produces a series of works made famous with the name Pixellation, at Bell Laboratories. At Renault factories, Pierre Bezier discovers and represents the first class of shapes and curves that now bear his name.

In 1971, the academic journal "Interactive Graphics for Computer-Aided Design" published by Prince's publishing house made its debut.

The first stereotypical workgroup in this field is organized by the SIGGRAPH section of ACM in 1972, with the name Graphics Standards Planning Committee. The same year, 1972, brings for the first time, from Utah, a system for film production, through two famous animation sequences: the movement of the hand [Catmull72] and the human face movement [Parke] respectively.

In the same year a Graphics Symposium (GRASS) system and a Sandin Image Processor appear. Academic year 1972 marks the launch of Academic Press of Computer Graphics and Image Processing, a successful publication that will become "Computer Graphics, Vision and Image Processing" in 1982, followed by the 1990's event, when it was launched in three distinct magazines.

The first major conference of this interface area takes place in 1973 in Boulder (the first SIGGRAPH conference). At Syracuse, Rich Riesenfeld introduced in his doctoral thesis approximation with b-splines in geometric design [Riesenfeld]. It is the year in which the first treaty is published - the milestone volume "Principles of Interactive Computer Graphics" by Newman and Sproull.

In 1974, (probably) the first animation company “Motion Pictures Product Group” was founded, but also a professional laboratory (CGL) at NYIT, having Ed Catmull as director. The “Hunger” film, made in Canada, receives the special jury prize for animation at the Cannes Film Festival.

In 1975 Benoit Mandelbrot, at IBM, introduces fractals, and Ed Catmull publishes a curved surface rendering algorithm [5].

In 1976, the year when Apple’s PCs were launched, Computer Graphics Newsletter, which will become, two years later, Computer Graphics World, is first published. Also there are two reference books: Artist and Calculator by Ruth Leavitt, and Mathematical Basics of Computer Graphics by David Rogers. Jim Clark publishes the hierarchical pattern for visible surfaces detection [6] and Jim Blinn sets up another important algorithm for creating images in virtual reality, which he will publish in 1977 [5].

In 1977, the visual effects produced by the computer are accepted as a category for the Oscars. Also, SIGGRAPH CORE Graphics is published and developed by Jim Folley. The GKS (Graphical Kernel System) standard is introduced.

1978 marks the launch of R. Greenberg’s Superman movie with CGI technique, and the emergence of Computer Graphics World on the market. Maybe even more importantly, James Blinn produces a first series of the animated cycle The Mechanical Universe that can be considered the first serious electronic course, the true beginning of what we call e-Learning today.

### **But Who is Actually Herbert W. Franke?**

Very briefly: an illustrious model of an interdisciplinary researcher, passionate mathematician, chemist and doctor in physics, uninterested in academic positions and titles, with an up-and-coming journalistic activity. He consistently promoted the introduction of technology in art as well as in the Natural Sciences and literature. A modest man, but a central figure in European computer art; but unfairly neglected by American historiography. Born in Vienna in 1927, he studied Physics, Mathematics, Chemistry, but also Psychology and Philosophy at the University of Vienna, finishing with a PhD thesis in electronic optics in 1950. After a short research internship at the Technical University of Vienna (in which he discovers a new method of geological dating with radioactive isotopes - carbon 14, immediately after Libby), he goes to industry, to Erlangen, working until 1957, especially in the area of experimental photography. In 1957 he becomes a freelancer, settling down in Bavaria near Munich, working as a journalist and scientific consultant and entering many research fields ranging from theoretical chemistry to experimental aesthetics and speleology. Since then he has been writing intensely, and

the list of published volumes is impressive, encompassing treaties, popularization books, and successful SciFi novels. Occasionally he has taught courses in Photography and Art, Cybernetics and Information Theory, Aesthetic Cybernetics, Computer Graphics and Art, or introduction to SciFi literature and introduction to Psychology of Perception.

His research activity also appears on at least three major directions: Aesthetics, Informatics, Geo-Physics; coordinating a research group in the aesthetics assessment (1974), studying image memories, analyzing the widespread application of miniature graphics programs, and animating curves and mathematical forms, while also taking part in climate reconstruction studies and speleological research.

In December 1974 he visited Bucharest, presenting the Goethe-Institute exhibition entitled “The Paths to Computer Art”, an exhibition by K.C. Schröder under the aegis of the Göthe Institute in Munich. Herbert Franke had edited the catalog of the exhibition, choosing Leibnitz’s 1702 article about binary arithmetic, and selecting the most suggestive images in the exhibition. He included there, for the promotion of German culture, Konrad Zuse’s attempts to reinstate his father’s contribution to the history of computer science. In other words, he presented the history of computers totally different from the official one at that time. The chapter titled “Art computer” in that catalog was even signed <Herbert Franke>. For many years this catalog was for me the main source to learn about the art of the computer. Even in 1973 I had the already the chance to meet Georg Nees (another important European pioneer in the field). It happens in my short visit in Erlangen; after my participation at a youth conference in (West) Berlin, presenting by dia-films few of my first HP plotter drawings...

## And?

One might say that this text is simply because I met and then listened to Dr. Herbert W. Franke in Bucharest, and he kept the drawings that I allowed myself to give them to him. Undoubtedly, my attendance to the 16th of June event in Bremen, my presence in the exhibition and its catalog are linked, over the years, with the meeting with Herbert Franke in Bucharest, and with the fact that I dared, under the conditions of 1974, to hand him the two sheets.

But my whole involvement in computer graphics is primarily due to the concern for the interdisciplinary research inspired by Professor Elena Popoviciu and, above all, to the way she looked and discussed with Tiberiu Popovici, in 1971, at the seminar at the Institute of Computing, my first plotter drawings. For me, from there, in the seminar room at the Cluj Computer Institute, I started to be involved in “computer graphics”.

Today a ‘Computer generated Pictures’ search leads to over 4 million results! But with the equipment at that time, with the resistance of those years even when

using the computer in scientific research, making drawings with him seemed almost an abuse here in our areas.

Then, in the 1970s, it was not easy, I received a lot of observations and penalties because I was staying in the lab over the program, rubbing the HP 9100B desktop computer and its plotter, consuming materials and electricity to smear some sheets of paper, not even related to the theme of the institute. Then I had to find all sorts of solutions to replace/rebuild wasted consumables (especially the felt nibs and the ink which I used to make the drawings).

My luck was that the Institute's director, Professor Victor Mercea, had become enthusiastic, admired what I could do and supported me (including traveling to the FGR at the West Berlin conference), and even managed to find an "outlet" - a use of my drawings when decorating ceramic objects. In other words, he negotiated a contract with the research service of the CERO manufactory in Cluj, regarding especially the decoration of ceramic products with computer graphics. Thus, drawings made with the computer got on cups, plates and porcelain vases, not only on the market, but also in some exhibitions through the country and neighboring countries. In addition, under the wings of this practical application, I wrote and published 2 papers - 2 chapters in the Computer Graphics section of the volume *Semiotics Mathematics of Visual Arts* [1, 2]. In the second part, I co-sponsored my then director, to whom I also owe the researcher's career.

In closing this chapter of my work, I also want to mention the gratitude I owe to all those who, in those years, encouraged me and helped me, who were enthusiastic or criticized, looking at / analyzing my drawings. Besides the reluctant teachers already mentioned (Tiberiu Popovici and Victor Mercea), I cannot miss Prof. Titus Mocanu (who did not leave until he put together my Bucharest exhibition). And I cannot forget the deceased friends: Liliana Bocu, Mircea Țoca, Dumitru Vonica (each contributing in those years with their suggestions and enthusiasm to my artistic digression).

And one more thing: in 1990, when I considered this chapter of my life closed long ago, I was suddenly asked by a person I didn't know personally - a teacher from the Institute of Fine Arts in Cluj, to deliver course on the use of computers in art there. Explanation: In the euphoria of that winter (1989-1990), the students in the terminal year, being a part of the board of the institution, decided that they could not leave the faculty as long as they did not have a course on the role of technology in the plastic arts, and therefore did not learn anything about computer-graphics. There (is?) no one else in the area with this "expertise". What could we do? We have accepted, prepared and (supported?) *delivered* for almost 3 years a course on the possibilities of using computers in art. (Especially because the staff from Conservatoire "Gh. Dima" heard about it and ask my also; consequently had to go from graphics with the computer to computerized music also.???)

Thank God that I had students who, after graduating, could take over and carry on those courses. Not for another reason, but from '94 -'95 I was passing through the barricade of connecting and promoting access to the Internet, connecting (with such efforts) the Institute of Isotopic and Molecular Technologies and, especially, organizing from 1997 to 2001 the annual seminars "RILW - "Romanian Internet Learning Workshop" to promote the use of the computer network, i.e. the Internet in training. So for Professor Oleg Aramă (former member of the Institute of Computing) I became "the pioneer of the Cluj Internet".

In 2006, when this writing started, I became a computer science professor at "Vasile Goldiș" University of Arad, so Professor Tiberiu Popovici's place of birth. A good opportunity to remember the few trips organized there in Arad by the Institute of Computing; good moments then for my outings in the world with computer graphics. All the more so since I found out that there, at the Arad House of Culture, were quite a lot of my works exposed 30 years ago. But it was also a good opportunity to try to re-bring the memory of the professor in the attention of people who live in Arad, to struggle to baptize the amphitheater in which I held the computer courses with his name.

And still there, in Arad, at the university where I became a computer science teacher, as a result of the new title of "fresh pioneer", I had to accept to teach also the "Computer Graphics" course; a course that was then in the syllabus, but "pushed" in the last semester of the last year because of the lack of specialists.

It has become my first course in virtual laboratories, and we have been using virtual groups on other courses [5,6]. Namely delivering a 'Computer graphics and Image Processing' course. Also a good occasion to organize some competitions and few digital-photography exhibitions with my best students.

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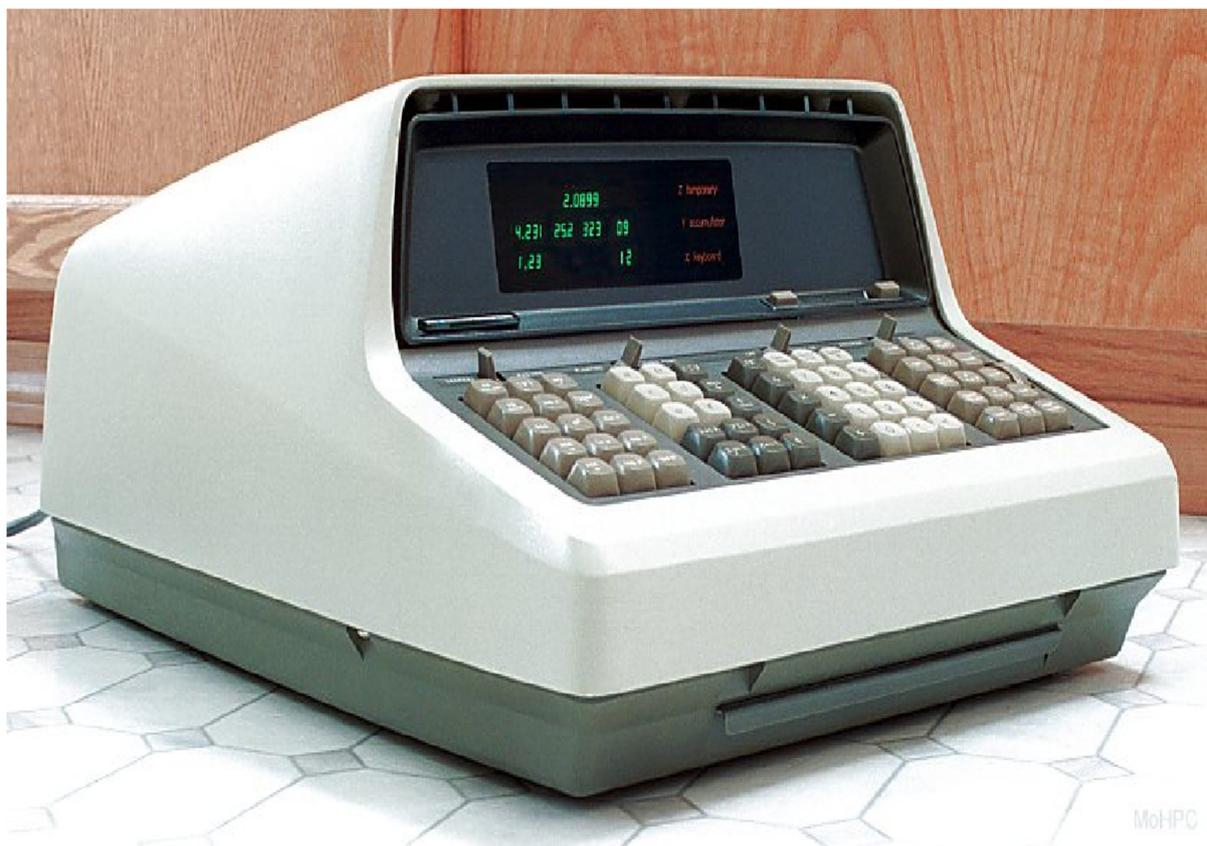
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**Extension - But How, With What Kind of Computers Did I Work/Draw?**

In 1969, after three years in which I was still calculating and programming in the code used in DACICC-1, then in Fortran, at DACICC-200, with programs on perforated tapes, I found myself with a small and friendly programmable office computer, the “HP 9100B”.

I have not been able to find out who and how was it ordered, by what means, for it was, for those years, a jewel ... produced by Hewlett Packard, the newly launched model.



I had just begun to discover their commands, operating mode, when I also received the drawing device, that is, the attachment of the apparatus, a two-dimensional flat plotter (in the terminology of these “peripherals”. It had a complex set of commands, it could be used in “manual” mode, commanded as well as in the “programmed” mode - that is, with the string of stored commands, which can be recorded even on magnetic cards, and is therefore successfully usable in the processing of experimental data. The drawing device as in the picture above used a personal distinct “pencil” system.

As you may find now with a simple google-search, Hewlett Packard 9100B Programmable Electronic Calculator “was the second calculator made for sale by Hewlett Packard. HP’s first electronic calculator, the revolutionary 9100A was introduced in the fall of 1968, with the 9100B introduced in fall of 1969.”

Quite soon after the minicomputer, just when I became more-or-less familiar with its operating system, the graphical device HP9125 plotter arrived in my lab.



This drawing device (namely a pen-plotter) launched in the market at 1969. This was the main executor of my computer graphics drawings, and consequently a lot of my drawings are signed with a combination of our initials (ex. MJ + HP).

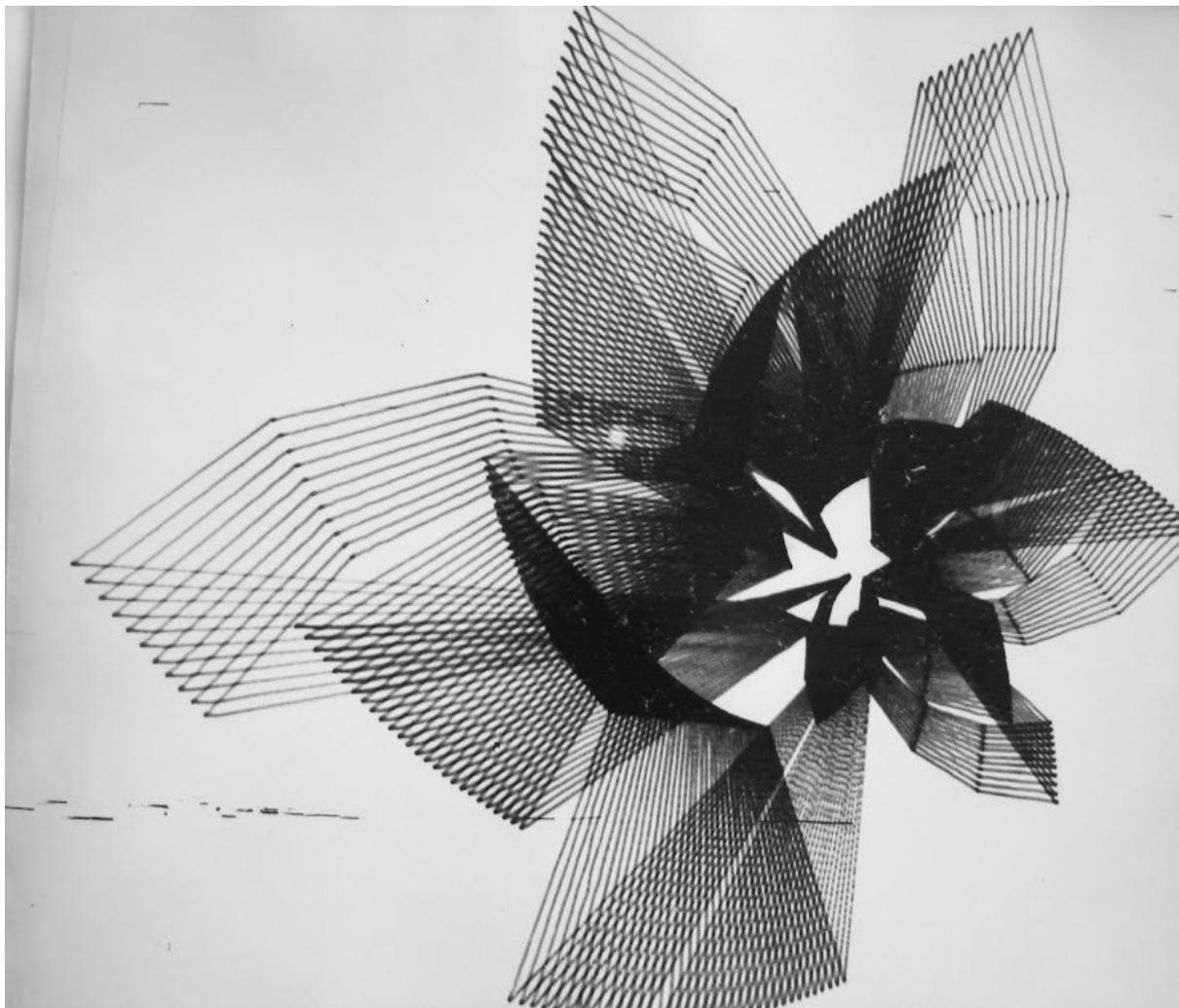
Unfortunately, after 9 years of quite intensive use, without the usual maintenances, without access to the corresponding market, this great mini-system became unusual. My attempt to continue “the adventure into computer graphics world” using a NOVA 3/12 computer connected with a Calcomp drum plotter was unsatisfied.

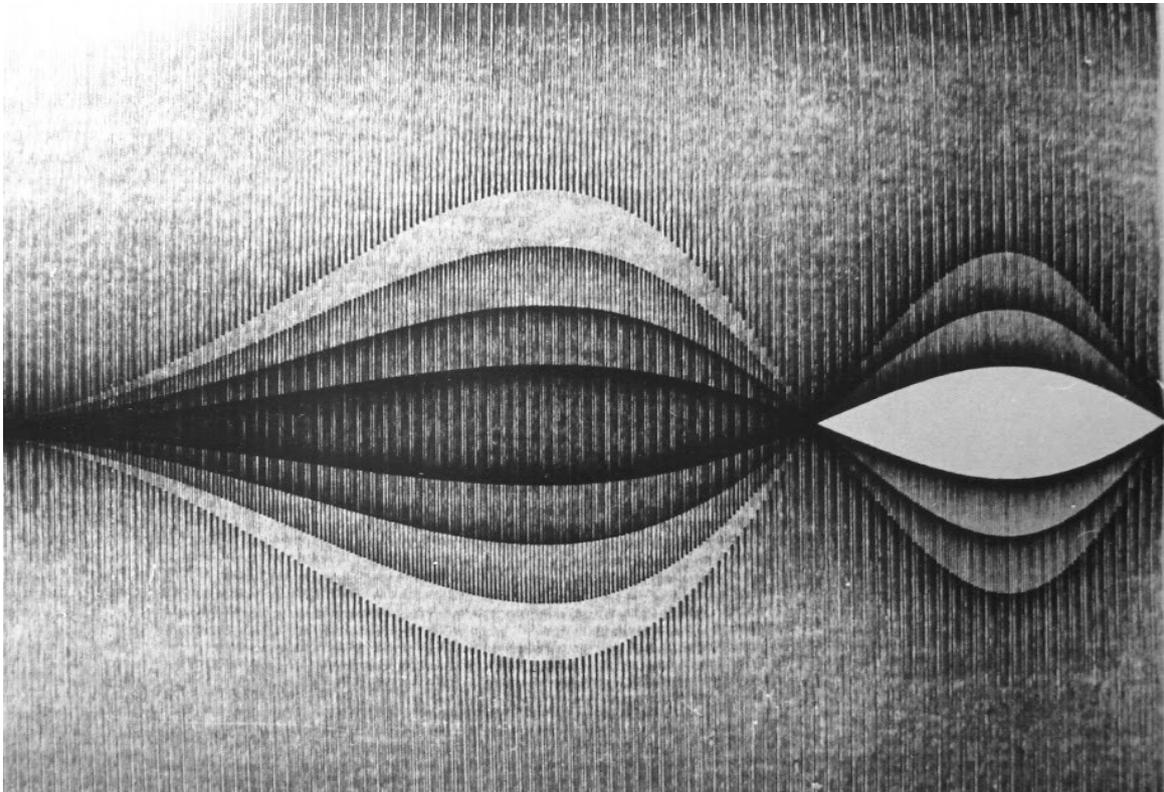
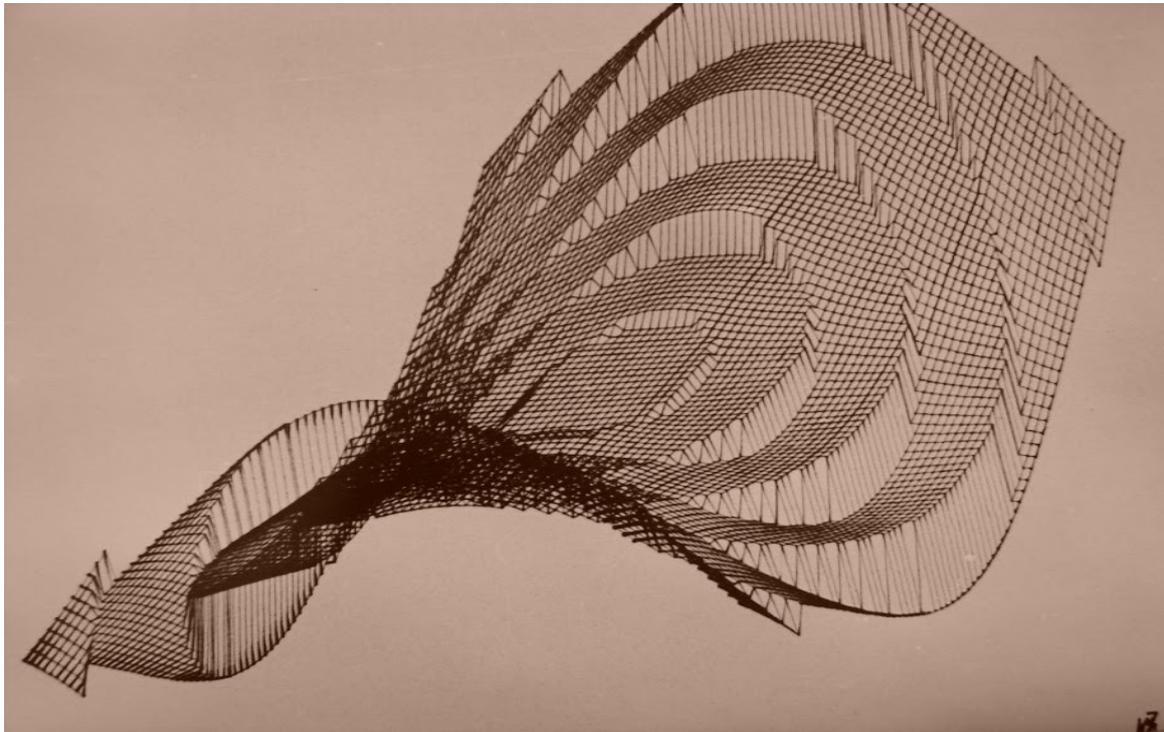
But professor Victor Mercea, director of the institute, succeeded in those dark period to find “an application” for my already done computer graphics: the decoration of ceramic products, a cooperation with “CERO” Cluj institute. Namely with ceramic object designer Adriana Dobra. Consequently selecting some of already done computer graphics for decoration of bolls, plateau, etc.

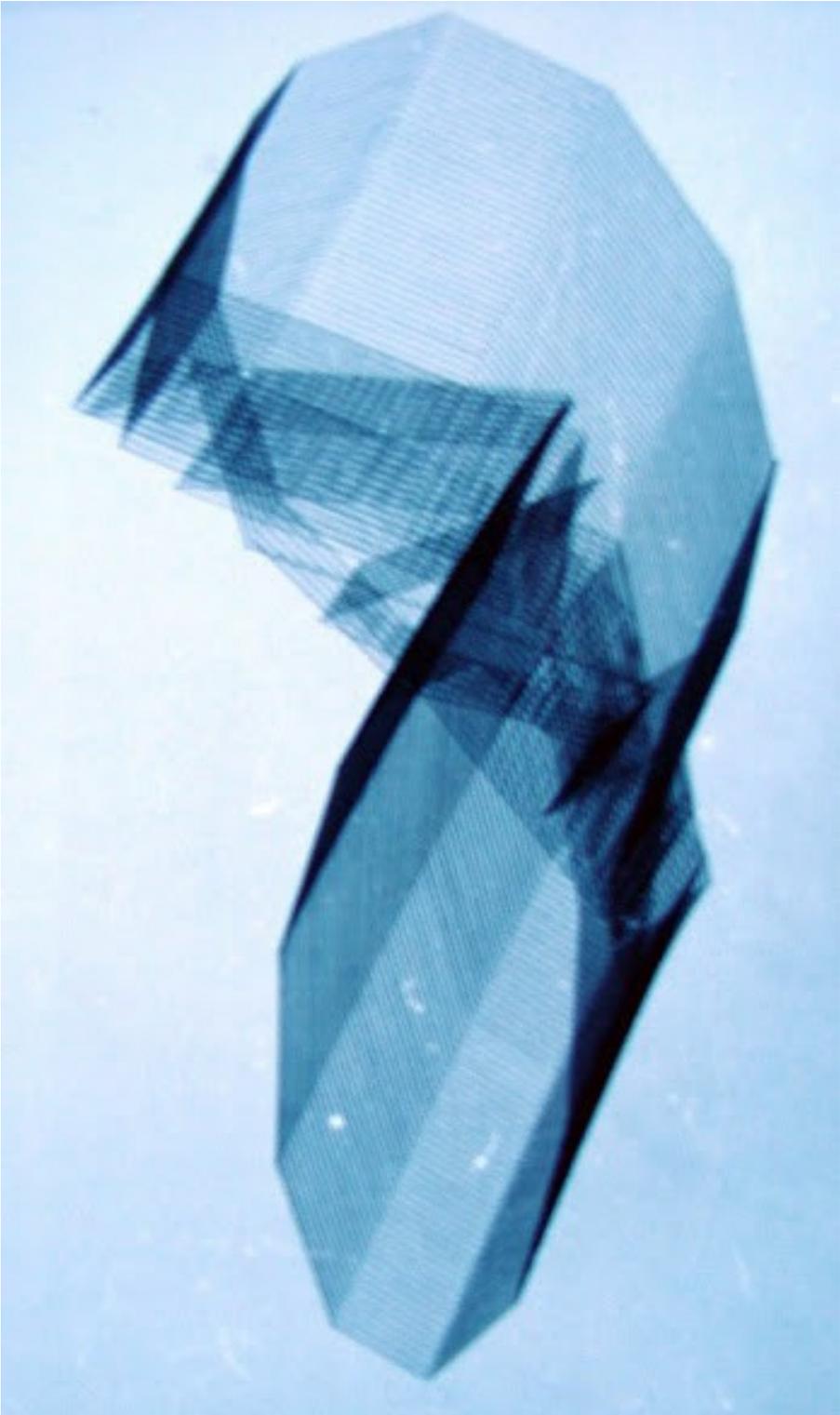
As a result, another exhibition with those decorated objects, and more important, a new chapter in a published volume; my only paper coauthored with my professor and boss, into a volume coordinated by professor Solomon Marcus. Unfortunately, those decorated object became more perishable as computer drawings.

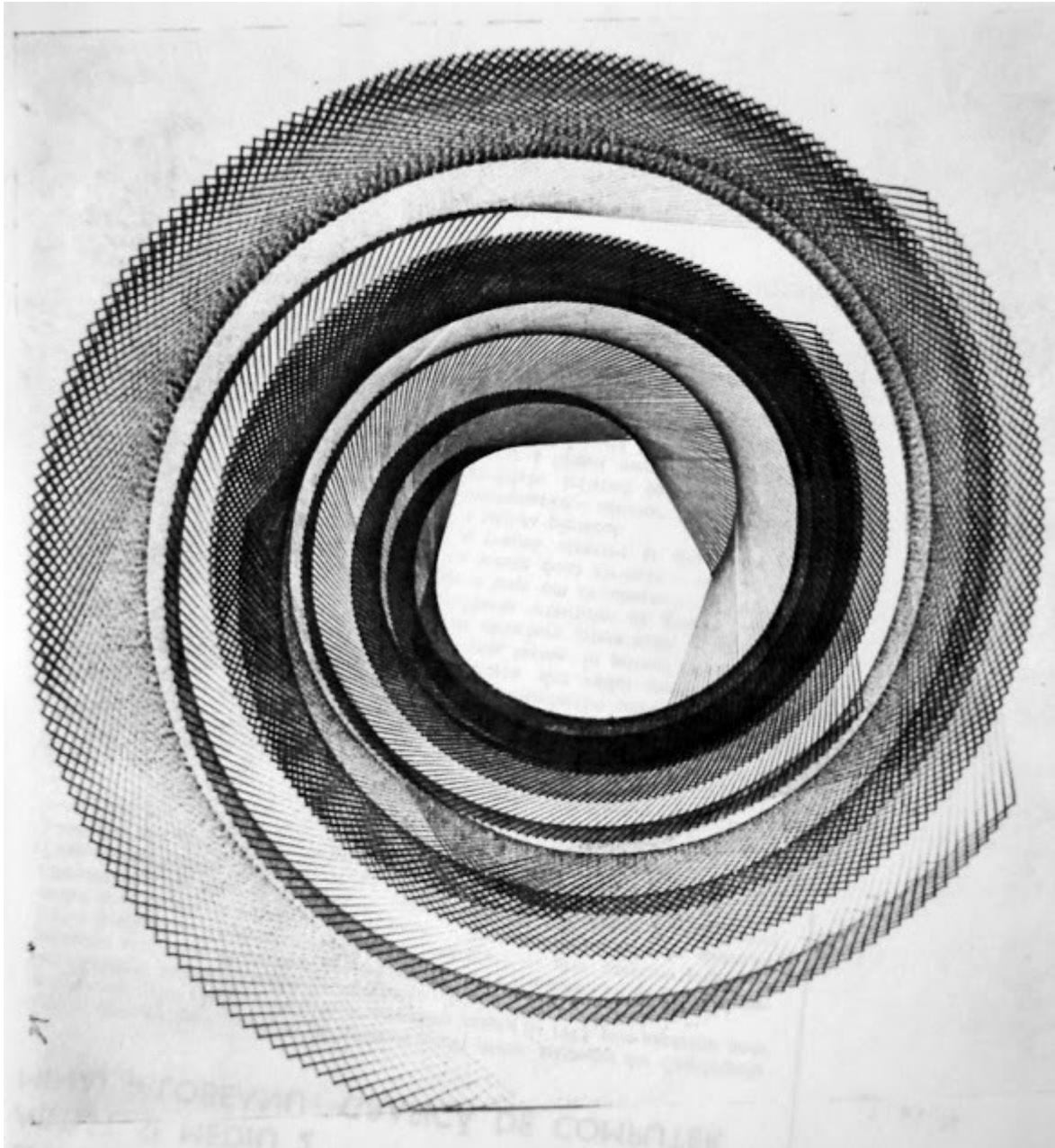
Some of my exhibited successful drawings already saved trough photo device, could be seen at the following annex. While some more comments and other details regarding the context, and different computer-graphics exhibitions in Romania between 1970-1989 are now available trough Internet, especially at Monoskop (<http://monoskop.org>).

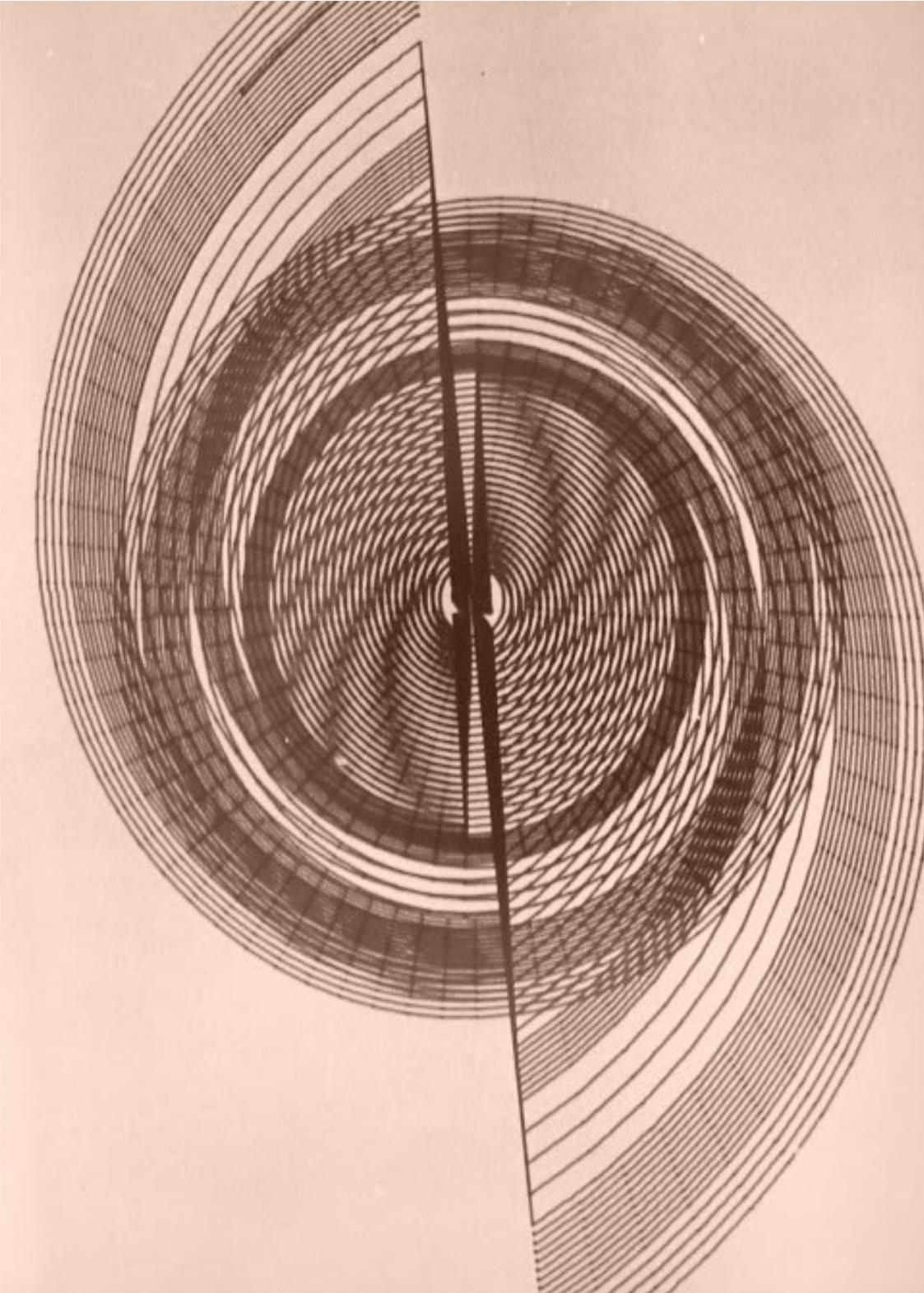
**ANNEX – A small selection from my drawings realized with HP system those years**

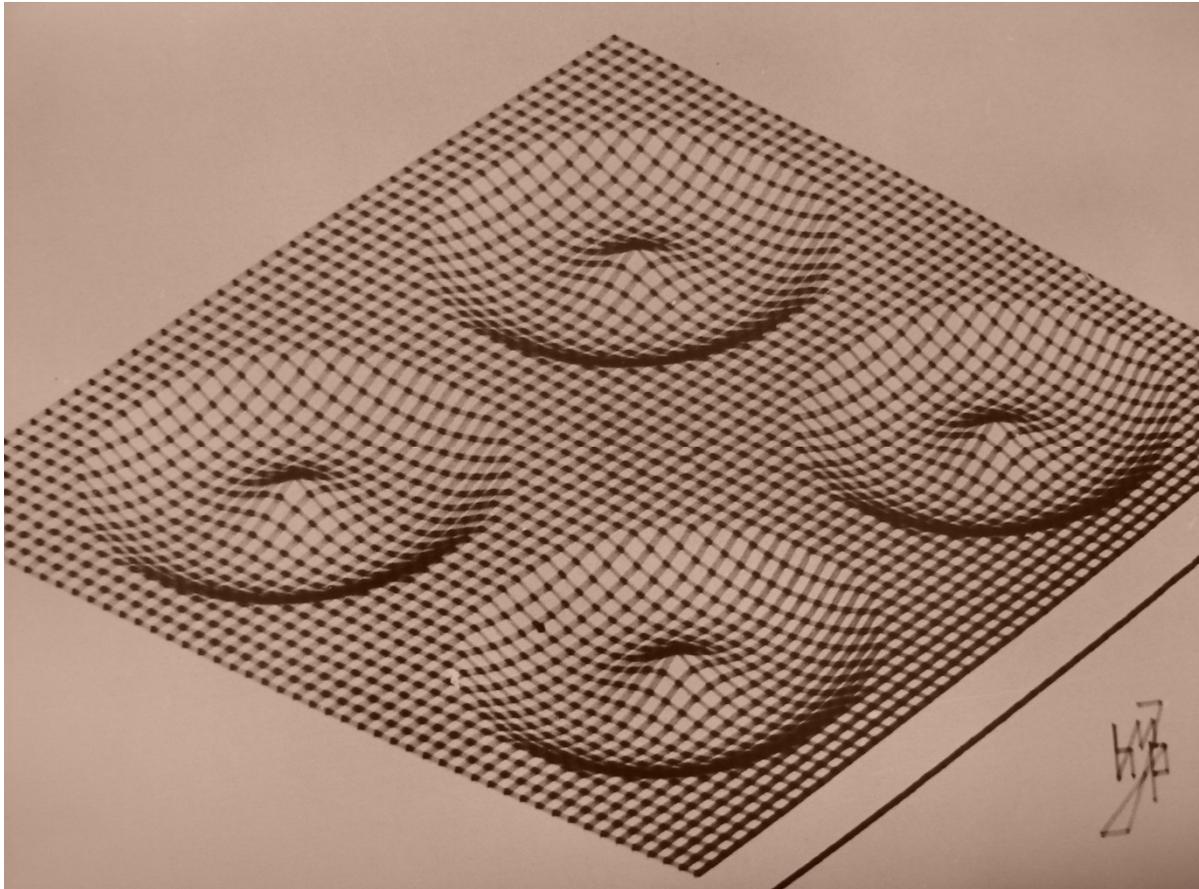












## **A short history of computer use at Faculty of Physics – University of Bucharest**

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**Abstract:** For physicists computing is a main activity. Starting from devising an experiment to problem solving with computer, from using mathematical tables to other aids to computation, physics has grown its strength by using each step the numerical computation. So, computing for researches as well as education was used and steadily improved by us, starting from first minicomputers to the last generation of computers and algorithms. In this presentation we will follow, in short, the evolution of computing, hard and soft, in physics at our faculty. We selected here the main field of interests that was connected with problems showing: programmed solutions, simulations and modeling, computer application and software during the time. Such a time recollection is interesting and surprises me as how diverse and far such activity was done. Examples will be from computation in tradition physics, to biology, chemistry, astronomy, medicine to data processing and visualization, data management, to create our own educational software and so on. The fields as nonlinear dynamics, complexity, chaos and fractals, as well as fluid dynamics, atomic, molecular or nuclear physics, earth or stellar physics, connected to improvement of the experiments and devices via artificial intelligence are some of our topics which will be exemplified here.

**Keywords:** Computational physics; data processing; data visualization; history of computers.

### **1. A short History**

Science being organically bounded to numerical and quantitative results was always related to computation. For science and in particular physics (Analytical and Rational Mechanics, Astronomy) is obvious that methods and procedures to simplify the

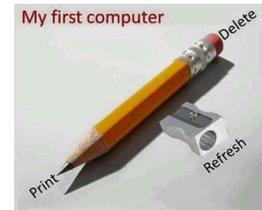
huge amount of computation was the main field that used the machines that could solve their problems. So, from the early abacus, we used currently a mechanical calculator or slide ruler or mathematical tables and the computation was enlisted on a worksheet.



Figure 1. Abacus



B. Pascal on a stamp



My old "computer"

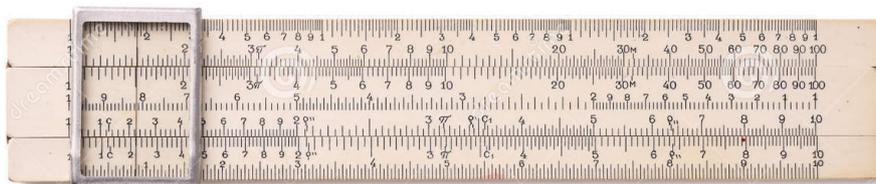


Figure 2. Slide ruler

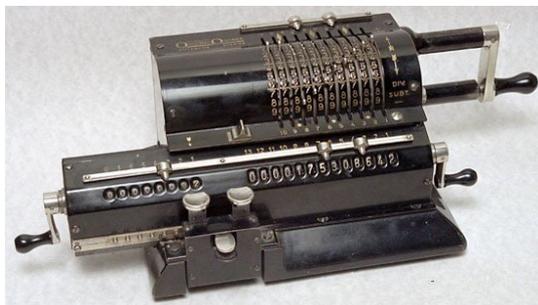
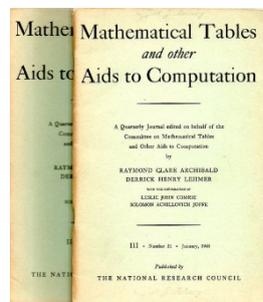


Figure 3.1 Mechanical calculator



Tables for computations

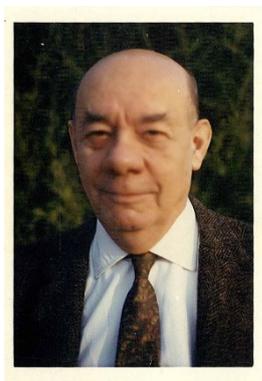


Worksheet, an endless calculations

After WW2 quick and important changes were made in the technology of computers and computing. A brief list is the following: 1961 – replacement of vacuum tube from old electronic computers with transistors and use the magnetic core memory; 1963 – ASCII – American Standard Code for information interchange; 1964 – CDC-6600, supercomputer designed by Seymour Cray and 1966 Hewlett Packard – general purpose computer HP-2115.

<sup>1</sup> [http://www.vintagecalculators.com/html/desktop\\_calculator\\_photo\\_library.html](http://www.vintagecalculators.com/html/desktop_calculator_photo_library.html)

In Romania, during the first half of the fifties decade, Acad. Grigore C. Moisil, as a true pioneer, visualized the future of computers in society [1 - 5], [9]. Even then, he realized the importance of mathematical logic and theory of automata for designing computers. In 1959, inspired by the International Congress of Romanian Mathematicians held in Bucharest (in 1956), Acad. Grigore C. Moisil (1906-1973), Professor of Algebra at the Faculty of Mathematics and Physics, founded, for the first time in the country, the Specialization of Computing Machines in the Department of Mathematics of the faculty [5, 7]. At the beginning, the curriculum was mostly theoretical but in time the staff used the experience of the Institute of Atomic Physics (IFA - Bucharest), which had built-up the first computing machines CIFA. A progress was achieved by the end of 1964, when the Center received the digital CIFA-3 computer, produced in the mentioned IFA. In 1968 the Romanian Government bought an IBM Computer which was assigned to three owners: CCUB (e.g. Minister of Education), Government Commission of Informatics (e.g. the high body for supervising Computer Science in the Country) and Minister of Agriculture. In 1969 Professor Gr. Moisil founded in the Faculty of Mathematics the Chair of Informatics, the first one in the country (Figure 4). In 1970, the staff of the Center consisted of 16 programmers and analysts and 6 technicians or junior operators and programmers [6, 7, and 8].



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Figure 4. Prof. Grigore G. Moisil (1906 – 1973) and his seminal book for Romanian computer scientists

Prof. Grigore C. Moisil was the real founder of the basis for computer use, namely the mathematical techniques for programming and problem solving. Computing Center of the University of Bucharest (CCUB), was an important step in the history of computer science in Romania.

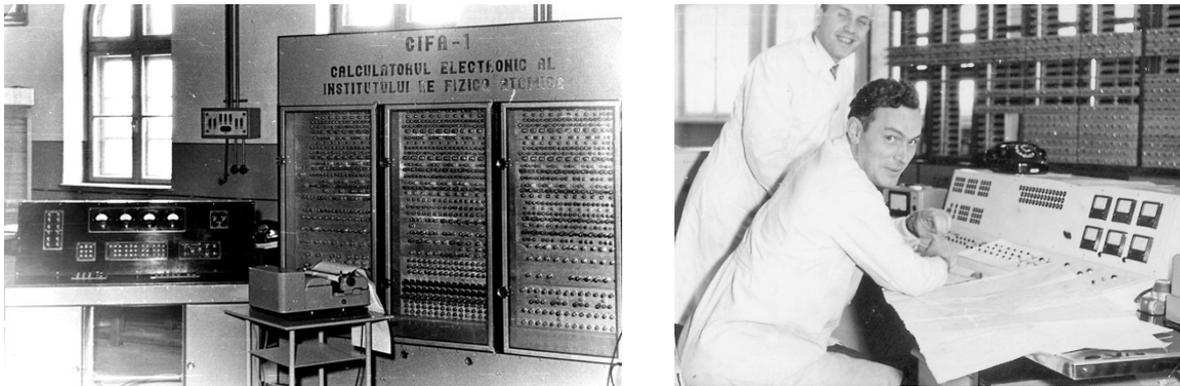


Figure 5. The first Romanian electronic computer – IFA – CIFA1 and his main designer Victor Toma

Meantime for us as researchers and professors was available the new hand-held programmable calculator, which made us able to learn programming and also to solve many difficult scientific problems, of course at its capabilities. In order: Hewlett Packard *HP-35* – 1972 the first hand-held scientific calculator; Hewlett-Packard *HP-65* – 1974 the first hand-held programmable calculator, Texas Instruments *TI30* - 1977 was a popular low-cost scientific calculator, Texas Instruments *TI 58* - 1977 was also a scientific programmable calculator. The last one has a replaceable program memory module that allows calculator to be customized. These calculators enabled us to use spreadsheets in our computing activity in physics laboratory and for student activities which was a great step for learning computations (Figure 6).

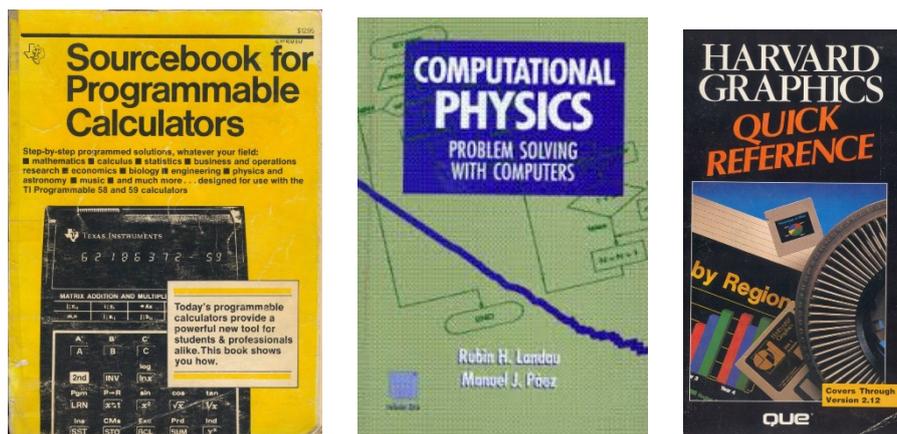


Figure 6. Some of the books we used for physics computing

In Romania at 1984 some 80.000 people were working in IT industry and universities (Felix computer) – IBM compatible.

A great step was made when the personal home computer was released in the United Kingdom in 1982 by Sinclair Research. It became quickly the main device for computing and working in physics (Figure 7).



Figure 7. The Sinclair home computer and his programming book in BASIC

Quickly a Romanian analog was released: namely CoBra, and after that a new version HC, in several models: 85 and 88 (Figure 8).



Figure 8. The CoBra and HC88 Romanian made home computer

All of the home computers needed TV or a video monitor screen terminal. The programs were stored on magnetic tapes, read and write by cassette recorder. We managed to create interfaces (hard and soft) to connect home computers to IBM matrix printer, so it was much easier to handle the data or to produce primitive graphics.

It was quickly adopted for teaching and teachers, as well as students. Even researchers used their capabilities. That was indeed a great step forward for disseminating electronic computers, learning programming and using them at home, in schools and also for games (Figure 9).

In the universities, learning programming was not bounded to the Faculty of Mathematics, but quickly spread in all science and technical faculties like physics, chemistry (Figure 10a and 10b). Departments of computing, electronics and computers, were established also in principal technical universities from Romania.

From my point of view one of most important aspects were the development of the skill for data management, data reduction and error analysis, data presentation and optimization using special computer codes (usually home made), random-process simulations and measurements, modeling and optimization of analytical data analysis, and so on.

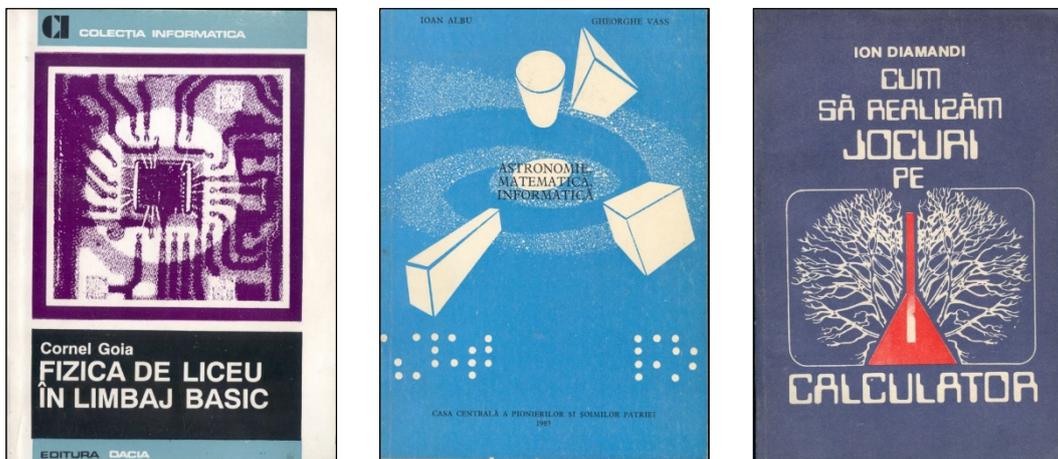


Figure 9. These are some of the popular books for computing used in that period



Figure 10a. The building of Faculty of Mathematics and the new Faculty of Physics



Figure 10b The front of the Faculty of Physics, the new building from București-Măgurele campus

Corresponding textbooks and other materials flooded in libraries (Figure 11).

Using computers and computing libraries, we learned by understanding the computer technology and also by programming. A lot of papers, books and periodical helped us to make our own programs for workout the scientific problems.

One of the most used and best fundamental books was the *Numerical Recipes* (Figure 12).

Other books (a selection) are presented in Figure 13.

In the following parts we will present a short summary of fields we use computer and computing methods: in physics, chemistry, biology, natural sciences, and also in art, and other humanistic researches (Figure 14).

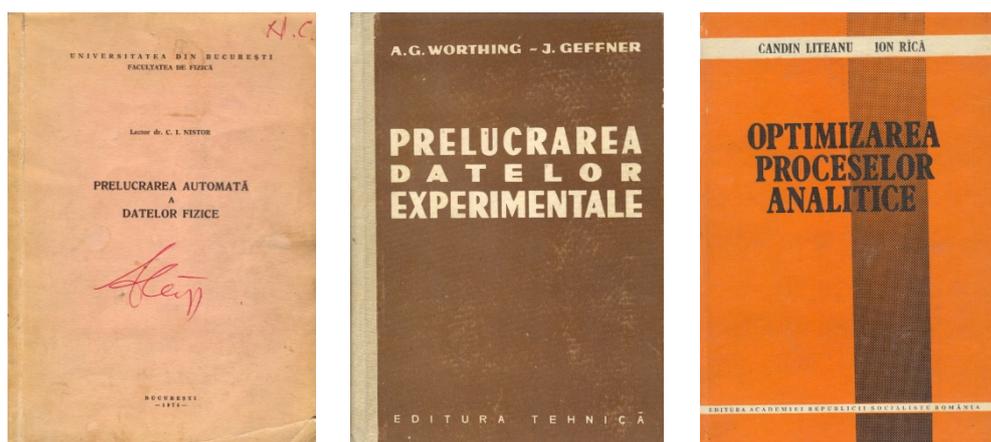


Figure 11. Several of the books used for scientific numerical data manipulation

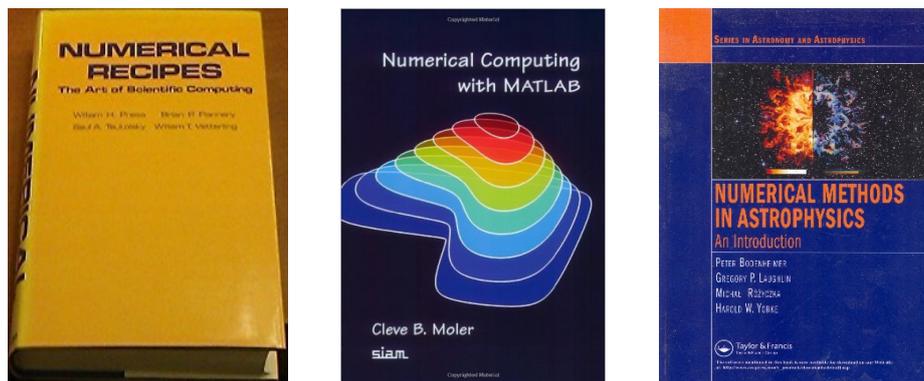


Figure 12. Books for numerical computing used by scientists and students at the Physics Faculty of Bucharest University

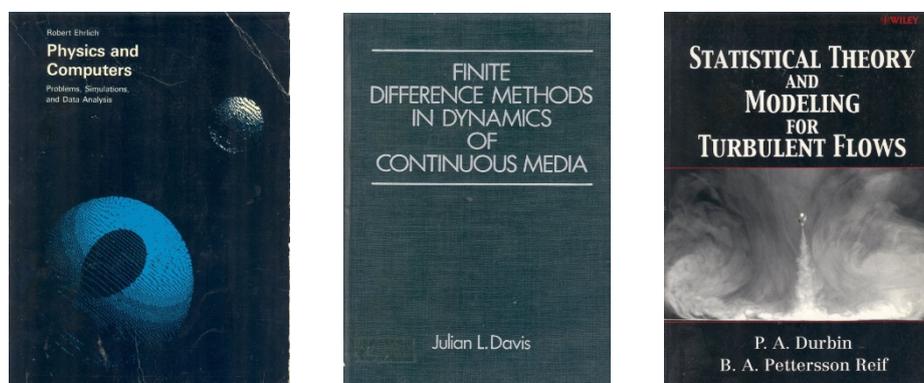


Figure 13. Books for numerical computing in physics, and for far more complex computations related to continuous media simulation and for plasma physics

The last quoted fields were closely related to the development of studies in nonlinear dynamic theories, complexity, chaos and fractals.

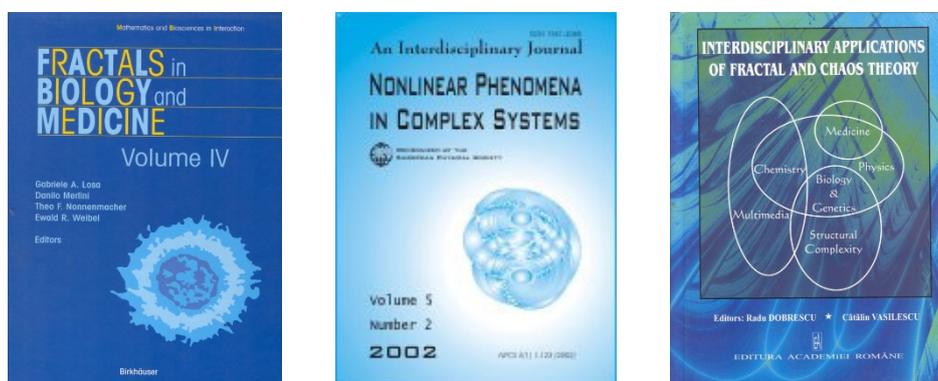


Figure 14. Complexity, chaos and fractals books that were intimately related to our researches and to computer facilities

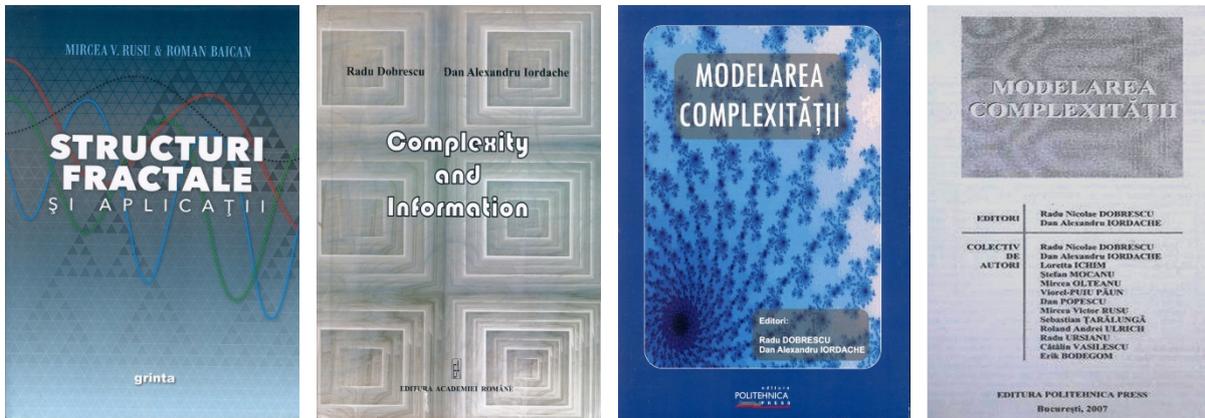


Figure 15. Some of our contributions and researches in fractal and complexity theory

Meantime we enriched our knowledge's and hence we extended our activities applying virtual instrumentations and started to develop our directions of researches using artificial intelligence methods and codes, like cellular automata, neural networks (Figure 16).

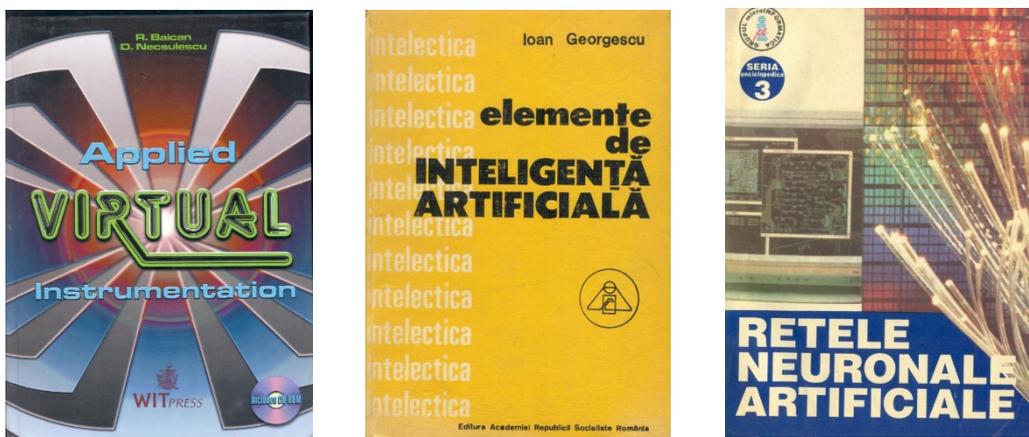


Figure 16. Books on virtual instrumentations and artificial intelligence methods and codes, like cellular automata, neural networks written in Romanian

All the mentioned books and others are listed at the end of our paper in **References**.

## 2. Fields covered at our faculty that extensively used computers and codes

**2.1 Spectroscopy.** *Different fields of spectroscopy: Nuclear Magnetic Resonance (NMR), Electron Paramagnetic Resonance (EPR), Visible and Infrared Spectroscopy (VIS, IR), Mössbauer Spectroscopy (MS).*

### *Magnetic resonance spectroscopy*

NMR spectroscopy was used for studies of molecules that contain hydrogen (protons). For that we built our own Magnetic Resonance Spectrometer, first of autodyne type [51] and after Bloch magnetic induction techniques (Relaxation Effects in Nuclear Magnetic Resonance Absorption). It has to be mentioned that our device was among the first built in Romania at that time.

A combination of experimental and computing methods was used in order to obtain the first reliable NMR signals. Early computing devices were used for electronics (autodyne) and for magnetic field distribution in the region of the coil and sample (figures 17 and 18).

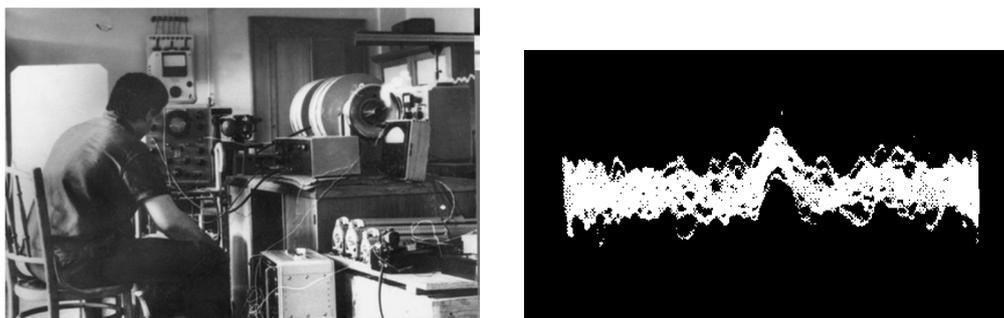


Figure 17. Student using for diploma thesis our NMR spectrometer (1963) searching for the signal on a scope

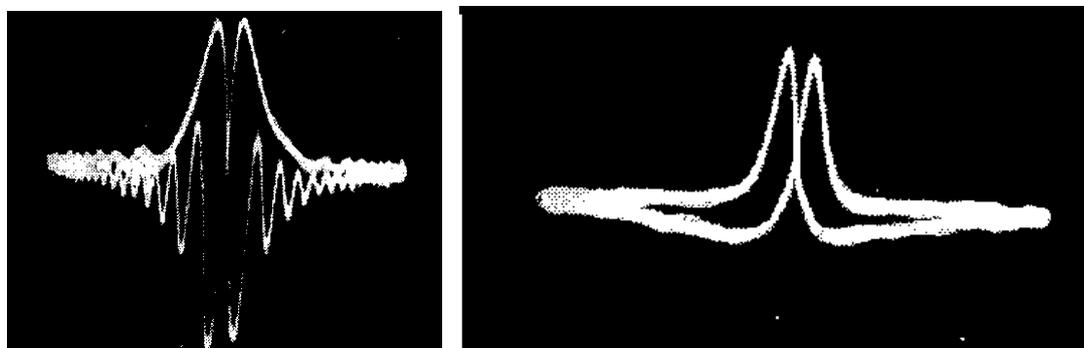


Figure 18. Photos of the NMR signal in homogenous magnetic field

NMR studies at low magnetic field need Helmholtz coils. Magnetic field distribution in center of coils was computed using basic formulas from figure and after were made corrections for the finite volume of the sample using series expansion (Figure 19) and corrections after measurements for calibration.

If the NMR studies need mainly computing capacities, EPR spectroscopy need difficult computations for spectra interpretation.

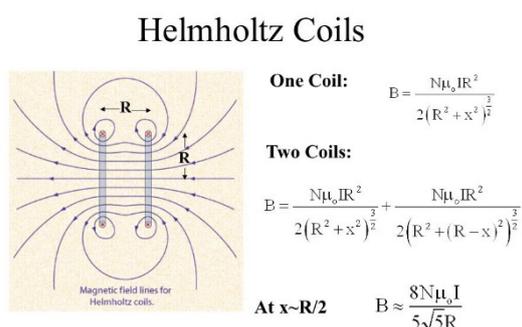
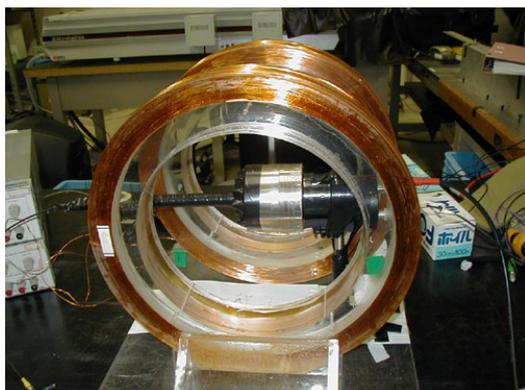


Figure 19. Helmholtz coils and design formulas in first approximation

Usually primary computations are done by spectrometer's electronics, but an additional computation has to be performed using computers special codes. Noise reduction, signal to noise improvement, spectra interpretation and simulations need farther specific computations, which are difficult to be done. The researchers have to be skilled to make their own codes or to rely to the existing one. We did such codes because of lack of money and also we want to have program codes suited for the experimental condition we work [52], [54].



Figure 20. The JEOL EPR spectrometer used at our laboratory

### *Mössbauer spectroscopy (MS)*

MS was an intensive period of work between 1964 and 1974. We built the spectrometer using available (scrap) components and made quite reliable system of measure [55] (Figure 21). We included an automatic change of the speed needed for exploring the desired range of Doppler shift energy variation of gamma rays (actually 14.4 keV – Fe-57 isotope) using an electromechanically switching system relays used

in telephony (Figure 22). On the other hand we used the same switching system relays for data acquisition of gamma ray flux in order to improve the signal to noise ratio using the techniques of accumulation of data for each channel corresponding to a given gamma ray energy [56, 57, and 58]. For that time this idea of noise reduction due to repetitive spectra acquisition was completely new and innovative way of obtaining accurate spectra. It was also the first of this type made in Romania. We obtained the high scientific award of Ministry of Education and Researches for Mössbauer device and the following researches done. We used these capabilities for many Mössbauer Effect Applications in Chemistry [59, 60, and 61].

With this spectrometer we were able to study magnetic materials, namely Magnetite with spinel structures  $F_3O_4$ . We obtained valuable data on magnetic structure of the crystal, the way of the distribution of the impurities in the crystalline lattice, their influence on the magnetic properties of the material, the atomic structure nearby the iron atoms (local order or disorder), and the way of phase transition between ordered and disordered structure, which lead us to a new approaches of these transitions and led us to conclusion that in some cases the structure is not ordered, nor disordered but acquire a fractal local distribution. Among the problems we studied were the Iron valence spectra in doped Magnetite [62, 65, and 67], spin and charge densities in Ti-doped Magnetite [63], the hyperfine interactions in Doped Magnetite [64]. In order to analyse and for data reduction we worked out a computer code for quantitative analysis of Iron compounds using Mössbauer Spectroscopy [66].



Figure 21. The radioactive source, electromagnetic drive to control the speed, the sample holder and the photomultiplier as a detector in a complete MS with a block schematic

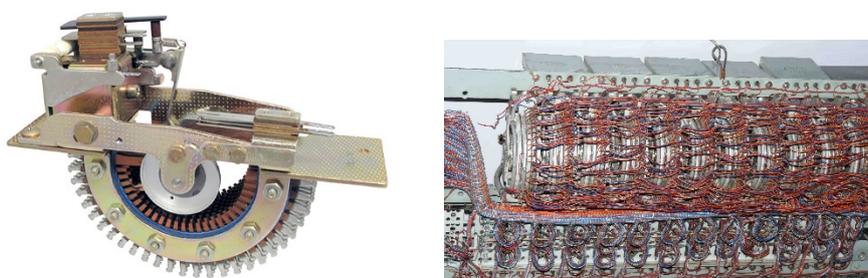


Figure 22. Electromechanically switching system relays that govern the speed and also the channel of data accumulation

A typical spectrum recorded and analyzed is given in Figure 23.

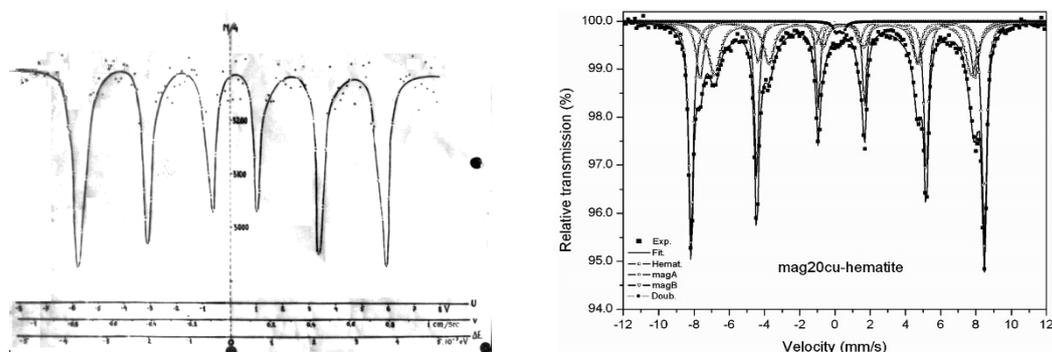


Figure 23. Our first Mössbauer spectrum of pure Magnetite and a complex spectrum of mixture of Magnetite ( $\text{Fe}_3\text{O}_4$ ) and Hematite ( $\text{Fe}_2\text{O}_3$ )

Each type of sub-lattice from the oxide has his 6-line Zeeman spectrum. If there are several sub-lattices the spectra is a convolution of all sub-lattices contribution. To understand the crystalline structure and their atomic arrangement it has to be deconvoluted. This task can't be done without specific dedicated software we managed to do. The task is hard and optimization for a minimum  $\chi$ -square deconvolution is cumbersome and time spending activity. Usually for a good deconvolution are necessary several days of work. We used the IBM's machine from Atomic Physics Institute with the help of Dr. Mircea Morariu from the Mössbauer group led by Dr. Dănilă Barb. The complexity of the spectra was impossible to solve directly so we needed to choose and enter the initial values of the parameters that define the whole spectra using a less performing computer (SINCLAIR). If we have six sub-lattices with 6 lines each we need to define  $6 \times 6 = 36$  lines and if we assume the shape of a line is Gaussian (defined by 3 parameters) we have to find optimized,  $36 \times 6 = 216$  parameters. It was a very long task for each deconvolution, so each sample took at list a couple of month to optimize. Usually a set of samples for one compound took some 6 month of work. But we created a basis for deconvoluting all kind of complex spectra whose complexity arise form superimposing several simpler spectra.

It is clear that without good, high memory, and high speed computers, such a task could not be finished.

### *Infrared (IR) spectrometry*

In our department of Atomic and Nuclear Physics, the activity concerned studies of atoms, molecules and substances in different environments and under different conditions. One of the main experimental studies was done recording and interpreting the IR spectra of some samples, at different temperatures. We used an IR spectrophotometer

Unicam SP1100, an analog device that records the spectra on paper. We had to analyze and interpret spectra on paper that was not so easy and precise. So we considered that is possible to improve the quality of interpretations if we make a modification of spectrophotometer in order to obtain the digital (numerical) file of the spectra. For that we made a digital to analog converter scheme that can be seen on Figure 24. We used an 8080 processor as core of the computing system and made all hard equipment and the soft necessary to accomplish the task [68]. In Figure 25 we present two spectra recorded by modified spectrometer and presented on a computer monitor. We considered that all these improvements necessary in order to be able to better understand the results. We studied the I.R. spectra of amorphous  $\text{Mo}_x(\text{a-Ge})_{1-x}$  thin films [69, and 71], and problems arised when surface we study presents roughness and hence the optical constants deduced had to be corrected [70].



Figure 24. Unicam SP1100 Infrared Spectrophotometer with analog to digital conversion and 8080 processor as core of the computing system

Many of the results that we will present in the following sections were done using this upgraded spectrophotometer.

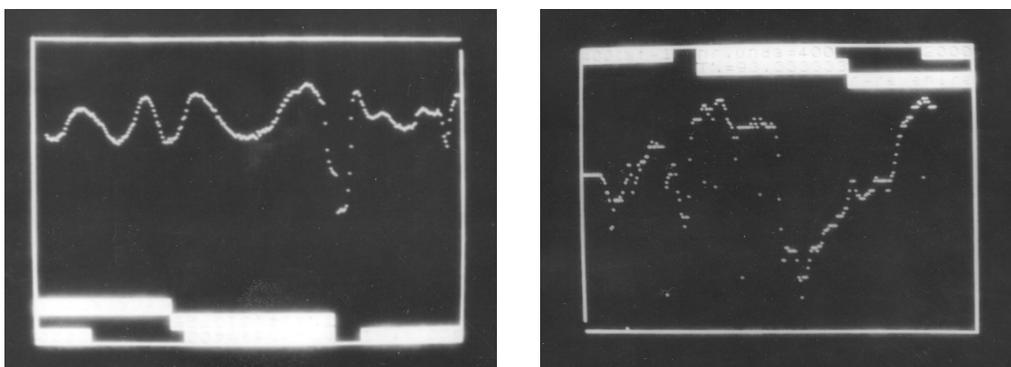


Figure 25. Two examples of IR spectra recorded using the upgraded spectrophotometer (photos from the monitor screen)

*Dinosaur Eggs from Hațeg Basin*

As an example of interesting studies that were done are the Dinosaur eggs studies found in Hațeg basin from Romania. We carried out measurements on serial sections through dinosaur eggshells (Figure 26) and used IR spectrometry (transparencies and reflectance) in order to capture as many as possible valuable data on the composition, structure and formation. Extensive and multitask studies were done. We measured physical, geometrical – allometric properties, optical (Visible and IR – transmission and reflectance), electron microscopy, thermodynamic analysis. We studied also dielectric properties, and carried out chemical analysis, and correlate all findings with paleontological, stratigraphical and geological data of the place where these eggs were found. We compared the data with the today's eggs of chicken and these gave us the possibility of inferring biological aspects on the Dinosaur biology, environment they lived, and other unknown characteristics. We were able to create a scenario of their life using the physics of the eggshell [72, 73, and 74].



Figure 26. A freshly discovered dinosaur egg fragment and a longitudinal section through eggshell, first layer – optical microscopy

The pore structure of these eggshells exhibits peculiar hierarchical self-similarity, from millimeter scale to nanoscale. At optical scale, the eggshell is built up by packing bundles of calcite carrots, well aligned with their axis perpendicular to the eggshell surface, with “gaps” (macro pores) in between. Each calcite carrot is about 0.5 mm in diameter and has the length equal to the eggshell thickness. Scanning electron microscopy (SEM) reveals that these carrots are in turn micro porous spongy calcite structure, with  $\sim\mu\text{m}$  average pore diameter. The structure on an even smaller scale is studied by transmission electron microscopy (TEM) on thin sections prepared by ion milling, using methods from material science, revealing yet another layer of complexity (Figure 27). The observed features led us to the conclusion that calcite crystallization leading to the carrot morphology is controlled from the nano- to micro-scale by the structure of the collagen net developed in the eggshell cell.

A surprising conclusion resulted from our study: the pore distribution is not a Gaussian but a power law that is typical for some self-similar structures. In this way we found that the biological survival of the eggs was much enhanced, despite the variability of the early harsh environment. This conclusion resulted from measurements and computations made using our image analysis codes and fractal dimension codes we made for that. In Figure 27 are presented results for one of the serial cuts slide from eggshell, and the fractal analysis code for determining the fractal dimension of the distribution. We found that this fractal distribution can be found even at micro scale, revealed by TEM scanning.

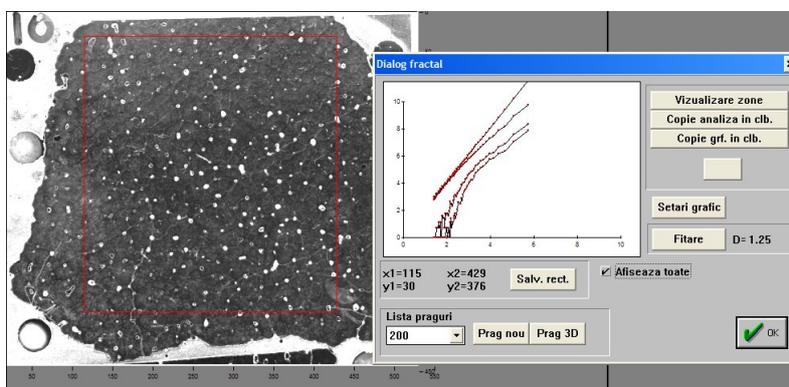


Figure 27. Example of fractal dimension computation using box counting method applied directly to the image

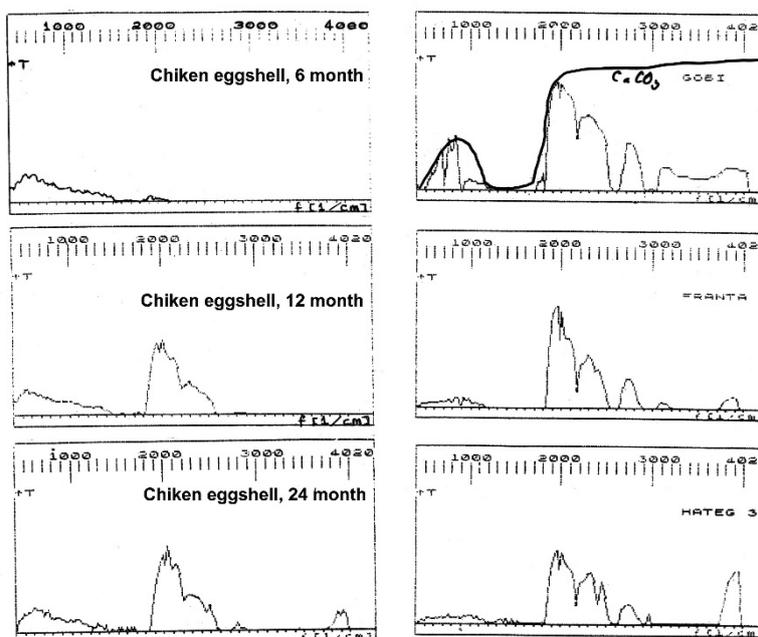


Figure 28. The IR transmittance spectra of the chicken eggshells and dinosaur eggshells

Another interesting result comes from IR transparency of the bulk shell of the egg. Comparing the chicken eggs IR transparency spectra with that of the dinosaur eggshell we found a nice evidence of the evolution in time of the calcite structure of the columnar structure (Figure 28). The main features of the eggshell could be recognized even there are millions of years as time leg. In the transparency spectra there is a gap around  $1500\text{ cm}^{-1}$  that is preserved in both types of eggshells. If we compute the temperature of the thermal radiation corresponding to that range of opacity we found a value near  $40^{\circ}\text{ C}$  which suggests that the eggshell is not transparent for this range of radiation. The direct conclusion is that the eggshell acts as an “accumulator” of inner heat energy in order to maintain constant temperature inside the eggs. So, the eggs could be hatched in great reliable condition despite the variation in environment condition. Hence the hatching has a high rate of survival yield.

### 3. Computing in nonlinear dynamics, fractals and chaos

One of the main fields we extensively used was the study of nonlinear dynamical systems, fractals and chaos. At that point we can quote the Sir Isaac Newton, from *Philosophie Naturalis Principia Mathematica*:

*“It is the glory of geometry that from so few principles, fetched from without, it is able to accomplish so much.”*

Indeed the fractals, chaos and nonlinear dynamics are inherent related to computing. The fractals were discovered by Benoit Mandelbrot in the time he worked at IBM Research Center (1982). Fractals, being “exactly the same at every scale or nearly the same at different scales” as defined by Benoit B. Mandelbrot, are complicated, yet fascinating patterns that are important in aesthetics, mathematics and science and engineering.

By using non-spatial dimensions, mathematicians and scientists have explored spaces beyond traditional 3-dimensions. Examples include 4-dimensional ‘cubes’ called tesseract. Understanding of these structures can offer insights into real world problems such as optimizing a network’s path to follow the shortest distance. Physicists and mathematicians, routinely formulate even higher dimensions, known as ordered states, to manipulate complicated equations that would be much harder to work with at a lower dimension. It is not uncommon for atomic physicists to work with a dimensional space in the teens in order to keep track of all possible states of particles found at the subatomic level.

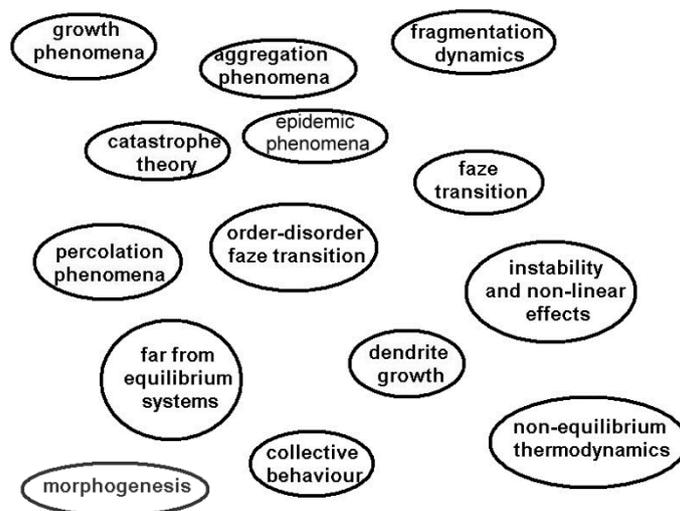


Figure 29. Different fields that were unified into a new general theory, *Theory of Complexity*

The aim this field is to understand the patterns and shapes found in nature: galaxies, clouds, snowflakes, ocean waves, coastlines, leaves, forests, patterns on skin and on butterflies, shapes and forms of crystals and molecules and macromolecules (e.g., synthetic polymers and proteins), shapes of biological cells and viruses. Mandelbrot (1982) developed and introduced a new kind of geometry, *fractal geometry* (different from Euclidean geometry) [72]. It was shown that many naturally occurring structures that are usually described as irregular, random, or chaotic actually have shapes that can be measured and categorized. Many shapes and patterns found in everyday life can be described on the basis of somewhat simpler geometrical considerations. In fact, fractal geometry can be considered a new way of looking at nature.

We started from 80's to use complexity theory, and more specific nonlinear dynamics, to understand many unsolved problems for atomic and nuclear physics, astrophysics, biology and medicine, and finally extended these studies to larger fields such psychology, social behavior, and other humanistic fields. In the following we will make a short description of these studies. All of them used extensively computers and computing for modeling and simulation of the phenomena [40], [73, 74, and 75].

### ***Fractals and chaos***

Because fractal theory and chaos gave us a powerful mathematical and computational tool, a lot of earlier researches were reconsidered and other were started once we put in work this tool. [76 to 92]. According to Benoit Mandelbrot, the father of modern fractals, a fractal is, "a set with self-similar geometry and fractional dimensions.

We started to workout the mathematical theory of fractal geometry; we produced several computer codes for computing parameters (fractality, fractal dimension, randomness, statistical distribution, noise, multi-fractality and so on) related to fractal analysis of the signal, image and data. In the above cited references you can find some of the most important of our researches. Being a vast area it is not intended here to make even a short description of them, but we can mention some of these problems. For example the first problems were related to define and measure the fractal dimension of the data. Our data came sometimes as time series or noisy data from a specific mathematical space, or image analysis, or sounds and so on. It was necessary to check for self-similarity of the data and the volume of sample we analyse. One of the difficult problems encountered was related to method of measuring the fractal dimension, knowing that primary data have to be transformed mathematical. This transformation has to be reliable not to smear-out the fractal characteristics. For example, any kind of noise reduction procedure or smoothing of the image or time series could destroy the fractal characteristics of the signal (data). Hence, the usual codes for numerical data processing are not usable for that task. We produced our codes for all kind of statistical analysis and fractal analysis that have to be used in such cases. On the other hand, there exist commercial codes for fractal analysis but unfortunately in some cases these are no reliable. Careful code production for fractal and nonlinear system analysis is compulsory for serious fractal analysis. We did that on time span of almost 10 years. A review of these codes and methods is described in [92]. Another interesting aspect is that in our department, teaching fractals and nonlinear dynamics as regular courses begins around 1985 and many generations of students finished these lectures. Some of them use fractal analysis in their researches activities in their field.

It is obvious that we made steps forward new computing strategies that include cellular automata (CA) algorithms, neural network (NN) based codes, statistical and mathematical algorithms on much more complex analysis, like Kolmogorov entropy, and other strategies for finding peculiar fractal or nonlinear aspects of the problems. In the same categories are methods of solving nonlinear differential equations, or using finite difference methods for exploring solutions of problems in the field of continuous media like: fluid dynamics, plasmas, jets, thermal propagation or electromagnetic propagation through non-homogenous materials and media. Topics are for example: self-organizing networks for extracting jet features; recurrent NN for real-time matrix inversion, deconvolution of complex spectra of different natures, fuzzy systems, ecological problems, atmospheric physics (Earth and planets, including stellar atmospheres), cancer and epidemic diseases, land erosion and forest preservation, tectonics and earthquake early warning, understanding the brain activity and learning processes and other mathematical models to

simulate a learning/problem-solving activity of the brain. A lot other models are dedicated to ultrasound tomography imaging of defects using NN; modeling of robot motion using NN; photogrammetric target processing using artificial NN; use of NN for an expert system in nuclear medicine image analysis.



Figure 30. Lightening images. The irregular path is characteristics and difficult to understand

A special attention and work we done on understanding atmospheric discharges – bolt of lightning, lightning, sparks, dielectric breakdown, branching electric discharges that sometimes appear on the surface or in the interior of insulating materials (Lichtenberg and Kirlian discharges).

Related to these are other collective phenomena, which are inherent non-linear. Among them are corona discharges, digital imaging techniques that record light produced by photons emitted during corona discharge electrical breakdown or arcing often seen as a bluish (or other color) glow in the air adjacent to pointed metal conductors carrying high voltages, and emits light by the same property as a gas discharge lamp.

New researches suggests that a) lightning are triggered by cosmic ray shower, b) lightning produce electromagnetic waves in upper atmosphere that create correlated lightings over the entire Earth that shoes power low time distribution, c) lightning create a specific electromagnetic noise that could perturb communications, d) lightning are sometimes associated to specific geometrical form like ball lightening, e) unusual type of lightning could be found in the upper atmosphere, over the clouds and are directed upward and not downward (elf and sprites). It is now well known that the intricate, tortuous, path of the lightning is a typical non-linear phenomenon produced by quickly changing in electric field distribution over a large region of space. Understanding of these features are of theoretical as well as practical interest. In the following we will present short description of our researches.

All of these phenomena are similar to other phenomena apparently un-connected, but today we can understand their behavior, through self-similar properties and also under the law of universality specific for complex phenomena. An interesting example is the St. Elmo's fire (light), a weather phenomenon in which luminous plasma is created by a coronal discharge from a sharp object in a strong electric field in the atmosphere (such as those generated by thunderstorms or created by a volcanic eruption). Equivalent is the function of the Geiger-Müller tube used in nuclear physics to detect charged particles coming from radioactive substances.

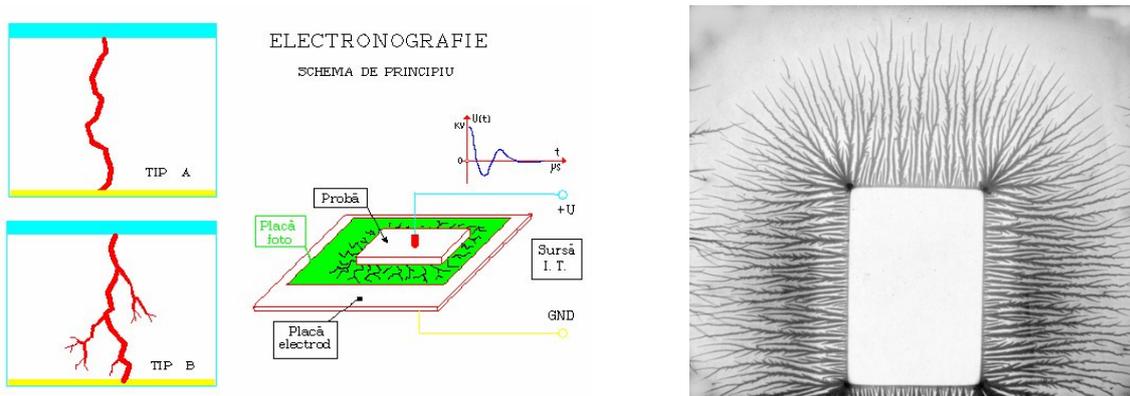


Figure 31. Device for studying surface electric discharge (electromyography)

Figure 32. Image of the branching structure of the surface electric discharge captured on a photographic film

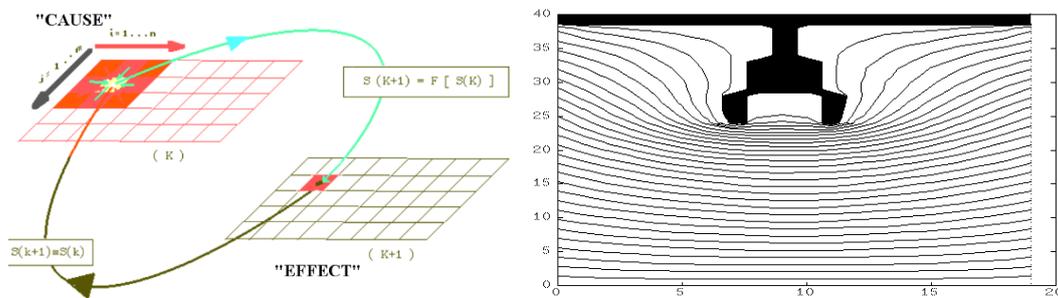


Figure 33. Algorithm for simulation lightning strimer, using cellular automata code

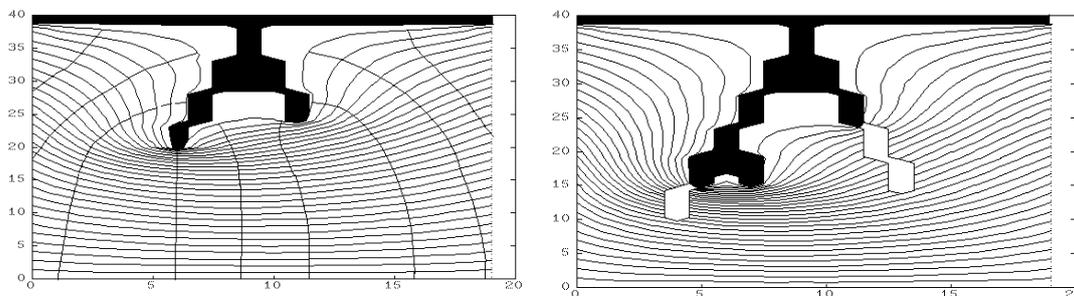


Figure 34. Step by step results of the simulation: propagation of the strimer (cellular automata)

It is amazing that that kind of phenomena we can find in liquid flow, liquid mixing phenomena, turbulence, diffusion phenomena starting from chromatography, electro deposition, and the transport phenomena governed by Brownian motion.

Turbulent flow, or turbulence, is found to have two important and interrelated properties. It is chaotic and it can transport, stir, and mix its constituents with great effectiveness.

By chaotic, we mean that it is characterized by irregular temporal and spatial dynamics that are unstably related to its initial and boundary conditions.

Connected phenomena, by their universality law, can be seen in particle deposition of thin films technology, or in sedimentation, or columnar growth of crystals, that could be well described by Diffusion-Limited Aggregation (DLA), a kinetic critical phenomenon.

DLA is a statistical growth process that progresses much like Eden growth, but the addition of sites occurs with the highest probability where the gradient of a substance that is diffusing toward the existing cluster is greatest. The sites with the highest gradients tend to occur at the sharpest and outermost points of the cluster, thus leading to the unstable and rapid growth of these points. Dendrite structures results that have been suggested as a promising model of growth for many natural processes. Unlike cellular automata and Eden growth, DLA is considered a global model as opposed to a local model. Whereas the probability of growth depends on the local gradient, the gradient itself is determined by the patterns of diffusion around the entire cluster that arise from the shape of the cluster as a whole. Growth therefore exhibits long-range correlation, an important characteristic in a structure that may approximate global optimization for transport of metabolic materials. The fractal dimension of a DLA cluster as a whole is known to be about 1.71 in a plane.

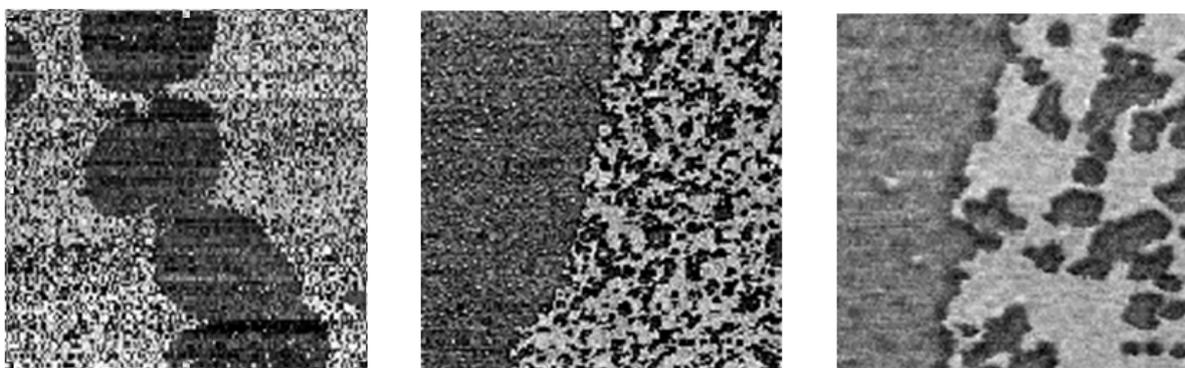


Figure 35. Experimental technique of adhesion AFM for dimyristoylphosphatidylethanolamine (DMPE) film, made by Langmuir-Blodgett (LB) technique, at a surface pressure for which coexist both liquid expanded (LE) and liquid-condensed (LC) phases

Careful analysis of images and computation of the free energy of the molecule layer on the liquid could (Figure 35) be understood that shows fractal geometry of the border separation between phases.

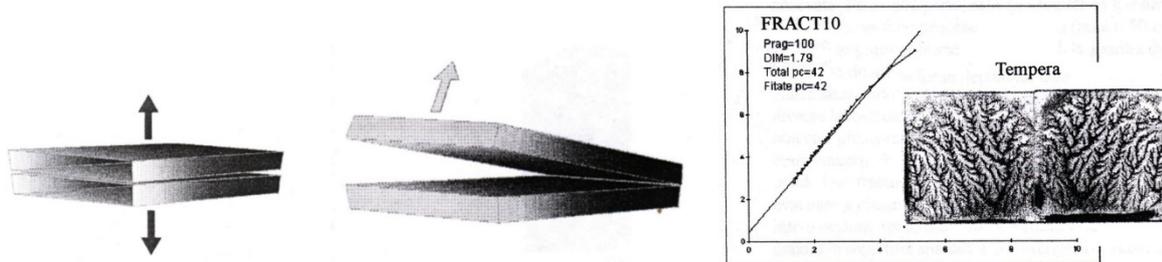


Figure 36. Detachment experiments and fractal analysis of the branching pattern using one of our codes for fractal dimension computation

These kinds of researches could be interesting as a special type of modern art, but in essence is related to the molecular interactions between liquids of different viscosity (oil, water color, tempera, glues, etc.) with a substrate. All of them exhibit fractal structure with different but specific fractal dimension. An interesting application was our study of the fractal dimension of the cracks developed in old paintings. There are notable (statistical) differences between the systems of cracks for a drying paint with quick drying time compared with the long time of drying. Application could be found in identification of forgeries, and also for approximate dating of old paintings [186]. Also we can benefit from these experiences in our home made painting activities of our house.

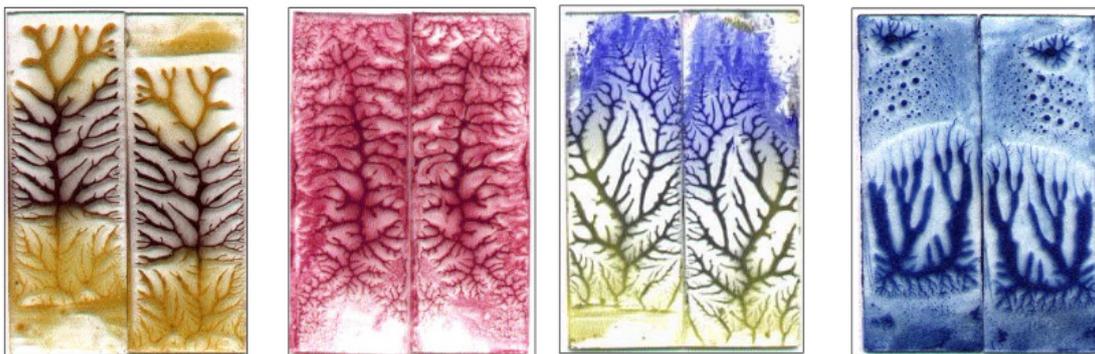


Figure 37. Lifting-Hele-Shaw-Cells; water-paint and oil paint (our experiments)

In figure we show our experiences using adhesion physics, limb formation and branching. All the physical effects are related to the intermolecular interactions between paint and substrate (glass plate), Figure 36 and Figure 37. The images are

representative for universality phenomena that include all kind of complex systems, starting from paint, rivers branching, dune formation and erosion, clouds, the climate on planets, plants and trees, limb formation and so on.

Without being directly connected to the above phenomena we studied charged particle movement in electric or magnetic (or both) fields that occurs in Solar wind and give rise to the famous auroras (polar lights, northern lights, aurora borealis) a natural light display in the Earth's sky, predominantly seen in the high-latitude regions. Auroras are produced when the magnetosphere is sufficiently disturbed by the solar wind that the trajectories of charged particles in both solar wind and magnetospheres' plasma, mainly in the form of electrons and protons, incoming into the upper atmosphere due to Earth's magnetic field, where their energy is lost. The resulting ionization and excitation of atmospheric atoms and molecules emits light of varying colors and complexity. The Solar wind interaction with magnetic field of Earth during Solar activity effects planetary magnetospheres. The heliophysics is closely tied to the study of space weather and the phenomena that affect it, and consequently to climatology.

Going in upper atmosphere we can find other phenomena, that were and remained our interests: in the cosmic ray flux of particles with origins outside the Earth environment, namely from deep space, active galaxies, neutron stars, black holes and so on. The cosmic ray flux produces avalanche by multiple collision with the atmosphere constituents and can be observed on the Earth surface like a background radiation. In order to model the movement of charged particles from deep space, to our Galaxy, to our atmosphere, we have to model the process by stochastic models for particle transport (sometimes by Monte Carlo simulation).

At the end of this lengthy list of phenomena which were studied by us in the last 30 years, we carefully analyse the limits of fractal analysis and models, because becoming a "universal panacea" to study unconventional and the non-linear phenomena, very easily it could be used as universal conclusions, an unwanted habit in the scientific research.

Who is interested in the above list of thematic and fields we studied, can find particular examples in the references.

A large area of interests was the computational electrodynamics or electromagnetic modeling of the interaction of electromagnetic fields with physical objects and the environment. Typically this involves computations for different approximations of the Maxwell's equations and is used to calculate antenna performance, electromagnetic compatibility, radar cross section and electromagnetic wave propagation in free space or in between a specific environment. Great deals in that computation could be to account for the scattering or absorption of radiation by small particles from atmosphere. This could be of interests also for astrophysics where we have to understand the propagation of electromagnetic wave (including light) in stellar or planetary atmosphere.

Not far from these topics are the electromagnetic propagation in non-homogenous media (natural environment) or in region with buildings, constructions, wires, metallic objects, usually man made artifacts (cables, metallic towers, antennas, airplanes, cars, ships, submarines). The last example of interest is in all kind of Radar applications, steals devices.

From these categories we studied extensively propagation in natural environment of the electromagnetic waves (for telecommunication needs, especially cell phones), and fractal applications in designing antennas with various characteristics impossible to achieve on conventional design.

The propagation was studied trying to find a better model of propagation though landscape (which is fractal in essence) in order to maximize the transmitted power with minimum number of antennas. We found that the fractal model is a much better model over the classical one.

For all kind of mobile vehicle the most important is to have a better gain of receiving the signals from emitters (Phone, TV, radio, information, GPS, radar and so on). The main problems are that all these kind of application work in different frequency bands and the antennas have to be small. This is a major problem for antennas, which must be designed to work in a broad band of frequencies (from MHz to GHz or even THz). We found after years of study that fractal geometry could give a better solution with reasonable good results using one or maximum two small antennas. All the details could be found in references form [93] to [126]. The work was covered by a patent from Adam Opel from Germany. We also succeeded to design small, patch antenna based on fractal design for wireless sensors (RFID). [http://en.wikipedia.org/wiki/Computational\\_electromagnetics](http://en.wikipedia.org/wiki/Computational_electromagnetics)

The most difficult problem that arises was to solve the Maxwell's equations for different conditions. Usually that is done using the *finite element* method (FEM) in order to find approximate solution of *partial differential equations* (PDE) and/or integral equations. The solution approach is based either on eliminating the differential equation completely (steady state problems), or rendering the PDE into an equivalent ordinary differential equation, which is then solved using standard techniques such as finite differences. Finite element programs with Websites: could be ANSYS/Emag, COMSOL AC/DC Module COMSOL RF Module, COSMOS/M, EZNEC Antenna Software.

Another method is the *method of moments* (MOM) or *boundary element method* (BEM). Both are numerical computational method of solving linear partial differential equations which have been formulated as integral equations (i.e. in *boundary integral* form). It can be applied in many areas of engineering and science including fluid mechanics, acoustics, electromagnetics, fracture mechanics, and plasticity. Because it requires

calculating only boundary values, rather than values throughout the space defined by a partial differential equation, it is significantly more efficient in terms of computational resources for problems where there is a small surface/volume ratio. Conceptually, it works by constructing a “mesh” over the modeled surface. However, for many problems boundary element methods are significantly less efficient than volume-discretization methods (*Finite element method, Finite difference method, Finite volume method*). Boundary element formulations typically give rise to fully populated matrices. This means that the storage requirements and computational time will tend to grow according to the square of the problem size. By contrast, finite element matrices are typically banded (elements are only locally connected) and the storage requirements for the system matrices typically grow quite linearly with the problem size. Compression techniques (e.g. multipole expansions or adaptive cross approximation /hierarchical matrices) can be used to ameliorate these problems, though at the cost of added complexity and with a success-rate that depends heavily on the nature of the problem being solved and the geometry involved.

Sometimes we used differential equation solvers such that *Finite-difference time-domain* (FDTD) is a popular computational electrodynamics modeling technique. It is considered easy to understand and easy to implement in software. Since it is a time-domain method, solutions can cover a wide frequency range with a single simulation run. This method belongs in the general class of grid-based differential time-domain numerical modeling methods. Maxwell's equations, in partial differential form, are modified to central-difference equations, discretized, and implemented in software. The equations are solved in a leapfrog manner: the electric field is solved at a given instant in time, then the magnetic field is solved at the next instant in time, and the process is repeated over and over again. Current FDTD modeling applications range from near-DC (ultralow-frequency geophysics involving the entire Earth-ionosphere waveguide) through microwaves (radar signature technology, antennas, wireless communications devices, digital interconnects, biomedical imaging/treatment) to visible light (photonic crystals, nanoplasmonics, solitons, and biophotonics). Approximately 30 commercial and university-developed FDTD software suites are available for use. For example *ScatLab* - electromagnetic scattering simulations mainly based on classical Mie theory solution and *Sonnet Lite* -a free MoM code <http://www.sonnetsoftware.com/products/lite/download.asp>

Other software we use was FEKO from EM Software & Systems and HFSS from Ansoft.

The results, as a Minkowski fractal antenna computed and produced using the above soft wares is presented in Figure 38.

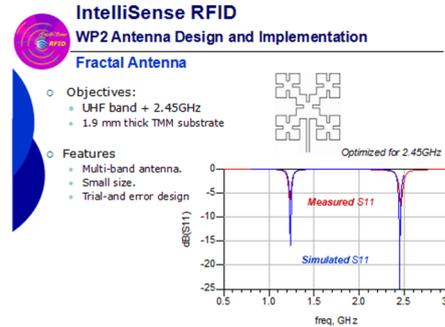
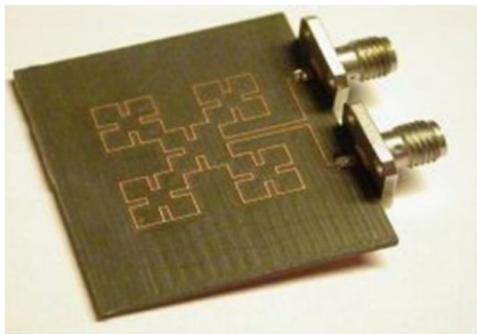


Figure 38. One of the fractal antenna designs as an interface for a Smart RFID [ ]

Another very interesting application of fractal geometry was energy harvester design inspired from fractal geometry. Energy harvesting is a process by which energy is derived from external sources – ambient energy. It could be solar power, thermal energy, wind energy, salinity gradient, kinetic energy, and one of the earliest applications of ambient power collected from ambient electromagnetic radiation was the crystal radio.

The harvested energy can power small autonomous sensors such as those developed using MEMS (Micro-Electro-Mechanical-System) accelerometers.

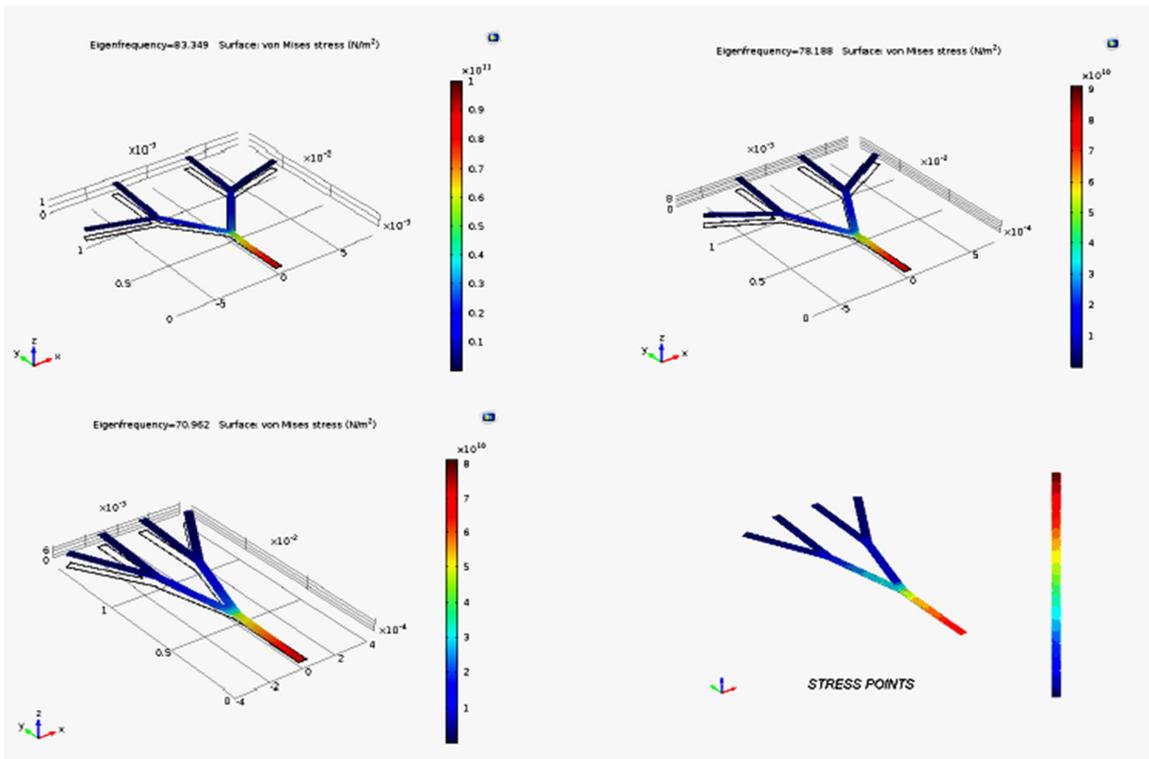


Figure 39. Fractal based cantilever design for energy harvester device

It was our idea to use fractal based cantilever configuration as vibration part of the energy harvester. It could in principle increase the number of piezoelements that could add their voltage so it increase the output voltage, can reduce the resonance frequency of the cantilever to meet the low frequency spectrum of the heart beat and also to reduce the physical dimension of the device.

In order to improve the voltage for broadband piezoelectric energy harvesting. Unfortunately for our case we can't use this idea because our harvester has to be used near the human hart in order to power the cardiac simulator. Images from our fractal, cantilever geometries used as cantilevers could be seen in Figure 39.

### ***Molecular Physics and Physical chemistry***

A large area of problems that have to be solved was in the field of atomic, molecular and physical chemistry.

These problems could be roughly divided in two main branches: solving Schrödinger equations for atoms and molecules and modeling interaction of atoms, molecules with surfaces. All of these problems belong to so called quantum physics of many particle systems.

The mathematical and physical problems are enormous. The mathematical treatment is extremely laborious and cumbersome. The only way of solving the problems is to find simplified models (physical approximation and mathematical simplification) because the equation was impossible to solve directly even with the best computers we have today.

So it is a kind of “game” to find ideas, and to “feel” the approximation you can do using your experience. It's difficult to discuss extensively these problems and so I live for reader to have the pleasure to run through references from [127] to [142].

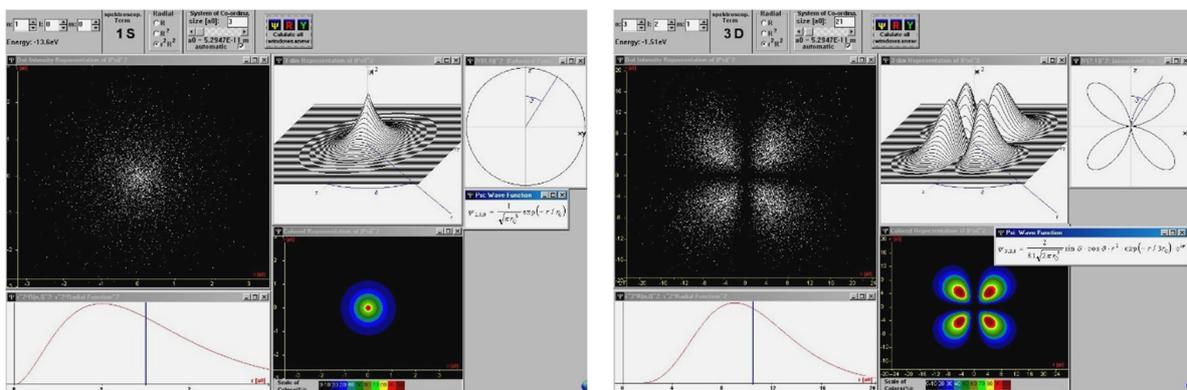


Figure 40. Visualization of the electron wave function and related parameters of an atom

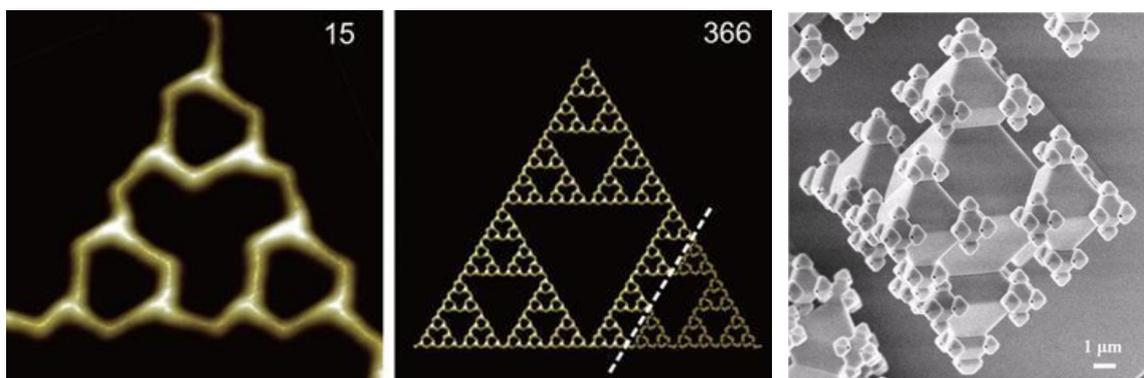


Figure 41. Molecule arranged as fractal structures and atoms in Sierpinski deposition on solid substrate  
<https://www.chemistryworld.com/news/fractal-first-as-molecules-form-sierpinski-triangles-/8408.article>

### ***Astronomy and astrophysics***

This is another extremely large and exciting field of computer applications. It implies not only mathematical difficulty in solving the equations but also to find physical data. But also we have to use the evidence for many possible scenarios of “what are there in space”. Combination of observations, data, physical unknown environment, and so many unknown local conditions are overwhelming. But still little by little, our understanding about the comets, planets, stars, galaxies, nebula, black holes, and other “cosmic fauna” was increasing. Having also in mind that we want, as mankind, to conquer the space, these models and computational solutions, or scenarios, become more and more important.

The astronomy has a peculiar situations, in great majority of cases you can't obtain direct data or to examine or experiments something in cosmos. So the only powerful “device” we have is modeling simulations and making scenarios. The computers are crucial for that endower. We started to work in astronomy and astrophysics using computers mainly after 1989. Till now we gained a great deal of experience and we had a large group of students, now PhD in astrophysics that created a large team of researchers. This can be seen after the notable results in all domains of astronomy, astrophysics and even in astronautics.

Some of the topics we studied were physics of the Sun (active Sun, physical phenomena visible on the Sun's surface – granulation, flares, sunspots, magnetic field, Nucleosynthesis, and solar jets). In the same line were the instabilities in star evolution, and the study of binary stars, eclipsing stars and their light curve. Also we studied

planetary physics, phenomena in high atmosphere; Sprites and Elfs fractal structure of continental crust; geodynamic activities, image analysis of planetary surfaces (Europa surface - finite element modeling the surface), and fractal dimension of the rough surface (Eros asteroid, Figure 42).

Another problem was the origin of the cosmic rays and the modulation of extragalactic Cosmic Rays by a galactic magnetic wind.

Difficult problems arise when we try to understand and model features observed of distant objects. One example was put by studying galaxies with active nuclei in center (AGN). They exhibit two visible features, a disc of accretion from a nearby galaxy, and two powerful jets of particles produced by AGN.

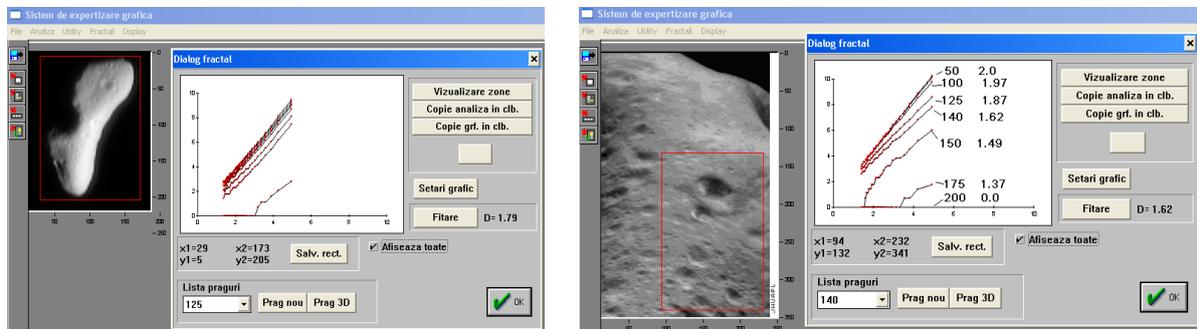


Figure 42. Eros surface analyzed using NEAR spacecraft close encounter (2000 February 10)

Having very good data form radio telescopes we made careful analysis of the jets and made some suppositions about the physics of the jets, in order to create an enough plausible model of the jet.

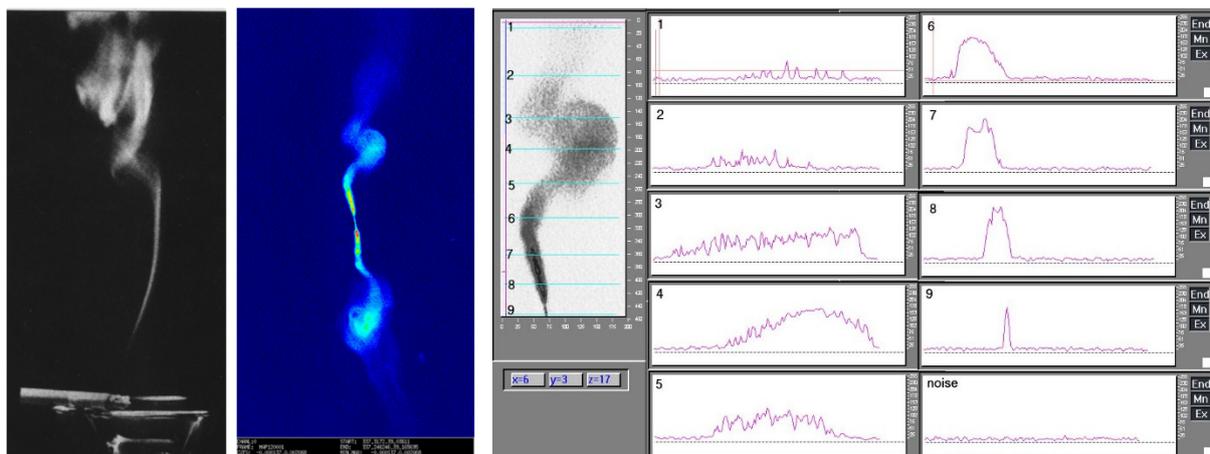


Figure 43. Universality of the turbulence in flow, smoke and jet form 3C449 galaxy. Example of image analysis of the upper jet of 3C449 AGN

As was expected a great number of nonlinear phenomena drive the mechanisms form these objects and a careful fractal analysis of the data and images seems to be in accordance with our scenario. Once again fractal analyses give fruitful result to incorporate in models.

As in the last section we can't describe here and discuss extensively all the problems we examined and in which we have notable results. I leave for reader to have the pleasure to run through references from [143] to [176] to find the spectrum of our activities. Once again, it is necessary to recognize that without computers was not possible to cover all the topics.

### ***Different other computer applications***

#### ***- Biology and medicine***

Recent studies have shown that fractal geometry can be useful for describing the pathological architecture of tumors and, perhaps more surprisingly, for yielding insights into the mechanisms of tumor growth and angiogenesis that complement those obtained by modern molecular methods.

Tumor vasculature has long been known to be more chaotic in appearance than normal vasculature (Figure 44). Now that angiogenesis has been identified as a critical event in tumor progression and as a potential target for treatment, there is an increasing need to understand the origins and consequences of the abnormal vascular architectures found in tumors. Fractals show promise as useful measures of these complex structures.

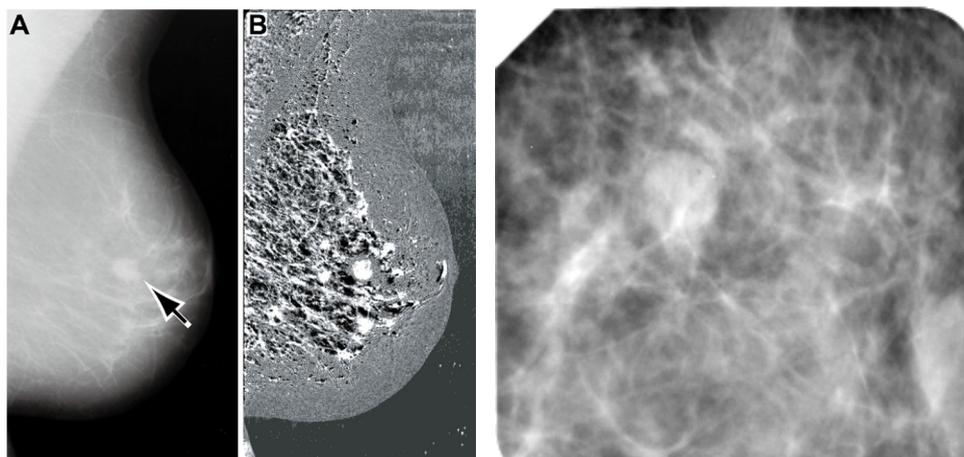


Figure 44. Medical image processing – breast radiography suitable for image analysis

The observed fractal dimensions of the tumor vasculature as a whole and of the minimum path closely correspond to those produced by a statistical growth process known as invasion percolation. Recent studies have shown that invasion percolation can be used both to describe the irregular vascular architecture in tumors and to elucidate some of the mechanisms that regulate the numbers of vessels and the patterns of their interconnections (Figure 45).

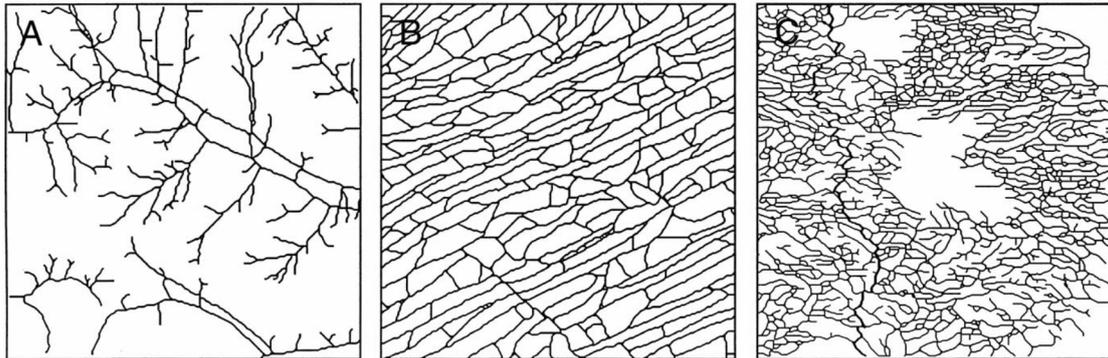


Figure 45. Skeletonized images of vascular networks (*A*, normal arteries and veins. *B*, normal subcutaneous capillaries. *C*, tumor vasculature). The path of minimum length is highlighted on the tumor vasculature to illustrate the tortuosity of these vessels [180a]

Because we were involved in a series of studies related to the possible radiation contamination of the population during a hazardous releasing of radioactive materials we completed a study that was finalized and described in “Bio-mathematical Models for Radon Daughters Inhalation”. The ModeLung<sup>®</sup> software was produced as an application to the data from Chernobil (Russia) disaster [181].

The spread of fractal models that describe different human behaviors are steadily increasing. Some of these studies, added here as examples are: *Fractal structure of mental and social processes: the hypothesis of affect logic*, *A multifractal dynamical model of human gait*, *Shape analysis applied to automatic recognition of tumor cells*, *Cytoskeleton as a Fractal Percolation Cluster: some Biological Remarks*, *Computer-aided estimate and modeling of the geometrical complexity of the corneal stroma*, *Cognition Network Technology: object orientation and fractal topology in biomedical image analysis. Method and applications*. [186], [187], [188].

#### - Computer in education

This was an essential part of our activities as professors at the physics faculty. The computer literacy is considered crucial for the future. Romanian students have won many prestigious prizes at different international Olympiads for Mathematics,

Physics, Astronomy and Astrophysics, Chemistry and of course Informatics. I think there is no better description than Daniela Rus<sup>2</sup> sad:

*I was born in Romania to a computer scientist and a physicist, which definitely gave me the science bug early. I was a big fan of Jules Verne and especially liked **20,000 Leagues Under the Sea**. I also watched reruns of *Lost in Space* and loved the computer prodigy Will Robinson and his B9 robot.*

*My father encouraged me to learn to program in high school and taught me Boolean algebra. From there, I knew I wanted to study computer science in college, and then at Cornell for graduate school. When my PhD adviser John Hopcroft talked about how the grand vision for computer science was to be able to use these equations and algorithms to get physical machines to do all of these things that humans cannot or do not want to do, I decided that robotics was the path for me.*

*My work is in part driven by my belief that everyone should know how to solve problems using computing. For years, people have talked about increasing accessibility to computers, with the goal of eventually having one laptop per child. But I have found that children are even “more” drawn to robots than computers, and so I believe robots, more than anything else, can help children learn about geometry, physics, programming and many other things. Technological literacy is as important as reading writing and mathematics, because it is all around us. We want to get children interested and excited in robotics from a young age, so that they can be tomorrow’s innovators. In a nutshell, we need to introduce computational thinking as a mandatory subject in all the grades, starting with kindergarten. Developing these abilities is not merely “learning to code,” but what you might call “coding to learn.”*

([www.CSAIL.MIT.EDU/PERSON/DANIELA-RUS](http://www.CSAIL.MIT.EDU/PERSON/DANIELA-RUS))

As I sad we had plenty of activity and results in the education. Our students benefit from computer assisted education in many fields, especially in physics. Our year log program of In service teacher training was a continuation of learning to program in high school. Also we diversify our activities in this field organizing regular summer schools on internet learning (Romanian Internet Learning Workshops – RILW, in collaboration with Dr. Mihai Jalobeanu from Cluj-Napoca) organized with SOCRATES – ERASMUS European funds, we won many years. It is possible to see our students activities if you take a glance on the references, in which almost 50% of them were done with our students form the faculty.

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<sup>2</sup> Director of MIT's Largest Research Lab on Computer Science and Artificial Intelligence. For more than 50 years, CSAIL's research has pushed the boundaries of computing and played a vital role in the digital revolution, from the first time-sharing systems and the first computer password to public key encryption and the free-software movement

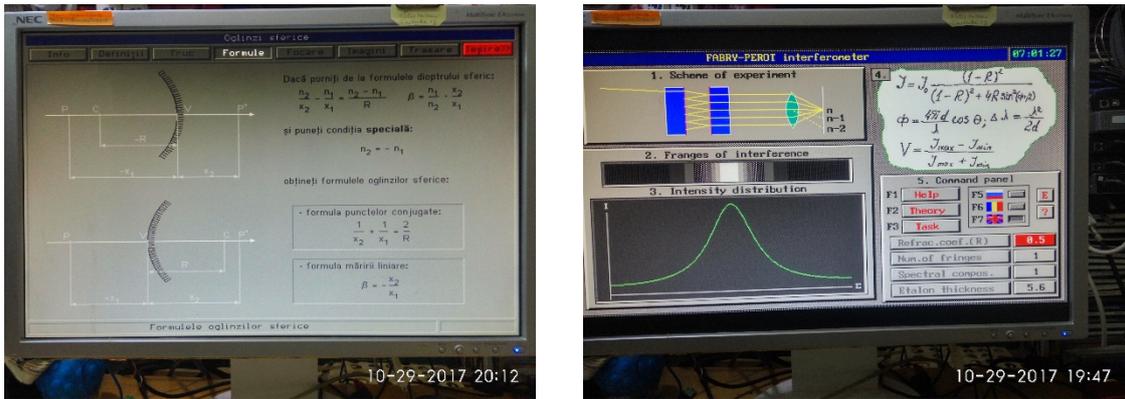


Figure 46. Example of computer codes for Physics [213]

Also we organized at the Casa Corpului Didactic (CCD – Teacher house) from Bucharest, lectures and activities for creating computer codes for physics. In this way also the teachers from schools were involved in creating their own codes for specific thematic, to help teaching.

It is difficult to mention all that products but I can mention the collaboration with Prof. Stefan Grigorescu from Bucharest and Dr. Roza Dubrăveanu from Chășinău (Republic of Moldavia), Figure 46.

One of the most efficient didactic activities was our collaboration with Bonn University in which at least 20 students did their MSc diploma. Because it was in the field of astrophysics their activities were creating and using specific software. These activities were done alternatively at the Max Planck Institute of Radioastronomy (Bonn) Figure 47 and 48, and at the Faculty of Physics, University of Bucharest Figure 49.



Figure 47. Our students at Bonn University, Max Planck Institute of Radioastronomy 2003.

The Romanian student’s lab with Prof. Peter Biermann, head of the department

Figure 48. The group of Romanian students in visit at the larges Radiotelescope

from Europe, at Efelsberg, Germany

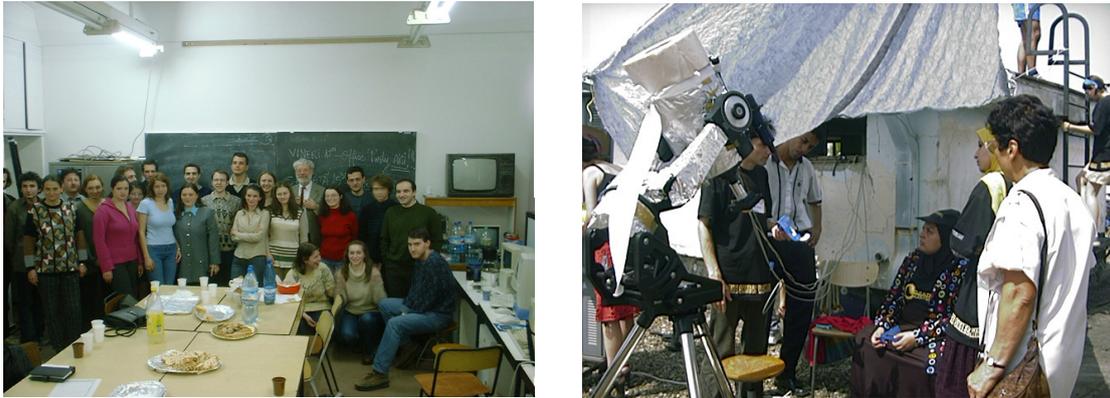


Figure 49. Students from Bucharest and Cluj, in Astrophysics laboratory from the Bucharest Physics Faculty with invited lectures from Germany, Prof. P. Biermann, and from France Dr. M. Birlan in the joint activity under Socrates/Erasmus European Program

A remarkable moment was in 1999 when the one of the place to observe and study of solar eclipse was Bucharest. We organized International School for Young Astronomers (ISYA-24, 1999) at our faculty and over 50 students and 20 professors from all over the world attended the event. In Figure 50 students on the roof of Physics Faculty, Bucharest, during the 1999 solar eclipse, that attended International School for Young Astronomers (ISYA-24, 1999)



Figures 50. Images of student activities and discussions at Bucharest during the 1999 solar eclipse, with Prof. Jay Pasacoff (U.S.A.) and Dr. Donat Wentzel (Univ. of Maryland, U.S.A.)



Figure 51. Sequences of the solar eclipse from 1999 at the Faculty of Physics made by students

As the result of our more than 15 years of collaborating with German Universities, we succeeded to obtain a powerful computer that was located at our Faculty (Figure 52).



Figure 52. Upgrading computing facilities at the Faculty of Physics at Bucharest University ALICE supercomputer from Wuppertal University, Germany

In order to improve students and specialist from different fields of activities (scientific of coarse) we organized with the help of an European program (Socrates/ Erasmus) a series of five seminars (Intensive activities), each year one, in collaboration with more than ten universities from Europe (England, Germany, Italy, France, Iceland) namely Romanian Internet learning Workshop (RILW). That was held in different towns from Transylvania. Organizer was Bucharest University and Dr. Mihai Jalobeanu from Cluj-Napoca. [221]

*- Archeology and anthropology*

The past fifty years have seen a rapid increase in fractal research in fields such as geology, anthropology, archaeology, and mathematics (Brown, 2007). The implications of fractals and their occurrence in nature and human culture continue to intrigue scientists and mathematicians, but much research remains.

*- Archeological study of ancient artifacts – The Hystria statue*

Pieces of a statue (an archaic Syrian Phoenician style) were uncovered in the sacred zone of Histria and dates about 6th century BC (Figure 53). The two pieces of the statuette were found in different location, having also in common the same constitutive material. We found that is not made by clay but nearly pure melilite. This suggests the casting material had a special provenance, providing some insight regarding the type of parent rock. We made also analysis of the materials and the inclusions and found

that the two pieces being to one statue that was found. In order to reconstruct the original, the fragments were analyzed by a nondestructive method (image analysis using digital X-ray images). To be sure we computed the absorption coefficient at X-ray of two energies, 55 keV and 70 keV.



Figure 53a. Archeological artifact found in Dobrogea, Romania

The absorption coefficient for the two pieces was computed and shows the same values in both pieces (Figure 53b). Variation from the middle part corresponds to the junction of the two parts. So, we concluded that surely the two pieces belong to the same statue.

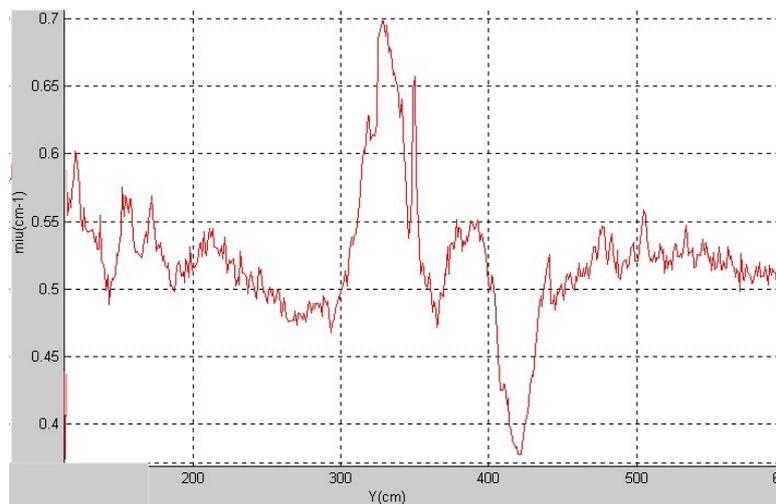


Figure 53b. The computed absorption coefficient for the two pieces

*- History and cultural heritage; fractal structure of human settlements*

The idea that a city could be “smart” was a science fiction that was pictured in the popular media. The performance of the computer codes dedicated for architecture and city planning, the prospect that a city might become smart, sentient even, is fast becoming the new reality. The convergence of information and communication technologies is producing urban environments that are quite different from anything that we have experienced hitherto. Cities are becoming smart not only in terms of the way we can automate routine functions serving individual persons, buildings, traffic systems but in ways that enable us to monitor, understand, analyse and plan the city to improve the efficiency, equity and quality of life for its citizens in real time. This is changing the way we are able to plan across multiple time scales, raising the prospect that cities can be made smarter in the long term by continuous reflection in the short term [188].

Smart cities are often pictured as constellations of instruments across many scales that are connected through multiple networks which provide continuous data regarding the movements of people and materials in terms of the flow of decisions about the physical and social form of the city. Cities however can only be smart if there are intelligence functions that are able to integrate and synthesize this data to some purpose, ways of improving the efficiency, equity, sustainability and quality of life in cities. We define in such a way so called “metabolic and organic city”.

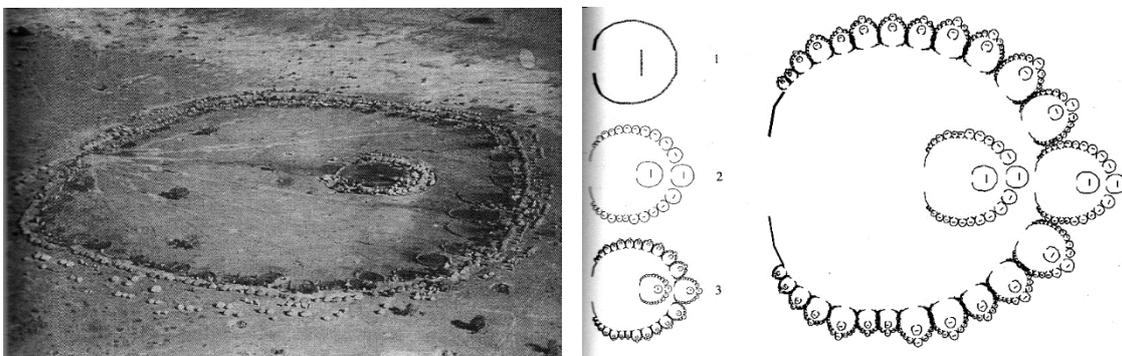


Figure 54. African settlements as example of spontaneous fractal “thinking” of a small village

Structural stability of the metabolism of cities as a process of morphogenesis will create adaptive cities that could fulfill various local demands in shortest time, and could easily adapt to changes and new demands. Interesting is that we can find self-similar, fractal geometry, in the development of some cities from the past till today’s organization. (London, Paris). Also we can find in some settlements (Figure 54) from Africa, a self-similar way of distribution of the huts [204], [205].

It seems to us that social systems spontaneously found such optimal arrangements. It could be that anthropology could benefit from the ideas of spontaneous self-similar systems not only for settlements but also for social activities, social interactions, and even beliefs that enable to develop a Theological Anthropology. Also a need for revisiting the Micro—Macro distinction in social theories emerge.

An exhaustive work on this topic was done with the Institute of Architecture from Bucharest, department of urbanism and city planning [188]. It was correlated as a problem of urban anthropology and change. Valuable results come from it that re-thinking the future city plans.

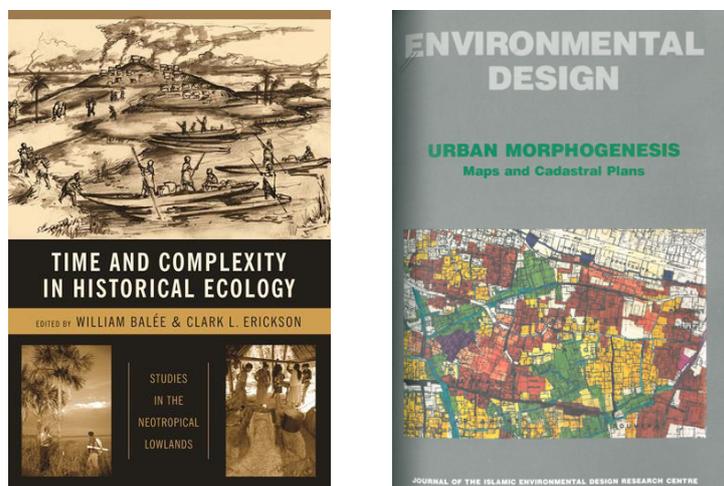


Figure 55. Two books that emphasizes how complexity theory enter in the filed of urban morphogenesis

#### - Music

We were asked to study the physics of the natural trumpets. The trumpet is, called the natural trumpet and is part of a class of blowing instruments spread in the Carpathians, Poland (*trembita*), the Balkans, Sweden (*näverlur / neverlur*), Norway (*Raklur, langlur*) and Finland (*touhitorvi*). Today, on the territory of Romania, instruments belonging to the natural trumpet category are found in Oas, Maramures, Bucovina and Apuseni mountains. The sound of the natural trumpet is present a ritual one - the funeral, and a ceremonial one - the measurement of the milk (*sâmbra*), event related to the pastoral life. About 25 years ago, the trumpet signals marked the beginning and the end of the day, from sunrise to the end of milking. They conveyed a hierarchy of the order of completion of the work.



Figure 56. A galvanized sheet trumpet and a opper one, in use

The phenomena we were asked to study was the way the sound could be modulated and how different pitches could be produced knowing the natural trumpets have no holes to do that. It is known that the way of blowing the air and mouth attached to the mouthpiece also the tongue of the singer can do that variation but how? The trumpet signal has identity connotations. The local people of the area are able to recognize exactly the one who launches the signal. What makes one signal different from another, at first glance, seems to keep the melodic profile of the signal. But if we try to identify ways of recognizing the signals, the situation proves to be more complicated. Stabilization of the sound emission is achieved by wetting the instrument before use in view of temperature equalization throughout its length. This makes it so important for the sound produced?

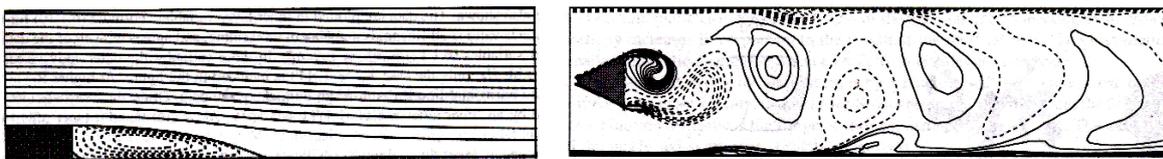


Figure 57. Simulation of the air flow and the turbulence (vortex) that is produced at the sudden changes of the flow geometry (lower part of the image, dotted lines)

Figure 58. Doppler measurements of the air flow around on obstacle. The vortex formation is evident

The simple physics of the wave propagation into the pipe, the length of the pipe that gives the standing wave conditions could not account well with the facts. We studied, and still we are in work to show that the main “secrets” lie in the turbulence that is produced at the entrance of the air. We are now trying to work out the Kolmogorov

turbulence theory in order to account for these peculiar phenomena.<sup>3</sup> An interesting idea could be to find if there are any relations of this natural trumpet with that used by Celts.

More on the diversity of ideas that arise in the recent times could be found in [189 to 203]

*- Art and Fashion*

Because fractal geometry and hence analysis could be used to quantize the irregular shapes or apparent chaotically shaped found in nature or in some artifacts, we analyzed images of old paintings crack pattern. A fractal analysis shows that original old paintings present cracks texture that is different from the artificial “aging” paintings. Sometimes paintings could be categorized as original one, but after the fractal image analysis they could be found as fake [186]. Drying paintings and structure of the cracks are specific in each case.

Fractal arts and design turns to be unusual application of fractals and computers in modern design. For example some type of the hairstyle (Figure 59) could show self-similar geometrical structure that sometimes could be considered as very original one.



Figure 59. Hair styles that show self-similar structure

<sup>3</sup> O. Richoux, C. Depollier, and J. Hardy, „Propagation of mechanical waves in a one-dimensional nonlinear disordered lattice”, *Phys. Rev. E* **73**, 026611 (2006). Daniel Appelö, *Non-reflecting Boundary Conditions for Wave Propagation Problems*, Stockholm 2003, Licenciate’s Thesis. John G. Proakis; Dimitris G. Manolakis (2007), *Digital signal processing*. Pearson Prentice Hall. ISBN 978-0-13-187374-2.

With a group of colleagues (some of them high school physics teachers) we design models for young ladies dress. Because the imprinting models on textile can be easily made by computer assisted manufacturing techniques, we made specific fractal software patterns.

It was finished and gave us the chance to produce such textile and fractal model imprinted (Figure 60).

A general conclusion is that almost all the human activities are results of competition between order and disorder. Fractal geometry and chaos theory could account for that.



Figure 60. Rebecca and Guinevere in fractal design dress and imprinted fractal motifs

At the end we can make some comments of how computers, IT, artificial intelligence and the broad band in scientific achievements have changed our civilization and way of thinking.

The complex systems research focuses on generic properties. The concepts and methods are largely inspired from the physics of disordered systems, but the basic ideas have also been expressed in mathematics as structural stability [73], in the physics of phase transitions as classes of universality [75]. The existence of generic properties, is a sensible explanation for the fact that although biological or social systems are difficult to entirely specify and exist under many variants, they are still able to maintain global functional and recognizable properties. The following definition of complex system is minimal and applies to most systems we might be interested in. Complex systems are composed of many different interacting elements that exhibit non-linear interactions. They form a network composed of the elements and their interactions have many entangled loops. The definition obviously applies to the brain and its neurons, the immune system and its molecular and cellular components, a society made of human agents and so on.

In fact the scientific interest in complex systems is not only motivated by the mathematical challenge they represent, nor by the fact that we constantly face them in our everyday environment. The real challenge to our intelligence is their functional organization: in the brain, assemblies of neurons think, the immune system is able to build an immune response to external pathogens; societies have evolved institutions enabling them to respond to their environmental challenges.

Furthermore this functional organization is both adaptive still robust. Complex systems can vary in composition; sometimes the chemical and even cellular composition of a given complex system such as an organ of a living system, e.g. the liver of a mammal, varies, but we consider it as the same system, with identical global properties. And maintaining this identity is much more than maintaining the invariance of some average over the properties of the constituents [223].

The native, spontaneous, human sense of self-similar patterns could be best represented by a famous XVIIIth century painting of Hokusai (Figure 61).



Figure 61. “The Great Wave”, Japanese painter Katsushiks Hokusai (XVIII-th century)

## Conclusion

Computers and information technologies helped us to reach a new way of viewing the world. All sciences, all human activities benefit today from these facilities. And the future will show us facets of these achievements that started in the modern form in the last 100 years.

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### **Journals, magazines and proceedings**

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Proceedings of the FTEM

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**Valuable insights into “Albina Bank”  
history revealed by the lecture of digital  
economic journal “Revista economica”  
(1899-1918)**

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**Abstract:** The paper reveals some valuable insights into “Albina Bank” history from a journalistic lens. This study is based on digital resources, in particular, the Economic Review journal “Revista economica” taking into consideration 20 years (1899-1918). Using a qualitative research method based on narrative inquiry and research techniques correlated to the type of data used, our study resorted to documentary research, historiography or the critical review of the business literature, and discourse analysis. In the analyzed period, the numerous mentions done by Economic Review Journal reveals the prolific activities of Albina Bank, helped and sustained the Romanian spirit and economic initiative. A new attempt of reconstructing the Romanian banking system’s activity of Transylvania was necessary due to the tracing of new possibilities to valorize both sources and a new effort, to achieve its framing within Austro-Hungary’s socio-economic and financial context. Albina Bank should be considered as a prototype, an innovation, as the successful introduction of an idea, perceived as new, into a given social system.

**Keywords:** financial institution, history, digital archives, economic journalism, financial and nonfinancial information

## Introduction

During the centuries, financial journalism and press emerged precisely within this economic context. Historical newspapers and journals are precious resources for the study of national and local culture, science, history and politics, and becomes most comfortable due to the digitisation of some journals collections.

Included in the area of historiography and documentary research, this study is based on digital resources, in particular, the Economic Review journal “Revista economică” taking into consideration 20 years (1899-1918). The paper focus on the evolution and the role of the first and most crucial Romanian bank of Transylvania, an Eastern European territory, under Austro-Hungarian Imperium since 1918 and then part of Romania. Till 1918, Transylvania it was inhabited by Romanians, the majority of the population but with fewer rights than Hungarians and Germans representing the nobility.

Although it is not always possible to separate the economic feature, our study focuses on Transylvania ‘economic background, assuming that it also mirrors the influence of many factors. The economic and political elements are highly connected, which is also the case of Transylvania, where the economic situation was strongly influenced by the politics led by different governments (Balog 24).

A considerable amount of literature argues in favor of the interdependency between the evolution of economy in general and banking system in particular and the environment, viewed as a sum of political, legal, economic and cultural factors. Banking arose in some form in all industrial nations of the world in the nineteenth century, almost by definition. And, the institutional structures varied, primarily based on the origins of the banking firm and the needs of the economy in which the bank operated. (Fohlin)

The discussion, to be useful for the paper purpose, by providing insights for understanding the socio-economic-political context, will be focused on the first period (1899-1918) Austro-Hungarian period. In the second one (1918-1948) Romanian period, the bank lost the status of a national bank for Transylvanian Romanians because the objective of national unity had been achieved. After 1918 it functioned as pure bank institution under industrial-commercial principles and does not present the same interest for Romanian intellectuals. The bank was nationalized in 1948 after 77 years of activity.

This paper aims to reveal the innovative and “integrated thinking” of the most significant Romanian bank from Transylvania of the second part of XIX century by the lens of an economic journal. On one side, the financial aspects concerning its growth, the support given to other banks of the same cultural background and commercial activities. On another hand, the nonfinancial elements, the bank contribution to the community, and the bank role in supporting the emancipation of Romanian culture, economy and social environment, in tough times. The two sides were integrated by the bank and contributed to the economic growth of the context in which it activated.

Papers on the history of banking systems as theory and practice, before the 20th century, are scarce for the context of Eastern Europe but is a well-explored subject for most developed European economies of that time. (Wurm; Guinnane).

Furthermore, the studies in English on Central-Eastern Europe, and Romania in particular, only a few analyzed XIX century and in particular Transylvania (Paun & Paun; Tiron).

Our research provides details on territory and period less familiar to national and international readers. Thus, it could stir a potential interest for enriching the history of banking, contra balancing the Robert Lucas' view that economists “badly over-stress” the role of financial systems in economic development. (Lucas 6).

The structure of the paper will have the following development: after the introduction, the second section of our study create a brief overview of business journalism of XIX century in Europe and Transylvania. Next section describes the methodological aspects, and then the follows sections present the investigation results about the Romanian banking evolution embedded into the economic background, comments on the economic, social and cultural influences of Albina bank in relation with the development of capitalism in Transylvania. The final section provides the concluding remarks.

### **Business journalism in Europe's XIX century**

Business journalism evolution is directly linked to the business activities development and referees to tracks, records, analyzes and interprets the business, economic and financial activities and changes that take place in societies. So, this area of journalism provides news and feature articles about people, places and issues related to the business sector.

In the late 15th century were discovered one of the first news provider in the world (as letters, not yet newspapers) covering banking, trade or political news, as the elites – who could afford to buy it – needed information about business and macroeconomics more than lifestyle or community news. The first Business paper published was *Neus Zeitungen* of the House of Fugger, which was a business journal that was well known to merchants during the fifteenth and sixteenth centuries.

One of the most crucial moments that marked the emergence of business journalism was the printing press invention. Newspapers (and to a lesser extent magazine) were the primary medium of journalists in the period 18th- 20th century, and after this together with the radio and television in the 20th century and the Internet in the 21st century. (Shannon & Copeland)

In the 18th century, the replacement of the hand-operated Gutenberg-style press by steam-powered rotary presses allowed printing on an industrial scale. In Europe, printing press spread and the revolutionary ideas of Renaissance époque contributed to mass communication by the appearance of newspapers, which permanently altered the structure of society. The printed press added to the relatively unrestricted circulation of information and revolutionary ideas transcended borders. Moreover, broke the monopoly of the literate elite on education and learning and encouraged the emerging middle class. Across Europe, the increasing cultural self-awareness of its peoples led to the rise of proto-nationalism.

By the mid-18th century, business press phenomenon covered the majority of the Europeans' economies, in a more or less developed state. For example, by 1845, there were 24 British business papers, and in 1889 one of the most prominent examples of business journalism like *The Wall Street Journal* began publishing in 1889. (Vaitlingan)

In smaller or less essential regions like Eastern Europe, the business newspaper phenomenon was starting to be developed in these areas. In Poland, we found the first traces of a business newspaper in the 17th century (Roibu).

### **Transylvania business journalism role in XIX century**

In XIX century Transylvania, the North West part of actual Romania, was part of Habsburgic Imperium and in this conditions, the western influence is thus responsible for the entry of industrialization, printed press, newspapers and journalism culture in Romanian territories, via Transylvania. Printing in Sibiu was first attested on January 9, 1525, by Lucas Trapoldner's typography. This was the first typography in Transylvania.

There were many tentative of Romanian Transylvanian elites, at the beginning of the 19th century, to establish a Romanian journal, without an official permission from the Habsburg Imperium representatives (ex. printed in Vienna in 1789 or in Buda in 1814 and distribute it in the Romanian territories) or with it (ex. printed in Lamberg in 1817) but without success due to the opposition of Transylvania governors, who suspected the national movement that such publications would produce among Romanians. (Petcu).

The honorary founder of the Romanian financial press in Transylvania, George Baritiu, promoted by his actions to support the social progress, cultural and economic development of Romanians. In 1838 he founded in Braşov the first Romanian newspaper and named it *Gazeta de Transilvania*.

In Transylvania, the press in the Romanian language continued to flourish after the draconic measures of censorship introduced after 1848 were softened in the 1860's. (Grancea)

The historical context was marked by the period of the absolutism of the 1850's, during which the Rumanians, who had failed to obtain territorial autonomy within the empire, were parcelled out among various administrative units and continued to suffer national and social oppression at the hands of the dominant Magyar classes. Then the so-called “liberal era” between 1860 and 1867, during which the court misled the Rumanians with promises that their national rights would, at last, be recognized in the monarchy generally and in Transylvania in particular; and the period of dualism and the forced incorporation of Transylvania into Hungary.

The year 1867, was marked by the Austro-Hungarian Compromise, the dualism and the forced incorporation of Transylvania into the Kingdom of Hungary as part of the Austrian-Hungarian Empire.

The favouritism shown to the Magyars, the second largest ethnic group in the dual monarchy after the Germans, caused discontent on the part of other ethnic groups like the Romanians and Slovaks. Although a “Nationalities Law” was enacted to preserve the rights of ethnic minorities, the two parliaments (Austrian and Hungarian) took very different approaches to this issue. The Hungarians, having been given self-rule and a separate status, only partially acquiesced to granting “their” minority's recognition and local autonomy. Moreover, in the Kingdom of Hungary, Romanians and other ethnic minorities faced increased pressures of Magyarization. For these reasons, the Romanians and non-Hungarian minorities of the Hungarian Kingdom became more aware and vocal and started to organize a defence for the national right.

The political regime and Austro-Hungary dualist system (1867-1918) find in Transylvania a period of high economic development. Habsburg Empire was part of the Triple Alliance (1882) and was involved in numerous military conflicts, and Transylvania was required to support these military efforts, with raw materials, workers and troops of soldiers (the 1868 military service is mandatory) which led tension to economic and political repercussions.

Despite the fact that the Transylvanian economy demand remains predominantly agricultural, the role of commerce and industry is exceedingly present (Balog 18). The industrialisation process is however inhibited by the lack of state support in the form of regulations until 1914, states Murgescu (197).

Balog (18) evaluate the process of establishing Romanian financial institutions definitive for the stage. These organizations support the local middle class to grow, according to Hitchins.

The journals in that period were used at first as a national and then political tool in the elites' mission of closing the historical gap between Romanian territories (Johnson) until Transylvania joined Romania only after WWI. In Transylvania, the Romanian

community was an Orthodox community without political rights for centuries, and their vast majority was living in the countryside. The cities were formed and populated mostly by German and Hungarian ethnics. The role of the emerging Romanian newspapers went beyond journalism. Being the first journal in the Romanian language, the journals became a public forum for discussion of Romanian problems, a catalyst of national consciousness. (Aumente et al.).

Meanwhile, significant amounts of news, information and articles on economic issues were published in regular journals. The bases of the Romanian financial press were thus laid. In Transylvania, this media genre materialized and singled itself out in the first newspapers released within the economic and cultural environment of the city of Brasov between 1800 and 1850. (Robu)

The first and most prolific and influent business journal, *The Economic Review* was published in Sibiu from 1899 to 1921, 1928 - 1948 and in Cluj from 1922 to 1927 as the financial - economic arm of the Romanian Transylvanian Banks. The magazine presented, especially in its feature articles, all the financial and banking problems, but also those of other economic branches: industry, commerce, agriculture, as well as the legislation of the economy during the 50 years of its publication. *The Economic Review* has not only presented these various financial and economic problems but also offered solutions. It has become over the years a critical review among similar publications of Romania.

During its 50 years of existence, the journal published around 52 numbers per year, by which a considerable majority are available electronically to be read now. The journal digitization is a part of the broader effort of Lucian Blaga central university library Cluj Napoca to make some of its primary sources material more accessible.

## **Methodology**

Using a qualitative research method based on narrative inquiry and research techniques correlated to the type of data used, our study resorted to documentary research, historiography or the critical review of the business literature, and discourse analysis.

To provide a fair and complete image of the surveyed period, we used parallel data, resorting to historiography and documentary research, respectively:

(a) Historical books and articles as primary and secondary sources, on the evolution of politic, economic and banking system practice and thought;

The primary sources are original periodicals and registers inventoried in State Archives volumes or authored books, available at the Romanian Academy Library and Central University Library. The selection of historical writings was based on the descriptive catalogues of the periods and items offered by the Library, and on searches according to our keywords: banking, economics and Transylvania.

(b) Archival data of the Albina bank, between 1871 and 1918, on the bank activities evolution.

(c) The Economic Review digitalized collection concerning the Albina bank activity for the period 1899-1948.

The rich archives offer the opportunity to investigate the role the bank played in the context. The paper explores over 20 years of the bank's financial and non-financial activity. The primary source is the Romanian newspaper “Revista Economică”, from 1899 (the foundation's year of the Journal) until the end of 1918, when the bank's role decreased because Transylvania becomes part of Romania.

The economic Magazine (Revista economică) 1899-1918 was considered among the most critical Romanian publications on economic subjects. It was the official journal of 45 Romanian banks from Transylvania, being sponsored by these banks. In this journal the Romanian banks were publishing their financial statements, their new activities through publicity, job vacancies, new initiatives. But most importantly, the journal reserves essential spaces to debates and promote the social and charitable activities of financial institutions. In the eve of the general meeting of all the Romanian banks, shareholders states as follow: “this time we will stop the distribution of charitable and cultural quotas, show how it is divided, actually, and enticing because it wouldn't find the way, kind and better suited for the use of this quotas”. In the analyses of charitable activities carried by the financial institutions the actions are classified in 6 macro categories: to set up the endowment funds of the specific organization; donations for schools; different cultural associations, social and economic; donations to Churches; Scholarships and sponsorships; other types of contributions. (RE4, 1909).

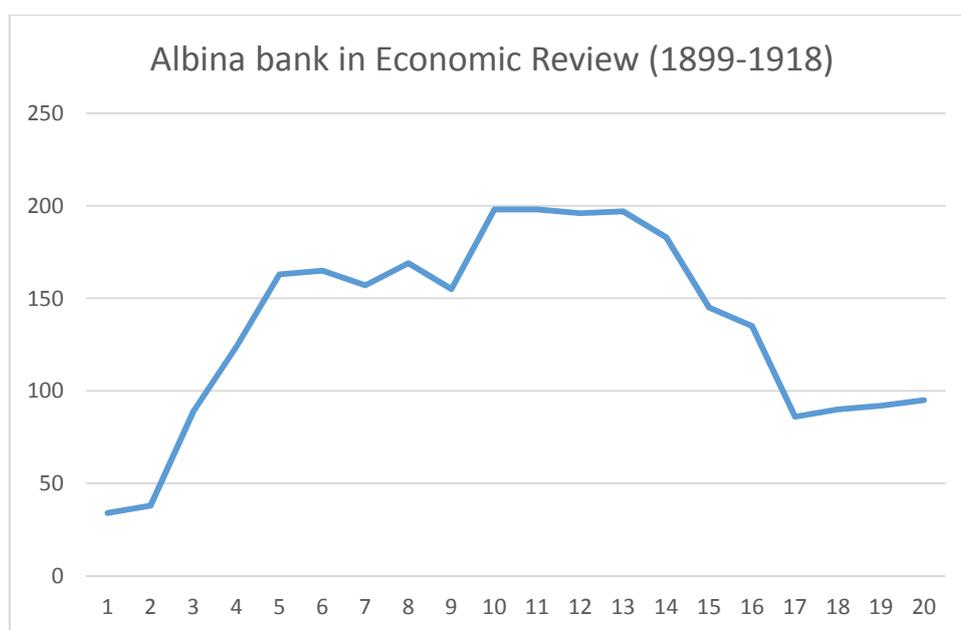
The majority of facts were collected from the newspaper, and each, non-financial actions, has been analyzed to find the real goal behind it using the archives, where the information gained matched the data from the newspaper. Historical books and articles gave information about the past framework, useful for a better understanding of the controversial period in which the bank developed its activity. The reconstruction of the historical moment gives the macro-image of that period.

The Transsilvanica library resources facilitated the journal consultation contain digitalized documents relevant for Transylvania, from which an unvaluable collection of journals. The Lucian Blaga central university library Cluj Napoca Digital Library has a

remarkable development. It contains valuable patrimony documents, as well as an extensive collection of periodicals which allows remote access. In Romanian, Magyar and German languages starting from 1795 ( *A'Bétsi Magyar Merkuriusnak* (1795-1798) till 1961 *Buletinul Universităților* (1956-1961).

### Overview of Albina Bank mentions in Economic Jurnal in 1899-1918

During the analyzed period (1899-1918) the Economic Review journal dedicated to Albina bank significant importance as is presented in the follow graph, with a total number of 2709 mentions, an average of 135 mentions per year and a maxim in 1908-1912.



Each mention of Albina Bank in Economic Review for the period 1899-1918 was examined and organized in categories to allow the constructions of results. The main two categories concern the financial and non-financial activities. In the follow table is presented a sequence of collected data for non-financial categories, more exactly the social activities.

Nr.	Year	Explanation	employee	cultural	charities	students	academia
2	1899	6% of the bank profit for cultural and beneficial purposes		x			
2	1899	Amount of fl. 100 for condolence of dead employees	x				
3	1899	Amount of fl. 6,500 for charitable purposes			x		
1	1900	References to the help Albina was giving/ Sustain to a sick employee in Lussinpiccolo	x				
11	1900	Maximum amount given for charitable purposes in amount of 6,500 from the previous year			x		
12	1900	Help to the students for 400 Cr. And from subsidiary of Brasov 237,50 Cr.				x	
14	1901	Albina build up a new school for boys in Sibiu.					x

In 1899 the Albina Bank became the most famous Romanian bank from Transylvania, with 75 branches in whole Transylvania, in most of the towns and boroughs, and owning 23% of the entire social capital of the Romanian banks.

Until the Great Union in 1918 Albina Bank it was, “after the two national churches, after Astra Cultural and after the two or three greatest newspapers [...] the most popular notion throughout Transylvania, Banat and the old Romanian Land, where the Romanian word could be heard “; was seen not only as an economic-financial institution, but [...] as a national institution, as a sort of fortress well established in the life of our Nation”(Rosca, S 1946).

Albina Bank was founded in 1867 with the financial and moral support of the most popular Romanian figures from Transylvania: brothers Alexander Mocioni (Chairman) and Anton Mocioni of Banat which were not just good patriots, but they had a strong economic power and several political relations in Vienna and Budapest, Paul Dunca (vice-president), Ioan Hannia (treasurer), Iacob Bologna (jurist), Timotei Cipariu, David Urs baron from Margina and Visarion Roman (interim director, then permanently).

Albina bank began with 300.000 florini as social capital after a long and hard journey because the constitutive act was sent to Hungarian governor at Budapest to be approved, and they required some significant changes like increasing with 100% the share values (from 50 florini/share at 100 florini/share) and decreasing the number of shares from 6.000 to 3.000, which drastically limit the opportunity to buy shares because 100 florins was an amount of money which few Romanians could pay to subscribe the social capital. Another discouraging condition, the bank could not begin its work only after the subscribing all the 3,000 actions planned and just if the cash was at least 90,000 florins, a condition that was not put to other institutions. For example, in the same year, it was set up a Saxon bank Boddenkredit Anstaldt in Sibiu with a mandatory subscription of shares an amount of 100 thousand florini.

Last but not least, the Hungarian government imposed a future capital growth which could not be done at a lower amount of 500,000 florins and only with government approval. Also, the Hungarian government introduced a clause whereby a “royal commissioner”; have the right to attend General meetings and Board meetings.

In the analyzed period in Transylvania, cohabited all three credit network (Saxon, Hungarian, Romanian) providing for its interests but also struggling to attract the client’s deposits, one to the detriment of the other. The relation of the Romanian banks was on the one hand mutual, then the Hungarian and Saxon banks followed, diverse institutions and private persons of Hungary and even Austria.

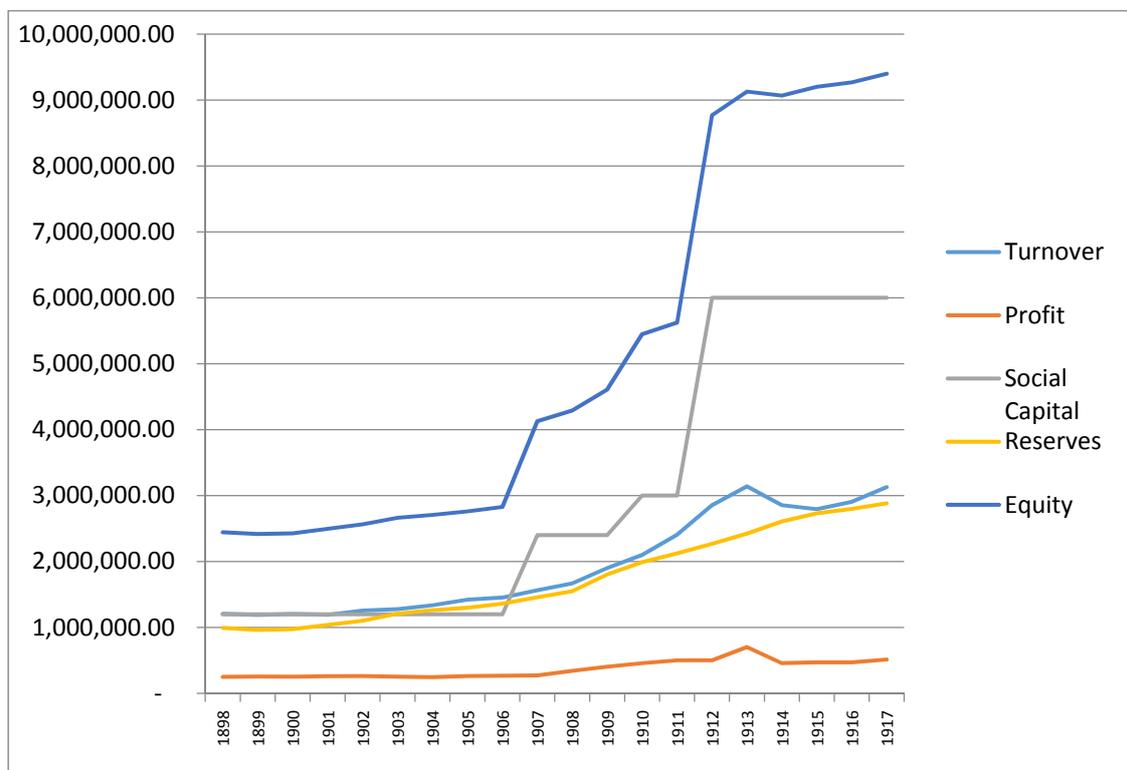
### **Financial activities of Albina Bank**

Albina Bank had been forming itself in time as the most important financial institution in Transylvania Romanian and a model for credit institutions which have studded Transylvania, contributing a lot to the economic emancipation of the Romanians. Moreover, the bank had a rich philanthropic activity, gave assistance and grants to schools and canteens, supporting the appearance of some speciality papers in economics, business and accounting.

Economic review journal published the balances of the Romanian banks in activity. The journal had been founded in 1899, so the first balance sheet published by the journal was the one referring to the year 1898. Unfortunately, the balance from 1918 is not available, because the journal has few numbers available.

Since 1900 the currency used was florin, and then krone (1 fl. = 2 K parity). So for our calculus, the data for 1898-1899 were exchanged from florini to krone.

The evolution of the Albina bank in numbers, extracted from the financial statements is presented in the following graphic.



The analyzed period show a constant increasing on the activity of the bank, because, first, the turnover increased with 259,47% moving from 1.205.550,10 K in the year 1898 to 3.128.140,48 K in 1917. The reason behind this high rate of increase is the fact that Albina bank was the unofficial national bank for the Romanians leaving in Transylvania. This increasing is reflected even on the profit, social capital, the reserves of the bank and the equity. They increased, respectively, 205,76% moving from 250.076,32 to 514.556,49; Social Capital from 1.200.000,00, to 6.000.000,00 with an increasing of 500%, reserves rising by 290,66% moving from 992.428,10, arriving at 2.884.598,71; and the equity with an increasing of 384,81%, in terms of numbers from 2.442.504,42 to 9.399.155,20.

The highest increasing, during the analyzed years, can be founded in 1907-1908 and 1912-1913. Because in each of those biennia the bank has first increased its social capital, each of this time the bank increased its social capital with 100%, this action reflects its essential benefits on the future economic year because the bank, through the rising of social capital had more money to invest in loans which generate, in the end, profit for the bank. Instead, a significant reduction in profit happened in 1914 when the profit decreased 245.420,05 from the previous year.

If we compare the analyzed and exposed data, there is a correlation between the social capital and the profit, as well with the equity. Because, as explained above, the bank had two significant increases in social capital and it results in an increase in profit for the next year. Still, the turnover increases year by year sustained by the yearly increase in profit, apart from the first two years of war 1914-1915.

According to Economic Review journal, Albina Bank has been the mother of the other Romanian banks, through actual subscription of the Social Capital and loans with the low interest rate. Along the years Albina sustains the foundation of the individual Romanian banks. For those banks and credit institutions, Albina Bank was a model, a landmark and it gave support, considering that they were excluded due to the discriminatory policy of the state, in lending from the Austro-Hungarian Central Bank. Albina supplemented the help of the state and supported the establishment of new institutions of credit, first by direct subscription of shares and later by granting loans rediscounted bills. They were loans of money with interest between 6-8% that those small banks needed to increase liquidity and to be able to operate. On the one hand, young Romanian banks had difficulty in obtaining loans from major financial institutions, so they often call Albina Bank, which has become a real central bank about them. On the other hand, by the lending arm, Albina secure a dominant position in its policy of small bodies having a heavy word to say in how they were organized and how to give loans. Albina Bank's advantage was that by the strength and reputation it obtained in time, very easy to receive funds from the Austro-Hungarian significant banks, which they then be able to place more easily by small institutions. More than 50 credit institutions have received loans from Albina Bank.

The Bank developed commercial relations with Landerbank, Paris branch, The Cheque Bank, London and Societe General Paris, through the mediation of which earned loans with lower interest rates than those of banks in Vienna and Budapest, which brought subsidiary remarkable profits in some years (in 1894-20000 florins in 1895-18200 florins). There have also been enhanced ties with financial and banking circles in Bucharest.

In 1907, Albina Bank subscribed capital to a new, banking association called "Solidaritatea" (Solidarity). This association of Romanian banks had the aim to protect the interests of the Romanian banks and their customers; the initiative started from the employees of the Albina bank, which subscribed 10 actions of the new association, just other four banks had ten shares, when the total shareholder were 31 banks. Albina was also offering loans with better tax rate to Romanians than any other bank, even central banks. (Nr. 12-26-30-38-52, 1907, RE).

Another vital step the bank tries to take was indented in 1911, by Partenie Cosma, the director who made the place instead of Visarion, when the bank tries to open a subsidiary in New-York, because of the increasing Romanian migrants to the USA and Canada in that period. The bank considered essential to help Romanians to send money home to support their families in Transylvania. The attempt failed, but through this is possible to see that Albina was mighty and had as one of its essential goals the sustain to the Romanian Population (Nr. 42-46, 1911, RE).

Together with Saxon larger institutions, Albina attended the modernization of society and especially the Transylvanian city of Sibiu. In 1895, along with Saxon banks, Albina established Electrical Plant in Sibiu who built two hydroelectric power plants on the river Sadu (1896 and 1907). The same banks set up in 1917 a brick factory in Sibiu. Together with Saxon banks participated in the financing railways Sibiu Turnu Rosu, Sibiu-Vințu de Jos building water supply and sanitation Sibiu etc. Albina has lent rediscounted bills not only Romanian institutions but indiscriminate to banks and cooperatives and Hungarian, German and Slovak. Lending conditions enjoyed by these were the same as the Romanian banks.

### **Albina’s bank non-financial activities and interaction with its social environment**

Also the intention to create a national spirit, showed through the years of the activity visible in the financial statements published in the “Economic Journal” of each year, under the voice «cote pentru scopuri cultural si de binefacere», in English «quotas for cultural and charitable purposes», in order to prove the bank commitment to the establishment of a national spirit.

This affirmation finds confirmation in the business magazine from that time, actually from 1899 when it was created, the journal was called “*Revista Economica*”, its purpose was to inform all the Romanians about the economic life of their people. In this journal the Romanian banks were publishing their financial statements, their new activities through publicity, job vacancies, new initiatives. But most important the journal was writing about the charitable, social and cultural actions and initiatives. Those initiatives were not “symbolic” and sporadic, but were very consistent and had a continuous character.

A part of bank’s profits has always been, for the period took into consideration, destined to charitable purposes. In the magazine, the name of Albina bank appears related to philanthropic objects, or other charitable activities, for the period taken into consideration 1899-1918, for 91 times, meaning an average of 4,55 times per year of operation. Now besides the quantity of apparition is interesting to analyse what the

bank was doing to see if it was sustaining the Romanian spirit and people. To prove it, a list with a historical order will be provided, beginning from 1899. All the reference comes from to the "Revista Economica".

In addition to crediting the peasants to buy the Hungarian and Saxons noblemen's land get into debt to banks in Budapest and Vienna, funding the school and Romanian churches, the "Albina" Bank has provided, from the annual profit, amounts to social objectives. These are: the high school students' eating houses, hospitals, popular kitchens offering food to the pours in cities, orphanages, TBC dispensaries, victims of floods and earthquakes in various provinces of the empire. What is worthy to note is that all the aid charities have included the suffering, "regardless of religious affiliation and ethnicity". This was a genuinely European way of understanding the need for solidarity in the face of the difficulties and trials of life.

Between 1872 - 1918, the amounts allocated for this purpose amounted to 684.540 k. Although the number may seem small compared to its possibilities, the importance had been determinative. Its help was not just monetary one (although often balance sheet amounts were not passed through to avoid attracting the attention of authorities) but also moral and human. The bulk of the sum granted during this period has focused on the enlightenment of people of different religions, and the most supported institution was the association "ASTRA" (more than 20% of the total)

It subsidized ethnographic museums in Sibiu and Lugoj, funded the magazine Our country, supported the endowment of books to municipal libraries, building schools Civil girls hospitalized and a boarding school for boys in Sibiu, scholarships, subsidies money for schools all Transylvania, supporting Romanian women's Reunion with money in Sibiu, Brasov and Lugoj. To improve the precarious financial situation of most students and teachers, Albina has contributed to numerous funds to help poor students or sick, young staff at the beginning of their careers. For 21 Albina Bank years housed and financed daily "Table students' Sibiu, Sibiu managed by Reunion women where 50 students and needy vocational schools were part of a free lunch. In addition to this meal students could meet in the library provided by Albina and equipped it. It is worth mentioning that among those who have benefited from these gratuities were Octavian Goga, Ioan Lupas, Andrei spots or Dumitru D. Rosca.

Albina Bank was also interested in cultivating knowledge of financial and banking younger students and to this end subsidized Romanian Commercial School in Brasov. Another way that supported the spread of financial and business culture has been organizing internships for officials who later contributed to the erection of numerous banks and credit unions.

At the same time, subsidized funds associations' disciples of Oravița, Sibiu, Brasov, Târnăveni, Cămpeni to help spread craftsmanship. Albina also supported Romanian students who study in major European university centres. Albina subsidized academic societies in which they were organized, “Petru Maior” in Budapest, Chernivtsi, “Romania Juna” in Vienna, “Carmen Sylva” Graz “Romania” in Munich and Cluj academic society. These funds have benefited many students who would become Romanian elites.

Albina has paid particular attention to raising people's material through the church. It supported with grants or loans with minimum interest term, both Greek-Orthodox and Greek Catholic for the construction or restoration of churches, religious schools, seminaries, elementary schools throughout Transylvania and Banat. The bank also supported the arts, peasant choirs, theatre companies and numerous other associations of the most varied.

#### **a. Charitable actions**

As the journal was found just in 1899, we report information beginning from that year when the General Assembly of the bank destined for philanthropic purposes 6% of its profit. The amount was of Florins (fl.) 6.500. In 1901 Albina bank gave K 13.000 for charitable purposes, being the leader in this type of actions (Nr. 37, 1901. RE). Still, on the first position for the charitable purposes, 17 Albina bank during 1902 gave K 13.000 from its profit (Nr. 18, 1902, RE). From its foundation in 1904 Albina gave, for charitable purposes K 257.122, the newspaper was repeating the importance of the bank for the sustain of Romanian people. (Nr. 22, 1905).

Those listed above were few of the donation of the year, 1905 were in total K 14.000. (Nr. 2-5-12, 1906, RE).

Sometimes the magazine in order to raise the interest above charitable actions took Albina bank and described its efforts to encourage other Romanian banks to do the same, or at least something for the Romanian population in Transylvania; or it could happen the journal was celebrating the help given to Romanian families from the bank to escape from bankruptcy, more than other banks.

In 1908 Albina gave K 17.000 for philanthropic purposes, looking back from the year of its foundation the bank gave the considerable amount of K 304.112,52. (Nr. 13-22, 1908, RE).

In 1909 the bank besides the K 18.000 destined to charitable purposes and donated K. 500 to sustain the Romanian population which was hit by a disaster in the village of Curitau. (Nr. 4-14-15-17, 1909, RE).

In 1910 another flood hit the Romanian population and Albina promptly helped the population with a donation of K 1.000. (Nr. 18-19-28, 1910, RE).

A part from the constant sustain to the population Albina was also pushing the Romanian entrepreneurial spirit through the constitution of a Romanian insurance company, the very first Romanian insurance company, in this initiative the bank contributed with 120.000 cor. (Nr. 14,1911, RE). Again in 1912, we find a donation for families which were hit by disasters, with donations from the bank. Considering the entire charitable work of the bank in the last ten years, the bank donated more than K. 186.000 for charitable purposes. (Nr. 17-18-24-25-26-37, 1912, RE). When in 40 years of activity the bank gave as a total K 419.122,52 for charitable purposes.

During the World War I the bank refused to tax the transfers of money to Romanian prisoners and also sustained the population of Sibiu buying 400.000 C. of wheat. (Nr. 11-33, 1915, RE).

### **b. Employee**

In 1900, the bank was providing financial sustain for a seek employee, paying the fee for the treatments in Lussinpiccolo, that will die later on. (Nr. 1, 1900. RE).

Also, the bank was investing in books, of Romanian authors, which were destined to its employees, in the same year the bank bought 50 copies of an accounting manual. (Nr. 14-38-45, 1904, RE).

### **c. Cultural activities**

The charitable purposes were not ending in “just” donate money; the bank has also been a promoter of new activities, for instance in 1904 gave K 3650 to found an association, called “Asociatiunii”, to create a museum of the Romanian people in Sibiu. (Nr. 14-38-45, 1904, RE)

The bank was also sustaining the magazine RE with a donation of 400 Cr. during the same year. (Nr. 14-37, 1901. RE). Beyond those donation and actions is very important to mention that *Revista Economica* received constantly financial help from Albina bank and also other Romanian banks, in each publication of the news paper there is a list of banks sustaining the activity of the magazine; in that section Albina has always been there since 1899 when the journal has been created.

During the following year, the bank sustained with K 300 the industrial exposition in Sibiu and also the bank was giving funds to maintain the researches regarding the Romanian economics. (Nr. 15-41, 1902, RE). In 1909, the bank sustained with K. 200 for the association “Solidaritatii” to organize a conference (Nr. 4-14-15-17, 1909, RE).

Also, in 1912, it was a donation for the Romanian journalists Foundation, “Fundatiunea Ziaristilor Romani” (Romanian Journalism ) with K. 1.000. (*Nr. 17-18-24-25-26-37, 1912, RE*). In the same year, the bank subscribed shares to the Romanian Theatre company. (*Nr. 17-18-24-25-26-37, 1912, RE*). In 1913, a donation of K. 500 for the construction of Aurel Vlaicu’s statue. (*Aurel Vlaicu was a Romanian inventor, engineer and pilot which lived between 1882 and 1930 in Transylvania.*) (*Nr. 3-12-15-16-41, 1913, RE*).

During 1917, Albina showed its interest again to sustain the Romanians initiative and gave K. 1000 to the foundation of Romanian Journalism. (*Nr. 10, 1917, RE*).

#### ***d. Educational activities***

The bank was also giving K 400, to a gymnasium in Sibiu frequented by Romanian students. For this donations the bank received in 1903 a special thanks from the Ministry of Education and (*Nr. 23, 1903*). Albina was also donating books for students in High schools. (*Nr. 22, 1905*).

The newspaper frequently thanked the Albina bank for its help to the Romanian people, but also the State of Sibiu was thanking Albina bank for its sustain, for example in 1903 the bank gave Kr. 400 donation for the needs of a High school in Sibiu. The magazine frequently wrote about the student’s canteen (“Masa Studentilor”) offered by the Albina bank for the Romanian students from Sibiu. Ay the canteen, the Romanian students from Sibiu could eat for free, also about the donation destined to the girl’s school in Sibiu for 1000 fl. (*Nr. 18-23-42-43, 1903, RE*).

In 1914, another K. 20.000 for the construction of a Commercial High school in Brasov, that was also the highest amount received. Which later on had been increased with other K. 4.000. (*Nr. 9-16-17, 1914, RE*).

In the last year of the war, it’s mentioned that Albina bank gave K. 7.000 to the Association “Asociatiunii” and also a contest financed by Albina for students, where the price was in the money.

#### ***e. Health care institutions***

The charitable actions were not limited to the zone of Sibiu, for example, in 1900 the subsidiary of the bank in Brasov gave for an orphanage 237,50 Cr. (Krone) and from the central direction of the bank, in Sibiu, 400 Cr. (*Nr. 12, 1900. RE*).

The philanthropic actions kept going on year by year, in 1907 the General Assembly required other ten years of savings for the funds to build an orphanage in Sibiu. (*Nr. 12-26-30-38-52, 1907, RE*). In 1913 the bank created another fund of K. 40.000 for

the construction of an orphanage (Nr. 3-12-15-16-41, 1913, RE) and in 1914, Albina, gave the considerable amount of K. 60.326 for a 19 hospital. (Nr. 9-16-17, 1914, RE). In 1916 the news-paper remember that Albina subscribed the considerable amount of K. 50.000 for the construction of the orphanage in Sibiu. (Nr. 22, 1916, RE).

#### ***f. Sustaining the Romanian population emancipation***

They bought mainly from Grof Hungarians over 180 000 yokes (approx. 90 000 ha) which has parceled and sold by mortgage loan peasants. This has not escaped the rulers of that time. Pesto-Hirlap in Budapest newspaper wrote "Transylvanian Romanian banks interests are support of the race. Buy the Hungarian lands, and then they give peasants with cheap interest". Albina Bank contributed significant sums to build the Orthodox Cathedral of Sibiu, the seminar (Faculty of Theology), the Association Museum (now ASTRA Library), building schools, etc. ASTRA has been able to operate just with the financial support of the bank.

The idea of Romanian population emancipation was sustained in the Transylvanian economic environment by the journal and the bank but also by business professionals (such as lawyers, consultants, bankers, or politicians) who spread new practices or aid in promoting new ideas.

#### **Conclusion**

The digital archive of Economic Review Journal provides a useful perspective for our topic, in a specific domain, area, period, culture and socio-economic and political context, more specific Romanian banking system innovation in Transylvania in XIX century.

Based on information from the "Economic Review" published in Sibiu, the first Romanian journal of the dualist epoch's Transylvania specialized on financial - banking issues, they emphasize a few moments of the Albina bank during the period of the years 1899 to 1918.

To achieve this aim, it was selected, the example of "Albina" bank, the first bank set up by Romanians with only Romanian capital, then it had become the most important Romanian bank during all the period of domination of the Austro-Hungarian Empire. In the analysed period, Albina Bank helped and sustained the Romanian spirit and economic initiative. Albina together with the other new Romanian banks competed with Hungarian and German banking systems, elements of a particular financial environment.

Beginning from its start passing through its evolutions and the difficulties the Romanian banks found during the domination, for getting the permission of financial activities and money to establish related activities (like insurance companies) the paper reveals the continuous growth of Romanian credit institution and their contribution to the community.

Starting with 1871 when the first bank with Romanian capital of Transylvania was founded – “Albina” Sibiu – the Romanians of Transylvania laid the basis of a real credit system, which although modern in its structures, provided for the necessities of the traditional occupations of the Romanian population – i.e. agriculture. This situation was determined by the unfavourable economic and political circumstances which favoured the trading and industrial investments, preponderantly of the Hungarian bourgeoisie.

The statement of some general information related to the functioning of the Romanian financial banking system of Transylvania was illustrated with concrete examples, provided by different banks whose activity was considered.

A new attempt of reconstructing the Romanian banking system’s activity of Transylvania was necessary due to the tracing of new possibilities to valorize both sources and a new effort, to achieve its framing within Austro-Hungary’s socio-economic and financial context.

Albina Bank should be considered as a prototype, an innovation, as the successful introduction of an idea, perceived as new, into a given social system.

The study argue that even there was a delay in the evolution of economy and banking system in Transylvania compared to the developed European economies, the gap was filled toward the end of XIX century. The economy, rural by excellence in Transylvania started its development, initially extremely slow, in XIX century, increased and triggered the emergence of capitalism, hence the development of banking system. Imperial (Austro-Hungarian) political domination and the social structure played an important role in this setting.

As a final conclusion is possible to confirm that Albina Bank made a lot for the Romanian people which the sustain to the Romanian spirit lead, in the end, to the union to the Romanian Kingdom on 1st December 1918. The charitable actions the philanthropic initiatives were crucial for Romanians during the Austro-Hungarian domination. A bank influenced more than other political activism, like it was in Brasov, to the creation of a sense of belonging to a nation rather than the feeling of population subordinated to another Emperor, in this case.

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## **Daguerreobase: Digitizing photographic heritage**

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**Abstract:** The tendency to digitize and create online archives has recently become more common among cultural institutions. Digitizing collections and crowdsourcing the information bring more benefits to museums and the public because the digital medium facilitates a wider exposure and the circulation of a more consistent body of work. In the same line of practice, the Daguerreobase Project is a conservation initiative to digitally archive daguerreotypes on a large scale.

**Keywords:** daguerreotype; photography; history of photography; archive; collection; Romania; Daguerreobase

The tendency to digitize and create online archives has recently become more common among cultural institutions. Digitizing collections and crowdsourcing the information bring more benefits to museums and the public because the digital medium facilitates a wider exposure and the circulation of a more consistent body of work. In the same line of practice, the Daguerreobase Project is a conservation initiative to digitally archive daguerreotypes on a large scale.

The daguerreotype is the first functional photographic process that was invented in 1839 by Louis J.M. Daguerre in France and was used until 1860. The photograph was made on a copper-silvered plate and could not be multiplied. The plate was polished to attain a mirror like surface, then it was sensitized, exposed in the camera and developed. The end result was a unique direct-positive image with great clarity.

Despite its superior qualities the process also had some drawbacks, such as a long exposure time that required a rigid posture that made expressions difficult to hold. The images were black and white and in some cases, the plates were manually colored with pigments in order to make them look more realistic.

The daguerreotype had a range of external elements of packaging that helped to display and secure the image, since the silver layer was more fragile and exposed to deterioration. In order to protect the plate, it was covered in layers of paper, cardboard, metal, glass and then it was sealed. The packaging format was diverse but two common types of housing were mostly used, the framed European model and the cased Anglo-American.

The invention of photography had a great impact on the public and it was used to explore reality and record the world. The daguerreotype was applied in equal measure in the arts and science, bringing new information and perspectives to these fields. The earliest photographic images are significant because they hold a high value as visual and historic documents.

The Daguerreobase Project archives daguerreotypes and digitally preserve these priceless images in a broader context. The Netherlands Photo Museum in collaboration with the Antwerp Photography Museum, Belgium elaborated the project and introduced several European countries, including Romania.

The online platform offers a complex network of collections of daguerreotypes presenting an overview of the global cultural heritage. The project consists of a digital database that includes detailed records and images, compiling a vast catalogue of over 16.000 daguerreotypes. The archive also consists of newspaper clippings, cameras, paper reproductions of daguerreotypes and historic literature. The items are inventoried according to a standard list that describes the photographic object. The centralized registration system acts as a collective cataloguing tool for daguerreotypes from private and public collections assembling a unitary international archive.

The project is also engaged in developing recent literature by online publications that can be accessed freely. The book *Daguerreotypes. Europe's Earliest Photographic Records* was compiled especially for the project in order to give an overview of this type of cultural heritage. It has been translated into ten European languages to bring closer the knowledge to the countries and communities involved in the project. *The Daguerreotype Journal* is an online magazine with five editions that present historic and technical aspects of the process, photographers, studios and methods of conservation.

During the project, Daguerreobase collaborated with Europeana cultural heritage portal and integrated a selection of the items into their website. In this context, the daguerreotypes benefit of a wider exposure. Another initiative is the online virtual

exhibition *1839-1860-Photography on a silver plate* that presents the history of the process in an interactive format.

The multilingual platform functions as a virtual and cultural environment that allows cross connections and relationships to be established between the collections based on the search of common criteria. The main goal of the project is to create a solid infrastructure of information in order to disseminate metadata and deliver a valuable digital content by opening collections to a wide public. As a result, a more cohesive body of work can be consulted and new knowledge can be generated by revealing and linking missing information. This approach provides a more engaging experience and interaction with the information and it develops new research strategies that are beneficial for photographers, artists, historians, curators, collectors, researchers and conservators.

With the implementation of the Daguerreobase Project in Romania, the first inventory of daguerreotypes took place at a national level. A unitary collection of a hundred fifty eight items was compiled from five public institutions and seven private collections. At the moment, seventy three items are available online and the rest are to be processed and uploaded into the database. Part of the daguerreotypes have not been identified, inventoried or exhibited online before.

The institutions and private collectors that participated in the project are the following: the Romanian Academy Library (13), the Romanian National Library (4), the Prahova County Museum of History and Archeology (1), the Arad Museum Complex (6), the Banat Museum Timișoara (1), Adrian-Silvan Ionescu (26), Tudor Berza (2), Ștefan Sava (3), Cristian Graure (2), Theodor Ulteriu-Rostás (7), Mihai Stănescu (75), Călina Bârză (6).

Following the registration, several findings have emerged from the research, such as new information about the photographer, plate manufacturer, studio, year, location, the packaging elements and the degree of deterioration of the object. The entire Romanian collection, with the exception of two items that depict statues, is composed of individual, couple or group portraits. Concerning the origins of the daguerreotypes and the nationality of those portrayed the institutions together with two private collectors hold twenty-three daguerreotypes that depict forty-one Romanians. The limited number of the photographs increases their value, as they are precious and remarkable images. In the case of the private collectors, most purchase theirs from abroad, making a larger and more culturally diverse contribution to the overall local collection. Most of those daguerreotypes come from France, the United Kingdom, the United States of America, Germany, Austria, the Czech Republic, Sweden and Denmark.

This documentation was possible due to the Daguerreobase project that made the information available through a detailed inventory and digitizing the photographic objects. The content is structured and delivered freely on the online platform. This approach brings many benefits such as digital conservation, disseminating metadata, valuing visual heritage and interconnecting institutions and collections. The Daguerreobase project continues to register daguerreotypes and to bring to light significant details about the earliest photographs.

## **The story of a project: a collective memory 1950-2000**

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**Abstract:** Conceived and started in 2007 as a result of a private initiative, the collective memory 1950-2000 transdisciplinary project is one whose story (creation, evolution, valorization) is of great interest in the history of digitalization in Romania. As one of the pioneering project of digitalization in the country, it focuses on the creation of an online image archive ([www.memoriecolectiva.org](http://www.memoriecolectiva.org)) and of its contemporary cultural use. Dedicated to Romanian images especially but not only from the 1950-2000 period, is unique in the field both on the Romanian and international level by how it was conceived, theme, concept, complexity and display.

Part of its uniqueness and values is due to the fact that besides collecting, preserving, archiving, digitalizing or presenting the images online it has an oral history component by presenting all the images together with records (voice, video, text) of their stories or/and the stories of their collectors or photographers. Thus an interesting and important asset of the project come into be discuss: the fact that the archive is an emotional one even if is created to be impartial, to have a scientific approach, to promote and encourage researchers and artists to work with it patrimony and an important part of the project it's dedicated to research, study and to the cultural exploiting of the online archive.

**Keywords:** Anthropology; art history; collective memory; image; memories; national; online archive; oral history; patrimony; photography; research; Romania; story; value; vernacular

Collective memory 1950-2000 is an online archive started in the Bucharest of 2007 emerged from an art history and anthropology type of approach as one of the pioneering projects of digitalization in Romania.

The project idea come out as a result of an enthusiastic meeting I had as an art historian in 2007 with Ioana Daia, friend and anthropologist, member of the contemporary anthropology research team generated and developed around the special figure of Irina Nicolau. We were both formed by that special 90's anthropology research emulation that flourished in the prolific ambiance of what was The Romanian Peasant Museum from Bucharest under the rule of the artist Horia Bernea.

The purpose of the meeting was to decide whether to write an article about the photo collection inherited by the photographer Florin Bobu, after the death of his childhood photography mentor, a casual and amateur village photographer that helped the villagers record their private or administrative events (identity card photos, weddings, funerals etc.). During this meeting, we have realized the fantastic potential (anthropological, sociological, technical, historical, artistic, emotional etc.) of the vernacular images created by ordinary people or amateur photographers and the importance of saving them from being abandoned or destroyed. Following the urge to do something significant to protect and put into value such a legacy we end up by being drive by the idea of collecting, preserving and making available images of yesteryears that captured lives and stories from the past, to the present and into the future. Thus, the meeting didn't end up with an article but with an idea to create a project and an archive: the collective memory 1950-2000!

A team was soon created which developed in time to become a management, scientific & research board. Later the team was enlarged with specialists and volunteers collaborating to conduct and implement research, digitalization, events, etc. but meanwhile Ioana Daia's idea to associate the images that we wanted to collect with their stories was developed and step by step the concept of this special archive emerged into becoming a unique transdisciplinary project on a national scale.

The collective memory 1950-2000 project is about the creation of a new archive concept, definitely more than just grouping images and their stories as an emotional/nostalgic online album of Romania in between 1950-2000. The purpose of the project is to create and to develop: a professional online, accessible and free archive; to recuperate, collect, preserve, analyse and synthesis in a professional way and to display in an accessible user friendly way a considerable number of images together with their stories in order to make use of the reach mnemonic load of the archive, to provide an important resource for future national or international cultural, anthropology, art, history, oral history, sociology, architecture, interior design etc. studies!

The creation of a private archive conceived to be online, open, with free access to the public was something unheard of in the bureaucratic Romania of the first decade of the 2000's. All the archives were State institutions with limited public access, slow and bureaucratic consultation procedures, not digitalized and with websites that were presenting the institution itself, not the patrimony they posed. Thus by analyzing and scanning all the collected images, by presenting them online and by developing a special adapted data base system behind the website created by our collaborators especially for us, the collective memory 1950-2000 project was pioneering the image digitalization in Romania and creating an accessible archive available quick worldwide. The access to the images is free but all the images are protected by national and international specific laws because the image use politic was special created both to protect the images, collectors, photographs but also to facilitate their cultural valorization!

The choice made in 2007 to document 50 years of recent Romanian troubled history was again for that time a pioneering and very courageous act because there were almost no national, academic, public or private interests for that specific period or for vernacular images. Strong emotions on a national and personal level were associated with almost everything that happened before 1989, leading to an attempt to re-order or get rid of the past and to embrace the new fashions on every aspect of life. Only in the last few years has it become fashionable to be interested from an academic point of view in the period before 1989 and the emotional approach regarding that historic period becomes a bit more balanced. This was the context in which the collective memory 1950-2000 project aimed to document with a scientific and impartial approach, an unstudied period of time in order to create a study base to understand a period with important, dramatic and fast transformation in every aspect of public and personal life (political, economic, social, mentality, technical etc.). Thus the archive contains images from Romania, especially but not only, from 1950 to 2000, mainly photography but also postcards, cards, wedding invitations, labels etc. The images are from different regions, cities or villages; shot in public or private occasions; captured by professional or amateur photographers; staged or vernacular; gathered from private or public collections or from family albums etc.

Since 2008, the archive is collecting images of every format, size, subject, type or support (photographic paper, film, negatives, glass etc.) by organizing research and collecting campaigns all over the country or by receiving image donations. Due to the fact that the creation and development of the collective memory 1950-2000 archive is an ongoing process the archive is flexible and permanently open to donations and any type of collaborations.

The material is analyzed, catalogued, archived and digitalized on scientific criteria then, based on the previous signed accords with their owners/collectors/donators, is uploaded online together with the personal stories and information (text, audio or video) about the author, collector/s or the collection they belong to. Developing it unique concept, the online image archive is not focusing only on presenting the technical data of the images following the scientific archivist procedures, but on putting in the spotlight the fact that all these images whether they be snapshots of everyday life or staged photographs, are actually personal stories that could recreate the history they carry both for the today's researchers and for the ordinary observer.

In this way as many image collections are added to the archive, as many stories will be shared and, due to the fact that the archive contained collections of images and stories of public figures from different domains (sport, culture, medicine, engineering, inventions, education, architecture, arts, music, theatre, film, business, etc.) together with the images and stories of ordinary people, the archive become an incredible information source capable of recreating and expressing all the changes in Romanian society in the last few decades.

In order to make all this rich and incredible material known and available to the general public and the specialists, the project was designed from conception to encourage all types of scientific or artistic research, collaborations and cultural exploiting of the digital/material image collections it has. To set the tone, several artistic shows and art performances were made as part of cultural events with large numbers of participants. Proposals for international and national conferences, seminars, publications, call for artistic projects based on the archive images etc. are to follow. But, regarding the promotion of the archive, the project brought another huge novelty in the Romanian ambiance of the first decade of the 2000's: the collective memory 1950-2000 archive was conceived as a brand!

The fact that a cultural transdisciplinary project with this topic, this scale and with such complexity on all its levels able to combine a high level of professionalism with accessibility emerge as a result of a private initiative, was unprecedented in Romania! Its creation and realization was possible with the trust and help from families, friends, specialists, collaborators, official partners and the essential financial support of the ERSTE Foundation!

However, being pioneers means facing all sort of problems and then finding or creating solutions to solve them; making many mistakes and, if possible, learning from them! We have experienced challenges from this point of view on all the fields we have dealt with: technical, logistics, efficiency, mentality, etc. but the main ones were of technical and emotional nature.

First one because the building of an online archive, the digitalization process, its techniques, systems, storage and all the procedures associated with were novelties at the time we have started. With only a few and not remarkable Romanian experiences on the online digitalization field until 2007 we've studied and learned from the international examples, procedures and systems trends on online archives, digital archiving process, data bases, news agencies, image banks, stock photography, online commerce, photo sites etc. Followed those studies and being inspired especially by models like Getty, Magnum, Alinari we have conceived our own digital archive system and website. The process was slow and with lots of experiments and tests but from 2009, we were able to have the first functional online version of the archive and the website, created and tailored for our interests and needs only. The need for an upgrade version followed soon, in 2012 and it was due to the fast changes on technology and to the improvements that we have brought to the archive operational system. Being an active archive, interested to keep a contemporary fresh approach and to make use of all the useful updates (on scientific and technological aspects of digitalization, archive procedures or cultural valorization), an updated version of it is now discussed and in tests.

The core of the archive is the search system and due to the fact that's always to be improved, we have faced many problems on this matter. A curious and interesting aspect of it is the fact that emotional particularities of the archive made out of the search system criteria a difficult task for all the three versions of the online archive, both from scientific and technical aspects!

Actually, except the technical matters that challenged us, the main problem we face is: emotions!

First, any archive is by default emotional even if resulted from the austerity of the scientific approach of the specific archiving methods and rules. By being different, collective memory 1950-2000 archive has the emotional approach of being an archive designed to accompany images with their stories and the stories of their photographers and collectors. More, this archive is unique in the field by being dedicated to recent history, a period of time rich in transformation (political, economic, cultural, mentality etc.) and this is always very controversial and accordingly, extremely sensitive regarding emotions!

As this was not enough, by being an ongoing project and by having open and direct contact with the users or the contributors to the creation of the archive and with the public from the events that we have organized, the archive is constantly exposed to different emotional reactions.

The most common of them is a mentality problem: the negative attitude expressing mistrust regarding the use of the archive for cultural and impartial purposes and its importance for nowadays and the future. This mistrust is one of the effects generated

in a subliminal way by the last decades of dramatic and traumatic transformations (political, economic, social, cultural etc.) that lead to a general lack of values, respect, self-esteem, indifference and eventually, to the alteration of the individuals.

In contrast, other type of reaction we face is the positive one, that understand, embrace and sustain our concept but has often the tendency to reach a point of developing a glorification of the past. This is characteristic for the young generation born in the 1990's that are curious about the past but due to the globalisation new phenomena of a "shallow" and "political correct" type of society, they refer to the past with a consumer interest, searching in it for "cool" aspects that can "decorate" their life.

But this are just the two dominant types of emotional reactions that we face directly because in the Romanian society of the last few decade emotional reactions are of many type and in constant change, fluctuating between complete indifference and strong emotions (excessive positive: propaganda, emphasis, empty patriotism or excessive negative: mistrust, destructive, resignation).

In such a context generated by fast mentality and society changes, we considered mandatory for the collective memory 1950-2000 archive to have an impartial role. That is why we did not want to develop any nostalgic, melancholic, propagandistic, emphatic, populist, patriotic etc. "tone" of the archive but neither a too academic one with a strong accent on data/archivist criteria. We were interested to develop an impartial and active archive with a neutral display by promoting acceptance of the all the realities/facts of the past, a scientific type of approach, academic without being rigid or too descriptive and an agenda of different type of cultural events. That's why the archive itself and everything connected with it (events, shows, visuals etc.) is well analyzed by the scientific, research and development board in order to be balanced from an emotional point of view and to be able to express the impartiality concept of the project!

The politic of the archive is not to judge but to collect in a professional way images and to record their stories/memories in order to be able to be analysed in scientific ways, leaving the story or image perception to depend on the viewers/receivers themselves. But even if we put a lot of work to build an impartial approach by running such a specific archive we are kind of trapped in between the emotions from within the archive itself and the external ones (society, viewers, etc.). This is the reason why we decided to explore certain aspect of this phenomenon and to make use of emotions and the emotional potential of the archive in order to promote a kind of statement regarding the archive politic.

The images and stories of the images, collectors or photographers we present in the archive are nothing else than fragments of life and life experiences/lessons. In this context every image, every story of the images and the story of every path and every individual become important. Thus, every image and story presented in the archive

is becoming part of a process of discovering who we are as individuals. But by gathering together the multitude of the images and stories that we've collect, the project of creating an impartial digital archive become in a natural way, more than just an impartial images & stories collection of all the different collections that we preserve! Even if we remain impartial and we do not interfere on the other side of a professional approach, we are actually creating an emotional archive about people, their memories, experiences and life! Thus the collective memory 1950-2000 archive becomes a kind of image album with stories about ALL OF US and extrapolating, an IMAGE OF ROMANIA itself!

This archive is a personal experience! It images and stories express all the change of the society and for the fact that is mirroring the realities of a period, group, etc. collective memory 1950-2000 archive is an image of Romania and it transformations! Is reflecting how we are! Is not just data! Is who we are! It consists of many image and story collections together and because they all are nothing else than memories, this archive it become a memory archive. By being a collection of OUR memories it shows the deep humanity of each of us and the fact that personal mistakes, dreams, failures, happiness, etc. become/are/can be collective or even national mistakes dreams, failures, happiness, etc. Thus this archive it contains our collective memory!

In this way, the archive is becoming so rich in emotions in all its impartiality, that any type of viewer can find in it a place for a personal introspection research. A direct contact with the archive is enabling for the viewer the exploration of WHO YOU ARE as an individual and who you are as a part of a family, group, country, a period in time, a generation etc. With this introspection process that lead from personal to collective/national, the archive project is developing in a spontaneous way and in the exact same time with it's creation, a WAY OF THINKING about the past, a type of ATTITUDE to the past, a SOLUTION to sort out the "problems that we have with the past": to use the material of the archive to discover with an honest approach who you are, to accept and to assume it in order to be able move on and to develop!

We have expressed this statement in public by exploiting the emotional and material potential of the archive within the three shows organised in Bucharest in 2009 at the Romanian Peasant Museum and in 2012 in Sutzu Palace. We were interested to create direct interferences of viewers/spectators with images from the archive collections trough performances that allowed communication, connection, mirroring, confronting personal experiences with the one of others. Focusing on the interactions in between images and the fragility, ephemerality, fluidity of emotions/memory/life we've explored and stimulated a process of introspection (identity; individual experience-memory as a "belonging feeling"; personal-collective/national; discover-accept-assume-get over it and go on) by using new media technology, indoor projections, outdoor big scale projections, vapour screen projections or prints on mirror surfaces.

This is an example of how we've make use of some of the emotional aspects of the archive and how we've presented a statement but due to the fact that the archive is formed by a large amount of image & story collections from all Romania, it potential is extremely rich, valuable and interesting for personal/individual or collective exploration (including a post trauma therapeutic process on individual or collective levels regarding the period before 1989) and for many professional research/study fields! With such a context, the politic of the archive is to promote and to put in value all it patrimony and in as many ways can be possible. The archive is open to collaborations for projects, studies, researches on different domains (art history, history, anthropology, sociology, psychology, architecture, etc.). We encourage scientific researches, biographies/monographic studies on the photographers/collectors or on people (famous or not yet) presented in the images of the archive and any type of photographic studies: on what the images of the archive depict (landscapes, architecture, houses, portraits, objects, people and ways of being, fashions, etc.) or on the evolution of photography (technic, materials, way of posing, attitudes of the subjects in front of the camera, styles and fashion of doing photos, etc.), etc. We also consider ways of working with any type of creative: artist or new-media artists, photographers, designers, architects, scenographers, movie/theatre directors, fashion designers, etc. Thus by collecting, preserving, studying and promoting the fantastic potential of the unique patrimony of collective memory 1950-2000 archive, researchers and viewers/spectator together we can build and explore our collective memory.