MATHEMATICS AND DATA PROCESSING

- Rumania -

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This publication contains translation of two articles in the
Hungarian-language periodical Korunk (Our Age), Kolozsvar, Vol XXII,
No 2, February 1963, on the specific subjects reflected in the table
of contents. Complete bibliographic information accompanies each
article.

VISIT TO THE RUMANIAN INSTITUTE OF MATHEMATICS

The road in Kolozsvar leading to the Academy Mathe-
matics Institute (Akademia Szamitasi Intezet) makes a steep
climb. It makes the heart pound, as did the steep staircase
leading to the mathematics classes of the past.

At that time, however, in the decade of 1920, the
heart pounding was accompanied by a certain amount of emo-
tion which dominated our thoughts which appeared reluctant
to conform to strict mathematical discipline. Secretly,
we had dubbed our instructor "Lucifer," and it was a sur-
prise when he enacted the role of Adam in the school play.
Mathematics and poetry bore this strange relationship to
us students at that time. After two performances our in-
structor ceased to be Adam, and he took all measures to
instill his subject in us as an independent, disciplined
concept. We began to believe that numbers governed the
world. We considered the graduates, and the youths hold-
ing positions in enterprises and in offices as slaves to
mathematics, who piped away their lives laboring over
enormous accounting books with needle-sharp pencils: debit
accounts, credit accounts, transferrals, totals, and in
the meantime their pocket watches at their breasts monoton-
ously marked off the passage of time.

Only a spark lacked, to ignite our interest and to
reveal the true poetry of mathematics to us. However, the
"Lucifers" of the mathematics department were unable to
light the sole possible road to recognition of the truth,
which leads from a vital viewpoint through abstract think-
ing and thence to practice. They were unable to impart to

us the way in which mathematics may faithfully describe
the most characteristic traits of reality, viz. change
and motion. They did not strive to train the students
in the functional viewpoint, based on known factors in a
few given equations, to find quickly and reliably the value
of unknown factors. They also neglected imparting inspir-
ing knowledge of the history of the subject. At those
times it would have been helpful to mount some kind of
time machine, and with the input of certain data fly through
ages, from the domain of simple arithmetic to the world of
cybernetics.

Flight on the Time Machine

It is a short trip to my goal: one-fourth the dis-
tance between the Beke Square (Peace Square) and the Astro-
nomical Observatory. Expression of the new emotion is ur-
gent, because within a few minutes I will be among scien-
tists who are characterized by mathematization of the think-
ing and action of modern man. Now I am swept up by the
time machine...
It is as though I were face to face with the pythagor-
eans of old, as magically they review the numbers they have
arranged by themselves, believing that the numbers actually
control the world. (At present, man exercises cybernetics,
the "art of control," in respect to the orbits of unknown
celestial bodies.) Ancient orientals, Chaldean, Egyptian
priests and Shamans rise up from the misty past. They
nurture numerology with religious trembling, associating
the number 5 with the major planets, and the number 7 with
the phases of the Moon. (In our era, liberated man realizes
five-, and seven-year plans with a confidence eliminating
centuries of retrogression, and mounts the rungs of the
ladder of scientific-technical development with gian steps.)

From our time machine we may look back with respect
upon the Hindou masters. They contributed a seemingly in-
significant, but actually epochal key to the simplification
and facilitation of computations, the zero, the numerical
space marker which is indispensable at present. (These
symbols aid man at the present day in computation of the
millions of kilometers of rockets aimed at foreign celes-
tial bodies.) Let us salute the Roman mathematicians bend-
ing over the counting table (abacus), and the Russian mas-
ters performing complex computations while manipulating
the ten beads per wire of the counting board (shtoshkhitiy).
Let us greet Neppert, the discoverer of the first logarithmic
table. We must pause a moment to tell Laplace that he was
right. Discovery of the logarithm shortened the performance
of computations ordinarily extending over a period of months,

thereby actually doubling the life or the astronomer. (Oh master, had it ever occurred to you that several thousands of operations could one day be performed per second on the latest devices, thereby rendering the "lifespan" of astronomers born in the 20th century computable only be electronic means?)

Stop the time machine; for the moment we shall entrust the trip to the area of science fiction literature. We have arrived.

The "Absolute and Local" Value of a School of Mathematics

The villa-type building, surrounded by an evergreen park now covered with snow, is being painted at the moment. We thread our way through a labyrinth of corridors and rooms, with "wet paint" signs framing the doorways.

We enter a not entirely unfamiliar surrounding. Our periodical has enjoyed contact for six years with the director of the Institute, Professor Tiberiu Popovici, corresponding member of the RNK Academy who is conducting world-reknowned research work, and especially with Engineer Laszlo Nemeti, chief of the computor division, who has informed thousands of our readers on timely problems of technical cybernetics. [see Note]

([Note] Laszlo Nemeti: "Electronic Computors," Korunk, 1957, page 1665. Laszlo Nemeti: "Computing Machines in the Public Economy," Korunk, 1960, page 647.)

Six years ago we could have obtained only a partial answer, in conformance with the modest degree of development of that period, to the question, phased in mathematical terms: "What is the 'absolute and local' value of the Institute? (considering the national, as well as the international level as absolute values)."

In the first year of our publication we were able to give a picture of the history of the development of the Institute, which is the history of the creation of an essentially Kolozsvar school of mathematics.

Our popular system has enabled mathematical research to exceed the narrow limits of academic chairs of universities at Kolozsvar, also; enabling clearly defined problems

to be undertaken through progress based on systematic col-
lection of data, enabling development in a well defined
direction, and enabling enrichment of this branch of science
with trained specialists and mature research personnel. Be-
ginning in 1951 research work has gravitated around the
plan of the Mathematics Department of the Academy. However,
quantitative and qualitative growth, activity in an increas-
ingly large sphere, and the theoretical and practical re-
sults attained quickly elevated the Department to institute
rank.

According to the text of the charter, the field of
research of the Institute is the approximation of functions,
and research on their application in numerical and graphic
computation and in the construction of computor machines.

The basis of purposeful and systematic research work
in conformance with plan is extensive information. At the
present time applied mathematics is an exceptionally complex
phenomenon; it may not be understood without knowledge of
the entire mechanism of development of mathematical thinking.
Because of this fact, the information of specialists and ex-
perts in our country is furthered extensively.

If the foreign voyages of associates of the Institute
were marked on a map with red tags, and if the direction of
the trips were indicated by lines between Kolozsvar, as the
starting point, and the great metropolises, we would have
a vital map of international connections. Contacts and in-
formation included the Soviet Union, the Polish Peoples
Republic, the Hungarian Peoples Republic, Austria, German
Democratic Republic, the Netherlands, France, Italy and Sweden
during the 1957-1962 period. Nine members of the personnel
of the Institute have participated in various scientific
conferences and study tours.

The visitor's registry of the Institute, as a docu-
ment of vital contacts, lists visits by 33 scientific per-
sonnel, from the Soviet Union, Bulgaria, Czechoslovakia,
China, Poland, Hungary, Germany and Italy.

Continuing contact has been established with the
Academy of Sciences of the Polish Peoples Republic (reg-
ulated by a treaty of cooperation for the years 1950-1962)
on the subject "Qualitative Theory and Numerical Integra-
tion of Differential Equations."

To the present time six personnel of the Institute
have published valuable studies in the scientific periodicals
of the Soviet Union, Poland, Hungary, the German Democratic
Republic and Italy.

Scientific Secretary Lascu Bal may point with pride
to the semiannual periodical of the Institute, entitled
Studii si cercetari de matematica. Due to the publication
of this periodical, which is increasing in circulation, the
Institute enriches its library with 200 foreign technical
periodicals. The majority of the articles in Studii si cer-
cetari de matematica are reports of the work of Institute
personnel.

Thus these few summary data offer obvious proof of
the absolute value in connection with the world level.

The visitor may feel that he is in a special kind
of school of mathematics here. In the departments (1. con-
structive functional theory; 2. numerical analysis; 3. com-
putors) and in the two subdivisions of each department the
majority of the expert personnel are young persons, trained
during the upswing period of our building of socialism. The
most striking impression is the purposeful application made
of party directives in the course of research work, and for
utilization of the various mathematical methods in the
public economy, at the enterprise, reserve, branch and
national levels. The department heads Professor Dumitru
Vasile Ionescu, Ferenc Rado and Laszlo Nemeti effectively
propagate the concept that at this time research is to be
characterized primarily by extensive practical application
of theoretical achievements.

Research Work is Materializing

We are gleaning for data relating to a high level of
connection between theory and practice. The prevailing
silence becomes tense because it is charged with the ten-
sion of the tasks. As an objective reality the computa-
tions become embodied in drawings, tables and mechanical
aids furthering production processes: the research work is
materializing.

Let us discuss the problem, not always in chrono-
logical order, but conforming to the individual task areas.

The first systematic studies of nomography in Rumania were undertaken at Kolozsvar. Lascu Bal and Ferenc Rado published the first Rumanian-language work dealing with nomographic research in 1956. In this connection we may already provide an answer to the problem affecting Rumania under its conditions of domestic reality, of how the research conducted along this line may be applied.

Graphic solution of various computation tasks, the nomogram serving planar depiction of multi-variable functions, is in fairly broad use in technical practice at the present time. The graphic symbols developed, which occur as functions of known quantities in the given equations, yield the value of the unknown quantity simply by reading it off. Nomograms are especially suitable for the nonferrous metal industry, in the computations connected with gears.

At the request of the tractor plant at Brasso, the Institute determined the thickness of the tips of the cutting blades used in the manufacture of gears with the aid of nomographic data, as well as the minimal number of gear teeth enabling processing without danger of vibration.

Computation of the data of special tools needed for production of screw-type oil pumps for the Kudasir plant presented a different problem. This enabled production of a demanding industrial product as a new step forward in our technical development.

The data of special tools also were computed for the Unirea plant at Kolozsvar, necessary for manufacture of the so-called knob-wheels of mechanical looms. This assistance represented a saving of 60,000 leu per year for the plant.

The Institute may cite significant achievements, especially in the field of numerical analysis. This is the theory of computation technology aimed at development of the most purposeful, rapid and precise methods of resolution of problems, and it engages the Institute personnel in an ever broadening field of research. The conference held at Kolozsvar in 1960 was very impressive. Sixty researchers from various parts of the country were invited. A total of 100 reports were presented at this conference.

This large-scale meeting of research personnel resulted in a high level of contacts between the fields of theory and practice.

At the request of the Municipal Development and Architectural Plan Bureau (Varosrendeszeti es Epiteszeti Tervhivatal) of Kolozsvar the Institute developed numerical aid tables for simplification of methods of planning illumination openings in buildings.

At the request of the Babes-Bolyai University the Institute developed the crystal grid constant of feldspar minerals. The Debye-Scherrer procedure was used in the investigation of the material structure. The places of maximum intensity were identified through the deflection of X-ray beams by crystals comprising the regular atomic spatial grid (the maximum intensity is indicated by the appearance of dark rings), and the crystalline structure was derived with the aid of the diagram obtained in this manner. This computation simplified classification and separation of silicate feldspar varieties.

The researchers also made progress in the field of linear programming. This type of computation furthers the most favorable (optimal) solution of the preparation of various plans and programs. It is used in the case of programs in which the quantity investigated for optimum values is in a linear (primary) relationship with the other quantities determining it.

Resolution of transportation problems on the basis of most economical distribution was one of the most special types of linear programming performed. The Railroad Administration of the Province of Brasso requested that the Institute develop an improved schedule for locomotives on the Brasso-Predeal section of the line. The result of this development was that the stock of locomotives was enabled to be reduced by two engines. The value of this computation technique may be appreciated from the fact that keeping up pressure for the daily operation of one locomotive costs 2,000 leu.

The Institute also received a request for application of the linear programming method from the Kolozsvar Tehnofrig plant. The task consisted of determination of the most economical composition of the charge of the cupola furnace of the foundry.

This was no simple task. The given circumstances required repeated revision of the calculations already performed. The various economic and technical factors set

a limit upon both the preparation and application of the program. What happened in the case of Tehnofrig? The first version of the linear programming was based on the supposition that the plant had the necessary amount of useful raw materials . During one-half year a saving of 20,000 leu was effected. However, when certain types of raw material were not available new computations became necessary. New versions of the computation had to be developed, taking into account incomplete stock of supplies and offering broader possibilities for implementation of the program. The second version also may result in savings.

At the Tehnofrig plant personnel of the Institute worked together with technical university personnel in studying the dynamic balancing of the ammonia compressors. The necessary balances were computed at the site of location of the various installations. This work resulted in improvement of product quality, together with a significant reduction in vibration.

Engineer and university lecturing professor Dezso Maros also is a very busy technical expert. He maintains the contact between the Institute and the industrial plants, and reviews fulfillment of the so-called applicable plans. The Institute concludes cooperative contracts with enterprises. At present the problems of optimum planning and of programming production processes are under study on the basis of ten contracts. Researchers of the Institute are occupied primarily with production problems of the nonferrous metal industry. The list of "customers" of the Institute includes the Voros Zaaszlo (Red Banner) Motor Vehicle Plant at Brasso, plants of the Cable Industry at Aranyosgyeres, the Leather and Shoe Factory at Kolozsvar, the Furniture Factory at Libertatea, the Porcelain Goods Factory, and other industrial plants.

In his article published in the No. 6, 1962 issue of Cercetari filozofice (Aspecte ale legaturii dintre teorie si practica in matematica) Professor Tiberiu Popovici reported that the Institute is developing its contacts with biologists, doctors and linguists. Since that time the doctors and biologists have undertaken close contact with the Institute and at present are participating in mathematics courses. Organized cooperation also has been established with doctors of the neurological clinic at Kolozsborsai. They are developing a so-called mathematical test method for detection of fluctuations in the condition of patients.

(An example of the expansion of mathematics is the fact of its progress in psychiatry.)

A new trend in the history of development of the Institute is the fact that concentrated work has been conducted on the solution of statistical problems on the basis of probability computations.

MARICA - The First Offspring

On our way to the cybernetics section, consisting of the machinery hall of the computation division, we pass through additional work rooms. We observe pleasantly serious young personnel at the desks, the so-called assistant research-personnel, who have graduated 1 to 3 years ago. (Their occasional chuckles lead us to surmise that they are speculating on the probability of our being smeared by the freshly painted door frames.) We muse on the question of how many of them are old enough to have witnessed the "birth" of MARICA. MARICA, of course, is a machine. Its complete name is "Masina Automata cu Relee a Institulu, de Calcul al Academiei."

In his aforementioned article, Professor Tiberiu Popovici brought up the question six years ago of whether importation of a computor would be the simplest solution. He also answered his own question: "No, this is an improper standpoint. We want to train experts, and we wish to utilize our own theoretical achievements. We would like to, and we will demonstrate that attainment of this goal is possible in Rumania."

In this way MARICA, the computor, was created. This first-born of Rumanian scientists, which understandably is esteemed, but also is called by pet names, serves mainly experimental and demonstrative goals. Upon catching sight of the computor we were impressed, and reminded of an infant whose features and structural appearance suggest a potential giant at maturity. Almost all its parts may be seen clearly in its small glass room. To a certain extent it resembles a telephone central exchange. However, it is incomparably more sensitive and complex than the latter. At a telephone exchange one may shout down the noise and clatter with concentrated effort. In this case, however, one particle of dust is sufficient to cause possibility of error in the computation. Maintaining the immaculate status of MARICA is an exceptionally demanding process. This first instrument is still too slow (it can perform only a few operations per

second), and its memory is too limited. The various steps may be traced from the input unit (which senses commands contained on perforated tape and converts them into electrical impulses) through the storage unit (in case of necessity, the "memory" unit, the "electric brain"), the control unit (co-ordinating organ), the arithmetic unit, which performs the four operations plus comparison, to the mechanical section which prints the results.

Thus we have the MARICA, the electromagnetic relay computor. A person entering the world of modern electronic machines suddenly, without transition, sees practically nothing. The modern computor has a complete "toilet" and is not as naked as MARICA; richly endowed with electronic elements, glittering with radio tubes and ferrite rings, unhindered by moving parts, it resolves its program with numbing speed. We may point out the advantage of MARICA, however, and state that it is equally suitable for practice concerning perfection of mechanical design and for didactic purposes. Because of this the small smile on the face of the graying blonde Laszlo Nemeti behind his thick eyeglass lenses is not deprecating, but appears to have a life of its own, as we walk around Rumania's first computor.

We may have no doubts that the second computor will be more highly perfected than the first. Young electronic engineers work at the laboratory desks. At first glance we are impressed by the integral relation hip between physical and intellectual activity. These young engineers themselves work on parts of the electronic computor with fine instruments.

Gyorgy Farkas, a tall, blonde young man, rises from his work with a slightly abstract air to greet us. He graduated at Moscow with honors in 1958. He is especially interested in impulse technology. He is at the moment welding memory units onto the lines of the output unit, although he has already worked on mechanical memory systems. Opposite him is Miss Jolan Juhasz, a graying red haired woman who graduated at Bucharest, and at present is working on the memory drum. Personnel at another table are working on the arithmetic unit. Every movement of this profound activity indicates without words that: It will succeed!

I take may leave, and as I pass through the gate of the Institute and walk toward Beke Square in the cold January morning air I find myself humming the refrain of Attila Jozsef:

> Work is worthwhile only when
> Exact and beautiful as the movement
> Of the stars in the skies.

MATHEMATICAL METHODS AND RUMANIAN LINGUISTICS

_[Following is the translation of an article by
Emese Kiss in the Hungarian-language periodical
Korunk (Our Age), Kolozsvar, Vol XXII, No 2,
February 1963, pages 179-184._]

Rumanian linguistics have a considerable tradition
in language statistics. Essentially, the theory of B. P.
Hasdeu relating to word circulation was the intuitive, and
first concept of certain basic statistical facts. The
vocabulary statistics of Dimitire Macrea (published in
Dacoromania, No 10, 1943) is based on a scientific founda-
tion, and is constantly cited in both descriptive Rumanian
linguistics and in historical linguistics. The author sup-
plements his statements with recent statistical data. In
his work Probleme de lingvistica romina, published in 1961,
he investigates the origin, structure and developments of
the Rumanian language with combined utilization of tradi-
tional statistical methods.

The use of mathematical methods began in an organ-
ized, controlled form in 1958, when the mathematical linguis-
tics club was formed within the Linguistics Institute at
Bucharest, at the initiative of Academician Al. Rosetti.
Since 1959 the Mathematical Linguistics Committee, headed
by Academicians Em. Petrovici, Gr. C. Moisil and Al. Rosetti,
has functioned as a subordinate organ of the Automation
Committee in conformance with the presidium resolution of
the RNK Academy. At the meetings of the Committee mathema-
ticians, linguists, psychologists and machine translation
experts read and discussed their works, and later two series
of reports were begun, discussing methods of mechanical
linguistics of the Rumanian language and mathematical lin-
guistics. These discussions were connected with the cyber-
netics and typological reports of 1961, the reports of
foreign scientists, technical-scientific conferences, and
description of the functioning of the CIFA-1 and CIFA-2

computors and the MECIPT-1 translating machine. Many of
the reports also were published. As in the case of all
new branches of study, the majority of the published works
popularize knowledge, clarify basic concepts, and offer an
introduction to the technical processes.

Linguistic Statistics, Computation of Probability

The first outstanding achievement in the field of
linguistic statistics is the computation of the entropy
value /_see Note_/ of the Rumanian language. Ed. Nicolau
(who was the first to discuss the bases of the theory of
information in the Rumanian language), M. Sala and Al.
Rocerio dealt with this problem in the No. 1, 1959 issue
of Studii si cercetari de lingvistica. They establish
that although the style and vocabulary material of Eminescu
and Arghezi are radically different, they impart essentially
identical information from the point of view of the theory
of information. The statistical structure of the Rumanian
language presents a fairly uniform picture from the point
of view of information, irrespective of the sources util-
ized in the investigation.

(/_Note_/ With respect to entropy and information
value, cf. Zoltan Szabo, "Cybernetics and Linguistics,"
Korunk, 1961, page 41.)

The generally popular and utilized field of mathe-
matical linguistics is that of sound statistics. The
Rumanian phonology, however, offerred relatively little
in this area, perhaps due to the formation of many schools
of thought. In the Em. Petrovici Memorial Issue of Cerce-
tari lingvistice, 1958, P. Neiescu arrives at interesting
conclusions through combined application of traditional
and statistical methods in an investigation of the accents
of Rumanian words of Hungarian origin. Liviu Onu estab-
lishes word accentuation by the statistical method in re-
spect to Rumanian neologisms terminating in "o" (such as
radio: radiouri) in Studii si cercetari de lingvistica,
No. 1, 1960; this group is unique in the phonological and
morphological system of the Rumanian language. Phonetic
and phological research work in Rumania has not exploited
the possibilities latent in mathematical methods as yet.

In the field of vocabulary research, however, de-
velopment of this method has had considerable success.

In Studii al cercetari de lingvistica, No 3, 1959, V. Suteu reports on lexico-statistical work based on 50,000 words of ten authors (including Sadoveanu, Bratescu-Voinesti, Rebreanu and Preda). He establishes that certain very common words are not included in the basic vocabulary list of Al. Graur, which already is in its second edition. Furthermore, some of the words listed in the basic vocabulary (such as muiere) were not observed among the 50,000 words studied. The results corrected by the statistical method comprise a significant advance in the field of examination of the composition of the Rumanian vocabulary. A report of the work of Gh. Bolocan, consisting of a statistical study of journalistic style, is published in the No 1, 1961 issue of the periodical, drawing a parallel to the style of literary works. He establishes the fact that journalistic style is characterized by the majority of neologisms, most of which are of French origin. The ratio of word types also differs from that of literature. In reference to the frequency of occurrance of words in journalistic style he states that 51.06 percent of the words are nouns, 16.6 percent are verbs, and 15.15 percent are adjectives. In literature, 39.65 percent of the words are nouns, 26.05 percent are verbs, and 8.61 percent are adjectives. These findings relative to the Rumanian language are in accord with previous analyses and provide scientific support for the latter. Thus the saying that the good author (such as Liviu Rebreanu) converts all words into verbs may have some basis. Similar analysis of old Rumanian linguistic examples and determination of the vocabulary characteristics of various branches of science enables an interesting historical comparison to be made. V. Pamfil is working on this problem.

Although the statistical method may not be considered as having universal application, especially if the investigator is working on the basis of relatively shallow material, the results achieved to date in the field of lexico-statistics may be considered as a starting point for the frequency-list of words of the Rumanian language, which although a practical necessity, may be considered merely as an idea at the present time. Following publication of the dictionary of literary language of Eminescu the time will be ripe for production of a frequency list of the rich and colored vocabulary of the poetry of Eminescu. This work, requiring great expenditures and considerable equipment, will be greatly aided by the perfected methods of the frequency dictionary of the Russian language now under preparation in Estonia, based on the frequency of occurrence of words in the works of Pushkin.

The special characteristic of the mathematical methods is that they provide a well developed system or method at any given level of the language for description of the relationships between phenomena, as well as for precise determination of the phenomena, themselves. The occurrence of similar relationships and similar units at the various levels of language (phonological, morphological, syntax and semantics) is called isomorphism. It relates to study of the isomorphism of the various levels of language, the relationships between individual elements, and the elements, themselves. Mathematical methods are almost exclusively adapted to description of the relationships, and precise determination of the individual elements also is performed for the most part by mathematical methods. In *Studii si cerce-tari de lingvistica*, No 1, 1959, for example, Em. Vasiliu deals with richness and redundancy, and homology and inter-relationship with respect to the phonological and morphological level of the Rumanian language. Through synchronous and diachronous analysis of linguistic factors he arrives at the conclusion that the analyzed factors are closely connected with the development of the language. The development may lead in the direction of reduction of redundancy elements. Redundancy and economy, however, may be considered as factors in determination of the trend of development of language. Although not entirely in accord with each other, the Czechoslovakian author Bohumil Trnka and the Belgian author Eric Buyssens published thought-provoking and interesting articles on similar problems in the Al. Graur Memorial Edition of 1960 of the aforementioned periodical. With respect to the future outlook of this problem, study of the isomorphism of the Rumanian language would be useful in investigation of Rumanian-Hungarian word borrowing, for example. As mentioned by the Soviet linguist Ye. A. Makayev on several occasions, there is close interrelationship between isomorphism of the language levels and the necessity of the system applied by the borrowing language upon the borrowed word.

Study of the linguistic system by the mathematical method assists determination of the language units on the phonological, morphological, syntactic and semantic levels. The fact that morphological phenomena may be counted and processed statistically indicates that morphology has found its basic unit suitable for computation. Florica Dumitrescu has dealt with words indicating the position of nouns (de-

monstrative pronous and adjectives, adverbs of place, and
interjections). Sorin Stati is working on morphological
homonyms in the greek, latin and czechoslovakian languages.

T. Slama-Cazacu has obtained surprising results in
the study of interrelationships between speech and syntax
through the experimental application of both structural and
statistical methods. This work is described in his work
entitled *Limbaj si context*, 1959. Investigating semantic
units, he arrives at the conclusion that the individual mean-
ings of the word, depending upon corresponding semantic re-
lationships, develop and are strengthened as a flower amidst
favorable surroundings, and wither and fade as soon as their
syntactic relationships fail to bring out the appropriate
meaning.

In the study of the relationship of linguistic phenom-
ena the danger of placing excessive emphasis on the above may
arise, with the result that individual phenomena and elements
are idealistically considered the products and foci of rela-
tionships. The glottochronology of M. Swadesh Nyugaton fell
into this type of trap. Ignoring the typological peculiar-
ities of individual languages and the particular subject of
linguistics, he arbitrarily adopts the formula used in de-
termination of geological strata through the decay of radio-
active elements for determination of the date of separation of
languages lacking written archives. The untenability of
this theory is demonstrated by Istvan Fodor on the basis of
linguistic facts assembled from slavic language materials.
In the 1961 issue of the Linguistic Journal (*Nyelvtudomanyi
Kozlemenyek*) he notes that glottochronology is essentially
the reverse of marrism. The Marrists attempted to explain
the internal laws of development of a language on the basis
of the social changes and history of the population speaking
the language. The unrealistic method of glottochronology
is erroneous (though their results historically may coincide
with results obtained by other means), attempting to draw
conclusions relative to the society and history of the pop-
ulation speaking the language, or the external development
of the language, from data of the internal historical regu-
larities of the linguistic development. In *Studii si cer-
cetari de lingvistica*, No 4, 1959, V. Gutu-Romalo attempts
to establish the date of separation of the Arumanian and
Dakorumanian dialects. Through his glottochronological
method M. Swadesh obtains as his result the 13th Century,
which is diametrically opposed to historical and linguistic

facts. The coefficients suggested by R. Lees and G. A. Klimov yield as a result the 6th to 10th Centuries, which ranges within rather broad limits, and thus is of no great practical value.

Applied Linguistics

The most outstanding domestic achievement in this field is the construction of the MECIPT-1 machine at Temesvar, which automatically translates mathematical text from English to Rumanian. (Its algorithm, the procedures serving resolution of the task and to be executed in a given manner, was described in detail by Erika Domonkos in her July 1962 report before the Mathematical Linguistics Committee.) The text to be translated is transferred in numerical form to punched tape. If a word cannot be found in a form given in the text, the machine store the word in a work slot, after which it converts to a program of elimination of typical endings (-ed, -s, -'s, -s', -ing, -er, -est). If the machine does no find the given word in its 80-word vocabulary, it inserts the untranslated word in the Rumanian text. The so-called "special" words (auxiliary verbs, articles) are not translated by the machine, and are indicated by numbers giving linguistic information. After completing differentiation of linguistic homonyms (such as nouns and adjectives) the machine converts to placing the words in the order required by the syntax of the Rumanian language. Next, the second portion of execution of dispatching, or "withdrawal," occurs. This consists of actual translation, or replacing English words with Rumanian words, and of modifications indicating Rumanian linguistic categories (such as number, gender, person). The last command actuates the keys of an electric typewriter, which types out the translation of the appropriate English word. Thus we have the generalized sequence of: given the English sentence; next step is an abstract series of English words, in English sequence; then we obtain the abstract series of English words in Rumanian sequence; this is followed by an abstract series of Rumanian words, in Rumanian sequence; the last step is the Rumanian sentence.

The practical tasks of machine translation have opened a new field of work, the organization of the mechanical linguistics of the Rumanian written language. Academician Gr. C. Moisil performed pioneering work in this field, with the compilation of the mechanical morphology of conjugation of verbs. The problems of mechanical translation gave P.

Diaconescu the idea for the development of an apparently
new method of description of the declension of nouns, ac-
cording to which all possible value and form combinations of
a word are taken into consideration in its writing. The
mathematical method, however, is limited to use in technical
expressions, as he critically noted in Lupta de clasa.
November 1962, and thus the results are merely mechanical
repetitions of certain conclusions which have been known
since ancient times (such as determination of the cases of
noun declension). These formal and unproductive attempts
are not suitable for popularization of modern methods, and
give the impression that they actually are fruitless.

Theory of Sets, Linguistic Models

The Danish linguist O. Jespersen has dealt with cer-
tain procedures of modern theory of sets in the course of
syntactic analysis, although he calls them by another name.
For example, in his view indefinite numerals differ from
pronouns in that they may not assume a predicative position;
in this way the phrase "the experienced, well trained doctor"
may be rephrased as "this doctor is experienced and well
trained;" however, the phrase "the many doctors" may not be
converted into "these doctors are many." He calls this pro-
cess "transposition." The US structuralists N. Chomsky and
Z Harris, who consider linguistics as the theory of the
structure of language, also employ modifications of this
method in the course of their syntactic analyses, which they
have named "transformation." The Soviet researchers O. S.
Kulagina and A. A. Lyapunov have recommended a meritorious
method for syntactic analysis of language. V. A. Uspenskiy,
Professor of Mathematical Logic of the Moscow Lomonosov Uni-
versity is dealing with problems of the organization of
linguistic models on the basis of the theory of sets; he
fulfilled a very important need of modern linguistics through
his formal determination of the concept of parts of speech.
According to the concept of N. D. Andreyev, Head of the Lab-
oratory of Applied Linguistics of the Leningrad Department
of Philology, combined application of the theory of sets
and probability computation is most effective in the field
of Rumanian linguistics research.

The transformation procedure has outstanding possibil-
ities in respect to the Rumanian language: for example, both
pronouns and indefinite numerals may be predicative (as
predicate auxiliaries). The phrase medici experimentati

instruiti may be transformed as medicii sint experimentati, just as multi medici may be transformed into medicii sint multi.

In addition to the aforementioned, application of the theory of information may be of interest in research on dialects. In drafting the indirect questions of the questionnaires syntactic relationships must be created ensuring as low informative value as possible for the word asked; the more insignificant the strength of the communicant, the more probable is its appearance in the reply. It would be an immeasurable achievement of Rumanian linguistic history if the Yezerovo Ring found in 1912, and containing 61 symbols were to be solved with the application of modern methods. These symbols are in Greek script, and the object probably is Dacian. The text is brief, the words are not separated from each other (scriptio continua), the number of previously known Dacian words is small, and nothing is known of the morphological and syntactical system of the language. Thus, the initial data are considerably less numerous than in the case of the Mayan texts.

In any event, the achievements attained to the present time in Rumanian linguistics with the use of mathematical methods are practical results, or else they are closely connected with practical problems of the language. In addition to the results obtained in the various problem areas and the exploitable possibilities, we must not overlook the shortcomings noted in the issue of Lupta de clasa cited. Criticism is lacking of the theoretical works of current bourgeois linguistic schools, which would reveal their idealistic essence.

Mathematical methods, and problems of the application of the theory of information in linguistics are included as separate plan themes within the cybernetics group of tasks in the development of long-range scientific plans. Both domestic and foreign achievements and results indicate that the role of these methods constantly is increasing in the further development of linguistics, and will serve as helpfull means for linguistics in ever more applications.

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