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MATHEMATICS
BETWEEN

SEMIOSIS
and
COGNITION

REJECT: MATH, EXACT
SCIENCE; MATH OPPOSED TO
HUMANITIES; MATH, STABLE ACROSS
TIME; MATH, STABLE ACROSS DIFFERENT
HUMAN COMMUNITIES (SEE ETHNO-
MATH); MATH PRECISENESS AS A
UNIVERSAL QUALITY

~~MATH~~ IN
OF THINKING: ORDERED; AN
METAPHORICAL; INDUCTIVE; CIR-
-EDUCTIVE, ABDUCTIVE; SPAN
VERSABILISTIC; RECURSIVE; A
Apologetica INFINITE; MET
AND HOPEFUL; SELFREFERRING
ANAPHORIC; CATAPOLETIC;
POLAR; CIRCUMLOCUTIVE; COPR
CONJUGAL PAIRS (OR SETS); SEMIOT
INJUGAL PAIRS; HEIJENBER
RECIPROCAL, TRUTHY, CRITERIAL,
REFLEX, REFLIPIY, SENSIBILITY, S
TO SEE, TO UNDERSTAND, CERTAINITY,
FAITHY, SYNTAX, SEMANTICS, COMPRE

SEMiotics is FULL
OF
CONJUGATE PAIRS

TENSION BETWEEN
INTERPRETANT AND OBJECT
SYNTAX AND SEMANTICS
PROOF AND TRUTH

40 YEARS AGO, i.e., in 1971
I WAS VISITING PROFESSOR
AT THE DEPT. OF MATH,
UNIVERSITY OF TORONTO.

ONE OF MY LECTURES,
HAVING IN AUDIENCE, AMONG
OTHERS, ANATOL RAPORT,
MATH, PSYCHOLOGIST, SOCIAL
SCIENTIST, DANIEL BERLYNE,
PSYCHOLOGIST, AND BARRON
BRAINERD, MATH.

DEVOTE THIS LECTURE
TO MY FORMER AND
THESE COLLEAGUES HERE
AND I WANT TO HONOR THE
MAJOR CONTRIBUTION
RESEARCH IN MET
CATEGORY LAKOFF

MULTIPLE FACES OF MATHEMATICS

BOTH COOPERATIVE AND CONFLIGURAL

FIELD OF KALEIDOSCOPIC PERSPECTIVE

CULTURAL PHENOMENON

IDEAS

DATA

THEORY

LANGUAGE

WAY OF THINKING

CATALOGUE OF SOME TRANSFORMATIONS
OF IDEAS, METHODS, RESULTS

DISCIPLINE TRANSITION

IDEAS, PLEASURES, ETC.

GAMES

FASHION

WAY TO UNDERSTAND THE MEANING
OF LIFE

WAY TO UNDERSTAND ONE'S MIND

MAN'S SKILL, KNOWLEDGE, ETC.

FEELINGS

WAY TO INTERPRET THINGS, FEELINGS

FOR ANYONE

FEELINGS

COMPONENTS OF MATHEMATICAL LANGUAGE

(4)

Both cooperative and conflictual

L ANLAGE

1) NATURAL LANGUAGE IN ITS WRITTEN FORM

2) ELEMENTS OF NAT. L. USED AS ARTIFICIAL SYMBOLS

3) SYMBOLS OTHER THAN THOSE OF NAT. L.

4) EXPLANATION, REASONING, RELATED EQUATIONS FORMED BY MEANS OF 1, 2 & 3 DIFFERENT PICTORIAL REPRESENTATIONS

5) CONTINUOUS PICTORIAL REPRESENTATION

6) LOGIC PROGRAM

7) SYMBOLIC MATHEMATICS

8) TALKING COMPUTER

9) IN SPOKEN COMMUNICATION

WHY IS THE NATURE OF
THE COGNITIVE FUNCTION OF
MATH SO CONTROVERSIAL?
BECAUSE THE FUNDAMENTAL
QUESTION
MATHEMATICS IS
ABOUT WHAT?

REMAINS WITH NO GENERALLY
ACCEPTED ANSWER.

THE PRINCETON COMPANION
TO MATHEMATICS (2008)

DOES NOT TAKE THE RISK
TO PROPOSE A DEFINITION
OF MATH.

MATH IS EQUALLY INVOLVED
IN THE UNDERSTANDING OF THE
UNIVERSE AND IN THE UNDERSTANDING
OF THE ARCHITECTURE OF HUMAN

GOETHE

⑥

DIE MATHEMATIKER SIND
EIN ART FRANZÖSEN:
REDET MAN ZU IHNEN,
SO ÜBERSETZEN SIE ES
IN IHRE SPRACHE, UND
DANN IST ALSOBALD GANZ
ANDERS

THE MATHEMATICIANS ARE LIKE
FRENCH PEOPLE. YOU TELL THEM
SOMETHING, THEY TRANSLATE IT
IN THEIR LANGUAGE AND THINK
BECOME COMPLETELY DIFFERENT.

BUT IS IT NOT UNDERSTANDING?

IN THE WESTERN TRADITION,
LITERATURE APPEARED AT THE TIME
OF HOMER, WHILE MATH CAME
LATER, WITH THALES AND PYTHAGORAS.
THEY BOTH CAN BE CONSIDERED
IN SOME RESPECT, DAUGHTERS OF
THE ANCIENT MYTHS, FROM WHICH
THEY INHERITED:

1. THE SYMBOLIC FUNCTION;

2. A BASIC MEDIATION PROCESS IN
COPING WITH THE REAL LIFE; MYTH,
LITERATURE AND MATH THEY ALL
TAKE PLACE IN A FICTIONAL UNI-
VERSE, WHERE A CERTAIN KIFOR

EXISTS, IMPOSSIBLE IN THE REAL LIFE;

3. THEY ALL TRANSGRESS SOMETIMES
THE LOGIC OF EVERY DAY LIFE (BASED
ON PRINCIPLE OF IDENTITY, NON-CONTRADICTION
AND EXCLUDED MIDDLE);

4. THEY ALL USE WHAT WE CALL TODAY
THE HOLOGRAPHIC PRINCIPLE (DENOTED

THE HOLOGRAPHIC PRINCIPLE
IS A SEMIOTIC PRINCIPLE (8)
SHOWING UNDER WHAT CONDI-
TIONS THE LOCAL CAN BE A SIGN
OF THE GLOBAL, THE PART CAN
BE A SIGN OF THE WHOLE, THE
INSTANTANEOUS CAN BE A SIGN OF
AETERNITY etc. IN THIS RESPECT:

MATHEMATICS IS TO A LARGE
EXTENT A HOLOGRAPHIC (i.e.
A SEMIOTIC) ENTERPRISE, BECAUSE
MOST OF ITS PROBLEMS AND RESULTS
ASK OR ANSWER UNDER WHAT
CONDITIONS THE SMALL FINITE
ACCOUNTS FOR THE LARGE FINITE,
THE FINITE ACCOUNTS FOR THE
INFINITE, THE COUNTABLE ACCOUNTS
FOR THE UNCOUNTABLE INFINITE, THE
LOCAL ACCOUNT FOR THE GLOBAL, THE
PART ACCOUNT FOR THE WHOLE etc.
THE MOST TYPICAL EXAMPLE AND

MYTHS CONNECT ANTHROPOS (THE LOCAL) AND COSMOS (THE GLOBE), EACH OF THEM MIRRORS THE OTHER AND EXPLAINS THE OTHER.

LITERATURE, MAINLY POETRY, AIM, AS WILLIAM BLAKE TELLS US, TO SEE THE WORLD IN A GRAIN OF SOUND / AND ETERNITY IN AN HOUR.

5. THEY ALL HAVE A NEED OF FREEDOM, UNDER THE FORM OF GAME AND PLAY. THE GREEK ETYMOLOGY OF THEATRUM MEANS SPECTACLE. IN WHAT IS MATH (OXFORD UNN. PRESS, 1941-1946) RICHARD COURANT AND HERBERT ROBBINS REFER TO THE THEATRICAL NATURE OF MATH. ANALYSIS, IN ITS E-S INTERPLAY, IN POETRY AND MATH (NEW YORK: THE JOHN DAY COMP., 1929: 175-197), SCOTT BUCHANAN SHOWS HOW ANCIENT GREEK APPLIED TO MATH THE PHENOMENA -E HYBRIS AND NEMESIS STAGED

6. RECOGNIZED FOR LONG TIME AS A BASIC INGREDIENT OF MYTHS AND OF POETRY, METAPHOR RECEIVED ONLY IN THE LAST 40 YEARS THE ATTENTION IT DESERVES IN SCIENCE AND MAINLY IN MATH. AMONG THE SCIENTISTS WITH ESSENTIAL CONTRIBUTIONS IN THIS RESPECT, WE MENTION I. RICHARD, MAX BLACK AND GEORGE LAKOFF. LAKOFF & JOHNSON'S METAPHORS WE LIVE BY DOES NOT REFER EXPLICITLY TO MATH, BUT ITS RELEVANCE IS UNIVERSAL, WHILE LAKOFF & NUÑEZ'S "WHERE MATHEMATICS COMES FROM" HAS METAPHOR AS AN EXPLICIT BASIC TERM OF REFERENCE. THERE IS IN THESE WORKS A RADICAL CHANGE OF PERSPECTIVE, METAPHOR IS NO LONGER REDUCED TO A RIFLETIONAL PROCEDURE, IT IS A WAY TO SEE, TO

AWAKE OF THESE FACTS, EVEN IF
THEY HAD THEIR FEELING. THE MATHE-
MATICIAN STEPHAN BANACH, WHEN
ASKED WHAT QUALITIES MAKE A
MATHEMATICIAN, HE PROPOSED, AS THE
MAIN QUALITY, THE CAPACITY TO
IMAGINE ANALOGIES OF ALL KINDS:
BETWEEN OBJECTS, BETWEEN IDEAS,
BETWEEN THEOREMS, BETWEEN THEORIES
AND... BETWEEN ANALOGIES.

IN MY MATHEMATISCHE KÖSTLICH
FRANKFURT/MAIN: ATHENÄUM 1973, I
PROPOSED TO ORGANIZE METAPHRONI IN
MATH ACCORDING TO THEIR POSITION
AND LEVEL: AT THE INTERFACE OF THE
NATURAL COMPONENT OF MATH. L. WITH THE
NON-MATH. L. (SERIES), AT THE TRANSITION
FROM THE NATURAL INTO THE ARTIF.
COMPONENT ($S \rightarrow \Sigma$), IN THE INTERIOR
OF THE ARTIF. COMPONENT (FROM THE
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DE RE GENTNER: AI - SCIENCE AND

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MANY FIELDS ARE BORN UNDER
THE GUIDANCE OF A METAPHOR 14
THAT DICTATES WHAT PROBLEMS WILL
BE IN ATTENTION, WHAT CONCEPTS AND
METHODS WILL BE USED AND WHAT WILL
BE LEFT ASIDE:

SET THEORY (CANTOR): THE BAG MET.
GENERAL TOPOLOGY: THE EUCLIDEAN SPACE
CATEGORY THEORY: THE ARROW METAPHOR
FUNCTIONAL ANALYSIS: THE MAPPING LIKE
ARGUMENT, NO
CYBERNETICS: THE BLACK BOX METAPHOR

SHANNON'S INF. & COMMUNICATION THEORY:
THE CHANNEL MET.

K. DEUTSCH'S THEORY OF INTERNATIONAL
RELATIONS: THE NERVOUS SYSTEM MET.

COMPUTER SCIENCE: THE BRAIN METAPHOR
MEMBRANE COMPUTING: THE CELL LIKE
COMPUTER METAPHOR

CHOMSKY'S GENERATIVE GRAMMARS:
THE GRAMMAR LIKE MACHINE MET.
AND CFS IN THE FUNCT. MIND OF COMPUTER.

TYPOLOGY OF MATH. METAPHORS

HOMOGENEOUS METAPHORS: IN THE INTERIOR OF THE SAME COMPONENT OF THE MATH. LANGUAGE; OTHERWISE HETEROGENEOUS.

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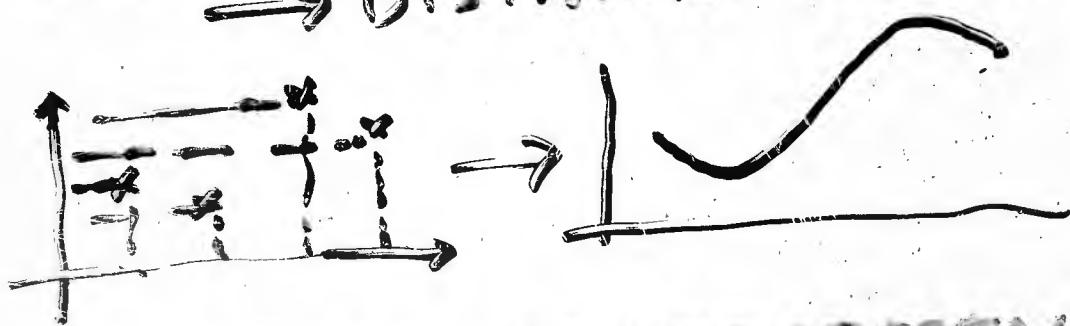
HOMO: SUM \rightarrow SERIES

$$\sum_{i=1}^n a_i \rightarrow \sum_{n \in \mathbb{N}} a_n$$

$$(R) \int_a^b f(x) dx \rightarrow (L) \int_a^b f(x) dx$$

CURVES \rightarrow SURFACES ? SCHWARZ

HETERO: DISTANCE (IN ORDINARY L.)
 \rightarrow DISTANCE (IN MATH)



DIALECTIC SELF-DIFFERENTIAL

METAPHORS: THE PICTURE

WHAT'S CAN BE PICTURED

A) $a + b + \dots + d_n + \dots$ WHAT'S FOR $j_1 + j_2 + \dots + j_n$?

FROM ARCHIMEDES UNTIL 'EULER' AND CAUCHY.

THE PICTURE $\sqrt{2}$ WHAT CAN BE PICTURED AS A NUMBER

THE METAPHORICAL PROCESS BY WHICH WHOLE NUMBERS (INTEGERS) ARE INTRODUCED, STARTING FROM NATURAL NUMBERS

(16)

IN THE SET \mathbb{N} OF NATURAL NUMBERS
WE OBSERVE THAT ANY $p \in \mathbb{N}$ CAN
BE CHARACTERIZED BY ALL PAIRS
 $\langle m, n \rangle$, $m, n \in \mathbb{N}$, $p = n - m$. TWO
ORDERED PAIRS $\langle m, n \rangle$ AND $\langle m', n' \rangle$
NAME THE SAME NATURAL NUMBER
 $n - m = n' - m'$ (1). BUT (1) IS MEANINGFUL IN \mathbb{N} ONLY IF $m \leq n$, $m' \leq n'$.
OTHERWISE, THE EQUATION WITH PINE
DOES NOT HAVE SOLUTION IN \mathbb{N} .

THERE IS HOWEVER THE POSSIBILITY
TO REWRITE (1) UNDER THE FORM

$$n + m' = n' + m \quad (2)$$

AND WE OBSERVE THAT (2) IS MEANINGFUL FOR ANY ORDERED PAIRS $\langle m, n \rangle$ AND $\langle m', n' \rangle$. SO, FROM THE ANALOGY (SEE U.
VALENCE) BETWEEN (1) AND (2) WE GET A
RELATIONSHIP BETWEEN (1) AND (2).

THE METAPHORICAL CAPACITIES
OF THE MATH. TERMINOLOGY AND
OF THE MATH. SYMBOLISM BECAME
RICHER BY THE CONTRIBUTION OF
THE NICOLAS BOURBAKI TREATISE,
IN THE 20TH CENTURY, PERHAPS
THE MOST IMMORTAL MATH. SYNTHESIS
AFTER EUCLIDE'S ELEMENTS. MANY OF
THEIR PROPOSALS WERE ADOPTED BY THE
WHOLE MATH. COMMUNITY; N, Z,
Q, R, C, \emptyset , G (FOR OPEN SET), F
FOR CLOSED SET, M (FOR FIRST
SAKE CATEGORY), KARE FOR NON-DENSE,
COMPACT, PARTIALLY COMPACT, U, n, C, E,
— WITH METAMATH. TRANSLATIONS
 $+ \rightarrow U$, $\cdot \rightarrow ()$, $X \in A$, \rightarrow CARTESIAN
 $U \rightarrow V$, $n \rightarrow \wedge$, $B \rightarrow \exists$

LOCATING THE WORK OF ILLUSTRATION
FOLLOWING STANDARDS: \exists , \wedge , \neg , \dots ; A , B
 $\Sigma = \{x_1, y_1, \dots, z_1, \beta, \dots\}$; μ, ν, π ; $E = \{$

THE METAPHORICAL ITINERARY FROM INTEGERS TO RATIONALS

CONSIDER THE EQUATION

$$(1) \quad ax = b \quad (a, b \text{ in } \mathbb{Z}, a \neq 0)$$

IT HAS THE SAME ROOT AS

$$(1') \quad a'x = b' \quad (a', b' \in \mathbb{Z}, a' \neq 0)$$

IFF a IS A DIVISOR OF b , a' OF b' AND

$$(2) \quad \frac{b}{a} = \frac{b'}{a'}$$

WHICH LEADS TO $(2') \quad a'b = b'a$.

IN CONTRAST WITH (2), WHICH IS
MEANINGFUL ONLY FOR SOME VALUES
OF THE INTEGERS, a, a', b, b' ($a \neq 0, a' \neq 0$)
(2') IS MEANINGFUL FOR ANY VALUES
OF THE INTEGERS $a, a'; b, b'$ ($a \neq 0, a' \neq 0$).

Pairs $\langle a, b \rangle$, $\langle a', b' \rangle$ ARE EQUIVALENT
IF (2') IS SATISFIED. THE RESPECTIVE
EQUIVALENCE CLASSES ARE RATIONAL

NUMBERS AND THEIR SET IS DENOTED

BY \mathbb{Q} . SIMILARLY THE ADDITION

OPERATOR FROM \mathbb{Q} TO \mathbb{Q} IS DENOTED

THERE AN ISOMORPHISM
BETWEEN COGNITIVE MODELS
AND COGNITIVE METAPHORS,
THEY ALL HAVE A CONFUCIAN
NATURE, BECAUSE IF A IS A
MODEL OR METAPHOR OF B,
THEN A SHOULD BE BOTH AS
SIMILAR POSSIBLE TO B AND AS
DIFFERENT AS POSSIBLE FROM B.
THIS FACT EXPLAINS WHY WE
NEED SEVERAL MODELS AND
METAPHORS FOR THE SAME SITUATION.

MATH. LANGUAGE: A VERY HETEROGENEOUS STRUCTURE: NATURAL-ARTIF., COMPUTATIONAL - NONCOMP., LINEAR-POLYDIMENS., DISCRETE-CONTINUOUS, WRITTEN - SPOKEN, VERBAL - NONVERBAL

CONTROVERSY: IS NATURAL LANG THE DOMINANT COMPONENT? ARE ALL THE OTHERS ORGANIZED ACCORD. TO THE ARCHITECTURE OF NAT. L.
DO WE PROCEED VIA WORDS WHEN WE USE ARTIF. COMP.?

REMININD: HISTORY OF LAST 50 YEARS
GAVE AFFIRMATIVE ANSWER FOR MATH LANGUAGES (LISP OF CHEMISTRY, ETC.)
PAUL HALMOS: NEED OF A BALANCE BETWEEN NATURAL AND ARTIF.

QUESTION: ARE WORDS THE ONLY WAY TO EXPRESS MEANING IN MATH?
STILL, OUR LEGIS CONTROVERSY
THAT BEFORIE THE LEGIMACY OF

COMMUNICATION IN MATHEMATICS
REQUIRES THE COLLABORATION OF
A LARGE VARIETY OF CODES. WHAT
WE CALL, BY SIMPLIFICATION, MATH.
LANGUAGE IS IN FACT A VERY COMPLEX
SIGN SYSTEM, WHERE THE METAPHRAXIS
OF POLYPHONY PROPOSED BY BAKHTIN
FOR HUMAN COMM. ACCORDING TO
THE EXAMPLE OF MUSIC, IS BY EXCELLER
VALID FOR MATH. COMMUNICATION.

IN WHAT SENSE IS THE VISUAL
THE PROTAGONIST IN MATH. COMMUNI-
CATION? IF INDUCTIVE INFERENCES
(THE MOST AVAILABLE) AND ABDUCTIVE
INFERENCES (THE MOST CREATIVE) ARE
ESSENTIAL IN THE INTERNAL LABORATORY
OF MATH., DEDUCTIVE INFERENCES
ARE THOSE BY MEANS OF WHICH
MATH CAN BE VALIDATED, BUT THIS
CAN BE DONE ONLY IN THE VISUAL,
WRITTEN FORM OF MATH. COMM. FOR TWO

SO, THERE IS A DISCREPANCY
BETWEEN THE PUBLIC FACE OF MATH
UNDER THE DICTATORSHIP OF 22
DEDUCTIVE INFERENCES, AND ITS
HIDDEN, BUT REAL FACE, INCLUDING
QUESTIONS, DOUBTS, MISTAKES, TRIALS,
FAILURES, INTUITIONS, GUESSES, EXPERI-
MENTS ETC.

IF THE POLICY ADOPTED FOR THE
PUBLIC APPEARANCE OF MATH UNDER
THE FORM OF DEDUCTIONS CAN BE
UNDERSTOOD IN THE CASE OF HIGH
LEVEL RESEARCH JOURNALS, WITH THE
AIM TO MAINLY TO VALIDATE A NEW
MATHEMATICAL RESULT, IT IS NO
LONGER POSSIBLE TO ACCEPT THIS
POLICY IN THE FIELD OF MATHEMATICS
EDUCATION.

SO, WE HAVE TO REJECT THE
TODAY BUREAUCRACY OF MATH
AND MUST MAKE TEACHER-STUDENT

ACCORDING TO I FOR SHAFAREVICH
MATHEMATICS IS LIKE AN ORCHESTRA
BUT ITS DIRECTOR IS ANONYMOUS, INVISI-
SIBLE AND COLLECTIVE, INCLUDING ALL
THE MEMBERS OF THE ORCHESTRA,
AUTHORS CONCOMITANTLY OF THE
PARTITURE. ACCORDING TO ANOTHER
AUTHOR, MATH. COMMUNICATION,
THROUGH ITS MULTIPlicity OF CODES,
IS, LIKE THE FILM, FOR EISENSTEIN,
UNDER THE UMBRELLA OF VERTICAL
MONTAGE.

LET US GO A LITTLE DEEPER
IN THE LIFE OF MATH. SIGN SYSTEM.
IT EXPLOITS ITS INFINITE SYNONYMY,
ANY STATEMENT CAN BE REFORMULATED
IN INFINITELY MANY EQUIVALENT STATE-
MENTS. MATH. PROOFS EXPLOIT USUALLY
THIS FACT, BEGINNING WITH THE HYPOTHESIS
THIS. WE CAN CONTEMPLATE IN THIS WAY
THE RICHNESS OF ANAPHORIC AND CATA-
POGORIC PHENOMENA IN THE MATH DISCOURSE

MANY MATHEMATICAL ADVENTURES HAVE A REMARKABLE NARRATIVE DIMENSION AND ARE FACED WITH DRAMATIC SITUATIONS. EXAMPLES ARE A LOT. ATTEMPTS TO ESTABLISH THE STATUS OF EUCLID'S PARALLEL POSTULATE EXTENDED OVER TWO THOUSAND YEARS, BEFORE LEADING TO THE SURPRISING NON-EUCLIDEAN GEOMETRIES. THIS STORY INCLUDED MANY MISTAKES, FAILURES, DISAPPOINTMENTS. A SIMILAR STORY, EXTENDED OVER SEVERAL HUNDREDS OF YEARS, CONCERNING THE ATTEMPTS TO CONFIRM OR TO INFIRM FERMAT'S LAST THEOREM. RECENT LONG PROOFS OF THE FOUR-COLOR THEOREM, OF KELLER CONJECTURE AND OF POINCARÉ CONJECTURE, OF THE CLASSIFICATION OF FINITE SIMPLE GROUPS WERE IN A SIMILAR SITUATION. ANDRÉ GIDE HAD PERHAPS

TEXTUALITY (RETÓR),
THE DIALOGIC PRINCIPLE
(M. BAKHTIN), INTERTEXTUALITY
(KRISTEVA) ARE AT
HOME IN THE SIGN SYSTEMS
OF MATH, BECAUSE THE
LOCAL-GLOBAL INTERACTIONS
IS STRONGER IN MATH THAN IN
MANY OTHER FIELDS. IN CONTRAST
WITH A BOOK OF (FOR INSTANCE)
GEOGRAPHY, WHERE THE ABSENCE OF
FIRST 20 PAGES MAY NOT DAMAGE
SO MUCH THE UNDERSTANDING OF THE
NEXT PAGES, IN A BOOK OF MATH
THE ABSENCE OF FIRST 20 PAGES
MAY COMPROMISE TO A LARGE
EXTENT, IF NOT TOTALY, THE
UNDERSTANDING OF THE NEXT PAGES.

THE NEED TO TRANSCEND LINEARITY AND SEQUENTIALITY CONSTRAINTS IS VISIBLE IN MANY ASPECTS OF MATH. HYPERTEXTUALITY, DEVELOPED IN THE LAST DECADES IN ARTIF. INTELL. AND COGNITIVE SCIENCE, WITH IMPACT IN BOTH SCIENCE AND THE HUMANITIES, BRINGS THE ANSWER TO SOME NEEDS EXPRESSED FOR LONG TIME IN MATH, IN POETRY ETC.

THE HOLOGRAPHIC PRINCIPLE (Denes Gabor, Nobel Laureate in Physics) LEAD TO THE HYPOTHESIS OF THE HOLOGRAPHIC STRUCTURE OF THE HUMAN BRAIN AND EVEN OF THE UNIVERSE. TO WHAT EXTENT, IN WHICH CONDITIONS CAN THE LATER ACCOUNT FOR THE GLOBAL ASPECT OF A SPECIFIC MIND? SEE THE ASPECT OF A SPECIFIC MIND IN THE MIRROR AND THE FEIER. MATH

(23)

SYNTAX AND SEMANTICS ARE IN MATH
SOMETIMES COOPERATIVE,
OTHER TIMES CONFLICTUAL.

RENE THOM: MERE ACT FOR

LESS MEANING

THERE IS A TENDENCY
TOWARD A MEANING THAT IS
SUCH THAT THE MOST TYPICAL
MATHEMATICAL MEANING
EMERGES FROM SYNTACTIC
ACTIVITIES.