Connes & Changeux

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Conversations on Mind, Matter and Mathematics.
(Jean-Pierre Changeux and Alain Connes)
Princeton University Press.
translated by M.B. DeBevoise.

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Nature of Mathematical objects: (i) Do they exist independently of the human brain. ?
(ii) Which discovers them ?
Only result of Cerebral activity ?

Central Question ↓

* Will it be possible one day to artificially create genuine intelligence out of matter ?

Brain = Net-work of Neurons - extreme Complexity

** Brain is an evolving System. — both in the embryonic Stage and after birth. — Connections of the nerve cells are subject to process of SELECTION. (Darwin's mechanism Contd ?)

Book NEURONAL MAN. ↑

Changeux: Mathematical tools are indispensable for Constructing Rigorous model of brain. function.

Connes: Mathematical objects enjoy greater purity, universal. and independence of Cultural influence.

Mathematical ability localized in Specific area of the brain ? Material Trace ?

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Connes: Mathematics necessary language for the formalization of nearly all other Sciences - quantitative or qualitative?

(Math: the only SELL SIGNS?) like CARS Repaired here

* physicists may use mathematics as a language, but the actual Content of their Science cannot be 'reduced to mathematics alone

physicists → approximations - neglect quantities etc.
↓ (renormalization theory - DOES NOT CORRESPOND
INTUITION. TO ANY PRECISE MATHEMATICAL OBJECT
not (FEYNMAN'S INTEGRAL)
rigorous math.

(Math Language - intended - fit for intuitive Communication?)

* Nature of Mathematical Objects

REALISTS: vs CONSTRUCTIVISTS
(Plato, Dieudonne, Cantor, Descartes)
↓
• Creatures of Reason that exist solely in the mind of mathematicians - not in some platonic Land independent of math.

Connes is a realist.
Mathematicians used thought forces for investigating mathematical reality

• Mathematical Objects Correspond to physical States of our brains
(observe with PET et ??
MRI.

(Do we understand Shakespeare from the Chemistry of the Ink and paper?) by analysing

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- p-adic numbers – No Contact with physical Reality.
- Non-Euclidean Geometry Came not because of physics – but for geometry of Small number of axioms

p-adic numbers

Small number axioms

What proves the Reality of the material world apart from our brain perception of it ? Chirgy COHERENCE OF PERCEPTION.

So it is both MATHEMATICAL REALITY.

CONNES: There exists independently of the human mind a stable and immutable mathematical Reality we have access to it by our human brains. (brain is a only a tool for exploration)

Are mathematical objects then immaterial ?

* Connes : I expressly do not locate it in physical Reality.

Changeux: The existence of mathematical Reality seems to me to be connected with human thought which itself is a product of the evolution of human species.

* knowledge acquisition apparatus = Brain for the Neuroscientist

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Con: Generative property of math. + Coherence
Math Reality differs from partial physical illustrations of math.

- Mathematical Concepts can be Communicated from one Civilization to another if we accept independent Reality of math.
- Reality is defined by Coincidence and permanence of perception by Single individual or Several within a group

Ch: What about Hallucination of Mexican Indians who take hallucinogenic mushrooms and all get the feeling of going to heaven? Mass Hallucination - identical experience - - caused by a type mushrooms

Darwinism of Math objects:

* · Raw mathematical objects differ from mathematical tools devised by mathematicians to understand Reality.
* · In mathematics as in every other disciplines knowledge evolves. but underlying Reality does not change The existence of math Reality independent of perception does not amount to any teleological claim.

Mathematician discovers the "mathesis universalis" MATHESIS UNIVERSALIS

Ch: Can this math world be present in a form other than organization of matter?

* Co: The idea that math Reality is located in physical world is foreign to my way of thinking. What is the relation between the two?

(Knot thing.)

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CO: In physics, every model is revisable and time dependent
- Einstein
- String Theory

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Math and Neurobiology
Hodgkin-Huxley equation

CO: QM — phenomena cannot be explained by reference to hidden variables.

- It is difficult to accept that at the microscopic level - quantum level - there are phenomena that are not reproducible - Nevertheless it is a fact
- What is incomprehensible is that Nature at the Atomic Level is unpredictable.
- Even physico-Chemical Reality is more SUBTLE than it appears threatening to undermine Materialism

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Neuronal Mathematician:

Three phases proposed by Hadamard: preparation, incubation, illumination

Evaluation Function during incubation period

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Godel's theorem:

✓ Logical System is insufficient to describe itself

✓ It is impossible to specify a finite number of axioms such that every question is decidable

✓ The theorem defines a sort of horizon of understanding determined by finite number of choices already made.

** In order to decide that a sequence has attained a certain degree of complexity, a considerably larger degree of complexity is required

⇓

The degree of complexity of Cerebral activity can't be decided by without having at our disposal a sort of Consideraby greater Complexity than brain itself —

What about Multiple Brains?

Maybe.

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Role of Harmony (Harmony)

II

- There exists in the world a pre-established harmony - in this case we live in a Platonic world. or
  We try merely to strengthen the harmonious resonance of the external world by our interior world - a world we build ourselves. ?

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CO: The Universe is atleast as far as we currently understand it is a ~~Universe~~ universe at the beginning of that - that is prior to the Big Bang - TIME HAS NO MEANING. So notion of CAUSALITY disappears

* What is reality in the absence of TIME?
You have to use philosophical tools in order to define what reality is

" I Consider external reality has a sort of intuitive and archaic existence and one understands a piece of it only when by a PROJECTIVE division this piece can be uniquely characterized with respect to the whole
From this point of view mathematical reality can be more firmly grasped than physical reality. ~~Its~~
|| Its existence is comparable to that of physical reality but distinct from it

CO || External ~~Reality~~ Physical Reality is a part of
|| the archaic Mathematical Reality
|| Atleast the two are on the same footing!

No Time, ∴ No CAUSALITY.
Notion of Causality is simply a feature of the math model of U.
(The physical world is a struggle between two main influences - the discrete and the Continuum.

archaic
→ The archaic mathematical reality is something that exists along side the Universe.

CO: It is the Physical U that is inside math & Reality
(physical world inside mathematical reality)

How Continuous becomes discrete

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How Continuous becomes discrete

CO: The physical world is a struggle between two main influences - the discrete and the Continuous.
External reality is the struggle between the loss of information due to ~~friction~~ friction with the outside world - the Continuous physical world on the one hand and on the other the biological phenomena constituted by the duplication ~~duplication~~ of discrete information processing of genetic transmission. They oppose each other

The important progress now being made in understanding the process of biological iteration shows that we can now encode many quite complicated and apparently non-geometric objects found in nature by using very small number of parameters

For example formation of TREES - by Fractals

XX
XY : We have confidence that we shall eventually arrive at a mathematical picture of the outside world that incorporates this genetic component

(even the non-Continuous and discrete)

CH: ∴ even functioning of the brain?
CO: Long way to go
(Arithmetic Site - Regularities in prime numbers)
may lead to understanding GRAVITY

Arithmetic Site — Regularity of prime numbers → Understanding of Gravity

Q's

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① Do Numbers and other mathematical objects enjoy a timeless existence or are they produced by cerebral inventions?

② Do we discover them as Plato supposed and many others have maintained?

③ or do we construct them as Brouwer proposed in the first half of this century prompting Wittgenstein to return to philosophy and occasioning Hardy's famous defence of mathematical platonism in 'A mathematician's apology'?

④ Was Kronecker right in asserting that "God made the integers" all else is work of Man?