A NEW IMAGE OF UNIFIED SCIENCE

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ABSTRACT: "Unification" is a logically controlled reconstruction in an optimized and instrumentable target language. — The synthesis of the axiomatization oriented computer theory and of the functional theory of the human brain by means of a "physical" logic is the instrument for a unification oriented reconstruction on a large scale. This reconstruction is characterized by its physical-metalogical basis and its total reducibility to fired-not fired replies of neurons or to yes-no replies inserted in a "metalogical coordinative schema". A fired-not fired pair within such a schema is the "ultimate" operational element of total reduction. Total reducibility is the basis of total instrumentation — and, (if the brain is regarded as a physically based automaton with total reducibility to fired-not fired patterns) of perfect brain simulation.

The human brain has to be programmed for conceptual problems and the efficiency of its concept generating and transforming operations is dependent on the quality of the programming language.

The present disunified state of science is a consequence of a far-reaching misconditioning which results from the poor programming qualities of the colloquial languages.

To reach a high degree of efficient thought processing the human brain must be reconditioned and reprogrammed by structures approaching isomorphism with the eigencode of the human brain at its optimized state. The "machine language of the human brain" or its "eigencode" is based on patterns made by fired-not fired replies of neurons, whereby each neuron has two physical coordinations: a) to a certain physical 'quality', b) to a subdomain of a structurized memory system. The same may be restated with preference to logic: each neuron generates an elementary argument for a "heterogeneously interpreted polybasic logic" (or in short "physical logic") and the argument is assigned to one of the (basic or derived, isolated or "context-

embedded") *domains* of this logic. This paper intends to draw the attention to a new fact: Unifying factors of decisive importance are inherent in the functions of the human brain at a conceptual level and in the structure of its eigen-code.

In the history of the quest for unification of science we can distinguish three sketchy plans or rather images of unification due to be included in every short historical description:

1. The approach of Descartes putting the emphasis on unified *control* by means of dimensional analytic methods.
2. The great conception of Leibniz suggesting an atomic-molecular method combined with formal logic and a logically based instrumentation, and proposing a control by means of mapping on the arithmetic of primes.
3. The efforts of a few outstanding physicists and logicians of the Vienna Circle resulting in the edition of the "Encyclopedia of Unified Science" consisting of 20 pamphlets. Their hopes to unify science by means of the interaction of formal logics, axiomatics and modern physics could not be materialized.

To-day, we can offer an explanation for the failure of these hopes: the interaction of modern physics (in the years around 1930), with the still young mathematical logic applied at an axiomatic level did not suffice to serve as the basis for unification.

Two further theories of considerable range, that of the computing devices at an axiomatic level and that of the metalogical-functional-reductive approach to the human brain were prerequisites for the development of a sufficiently rich basis for a synthesis. Neither of these theories existed at that time. Moreover, unification presupposes new kinds of instrumentation oriented languages and a new kind of multipronged approach: i.e. a combined physical-logical-brain-functional approach projected to a genetically stratified background (or operational space).

The prerequisite of unification is a very powerful artificial language involving a greatly adaptable physically applied logic.

If we apply a language which is *instrumentation oriented, totally reducible* and *physically based* and able to deal with the *functional theory* of the *humain brain — unification emerges as*

a fact of surprising simplicity, hidden until now by the misconditioning effects of poor linguistics.

The term "linguistics" is used here in the sense as it is used in computer science, e.g. "machine code", "compiler language".

Speaking of unification we must use a *language* capable to deal with many and technically greatly different branches of science, including their internal logic, linguistic arsenal and intercommunicative aspects. It is a preliminary condition of unification to have a greatly task-adaptable language to deal with any required branch of science — as the objects of unification are the various "branches" of well developed and poorly developed scientific disciplines.

The language of unification must be an artificial construct developed for and adapted to such an interdisciplinary or transdisciplinary task.

Now, we introduce one of the dominant characteristics of this language: If we use a language to speak of another language, we speak in a "metalanguage" about an "object language".

If we speak of *several object* languages in a *single* metalanguage, we use a "*common-meta* language".

If we speak in a single meta-language of *several strata,* each encompassing one or more object disciplines and object languages, we use a "*genetically stratifiable common-meta language*".

As the objects of unification, i.e. the various scientific and prescientific disciplines are of greatly different technical and genetic development, it is evident that the language of unification must be such a "genetically stratifiable common-meta language". The range of genetic stratification and with it the range of technical adaptability to the objects must cover a very extended span.

Turning the attention to the conceptual functions of the human brain, at the very beginning we face a fact of axiomatic importance: its neurons are able to generate only fired-not fired replies and *patterns* of such fired-not fired replies or bits of a binary basis. The next fact is the existence and the cooperation of a memory system of a somewhat physical nature having a greatly refined, presumably dynamic-topological, structure. For

a sufficiently abstract approach the pair of replies "fired-not fired" may be replaced by the pair "1,0" or by the less elementary pair "yes-no". To simulate the simplest functions of such neurons, totally abstract automata, in particular "Turing machines" have been developed. Since the first proposal of A. M. Turing in 1936, a new discipline of very considerable corpus, the theory of abstract automata, has been developed and lately unified [1-2-3].

The point is that the algebraic approach to automata goes too far with the process of abstraction. It assumes steps and memory systems of a far too simple structure. It disregards the peculiarities and the functional structure of the memory system of the human brain. This is why neither Turing machines nor the digital computer are able to simulate the functions of the human brain without very great non-algebraic amendments by the programmer. But even the most ingenious programmer is limited and often doomed to failure owing to the inadequacy of the totally abstract algebraic approach.

The central assertion of this paragraph is this: There are other kinds of automata possible: automata generated by 1,0 pairs within a metalogical *schema* for domain coordination of the pair — whereby the domains applied in coordination are structurally interrelated as required by the rules of a "physical logic". Automata of this kind, the "hetero-automata" are able to simulate, apparently without inherent limitations, and at any of its genetic strata, the concept generating and transforming functions of the human brain. Living in a very realistic environment, the human brain cannot afford to stop its functions owing to undecidable problems.

Heter-automata may be regarded as a physical generalization of the Turing machines — but the converse approach seems to have more justification: Turing machines are totally abstracted hetero-automata, reaching a higher degree of generality by sacrificing and eliminating the basic coordinations and restrictions characterising the "physical" basis of hetero-automata.

Now we repeat and reformulate our important assertions:
The human brain in its concept generating and transforming

actions is a physically based *hetero-automaton* of 1,0 replies of single neurons and averages of sets of neurons of equal coordination, whereby each neuron is coordinated to a quality, defined by a "domain" of the physical-topological memory system. The definition of a domain of the memory system includes a reference to a physical quality — which may be a basic or a derived quality — and this coordinated reference is the so-called "physicalization" of the domain whereby each case of physicalization is a local case within the structure or *context* of such physicalizations.

Basic assertion:

Any concept and *system of concepts generable by the human brain is reducible to 1,0 replies of neurons with physical domain connections.* Each such domain is a member of a structural *context* of domains and each context belongs to a genetic stratum. It is possible to give a semi-axiomatic definition for each of these genetic strata.

The basis of the function of the human brain is its relation with that environment which produces the stimuli. This environment is definitely not abstract. This is why we have to start with the assumption that the human brain functions on some kind of physical-relational basis. For the very first approximation only, the basis of brain functions is such a relation of the brain to its environment. But neither "brain", nor "environment" are practicable data, moreover both of them have very far reaching social dependences. What we need are data of simpler, if possible fundamental character and the reduction to a minimum of the influence of any secondary effector like education and programming by language of a poor logical structure.

This is why we chose three kinds of data in our approach to the biological hetero-automaton usually called "the human brain":

1. Data generated by external effectors (or raw input data generated by measurements etc. in the external environment of the brain;

2. The 1,0 replies of real or hypothetical neurons including

their physical back-connection a) to specified "qualities" stated in the form of "domains"; b) to specified allocations within the structure of a system of memory-subdomains (within a "stratum" for such systems);

3. The system of patterns and related rules stored or implanted by teaching in the brain and located in the strata of its memory systems — being today the essential brain-internal materialization of the colloquial language and its logical, semilogical and semantical rules.

For that stratum of the brain which applies concepts, the programming and conditioning agent is the logic and patternology of the colloquial language. For scientific purposes this colloquial language is enriched to various degrees; often the interrelation of a technically enriched colloquial language to a "formal language" is used. But the "text language" (a term coined by P. W. Bridgman) is always a colloquial language, at least from a logical point of view. Unfortunately, even in this restricted task the colloquial language has a misconditioning and limiting effect on the brain. (Semantical barrier).

The central fact remains that there exist heterogeneous sets of external data of physical nature at the — say — right-hand side of a heterogeneous relational *schema,* and patterns of 1,0 replies with qualitative back-connections and equivalent allocations or coordinations to memory-subdomains at the left-hand side. The brain may be regarded 1) as a transforming "black-box" of 1,0 outputs of neurons, or 2) as a structure generated by heterogeneous coordinative relations materialized by the memory structure, as proposed by me. The second proposal is technically far more developed and yields the logical basis for instrumentation. In this approach the black-box is dissolved into coordinative schemata and rules, back-connections to domains defined by standardized physical qualities and to — sequential and context-generating interrelations of basic and derived "domain-qualities".

Now, we want to reformulate the same subject with a strong emphasis on the technique and functions of the human brain at its concept applying level.

The human brain as an instrument has a "machine-eigen-language" or eigen-code. This is a totally reducible code, the single ultimate operational unit "1,0 reply with physical back-connection". This code is subject to a system of restrictions derived from the physical conditions represented by physical domains and their interrelations. Interrelations of domains exist in two variants: a) in the systematization of external data i.e. data generated by external effectors; b) within the structure of the memory system of a given genetic stratum. Depending on the genetic stratum involved, the technical and logical refinement of the reduced structure is very different, and considerably variegated.

Thanks to the physical back-connection affixed to each neuron, the so-called "physical interpretation" of the relatively abstract patterns has been reduced totally to the interrelation of domain-qualities. Only such totally reduced data may be combined with a classical Turing machine to have a "physically generalized Turing machine" or hetero-automaton.

On this background of reduced physical characteristics the human brain works with a technically and methodologically fully unified system.

As a consequence of the structure of the eigen-code of the human brain and its total reduction to physically back-connected digital pairs of most elementary replies -- the functions of concept construction and context generation and transformation are t e c h n i c a l l y, biologically and methodologically u n i f i e d.

It is due to an unfortunate interference by poorly built programming languages that this state of affairs is not immediately evident.

If the brain is able to reduce in a unified manner its interrelation with the external world, there is no reason why this could not be done with the formulations of the various branches of science. This is a task for logicians, computer scientists and engineers in organized teamwork and it can be carried out at least with a high degree of approximation. The task is fairly delineated: We have to construct a sequence of programming

languages to approximate the structure of the eigen-code of the brain, if necessary, by means of several intermediate programming steps. This is an important aspect of the master plan for interdisciplinary unification and instrumented formulation of unified science.

The interrelation of "unification", "brain theory", "total reducibility to 1,0", and "total instrumentation":

Why are we interested when looking for unification in the total reduction by the human brain to binary replies of 'physicalized neurons' and especially in the quite complicated structure of the human memory system ? We are interested in the particulars of its machine logic. If the human brain is a heteroautomaton using as basic constituents 1,0 replies in coordination to domain interrelations, whereby some of these domains incorporate somehow the physicalization of a basic 'physical quality', all we have to find out in order to build efficient brain simulators is the logic of the human memory system. If and only if we have this logic, we may proceed to the next question:

Given the functional structure of the human brain and its memory system, given the logic governing them — how can we *optimize* the functions and the memory system of the human brain ?

If we have an appropriate answer, *we can start to construct concept generating artificial brains.*

This would mean the transition from the age of computers to the age of artificial brains — which is certainly a quite considerable progress of human evolution.

Present-day efforts to simulate the functions of the human brain by means of "artificial intelligences" suffer from a wrong basic assumption. It has been assumed *silently* that to simulate present-day methods of brain application is a laudable objective. But this assumption seems to have misleading effects. Why simulate a brain application which is disunified, fragmentized, misconditioned, if we have better assumptions with reference to totally reducible, physically based, unification generating and optimum oriented applications ?

We need unification because any effort for optimation presupposes a unified state of the subjects. We need the functional

theory of the brain, because it explains the dominant rôle of the structure of the system in its governing effect on binarization.

The study of unification introduces the epistemic recognition: we are dealing with various aspects of a synthesis of grandious structure of convincing simplicity and theoretical elegance. This synthesis starts with the theory of interdisciplinary unification and results in the optimized artificial brain.

In the *context* of this *synthesis* every derived detail is governed by a web of rules most of which are stated at an axiomatic or physically basic level. Any concept generated, any formula derived must comply with this dominant control either immediately or after suitable complementation by "compensating" symbols.

Before closing our train of thoughts on this synthesis of interdisciplinary range, it seems to be appropriate to include a few technical remarks. Until now we did not define here terms like "hetero-automaton" and similar key concepts. Instead of names of accepted algebraic systems, phrases of a popular-intuitive language were used, like "abstractions driven very far" or "neurons supposed to function over a totally abstract basis" and "generating 1,0 replies". Inspite of this non-technical language we tried to emphasize that brain research should not be approached by totally abstract algebraic methods and systems, as this contradicts our synthesis. We do not regard the neuron as an absolutely abstract elementary generator of 1,0 replies so that its functions cannot be described by means of any purely abstract algebraic system.

For our large-scale synthesis the term "algebraic" implies "memory without structural subdivision dependent on the theory of physical interpretations". We emphasize again: what we need is a memory which includes structural compartmentalization as required by the theory of brain-selection and by the theory of physical interpretation. This explains our objection to non-categorically based algebraic structures, like free semigroups, monoids, totally abstract automata, including totally abstract Turing machines. They are very efficient for computers but are unsuitable for efficient brain simulation and for artificial brains.

Our approach includes and supports the basic approach of Warren S. McCulloch — but we are going further. According to McCulloch: a neuron is something physical and to disregard this means to take the wrong way. The neuron cannot be studied from a totally abstract point of view, we should not apply purely abstract algebraic systems to explain this non-abstract neuron [8]. We go further along this path. A neuron is not just "physical": it is physical with a *specified basic quality* of physicalization *predetermining the rules of its physical interpretation.* This is the essential point materialized by the structure and eigenlogic of the artificial memory system and embodied in the topological and anatomical structure of the human brain. The ultimate functional elementary unit of our synthesis is the *schema* of a coordinative relation for basically heterogeneous arguments of which at least one is a physical data [8-9]. This ultimate functional unit can have different interpretations. This is why it can serve as the common unifying outset constituent 1) to a well constructed theory of the functions of natural *and* artificial *brains,* 2) to the theory of *interdisciplinary* unification, 3) for technical devices in engineering based on total reducibility [11]. This ultimate functional unit of reduction is, historically regarded, a schematic simplification of the 'basic coordinative rules' used in the foundation of Physics.

The relation of abstract automata to 'physical' and heteroautomata is this: Both of them have their own kind of ultimate elementary step. The more general case is the ultimate step unit for the physical case. If we disconnect the "back-connections" to physical data and their metalogically defined domains, the remaining variant of the ultimate step is that for the abstract automata, including Turing machines. The schema for the ultimate elementary operational step for physical instruments subsumes — as a specific case generated by means of abstraction — the corresponding schema for *digital* instruments. — The interrelation of various bases met with in technique of abstraction is described in a chapter of the Theory of Interdisciplinary Unification. A brain simulating and unification oriented reconstruction of *context based* systems of concepts cannot be carried out in any other way than by physically adapted Turing

machines controlled by systems of bases and structurized memory systems described by the Theory of Interdisciplinary Unification. *The range of such machines transgresses all the known variants of the semantical barrier.*

The new image of Unified Science is a result of the influence of egineering methods and physical methodology on metalogical research and on some overabstracted ideas developed by computer scientists. "Unified Science" is, evidently, a theoretical construct, but it is of great practical applicability: It is quite probable that its more or less partial embodiments will meet us in the form of a new generation of computing devices for general purpose tasks including surprisingly new ranges of application.

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