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ON GENERAL PURPOSE UNIFYING AUTOMATA

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The Theory of Heteroautomata and its chapter, the Theory of Automata with respect to set theoretical bases, are applications of semigroups generated over the heterogeneous field of theory constructing constituents. A theory is a physical one if at least one physical constituent is present in the set of its basic constituents. Such a set is renamed "heteroset". If a heteroset includes operations required for theory construction, we use for it the term 'agglomerate'. The possible agglomerates are partially ordered into a well stratified "array", interpreted in its totality as a genetic theory with respect to bases for theory construction. Over the same given stratification of bases the following theories were constructed: a) The Generalized Dimensional Analysis; b) the "Genetically Extended Dimensional Analysis" covering the different basis-strata of the genetic array; c) a generalized approach to the Theory of Automata; d) a unifying commonmeta machine-code based on the Theory of Interdisciplinary Unification and suitable to be the machine language for General Purpose Artificial Intelligences. Attention is being directed to the replacement of the current bases and to the subsumptive interrelation of the occuring theories. The solution for the problems of General Purpose Automata has been transferred a) from the set theoretical basis to a physical heterobasis; b) from the usual singular logic to the interrelation of logics with respect to a metaschema for commonmeta logic; c) from unilevel treatment to stratified multilevel treatment.

An automaton, as seen by the present-day theory constructeur, is basically a set of rules with respect to indecomposable ultimate elements, including one for the interconnection of them. We intend to refer to such a totally abstract basis as the "set theoretical basis".

The definition of various mathematical automata by M. Rabin-D. Scott

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and S. Ginsburg are given in principially set-theoretical terms and constituents, like "5-tuples", "states", "free semigroups". As an example we may citate a definition by Ginsburg, given as a 5-tuple:

1) K . . . . . . set of states
2) Σ . . . . . . the input set
3) the next state function δ
4) the "start state" s_0
5) F . . . . . . a subset of K

the automation being a concept $\mathcal{A} = \langle K, \Sigma, \delta, s_0, F \rangle$.

Our first aim is to look for possible generalizations of this kind of concepts by 1) generalizing logic, respc. 1a) its machine-code logic; 2) the basis used for the construction of 5-tuples by replacing it with a basis including physical constituents.

The conceptual content of the term 'automaton' (resp. 'mathematical machine') is the above described 5-tuple including the silently presupposed reference to their context.

This approach is of a very specific kind of abstractedness which has a considerable restricting effect on the development of machines for less abstract tasks. The development of machines over less specific ultimate elements is of great importance from a practical as well as of a theoretical point of view. At the present we have a set-theoretically based machine-theory and there exist huge and exceedingly efficient machines working with respect to this highly specific basis (or with respect to a physically very restricted analogous basis), making programming for non-specific tasks very difficult. A basis related break through which should open a new chapter in the development of instrumentation, is a requirement of great urgency. - History of technology suggests a hint, namely that this could be achieved only by the creation of a more general foundation and methodology. With this remark stored in our human memory we should try to include the just stated aim in a broader framework and look for a basis of theory construction suitable for generating models of the General purpose Heteroautomation (**GPH**), and of the General Purpose Artificial Intelligence (**GPAI**).

What we need to look for are:

1) A more general concept for a physical automaton;
2) The logic for such a concept;
3) The *basis* for such a logic or logics.
4) A methodology governing transition from set theoretically etc. restricted basis to more general bases which means a methodology for *interdisciplinary* criticism and reconstruction. This means, inter alia, a stratification of bases, representing the stratification of the theories constructed on them.

1) to 4) should enable us to construct a machine logic with an isomorphic machine code for the construction of **GPAI** and **GPH**.

This theoretical background, intended for general purpose and physical machines, is found in the *interconnectedness* of the following 3 theories:

A) The Theory of Heteroautomata - which is a generalized theory of set-theoretically based automata as it has been adapted to the requirements of the physical application of logic.

B) The metalogical control theory of physics, called "Dimensional Analysis", as it has been reconstructed by the introduction of the concepts of a Polybasic Logic of N domains and the methods of interpretation by physical systems.

C) The theory for "general purpose applications". - This is a section of the "Theory of Interdisciplinary Unification of Sciences". (See for introduction: "Principles of the Theory of Interdisciplinary Unification of Sciences" forthcoming in *Notre Dame Journal of Formal Logic,* and "A preliminary report on the theory of unification of sciences and its concept transforming automaton", *ibidem,* v. III, pp. 152-166. These two papers deal neither with code methodologies for unification, nor with the retrievable arithmetization of the compound metacode). This theory emphasizes that the unification of the conceptological range for a machine *must precede* the general purpose applicability.

C.1.) The Theory of Interdisciplinary Unification applies a metalogical many-one coordinative *schema* for its so-called "transformative translations" of the disciplines to be unified (called the "unificanda") into a *commonmeta* target system, which is realized, resp. "physicalized" as a commonmeta and compound target code. (For other isomorphic physicalizations see: The Epistemology of the General Purpose Artificial Intelligence. *Cybernetica,* 1963, No. 2).

Explanation of the terms "interdisciplinary", "meta-" and commonmeta-". These metapredicates are used for theory constructing and criticizing activities, i.e. for characteristically external points of view. - The term "interdisciplinary" is an abbreviation for the existential assertion for at least two nonisomorphic disciplines, interconnected relationally by a third discipline, which by itself is suitable to analyze the first two and their interrelation. The third discipline is called "commonmeta-" with respect to the two (or more) others. "Meta-" is a degenerated case of commonmeta for which the n-1 relational schema turned into a 1 - 1 case. (Note: This re-definition of "meta-" and its variants has been accepted in a debate by the constructivistic metalogician Prof. P. Lorenzen (Erlangen)). On a level dealing with whole theories and disciplines, we have to direct our attention to the metalogical *schema* of their interrelations. The schema is the point, the disciplines being arguments, the relation of disciplines an instance for the 'blanks' of the schema. Thus, the two mentioned disciplines are, *with respect to the commonmeta schema,* "object-" arguments (resp. argumental instances) - but if the schema is being used for unificative purposes, the object-disciplines turn into unificanda. "Commonmeta-" refers to such many-one relational schema with n nonisomorphic unificanda. For this schema the iterability of the type level of its arguments and instances is generally presupposed.

If D_a and D_b are the two unificanda-disciplines and if their coordination in the form of a relation is $\mathsf{D}_a\ .Z.\ \mathsf{D}_b$ and if this relation is an instance for the relational schema $---.\bar{Z}.--- = |Z|$ we may use the term "inter-disciplinary". Nothing refers yet to unificative activities. If the subscript '$_{n,\,.\,.\,,1}$' stands for the many-oneness of the relational form, written as $Z_{n,\,.\,.\,,1}$' no constituent is included yet which would turn the relational schema into a metarelational one excluding the metameta-, metameta-meta-, . . . infinite regress. An artificial rule for the construction of 'zero-type converging' or 'real meta-relations' will be expressed by the affixed type-operator T with a negative integer as power: T^{-r}.

Within a well defined genetic stratum of theories a many-one real meta schema $---.Z_{n,\,.\,.\,,1}.---$ could be used for unification. But the unificanda are of very different genetic levels, so that we need a far richer structure for interdisciplinary unification than the just described one.

"Interdisciplinary relation" and "Translation" with respect to the axiom of semantics. A greatly specific case of the schematized constellation described has an "interdisciplinary" one, is the schema with the name "translation". We intend to explain this in view of a polybasic meta-language. If we want to use a precise parlance we should say instead of "translation" "the metalogical schema for operations called 'translation'", or "the instance for the metalogical schema" abbreviated to the term "translation". One should be aware of the disturbing effect of the existence of different modes of speaking, like: a) the operationally emphasized one - representing it as a sequence of operations; b) the subject-emphasizing one, coining the subject "translation" c) the metalogical one stating that "translation" is the *name* for a schema, the name being just an abbreviation, the schema being the vehicle of the metalogical content. - To put the emphasis on a certain parlance - then to transfer this emphasis to a second kind of it is not yet a translation. It is just a domain-internal rearrangement of emphasis, usually combined with slight difference of genetic strata. "Interdisciplinary" asserts the existence of at least two disciplines, not excluding some interconnections - but nothing more. "Translation" is the name for the schema of the concatenation of two elementary metalogical two-domain schemata by one of their domains.

Here we need an explanation. - This schema is very suitable for the first introduction to polybasic thinking, being a comparatively very simple two basic specific case of applied polybasic logic. Let us restate that "semantics" is the current name for the linguistically applied two-basic logic. (Note: sometimes we have to write down the number of bases for a polybasic constellation. We use for it an elevated prefix, e.g. ${}^2\mathsf{L}$. If we have to express a stratification of bases, we use a prefix like ${}_i\mathsf{L}$.)

The polybasic axiom for semantics, treated as a two-dominal specific case (with C for any syntactical constituent, I for any constituent representing interpretative content of sufficient invariance, L for "derived domain" generated by the coordination of basic domains, T^x for type-level operator prescribing an elevation by x levels with respect to an artificial hierarchy given in advance) will be:

$$C.T^x : Z_{1,1} : \mathsf{I}.T^x = \mathsf{L}.T^x$$

being an instance for the metalogical schema of domain-coordination

$$\ldots\ldots Z_{1,1}.\ \text{---}\ .=.\ —\ —\ —$$

This could be complemented by a prefix stating the stratum of a genetic stratification, e.g. '*i*' for a general stratum, '*a*' for a high stratum. The subscript '*b*' may be added to individualize the case.

$${}_iC_b.T^x : Z_{1,1} : {}_i\mathsf{I}_b.T^x = {}_i\mathsf{L}_b.T^x$$

x is, by hypothesis, practically equal for the three occurrences. For $x = 1,2,3,4, \ldots$ a tripartite table of the key concepts of an artificially reconstructed semantics is the result. We regard any hierarchy of types as a partial arithmetization of the sequence of theory constructing operations restricted to the basic level of the hierarchy. This arithmetization is the key to the instrumental re-edition of the range of the hierarchy. ${}_iC$ being the syntactic system, ${}_i\mathsf{I}$ the system of interpretations of a corresponding type level, ${}_i\mathsf{L}$ is the definition of the i-th level language.

The schema for translation of the linguistic system L_b into L_d presupposes nearly equal genetic strata '*i*'. As soon as the genetic strata are greatly different, translation must very strongly be supplemented by reconstructive activities so that the unquantified term ought not to be applied!

In the case of "translation" of L_b into L_d we face the requirement: concatenate $C_b.Z_{1,1}.\mathsf{I}_b$ to $C_d.Z._{1,1}.\mathsf{I}_d$ under the condition that I_b should remain the same, or as far as possible unchanged, in its new task as I_d. Metalogically it means that (with $\overline{Z}$ for Z-converse)

$${}_i\mathsf{L}_b = {}_iC_b\ .Z_{1,1}.\ {}_i\mathsf{I}_b \qquad \text{and} \qquad {}_i\mathsf{L}_d = {}_i\mathsf{I}_d\ .\overline{Z}_{1,1}.\ {}_iC_d$$

should both be instances of a section of the concatenated schema: ('|' for concatenation)

$$\ldots{}_b.Z_{1,1}.(\text{---}_b\ .|.\ \text{---}_d).\overline{Z}_{1,1}.\ \ldots{}_d$$

If ---_b practically equals ---_d, it may be written once and as $\text{---}_{(b=d)}$ or even without suffixes.

$$\ldots{}_b\ .Z_{1,1}.\ \text{---}_{(b=d)}\ .\overline{Z}_{1,1}.\ \ldots{}_d$$

is the essence of the compound schema for the operation "translation". Now, $—\ —\ —_b$ and $—\ —\ —_d$ are the same blank just with different arguments indicated, as long as the prefix '*i*' may be regarded valid for the whole schema, we may complete the above to

$${}_i—\ —\ —_b = {}_i(\ldots{}_b.Z_{1,1}.\ \text{---}_{(b=d)}.\ \overline{Z}_{1,1}.\ldots{}_d) = {}_i—\ —\ —_d$$

The question, how long may L_b and L_d be regarded as arguments with the same prefix '*i*' for the same blank introduces new problems. The first tentative answer is the following: as long as both of them may be constructed using the same, or practically the same basis, (whereby we regard as 'a basis for theory construction' an 'agglomerate of theory constructing constituents'). For an exact language its C-domain is an algebraic system with derivability; for any less exact language we have to look for the totality of phrase-structures which may be constructed. But according to the above axiom for semantics, these phrase-structures and their tree figures cannot be represented in a single plan, but only in 3 planes, with one for each of the 3 domains. For languages not fully exact the problem has to be solved on a type level of a simpler structure not requiring complicated phrase structures and allowing for an easy recognition of the constituents.

Translation versus transformation. Let us suppose that a concept of the i-th genetic level, that is, constructed over the i-th basic agglomerate of all kinds of theory constructing constituents, is

$${}_i\mathsf{L}.T^\circ = {}_i\mathsf{L}, \qquad T^\circ \text{ being the unity.}$$

Let us further suppose that ${}_i\mathsf{L} = {}_i i_{1,2,\ldots,k} \cdot\hat{+}\cdot {}_i i_{k+1,\ldots,m}$.

This $i_{1,2,\ldots,k}$ is the kernel of the concept at the i-th level, the others being just complementary constituents (as long as the nonexistence of a redundancy has not been proved.)

If the same concept is presented at different genetic levels of the technique of presentation, its kernel must remain principally constant. Thus if we face the same concept on a higher technical stratum of theory construction with a more appropriate heteroset of basic constituents, we find the same kernel, stated by somewhat better defined, but nevertheless identical constituents with a new and better built complementary heteroset, resp, sub-agglomerate.

The same concept re-edited on the a-prefixed level will be the former kernel (with secondary refinements neglected here) with a new, a-prefixed complementary sub-agglomerate ${}_a i_{k+1,k+2,\ldots,n}$. As an agglomerate includes elements, operational rules, coördinative definitions, etc., etc., we may not use for it Boolean operations like union, intersection and for the time being use for additive operations "$\hat{+}$" and for its converse "$\hat{-}$", for multiplicative ones a slightly elevated dot '$\cdot$'.

Supposing that the stratification of bases exists and the transition from the n-th to the $n+1$ -the stratum may be expressed symbolically by the operator (i) of r levels by $r\cdot(i)$, the elevation of the stratum of ${}_i\mathsf{L}$ to ${}_a\mathsf{L}$ being expressed as $r\cdot(i)\cdot{}_i\mathsf{L}$, this symbolic expression will be equalled by the total heteroset of its constituents on the i-th stratum, but as far only as they interlay to generate the kernel, complemented by the a-stratum complementary sub-agglomerate, resp, sub-heteroset over the same.

Now, as theory construers work usually in a semantically concentrated metalinguistic level, the above exchange of complementary sub-heterosets may be carried out over the '---' blank-domain. He actually applies the schemata of semantics in a methodologically iterated way. Therefore we write the operation in terms of the domain for I (systems of interpretations).

$${}_i\mathsf{I} = {}_i\mathsf{I}_{1,\ldots,k} \cdot\hat{+}\cdot {}_i\mathsf{I}_{k+1,\ldots,m} \quad \text{is the argument for } {}_i\text{---} \;;$$

$${}_a\mathsf{I} = {}_a\mathsf{I}_{1,\ldots,k} \cdot+\cdot {}_a\mathsf{I}_{k+1,\ldots,n} \text{ is the argument for } {}_a\text{---} \;;$$

$${}_a\mathsf{I} = {}_i\mathsf{I}_{1,\ldots,k} \cdot+\cdot {}_a\mathsf{I}_{k+1,\ldots,n} \text{ as } {}_i\mathsf{I}_{1,\ldots,k} \approx {}_a\mathsf{I}_{1,\ldots,k}$$

and with it ${}_{i}{-}{-}{-} \approx {}_{a}{-}{-}{-}$ at least as far as the range of the kernel reaches.

The replacement of ${}_{i}\mathsf{I}_{k+1, \ldots, m}$ by $\mathsf{I}_{k+1, \ldots, n}$ with another prefix with respect to a nearly unchanged kernel, followed by the refinements required by the new context, is an operation we want to call "transformative translation". Its componental term 'translation' is justified by the unchanged I-kernel.

The concept of "text". The relative size of the kernel to the complementing heteroset is of considerable importance. In the previous paragraph the kernel has been the larger of the two and with respect to its comparative invariance the elevation of the genetic stratum has been carried out by reconstructive operations. Another kind of kernel is the one which is smaller than the complementing heteroset, but still suitable for the dash-blank as I-argument. Such a kind of smaller kernel, with some variability on its restriction, is the interconnecting "context" for a *text.*

The content-based schema-interconnection, called "text" is a (repeated) concatenation of two or more *propositions* (and in an indirect way only, of sentences). The terms "proposition" and "sentence" are used here as by R. Carnap in his 'Introduction to Semantics': 'proposition' may be an argument for '---', 'sentence' for a '— — —'. If the kernel set is I_k and the complement I_c, the condition for transformative translation is $\mathsf{I}_k > \mathsf{I}_c$ and for the textual concatenation $\mathsf{I}_k < \mathsf{I}_c$. The type-levels for "concept" and "proposition" are different - that for "proposition" being fixed, for "concept" being either undefined or variable.

Conclusion: Metalogically applied domain-connection schemata are, in general, physicalized in a way which is independent of type-levels, but nevertheless the relative size of the concatenating heterosets of constituents is of real importance: a) total heteroset as the concatenating member stands for translation; b) a fixed and 'larger then the complement' kind kernel, with an exchange of the complement and reconstruction stands for transformative translation; c) smaller than the complement and not fixed kernels are used for the kind of content concatenation for a text.

On the preceding pages we explained the terms "meta-", "common-meta" as names for metalogical schemata of domain-interrelations, then "translation" as the concatenation by a single common domain of two two-domain schemata. "Transformative translation" is a concatenation by a partial argument restricting the range of the common domain and followed by the exchange of the original complement for one taken from a higher genetic level. This opens a new chapter: that of the stratification of possible systems from a logical point of view. - Now we want to follow the path by

a) inserting the concept of transformative translation as instance into the metalogical schema of many-one metarelation;

b) introduce a stratification into logic and its systems of interpretations;

c) extend the range of the N object domains of the many-one meta schema over the different strata, turning it by doing so into a commonmeta schema with respect to N different object strata.

Prof. Leo Apostel emphasized the importance of a multilevel-logic. What we need for our purposes, is illustrated by the transformative translation: a stratification with a method of stratum transition in both directions of the array of strata with a distinguished stratum (or subarray of strata) which could serve as a commonmeta - target stratum for all the transformative translations we intend to carry out.

The first point is to clear what could in a technically and logically compact manner represent a stratum. For exact, resp. well formed calculusses, $_aC$, the system of axioms and basic rules is doing this task. But how to deal with not axiomatized and poorly developed systems? Once more the age honored idea of unification gives us a viable hint. Unification of poorly developed branches of science should be combined with their transformative translation into a genetically high target level. Let us, therefore, start with highly developed targets, at least for orientation.

Unification is aimed at a well reconstructedness or well constructedness. We regard this metapredicate as physical and as a counterpart of the logical metapredicate "well formed". Well formed calculusses only have a context suitable for instrumentalization. "Well constructed" is the best possible approximation within a physical context to "well formed" in the corresponding logical context. Transformative translation into well formed and well constructed strata is, therefore, *a condition of instrumentation!* If this is so, the problem of multistrata-logic, which may be renamed "genetic approach" is a practical one.

Obviously, the only acceptable outset for the construction of a theory with genetic stratification is its upper limit stratum and its approximations represented by the most developed physical theories. If this is the case, we have to build our theory just in the opposite direction as is usual in biology by setting out from the highest stratum and its environment and try to construct lower strata by loosening the context and cancelling, one by one, key constituents. This cannot be done in a formal system, but if starting with a physically interpreted system, the reconstruction results in something not unsimilar to the logically well grasped system of genetically ordered taxonomy for biology. For both cases, constituents generating a wider range or having a farther reaching genetic influence are responsible for broader genetic subdivisions, those of a lesser range for secondary ones.

The point is that the calculus is an external target and being an axiomatized derivative system, it exhibits features not prevalent in the array of strata which ought to represent an array with some convergence to it. We have, therefore, to use as outsets for a genetic array construction - or reconstruction as it is - highly developed systems of applied physics within the whole context of their appliedness. This context includes several calculusses for more local tasks. In view of this, the concept of "methodology" on a level for which complete calculusses are inserted not unlike arguments, enters the picture. As calculusses and systems of interpretations are regarded as units to be inserted into a more general framework, the point of view given by the many-one commonmeta relation comes into focus. Together with "commonmeta" the terminology for unification has definite advantages.

Several sections of the desiderandum described above, the genetic array of strata, could be reconstructed by collecting their respective basic constituents - or whatever is apt to take over the task of them on low genetic levels. They are good enough to serve as the physical basis for the construction of a general theory for the genetic array of strata. (We prefer the term "array" to "sequence" or "tree figure" as it has no silent references.)

We start by assigning to the well formed and with a good approximation well constructed systems, resp. to their representanting heteroset of basic constituents the highest strata of the array. Such systems have a closed context of deductibility. Where deductive rules and more than the mere outsets of a deductive system could not be detected, we look for "constructibility" from the constituents making up a heteroset with respect to a basic agglomerate. This is actually the case with all the nonexact unificanda. These constituents are regarded as representing the range of constructibility in a somewhat analogous way to the representation of the range of an axiomatized system by its axioms and basic rules and by pinpointing the place of the system within a polybasis logic.

The construction of the genetic array goes on with the decomposition of supposedly stratum-characteristic systems into their constituents. We should emphasize here that the term 'constituent' is being used here in a very general manner and on a very high level of theory criticism. We ascribe the task to be a constituent to very different constructs of greatly different type levels and fix only the details of the "basic constituents" amongst them. E.g., the schema used for the interrelation of two branches of precise science may be regarded as a constituent in spite of the fact that schemata are, in general, reserved for argumentally inserted instances of the type levels for formulas. The next step is to look for the reduction of the constituents to the agglomerate of the *basic constituents.* This is followed by attempt to arrange the agglomerates into an approximation of an order, based on the maximal reach or range of the most important constituents present in the agglomerate.

The presence or absence of certain specified constituents of a great range with respect to theory construction is metalogically interpreted by us as the manifestation of the presence of different strata of the array of genetic development. We do not suppose that this array is monolinea. In consequence of the above, we arrive at a (not totally artificial) genetic method simulating stratification, expressed by the "array of basic agglomerates of constituents".

This constructivistic frame for the organization of the real and potential bases turns out to be a very powerful instrument of orientation for theory construction as well as for the unification as the prelude for instrumentation - and in an emphasized way, for the instrumentation for general purpose machines. - This stratification of theory bases exploits the refinements yielded by the polybasic logic, as it relegates the classical single-casic approach a) to the underdeveloped sections of the array, b) the single basis occurring on a well formed level within the polybasic more general constellation to a detailedly defined specific case (the vacuogeneous domain) on the highest possible of the strata.

The meaning of the term "general purpose". The precise meaning of this term is in its being an abbreviation for the following two long sentences: The general basis of theory construction for theories (or for the generating activities for heterosets of the automaton intended for similar purposes) is the ordered array of basic agglomerates. The possibility of the elevation of the content of any of the strata to a good approximation of well constructedness is given by the schema for transformative translation along this array. Well reconstructed results of the transformative translation are subjects of the unified field and in view of the array any unificandum may be transformatively translated into this unified field.

A more detailed meaning of the term "Unification for instrumentation". Unification is a theory reconstructive operation according to the commonmeta-schema. The reconstruction is being carried out in the highest strata for the commonmeta domain. The steps preparatory to the final reconstruction are governed by the transformative translation schema with respect to the array of basic agglomerates, opening up the range for general purposedness. A code in the commonmeta domain is used as the target code for the reconstruction combined with encoding of all the greatly diverse unificanda taken from the different strata of the array of basic agglomerates.

The hig-stratum unificanda themselves may be encoded by the unifying target code: for this case no elevation of stratum is necessary.

Now we want to shift the emphasis from concepts to be unified, resp. prepared for instrumentation for the **GPAI,** to *methodologies.* Methodologies reprêsent a much higher level of type with respect to the metatechnical hierarchy used by the constructeur of theories.

We want to exclude by convention the term "methodology" from the range of definition of the term "concept". We delimitate the range for "concept" up to the type level of interpreted calculusses with respect to a polybasis with an N-domain system of interpretation on any genetic stratum or sub-array.

Instrumentalizable concepts and instrumentalizable methodologies. Unification, being a kind of preparation for general purpose programming, is decisive for the instrumentation of concepts, their conceptological context and framerange as well as of methodologies. Methodologies are very high type level schemata for which the interpreted calculus is just like an argument and operations involving it in its totality are like instances.

With respect to methodologies we intend to use, instead of "formalization" the term *"schematization".* This schematization of methodologies is to be subject to restrictions imposed by the requirement of unification under the condition that from unifiedness should follow the possibility of easy instrumentation. The unifying schematization of methodologies is their reconstruction from the - already mentioned - "elementary metalogical coordinative schema" variants:

1) $---.Z. \ldots = (Z)$ 1a) $\ldots .\overline{Z}. --- = (\overline{Z})$
2) $(---.Z. \ldots).Z'. (\ldots .Z. ---) = [Z']$
3) $---.Z.--- = [Z]$

and the purely formal (vacuogeneous) counterpart of 1)

4) $\ldots .S. \ldots = (S)$

The steps for reconstruction are: coordinations; inserting a (Z) or (S) as argument into a domain-blank, called "subordination"; and concatenation by means of a common domain-blank.

The main thesis for the schematization of methodologies: Any well constructed methodological schema is constructed by repeated application of the elementary metalogical coordinative schemata (Z) and (S) and their variants and has, as its core, a closed ring generated by direct and converse concatenations of the elementary schemata.

A core ring is a repeated concatenative schema returning after several such steps to one outset domain-blank.

The above principle for well constructed methodologies, (actually for well schematized methodologies) is valid for automata and heteroautomata as well as for **GPAI**-s. Methodologies-bound terms, like e.g. "evaluation", "decision", "control", "deontic-logic" refer to methodological schemata with (at least) *two* such rings, the second 'over-riding' by type-level reducing concatenation (as required by a real meta relational schema) with respect to the first one. The inductive method and some of the methods applying probability concepts use, in addition to the two core-rings, the *alternation* of the occurring bases (together with their stratum) of their methodological core-rings. This is a principal point for the understanding of such methods and methodologies and no real progress may be hoped for without the elucidation of the interplay of alternating bases along the methodological schema.

In other words: the genetic approach, represented by the array of basic agglomerates, must be extended to schemata of methodologies as well. Therefore, the thoroughgoing systematization of the possible bases with respect to a polybasic logic and an array of agglomerates is a most important tool for the elucidation of bases and ranges of any instrumentation and the key for the construction of general purpose instruments.

Let us draw the attention of the unifying effect of the main thesis for the schematization of methodologies. It has a farther reach than required by instrumentation, it has a great epistemic importance. (S) is the identity element of the vacuogeneous (i.e. purely formal) polybasic logic. A degenerative case of this $(S) = \ldots .S. \ldots$, reduced to a single blank for a vacuodomain, namely '. . .' is the *empty class* concept of the set theory: the ultimate element, starting by which the whole of mathematics may be generated by constructive steps. Thus, our claim for the totality of well constructed and instrumentable unified science is just a generalization of a well known basic assertion for mathematics. No such claims could be upheld for the not-well constructed branches of science. But "well constructed under the auspices of the Theory of Interdisciplinary Unification" is *equivalent* to "instrumentable" and to "generated by using the (Z) schema and its variants with respect to the target level of unification".

Unification, constructivability and *Instrumentability* are different facets of the same scientific constellation. They refer to emphasized aspects, characteristic elements of "modes of speaking", whereby such modes of speaking are slightly different semantic models of the basically nearly identic structural situation. In a more technical mode of expression: Given a stratification of real and postulated bases for theory construction and a heterogeneously applied polybasic logic, they are different variants of the principally same metasemantical model.

A considerable synthesis is the outstanding characteristicum of the above results. It is evident that they could not have been asserted without previous experiences with a machine-code demonstrating on paper and pencil operations the functioning of instrumentalized unification.

This directs our attention to the already existing application of the heterogeneously applied polybasic logic. This is the already mentioned control method of Physics, a metalogical method with a very considerable unifying capacity (as emphasized by Prof. R. Harré, Oxford): the Dimensional Analysis.

As soon as we bring Dimensional Analysis into the context of our discourse, we have to shift the emphasis and point at the new, more general basis of the enlarged context: the basis for the stratified heterogeneous polybasic logic, SHPL. The reduction to a common basis is a classical method for unification and had not to be detailed in this paper, the more so as it is not a metalogical method and is always restricted to the range of derivability of the common basis. We look for the constructivability of accepted theories from bases being members of the array of SHPL-bases and the precise place of their strata within this array. The strata are constructivistically interconnected by the theory of the transformative translation so that they are tools for unification. The reduction to such an array is a weaker method of far greater range and applicability.

Remarks on Dimensional Analysis.

A) Dimensional Analysis is an extremely compact application of 2 to 5 basic domains with a separate physicalization for each of them. The physicalizators are incompatibles. A physicalizator may be a basic or a derived one, but the condition of incompatibility covers all of them. Derived physicalizations are constructed, after arithmetization, by means of a single operation and are presented as products of powers of the arithmetized and physicalized basic units.

A.1) This incompatibility of physicalizators is reflected by the rule excluding additive operations between elements taken from domains of different basic or derived physicalizations. This rule remains valid after the *commonmeta-arithmetization* of all the domains. This commonmeta arithmetization, combined with securing the independence of the numerical value of the measurement result from changes of the sizes for basic units, is a characteristic partial method for Dimensional Analysis.

B) In spite of its compactness - it is the outstanding control instrument of Physical Theory and Engineering. This control has at the same time a powerful unifying effect.

C) Its backbone is a methodological schema of which the many-one valued meta-relation, preparing for arithmetization, is the constituent responsible for the great unifying effect.

D) The schema allows for a certain variability of instances so that different isomorphic models and applications are possible.

E) Its methodological schema covers the high and highest strata of the array of basic agglomerates, resp. of SHPL. The methodological schema is constructed over at least two different basic strata forming over these alternating bases a closed methodological core-ring with a superimposed mathematical ring for the deductive "partial methodology".

F) The main hypothesis of the applied methodological schema of Dimensional Analysis may be stated as:

The coordinated interrelation of physicalized basic domains, (represented by 'basic units') serve as the fundament of a deductive system, in which for any 'deducted connection of symbols' a 'deducted physicalization' exists - and vice versa and in a one-one coordination.

The methodology of Dimensional Analysis is a combined physical - mathematical - metalogical one based on a heterogeneously interpreted polybasis applied within the meta domain of a many-one metarelational schema. But it is restricted to the high and highest strata of SHPL. This constellation is the basis to generate the "heterogeneous N-tuples" for heteroautomata - and if the N-tuple elements are taken from all the strata of the constituents and their complements, this far broader basis is used to generate the N-tuples for the General Purpose Artificial Intelligence.

With respect to Modern Physics and indeterminability, the comparison of the two following theses enlightens the point:

Thesis A. The Dimensional Analysis of classical physics uses hetero-N-tuples over a polybasis with 3 to 5 incompatible basic physicalizators and commonmeta arithmetization combined with a local method for the invariance of the numerical value and the designatum of the results of measurements.

Thesis B. Modern Physics uses the *relational value* of a relation of ultimate measurements (while the single components of the relation remain indeterminable) as a *single-domain* physicalizator for a pair of basic domains.

Comparison of methodological constituents of Dimensional Analysis and Automata Theory. - The methodology of the first is restricted, as stated above, to the high and highest physical and vacuogeneous strata; the methodology of the Automata Theory is far more restricted: viz. to the highest, non-physical, i.e. vacuogeneous stratum with its possible secondary internal substratification.

Both of them are generating semigroups, the first according to the more general (Z) elementary schema, the second according to the (S) schema. By repeated steps of abstraction, (S) may be constructed by starting with (Z), so that we regard (S) as a specific case of (Z).

Now, we interpret the generating operation (Z) as an instruction for theory construction with respect to the sequence of steps for theory construction. We call it therefore "*simultaneous consideration*" and regard it as more general than the juxtaposition, 5-tuple generation, etc. of the automata theory. It is general enough for physical theories and for heterotuples. It may be used even if we have to replace semigroups by groupoids.

Going on with the comparison without entering into technical subtilities we may give the relevant definitions in the following juxtaposition:

A) A *heteroautomaton* is an N-heterotuple over the SHPL array of basic agglomerates of methodology and concept constructing constituents occurring within the framework of a methodological schema with

a) physicalizator-coordinations in interrelation,

b) a basic methodology represented by a closed ring and extending at least over two strata with 'basic alternation'.

c) a superimposed secondary methodological ring, closed for tasks like verification, evaluation, decision. This secondary ring is "meta-" with respect to the basic one.

B) A mathematical finite *automaton* is a 5-tuple, as detailed in the introduction. But this definition ought to be completed along the line set out for A), i.e. a), b) and c) could be included as identity cases. This would turn the 5-tuple into an 8-tuple. c) has been realized technically by internal control devices for modern machines.

The mathematical automaton is restricted to the highest stratum and to the vacuodomain. A methodological ring may be constructed for it in spite of these restrictions.

A similar relation exists between Dimensional Analysis and what we intend to call "Generalized Dimensional Analysis".

Standard Dimensional Analysis is constructed over the highest physical and vacuogeneous strata. If we extend the range of the bases for its methodology along the array of SHPL, retaining the core of the dimensional methodology, we arrive at a more general more diversified, but less precise and less efficient method. We actually do not need a less efficient method. It may be used for the preparation of unificanda in their translation combined with stratum-elevation. Its real importance is its capacity to explain the general background for the functioning of the Dimensional Analysis on the higher strata.

The first point to be clarified is the situatedness of Dimensional Analysis with respect to or within the genetic stratification. Whatever this stratification may be, Dimensional Analysis must represent a very high physical stratum. This is why a) its methodological application, b) its structure and c) its constituents are giving us good hints for our constructive activities aimed at a complete stratification.

Somewhere at the lower sections of a complete stratification the colloquial languages, resp. their basic constituents should appear. The stratum for them should contain whatever is necessary to reconstruct with a good approximation the methods characteristic to such linguistic structures, their semantical methods and their conditioning effects. The completion of the stratification requires tools of transition from stratum to stratum. Symbols used at the transition from one stratum to another one, as well as symbols to complement a constituent on a given stratum if it should be transferred to another one were mentioned already in the short description of the transformative translation. They cannot, however, be detailed in a non-technical paper.

We mentioned already how the dimensional analytical methodology is using a many-one metalogical schema on a know-how basis. Now we point to a second methodological step, applied as well on the half-conscious know-how basis: the alternation of bases within a methodological of operations, called in short "basis-alternation".

Physical measurement results over a physical basis are transposed into an arithmetical calculus with multiplication as its single operation over a mathematical basis; later the results of calculations over that mathematical basis are reprojected into the context generated over the first, physical basis. These are the principal steps of a (far more detailed compound) methodological ring. If probabilities or programming are involved, more and more refined alternations of bases enter the picture. What we want to emphasize: Different bases taken from different strata of a stratification are used in accepted methodologies on a laboratory-praxis and know-how basis. None of the possible physical strata and the bases corresponding to them may be as perfect as a purely mental construct, i.e. arithmetics and its basis. It appears that the performance of the interpreted calculus within a methodological chain should be evaluated and taken into account for the complete definition of a stratum.

Schematized methodological rings, complete well constructed methodological schemata including their back-connections to the world of physical phenomena are, with no exception, construable from the (Z) elementary schema and its variants. This is important for easy instrumentability. If a methodology in present usage may not suggest this, it may be replaced by its own reconstructed variant. On high genetic levels we are accustomed to artificial constructs and some more artificial steps, like those for the reconstruction for the sake of instrumentation. On low genetic levels a subjective feeling appears: the reconstructions appear to be far from the intuitive concepts and make the impression that they are very artificial. But the principle of (Z) constructability holds for all levels of the stratification.

Simulation and replacement of some brain-thinking methods. We cannot use our computing instruments without some well defined relatedness to brain-thinking and its methods, without a minimum of simulation and without a method of programming and re-translating the results in the methods and expressions of brain-thinking. A general purpose instrument must include some more structural constituents, (justified by their simulative effect,) than a digital one. Now, brain thinking is highly iterative in its methods. It is very elastic and indefinite. We meet this characteristic by the introduction of the "compound" kind of target code. This is a simultaneous application of several "componental codes" successively subordinated and combined into an apparently single code. Each of these componental codes has been devised by adaptation to certain methods of brain-thinking. Ostentative methods, e.g. of which physicalization is a refined reconstruction, the interrelation and derivation of secondary, "derive" physicalizators are coded by a componental code with the roman subscript "II": L_{II}. - Evaluative methods, deontic, verifying methodology-chain elements are coded in L_{III}. L_I is reserved for simple formalism in two variants: one for algebraic-vacuogeneous, the other for polybasic-heterogeneous cases. This is why the formula for the compound code is built as

$$L_{(IV,\ldots,I)} = (L_{IV}(L_{III}(L_{II}(L_I)))) \cdot Z_{n,\ldots,1} \cdot ---$$

where a pair of brackets may be interpreted as another way of writing the T^{-1} operator for generating real-meta regresses on (Z). The above formula, if completed, may be an instance for a commonmeta-schema.

Synthesis. If we agree that the essence of a general purpose machine and of its machine-code as well is a logical structure influenced physically, of which the machine is one, the code a second physicalization then any requirement with respect to the structure of the machine is a requirement with respect to the code and vice versa. The same holds if more physicalizations are taken into the picture. It is the easiest way to state the requirements on the logic of the machine by expressing them with respect to its code-physicalization. Now we want to enumerate conditions for the construction of a successful general-purpose machine-code:

1.) '(Z) - constructivability' - for binarization and for electronic physicalization.
2.) Polybasic-heterogeneous logic - to avoid antinomies, to remain 'physical', to have the generalized dimensional analysis for its control-theory.
3.) Genetic stratification - for general purpose applications.
4.) Applied genetic theories with definite and general stratum-indices (e.g. theory of precision, the vacuogenous theory of exactitude) to avoid the intermixture of methods having different basic sets of constituents. This means: to avoid the intermixture of different systems of applied logic without control and without complementing symbols.
5.) Common-meta approach - for unification.
6.) Compound-commonmeta target code - for a limited simulation of brain-methods.

7.) Concepts and methodologies are created usually for the same context: if not, they are not good for instrumentalization. If a methodology passes over different bases or genetic strata, this has to be indicated by equalizing symbolic operators.
8.) Instrumentalization should concentrate on basic constituents and basic concepts: the others may be generated by secondary operations, e.g. construction and derivation, applied locally. The representation of such structures should be derived from that for basic ones. Concepts should appear embedded into the internal hierarchy, the whole of it generated by repeated (Z) steps from the same delimited basis.
9.) Complete and single valued retrievability for basic as well as for derived structures is a requirement. This includes constituents with their stratum-indicator. The tool for it is the arithmetization using products of powers of primes and exclusively primes. To avoid high powers and in consequence of it transgression of machine limits, primes are used in pairs for arithmetization.
10.) A powerful machine-logic should be intercommunicated by a powerful sign-vehicle technique for coding.
11.) The words of the code are made up of long rows of characters as elementary symbols, so that the human encoder needs a method for the extension of the range of the human memory. This is why "phonetization" has been created. In this mnemotic way it is easy to memorize 15-18 characters in their quite complex interrelations.

As in "Dimensional Analysis", by consequent construction, there exist for any deducted connection of symbols a deducted physicalization (see p. 317, F)) so in the "arithmetization with respect to the retrievability" of the symbols for basic constituents and derived words, the same relation has been preserved (see 9.) above). This is not a mere chance, but a methodological isomorphy.

An efficient code incorporating the above 11 conditions is the only demonstration of the synthesis - the very same synthesis which may be materialized as a General Purpose Artificial Intelligence. Restricted and specific cases of it are the Heteroautomata for one or a few genetic strata and the mathematical machines for the vacuogeneous fully exact highest stratum of bases.

Conclusion: The scrutinized subjects are models generated over differently restricted sections of the same basic structure. All of them are generated over the genetically stratified array of agglomerates of theory constructing constituents, whereby

a) Automata Theory is constructed over the vacuogeneous exact stratum;
b) The Theory of Heteroautomata over several of the highest strata;
c) Dimensional Analysis over the highest physical and vacuostrata;
d) The logic used with respect to the total stratification of agglomerates for theory construction is the polybasic logic in its heterogeneous applications.

e) The Theory of Interdisciplinary Unification over the range of the total stratification supplies the tools for instrumentation-aimed unification.

f) Genetically generalized Dimensional Analysis and Theory of Interdisciplinary Unification *are different adaptations of the same theory over the same stratification using the same logic.* a), b), c) are specified restricted cases of them.

g) Methodologies without or with operations on automata of any kind are dealt with by our approach as compound schemata constructed by the concatenation and superimposed incatenation of several rings generated by (Z) and its variants. - The automaton often performs a task restricted to a domain of the methodological schema.

h) Well concatenated schemata for methodologies, if stretching over alternated bases, have to be equalized with respect to a suitable stratum by symbolic operators. Only stratum-equalized methodological schemata are efficient.

i) Argumentally inserted interpreted calculusses are dependent upon their own genetic stratum and in addition to this, on the strata of other argumentally occurring calculusses within the same methodological schema so that if for any reason 2 calculusses of different stratum-prefixes appear in concatenation, at least one of them should be complemented as required by h). This refers to methodologies on computers as well. This requirement is more conspicuous for analogue than for digital computers, as the range of basis alternation is much larger for the first ones.

j) The reduction of all the main components of a methodology to the same genetic stratum is not unsimilar to the conditions of equilibrium for mechanical systems. A second similar condition for methodological schemata is that for the zero closure (or zero closure approximation) for closed rings. Both of them may be required simultaneously).

A new outline for foundations and a new background of scientific methodology have been presented in this paper. In spite of the considerable abstractness of the subject and in spite of the advantages of formalized presentation, no efforts were spared to remain as non-technical as possible. The new background is the several times mentioned multilevel polybasic heterogeneous logic and the applications are controlled by the metalogical Theory of Interdisciplinary Unification, resp. by a model of the strata-extended Generalized Dimensional Analysis.

Let us hope that like in the case of previous successful generalizations of the foundations of science in its history the above outlined new kind of logic and the constituents based multi-unit programming will successfully be developed and followed up by deeper theoretical insight and by efficient General Purpose Artificial Intelligences.

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