NOTE: I wrote the book from which this chapter is excerpted when I was 25 to 27 years old and at MIT. At that time my writing style and skills were still developing, and what I wrote had many peculiarities. I have occasionally tried to edit chapters in my book on the brain, but for a variety of reasons I have never been satisfied, or felt at ease, with the results of such attempts. It seems to me that there is something presumptuous, naive, and actually injurious in introducing changes and corrections in a manuscript that one wrote almost a quarter century before in radically different circumstances and at a time when one's basic character and style were undergoing transformation. Moreover, my knowledge of neurological literature was far larger, or at least more vivid to memory, at the time; and today I can no longer be sure what the meaning of what I wrote on the subject then was or what its underpinnings were or its thrust was - or of how to translate it into contemporary terms. So I conclude that it is best to leave my material untouched.

One other thing I should mention, however - in view of the extraordinary size, and grammatical and semantic complexity, of the typical paragraph in "Brain Hypotheses" - is that at that time my powers of concentration and memory were absolutely extraordinary. Moreover, I was able to, and did, SPEAK in sentences and paragraphs just as extended and complex as in my texts. In fact, when discussing the brain I had the ability to speak in what was literally an infinite - and yet, as I recall, perfectly punctuated and coherent - sentence.

So there is a grand logical architecture that haunts the pages of my youthful book, and it would be hubris to tamper with it now. Perhaps it might be better appreciated by analogy to the chess skills of a grandmaster, or the complexity, vision, and determined order of his game.

CONCINNITY, SPONTANEITY, AND CIRCULATION, IN THE ORIGIN OF MAN

The primacy of the mind of Man may have many bases - some first, some consequent, some parallel - but it is likely that our knowledge of the brain of various animals already foretells the changes and mechanisms that explain it. Even simple pairing of the set of 73 types of first-order order, which are described in the chapter "Order in Experience", is sufficient to hint the basis of intellect through a natural process of the continuous discovery of interrelationships.

The focus of the present chapter is upon a few things that are indeed suggestive.

The small parietal lobe locus of CALCULIA, which is coextensive with the finger representation on the cerebrocortex, and the dependency of arithmetic defect - e.g. acalculia - upon coextensive lesion, are not hard to understand, if one reflects upon the form and size of representation of the hand VIS the rest of the somatomotor homunculus.

Imagine an anthropomorphic but mad balloon, with this very large representation of the fingers as a cluster of so many extrusions. Especially in the context of how fingers - in whole, their tips, flexures, and so forth - are applied in tactility, it is easy to see how that which corresponds to calculation would readily gravitate to, and originate in, this digital zone or anomaly. It is generally suggestive how the spatial, functional, and bodily topologies would clash and be complex, so that a conflictual and nuclear algebra would automatically arise in this case, such that, e.g., receptive fields of units would exhibit in a bridge- or string-work this complex - and functionally complex - organization.

Similar economies, serving ideation by their structure and timing, apply to all kinds of similar facts.

The nature of textural perception in touch, as in vision, suggests some basis for a sort of counting, particularly when the like of fovea and finger tip COMBINE WITH the central emphases and other individuations of same.

I am concerned with DEMONSTRATION and SEMIOSIS; as in the evolution and culturalization of signal communication in, sensu lato, dance and facial expression. I am convinced that the parallel existence of possibilities for movement or position would lead to the differentiation of a homogeneous and rather universal nonverbal embodiment and conveyance of internal states and ideas, and especially some order of abstraction in conception (regardless of interpersonal communication).

It is notable that the frontal and variously motor cortex has expanded so uniquely and greatly in man, as have other systems directly serving it, and there is the hint that the production of all kinds of action should have taken on a kind of inner purpose, experienced a great differentiation in the height of the cortices, and had some independence of the posterior, variously sensory cortex. This could have led to the indefinite and greater elaboration of all kinds of actions, but in particular - as it happens - of such actions as might serve some cognition and communication or the conceptual development of motivation. Thus at this point I introduce faciovocal operations as significant in their human salience.

A particular type of SYNESTHETIC CONCINNITY I have in mind is the stressed union or interaction of sounds, touches, sights, and acts in the like of Wernicke's Area. It should be noted that the highness of these synesthesias in a remote cortex dispenses with the distraction of immediacy in the primary areas, and generally - within the diffuseness and stretch in time and complexity - opens the way indeed for the synthesis of all sorts of really higher combinations of impression and their definition through some remembrance. So I imagine that the fascination of simply the structure of letters and words makes SYNESTHETIC onomatopoeia universal, bottomless, and of much greater importance than is usually assumed. This holds equally - and notice how - for mania, philia, pleasure, abstraction, culture, and generalization of such associations or figures.

But notice in particular the wonderful generalization that proceeds, for instance, from the grouping and forceful superimposition or intraposition of possibly related sonic and tactile stimuli and monosensory concepts, so that a unified texture appears between such things as surfaces of rocks and fabrics of sounds and larger events of these two.

Now much as "bridging" should inevitably occur between the fingers, I would anticipate ALGEBRAIC PROPERTIES AND TRANSFORMATIONS to emerge in a sensorimotor sphere, and then, more important still, in all spheres whatever, or in those which we perhaps unreasonably delimit as "abstract", special, and human; that is, at least in the algebraic sense the world is a simple, and thus simply generalizable, CONTINUUM, with the ontogeny and relative attainment of intellect as a graduation on this continuum - a continuum only naturally, as I have said, extending through time relations and parting with any so-called concretes.

There remains the task of describing in a vivid way the abundance and natural differentiation of the degree of the process of motor extrusion of Man in the world, wherein which extrusion and constancy the detailed elaboration of types of active organization of experience bring intellect by the agency of a simple continuum between elementary actions and highest actions.

ONE (a new) VERSION:

En passant, Man may be distinguished by

the [degree and purity] (by which is intended, the [isolation, self-concern, etc]) of so-called thoughts,
the [nontermination and exogenous construction] of these [thoughts or inobvious actions] in Man as opposed to animal,
and, in [isolation and independent expression], the CHANCE

FOR these actions to be apparent in all other actions

(as in parallel cellular processes with special latency,
or in the [coaction, mergence, and sui generis aloofness] of [these processes or the remaining process or cell fidelities] in the realization of the

originally simple actions),

AND therefore to be in constant [exercise and recorrelation] (despite [specific and excellent] action),

AND therefore, but in general,
FOR specific systematization of these actions to occur,
OR, in [a sense or a way], for this to result in the deposition of [so-called divided elements or mathematical-like functions])

--|| of reverbatory continuation or such time relations, of his internal thoughts

(as the process of association, and especially the value of thought, are timeless, or rather are macrotemporal).

ONE (a new) VERSION:

En passant, Man may be distinguished
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||-- (by which is intended the isolation, self-concern, &c of so-called thoughts, the nontermination and exogenous construction of these thoughts or inobvious actions in Man as opposed to animal, and, in isolation and independent expression, the CHANCE FOR these actions to be apparent in all other actions
|-- (as in parallel cellular processes with special latency or in the coaction, mergence, and sui generis aloofness of these processes or the remaining process or cell fidelities in the realization of the originally simple actions), --|
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--|| of reverbatory continuation or such time relations, of his internal thoughts
(as the process of association and especially the value of thought are timeless or, rather, macrotemporal).

If so, one might expect adaptations of parts of the brain, such that equilibria of activations, drives, modi, etc are more tied to internal processes of the brain of great complexity. (Note that the peculiar subtlety and diffusion of cell activities in association areas, proportionately to their height, induces a so-called "flattening", which - IF it is authoritative in such arousal, etc - must automatically redefine, spread, etc the timetable of cortical activation and the morphology of thought and character.)

ANOTHER (the old) VERSION:

En passant, Man may be distinguished by the degree and purity ||-- (by which is intended the isolation, self-concern, &c of so-called thoughts, the nontermination and exogenous construction of these thoughts or inobvious actions in Man as opposed to animal, and, in isolation and independent expression, the chance for these actions to be apparent in all other actions |-- (as in parallel cellular processes with special latency or in the coaction, mergence, and sui generis aloofness of these processes or the remaining process or cell fidelities in the realization of the originally simple actions), --| and therefore to be in constant exercise and recorrelation (despite specific and excellent action) and therefore, but in general, for specific systematization of these actions to occur, or, in a sense or a way, for this to result in the deposition of so-called divided elements or mathematical-like functions) --|| of reverbatory continuation

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These and other peculiarities of higher and anterior cortices in Man (such as the restful opportunity for such multi-areal nondistraction, continuity, self-importance, and redirection, inter alia, of association) might bring into play and prominence not only a coexistence but a simultaneous and unbounded multiplicity of both what, in the posterior cortical sense, might be called 'static' elements for association, and of (motivationally and motorally) 'dynamic' elements, in such legion and continuum that possibilities would indeed seem unitary - and change, or at least motion, false - in a dispersion covering all time relations, actions, and sensa of arbitrary complexity or simplicity, and interaction and arbitrarily subtle redifferentiation of categories of perceptions.

Obiter. Excessive conductance between frontal and temporal cortices could result in a peculiar simplification, wherein the complex ideas and actions learned or developed already or occasionally in life, and embodied differentially over this topography, could be collapsed in chaotic mixture - or perhaps in a similar way, just excessive prefrontal electric activity could involve such polysynaptic and complex neuropile - to produce the possible basis for schizophrenia.

(TRANSCRIPT INCOMPLETE; 65% OF ORIGINAL TYPESCRIPT REMAINS)

cells enfolded and extended compactly and privately in the slender (eg 32:1) columns. Thus the function of the columns might be to create single-cellular domains. In this term, is it possible the function of the subcortic alba was to link adjacent alveolar columns in extraordinarily complex series (eg even as connexions go longer distances or interareally, these connexions would exist and information would coexistentially semiindependently and ideally (because of uniformity or 'familiarization') move acutely and chronically between contiguous columns in series that could well slowly process and interrelate information in an extraordinarily regular and great serial and parallel fashion (furthermore, where the flow would be pandirectional and reciprocal; eg a hierarchy might evolve between 'columns').

The volume of the thalamus of semnopithecus is 285 mm^3 or 6^3 (which is $\leq \frac{1}{2}$ the dog) or a sphere with a radius of roughly 2,500μ, in which there are dozens of subnuclei. The volume of man's thalamus is 3,300 mm^3 or 15^3 or a sphere with a radius of roughly 7,000μ. The lateral geniculate in the guinea pig is 2.4 mm^3 or 1.3^3 or 600μ. Similarly the (topographic) caudate of the rat is 8.9:2^3:1000. The cerebral hemisphere of the rat is roughly 1,000 mm^3:10^3:2000μ in radius, despite its subdivision (eg if a rat hemicortex is 16 mm^2 and consists of, say, 50 areas, then these would each be about 250μ in radius; since we are now in the neighborhood of the number of fibers in the sensory and motor nerves, where these could only be fit adjacently and exhaustively in the whole area of the cortex, far from having columns as we think of these in man, it may be wondered whether this is the origin of cortex; indeed, it is interesting to look at the sizes of the brains of reptiles since the conclusion suggests itself that in these lower forms the number of central cells per peripheral fiber, and any division of these by total number of nuclei, would give little suggestion of complexity of processing or of many cells per activity). Thus it may be asked whether what distinquishes higher mammalian and human intelligence is not a departure from an old rule of serial processing &r of centers roughly as wide as their cells and processes are wide, eg an exploded thalamus critically yielding a pluralism of activities vs a former monism (in this connexion it may be wondered whether the peculiarity and secret of cortices is not an orthogonalization of processes, layers substituting for cell widths, and an enormous vertical and intercolumnar serialism). It may be a natural end for nervous masses to organize into layers et al once a critical size, perhaps, is exceeded (eg laminar tendencies are apparent in many subcortic nuclei, some reticular neurons extend the length of the core. the basal ganglia of the bird are not only hypertrophic but exemplify these

→Note: Numbers inserted refer to page ## in Blinkov&Glezer's "The Human Brain in Figures and Tables" (Plenum, 1968).

See Fig. 5. Note that in this tiny thalamus, cells approximate the size of the nuclei so that it is as tho the machines of the nuclei were single cells. Indeed, was this the original reason for the size and multiplicity of nuclei, the 'spheres' of cell branches? (Eg note the ventrobasal complex is vastly larger than the medial nuclei shown in the upper right (which latter, however, are just the size of the cells?).) In the cortex similar single-cellular domains might have been created as cells as large as columns or laminar segments thereof and with the processes of the cells enfolded and extended compactly and privately in the slender (eg 32:1) columns. Thus the function of the columns might be to create single-cellular domains. In this term, is it possible the function of the subcortic alba was to link adjacent alveolar columns in extraordinarily complex series (eg even as connexions go longer distances or interareally, these connexions would exist and information would coexistentially semiindependently and ideally (because of uniformity or 'familiarization') move acutely and chronically between contiguous columns in series that could well slowly process and interrelate information in an extraordinarily regular and great serial and parallel fashion (furthermore, where the flow would be pandirectional and reciprocal; eg a hierarchy might evolve between 'columns').

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It must be remembered that neurons are larger in larger animals and thus an adjustment must be made in comparing the widths of individual cells and nuclei or columns in these animals; but if this is done, it might have the effect of making all the more clear and extraordinary a departure from a coextensive rule, proper to prior animals, in the higher mammals, the primates, and in man (the notion of a transition from monism to pluralism, or roughly, perhaps, something like a multiplication of consciousness).

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