
JOHN C. LILLY, M. D.

Programming and Metaprogramming in THE HUMAN BIOCOMPUTER

All human beings, all persons who reach adulthood in the world today are programmed biocomputers. None of us can escape our own nature as programmable entities. Literally, each of us may be our programs, nothing more, nothing less.

Despite the great varieties of programs available, most of us have a limited set of programs. Some of these are built in. In the simpler forms of life the programs were mostly built in from genetic codes to fully formed adultly reproducing organisms. The patterns of function, of actionreaction were determined by necessities of survival, of adaptation to slow environmental changes and of passing on the code to descendants.

Eventually the cerebral cortex appeared as an expanding new highlevel computer controlling the structurally lower levels of the nervous system, the lower builtin programs. For the first time learning and its faster adaptation to a rapidly changing environment began to appear. Further, as this new cortex expanded over several millions of years, a critical size cortex was reached. At this level of structure, a new capability emerged: learning to learn.

-John C. Lilly. M.D.

Also by John C. Lilly, M.D.

THE MIND OF THE DOLPHIN

MAN AND THE DOLPHIN

THE CENTER OF THE CYCLONE

JOHN C. LILLY M . D. is a graduate of the California I Institute of Technology and received his Doctorate in Medicine from the University of Pennsylvania in 1942. He has worked extensively in various research fields of science, including biophysics, neurophysiology, electronics, and neuroanatomy. Dr. Lilly has done many years of study and research on solitude, isolation, and confinement and is a qualified psychoanalyst. He spent twelve years working on research on dolphinhuman relationships including communications and two years at Esalen Institute, Big Sur, California, as a group leader, resident, and associate in residence. Recently he spent eight months in Arica, Chile, investigating and participating in the Arica Training Group of Oscar Ichazo, the Master of a modern esoteric school in the mystical tradition.

PROGRAMMING AND

METAPROGAMMING

IN THE HUMAN

BIOCOMPUTER

THEORY AND EXPERIMENTS

JOHN C . LILLY, M.D.

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Foreword to Second Edition

This work has a curious history. It was written as a final summary report to a government agency (National Institute of Mental Health) concerning five years of my life work. (The agency paid my salary for the five years.)

It was conceived from a space rarer these days than it was then: the laws suspending scientific interest, research, involvement and decisions about dlysergic acid diethyl amide tartate were passed just as this particular work was completed; the researchers were inadequately consulted (put down, in fact). The legislators composed laws in an atmosphere of desperation. The national negative program on LSD was launched; LSD

was the big scare, on a par with War, Pestilence, and Famine as the destroyer of young brains, minds and fetuses.

In this atmosphere (1966-1967) *Programming and Metaprogramming in The Human Biocomputer* was written. The work and its notes are dated from 1964 to 1966. The conception was formed in 1949, when I was first exposed to computer design ideas by Britton Chance. I coupled these ideas back to my own software through the atmosphere of my neurophysiological research on cerebral cortex. It was more fully elaborated in the tank isolation solitude and confinement work at NIMH from 1953 to 1958, run in parallel with the neurophysiological research on the rewarding and punishing systems in the brain. The dolphin research was similarly born in the tank, with brain electrode results as parents in the further conceptions.

While I was writing this work, I was a bit too fearful to express candidly in writing the direct experience, uninterpreted. I felt that a group of thirty persons' salaries, a large research budget, a whole Institute's life depended on me and what I wrote. If I wrote the data up straight, I would have rocked the boats of several lives (colleagues and family) beyond my own stabilizer effectiveness threshold, I hypothesized.

Despite my precautionary attitude, the circulation in 1967 of this work contributed to the withdrawal of research funds in 1968 from the research program on dolphins by one government agency. I heard several negative stories regarding my brain and mind, altered by LSD. At this point I closed the Institute and went to the Maryland Psychiatric Research Center to resume LSD research under government auspices. I introduced the ideas in work to the MPRC researchers and I left for the Esalen Institute in 1969.

At Esalen my involvement in direct human guttogut communication and lack of involvement in administrative responsibility brought my courage to the sticking place. Meanwhile, Stewart Brand of the Whole Earth Truck Catalog (Menlo Park, Calif.) reviewed the work in the Whole Earth Catalog from a mimeographed copy I had given W. W. Harmon of Stanford for his Sufic purposes. Stewart wrote me asking for copies to sell. I had 300 printed photooffset from the typed copy. He sold them in a few weeks and asked permission to reprint on newsprint an enlarged version at a lower price. Skeptical about salability, I agreed. Book People, Berkeley, arranged the reprinting. Several thousand copies were sold.

I had written the report in such a way that its basic messages were hidden behind a heavy long introduction designed to stop the usual reader. Apparently once word got out, this device no longer stalled the interested readers. Somehow the basic messages were important enough to enough readers so that the work acquired an unexpected viability. Thus it seems appropriate to reprint it in full.

On several different occasions, I have been asked to rewrite this work. One such start at rewrite ended up as another book. (*The Center of the Cyclone*, The Julian Press, Inc., New York, 1972.) Another start is evolving into my book number five (*Simulations of God: A Science of Belief*). It seems as if this older work is a seminating source for other

works and solidly resists revision. To me it is a thing separate from me, a record from a past space, a doorway into new spaces through which I passed and cannot return.

J. C. L.

February 7, 1972

Los Angeles, California

n Preface to Second Edition

All human beings, all persons who reach adulthood in the world today are programmed biocomputers. No one of us can escape our own nature as programmable entities. Literally, each of us may be our programs, nothing more, nothing less.

Despite the great varieties of programs available, most of us have a limited set of programs. Some of these are builtin. The structure of our nervous system reflects its origins in simpler forms of organisms from sessile protozoans, sponges, corals through sea worms, reptiles and protomammals to primates to apes to early anthropoids to humanoids to man. In the simpler basic forms, the programs were mostly builtin: from genetic codes to fullyformed organisms adultly reproducing, the patterns of function of actionreaction were determined by necessities of survival, of adaptation to slow environmental changes, of passing on the code to descendants.

As the size and complexity of the nervous system and its bodily carrier increased, new levels of programmability appeared, not tied to immediate survival and eventual reproduction. The builtin programs survived as a basic underlying context for the new levels, excitable and inhibitible, by the overlying control systems. Eventually, the cerebral cortex appeared as an expand-

*Quoted in entirety from John C. Lilly, Simulations of God: A Science of

Belief, in preparation, 1972.ing new highlevel computer controlling the structurally lower levels of the nervous system, the lower builtin programs. For the first time learning and its faster adaptation to a rapidly changing environment began to appear. Further, as this new cortex expanded over several millions of years, a critical size of cortex was reached. At this new level of structure, a new capability emerged: learning to learn.

When one learns to learn, one is making models, using symbols, analogizing, making metaphors, in short, inventing and using language, mathematics, art, politics, business, etc. At the critical brain (cortex) size, languages and its consequences appear.

To avoid the necessity of repeating learning to learn, symbols, metaphors, models each time, I symbolize the underlying idea in these operations as metaprogramming. Metaprogramming appears at a critical cortical size-the cerebral computer must have a

large enough number of interconnected circuits of sufficient quality for the operations of metaprogramming to exist in that biocomputer.

Essentially, metaprogramming is an operation in which a central control system controls hundreds of thousands of programs operating in parallel simultaneously. This operation in 1972 is not yet done in manmade computers-metaprogramming is done outside the big solidstate computers by the human programmers, or more properly, the human metaprogrammers. All choices and assignments of what the solidstate computers do, how they operate, what goes into them are still human biocomputer choices. Eventually, we may construct a metaprogramming computer, and turn these choices over to it.

When I said we may be our programs, nothing more, nothing less, I meant the substrate, the basic substratum under all else, of our metaprograms is our programs. All we are as humans is what is builtin and what has been acquired, and what we make of both of these. So we are one more result of the program substrate-the selfmetaprogrammer.

As out of several hundreds of thousands **of the substrate** programs comes an adaptable changing set of thousands of metaprograms, so out of the metaprograms as substrate comes something else-the controller, the steersman, the programmer in the biocomputer, the selfmetaprogrammer. In a wellorganized biocomputer, there is at least one such critical control metaprogram labeled I for acting on other metaprograms and labeled me when acted upon by other metaprograms. I say at least one advisedly. Most of us have several controllers, selves, selfmetaprograms which divide control among them, either in time parallel or in time series in sequences of control. As I will give in detail later, one path for selfdevelopment is to centralize control of one's biocomputer in one selfmetaprogrammer, making the others into conscious executives subordinate to the single administrator, the single superconscient selfmetaprogrammer. With appropriate methods, this centralizing of control, the elementary unification operation, is a realizable state for many, if not all biocomputers.

Beyond and above in the control hierarchy, the position of this single administrative selfmetaprogrammer and his staff, there may be other controls and controllers, which, for convenience, I call **supraself metaprograms**. These are many or one depending on current states of consciousness in the single selfmetaprogrammer. These may be personified as if entities, treated as if a network for information transfer, or realized as if self traveling in the Universe to strange lands or dimensions or spaces. If one does a further unification operation on these supraself metaprograms, one may arrive at a concept labeled God, the Creator, the Starmaker, or whatever. At times we are tempted to pull together apparently independent supraself sources as if one. I am not sure that we are quite ready to do this supraself unification operation and have the result correspond fully to an objective reality.

Certain states of consciousness result from and cause operation of this apparent unification phenomenon. We are still general purpose computers who can program any conceivable model of the universe inside our own structure, reduce the single selfmetaprogrammer to a micro size, and program him to travel through his own model as

if real (level 6, Satori +6: Lilly, 1972). This property is useful when one steps outside it and sees it for what it is—an immensely satisfying realization of the programmatic power of one's own biocomputer. To overvalue or to negate such experiences is not a necessary operation. To realize that one has this property is an important addition to one's selfmetaprogrammatic list of probables.

Once one has control over modelling the universe inside one's self, and is able to vary the parameters satisfactorily, one's self may reflect this ability by changing appropriately to match the new property.

The quality of one's model of the universe is measured by how well it matches the real universe. There is no guarantee that one's current model does match the reality, no matter how certain one feels about the high quality of the match. Feelings of awe, reverence, sacredness and certainty are also adaptable metaprograms, attachable to any model, not just the best fitting one.

Modern science knows this: we know that merely because a culture generated a cosmology of a certain kind and worshipped with it, was no guarantee of goodness of fit with the real universe. Insofar as they are testable, we now proceed to test (rather than to worship) models of the universe. Feelings such as awe and reverence are recognized as biocomputer energy sources^{xii}

rather than as determinants of truth, i.e., of the goodness of fit of models vs. realities. A pervasive feeling of certainty is recognized as a property of a state of consciousness, a special space, which may be indicative or suggestive but is no longer considered as a final judgement of a true fitting. Even as one can travel inside one's models inside one's head, so can one travel outside or be the outside of one's model of the universe, still inside one's head (see Lilly 1972 level or state +3, Satori +3). In this metaprogram it is as if one joins the creators, unites with God, etc. Here one can so attenuate the self that it may disappear.

One can conceive of other supraself metaprograms farther out than these, such as are given in Olaf Stapledon's *The Starmaker* (Dover, New York, 1937). Here the self joins other selves, touring the reaches of past and future time and of space, everywhere. The planetwide consciousness joins into solar systems consciousness into galaxywide consciousness. Intergalactic sharing of consciousness fused into the mind of the universe finally faces its creator, the Starmaker. The universe's mind realizes that its creator knows its imperfections and will tear it down to start over, creating a more perfect universe.

Such uses of one's own biocomputer as the above can teach one profound truths about one's self, one's capabilities. The resulting states of being, of consciousness, teach one the basic truth about one's own equipment as follows:

In the province of the mind, what one believes to be true is true or becomes true, within certain limits to be found experientially and experimentally. These limits are further beliefs to be transcended. In the mind, there are no limits. (Lilly, 1972).

In the province of the mind is the region of one's models, of the alone self, of memory, of the metaprograms. What of the region which includes one's body, other's bodies? Here there are definite limits.xiii

In the network of bodies, one's own connected with others for bodily survivalprocreationcreation, there is another kind of information:

In the province of connected minds, what the network believes to be true, either is true or becomes true within certain limits to be found experientially and experimentally. These limits are further beliefs to be transcended. In the network's mind there are no limits

But, once again, the bodies of the network housing the minds, the ground on which they rest, the planet's surface, impose definite limits. These limits are to be found experientially and experimentally, agreed upon by special minds, and communicated to the network. The results are called consensus science.

Thus, so far, we have information without limits in one's mind and with agreedupon limits (possibly unnecessary) in a network of minds. We also have information within definite limits (to be found) with one body and in a network of bodies on a planet.

With this formulation, our scientific problem can be stated very succinctly as follows:

Given a single body and a single mind physically isolated and confined in a completely physicallycontrolled environment in true solitude, by our present sciences can we satisfactorily account for all inputs and all outputs to and from this mind- biocomputer (i.e., can we truly isolate and confine it)? Given the properties of the softwaremind of this biocomputer outlined above, is it probable that we can find, discover, or invent inputsoutputs not yet in our consensus science? Does this center of consciousness receivetransmit information by at present unknown modes of communication? Does this center of consciousness stay in the isolated confined biocomputer?XIV

In this book I try to show you where I am in this search and research. In previous books I have dealt with personal experiences. Here I deal with theory and methods, metaprograms and programs.

February, 1972 Los Angeles, Calif.

T. L. C.

Preface to First Edition

This work is the result of several years of personal effort to try to understand the various paradoxes of the mind and the brain and their relationships. It is felt that the basic premises presented in this work may help resolve some of the philosophical and theoretical difficulties which arise when one uses other viewpoints and other basic beliefs.

Some of the major philosophical puzzles are concerned with existence of self, with the relation of the self to the brain, the self to the mind, and self to other minds, the existence or nonexistence of an immortal part of the self, and the creation of and the belief in various powerful phantasies in these areas of thought.

In Man there is a basic need for imagining wishfulfillments. Man's wishful thinking becomes interwoven among his best science and even his best philosophy. For the intellectual and the emotional advancement of each of us we need certain kinds of ideals. We also need ways of thinking which look as straight at the *inner* realities as at the physicalchemicalbiological *outer* realities. We need truly objective philosophical analysis inside ourselves as well as outside ourselves. This work is a summary of a current position in progress to try to attain objectivity and impartiality with respect to the innermost realities.

One might well ask where is such theory applicable? Once mastered, it may be directly applied in selfanalysis. If one remembers that one's self is a feedbackcause with other human beings, one can start at this personal end of the system and

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achieve beginnings of interhuman analysis by analyzing one's self first. If successful, one may see one's self operating in improved fashions with other people, as judged by one's self and, much later, as judged by others. The reflections of one's intellectual and emotional growth later may begin to be distributed and are then seen operating in one's interhuman transactions- with one's wife, children, relatives, colleagues, and professional and business contacts.

The persons who can understand and absorb this kind of theory need understand over a broad intellectual and emotional front. Each one needs understanding and training in depth in multiple fields of human endeavor. Those persons who probably can understand it best are the general scientists. * Among those in this group to whom I have presented the theory, there was immediate understanding and an immediate grasping of the basic fundamentals and of the consequence of the theory.

A second group who have no difficulty with the computer aspects but who may have difficulty with the subjective aspects is that large group of young people who are becoming immersed more and more in computers, their use and programming. A few of these may have the necessary biological and psychoanalytic background to understand this viewpoint. Additional training may be given to these few in selfanalysis itself.

Several members of a third group may find it useful with further study, the classically trained psychoanalytic scientists.

*A general scientist (as defined for purposes of this discussion) is a person trained in the scientific method and trained in watching his own mind operate and correcting his scientific as well as philosophical and pragmatic errors. In a sense he is a scientist who is willing to study more than just one narrow specialty in an attempt to grasp as much knowledge as he can under the circumstances from other fields than his own. He has a grasp of symbolic logic and of mathematics which he can apply to problems

other than his own scientific specialty.

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The psychoanalytic group may have difficulties in that very few are trained in the general purpose types of thinking involved in general purpose computers.

There are difficulties in the way of a multidisciplinary group, as a group, to use this theory. It seems necessary that each individual absorb the necessary kinds of thinking and kinds of motivations involved in each of the fields represented. Members of such groups can motivate one another to do individual learning in these areas and can help one another learn in these various areas. It is up to each responsible individual to absorb enough to gain understanding on the levels presented.

As with most insights into the innermost realities, it is felt that many of the advantages of this viewpoint cannot be seen directly until this way of thinking is absorbed into one's mind. The thinking machinery itself is at stake here. Once absorbed and understood I have found it possible to see that the properties and the operations of one's mind in many different states can be accounted for somewhat more satisfactorily. With the resulting increased control over conscious thinking and preconscious computations, with the newly enhanced respect for one's fixed unconscious (as if builtin) programs, the integration of one's self with the deeper inner realities becomes more satisfactory.

The theory is phrased in definite statements. However, it is not intended that the reader take this version as definitive, final, completed, or closed. Each of these definite statements is to be accepted only as a working hypothesis as currently presented by the author. My aim is not to make a new final philosophy, a new religion, or a new rigid way of approaching man's intellectual life. My aim is to increase the flexibility, the power, and the objectivity of our currently limited mind and its knowledge of itself. We have come a long way from the lowly primate to our present level. (However, we have a long way to go to realize the

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best obtainable from ourselves.) One has only to look at the inadequacies of Man's treatment of Man, and see how far we must go if we are to survive as a progressing species with better control of our battling animalistic superstitious levels.

It is expected that this theory will be useful in understanding and in programming not only one's self but other minds as well. Enhancement of the very human depths of communication with other minds may be approached. The current limits and the attainable limits for education, for reprogramming, for therapy and for cooperative efforts of all sorts between men, may be aided in the terms here presented. This is at least a hope of the author. Only time and use of this kind of thinking can test out the further working hypothesis.

One fact which must be appreciated for applying this theory is the essential individual uniqueness of each of our minds, of each of our brains. It is no easy work to analyze either one's self or someone else. This theory is not, cannot be, a miracle key to a given human mind. It is devilishly hard work digging up enough of the basic facts and enough of the basic programs and metaprograms controlling each mind from within to change its poor operations into better ones. This theory can help one to sort out and arrange stored information and facts into more effective patterns for change. But the basic investigation of self or of other selves is not easy or fast. Our builtin prejudices, biases, repressions and denials fight against understanding. Our Unconscious automatically controls our behavior. Eventually we may be able to progress farther. It may take several generations of those willing to work on these problems.

I have a question about the wisdom of publishing too much of me, myself. I hesitate to publish in this small work certain personal observations in depth and in detail. If the society in which we live were more ideal, I might so publish. (Possibly in such an ideal society there might be no need for such work.) I do not know the answer, nor will I espouse the cause of those who feel they do know either the yes or the no answer. Frankly, I am an explorer in this area. My ambition is to be free to **explore**, not to **exploit**. I share what I experience because that is my profession—to search, to find, to discuss, and to write within Science what I find. Let others use what I may be privileged to find in their own professions, businesses, and/or pursuits. I have found that as soon as I go commercial, go political, or any other motivational endeavor, I lose what I personally prize most—my objectivity, my dispassionate appraisal, my freedom to explore the mind within my own particular limits. To make money, to cure someone, to rule, to be elected, to grant money, to be a specialist in one science are all necessary and grand human enterprises needing persons of high intellectual and dedicated maturity. I do not seem to be of those (maybe I do or did not choose to be). In the United States of America in 1966, to insist on the explorer's role in the region of Man's innermost mind is to insist on being intellectually unconventional and to espouse a region of endeavor of research difficult to support. Grants for scientific research tend to be awarded by specialists to specialists; this is true in medical sciences as well as others. This current work cuts through too many specialties for that kind of support. I hope someday that approaches such as this one can be supported on their own merit.

Respect for the Unknown is hard to come by. Support for a science devoted to the Innermost Unknowns is needed.

METATHEORETICAL CONSIDERATIONS

In general there are two opposing and different schools of thought on the basic origins of systems of thought or systems of mathematics. In a simplified way these two extreme positions can be summarized as follows:

1. In the first position one makes the metatheoretical assumption that a given system of thinking is based upon irre-

ducible postulates- the basic beliefs of the systems. All consequences and all manipulations of the thinking machine are then merely elaborations of, combinations of, these assumptions operating upon data derived from the mind and/or from the external world. This is called the formalistic school. This school assumes that one can, with sufficiently sophisticated methods, find those postulates which are motivating and directing a given mind in its operations. A further metatheoretical assumption is that once one finds this set of postulates that then one can account for all of the operations of that mind. (Whitehead and Russell, 1927; Carnap, 1942; Tarski, 1946.)

2. The opposing school at the opposite end of a spectrum of schools, as it were, makes the metatheoretical assumption that thinking systems arise from intuitive, essentially unknowable, substrates of mental operations (Hilbert, 1950). This school states that new kinds of thinking are created from unknown sources. Further, one is not able to arrive at all of the basic assumptions on which systems of thinking operate. Many of the assumptions from this point of view must be forever hidden from the thinker. Thus in this view the origins of thinking are wide open. With this metatheoretical assumption one can then conceive of the existence in the future of presently inconceivable systems of thought.

3. There is an intermediate position between these two extremes in which one assumes the existence of both kinds and that each of these two extremes has something to offer. Thus one can select kinds of thinking which are subject to formalistic analysis and formalistic synthesis based upon basic beliefs. But this does not include all thinking. Some kinds continue to be based in unknown areas, sources, and methods. Metatheoretical selection is

being done by selection of the formal kind of thinking from a large universe of other possibilities. This position does not state that the origins of the basic beliefs are completely specifiable. However, once some related basic beliefs are found to exist, a limited system of rules of combination of the basic beliefs giving internally consistent logical results can be devised for limited use of that system. This organization into a limited integral system of thinking and the selection of those basic beliefs which naturally fit into such systems of thinking, is a way of dividing off this territory.

Among many other metatheoretical ways of looking at one's own thinking machine and its activities is one which considers the unknown origins of basic beliefs and finding those whose origins are unknown. The whole problem of origin and the whole problem of how one constructs basic beliefs is at stake here.

If one takes a naturally occurring, thinking mind and obtains a sufficiently large sample of its thinking, one can have a metatheoretical faith that one can then find the basic beliefs and their origins. I am not too sure that such metatheoretical faith in one's ability to adequately observe, adequately record, and adequately analyze mental events and construct them into logical explanations is warranted. With certain areas of thinking one can do this, with certain kinds of minds one can do this, but are not these the minds which have been organized along the known metatheoretical pathways? Are not these the minds which believe implicitly in metatheoretical terms in a basic set of beliefs and operate with them in an obvious direct logical fashion?

May it not be better to conceive of minds and of criteria of excellence for general purpose minds in which one plugs in, as it were, metatheoretical positions which do not have only this area of applied formalism. In certain areas of thinking, of course, it is necessary to have a set of basic beliefs including

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those of the rules of various kinds of games that one must play in the external physical reality and in the social reality.* One can play these at different levels of abstraction with more or less excellence at playing, with or without dedication, etc. Interlock with external reality has its own requirements, not just those of the mind itself. In this paper external reality is not the area of major emphasis as can be seen in other portions of the paper. The interest of the author is more in the thinking machine itself, unencumbered. During those times when it is unencumbered by the necessities of interlock with other computers and/or with an external reality, its noninterlock structure can be studied. A given mind seen in pure culture by itself in profound physical isolation and in solitude is the raw material for our investigation (Lilly, 1956).

Thus our major interests are in those metatheoretical positions which remain as open as possible to reasonable explanation and reasonable models of the thinking processes of the origins of beliefs, of the origins of self, the organization of self with respect to the rest of the mind, and the kinds of permissible transformations of self which are reversible, flexible, and introduce new and more effective ways of thinking.

Is one of the sum and substance of one's experience, of one's genetics, genic inheritance, of one's modeling of other humans and of other animals and of plants, or is one something in addition to this? As we chip away at this major question of existence of self, as men have chipped away at this question over the millennia, we find that this kind of question and the attempt to answer it have led to new understandings, new mathematics, new sciences, new points of view and new human activities. If one attempts to conceive of one's self as having gone through another kind of evolution other than that of the

*Von Neumann & Morgenstern.

human, if one attempts to conceive of himself having lived in an environment different from the social one that we have been exposed to, or if one attempts to imagine having evolved as an organism with the same (or greater) degree of intelligence in the sea or on a planet nearer the sun or farther from the sun, one realizes the essentially prejudiced nature of one's self. Let one carefully consider, for example, the genic mutations leading to different human form, structure, function and mental set. One metatheoretical position is that all such mutations in their proper combination exposed to the proper environment (of which there must be millions of possibilities) can survive and progress. In other words, even those mutations which are lethal now, may have survival value under special new and different conditions.

If there is any truth in this statement then we should be doing a whole set of experiments on the adaptability and the seeking of the proper environment, proper peculiar diets, proper relation of sleepwakefulness, light to dark, amount of various kinds of radiation, amount of noise, amount of motion, and so forth for mutants at each stage in their life cycle. In other words, we should experiment with all of the vast parameters in which we have evolved and their variations in order to seek optimal survival values of these for the embryo, fetuses and children who do not survive under our peculiarly narrow range of values of these parameters. To change lethals to optimals seems possible and even probable with imaginative and thorough research.

Our genetic code with all its possible variations is a general purpose construction kit for a vast set of organisms, only a few examples of which we see in the adult human population in all races around the world. This molecular construction kit for organisms (through the exigencies of matings, of early embryonic development and growth, of the conditions imposed by mother, her diet and physical and social surroundings) gives

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rise to organisms which test experimentally the conditions imposed upon them and test how well the particular combination and particular values in their genic code are combined to form an integral complete organism for coping with that particular environment and those particular organisms found in that environment (including bacteria and viruses).

One can conceive of an infinity of other environments populated with other viruses, bacteria, and complex organisms in which Man as such could not survive in his present form. One could also conceive of our genetic code (as given) generating organisms who could and would survive and progress under those new conditions.

Until we have thoroughly explored this genetic code, until we can specify the organism and the conditions under which it can reach maturity, and become an integral individual, we will not have the data necessary for specifying all of the characteristics of the human computer which are brought to the adult from the spermegg combination.

We have not tested our own range of adaptability (as integral adults) to all possible environments. Scientifically we have little experience with the extreme; we know something of the extremes of temperature, of air and of water in which we can survive. We know something of the radiation limits within which we can survive. We know something of the oxygen concentrations in the air that we breathe, we know something of the light levels within which we can function. We know a little of the sound levels in which we can function, and so forth. We are beginning to see how the environment interlocks with our computer and changes its functioning. We are beginning to see how certain kinds of experiences with these conditions set up rules which we call physical science within our own minds. We are beginning to see how, if we change the external conditions, in a limited way within a limited piece of apparatus, that these rules must be changed in order to understand how we can model these changed conditions and the way that atoms, molecules,

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radiation and space behave, in our own minds. This century has seen vast advances in our modeling of radiation, material particles of matter, space, stars, galaxies, solid materials, liquids, and our small modifications of all of these. This century, however, has not seen a similar gain in our understanding of the operations of our own minds, of the essential origins of thinking, and of those conditions under which we can elect to create new thinking machines within our minds.

In this century we have begun to appreciate some of the powerful and special organizations of matter which are our essential organisms. The advances in the last fifty years in biochemistry, in genetics, and in biophysics and molecular biology are the beginnings of a new control of these distributions of matter within ourselves.

Schrodinger* said that the chromosome (which contains the linear genetic code) to a physicist is a linear twodimensional solid; along its length it has a great strength and yet it is a flexible chain which can move and which can be split down the middle during mitosis. These carriers of the orders for our ultimate structure as an integral adult, their essential immortality in being passed from one individual to the next in creating the next individual in line, should not be neglected in any theory of the operation of our mind. It may be that our basic beliefs, the unique ones of each one of us, can be found by careful correlations between our essentially unique genic maps and our thinking limits. It may be that the kinds and levels of thinking of which each of us is capable is essentially determined by the genes which are contained in each of us. It may be that each of our private languages is genically determined. Even if this is true, that there is genic determinism in regard to our thinking machines, we are not yet at the point at which we can specify the levels of abstraction and the cognitional and theoretical entities which are genically controlled.

* Schrodinger (1945).

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If we can free ourselves from the effects on our thinking machine of storage of material from the external world, if we can free ourselves up from the effects of storage of metaprograms which direct our thinking, programs devised by others and fed to us during our learning years, we may be able to see the outline and the essential variables which are genically determined. This is an immensely difficult area for research. It will require the services of many talented individuals considering their own thinking processes, combined with a detailed knowledge of their genic structure and their genic predecessors.

Of course in this discussion we are entering into difficulties brought about by the phenotype/genotype differences. These will have to be taken into account as will all of the other mechanisms so laboriously worked out and discovered in the science of genetics. But these rules of genetics must not be limiting in the metatheory; they must enter as part of the knowledge of these talented individuals and at the correct level of abstraction for seeking the patterns of thinking which are genically controlled.

This genic determinism of thinking can turn out to be a willo-the-wisp. It may be that in the subsequent development of the computer it has become so general purpose that the original genetic factors and the genes are no longer of importance. Even as one can construct a very very large computer of solid state parts or of vacuum tube parts or of biological parts, it makes little difference as long as the total size, the excellence of the connections and the kinds of connections are such that one can obtain a general purpose net result from the particular machine. So may we possibly cancel out genic differences. So may each one of us, as it were, attain the same kinds of learning and the same kind of thinking machine little modified by genic differences.

I do not wish to take sides on these issues. I merely wish to say that if one is to take an impartial and dispassionate view, one cannot afford to espouse deeply any fixed pattern of thinking with regard to these matters. I would prefer to see talented individuals with large mental capabilities investigating their own

minds to the very depths. I want to aid these individuals in their communication of the results to others, with similar yet different talents. I believe that by using certain methods and means, some of which are presented in this work, that truly talented and dedicated individuals can forge, find, and devise new ways of looking at our minds, which are truly scientific, intellectually economical, and interactively creative. Consider, for example, the case of the fictitious individual created by the group of mathematicians masquerading under the name of Dr. Nicholas Bourbaki

This group of mathematicians in order to create a mathematics or sets of mathematics beyond the capacity of any one individual, held meetings three times a year and exchanged ideas, then went off and worked separately. The resulting papers were published under a pseudonym because the products of this work were felt to be a group result beyond any one individual's contribution.

Whether or not this group was greater than or lesser than a single human mind, operating in isolation on similar materials, will not be known for some time. It may be that the

human computer interlock achieved among these mathematicians created a new entity greater than any one of them in regard to modes of thinking, complexity of thinking, and creative new ideas. Certain kinds of things that Man does of necessity require tremendous amounts of cooperation among very large numbers of individuals. Such accomplishments are beyond any one individual and are a product only of the group effort. This is true, for example, in building the Empire State Building, a subway system, a railroad system, an airline, a large industrial factory, etc. In each of these cases there is a rearrangement of external realities, a setting up of a communication network between many individuals and a dedication of each of these individuals to the purposes of the organization of which they are a part. This is probably the greatest accomplishment of our industrial, military, educational and religious efforts in this century. Man's

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effective interlock with other men can accomplish certain kinds of things beyond any individual.

However, in certain areas, gifted, talented, intelligent individuals seem to function almost autonomously as solitudinous computers giving rise to new findings. This is seen in the case of the mathematical geniuses raised in isolation. One is almost afraid to educate such people for fear that they will lose their general purpose nature and their ability to make original creative contributions. Somehow or other they have escaped interlock into Man's ever more pervasive social organizations and their demands. As in the case of the creative physicist Moseley, who was drafted and killed in World War 1, such talent can be thrown away by the operations of the necessity of interlock in our society.

There is a point of view in the modern world and there are divisions among intellectuals which are wasting our use of talent and genius. There are antithetical philosophies which cause diversive intellectual activities. It may be that such conflict is necessary for the intellectual advancement of each individual. It may also be completely superfluous and nonsensical. C. P. Snow has pointed out in his writings (especially those about the two cultures) that one kind of social dichotomy about which I speak. The value systems of each intellectual reflect his prejudices, his biases, his blindnesses, as well as his areas of competence. It seems to be a very foolish maneuver to take that which one knows, that in which one is excellent and raise it above the general intellectual level of all other intellectuals. One technique of raising what one and one's most intimate colleagues know above the surrounding intellectual terrain is to literally dig an intellectual moat around one's field of activity. To dig this moat one demeans and denigrates areas of knowledge and individuals in those fields surrounding one's own field. This kind of activity seems to be almost builtin in our structure as biological organisms.

T.C.L

St. Thomas, U.S. Virgin Islands, 1967

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Introduction

"The general (purpose) computer is. . . a machine in which the operator can prescribe, for any internal state of the machine and for any given condition affecting it, what state it shall go to next. . . All behaviors are at the operator's disposal. A program . . . with the machine forms a mechanism that will show (any thinkable) behavior. This generalization has largely solved the main problem of the brain so far as its objective behavior is concerned; the nature of its subjective aspects may be left to the next generation, if only to reassure them that there are still major scientific worlds left to conquer." (W. Ross Ashby, "What Is Mind?" in *Theories of the Mind*, Macmillan, New York, 1962.)

The relations of the activities of the brain to the subjective life in the mind have long been an arguable puzzle. In this century some advances in the reciprocal fields of study of each aspect of the question apparently can begin to clear up some of the dilemmas. This is a report of a theory and its use which is

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intended to attempt to link operationally, the

- (a) mental subjective aspects,
- (b) neuronal circuit activities,
- (c) biochemistry, and
- (d) observable behavioral variables.

The sources of information used by the author are mainly

- (1) the results and syntheses of his own experiments on the CNS* and the behavior of animals,
- (2) the experiences and results of experiments in profound physical isolation on himself,
- (3) his own psychoanalytic work on himself and others,
- (4) his studies and experience with the design, construction, operation and programming of electronic solid state digital storedprogram computers,
- (5) studies of analogue computers for the analysis and conversion of voice frequency spectra for man and for dolphin and the online computation of multiple continuous data sources,

(6) studies and experiments in neuropsychopharmacology,

(7) research on and with communication with humans, with dolphins, and with both,

(8) study of certain literature in biology (B), logic (L), neuropsychopharmacology (N), brain and mind models (M), communication (T), psychoanalysis (P), computers (C), psychology (O), psychiatry (I), and hypnosis (H) (see References and Bibliography).

The introduction of openminded, multiplelevel, continuously developing, online, operational, dynamic, economical, expanding, structuralfunctional, field-jumping, fieldignoring theory is needed. The applications of this theory extend from the atomicmolecularmembranescell levels, though cell aggregational levels, total behavior and mentalcognitive levels of the single organism of large brain size, and to dyadic and larger groups of such individuals.

* Central Nervous System

BASIC ASSUMPTIONS (Table 2, Figs. 4 & 5)

The basic assumptions are as follows:

1. The human brain is assumed to be an immense biocomputer, several thousands of times larger than any constructed by Man from nonbiological components by 1965.

The numbers of neurons in the human brain are variously estimated at 13 billions (1.3 times ten to the tenth) with approximately five times that many glial cells. This computer operates continuously throughout all of its parts and does literally millions of computations in parallel simultaneously. It has approximately two million visual inputs and one hundred thousand acoustic inputs. It is hard to compare the operations of such a magnificent computer to any artificial ones existing today because of its very advanced and sophisticated construction.

2. Certain properties of this computer are known, others are yet to be found. One of these properties obviously is a very large memory storage. Another is control over hundreds of thousands of outputs in a coordinated and programmed fashion. Other examples are the storage and evocation of all those complex behaviors and perceptions known as speech, hearing and language. Some of the more unusual properties of this computer are given further along in this paper.

3. Certain programs are builtin, within the difficultto-modify parts of the (macro and micro) structure of the brain itself. At the lowest possible level such programs which are builtin are those of feeding, eating, sex, avoidance and approach programs, certain kinds of fears, pains, etc.

4. Programs vary in their permanence, some are apparently evanescent and erasable, others operate without apparent

change for tens of years. Among the evanescent and erasable programs one might categorize the ability to use visual projection in the service of one's own thinking. One finds this ability with a very high incidence among children and a very low incidence among adults. An example of a program operating without change for tens of years one can show handwriting, over a long series of years, to maintain its own unique patterns.

5. Programs are acquirable throughout life. Apparently no matter how old a person is, there is still a possibility of acquiring new habits. The difficulties of acquisition may increase with age, however, it is not too sure that this is correct. The problem may not be with acquiring programs so much as a decrease in the motivation for acquiring programs.

6. The young newly growing computer acquires programs as its structure expands some of these take on the appearance of builtin permanence. An example of such acquisition of programs in a child is in the pronunciation of words. Once it agrees with those of the parents the pronunciation is very difficult to change later, i.e., there is really no great motivation for the child to change a particular pronunciation when it is satisfactory to those who listen.

7. Some of the programs of the young growing computer are in the inherited genetic code; how these become active and to what extent is known only in a few biochemical-behavioral cases, at variance with the expectable and usual patterns of development. The so-called Mongoloid phenomenon is inherited and develops at definite times in the individual's life. There are several other interesting clinical entities which appear to be genetically determined. To elicit the full potential of the young growing computer requires special environments to avoid negative antigrowth kinds of programs being inserted in the young computer early.

8. The inherited genetic programs place the upper and the lower bounds on the total real performance and on the potential performance of the computer at each instant of its life span. Once again we are assuming that the best environment is presented to the young organism at each part of its life span. It is not meant to imply that such an environment currently is being achieved. This basic assumption seems highly probable but would be very difficult to test.

9. The major problems of the research which are of interest to the author center on the erasability, modifiability, and creatability of programs. In other words, I am interested in the processes of finding metaprograms (and methods and substances) which control, change, and create the basic metaprograms of the human computer. It is not known whether one can really erase any program. Conflicting schools of thought go from the extremes that *one stores everything within the computer and never erases it to only the important aspects and functions are stored in the computer* and hence, there is no problem of erasing. Modifications of already existing programs can be done with more or less success. The creation of new programs is a difficult assignment. How can one recognize a new program once it is created? This new program may merely be a variation on already stored programs.

10. To date some of the metaprograms are unsatisfactory (educational methods for the very young, for example). It is doubtful if any metaprogram is fully satisfactory to the inquiring mind. Some are assumed to be provisionally

satisfactory for current heuristic reasons. To keep an open mind and at the same time a firm enough belief in certain essential metaprograms is not easy; in a sense we are all victims of the previous metaprograms which have been laid down by other humans long before us.

11. The human computer has *general purpose* properties within its limits. The definition of *general purpose* implies the ability to attack problems that differ not only in quantitative degree of complexity but also that differ qualitatively in the levels of abstraction in the content dealt with. One can shift rapidly one's mind and its attention from one area of human activity to another with very little delay in the reprogramming of one's self to the new activity. The broader the front of such reprogramming the more general purpose the computer is. The ability to move from the interhuman business world to the laboratory world of the scientist would be an example of a fairly general purpose computer.

12. **The human computer has *stored program* properties.** A stored program is a set of instructions which are placed in the memory storage system of the computer and which control the computer when orders are given for that program to be activated. The activator can either be another system within the same computer, or someone, or some situation outside the computer.

13. **The human computer, within limits yet to be defined, has "selfprogramming" properties, and *other personsprogramming* properties.** This assumption follows naturally from the previous one but brings in the systems within the mind which operate at one level of abstraction above that of programming. As is shown in Fig. 1, one literally has to talk about selfmetaprogramming as well as selfprogramming. This does not imply that the whole computer can be thought of as **the self**. Only small portions of the systems operating at a given instant are taken up by the selfmetaprograms. In other words there has to be room for the huge store of programs themselves, of already builtin circuitry for instinctual processes, etc. All of these exist in addition to others leaving only a portion of the circuitry available for the selfmetaprograms. The next section emphasizes this aspect.

14. This computer has *selfmetaprogramming* properties, with limits determinable and to be determined. (Note **selfmetaprogramming is done consciously in metacommand language**. The **resulting programming then starts and continues** below the threshold of awareness.) Similarly, each computer has a certain level of ability in metaprogramming othersnotself.

15. The older classifications of fields of human endeavor and of science are redefinable with this view of the human brain and the human mind. For example, the term *suggestibility* has often been used in a limited context of programming and of being programmed by someone outside. Hypnotic phenomena are seen when a given computer

allows itself to be more or less completely programmed by another one.

Metaprogramming is considered a more inclusive term than *suggestibility*.

Metaprogramming considers sources, inputs, outputs, and central processes rather than just the end result of the process (see Fig. 1). Suggestibility names only the property of receiving orders and carrying them out rather than considering the sources, inputs, outputs, and central processes (ref. H. Bernheim, Clark Hull).

16. The mind is defined as the sum total of all the programs and the metaprograms of a given human computer, whether or not they are immediately elicitable, detectable, and

visibly operational to the self or to others. (Thus, in alternative terminology, the mind includes unconscious and instinctual programs.) This definition and basic assumption has various heuristic advantages over the older terminologies and concepts. The mind-brain dichotomy is no longer necessary with this new set of definitions. **The mind is the sum of the programs and metaprograms, i.e., the software of the human computer.**

17. The brain is defined as the visible palpable living set of structures to be included in the human computer; the computer's real boundaries in the body are yet to be fully described (biochemical and endocrinological feedback from target organs, for example). The boundary of the brain, of course, may be considered as the limits of the extensions of the central nervous system into the periphery. One would include here also the so-called *autonomic* nervous system as well as the CNS.

18. There is in certain fields of human thinking and endeavor, a necessity to have a third entity, sometimes including, sometimes not needing the brain-mind-computer; commonly this entity is defined as existing by theologians and other persons interested in religion. Whether the term "spirit" or "soul" or other is used is immaterial in this framework. Such terms inevitably come up in the discussion of the ultimate meanings of existence, the origins of the brainmind computers, the termination or the destinations of self after bodily death, and the existence or non-existence of minds greater than ours, within or outside of braincomputers. This extra-brain-mind-computer entity can be included in this theory if and when needed. (I agree that such assumptions may be needed to give overall meaning to the whole of Man. Religion is an area for experimental

science. Work starts in this area with the basic assumptions of William James, the great psychologist. The definitions in this area of this theory may be expanded in the future. Some compound term like "brain-mind-spirit-computer may be developed at that time.) There is still the problem of the existence theorem to be satisfied in regard to this third entity. There are some persons who assume it exists; there are others who assume it does not exist.

19. **Certain chemical substances have programmatic and/or metaprogrammatic effects, i.e., they change the operations of the computer, some at the programmatic level and some at the metaprogrammatic level.** Some substances which are of interest at the metaprogrammatic level are those that allow reprogramming, and those that allow and facilitate modifications of the metaprograms. (The old terms for these substances are

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