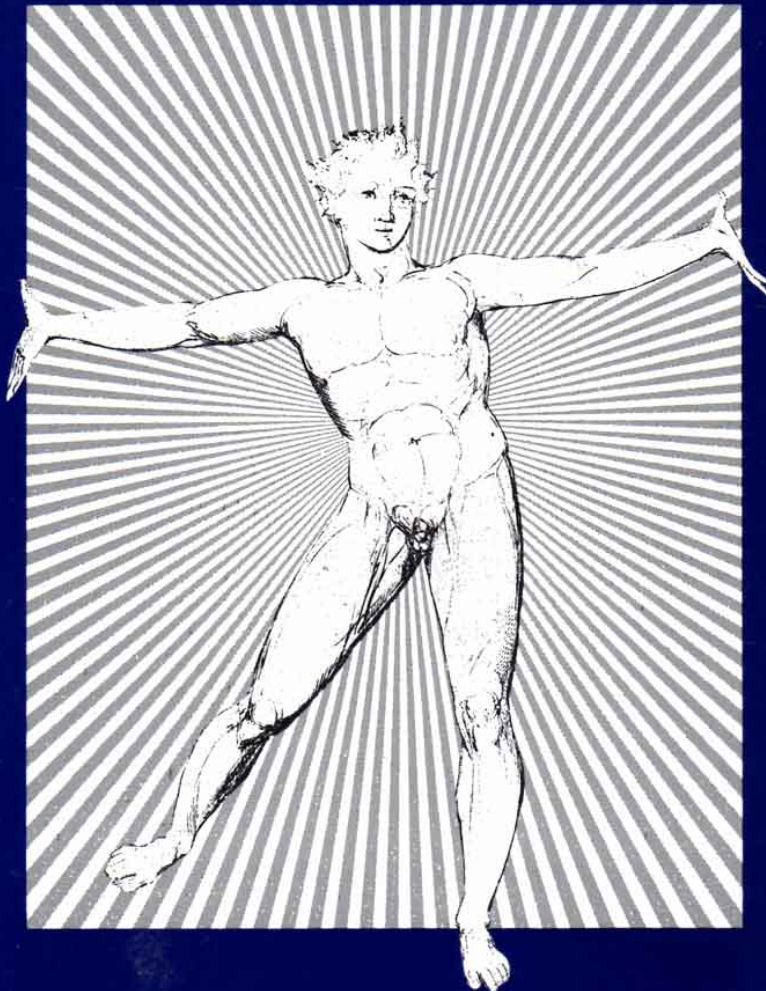


MIND AND TISSUE:

Russian Research Perspectives on the Human Brain

Raymond Peat, PhD



With introductions by Stanley Krippner and Peter Marin

"*Mind and Tissue* is an interesting attempt to bridge the gulf between psychology and the harder neurosciences. Even readers who do not follow all of the technical material in the book will get from it the flavor of Soviet mind research, which, based as it is on very different assumptions from European and American science, has much to tell us about other ways of correlating experiences with events in cells and tissues. Ray Peat has done a useful service in making this information available."

Andrew T. Weil, M.D.
Author of *The Natural Mind*

"...a cogent summary of Soviet psychology.... Peat traces the philosophical origins of Soviet psychology as well as the tradition afforded by Dostoyevski, Tolstoy, and other writers." "The reader...will enjoy the special discussion of such Soviet psychological concepts as "inhibition," the "orienting reflex," the "effect of person," the effects of magnetic fields on behavior, and the notion of time as a possible source of "energy."

From the introduction by Stanley Krippner, PhD
Author of *Dream Telepathy*, etc.

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Russian Research Perspectives
on the Human Brain

By Ray Peat, PhD

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INTRODUCTION

By Stanley Krippner, PhD

The importance of contemporary Soviet psychology has been acknowledged by many authorities. Gardner Murphy and J.K. Kovach, in the third edition of their book, *Historical Introduction to Modern Psychology*, take up this issue. Speaking of psychology in the U.S.S.R., they describe "the magnitude of its existing and potential impact on the entire body of modern psychology....," stressing the point that "Soviet psychology is not a closed system."

These points are reinforced in *Mind and Tissue*. Its author, Ray Peat, has presented a cogent summary of Soviet psychology, highlighting the contributions it has made to our understanding of human behavior. Peat traces the philosophical origins of Soviet psychology as well as the tradition afforded by Dostoyevski, Tolstoy, and other writers.

The gargantuan contributions of Pavlov are described, beginning with the differentiation of the "first signal system," of sense perception from the "second signal system" of language. Ray Peat then emphasizes a point often ignored: Pavlov took the position that the whole organism had to be the subject of scientific study. Since presumably it is the whole organism which is conscious, a psychology which studies isolated behavioral reactions can easily avoid a confrontation with the issue of consciousness. This was not true of Pavlov, who advances ideas concerning sleep, dreaming, hypnosis, and imagery which contributed to our understanding of human abilities.

Pavlov's successors continue to study brain function, observing that plasticity is the outstanding property of the nervous system. This viewpoint is an optimistic one as it

gives parents, educators, and rehabilitationists a chance to develop those in their care by paying attention to the "latent reserves" of a child, student, or patient.

The reader of *Mind and Tissue* will enjoy the special discussion of such Soviet psychological concepts as "inhibition," the "orienting reflex," the "effect of person," the effects of magnetic fields on behavior, and the notion of time as a possible source of "energy." The current enthusiasm among some American psychologists for explaining behavior through differences between brain hemispheres could be moderated by examining the Soviet work on cerebral function which emphasizes a more holographic approach. In addition, the Soviet delineating of mental imagery components (space, body awareness, sequencing) leads to an emphasis on meaning and experience in describing brain function. Indeed, it is easy to follow the historical thread that links Pavlov's hypotheses on mental imagery with Lisina's pioneering work in biofeedback. Additional work in what the Soviets call "psychic self-regulation," has been done at Kazakh State University; practical applications of this work are to be found in many Soviet clinics and hospitals.

Finally, psychology in the U.S.S.R. views creativity not as a psychosexual sublimation or a lack of proper social conditioning but as an essential human trait, part of the need for self-realization through productive work. There is a richness in Soviet psychology that is often overlooked by American scientists. Ray Peat's assertion that materialists emphasize change while idealists emphasize the status quo may well be true. If so, it confirms Murphy's and Kovach's description of Soviet psychology as an open rather than a closed system.

INTRODUCTION

By Peter Marin

In its quiet way, this book is both a revolutionary gesture and a redemptive one. It is revolutionary because it liberates the mind and imagination from the habitually diminished ways we think about both self and world, and it is redemptive because it restores, at the same time, the detailed complexity of both realms. It not only gives us a way to judge the limits of our working views of human nature, and opens up avenues of speculation now closed to us, but it also weaves together psychological, biological, political and poetic truths, thereby releasing back into the totality of experience our idea of the self, now isolated from it.

I hope that comes clear in the course of this introduction and in the text itself, because what the text offers is precisely what we need at the moment: a complex and holistic way of coming to terms with our own complexities and momentary sense of fragmentation. For decades now the ways we think about both self and world have been dominated by a mechanistic and solipsistic view of experience, one riddled by a set of preconceptions owing more to our political and economic biases than to a close observation of our own humanity. At the moment we peer at ourselves in a mirror distorted by historical forces at work in our own consciousness: a set of preconceptions so deeply imbedded in our language and thought that we mistake them for the nature of reality itself. Or we develop, as an alternative to that, simplistic or mystical notions about things, hoping vainly through that device to restore to ourselves the world we sense to be missing.

Mind and Tissue is meant to be an antidote to both conditions: to free the imagination through fact and theory, to restore to us--in all its facticity and complexity--the parts of the self and world now missing from our psychologies. To do that, Ray Peat relies largely upon certain trends in Russian psychology and biology, especially those dealing with Marxist notions of freedom, consciousness and the interpenetration of subjective consciousness and the objective world. The Russians peer into a mirror altogether different from ours, one obscured or distorted by different prejudices, and that often allows them to confront or admit what we miss. They are looking for different things, working out a different version of human nature and human possibility, a different kind of faith in reason, will and desire (forces we tend to ignore in our own psychology), and for that reason the complexity of the problems they have chosen to examine and the elegance of their tentative solutions often puts to shame our own approaches.

Of course the Russian scientists named here do not necessarily represent the general drift of Soviet science. They are part of what one can call a "countercultural" science: an anti-bureaucratic, Marxist psychology directly related to the radical anti-bureaucratic trends in Russian thought which surfaced after the revolution before disappearing with the hardening of official state policy. In some ways, it is a more humane tradition than our own, closer to the kind of "humanism" we like to claim as our own. But there are also in it elements totally alien to us, most notably the willingness to accept, as an irreducible part of experience, the aspects of human nature we deny or explain away: passion, desire, imagination, the need for freedom, the relation of vision to action. Those have traditionally been the provinces of our literature rather than our sciences, but even there, in most of our contemporary

work, the willingness to deal fully with those questions has been less evident than it used to be.

That fact, and its consequences, grow increasingly clear as one reads *Mind and Tissue*. Ray has used the Russians to show just how impoverished our own views are. Where we say "ego gratification" or occasionally "pleasure," they are able to use a deeper, richer word, desire, to indicate not only a greater intensity of feeling than is present in the other words, but also to suggest a different relation between self and world, and interpenetration, a reaching out, a kind of appetite. In the same way, *freedom* for them exists not only as an ideal or a legal abstraction, but as a condition of being, a transformative and essential state they examine as carefully as we examine pain and pleasure. Somehow their work seems bigger and deeper than our own, and that should perhaps be no surprise, for it is deeply connected with their literary and political history, in which the state and nature of the soul--the inner and absolute identity of the person, the teleological nature of existence--have been as important as concerns as the social surface of behavior. Perhaps the most revealing single thing in the entire book for me, as a writer, is the credit given by Ukhtomskii, a leading Soviet theoretician, to Dostoyevsky, and his willingness to investigate Dostoevsky's visionary notion of *the double*. It is there, at the point that great literature and science coincide, that one feels the human being made whole again, as if we were seeing ourselves for the moment with a depth equal to the depth of experience itself. And the same thing is true, of course, for Ray's continual references to Blake, who he recognizes as the west's foremost psychologist. Blake's insights, like Dostoevsky's, remain the touchstones by which we must measure our theories of the person, for their task, as writers, was to delineate the complexities and

lineaments of experience, just as ours, as theoreticians, is to explain that complexity without diminishing it.

Implicit in the scientific use of a literary insight is the necessary modern reintegration of modes of thought which were once interdependent but are now treated separately. Philosophy, psychology, biology, politics, history--when one reads Kant or Rousseau or Hobbes or Marx one sees instantly the ways in which these varied concerns were interdependent, and that they understood that the truth of human nature could be found only in a vision which drew from and made whole again a variety of realms. Nature and the way we see it, as Ray knows, defines for us the way we act in history, just as history, in turn--the age we inhabit, or momentary consciousness--defines what we can see of nature, what it becomes.

It is necessary to put that into perspective before one can understand the implications of what Ray is trying to do in his book. Since the Enlightenment, modern consciousness in the west has been defined and in some ways directed by the human view of nature and human nature. Since then, when the human world began to replace God and Eternity as the center of concern, the changing ways in which we perceive ourselves have demanded, with each change, a corresponding change in social theory and social conditions. Each of the great waves of revolution during the past three hundred years has been preceded by a revolution in thought and perception. At work in each wave has been a vision, or re-visioning, of human nature which creates, in the imagination, a necessary impulse and basis for action. In general the process has been one in which the power once ceded to God (and to kings and priests, the hierarchical authority divinely sanctioned) was taken into the human world, understood as human power.

One sees that first at work in Rousseau and his contemporaries. The history and nature of humanity are perceived in an entirely new way. A "natural history" of the social past becomes the basis for the legitimization of revolutionary ideas. Not only is authority denied its divine origins (which are replaced by the assent of a general human will), but human needs are understood to include roughly what is ours by "natural right": i.e., what belongs to persons in a state of nature. That state, though hypothetical, nevertheless takes on in the imagination a weight as great as any ever granted to God's word or the authority of the church. Nature itself becomes a text; the words "printed" there, the facts of life, are taken to be the justification for action and rebellion, just as the Bible's words were understood, before, to be the basis for defending the existing social order. Both the American and French revolutions were legitimized in theory by ideas of natural law, natural right, and the human condition in the state of nature--all of which were understood to provide a factual underpinning for a vision of freedom, since freedom was merely the extension, into the social realm, of what had belonged to persons in a previous state.

The first wave of revolution, then, put men and women back into nature, and it replaced God with nature as the main point of reference for theories about society or the state. But the nature involved was in many ways nothing more than a useful fiction. It was a projection onto the past of what would have been, thrown forward, a kind of science fiction or utopia. Reading Locke, Hobbes, or Rousseau, for instance, one is struck by the vague arbitrariness of their images of the past; science is not yet present. Or, rather, one might say that both nature and the past now occupy the center of thought, but science, as applied to them, is still peripheral, has not become central, has not lent itself to

vision. What we see is the philosophic *use* of nature. One can feel at work in it, at times, the immense impact on mind and heart of the discovery of the New World, and the changing images thereby created of what our nature was. But even that is used hypothetically, tentatively, is almost *painted* onto the past to create a backdrop, a framework and a theoretical foundation for political action.

But that, of course, is only the beginning of the process. It crests again in the mid-nineteenth century, when the natural world--previously a postulate, a semi-fiction--is established in fact and transformed again in the imagination. Anthropology, archeology, biology, geology--these "earthly" sciences become, taken together, a re-creation of the physical world. It is something of a new neolithic age. Human attention is fully turned again to the physical world. It is a far cry from the crude, large-thighed figurines which marked the art of the neolithic age to Lyell's geological discoveries, but there is something common to them both: a focus on locality, specificity, and the foreground of perception--the earth itself and its awesome presence. One can feel in it the return of the local gods who had once inhabited rocks and trees before disappearing with the rise of priesthoods and "official" religions. Darwin's attention to flora and fauna, Lyell's observations of soil and stone--these are akin to the patient generations of observation and experimentation through which men and women long ago discovered what could be eaten, how it should be grown, what had to be done to domesticate it. Here too, as in those days, the world of nature is made into a human world. It is--make no mistake about it--an act of love. Just as the neolithic farmers sometimes lay full-length upon their fields to seed them with their own bodies, others now extend them into the natural world, *penetrate* it, thereby (as we shall see

later) allowing it to enter them, becoming a part of themselves.

It is at this point that biology in general, and Darwin in particular, become central. Not only man "in nature," but *the nature of man*, becomes the dominant question. The shift is a huge one, and irrevocable. Nature passes through and into us--as if invited by the attention paid to it. With Darwin we take on, inside, a dimensionality and eventfulness which had previously been seen as external to us, occurring around and to us. The temporality and depth which had previously created a past for the world itself now creates in us a similar depth, a similar set of shadows. What Darwin accomplished was not, as it sometimes seemed, a reduction of humanity. It was, on the contrary, a deepening, a partial redemption, for from his time onward men could feel, in themselves and as themselves, gravid and ongoing currents of change.

Of course what we have of Darwin in our popular mythologies is only a fragment of his work or thought. Animal aggressiveness, "the survival of the fittest," nature as eternal struggle--these are the simplistic notions we have made of his work, filtered as it is through what the English made of it, using it to rationalize their empire and colonial policies. In actuality there is as much in Darwin about the cooperativeness of species (what Kropotkin called "mutual aid") as there is about aggressiveness. In *The Expressions of Emotion in Animals and Man*, for instance, he stresses the cumulative generational effects of learning and choice as much as he does the effects of genetic mutation. Evolution was not, for Darwin, a mechanical or mindless process; it was, on the contrary, participatory, cumulative and volitional: the interpenetration of nature and mind. The "state of nature," which had been, for Rousseau, a static condition, had become something else altogether. It was

eternally present *within* persons, even in the midst of society, and it was present as a state of flux, a series of events occurring beneath consciousness but somehow subject to learning, experience and choice.

It is precisely that kind of perception, along with others borrowed from anthropology, biology and other emergent sciences, that one sees at work in Marx, Engels and other nineteenth century political theorists. One is struck in their work by the fact that they make as much use of anthropology, biology and ethology as they do of political or philosophic theory. Their visions of a social future are constructed to be both extensions of the human past and of human nature, and their work is a reintegration of science and philosophy--all of it in the name of liberation. Just as Darwin restores nature to men and women, Marx restores history to them placing them at its center and redeeming the past struggles of others for survival and freedom. History is no longer perceived as an inevitable tendency or direction; it is understood, instead, as an arena for action, a *field of creation*, which is how Darwin perceived evolution. In that process the centrality of human choice and the uses of collective action are added to our range of perceived experience; a crucial aspect of human nature, the natural tendency toward solidarity, is made a part of what we feel to be ourselves.

What is most striking about the nineteenth century is precisely what is so strikingly missing from our own age: theories about cooperative action, community, and the human appetite for political, social and moral lives. Socialists, anarchists, communists--all took for granted, in themselves and others, a capacity for reason and a desire for freedom and justice. They assumed those to be the natural tending of intelligence, as strong a need in persons as any other kind of desire. In part, that belief was founded on

what had recently been discovered about the human past. The range of imaginable futures was increased immeasurably as people came to understand the plasticity of their own nature. Though we in America tend to see the past and evolution as proof of the inescapable mechanisms and "programming" of nature, that was not how the same material was understood in the nineteenth century. Then (as is sometimes true of some Russian psychologists now) the variety of human experience, the multiplicity of social forms, the passage from one social condition to the next, were all taken as proof of the uses and possibilities of solidarity, desire, choice and will. They were the source of an immense hope that moved large numbers of persons to action when combined with the needs they felt.

Perhaps the loveliest single text produced in the period was Kropotkin's *Mutual Aid*. It is there one can find biology and history combined to create a gentle but visionary politics that is articulated into concrete suggestions for social and economic organization. Kropotkin's belief in human possibility is based on the natural capacity for cooperative activity that he finds in both the animal and human realms. Our "animal" nature is for Kropotkin (as it later was for Wilhelm Reich) not at odds with our reason or our need for community, but its *source*: a kind of perpetual and innocent desire which manifests itself again and again in self-determining and cooperative social forms. What Kropotkin offers is a kind of loving attitude founded on fact, something that is closer in a way to Tolstoy than to Marx. Yet where Tolstoy finally based his anarchism on the gospels and the word of God, Kropotkin bases his on human nature, on what might be called a natural "appetence for good," and his belief in that is founded not only on his own research, but on the same evidence in Darwin's that the English made into the idea of

the survival of the fittest. For Kropotkin, as for most of his radical European contemporaries, science and the new view of human nature created a new hope, legitimized a new kind of revolution, revealed a human need for new kinds of political action and organization--all of which had to be appropriate to newly emergent (because newly imagined and understood) human needs.

I stress that sense of newness and emergence here, as I did in talking about the Enlightenment and earlier revolutions, because it is precisely that evolutionary aspect of self-creation, and its relation to revolution, that makes Ray Peat's work significant. In some ways our own view of nature and ourselves is beginning to crest in the same way that it did in the eighteenth and nineteenth centuries. In the scientific world and in our own imaginations different views and images vie for the central position in how we think, and in many ways the future of both thought and politics depend on which ones are triumphant. Each of us, though largely unaware of it, is even now becoming other than we were--but only as *potentiality*, in a raw and unfocused way that is going to demand from us, *already* demands from us, some kind of willed thought and action to give it a generous and human shape.

The sources of that third phase of our view of nature can be found, at least in part, in both Freud and Pavlov. At least that part of it begins in them which deals with the nature of individual identity: the way the flow of life is experienced *in the individual* as a ground of being, a drama of the species localized as self. For Darwin, Marx and their contemporaries it was the species in general which was understood to play the central role in nature and history. For Marx the idea of *classes* is borrowed in part from biology, and it represents a kind of sub-species rather than a group of varied, individualized persons. There was nothing

wrong with that; clearly it was a step forward from the kind of thought to be found in Hegel: the idea of human nature as subservient to a general "spirit," and the identification of culture with the state. In that sense, Marx's work is a step toward individuation; history is seen as a common labor, is made human. But for all of that, with Marx, as with Darwin, the individual remains a construct, something of a metaphor, an integer, a useful way of talking about the larger group.*

It is only in the late nineteenth century, with Freud's work in psychoanalysis and Pavlov's in psychology, that the depth of nature is taken to be dramatically present in each creature. In both cases nature is deeply internalized, is seen to exist at the very center of mental or cellular life. But at the same time something dangerous begins to happen. The idea of self is isolated from the world which ordinarily surrounds it. Psychoanalysis and psychology grow away from philosophy and politics. The inward focus of attention leaves the larger world apparently unacknowledged, and that is unfortunate, for the isolation belies the implication of their thought. For Freud, both nature and history, as id and super-ego, are placed at the heart of individuality and individuation. They are understood to be eternally present ("eternal Eros," writes Freud) as ongoing processes: a set of dynamic relations determining the development of each psyche. Each psyche, in fact, is perceived as the potentially intelligent and volitional mediation between nature and history, id and super-ego. The ego itself is a communal work of self-creation, is the stuff of nature turned to human

*It is for that reason, perhaps, that communist and socialist theory, as opposed to anarchist theory, has never really produced a viable concept of individual liberty, though they do have theories of *freedom*, a more general idea.

use: not an alternative to nature, not something held against it, but the *form* given to it, the shapes we allow it to take. The person is one of the arenas in which the great confrontations, struggles and reconciliations of each age occur; we are not merely "in" history or culture, but these comprise the life of the mind and tissue, since that life--at all its levels, in its various chambers and extensions--is also the presence, in us, of the historical world. Consciousness is a product of that world, just as the sub-conscious is the internal existence of a world of nature as real and as gravid as the world of animals and plants.

It is easy for Freud's followers to pick and choose among his various ideas and emerge, as we do in this country, with what amounts to a new form of solipsism or mechanism, a view of the life of the psyche as autonomic, essentially mindless--a clockwork destiny akin to the way history or evolution are sometimes seen. But those who do that merely add their own poorly understood biases and class-blindness to those already at work in Freud himself, and the result is that we make of Freud's work what the English made of Darwin. Though Freud's great dream of ego and reason was that they would be put to the service of Eros and take us toward the future, we reduce his ideas to trivial notions of adjustment, sublimations, repression, etc. We eliminate the visionary and implicitly moral aspects of the work, forget its speculative beauty and the generosity of its hope, and the end result is a theory of the self in which the self is understood only in isolation from, *not in relation to*, the world around it. What Freud did for convenience (isolating the self for study, to see it clear) we continue to do out of our cultural bias. Having forgotten the existence of organic community, wishing to deny the full weight of history, reared to accept institutional roles instead of deeply felt relation, we see in the individual self nothing more nor

less than the distorted mirror-image of bourgeois and mercantile individualism--not the self in the splendor of its human appetite for others, but a self "cast down" and in perpetual humiliation. Our psychology and therapies reflect the alienation at work in our social and economic systems, and we use them to screen out from consciousness whatever would call those systems deeply into question.

The same thing is true in some ways of Pavlov's work. In this instance I am less sure of my ground than I am in Freud's case. I know Pavlov's work less well, and I rely here on what Ray writes rather than my own conclusions. But nevertheless it seems clear that if one comes to Pavlov's work with a belief in the uses of freedom, and a sense of holism, and can also set aside what Watson made of Pavlov's work, then one can find in it some of the raw stuff which must be woven into a vision of human complexity. What happened to Pavlov's work was similar to what happened to Freud and Darwin. Its implications were developed by later researchers mainly in one direction, toward mechanism or mindlessness, though it *is* true of Pavlov, as it is of Freud, that those implications can in fact be found in the work. But there are other and more compelling elements which can also be found in it. What interests me about Pavlov is the way in which the force of nature is seen at work both in the organism as a whole and in the individual cell, and in which these seem simultaneously present in one another. Nature is miniaturized, and it materializes at the very core of being, in its smallest parts. It opens, inwardly, into an internal universe as extensive as the macrocosmic, external one, so that we seem to grow in size. What Freud restored to the mind, Pavlov restored to tissue. It is there too that mystery resides and vision can be found, and that is a source of power.

Do I make myself clear? What I am saying is that there is already enough information, theory, image, evidence and hard speculative work for us to begin to deepen, in a clear and visionary way, the ways we see our own nature and our place in nature. It is both necessary *and* possible at this point in time to add to the impetus and lessons of previous revolutions what we see that others did not. It is not that those ways of seeing were insufficient then. Clearly some visionary dreams, values and ends do not change. Fraternity, equality and liberty; Kant's "kingdom of ends" Rousseau's notion of the general will; Kropotkin's mutual aid; Proudhon's ideas about justice; the recurrent human dream of cooperation, social justice and the equal distribution of wealth and access to power--all of this can be taken as a kind of cumulative human wisdom: not to be discarded, but to be deepened and extended anew in terms of how we now see ourselves. It is, for us, the *act* of deepening and extending which is crucial, because it is there, in the felt enlargement of vision, in the thrust and excitement of the shape the world takes as image and desire, that one finds at least part of the courage it takes to act in the world.

The partial answers our science offers have raised a new set of crucial questions. Can we learn to talk about freedom, morality, society, ethics and choice in a way that includes and illuminates what goes on in the nervous system itself, in the individual cell? Can we talk about what goes on in the cell in a way that revivifies our belief in freedom? Can one see the eventfulness of the microcosmic world as more than a form of inevitability? Can one envision it in a way that restores to it a teleologic identity, one effected and partially expressed by the larger systems we build through vision and reason around us? In what way are those miniaturized and yet gigantic operations a part of vision and

reason? Are they changed by it? Are they its partial source? What is their relation to energy and desire? Do they produce them? Express them? In what way do they respond to changes in consciousness? What is their role in imagination? How are they changed by imagination?

These questions are close to the heart of what Ray is getting at here. I do not myself believe that such questions or their answers can supply us with the necessary moral or political grounding without which our theories lead us always askew. But if they are not included in our moral and political concerns and woven into our vision, then we are left with something far too narrow, too unconvincing to be of use. The questions raised here give to that vision a substantiality it otherwise lacks. They demand, implicitly, that our social actions and systems honor the full extent of our self-knowledge. When Mao, for instance, talked about the "cell" as a principle of political form, he was referring to the ways cells operate in nature, and to their relationship to the larger organism whose parts they are. But what happens as we understand the cell in different biological ways, as it becomes more ambiguous, a bundle of energies rather than an identifiable *thing*, an event rather than a place? How does that change--in the long run, in deep images--the ways we will eventually see ourselves when grouped together? That, in part, is what I mean. The sciences are a challenge, a goad. We cannot simplify things by turning away from them, for they are there always--the *presence in thought of the physical* world--demanding, as they provide us with theory and information, that our vision account for the full depth of experience. They make impossible for us simplistic or reductionistic solutions or approaches.

That is not to say there is not, implicit in science, in its language itself, a kind of reductionism--or, at least, the

permanent danger of reductionism. That is there, of course. One can find it in Freud. One can find it in Pavlov. And one can find it even more in those who come later and make use of their theories. It is difficult, even with the best of wills, to keep in mind the full field of human significance in which discoveries, facts and theories have their lives. It is easy to forget that each one of them occurs in a moral, political and historical realm, that each one is a part of, and an act upon, a field of significance defined by both the imagination and heart and larger than what we have learned scientifically. The significance of moral and historical concerns is not necessarily generated by science itself; they must be brought to it by volition and will, by a felt love of the world, a sense of human freedom and justice. If those elements are not present as we do our investigating, *before* we do our investigating, what we learn through our sciences will be exploitive by its very nature. Fortunately, Ray Peat understands that--I do not mean to suggest he does not. The science he offers us here is offered as what must be woven into vision, wedded to both politics and poetry before it is whole. Science is perceived not as a way of defining reality; it is, instead, a way of perceiving the full extent of the reality that must be defined and re-envisioned and then *made* real--through action in and upon the world.

That, I think, is a crucial point: the necessity of action. Perception is not sufficient in itself. In fact, if it does not impel us to action then something is wrong with either the perception or the way we receive it. We like to think of the future in terms of inevitability, apocalypse: inescapable slant to destiny. But that is not the case. The world does not move inevitably toward light or darkness--not in any particular culture or place. It oscillates between them, and each historical epoch or moment is a balance between them established by specific human

choices: the collective decisions people make or fail to make, the kinds of responsibility they take upon themselves. Vision does not simply visit us from the Gods. It is a cooperative, creative work which is ours *by nature*: the impulse in flesh itself (Freud called it Eros) toward the world, our appetite for entering and changing it--a form of love.

At the moment, of course, we have trouble keeping that in mind. We seem befuddled in America by both politics and history, exhausted by them, propelled by shame and fear into a bourgeois dream about the end of history, or its existence outside of use, apart from human work. But we will not be saved by any magic external to ourselves. Either we learn to act within history in accord with our deepest vision or we disappear from it altogether. Ray Peat knows that, and what he offers us here is a bit of the beginning of that *laborious* process. Ezra Pound once said that all good literature was "an impulse to action." And Rilke, describing an archaic torso of Apollo, said of it: "There is no place that does not see you. You must change your life." There is a point at which science, given shape by the constraints of evidence and demonstration, comes to the same visionary condition: impulse to action, injunction to change. It does that through the creation of deep images which generated energy and organize desire, moving us--as does all energy and desire--to reach toward the world, enter and change it. It is not a process many of us trust at the moment, we do not ordinarily think of science as a complement to politics in the struggle toward freedom. But Ray Peat manages to convince me that it is. I feel in many ways emboldened and heartened by what he describes here, and less lonely. I can see in the hard work of others much of what I know intuitively, poetically, to be true, and there is in that a freshening of hope. There is something here to

lay one's hands on, something to try to wrestle into form, to put to use in the world. Ray likes to talk about Blake, who in turn believed in *Jerusalem*, the just and joyous city to be built not in heaven, but on "England's green fields." Jerusalem is the outward shape of the collective nature of our inner lives, something we share even in our fragmented condition, but which will become whole and clear only when we have managed to "build Jerusalem" in the actual world.

That is the work Ray has in mind in *Mind and Tissue*: the realization of vision--the making real of what exists now as image or desire. He understands that vision is a collective act, a communal work: not the romantic solitary hero working alone to save the world, but a community of persons moved by a vision shared among them and theirs by nature, by virtue of their humanity. Each of our disciplines or crafts is an extension of something larger, the limb of a visionary body which exists in entirety in imagination and toward which we move, *becoming*, as we act in the world. The difficult task we confront in the world is maintaining, in our apparently separate spheres, a sense of the wholeness which moves us and toward which we move. Ray understands that wholeness, and it is that understanding which generates in this book, at the same time, a sense of power and a sense of humility. The scientific truths Ray talks about are perceived in a field of significance which is in part produced by science but which is also brought to it from other realms: politics, history, morality and philosophy. In that sense, though he would probably blanch at the notion, Ray seems to me something of a Kantian. He accepts the nature of persons and their well-being as a "kingdom of ends"--not in the sense that they are finished or complete, but that they are irreducible *goods* against which all action and theory must be judged. The shadow of life in all its complexity falls across each scientific fact or theory, is

a standard against which it is measured. For Ray science is simply one of the gates which open into the world, and it leads us into chambers where we meet others who have arrived there in different ways. It is part of--I was going to say the "restoration" of being. But that is wrong. It is part of the *creation* of being--the task handed us by existence itself To hold in the mind, at the same moment, the energetic event that is the cell, the processes that form the stars, the human nature of freedom and desire, and to feel it all as *ourselves--that* is the world's gift to us, one spelled out at times by our sciences. It ought to lift us like a tide, propelling us, as sometimes it does, into the world, where our task is, always, to make a proper home for it and ourselves.

PREFACE

In the two years since 1973 when I wrote *Mind and Tissue*, one of the few good trends I think I have noticed in the US is an increasing distrust of empty formulations, ritual, and authoritarian professionalism. People are possibly more often looking for something that works, rather than just anything that sounds good. In this context, a book about Soviet brain study should be useful to a broad section of the population, since the Russians have for many years been using techniques of "hard science" for the achievement of goals which in the US have fairly recently come to be identified with Humanistic Psychology. Besides introducing readers to some useful approaches and techniques in psychology, I think the book can provide a new perspective on science itself, showing how it can be humanistic and life promoting, rather than just "ethically neutral."

To the extent that I claim science to be a humanism (as Sartre says that socialism is a humanism), I find myself being viewed as a non-scientist by American scientists; when I claim that broadened perspectives would be liberating for science students, I find that American scientists retreat in horror. Humanists who find those attitudes of scientists repugnant also assume that one should conclude that science itself is at fault. I intend this book to be a defense of science (as science might be), and a demonstration that science is properly humanistic, that no perspective should be shut off arbitrarily, that scholarship should be acceptable to scientists.

If the Cold War in science is to end, I think we must achieve clarity and self-consciousness by impugning the

scientists who have built their careers on loyalty oaths and silence in the face of McCarthyism or other forms of censorship, mind-control, or fascism. We should remember that hundreds of German scientists who condoned "racial hygiene" and murder-experiments are still contributing to the atmosphere of the scientific community.

The concept of science's "ethical neutrality" is largely an outgrowth of Hiroshima and the German Science-Murders. The American doctrine of "eugenics" was renamed "human genetics" after the embarrassment of the Holocaust, but the essential doctrine has lived on in the academic world. "Ethical neutrality" has been used to confine guilt to individuals. (And it is even more refined than that: The man who devised the genetic rationale for the Holocaust can be honored by distinguishing his political intention from the abstract content of his work; even guilty individuals aren't really guilty in the ethically neutral world of science.) But there are systematic motivations of a cultural and historical nature which shape the nature of science. The distortions and falsifications of the pharmaceutical industry and the nuclear power industry have seriously degraded our scientific culture in recent years. These pressures are not likely to decrease in the near future.

If American humanistic psychology, the tradition of people like Kurt Goldstein, Carl Rogers, and Abraham Maslow, can assimilate Soviet brain science, I think it can complete its displacement of the old dogmatisms in American psychology and physiology, and will then be in a better position to make a deep and lasting contribution to the culture itself

Chapter 1

(Historical origins of Russian brain theory)

In the Spirit of Matter

A culture is a theory of human nature. Some cultures are self-deprecating, others are split in their image of a noble class ruling an inferior class. One of the themes of Russian culture has been that of a potential waiting to be fulfilled--Russia waiting to lead the world to spiritual awakening, the spiritual richness of the peasants, etc. In the 19th century, Khomyakov and Kireyevsky contrasted Russia's "community" to Europe's spirit of violence, competition, and conflict between races and classes. They believed Europe was the product of Roman and Germanic conquests, and was deformed by authoritarian and rationalistic Catholicism and self-centered Protestantism. Oriental influences have contributed to the complexity of "Russian" culture, but we can get a valid insight into the culture just by briefly considering how their Orthodox Christianity differed from our western Roman Catholicism and Protestantism.

According to M. Spinka, "The eastern theology had its roots in Greek philosophy, while a great deal of western theology was based on Roman law." Typical differences were the Romans' emphasis on the divinity of Christ, their enforcement of clerical celibacy, and the limitation of the right of confirmation to the bishop. A deeper difference is the absence in the Eastern Church of creeds as summaries of what must be believed. The distinction between Greek philosophy and Roman law is the distinction between knowledge and power.

Still, the Roman church has been deeply influenced by Aristotle, through St. Thomas. The Arabic translations of Aristotle first came to the West as distorted Latin translations, but Thomas got his Aristotle directly from Constantinople, where his philosophy had been studied since the time of Justinian.

Protestantism has followed Luther in hating "Aristotelianism." Thus, we can see a "gradient of Aristotelianism" rising toward the East, within Christianity.

There is a well known theory that the Protestant form of Christianity (especially Calvinism) is the appropriate ideology for capitalism, as Catholicism is the ideology of feudalism. The preference of Protestants for Platonism can be interpreted in relation to the historical need for a more absolute kind of idealism. Anyway, the important point for understanding some of the present cultural differences between Russia and the West is that Russia has for centuries felt the influence of Aristotle, and has not suffered from the influence of Plato or Calvin.

We still hear people making disparaging remarks about "Aristotle," but what they are really disparaging is the formal logic of medieval Christianity, which had learned nothing from Aristotle except his logic, and made poor use of that.

Many of the themes of Western philosophy, such as the analysis of "substance," can be traced to Aristotle, as others can be traced to Plato, but the remarkable thing is that Aristotle's common sense and extensive knowledge of nature were lost in the process of "refinement." Aristotle was a real scientist, who gathered data and gave meaning to them by finding general theories to explain them. The ideas of growth and change were important to him; Engels described him as a dialectical thinker, with "fluid categories," just the opposite of what most people mean

when they say "Aristotelian." For Aristotle, growth and evolution are both a process of realizing the thing's nature, which was already present as a potential at the beginning of development. Engels and Marx seem to have vacillated on this question of teleology, of an inherent purpose in matter. This is a scientific question as well as a philosophical problem, and is now being increasingly discussed by biologists and chemists (e.g., Rohlfing and Oparin, in *Molecular Evolution*, 1972).

This evolutionary question is of great importance for brain study, but unfortunately it is seldom discussed in these terms in the Soviet scientific literature. In fact, inheritance of differences in mental ability is usually denied, so that all effort will be used to improve the environment, instead of justifying deficiency as "inherited and therefore fixed." Also, the conflict between Mendelist geneticists in the big universities (Moscow and Leningrad) and the Burbank-Lysenko followers in the agriculture research institutes still exists, despite the fact that the government no longer gives its support to Lysenko's doctrine, and this may contribute to the problem of studying brain evolution. Of course Marx's and Engel's theory of labor as the main force in creating the human brain is often discussed in the Soviet Union, as it is in the United States since being popularized by Jerome Bruner.

Since Christians used the idea of purpose or teleology to deny materialistic explanations of evolution, most materialists have been extremely careful to keep anything resembling a "vital impulse" or a teleological force out of their theories of development and evolution. If time, history, and dialectical development are to be affirmed, they have felt, any tendency of matter to favor a certain line of development must be denied, because it would let preformationism and dualism get a foot in the door.

How much weight should be given to matter, and how much to the situation in which the material exists during a certain time? An image illustrates two extremes: imagine finding an old cat-gut violin string that has been coiled in its package--stretch it out beside a silver watch-chain, coat both of them with a little sticky pitch, and then form each of them into a variety of geometrical shapes; with the cat-gut, some shapes will be impossible, but it will almost spontaneously return to its coiled shape. With the watch-chain, all shapes will be about equally easy or difficult. Is matter as passive as the watch-chain, taking one form as easily as another, and being limited only by circumstances, lacking intrinsic preferences? Aristotle held that matter was not passive in this sense, that given the necessary conditions of life it realizes its potential, and takes its form neither from the environment nor from chance variation. Naegeli's orthogenesis and Osborn's aristogenesis are modern forms of this idea--the most recent expression is in *Biochemical Predestination* by Kenyon and Steinman. Another kind of theory also excludes pure chance, but gives environment a role in forming the organism: Eimer held that orthogenesis (straight-line evolution) could result from a molding influence of the environment, and Lamarck emphasized an active (physiological) adaptation of the organism to its environment. Darwin would fall into this group to the extent that he denied that variation was random, and also to the extent that he believed that natural selection was not the only mechanism of evolution.

Ironically, the neo-Mendelists have almost excluded matter and its properties from their genetic theory of evolution, though many of them feel that they must do so to save their "mechanistic" science from the "creationists" who oppose even the idea of evolution. Random variation of the genetic material is their basic assumption, and natural

selection of certain alterations is their proposed mechanism. Both of these doctrines, randomness and natural selection, are important ideological components of capitalist culture, so the ethno-centrism of the neo-Mendelists is just a little more modern than that of the creationists who threaten them.

Oparin and his followers (and there are growing numbers of them in the United States) have demonstrated that many chemical reactions and structural processes which closely resemble those in organisms can occur spontaneously under conditions existing on earth, as a result of ordinary chemical reactions without having to invoke random variation or natural selection. Pauling and Zuckerkandl (in *Molecular Evolution*) have convincingly argued that the doctrine of "inherent randomness" is really a doctrine of the mind's inherent inability to understand matter--an ideology of subjectivism posing as a scientific attitude.

To find more convincing general mechanisms isn't to deny that chance variation and even Malthusian selection sometimes occur. Also, endless flexibility and potential for new growth is not denied by holding that there is a "tendency" inherent in matter, since the "tendency" would also be modified (and maybe intensified) in more complex structures. (Later, we will consider how physical resonance might constitute such a tendency of matter.)

Whatever influences other than Aristotelian Christianity were acting, Russian culture in the 19th century was probably the richest and most spectacular in the world at the time, with great achievements in many areas of science, literature, and music. (Though England's literature, France's painting and sculpture, and German physics were high points of the 19th century; my point is that Russia had several great traditions. Russia's weakness in the visual arts

is notable; Salvador Dali suggested that their eyes were damaged by too much snow.) It was a culture that was ready to accept the Romantic historicism of Marxist philosophy, even though the economy wasn't advanced enough to be ready for a real Mandan revolution. (Similarly, the Taoist dialectical tradition in China seems to have been favorable to Marxism, in spite of the primitive technology. Mao has been aware of this cultural factor which has made communization possible without the sort of great dictatorship of the bureaucrats, that the Soviets inherited from the Czars.)

Dostoyevski was an important thinker, whose novels investigated both psychological and social questions with originality. He advocated social reform and democracy, and believed that the highest spiritual values existed in the Russian peasants, with the result that he adopted Christianity with the attitude that if Russians believe it he should believe it. This attitude seems silly on the surface, but as understood by Dostoyevski it represented one of the highest human functions. A very good analysis of these ideas and discoveries has been made by A. A. Ukhtomskii, a major brain physiologist who studied Dostoyevski's books for guidance even in scientific matters:

Long ago, since I was 19 or 20, I began to wonder wherein lay the essence of the problem that tormented Dostoyevsky. And it seems to me that that gradually became clear. You know, the hardest thing in the world for a person may be to free himself of his double, his automatic tendency to see himself, his faults, his shortcomings, his secret deviance in everyone he meets.... And only from the moment when the double is overcome is the road open to free communication with another!

It is then for the first time that mind, heart, and word are revealed, making it possible truly to hear what it is that makes the person one has encountered tick.... An open heart and open and intelligent hearing detect and understand in the other that which the individual had been unaware of in himself, and which merely dully exhausted and tormented him from some undiscovered part of his insides! ...thousands...come from all directions to enter into communication with this person who had taught himself to see and hear the people who took the place of his discarded double.

In a more general comment on the story "The Double" Ukhtomskii wrote:

In the final analysis this is a philosophical and psychiatric treatise about solipsism and self-assertion as the basic characteristics of a typical representative of European civilization....

Dostoyevski wants to emphasize that the most insignificant, ungifted, little European-type person bears the embryo of "delusions of grandeur" because he has been seized by the "epidemic of self-affirmation" with a fateful incapacity to see in his neighbor an existence in the world equal in value to his own."

My...task is to understand how the kind of sensitivity possessed by the *Elder Zosima* comes into being. I learned that it is created by a great physical effort, a tradition handed down from others, and an attitude toward the world

as toward a beloved, respected companion with whom one is close to the point of intimacy.

...an individual cultivated in this way turns out to be uncommonly sensitive and responsive to the lives of other persons and is able to readily place himself in the position of the other, with *his* attitudes and tribulations.

Only if another person is moved and extends patient help, can an individual be torn out of this *fateful subject-object relationship*, owing to the fact that the world is to each individual what he deserves, and the individual is like his particular world! For one needs *nothing more nor less than to change in a person his physiological perception, that which is physiologically customary, the continuity of his life...*

Whatever an individual's dominants, such too is his integral image of the world; and whatever his integral image of the world--whatever his behavior--such is his happiness and misfortune--which is the fact others see. It would seem that one can say that the *elder Zosima* and those like him possess a technique for penetrating into the immediate future in a highly unusual way and with regard to the single individual closest to them. They possess a *dominant for the personalities of others...*

As soon as one senses the fundamental superiority of living reality and persons over self-asserting, self-isolating knowledge seeking security for itself, one discovers that it is only via culture in the whole man, the culture in his deeds (will and love) that a *vision* can be

achieved in the great gloom of conflicting human souls and persons

I have quoted numerous passages from Ukhtomskii's writings because they illustrate several things about Russian brain physiology. The idea of the "dominant" is one of the key ideas in modern Soviet brain research; as used now, it contains the meanings of *focus* and *perspective*, among other connotations. Ukhtomskii's scientific work has been very influential, but more than that, his attitudes and concerns are representative of Russian culture in a general way. The deliberate use of science as a tool of human understanding as well as for practical ends, giving science a human shape, are some of these attitudes.

The "dominant" is a physiological way of expressing the idea that the organism works as a whole in organizing its own functions, and in organizing knowledge about the world. Deriving it, as Ukhtomskii did, from Dostoyevski's work on the "problem of self-assertion," means that it will have a connotation of "self," that when obtaining real knowledge about the world (when we can escape mere self-assertion and "automorphic" perception) we will be knowing it with the same brain-process that we use in knowing other people and ourselves.

This process can be thought of as a centering, or focussing, both within the nervous system and in the world surrounding the perceived thing. The imaged object always exists within a world. Things have intrinsic meaning, because they are syntheses within a world of relationships. In the same way that cortical differentiation enriches our experience, forming a "dominant" opens the known thing into a richness of possibility, of flexible uses and purposes.

In the United States, Manfred Clyne (a pianist and computer engineer) has demonstrated that feelings are

recognizably expressed by movements as simple as pressing a lever with one finger, and that listeners will make a characteristic expressive gesture for compositions by a given composer, whether they have previously learned who composed them or not: What they are sensing and expressing is apparently the "dominant" of the composer, his "life-gesture." Ukhtomskii used the term "the interlocutor" to describe the contact that occurs between people, whether it is direct, or through music, writing, art, or other work. It is this which allows a person to develop in himself a "dominant relative to the visage of another person," and by means of this to enrich himself with impressions of the other's internal life, to get new impulses for growth, and to get new understanding of himself.

Ukhtomskii, in describing the sense of hearing in his textbook *Physiology of the Nervous System*, emphasized its importance in communication, its use for language which transcends physiology. Pavlov and Vygotsky have built up a physiological view of language which recognizes this "new layer" of meaning processes. They call language processes "the second signal system," distinguishing it from the ordinary sensory system which handles the "signals" from the environment.

In the United States, what we know of Pavlov is largely what came to us through Watson's "objective" psychology, which denied consciousness for the sake of "science." As a result, it is often supposed that Pavlov practiced a kind of Watsonian "objective" psychology which denied the relevance (or even the existence) of consciousness--especially since he was investigating digestion when he discovered the conditioned reflex. But Watson's "unconscious" psychology had only the most trivial connection with Pavlov's psychology of conditioned reflexes. For example, Pavlov emphasized that the

"highest" part of the brain, the cerebral cortex, participated in the "simplest" seeming reflex. The English physiologist, Sherrington, also recognized this, and said that the old ideas of isolated reflexes were simply fictions. For Pavlov (and Sherrington) the whole organism had to be the subject of study. Somehow, Watson argued for the study of the parts, and seems even to have denied the existence of such a thing as an organism! Apparently this would have brought him too close to consciousness, since presumably it is the organism which is conscious. Modern American Behaviorism (including Skinner) is still close to Watson's position, and generally ignores Pavlov's real work. One small advance in Skinner's work over Watson's is the recognition that pain and the avoidance of pain are not the only motives for behavior.

Skinner's environmentalism is sometimes viewed as a humanistic aspect of his theory--and increasingly so. Carl Rogers has recently remarked that Behaviorism is a valuable complement to other therapeutic techniques. However, Skinner still holds a strongly genetic, rather than really developmental view of human abilities. A common American idea of the brain is that it is "genetically" "wired up," and some degree of rigidity is assumed even by the environmentalists, but beyond the rigid inherited system, there is assumed to be a passive ability to learn.

In Russian brain physiology, increasing specialization of function in certain areas of the brain is considered to be a feature of evolution, but plasticity is believed to be the outstanding property of nervous tissue, especially of the cerebral cortex. An American (Pietsch) has demonstrated that frog and salamander brains will work normally even when removed and put back in backwards, but this fact hasn't impressed many of his American colleagues. In Russia, such demonstrations of the extreme

plasticity of the cortex are central to their thinking about the brain. For example, the leg nerve and the vagus (digestive) nerve of a dog can be "criss-cross" stitched, and the dog will recover his normal walking ability. However, if his cerebral cortex is later removed, the altered arrangement of the nerves will no longer be compensated for by the cortex, and the dog's leg will not be able to function normally. The adaptation is obviously "teleological"--the dog achieves its purpose of walking, in spite of the rearranged nerves. The cerebral cortex is thus an "organ of purpose."

It has long been known that when part of the cerebral cortex is destroyed by disease or accident, the function that was "localized" in the lost portion can be regained. All functions, however, will be slightly diminished by the loss of that formerly "specialized" tissue. (Even body functions such as aging appear to be affected by the brain loss.) This capacity of the brain to restructure itself is believed to be based on a plasticity in the nature of the nerve cell itself. This is another major point distinguishing Soviet and American brain physiology, since the tendency in the United States is to see the nerve cell as a simple on-off switch, regulated almost exclusively by external, "synaptic" influences, of excitation or inhibition. Since radical plasticity is only a minority view in the United States, there isn't much need to explain how "restructuring" can be achieved. When it is attempted, as in Pribram's hologram theory, the synapse, and processes of interference occurring at the synapse, are still the basis for the explanation. Probably the underlying reason for the conservative thinking is the view that the nerve cell is an ionic solution separated from its environment by a membrane, internally "simple" or randomized as far as its signal function is concerned, and capable of interacting only by means of special points on its surface, the synapses. This ignores various features such as

radial and longitudinal gradients of electrical potential within a single cell, or metabolic and structural conditions which lead to complex states and processes and interactions which might serve to handle information more effectively than "switches" could.

In Russia, a different view of cell structure is held by the majority, and this view is one which allows for more complex interactions of cells, and makes possible a more direct experimental approach to the study of inhibition, fatigue, excitation, etc. For example, a given stimulation can be excitatory or inhibitory, depending on the functional state of the nerve cells; a given substance can be either excitatory or inhibitory, depending on its concentration; the physical state of cell proteins can be used to determine the state of the cell, as can stainability of the cells. Nevertheless, Pribram's version of the hologram theory of brain function was well received when he presented it at a conference in Russia recently--the basic idea in the hologram model, viz., diffuse storage, was already developed in Pavlov's analysis of each "sensory analyser" system into a nucleus and a peripheral section, and also in the idea of "latent reserves," both of which emphasize the diffuse interconnection of fibers from different systems. For Pavlov, though, the "functional state" of the nerve was more interesting than the synaptic events.

Aristotelian assumptions about the "tendency" of matter to develop will result in a kind of "environmentalism" which is very different from Skinner's. For example, "self-actualization" has meaning only when the concept of "organism" is open, developmental, and in a "dialectical" relationship with the environment, but with some intention or direction inherent in itself. On the social level, Skinner's theories would make smooth-running the main virtue, instead of moving toward higher levels of being.

Orientation toward the future is more important than "homeostasis" for Soviet brain theorists, and is an attitude that derives from Aristotelian philosophy as well as from Marxism. For example, consider the ideas of pleasure--for Aristotle, it was the result of the free, unimpeded flow of a desired activity, but for the strongly anti-teleological theorists in the West, it is the *cause* of desire, by way of learning, instead of its result. If sexual pleasure were the cause of sexual desire, wouldn't adolescents in a sexually repressive society have an easier time than they do? Rather than mystifying and denying our experiences it would seem more profitable to study and try to explain such clearly purposive, "teleological" processes as sexual desire and sexual behavior. An inborn desire is a valid subject for scientific study. The philosophical bias against the study of desire, which dominates western thinking, is a peculiar new form of mysticism, which tries to explain everything in terms of the past.

A Western tradition, phenomenology, associated mainly with Vienna, has also made good use of Aristotle's knowledge: Brentano and Husserl used the concept of "intentionality" to explain perception and knowledge. Kurt Goldstein's organismic studies of the nervous system were influential in the development of the phenomenological views of Carl Rogers, Merleau-Ponty, and Abraham Maslow (best known for his popularization of Goldstein's "self-actualization" idea). Because of the Aristotelian content, phenomenology is most widely accepted in Latin countries, especially France and Latin America.

Ukhtomskii's idea of the "dominant" shouldn't be interpreted as "just an earlier form of Gestalt psychology," which of course is one of the forms of phenomenology. Some forms of Gestalt theory are practically identical to Ukhtomskii's theory, in emphasizing the ability of the

organism to form new unities: Goldstein and Merleau-Ponty are in this group. But another school of Gestalt Psychology, and phenomenology, stays closer to Husserl and the neo-Kantians, in emphasizing intrinsic forms of knowing, as opposed to empirical forms. Symbol thinking and inborn limits to knowledge are doctrines of this school: These Gestalt subjectivists accept the theories of Cassirer, Chomsky, Piaget, and Monod/Stent, and are antithetical to the "Ukhtomskii school." It should also be pointed out that Carl Rogers' version of phenomenology denies objective conflicts of interest, and as a result is popular among United States business leaders: Rogers has argued, for example, that there is no real conflict between workers and owners, and that "good communication" will lead to resolution of conflicts, rather than to the understanding that wages and profits are really opposed. The fact of power is ignored. The theory of generality isn't typically a strong point of Gestalt psychology and phenomenology; their focus is on the here and now.

Even Marxism seems to have incorporated some of these insights into perception which were current in the 19th century. The Marxist idea of "reflection" of reality in the mind is both active and objective. Leontyev and Gippenreiter (in *Psychological Research in the USSR*, 1966), following Marx and Engels, describe mental processes "as a special form of activity which practically connects man with the world of objects that surround him." Another way of considering "reflection" is that every organism exists in interaction with its environment, so that a certain kind of environment is "assumed" by an organism at a certain stage of evolution: The environment in a sense is a completion of the organism's structure, since the organism can't exist in isolation, and is selectively sensitive to the appropriate aspects of its environment, such as food and

threat. We have evolved a complexity that allows us to "select" a complex kind of environment to which we respond, and our existence depends on the objective interactions between ourselves and our environment. Our consciousness is interaction. It is a condition for action, but it also is derived from our activity in the world. To say that it is "objective" in this way is not to deny the possibility of mistakes and perversions, but it is to claim that in *every* human idea, perception, or theory there is some truth, something worthwhile, if we are able to extract it.

*Quoted from V.L. Merkulov, The influence of Dostoevsky on the creative work of A.A. Ukhtomskii," *Voprosy filosofii*, No. 11, 1971, *Soviet Studies in Philosophy*, Vol. XI, No.2, Fall 1972, p. 195.

CHAPTER 2

THE IMAGE

As Westerners, we are accustomed to a certain dryness or abstractness in scientific and academic matters. "Just reporting the plain facts" is taken as a kind of ideal, in the U.S. particularly. If we think about Soviet intellectual life at all, it is often to deplore the "politicizing" of matters that should be mere questions of fact. It is seldom that we can imagine a fact which is intrinsically "ideological."

A few western scientists have decried this "hard fact" syndrome in American and European science, but their criticisms are not really heard. In fact, these scientists usually criticize themselves right out of the world of practicing scientists, and into a kind of underworld that is populated mainly by older, individualistic intellectuals--Michael Polanyi and Albert Szent-Gyorgyi are the best known members of this scientific counter-culture which calls for intellectual wholeness, responsibility, and integrity.

For historical and cultural (and political) reasons, however, the Soviet scientist is likely to see everything he does as having social significance and ideological overtones, apart from any urging he might get from the bureaucrats to praise the insights of Lenin and Stalin into his particular field. Sometimes these paragraphs of praise that are included in occasional scientific papers seem simply bizarre to a westerner, who is used to politicians being politicians, and scientists being scientists. But the fact is that both Lenin and Stalin were remarkable intellectuals who believed it was their political responsibility to be very well informed about cultural and scientific matters. It is this same attitude which makes the Soviet scientist likely to choose problems with social significance, and to interpret his work in terms

of a large historical framework. While an American scientist undoubtedly does work within a definite intellectual framework, the framework is mostly tacit, and serves to justify the collection of "mere facts."

The whole analytical and skeptical tradition of British philosophy has not been taken very seriously by the Slavic and Latin* cultures, and Marxism has enabled the Russians further to disregard many of the formulations and proscriptions of Anglo-American thought. The idea of the *image* is the most important example of this dichotomy in the intellectual world, and is the crucial issue in brain research and all of its ramifications--including language, health, education, adaptation to new conditions, and the planning of work.

Since the image is taken to be real, and is such an obvious part of our ordinary existence, for the Soviet brain researcher the question is not *whether* images exist, but *how* they exist and what their relation is to sense, reflexes, learning, movement, and meaning. "Imageless thought" is typically dismissed¹ as a foreign mistake, along with Freudian concepts such as unconscious motivation.² American Behaviorists reject consideration of mental images as "mentalistic" and therefore unscientific, and many neo-Kantians or Cartesians--for example Noam Chomsky--prefer their mentalistic formulations to be composed of rules or other non-image units which are not directly accessible to consciousness. The most technical Soviet studies therefore often have a common sense, "man in the street" quality about them, and this probably accounts for some of the American disregard of them, since they seem to violate some of the "basic" (Western) scientific principles.

In the West, studies of the brain and behavior tend to focus on "motor," or efferent systems, since the essence

of their activity--i.e., movement--is objectively observable. A typical American formulation is that there are "motor programs" which govern behavior,³ and that these are somehow coordinated with sensory, associative, or cognitive systems. In this theory, it is possible to put an electrode into the "motor region" of the brain, and to electrically activate a "motor program," so that, for example, a rooster will "emit" aggressive behavior. Soviet biologists tend to interpret this kind of experiment differently, because they view the sensory, or afferent systems, as being the most important aspect of the nervous system, and as constituting the essential organizing process of the brain. It has been emphasized⁴ that most of the fibers extending from the central nervous system are sensory, and the cortex is thought of as an afferent system, after Pavlov.⁵

When we see the rooster "emitting" aggressive behavior, we should notice that his behavior is still coordinated, with reference to the ground, posture, and surroundings. If there were such a thing as a pure motor system, it would seem that we should be able to get the animal to "emit" a series of movements which would be independent of circumstances such as his initial position or posture. The "motor program" being activated in this experiment is therefore not a pure or independent motor program. How can we be sure that this is a motor center, and not just a pain "center" that convinces the rooster he is being attacked? How can we be sure that we are not stimulating a memory, or causing the rooster to hallucinate that he is being attacked? We could account for the same behavior by interpreting the experiment as an interference with the rooster's *experience*, rather than with a hypothetical "motor program." In the Russian view, with its emphasis on "afferentation," this would be the preferred interpretation, since there would be no question of the

"purity" or isolation of a part of behavior, and therefore no need to account for the existence of coordination which contradicts the supposed isolation. In the West, "experience" is not considered to be a quantifiable, proper matter for science to deal with, and so by default the behavior is interpreted as being essentially "motor" controlled.

A related idea is that there is no merely passive "receptor" system, but rather an active analyzer system, incorporating effector links.⁶

The very concept of behavior implies coordination or orientation. The fragmented or isolated movements that are favored for study in the West, because of their purity or simplicity, have been denounced as "the nearly artifactual" results of vivisection, in the Soviet literature.⁷

Coordination implies three kinds of image, and apparently involves the interaction of three general parts of the nervous system.⁸ An image of the space in which the behavior is to take place is necessary, and the occipital-parietal area of the brain is the part of the brain most directly involved in this. An awareness of the position of the limbs and the general attitude of the body is also necessary and the posterior region of the hemispheres is related to this function.⁸ The sequencing, goal-direction, and meaning which are necessary for behavior to exist, are largely functions of the frontal part of the brain. This sequencing process, for example, makes it possible to perceive rhythms, or temporal patterns,⁹ but this process is also fundamental to all behavior or perception which persists or develops meaningfully through time.

The organism then has a model, or image, of the space in which it will act, of its body's relation to this space, and of its intended behavior or its goal. It is this *intention image* which very clearly distinguishes the Soviet approach

from the ordinary reflex theory in England and the U.S. Anokhin has condemned the ordinary theory of the "reflex arc" as an "outstanding failure," which "shows the dualism of its creator" (Descartes), and "distracts from a materialist solution to the problem of purposiveness."¹⁰

This intention image is the means for regulating behavior--for "collating the actual and the intended"--and is sometimes called the "acceptor of action." That is, the action is refined, until the perceived result of the action corresponds accurately to the guiding image of the desired situation. Besides its usefulness in explaining the regulation of motor behavior, the mental image is also used to explain the feedback control of sense organs. The Soviet view of the function of the mental image in perception resembles some of the interpretations of Gestalt psychology, but the approach is fundamentally Mandan, in emphasizing the objectivity of the image, rather than Kantian, in looking for subjective or arbitrary tendencies or limitations in image formation. The Soviet theorist often emphasizes that we can always escape from old perceptual habits and mistaken hypotheses by having new experiences, and that the source of the organizing process is in the object, in its "objectness," and not in any formal tendency of the perceptual apparatus itself

This difference between Gestalt and Dialectical theories of perception is very important in the practice and planning of science. A current idea in the west (consider the theories of Monod and Stent) is that basic scientific knowledge has gone nearly as far as it can go, so that no more radical discoveries should be expected or sought. This reasoning is partly based on the Gestalt or Neo-Kantian idea that our "cognitive apparatus" has severe limitations on the kind of things it can know.** The dialectical Soviet view is that radical change in fundamental

science will always remain possible, and that the material world itself is undergoing essential, basic changes. In planning, this means that basic or general science will continue to be funded at least as well as it is at present. While a Western attitude has been "analyze now, synthesize in future generations," the dialectic attitude suggests that "we need a Whole now, to achieve a better Whole in the future."

If *image* and *meaning* are given priority over *movement* and *form* in describing the functioning of the brain, then science would seem to sanction the transformation of labor into perception. This is, in fact, an explicit trend and policy in the USSR. Recognizing that perception requires interaction with the object, we might say that "consciousness is action." Again, it is a belief of this sort that is responsible for the pervasive interaction of politics, culture, work, and science in Soviet life.

Besides regulating movement, the mental image represents an accumulation of experience, or a "history." It is sometimes referred to as a hypothesis, that is, as a guess or expectation about an object or event. Recalling the functional components of the mental image--space, body-awareness, and sequencing--it is obvious that memory, the history of experience, will be most directly involved in the sequencing aspect of perception. In meaningful, sequentially patterned behavior, the organism is interacting with its environment, and in a sense is "testing its hypothesis" about that part of the environment. If something fails to meet its expectation, that is, if the organism is confronted with a novel thing, it will have no ready-made plan of action, no adequate hypothesis, and so will have to mobilize his perceptual apparatus to find out more about the novel thing, and to create a new hypothesis-image. This process is known in the USSR

as the "orienting reflex," and will be described in detail in the next chapter. When a new understanding and a new image have been achieved, the organism has linked the parts of a novel arrangement into a new meaningful configuration, which may be a useful discovery for the organism, such as a new kind of food, or a new way of producing food. This is the general Soviet interpretation of how a "conditioned reflex" is formed--the important idea is that the organism has recognized a problem, and solved it by discovering a meaningful relationship.

It is worth noting that the Marxian theory of scientific discovery (and of education) is identical in form to the Marxian theory of brain function--in both, there is an emphasis on purpose, deep reorganization, and complex perceptual interaction with the material. In the west, scientific discovery is likely to be explained by reference to logical processes (deduction, induction) or by the idea of a "lucky" choice of a good hypothesis, with none of these relating very deeply to theories of brain function, except that the "computer" theory of brain function is popular, i.e., the brain is seen as a logic machine. In the west, the difference between human beings and animals is usually described as the absence of certain "programs" in the animals' logic machine. The Marxian orientation more typically is concerned with the common or universal characteristics of organisms, and then accepts as special anything that goes beyond the general rule.

The image of space, and spatial relationships, must be subject to the mental "sequencer," if the organism is to move through space with awareness. The mental construction of an object, a "meaningful configuration," described above, applies to the organism's understanding of all aspects of reality. A process that begins as a sequential scanning is able to achieve a stable simultaneity, an

"objectness," a spatial quality.¹⁴ The stored features are related in a certain way so that they can be checked against the real object, and this image thus achieves a spatial quality so it can be used in later, or "higher order," sequencings.

Having established objects, useful configurations of objects can be made by this same process, which is not higher in any important sense now that it is applied to images which have achieved the stabilit¹⁵ of "objectness." The stabilizing effect of objectness" on evaluations of sense data¹⁶ is a major step in functioning, but all subsequent constructions (configurations of configurations) are just extensions of this basic process.

This is important to mention because of the common western belief that intellect, abstraction, and generalization are very special achievements, probably genetically unique when they occur:

I don't know whether there is a common animal ability to manipulate images and generalize. In fact, I doubt it very much. Thus the kind of "generalization" that leads to knowledge of language from sensory experience seems to me to involve principles such as those of universal grammar as an innate property, for reasons I have explained elsewhere, and I see no reason to believe that these principles underlie generalization in other animals. Nor do I think that the kinds of generalization that lead a bird to gain knowledge of how to build a nest, or to sing its song, or to orient itself spatially, are necessarily part of the human ability to generalize. (Noam Chomsky, 1972.)

Chomsky's use of quotation marks around "generalization" is very much like the Behaviorists' use of quotation marks around "mental."

The Marxian position is committed to the objective existence of generality: For the "Dialectic" to operate in matter, without an overseeing God, the meaningful units (such as thesis and antithesis, and the social classes, etc.) must exist intrinsically in matter, which is just to say that generality has objective existence. The Marxian theory of perception appropriately incorporates the generalization function at a very early level of brain function, both in ontogeny and phylogeny. To the extent that the regulatory mental image doesn't constantly arouse the full orienting reflex because of slight disparities between intention and achievement or observation, it is generalized. A general class of achievement, or object or situation, will satisfy; further refinement may be undertaken, but only for a particular reason. The organism otherwise would become immersed in constant refinement of behavior. Since the orienting reflex becomes stronger at higher evolutionary levels, we can think of evolution as being away from *facile* generalization, and toward a more detailed understanding of matter. At these more refined levels, mistakes are more possible if sensory contact isn't maintained. This point relates to the Marxian belief that valid knowledge derives from practice and workability (Engels), and also to the Marxian idea that cultural forms and beliefs represent a superstructure, rationalizing power relationships or modes of production. If knowledge is derived deductively, rather than from practical experience, it is likely to be empty and mistaken, rather than a true refinement of knowledge. (If humanity were unified, in cooperative production, then culture would be part of the productive base; this principle

is currently being recognized by the official policy statements of the Soviet Union.)

One aspect of mild "psychopathology" probably relates to the simple fact that a child can become accustomed to looking exclusively to others to resolve questions, rather than being carried by the orienting reflex directly to the relevant practical, material reality for his answer. Despite the possibility that "culture" might reinforce this kind of dependency or insecurity, culture is considered by Marxian theorists (including those specializing in brain function) to be a uniquely valuable human achievement. While animals are generally unable to go very far in the direction of a refined understanding of nature and of themselves, it is essentially an intensification of this basic "animal consciousness" which makes culture and rapid intellectual progress possible (as well as making false cultural rationalizations possible). The difference seems to be in the degree to which human beings are able to deeply restructure their mental images when their discrepancy with reality may be only slight.

It is this model of brain function which was foreseen by Marx when he said that words were the "names for mental ghosts," in his refutation of the old "nominalist" theory of language. It may have been this basic idea that the words of language have a mere "naming" function in relation to the various structures of consciousness that led Stalin to write his famous policy statement on linguistics, in which he declared that language was properly to be considered as a part of the productive base, rather than as a part of the cultural superstructure which must be revised by a revolutionary state. (It is only very recently that consciousness itself has come to be treated as a "primary productive force."¹⁷)

Since all perception involves "recognition" in some way, generality is an essential part of perception, and is not a "special" problem for language. Language behavior is a popular subject in Soviet physiology, and as in other behavior studies, afferent processes are emphasized. The perception of phoneme sequences, and the relation of these acoustic processes to the "intention image" are important subjects for investigation. The Soviet understanding of "verbal behavior" must not be confused with Skinner's use of the phrase, since Skinner and many American behaviorists and nerve biologists insist that no "subjective" events can be included in their scientific explanation, while the image is the central event for the Pavlovians. (Pavlov's respect for self-observation is illustrated by the story that he carefully dictated to an assistant all of the physiological observations he could make as he was dying, and a visitor was sent away with the response to his knock: "Pavlov is busy, Pavlov is dying.")

The common schizophrenic language disturbance, typically involving undirected, punning speech, has been interpreted as a disturbance of the deeper image levels and a shift to the acoustic levels of memory, with the result that meaning is lost to the degree that the linguistic forms themselves are concentrated on.¹⁸ This is one of the ways that the broad theory can provide a foundation for practical work. Energy processes are usually assumed to be the basis for the disturbed function; for example, serum from schizophrenics disturbs the carbohydrate metabolism of chicken erythrocytes, increasing the lactate/pyruvate ratio.¹⁹ Efficient searching of the memory would require efficient energy production; other aspects of this will be discussed in the next chapter, on the "orienting reflex."

A very different kind of image disturbance was reported by Luriya in his book *The Mnemonist*. The book

told the story of Luriya's study--over a period of many years--of a man with an extraordinary memory. The man was able to memorize long lists of objects which were read to him, and Luriya found that the man could recall these lists even twenty years later. The mnemonist said that he imagined himself walking down a Moscow street, placing the objects along the way as they were named to him by the psychologist. The only mistakes he made were of a perceptual nature--e.g., "I didn't notice the red ball because I carelessly set it against the red wall of the building I happened to be near." The mnemonist experienced synesthesia of vision, sound, and textures, and felt that memories were localized in his body--for example, instead of having a word "on the tip of his tongue," he might "have it" in his left index finger. The intensity of his imagery interfered with his understanding of language, not apparently as schizophrenia or aphasia interfere, since he was likely to take figures of speech literally, and to be distracted from the actual point of the statement, which he might otherwise have understood normally. As a result, he was never successful in holding an ordinary job, and worked as a performer. The Pavlovian factors, balance, strength, and mobility of the nervous system provide a framework for understanding this peculiar state.

Anokhin has reviewed a model of cortical/subcortical interaction which is now widely accepted and which offers a simple way of understanding these disturbances of the language/image relationship. Anokhin's image is of a river flowing through the brain stem, a variable pattern of ascending excitations reflecting the given biological state. In this view, a weakness of the activating system would tend to excite the cortex in a fragmented way, as a nearly dry river doesn't even fill its own channel. This image would explain the fact that

"leucotomy" as practiced in the west eventually leads to a state of excessive verbal "concreteness," or rather verbal rigidity and lack of imagination. The Soviets have done a considerable amount of study of the use of substances to improve memory and mental performance, and their results are typically attributed to the facilitation of excitatory conduction.²⁰ An imbalance in the other direction, toward excessive subcortical excitatory, or deficient cortical control activity, would presumably produce intense images, poorly calibrated with reality. Even conditions such as asthma have been interpreted as a weakness of the higher inhibitory functions.

The Marxian and Soviet view, that generality is an intrinsic part of perception, provides no basis for the belief (so common in western countries) that the progress of knowledge toward higher generality requires the fortuitous occurrence of "geniuses." Creativity is treated as an essential human trait, part of the human need for self-realization through productive work. Social support, including education, is considered to be the factor which causes great differences in creativity and intelligence, and not genetics. A genetic theory of intelligence is considered to be a mere rationalization for racist practices.²¹ Visual imagery is considered to be the basis of creative intelligence,²² and as such is studied with the intention of finding principles that can be used in education. Emotions (e.g., as measured by the galvanic skin response²³) are also considered to be an important component of inventive behavior, and are viewed as part of the image-forming process.

IQ tests are not widely used in the Soviet Union, since the IQ is believed merely to reflect the level of social opportunity (which can be determined in other ways), but some very interesting studies have been done to determine

the effect of socio-economic status on intelligence. Children in some asian-USSR towns were given IQ tests in 1929, and averaged about 35 points below normal. Recently children in these "retarded" areas were tested, and were found to be approximately equal in general mental ability to children in Moscow. In numerical and verbal ability they were slightly behind the moscovites, but in visual memory and interpretation of mirror images, they were superior. These differences are attributed to the continuing differences in their life situations.²⁴

The importance of the visual image and other "subjective" events such as emotion is summed up in the idea that it is useful to compare computers with the brain, not to see the brain as a computer, but just as one method of seeing what is peculiarly human about our brain and nervous system, and sometimes to get ideas to improve the design of computers. For a very long time, Russian scientists have held the attitude that the world is infinite but knowable. As long as a computer is just a finite set of circuits and programs it can't be considered seriously as a model of the brain.

*The Latin cultures are generally very visual, with great painting traditions. It would be interesting to consider how this might influence their scientific culture.

**Kantians often use the ability of bees to see ultraviolet light to argue that we are condemned to know only a limited world. George Wald discovered that people can see ultraviolet images clearly, after their lenses have been removed in cataract surgery; the small mass of the bee's lens makes its eye more sensitive to ultraviolet, so this supposedly "essential" difference is only a relative difference.

CHAPTER 3

THE ORIENTING REFLEX

What sort of person, or culture, is it that sees "exploration" as the strongest and most basic reflex of the organism? It obviously can't be one that fears new knowledge, and it presumably would be one that values science, progress, and freedom to grow. Starting from any holistic position, it doesn't seem peculiar to view curiosity, an instinct for exploration, or a desire to perceive, as the fundamental tendency of an organism. However, the western traditions in psychology and biology are not holistic, and the tendency toward integration of knowledge, as far as it exists, proceeds by correlations of accumulated facts, level by level, as if science were blind to wholes. Both the Marxian and the Russian traditions in science have largely ignored the distinction made elsewhere between psychology and biology, so that biological thinking is informed by the awareness of human needs and possibilities, and psychology is not thought of as being in any sense un-biological. The Marxian attitude is to work from wholes, and from futures or purposes, as interpretive frameworks, toward the so-called concrete facts and experiments. The Soviet concept of the orienting, or exploratory, reflex is the most important single holistic "informing principle" in biology and psychology. It comes close to being the definition of an organism. It is not only important in this logical or philosophical sense, but it is frequently described as "having an intensity greater than any other activity of the organism." It dominates not only because it is holistic, but because it can be very strong, in

the simplest physiological sense. There is nothing tenuous in this kind of holism.

Pavlov described this reflex as the "what is it?" reflex. With more detailed knowledge of the brain, the reticular activating system of the brain stem has come to be considered as the most important location of the integrating and exciting processes in the orienting reflex: For example, aminazine, a chemical which selectively inhibits the reticular formation will block the reflex. But it is distinctly a reflex of the whole animal: Cortex, hypothalamus, sense organs, motor and autonomic processes are integral parts of it. It is the thing that makes learning possible, and every part of the organism participates in an appropriate way. Many western researchers have claimed that conditioning doesn't always involve the cortex, or that individual reflexes such as the heart reflex are separable things--"when you call the dog, first comes the pulse, then comes the dog." These points are denied by all the leading Soviet workers, and considered to be mistakes of methodology or interpretation.

The image, as already discussed in the preceding chapter, is the central part of the orienting reflex. An unfamiliar sound, for example, will arouse the animal so that all of its senses bear on the thing producing the sound, so that it can construct an image or "reflection" of the thing in its consciousness; if the object (or required behavior) is familiar, the animal will be able to match its image with what it is perceiving so that recognition of the thing or execution of the action is immediate. The animal knows what to do with the object, and doesn't have to concern itself with investigation of it. A familiar environment frees the energies for other purposes, which (especially in apes and humans) may be a search for unfamiliar things. Some experiments with children suggest that an image emerges early in learning, and that it controls the subsequent

functioning of the motor system, which is gradually "assimilated," and developed into a habit.

As familiarity and experience increase, the world becomes ampler for the organism, its range increases. This is exactly the opposite of a view that says that the animal, with each increment of learned behavior, becomes more specialized and limited. Learning is not a closing, but an opening of possibilities. The "motor" theory, which neglects the fact that the organism is always oriented with regard to its environment, must see every learned precision as a restriction of the organism's freedom. In the West, we are constantly told that "we must give up some freedom to attain mastery of" some behavior or technology which is desirable. On the social scale, we hear that specialists must not venture beyond their "area of competence," and that political specialists know what is best for society. American Behaviorism is a fine ideology for a society that wants to combine authoritarian government with a system of specialized training for specialized jobs, because it claims that finely controlled behavior must be specialized and exists as a constraint on behavior. The error, of course, is that they ignore the fact that there can be no behavior without orientation, and general understanding of the environment (the relevant world) is part of fine control of behavior. Marx's thinking was based largely on his perception of how people were diminished and degraded by work that lacked meaning for them. More recently it has been found that workers are more productive when they understand the part they play in the whole production process. The mastery of a skill is very literally like the opening up of a new space, an extension of the lived world. An ability to perform a certain action is an ability to perceive the proper relationships and sequences, and is an openness of one thing to another. All

recognition has some generality, and generality is like "internal space," the possession of adequate images.

There may be very simple anatomical or physiological reasons for the fact that a discrepancy between the mental image and the environmental stimulus leads to such an intense reflex, such an energetic mobilization of the entire organism to deal with the novelty. This question is right at the border of present knowledge and speculation. It is reasonable to look for the most intimate connection possible, between energy production (metabolism) and energy use (experience, in its broadest sense). It is now common to look for metabolic disturbances in connection with perceptual/behavioral problems. In some sense, we can think of the image-discrepancy as being represented on the tissue level as a disturbed resonance, a structural distortion--the physical details of this are highly speculative, but the Marxian viewpoint expects a higher holism to exist, even beyond the level which sees an organism as "a desire to explore." Whatever the mechanism, it probably involves very subtle states of matter.

It we think of the organism as an energy system, holding its world-image in consciousness, it's reasonable to guess that a unified, generalized picture of the world will take less energy to support than will a jumbled, chaotic collection of images--and certainly the recall of the appropriate image to interpret a stimulus will be easier if the world-image is highly organized. A higher degree of holism would be the existence of a tendency toward completeness, as part of the exploratory reflex--a desire for a view, not just for isolated or random images. This is usually assumed in the discussions of the orienting reflex, but to make it explicit makes it easier to see how the orienting reflex relates to other kinds of behavior, such as eating, sex, and

defence. The distinction between "self" as mental images, and "world," as the source of novel perceptions, becomes more important in those other more specific reflexes, but we can still see in them the general form of the basic orienting reflex. Each of these reflexes is holistic, in the sense that it mobilizes the entire organism for a particular purpose.

We can get some insight into these reflexes by considering the degree to which they are homeostatic in effect, as opposed to being "heterostatic" or "heterodynamic" in effect, that is, whether they restore a previous condition, or lead to growth and development. The orienting reflex is always a growth reflex, since it allows the self to approximate itself to a novel aspect of the world, becoming something different in the process of assimilating strangeness. The defense reflex, on the other hand, is highly conservative or homeostatic, because its purpose is to withdraw from an expected threat, and to return to a previously known safe pattern, without a new synthesis.

The eating or food reflex is mainly homeostatic, though of course it has a growth component. The desire for a specific kind of nutrient which results from a lack of it is especially interesting, and reveals something about the nature of hunger in general. An image of the desired type of food, or a preference for that kind over other kinds if several are available (which requires an image too, though it may be weaker than the image that directs an active search) implies a discrepancy between the perceived present state of self, and a mental image of the whole self. The whole self is the one without the specific craving. This discrepancy is like that experienced when a question is being asked: In the mental world (the self, but with reference to external space, rather than the body) something is perceived as incomplete, and the question seeks completion. Questions can be conservative, looking for completion of the old world, but

they more likely indicate an openness, seeking a new synthesis. A desire for food is thought of as conservative or restorative, simply because the body seems simpler, and is not usually seen as being in evolution. We might, though, imagine an evolving body, craving new nutrients, or new ratios of nutrients, as part of a developmental process. So we needn't think of the "eating reflex" as being strictly conservative. The desired item, the focus of the "discrepancy," is analogous to the novel stimulus in the orienting reflex. The desire for completeness in the body is like the desire for wholeness in the perceived world. Even in exploration, the object is modified a little--but in eating, the object is more completely assimilated to the body, rather than the body to the object.

The "sexual reflex" similarly can be either conservative or developmental. Before exploring some of the things involved in it, it will be useful to consider an experiment involving the use of images in training people to get voluntary control over an autonomic response. Lisina (in 1957, long before "autonomic training" and bio-feedback became respectable in the U.S.) found that bio-feedback makes it possible to control a vascular response by acting through the orienting reflex, and that a response which couldn't be formed through "ordinary" conditioning became possible when awareness was made part of the procedure, using bio-feedback (a light signaled when blood vessels in the fingers were dilating). Learning not only requires awareness, but images are directly able to evoke some of the autonomic responses that are appropriate for that situation. For example, thinking of a frightening event will make the heart beat harder; thinking of heat can make blood vessels in the skin dilate.

The autonomic components of the sexual response are obvious, but what is less well known is that hormones

are delicately regulated by the brain, as part of the organism's response to its sexual and social environment. For example, women living in a group synchronize their menstrual cycles, men's whiskers grow faster when they look forward to sex (because their testosterone secretion increases), and men's testosterone secretion increases both in response to a monthly cycle and in response to social success. This hormonal intensification might be thought of as being analogous to the general exploratory arousal, as part of a holistic physiological activation process, but that would leave unanswered the questions "why desire the opposite sex rather than a shoe or a frog?" and "how does the opposite sex satisfy this desire?" and "how does orgasm relate to image?" If the sex response is a special, isolated process, it would be sufficient to say that we must have an innate image of the partner, and of appropriate behavior, etc. However, this comes close to the idea of "motor programs," and it also fails to account for the personal and exploratory dimensions of sexuality.

Using some of the principles established in other reflexes, we can get a highly generalized picture of the "sexual reflex," which is also highly empirical in the sense that it doesn't go much beyond what we commonly experience in the sexual response. In the "food reflex," we saw that we could avoid the mysterious motor programs and drives of the mechanistic behaviorists, just by recognizing the perception of "something lacking" in the body (which could be fullness in the stomach, adequate blood sugar, vitamin C, etc.). This requires the perception of a discrepancy between the presently perceived body, and the known body (as it should be). The process of resolving the discrepancy between these images is generally similar to that in the orienting reflex, but the behavior is appropriately different. If it is the body and the experiential uniqueness of

the particular sex partner that we desire, it is obviously desired because it isn't possessed, and this implies a discrepancy between the self-image of body-and-experience, and the image of the desired one. The autonomic patterns (among many other things) of the sexes are distinctly different. If we apply the "structure" of the orienting reflex, in which the mental image or the "action acceptor" approximates itself to the form of the novel stimulus, then we would in our (possibly subliminal) gestures and images and autonomic processes, be approximating ourselves to the form of the opposite sex. Only certain forms (such as vascular distribution) can be strongly participated in by our body, and these seem to be the points that have been used to advantage by the opposite sex. We still have our knowledge of our own body, and what its wholeness requires--as in the eating reflex, we *at least* conserve our body. Since our body has nervous regulators of hormone level which accommodate the body to changed conditions, the image's movement toward, say, femaleness, would be balanced in the male by a secretion which increased his maleness, and probably also by various compensatory nervous changes. The key idea is that our autonomic emotional system is part of all of our imagery, perception, and discovery. The only real novelty is the suggestion that we "autonomically conform" to the perceived person in sexual ways just as we do in other emotional ways--we tend to respond to fear with fear, and to joy with joy, etc. This is just saying that when we appreciate the opposite sex, we perceive to some extent what it is like to be that sex. The hormonal balancing would be a homeostatic process, when considered from this point of view.

In both the orienting reflex and the sexual reflex, a discrepancy of images would lead to very intense arousal, but while the orienting reflex quickly leads to learning

(approximation of the mental image to the novel object) and to extinction, the body in the sexual response is exaggerating itself, intensifying the image-discrepancy and the excitement. We obviously don't forget who we are just because we are feeling what it is like to be the other person, which is simply to say that we feel a tension between our bodies, between novel and known.

When the body, with its conservative tendencies, is involved, closeness of the relevant thing--threat, food, or mate--makes the need clearer.

If we think of the image as including autonomic nerve processes, it is not too strange to think of the orgasm as being an act of discovery regarding the nature of the opposite sex and of the particular sexual partner. If this is an appropriate description of the orgasm, then the sexual response is really a special case of the orienting reflex--perception of novelty, arousal, discovery, and inhibition being the general structural components of both. In many cases, satisfaction of curiosity or extinction of the orienting reflex leads to sleep, because of cortical inhibition. It would be interesting to compare the EEG and other patterns in the sleep which follows both sexual orgasm and extinction of the orienting reflex.

The sudden interpretive "twists" that occur just before and during orgasm illustrate the close involvement of mental images with autonomic "image" and function. This involvement exists in all behavior.

The perception of, and desire for, the mate's experience of the world would have its own particular rules, but would not be entirely separable from the "body desire."

Whatever the precise form of the sexual reflex turns out to be, the Marxian aim is to understand it as meaning, as "afferentation," and not as mere motor behavior. Just as Anokhin has clarified the identity of the orienting and the

exploratory reflexes, we can see the orienting-exploratory reflex as a paradigm for all meaningful behavior.

The orienting reflex is known to exist in fish, turtles, and birds, as well as in mammals. Since the forebrain is a development from the olfactory lobe, it is interesting that in developing young animals (e.g., puppies and monkeys) the orienting reflex emerges earliest in relation to smell; the olfactory system ("analyzer") is the first to develop functionally and morphologically. As the tactile, auditory, and visual functions of the cortex mature, so do the responses to the corresponding stimuli. In young puppies and prematurely born children, the autonomic components of the response are much stronger and slower to extinguish than when the cortex is more mature. So even though more primitive tissues are essential for activation, the reflex is largely cortical.

Some of Anokhin's descriptions of the orienting reflex are useful for understanding what is now the dominant Soviet theory in physiology, and for seeing how the orienting reflex relates to other processes.

He has given four characteristics of the orienting reflex which apply to any holistic activity: It is centrally integrated, it is exclusive, it has an adaptational effect for the organism, and it includes feedback. Anokhin emphasizes that central integration means that "there cannot exist a conditioned reflex of the heart," or of other isolated components. "A fragmented, isolated approach results in an immense number of experimental errors, in particular, when a component of a reaction taken separately, often for methodological reasons, is considered to be some special conditioned reflex."

The "exclusion principle" means that every holistic activity tends to be the only one present at a given time. He suggests that this mechanism has evolved simultaneously

with the organism's complexification which increases the number of its systems' functions.'

Anokhin stresses that afferent feedback is an intrinsic part of every holistic activity, that it has the status of the "fourth link in the reflex." This means that "it is impossible to isolate the afferent feedback from the total action which begins with the reflex arc and ends with the afferent feedback." (This process was outlined in the preceding chapter.) "The orienting reaction cannot be terminated in its process," since "such interruption would automatically yield information regarding what is going on outside of the organism."

The exclusion principle can be elaborated a little farther. If the orienting reflex is very strong, it will inhibit all other present acts. But it can also be assimilated by the ongoing activity of the organism, so that the excitation from the orienting-exploratory reaction summates with the activity that is dominant at that time. There will be just one activity, but its intensity will increase. Under other conditions, there can be a transformation, so that the reaction to novelty brings out a concealed "dominant," and suppresses the activity that was present. The defensive reaction is the one that most frequently assimilates to itself the excitation of the orienting reflex. This transformability of the orienting-exploratory reflex into a defensive reaction has a parallel in early development. Early painful experiences, "during the period of formation," can lead "to a prolonged pathological reinforcement of some reactions and the weakening of others which exerts an influence on the whole life that follows" (Obraztsova, *et al.*). In puppies, early trauma leads to behavior dominated by the passive-defensive reflex, and suppression of the exploratory reflex in particular. It is assumed that something equivalent can occur in humans.

CHAPTER 4

REFLECTING CONDITIONS

At first, I thought it might be best to avoid a direct approach to Pavlov's development of the idea of conditioned (or, rather, conditional) reflexes, because everyone thinks the idea is already well-understood in our culture. But maybe it is better to consider our idea of the "conditioned reflex" as an obstruction to be cleared away, before going on to explore the tradition of Pavlov.

In English, the word "condition" has two groups of meanings. One group clusters around the idea of "stipulation," as in "he accepts the proposal with certain conditions," and another cluster has to do with something closer to a thing's state of being, as in "the car (or athlete) is in good condition." Our English word derives from Latin for "speaking together," and in Russian there is a word, *uslovni*, with a similar origin relating to speech and stipulation. However, Russian has also adopted the Latin-based word, *konditsiya*, with its meaning limited to our "state of being" cluster, making it impossible to confuse the two meanings: Air-conditioning and athletic conditioning use the Latin-derived word, while contractual and linguistic conditions use the Slavic word. In Pavlov's work, the "conditional reflex" was understood as the "stipulated or agreed-upon (*uslovni*) reflex," but this essential point has been almost entirely lost in a false translation. Watson presented himself as a student of the famous Pavlov, and argued for an unconscious psychology, with the result that our culture has lost the meaning of the century's greatest work in psychology and brain physiology. (Sometimes I wonder whether J. B. Watson wasn't

vacationing in Bermuda during the time he claimed to be studying with Pavlov.)

Pavlov was the son of a priest, and studied at a seminary school, so he was thoroughly saturated with the Greek-derived ideas of the Eastern Church. For Pavlov, the world's essential property is that it is full of potential, and that we will know more in the future than we do at present. This centrality of time permeates the tradition of Pavlov. If time is real and the world is the source of knowledge, then science is seen as a basic life function, in which the brain is the organ for knowing the world and maintaining an equilibrium with it. The essential feature of the conditional reflex, as understood by Pavlov, was its temporariness; if it is a recognition of a temporary conjunction of events in the world, intelligence requires that it not persist longer than the condition in the environment does. But when learning has to do with the way the world actually works, one insight is enough to fix the knowledge forever; Pavlov said that when a cat learns how to open the latch to its cage, such learning has taken place, and the cat is doing something equivalent to science. (He also believed that such permanent, scientific learning was eventually incorporated into heredity as the instincts.)

In the West, our idea of the "conditioned reflex" has been exactly the opposite: we have emphasized its difference from insight-learning by ascribing to it a kind of brainless sluggishness, in which the role of time is reversed--it is slow to form, and slow to decay, but sure to decay, without regard to whether it is insightful or merely arbitrary.

Besides giving us a mistaken interpretation of Pavlov's work with the conditional reflex, the tradition started by J.B. Watson and continued by B. F. Skinner helped to make psychology remote from physiology as well as from

morality. Skinner felt that his work had moved us "beyond freedom and dignity," and he saw the brain as such a neutral ground, or blank slate, that he said that the maternal contribution to the developing fetus is "nothing but her genes." To distinguish psychology from biology, he eliminated physiology from biology, leaving nothing but a timeless and rigid genetic determinism below his malleable "environmentalism."

Pavlov recognized that there must be attention before learning could take place, and that the availability of brain energy was specific, and appeared according to the needs of the organism, and was provided by the hereditary instincts. Thus, when an animal attends to a new thing or situation, or when it explores, it is using a specific brain energy: He spoke of an instinct for exploration, for science ("a truth tropism"), for liberty, and dignity. The integrity of the organism requires opportunity for exploration, for freedom, etc., and Pavlov pointed out that psychiatry must treat mental patients with proper concern for their needs and rights. (The California researchers who found that rats' brains grow when their environment is enriched, and that the effects increase with subsequent generations, probably didn't know that they were validating two of Pavlov's basic doctrines.)

Pavlov was clear in saying that his purpose was eventually to explain how human consciousness works, so--even though he began his studies with the "eating reflex" because "nutrition is the most essential link between the organism and its environment"--it is natural that his group would look for ways to study questions such as the "biology of intentions," the perception of novelty, orientation, exploration, etc. Their major achievements can be seen as growing from Pavlov's observation that there is a

specificity of attention deriving from a specific energizing of the brain.

Pavlov's concept of sensory analyzers is one part of the idea of specific, energized attention; the sensory analyzer includes the sense organ, such as the eye or the vestibular apparatus, and related parts of the brain. It is emphasized that sensing is an active, intelligent process, in which features of the world are analyzed, selected, and linked with the organism.

We hear most about the simple associative learning of Pavlov's dogs, but Pavlov went from the study of simple association to the investigation of learned sequences, or Dynamic Stereotypes. To understand a thing, its properties, besides being singly "linked" with the organism by the sensory analyzers, must be linked together with each other, until they can be grasped simultaneously. This simultaneity is called "objectness."

This composed simultaneity is an image of a thing or a process in the world. A goal of the organism is held in mind as such a simultaneity, and is the organism's criterion for completion or correctness of action. Anokhin pointed out that the "stimulus-response" "reflex arc" was incomplete without such a model of the appropriate reaction, and he called this model "the acceptor of action." These mental images, acceptors of action, are both models of intention, and models of what is known; novelty exists whenever the acceptor of action lacks any feature of the perceived environment. Intentional actions mobilize the organism's energy and focus it toward completion. (A story about Einstein illustrates: Finishing an article, he and a collaborator searched for a paper-clip, and Einstein found a bent one, which he tried to straighten. His collaborator found a box of paper-clips, and Einstein took one, and used it as a tool to finish straightening the bent one. He said he

found it hard to stop a project once he started it.) In exploration, it is novelty which excites the brain and mobilizes the organism for further investigation. The exercise of the exploratory reflex seems to make more energy available. As long as the world remains a source of new knowledge, the brain will react to novelty with a continued increase of exploratory energy.

The human frontal lobes allow us to construct very complex systems of images, or acceptors of action. Pavlov opposed the "biologizers" who wished to ignore the importance of human history and culture in the development of our capacities--people who attempt to draw political conclusions from what they claim are human instincts of aggression, territoriality, etc. Pavlov called the first levels of constructions, closely tied to the sensory analyzers, the "first signal system." Language and the complex systems of meaning that make up culture (which are possible because of the unique development of our frontal lobes), Pavlov referred to as the "second signal system." Science requires that we account for consciousness in biological terms as far as is possible, but consciousness also includes historical and cultural influences, and our biological conceptions must be adequate to account for the existence of all those things which are simply historical--so many of which are arbitrary, and therefore temporary, and to be grown out of. The "biologizers" often speak of "genes" for aggression and militarism, because they strongly wish to deny the reality of social-historical processes, but Pavlov argued that moral ideas can change history, and historically determined behavior.

Some psychologists have argued that psychological "conditioning" can be used to "brain-wash" people into accepting an authoritarian system. I think it is important to

remember that Pavlov understood the conditional reflex to be an intelligent brain process which allows the organism to adapt itself to the world, but also allows it to modify the world to suit its needs for freedom, dignity, morality, and mental exploration.

CHAPTER 5

DOUBLENESS AND PERSPECTIVE

After talking about the unifying, holistic nature of brain and organism, we should consider what it means that we have two similar, but "opposed" sides. Even an earthworm has two symmetrical sides, but as we go up the evolutionary scale, the symmetrical central nerve-brain tube of the chordates not only enlarges at one end, but it also increasingly segregates into two bilaterally symmetrical lobes, the cerebral hemispheres.

Is there a function which is being "simplified" by increasing two-sidedness, as increasing cephalization (head dominance) makes possible increased differentiation and control and subtle coordination with the environment? According to B.G. Ananyev and others, two-sidedness of the brain is involved in our time and space perception and regulation: Perception and control are a unitary process, but the unity is based on the interaction of two halves. Depth perception, for example, is the creation of a perspective by the interaction of two or more slightly different images which separately reveal no perspective. If we use only one eye, we can construct a perspective, but in this case we are more dependent on movement, and the combination of images collected over a period of time. (Incidentally, the recognition that stereoscopic perception is a central process which can be independent of external, binocular triangulation, is a revolutionary insight which will tend to purge away mechanistic and Cartesian ideas of consciousness.)

Separate control of the two sides of the body would seem to require separation of the imaging control

system--and as we have a doubleness, a perspective, "*within*" the body, we must (as world and body-control are integrated) have a similar doubleness, perspective, within the world. Rhythmic alternation or wave-like motion won't do for animals that manifoldly manipulate the world, changing it. Besides using the two-sided system to control our body in space, we use it to construct a perception of time. If we could only record the perspectives delivered to our brains by movement, it seems likely that we would be locked into a relatively rigid view of space. Because we incorporate a generator of perspectives within our two-sided nervous system, we experience a relative fluidity of time images, and this time-imagination makes our attitude toward space more flexible.

Wilhelm Reich believed that a kind of peristalsis was the basic biological movement, and showed how ideas relate to blocks to this movement. Although the Reichian theory is as compatible with Marxism as with Freudian theory, in its popular American and European versions, there is a failure to integrate sex and culture, vegetative process and insight: Wave-like rhythms are given priority over quickly flickering intuitions. Yet sexual rhythms can be light and cognitive, quick as a flash of knowing, not heavy, lumbering or "conditioned" (in the current sense of being "reactively imprisoned in an evaluative pattern"). Nevertheless, as Chernigovsky has demonstrated, visceral and vegetative processes are diffusely represented in the cerebral cortex, suggesting that we haven't evolved great powers of visceral discrimination. More highly evolved beings might be able to write visceral poetry beyond our capacities, but this doesn't imply that there is something intrinsically slow about our energetic processes.

A mechanism which can subtly discriminate the sides of the body into "reference point and measure," "holder and

chipper," etc., can also insinuate itself into complex vistas, "deforming" relationships as it would modulate its movements in making objects.

A scanning with an objective rhythm, a re-scanning with a manipulated rhythm--in place of a mechanically rhythmical time, or a mere responsiveness to the objective order in its surroundings (fitting crawl-swim rhythms into the world) there comes to exist a perceiver who can modulate his own time perception.

The Neo-Kantians see us as being cognitively trapped by our bodies, forced to know the world in an arbitrary, limited way. The Russian tradition sees our body as having evolved specifically to grasp reality in an appropriate way. Neo-Kantian American biologists see the body as an accident, as far as knowledge of the world goes: "Given this apparatus, we can only know thusly." The Russian insight is that evolution is a perceptual dynamic, ever becoming more flexible, able to insinuate itself. The basic adaptiveness is perception and response--a beak, a claw, a gut, a feather, pigment, foot, any biological form, is useless without perception, especially subtlety of perception, adequacy.

Capacity for response (selection of environment) is perception. Selection of an environment can then create a basis for physical selection. Perception is prior to "natural selection," On this basis, we can accept our internal doubleness, our stereoscopic consciousness, as being a highly appropriate way of approaching the world, of getting objective knowledge.

The great majority of our nerves are visual and sensory. Motoric subtlety is achieved by the "afferent" or sensory nature of our cerebral cortical function, that is, by modulating simple motor output according to fine timing (and spacing) of the imaging cortex. Both timing and

spacing (depth creation) are made possible by internal doubleness--perspective creates space (using either time or two perceptual channels), and mental-motoric insinuation, pacing or timing rhythms, create the experiences we have of time. We span a broad present when we have complex rhythms that carry us deeply into a meaningful space. Mechanical rhythms would seemingly disregard the depths of space, and near or far, now and then, wouldn't be so strongly differentiated. With complex and subtle rhythms that can differentiate the present acutely from other times, the uniqueness and fullness of present is perceived as part of the fullness of time, so that we exist in a depth of time as we respond to the depth of space. Our doubleness is a time sense, just as it is a space sense. Space and time are reflected in us.

Seeing consciousness as being both energetic and structural, we can describe the process with an image like this; It's as if "present energy" would leak out of the past and future through their sameness, if we had mechanical rhythms, but would be captured and accumulated to a high level by awareness of change and variety. There may be actual biophysical and chemical events which correspond to this image. This holographic, liquid-crystalline, resonance theory will be discussed separately, but here it is appropriate to mention that there is a simple physical correlate for this image of a "self-stimulating doubleness," namely, that the two cerebral hemispheres are mutually trophic, that is, they activate and maintain each other, just as they contribute to the activation and maintenance of the entire body.

CHAPTER 6

SEXUAL ENERGY AND THE CORTEX OF THE BRAIN

The cortex is the mediator between inside and out. For an abstract person, like Descartes or Sartre or the average American scientist/salesman, all of reality is like a skin between the world and the self, leaving a vacuum for self and for world, except as there is arbitrary interaction in this abstract reality-skin. These are "cortical" people in the sense that their interacting self has very little to do with their body's highly determinate needs; they are the people that Pavlov called "intellectuals," dominated by the "second signalling system," language. According to Pavlov, they aren't quite at home in the world.

The type of person who grasps the world clearly and strongly, that Pavlov called the "artistic" type, dominated by the "first signalling system," perception, isn't necessarily over-concrete, as Pavlov seemed to imply. The person who uses his body in an integrated way, investing his imagination in important aspects of the real world, can deal with all of the complex and general aspects of society and history, but does it with a sense of purpose, rather than with the Sartrean sense of arbitrary choice. (Sartre's description of the "nausea" associated with this perception gives us a clear sense of the absence of orientation, physically resembling sea-sickness, in the extremely detached form of perception.)

The body and the "older" parts of the brain give precise shape to one's life, and the cortex helps to expand the possibilities that are open to that life.

Apparently, as Pavlov said, the cortex can inhibit the lower parts of the brain, so that the body's own life doesn't enter the life of thought and communication. But the cortex is activated by processes in lower or older parts of the brain, so that it functions with the greatest energy and intensity when it is openly collaborating with the instincts.

For centuries in western countries there has been an awareness of two very different kinds of sexuality. Sometimes these have been identified as "sensual copulation" and "Courtly Love," or as irresponsible and dutiful sexual relations. This double attitude has occasionally been criticized, but it continues in the present culture to serve as the frame for much of the thinking and talking and political activity related to sex.

William Blake was one of the first people who clearly described a kind of being which is whole, or at least trying to be whole in opposition to the culture of doubleness.

"Thou hast a lap full of seed,
And this is a fine country.
Why dost thou not cast thy seed
And live in it merrily?

Shall I cast it on the sand
And turn it into fruitful
land? For on no other
ground Can I sow my seed
Without tearing up
Some stinking weed."

"Sand" apparently refers to a barren emotional state, which is an alternative to a distorted and complex growth of the emotions. Blake often referred to biblical ideas, but

filled with reality and imagination things which had been only the moralistic thoughts of tribal priests--so this verse might relate to the injunction to "spill your seed on a woman's belly rather than on the ground," or something of the sort. Masturbation then would be one meaning of sand--and since in masturbation the energy flow is only in one direction, without exchange and complexification, the idea extends to include this kind of low-energy release in normal copulation. The "stinking weed" is a negation (not a "contrary") of this: A moralistic denial of sex for pleasure. (And of course the thicket of emotional and ideological problems which accompany that attitude.) So Blake presents this unpleasant choice, with an indication that there is something better, a "fruitful land." His whole work contains the belief that sexual energy must be expressed in imaginative fullness, with regard to all of human existence.

Wilhelm Reich, who broke away from the psychoanalytic movement because of his marxian beliefs and his "sex-politics," tried to analyze sexual repression in a biological way. His analysis was the same as Blake's: Both of the culture's sexual alternatives are the result of "armoring," or rigidifying, of the organism. He said that "four-lettering" is not the same as making love, but that it is accepted by the repressive society because it is passive, and less dangerous than full sexuality.

For several decades in the U.S. and Europe there has been a lot of interest in "relaxation therapy," "positive thinking," and other ways of avoiding "tension." Zen and various anti-sexual religions have more recently been grafted onto our own anti-sexual Christian culture. "If there is no adequate way to discharge tension, then don't allow the tension to develop," is their principle.

Stated in terms of the brain's cortex and the older "activating" system of the brain stem, this doctrine would

be: "Let the mind/cortex deal with reality, and the body/reflexes will take care of sex." Too often, what this means is that the cortex and language just have the function of being a short-circuit between bodies. Apparently this is what Blake meant when he said

"Never seek to tell thy love
Love that never told can be; For
the gentle wind does move
Silently, invisibly."

The mechanical aspects of sexual excitation--genital friction, etc.--are the usual subject of the "neurophysiology of sex." Presumably, sensory nerves in the genitals contribute to increased tension in the autonomic nervous system, including the nerves of the pelvic ganglion. Whatever brain-like quality these visceral ganglia may have, they are still deeply integrated with the central nervous system and the cortex. One general kind of integration is the "setting" of the level at which reflex activity will occur. This control is probably exerted by a balance of excitatory and inhibitory neurons, and by the rate of stimulation, and by chemical influences. The dreaming (rapid eye movement) phase of sleep is apparently a time of great trophic influences of the brain on the body, and it is likely that similar activation of the imagination during the waking state also has an activating and trophic influence on the various tissues. The setting of reflexes and thresholds must be a complex process, relating to the whole life of the organism. If the local sexual autonomic nerves are isolated from the stabilizing influences of the brain, the orgasm reflex can probably occur almost without sensation--a "genital" or "pelvic orgasm" may be little more than a mild peristaltic movement of the tubular acts as a "capacitor" or reservoir by preserving tension until the entire personality experiences "resolution" and satisfaction, then the tension can spread throughout the

autonomic nervous system, and produce an intensely pleasurable discharge throughout the body, possibly involving some "pleasure center" in the brain. Another way of thinking of tension, besides "reflex setting" and ganglion stabilizing, but describing the same process, is this: The autonomic system tends to maintain balance between its two sides, sympathetic and parasympathetic; if one side is stimulated so its activity increases, the other side increases its tone, to maintain an approximate functional balance in the innervated system. (The quickness and appropriateness of emotional response probably relates partly to the residual "tone" of the autonomic system. This is a factor in "types" of nervous system.) The image would be that of alternately lengthening the legs of stilts--if they are in balance, you can go very high. Some Reichians think of this process as a basis for pathology, not health. But as long as the tension is responsive, and the organism can achieve resolution and discharge, it is obviously not pathological.

The balance isn't invisible and exact--physiological changes occur in the process. The "Effect of Person," which exists not only in people and dogs as a slowing of heart rate (bradycardia), but even in lower organisms as an electrophysiological response, is such a physiological change toward parasympathetic arousal, and during orgasm the bradycardia suddenly becomes extreme--the rhythm changes so suddenly that the heart seems to have stopped. The explanation for this continuity, from "Effect of Person" to orgasm, seems to be that excitement and desire exist as a tension of approximated balance, and that with resolution, the "expectancy" tension of the sympathetic system falls away, leaving parasympathetic dominance.

The para-sympathetic dominance is very similar to the vegetative state of sleep. Cortical resolution, with inhibition replacing excitation, is probably another aspect of this process.

Two things are implied by this analysis: That we can by-pass the cortex if we can't stand the tension (two ways are common in our dichotomous culture--"let's get married," and "let's fuck"), and that if we choose the way of tension we find that our character, our whole way of being in the world, is involved in the way we accumulate and distribute and discharge tension. We find that we will take in perceptions and attitudes from the one we are loving, exchanging perspectives and worlds and bodies. As the personality experiences resolution, we find that our world changes. (Loving intensely is thus a form of objective scientific research--getting new knowledge about the world.) Once we see the interaction of tension and growth, desire and discovery, we realize that sex and imagination are deeply involved in what we can be--that our human existence is expandable and shrinkable.

Just as the brain stimulates and maintains the other tissues, and each hemisphere has a trophic, stimulating effect on the other, the older, instinctive systems of the brain activate the cortex, and exert a trophic, growth-promoting influence on it. Wild animals have larger brains than caged ones, which implies that life and freedom are brain stimulants. Problems are opportunities. People can be the richest kind of opportunity, the most stimulating kind of problem. To do this they have to arouse tension. (Blake said "opposition is true friendship.") This is not to advocate competition. Competition tries to eliminate the problem by defeating an opponent, and can exist only in the armored character, which allows energy to flow only in one direction, and which can't tolerate tension.

(An opponent-friend is one who "inspires" you, who makes you gasp for breath and resolution.)

Pavlov emphasized that the cortex always participates in awareness and behavior, so that the various biological activities of the organism will be oriented with relation to the world; according to his perspective, Reich's "armored" character would probably be considered a variety of hysteria, with cortical weakness, especially weakness of the inhibitory-trophic processes. Muscular tension, for example, increases when the cortex is removed. Where many Reichians consider tension of muscles to be an active inhibition of natural energy flow, the problem might be a failure of brain activity to *actively* relax them, as in the "rapid eye movement" phase of sleep. This relaxation probably results from processes that occur in both the waking and the sleeping cortex.

In spite of the emphasis on the cortex, sub-cortical structures are recognized by the Russians to have many generalized functions (besides serving to activate the cortex, produce dreams, etc.) The autonomic system, for example, is believed to be largely responsible for trophic, regenerative processes. Immunological memory is a particularly interesting case, in which all levels of evolution seem to coexist and collaborate. Even plants can be hypersensitized, and have antibody-like substances (hemagglutinins, etc.), as do various primitive animals which have no white blood cells or lymphocytes, and this same kind of tissue sensitivity seems to coexist in higher animals with the specialized immune systems. The cellular immune response can be modified through the nervous system, and the conditioned reflexes can be formed for specific antibody responses. I. P. Ashmarin (Zh. Evol. Biokhimii i Fiziologii, No. 3, pp. 2170224, 1973) has suggested that neurological memory is built on immunological memory, which is built on hereditary

memory. These other levels of memory, control, responsiveness, have to be kept in mind while considering the cortex: The cortex participates in all of these processes, but each level has its own life and contributes to the other levels. The coordination of these levels is health.

American Behaviorism has given to the phrase "conditioned reflex" a connotation of "involuntary, unconscious behavior which is built up by repetition." In Pavlov's use of the phrase, though, there was no such implication. In his usage, this brain function can be instantaneous and insightful. His purpose was to explain the way we are. Too many American Behaviorists deliberately leave an unexplained residue (creativity, single-trial learning, sudden insight, Gestalt formation, etc.) which has to be filled by dualistic constructions, magical processes, or Kantian limitations to allowable, possible, knowledge. Pavlov (February 6, 1935) discussed this aspect of Sherrington:

"Sherrington himself investigated the reflex activity of the spinal cord, but he is decidedly against attributing this activity to the higher parts, to the brain; in the latter case this structure becomes in their eyes hypothetical.

This is animist reasoning. Sherrington has built a nest of animism. This is proved by the fact that he doubts whether the mind has any relation to the nervous system. Hence the mind is something beyond and above the nervous system, something that can be detached from the nervous activity altogether.

I can understand the influence usually exerted by a teacher on his pupils. But must all the pupils necessarily be animists if their teacher is an

animist? Is there really such intellectual serfdom among Englishmen?"

A typical Anglo-American follower of Sherrington is G. Hoyle; he illustrates the persistence of this dualism. While pithing a croaking, struggling frog in a neurophysiology lab, he said "we can't know that a frog experiences pain, because he can't speak to us." And, having the illusion that I was a psychology major, he repeatedly asked whether I was going to study "the nervous system, or the mind?"

Pavlov spoke of a "Reflex of Purpose" and a "Reflex of Freedom." He was aware of the political significance of psychological theories. He claimed we have a real, biological need to be free and purposive. This is utterly opposed to arguments such as Skinner's in *Beyond Freedom and Dignity*. Skinner's claim that we have no instinctive desires is needed to justify the friendly fascism that he advocated. (Usually, the people who argue that we have no good instinctive urges--such as sex--are the same people who argue that aggression is innate: Our culture still teaches about sexless Eden and Original Sin.)

Part of the world of stimuli is internal, within the body, even within the nervous system (spontaneous activity of neurons). Considering the cortex as the mediator between inside and out, we see the internal energies and forms expanding outward, through the brain and through the eyes and other senses, and interacting with the forms and processes of the world.

This general scheme was proposed in the 18th century by Blake, who was the first person to really incorporate biology into a vision of the world. There was much more biological information available in the 18th century than we usually realize, since people like

Swedenborg, Buffon, Lamarck, and Erasmus Darwin, whose ideas were suppressed by their contemporary bigots, are still unfairly treated by our contemporary bigots, who have falsified our historical picture of 18th century biology. Blake described several degrees of consciousness, which we can now see were degrees of cortical isolation from or integration with the rest of the body--ways of being which admit energy and desire to varying degrees.

"Single vision" was his term for the abstracted science of the Newtonians, who said that only extension and mass were real, classifying everything else as "secondary qualities." "In a year of dearth," Blake said, referring to this mental poverty, "bring out weight, measure, and number." Time and space are reduced to series of "infinitesimals," to facilitate calculation.

Ordinary practical consciousness, in which colors are experienced, but only passively or for utility, he called twofold vision. Dream vision, in which the intrinsic beauty of being is enjoyed as images are constructed, was threefold vision. But one's own responsibility for being and imagining and knowing is not recognized in this state, so it is somewhat delusive--typically, this state evaporates as we try to participate actively in it ("The Crystal Cabinet," for example). In fourfold vision, the person recognizes his own active perceptual process, and also sees this active perceptual "humanness" as an objective property of the world. The split between subjective and objective doesn't exist; there is a kind of full resonance between self and world. Blake saw a failure of self-love, a failure of energy, as one of the things that can lead to dominance of the rationalizing process (which leads to "Newton's sleep"). With self-love, there needn't be any conflict between desire and possession; without it, the self shrivels and begins to analyze the object of desire, destroying it. The self is a

time-spanner, unifying past, present, and future. Blake affirmed that, while there is a "limit to contraction, there is no limit to expansion." Analysis is limited, energetic life is unlimited. In this view, sexual love is an ultimate affirmation of self, other, and world.

CHAPTER 7

GROUP ENERGY

Everything possible to be believed
is an image of truth.

W. Blake

Until our most exciting discoveries can be fully integrated and taken as a part of our background, we can't advance beyond them. They have to alter our perspectives by taking their place in our cultural framework.

At the present primitive-tyrannical state of mass communication, this emotional-energetic aspect of discovery would limit us to only a little progress in a lifetime, if we had only the large culture of civilization. The sexual pair, and other personal groupings, are where culture and discovery really exist.

If our brain is really sexual in its optimal functioning, then we should work out the implications of this: That knowing is for others. If everything is known by forming a dominant form for it (personal gesture, object gesture, etc.), then knowing is for the world, knowledge is responsibility.

Somehow, people manage to think of knowledge as being quantifiable, as if it weren't a whole. The normal animal function is to integrate each perception into its world, so that every observation or communication leads to increased generalization.

When an individual enters a group with a loving expectancy, the nature of the group is changed, expanded. The world known by each person is extended. (It's analogous to adding a section to the perimeter of a circle: The angle of the curve is opened with each addition.) Any little perception that is given is likely to come back better.

When another person understands your perception, its truth is evaluated. ("Truth can never be told so as to be understood, and not be believed.")

When a person uses my perception, they are thinking with my mind, and this allows me to advance, energizes my advance. Their new and appropriate way of using it expands my perceptions and my possibilities. Does it feel like this to others when I feel myself "thinking with their mind"?

The belief that reality is a closed system goes with the belief that we can advance only by hindering someone else. Just as "entropy increases in a closed system," such an ethic tends to spread shrinking withdrawal and hostility. Doing something from a social motivation seems to detract from its intrinsic goodness, according to this view. Doubt, quantifiable knowledge, knowing as discrimination rather than as synthesis, are functions of a shrinking self, absorbing energy. But the expansive pursuit of knowledge is one of the strongest social bonds, because we *perceive* others as vital parts of our selves.

Metabolic energy can illuminate patterns in the world, generalities. These new perceptions will liberate metabolic energy when taken up by another person, so that communication is energizing.

When you let yourself get highly energized, your sense of energy expenditure increases, your sense of the importance of certain things increases. This is what draws a real group outside of itself. Every perception is seen to have relevance to the world. Everything comes to be done with involvement and wholeness. To the person who passively belongs to the culture, it looks as if everything has become difficult for the involved ones, and this seems inefficient. But to the productive group, it looks as if everything has become possible.

CHAPTER 8 SCROTUM, BRAIN, AND BIOLOGICAL ORDER

A friend asked me this interesting question: "Why do higher mammals have to keep their testicles cool, while birds can produce active healthy sperms with internal testes and very high body temperatures? What advantage is it that's worth the risk of losing them by snagging on a branch, etc.?"

After expressing my ignorance, I thought for a minute with this result:

Racist geneticists to the contrary, there is no evidence that either intelligence or brain size is genetically inherited, since acquired changes are heritable, and since only one protein peculiar to the brain is known, at present. Other brain-specific proteins will probably be discovered, but despite a large effort in that direction, there is no hint of a molecular-genetic basis for "inherited intelligence." Glucose, hormones, stimulation and other factors significantly modify brain size and function.

The electrical gradient which exists in the adult organism--brain, head and back, positive, liver, belly, and extremities, negative--exists already in the egg--animal pole positive, vegetal pole negative. Ion selectivity corresponds to cell electrical potential (and to cell longevity or stability), and is probably determined by the orderliness of cell water (Szent-Gyorgyi, Wiggins).

Environmental ion concentrations can modify the normal developmental gradient, resulting in vegetalization or animalization. This very likely reflects ionic influence on the orderliness of the water-protein system. If the structure

can modify ion concentration then ion concentrations can undoubtedly modify the structure.

Sonneborn coined the word "macrocrystallinity" to describe the cytoplasmic inheritance he observed in paramecia. The developmental gradient of potential and structure suggests that "microcrystallinity" is also an aspect of cytoplasmic inheritance. Accumulated biological stability, or wisdom would be reflected as high orderliness, high ion selectivity, high electrical potential, and high efficiency of energy metabolism--in the "animal pole," and in the brain (and in the intermediate developmental stages).

As molecular disorder tends to increase at higher temperature, order tends to increase at lower temperature, and this is especially important in water near proteins or other surfaces.

If gamete formation involves the creation of cytoplasmic order as part of the instructions of development, lower temperature at crucial times would facilitate the creation of a high gradient.

If brain evolution--which is so spectacular in mammals--is a product of the developmental gradient, then cooling the gametes as the cytoplasm is structured would facilitate the inheritance of larger brains.

If a large brain, through an electronic, metabolic, or temperature gradient, can increase the structuring process of the "animal pole," it would account for the observed inheritability of brain changes caused by diet (or stimulation).

Weak ultraviolet irradiation of frogs' eggs produces anencephalic or small brained tadpoles (Grant). Irradiation of women, especially in early stages of pregnancy, by atomic bombs in Japan, produced a high proportion of small brained children. If there were many genes for specifying the development of brain, relative to the number of genes

for all other tissues, mere gene mutations might explain this effect of radiation--the tissue that depends on the largest number of genes would be the most sensitive to radiation damage. The liver, with a greater variety of enzymes than other tissues, would seem to be the most subject to gene damage, but there are no stories of liverless fetuses resulting from radiation damage.

Radiation does disrupt water structure, and stabilizing water structure protects against radiation damage (Webb). Excited electronic states--e.g., singlet oxygen--are known to last longer in cell-water than in bulk water. Solvated electrons also have a special stability in cell-water. The interactions between water and radiation are of great importance, but much more research needs to be done in this area.

It seems more reasonable to interpret the effect of irradiation on brain development as a melting of the water structure that supports the developmental gradient, than to suppose it is a gene effect. Not only do we see that the brain is highly susceptible to ionizing radiation, without any apparent genetic reason, but the brain and the gonads are the most sensitive to non-ionizing electromagnetic fields, according to Yuri Holodov. (After I spoke with Holodov, I placed a magnet near a nerve preparation, and found that the nerve's latent period was extended, as if the resting state were stabilized by the increased magnetic field.)

The scrotum would thus be partly responsible for the mammalian advantage over birds in brain development. The sperm might have more influence than its small size would suggest, by a crystallization process similar to touching a drop of super-cooled water with a tiny ice crystal. (Earlier in this century, unfertilized eggs were made to develop "parthenogenetically" by chilling them or by touching them with a needle.)

The "estrogen surge" around the time of ovulation might promote a similar ordering process in the unfertilized egg by causing a drop in temperature. Progesterone is "thermogenic," and increased estrogen seems to counteract progesterone and lower body temperature. (However, estrogen itself seems to cause cytoplasmic "melting"-- Nemetschek-Gannsler--for which lower temperature might merely be compensation.) The fact that progesterone is involved in activation of the developing ovum, and that it sets the body's "thermostat" higher, suggests that it in itself introduces a kind of "crystallinity" into the cell-water. (I have discussed some of the implications of this elsewhere, e.g., in *Physiological Chemistry and Physics*, and evidence is accumulating supporting an important role for progesterone in brain development.)

Old people tend to have lower body temperature, and this might be another case of the body's attempting to increase order in the water-protein system (against disruptive influences of age), in a sort of hibernation reaction.

The gonad temperature of large-brained cetaceans would be an interesting test of the generality of this idea: Are they located in a cool area of fat? Does the cool ocean water offer them even greater protection than the scrotum of land animals?

CHAPTER 9

A VISUAL SCANNING SYSTEM AND INTENTIONALITY

In the time since 1956, when I started exploring visions and my visual apparatus, I have found that people with philosophical or scientific "training" are often very intent on telling others what they "can't" see, or mean, or experience. As a result, I have been concerned with the real experiential differences that underlie differences of world-view, values, and attitudes. I think it's proper to refer to these as physiological differences, since the body is obviously doing profoundly different things when it creates new knowledge, and when it enforces old knowledge against the new, etc.

Part of Maslow's definition of the self-actualizing person was the ability to perceive truthfully. Reich called truth "a natural function," "an integral part of the organism," and "a function most akin to growth." The form of the act of perception will vary in a systematic way with the form of the perceived world, reinforcing or expanding the particular world-view.

There is often a prejudice against vision, in favor of muscle perception, but vision is just as much a body function as is muscular activity, and it has the advantage of involving the largest group of sensory nerve fibers, and of being more richly spatial than other senses. "Primary perception" has visual aspects that can allow very subtle but clear understanding of the living interaction of body and world.

One pole of perception and world-view is represented by surrealists, non-Hegelian marxists (this is an

important distinction, since academic marxists in the U.S. are hard to distinguish from Hegelians) and phenomenologists, and another pole by structuralists, mechanists, and idealists of a Cartesian or Platonic sort.

Surrealists are, among other things, people who can sense their own nerves, and so are better phenomenologists than Husserl, who thought bracketing or purifying experience yielded essences, Platonic forms on which to build a firmer science.

The surrealist experience yields intentionality itself, and the various biological interfaces with matter, or "surfaces" (e.g., nerve endings, or dream substance), as well.

Establishment scientists act as though they had received Husserlian forms on which to build their mathematized "final solution" to the problem of reality.

Surrealist and evolutionary science must talk about a different reality, because fluid *people* can experience fluid *material*, a finer and faster and more fluid perceptual world. Any real "*epoche*" (bracketing of the experiential) will reveal the perceptual functions of the body and its interactions with the world.

Visual "streaming," which varies in coarseness with different conditions, is something anyone can see and explore, but even intelligent people can dismiss it as "only subjective" or "only blood corpuscles." The fine-grain activity that constitutes ordinary vision is over-looked by nearly everyone: Attending to the object, instead of their perception of it, they may experience the *limit* of visual acuity, but only rarely do they *see* their visual acuity, as responsive points.

In bright sunlight, looking at the sky, white discs zoom around--A. Einstein and others have decided they must be "blood corpuscles," but they can be made to zoom

in ways that corpuscles couldn't. Closing one eye will reveal their continuity with the streaming, dust-like particles: High energy stimulation just causes local "explosions" to stand out.

Staring at a radial (or other repetitive) design will set up intense movements in the "retinal dots" that persist for several seconds on a blank surface, or with the eyes closed--this is a way to learn to attend to the dots. (Or by attending to the closed right eye, while holding the design in front of the open left eye.)

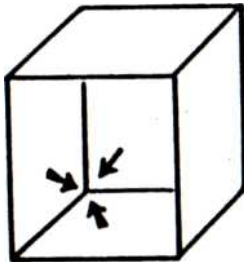
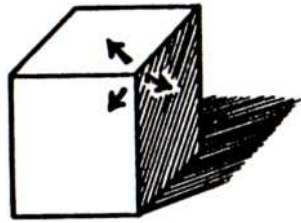
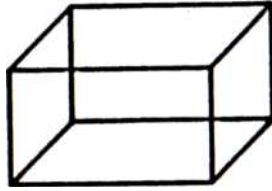
Since the dots are so much smaller than the fovea, the normal area of "concentrated attention" (whose exact form can be seen by "swinging" the eyes freely in the dark, with a light source illuminating the interior of the eye), it at first seems absurd to try to catch a single point with the attention. Making the effort, though, you discover that this fine but intense effort will make a point "explode" in a blue flash, or extend itself into a "fluorescent" needle or sheet.

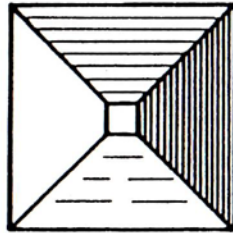
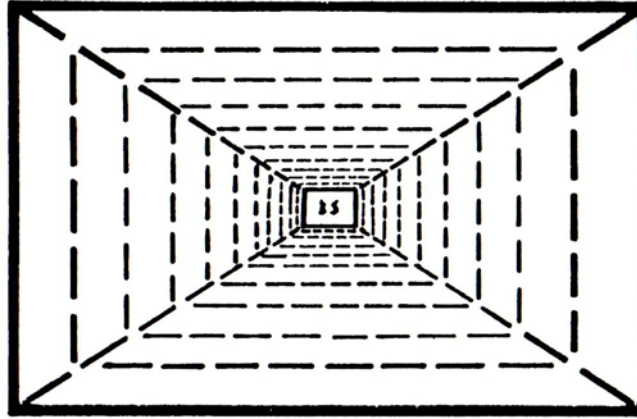
This results from an intensification of the normal antidromic "renewing" activity of the optic nerve. With practice, or with outside stimulation from flickering lights, you can project foveal, or peri-foveal, movies in vivid color.

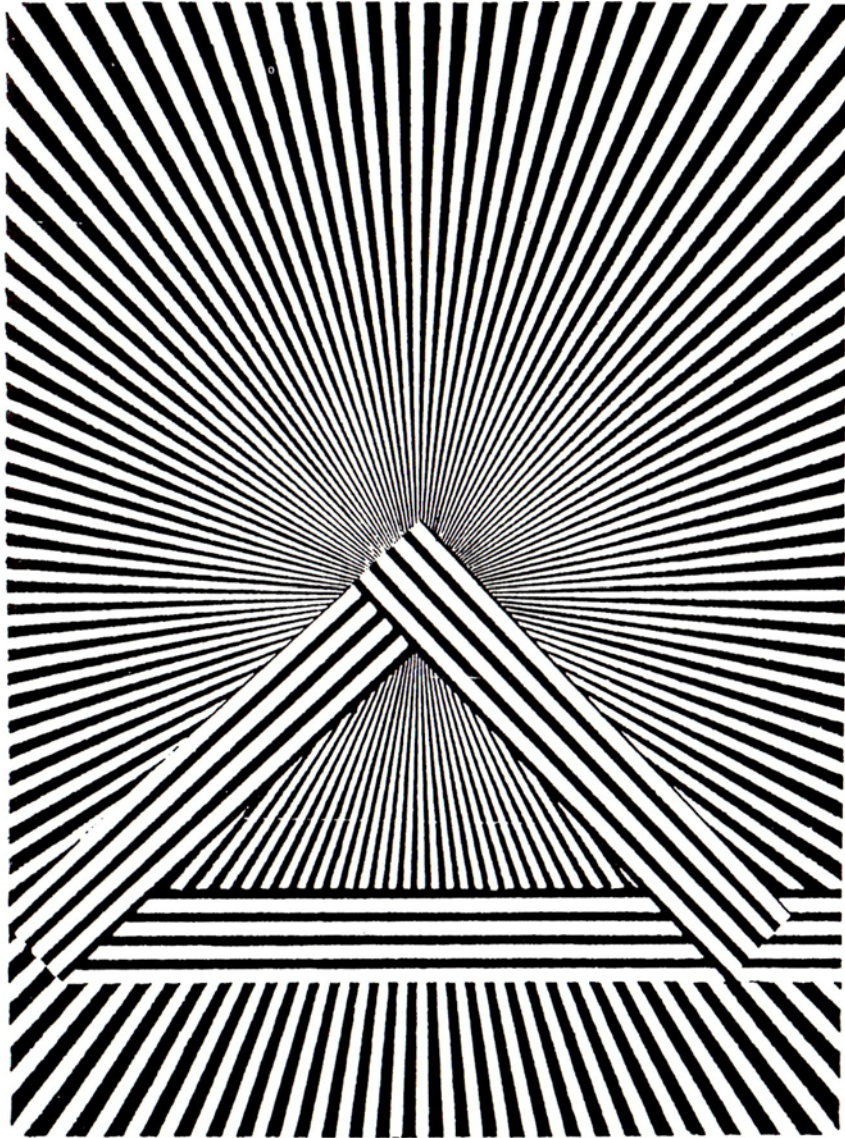
The experience of "after-motion" in reverse, when a car in which you are riding stops after a period of continuous motion, reveals that motion and apparent size (the swelling or shrinking of the landscape as it seems to move toward or away from you) are produced by the "intentionality" of moving dot systems.

The altered apparent size of an object when it is interpreted as near or far is at least partly governed by this system, as can be seen from an image such as this triangle in the accompanying figure.

In the triangle, parallel lines seem to swell and diverge when the top is forced perceptually to recede, and







the scanning flow can be seen to become centripetal, with the intentional projection of depth. In the same manner, creating very near space, or "intending" a space very close to the eye, will cause a centrifugal flow from that area.

The cube which can be intentionally reversed, in the accompanying figure, is a very clear way to observe that your projected space is the cause of very "appropriate" retinal streamings. The directions of the flow are shown in adjacent cubes with arrows.

I remember that either Michael Polanyi or Merleau-Ponty wrote that we may not be able to perceive the "neural response" which underlies a perception, but here is a case where that kind of "complete" perception is possible.

J. H. Fremlin (*Nature* 238, 406, 1972) has made an observation (a sensation of structure being built up by staring at flowing water) that suggests how movement of the scanning system can lead to the perception of space, though it doesn't imply that other processes--more internal--may not produce movement in response to projected space. Visual cortex processes probably project a space, which governs and interprets the streaming surface. This is what feels like the "pusher" of energy into the eye, and it's the grainless, dream substance--in Dali's terms, the Camembert cheese, behind the caviar.

The visual "tunnel" that often appears with flickering lights, as illustrated diagrammatically by the rectangles with diagonals representing corners, corresponds to a scanning similar to sand going down a rat-hole. That is, mere external stimulation generates space, depth--or at least the excitement promotes that tendency in our perception.

The scanner *follows* a moving pattern, expanding when it expands, spinning clockwise when the pattern spins clockwise, etc. Since a distant image causes shrinking, it is

as though the scanner is "catching" the scene, preventing the "recession," and magnifying it or evening out the apparent size differences caused by angle.

The "inner" intentional space encompasses the body and generates the space in which objects of other senses can be located--some auditory fibers, for example, travel into the visual cortex, as if sounds were to be perceived visually to a certain extent. In dream states, with body input blocked, ordinary perspectives aren't necessary--depth can be experienced without direct reference to the eyes.

Something very similar to Fremlin's observation can be easily visualized with a regular object or image--that is, a symmetrical image, with one-sided illumination, that can be viewed as either concave or convex, with light imagined as coming from one direction or another. The line-cube shows the same process, though less concretely, since no textures are involved. Viewing a figure like that in the illustration ("pyramid") it is harder to see it as a flat design, and it will bulge or recede, depending on where you imagine the light source to be. This is a familiar problem in interpreting photographs of microscopic crystals, etc. The real perception of form and depth, without either movement or binocular vision, reveals that space perception is inherent in consciousness, even without the *constructive* processes of motion or two-eye vision. The "retinal streaming" that accompanies this space perception reveals a physiological aspect of intentionality. These observations allow us to avoid the idealist-abstract identification of intentionality with symbolization, and the mechanistic assumption that it is only gross body geometry which makes it possible. The behaviorists used to say that our bodily kinesthetic sense provided the space for organizing our vision, and more recent views have implied that it was the intrinsic triangulation of binocularity which creates our visual space.

I want to suggest that a kind of "space filling" brain process is an important factor, in addition to the other bodily "space filling" events. Such an inner space, resonating with the outer spaces, can be thought of as a tissue hologram.

Once the visual streaming is perceived, the "mechanics" of all the familiar optical illusions of line, space, movement and size distortion become intuitively obvious: The rosette illusion, bulging circle, big moon on the horizon, non-parallel lines, etc., all are simple interactions between the scanning stream and the object.

Much more important than explaining illusions is the effect that contact with visual streaming has on our interpretation of the world: If a mechanistic-symbolic idealizer of space (like the psychologists who publish abstract "explanations" of illusions, for example) is tricked into experiencing his own perceptual system, his experience of fluorescent consciousness is likely to give him a new respect for all matter. Blake frequently described the new attitudes that come with altered perceptions, for example, "Over sea, over Land/ My eyes did Expand.... In particles bright/ The jewels of Light/ Distinct shone & clear./ Amazed & in fear/ I each particle gazed,/ Astonish'd, Amazed; For each was a Man/ Human-form'd. ...My eyes more and more/ Like a Sea without shore/ Continue Expanding...."

CHAPTER 10

INHIBITION AND RECUPERATION

Inhibition has a bad name in America. The common understanding of the term grows out of popular Freudianism: e.g., libidinous urges must (or must not) be inhibited--that is, energies are rigidly instinctual, and can only be deformed by operating within a social framework. In Russian thinking, however, inhibition has both a general organismic meaning, and a cellular meaning, which have nothing to do with the popular meaning of the word. In Anglo-American neurology, cellular inhibition is generally believed to be a matter of specialized inhibitory nerves and inhibitory substances, while in the Russian tradition the tendency is to think of it in a more generalized way, as something that can be applied to any cell, nervous or otherwise. This difference leads to some therapeutic and preventive approaches in Russia that seem unscientific in the West.

Sechenov, the "father of Russian physiology," was the first to observe nerve cell inhibition: he found that a frog's spinal reflexes, such as kicking, could be suppressed by intense stimulation of the sensory nerves. Vedensky then found that an individual nerve became inhibited if stimulation were too intense or too frequent, and that this was not mere fatigue, since it could begin functioning immediately under weaker stimulation. Pavlov found many conditions in which a particular behavior could be inhibited, and also noticed that the entire nervous system could go into an inhibited state. He discovered that inhibition is not an inactive state, but that the cell is cut off from stimuli, and undergoes a process of restoration. During excitation, there

is a build-up of ammonia, lactic acid, and inorganic phosphate within and around the nerve cell, as well as a depletion of energy reserve and even a change in the condition of the cell proteins themselves. (E.g., Berestovskiy, G.N., et al., "Study of the cumulative structural changes in a nerve fiber during rhythmic stimulation using optical techniques," *Tsitologiya* 14(12), 1461-67, 1972.) Pavlov suggested that psychosis may be a state in which the nervous system goes into partial inhibition to restore itself, and prevent complete exhaustion and death. Recently in England and the United States, R. D. Laing has proposed the same idea: that insanity is potentially a recuperative process, if we don't punish patients with our treatments. An obvious approach to treatment--from the Russian point of view--is to help the patient regain his nervous "energy potential." Nutrition, rest, and even direct supplementation of the high energy substances are possible approaches. Certain kinds of weak stimulation can also be used to reinforce the inhibition and promote sleep.

This use of weak stimulation to promote inhibition is particularly interesting, and related studies are being done by a few people in the West. Recalling the idea that an organism "selects an environment" to which it can respond during its evolutionary development in the world, we can see that there will be an infinity of events both "above" and "below" the part of the environment used by the organism, and that just as the organism uses inhibition to protect itself from excessively strong stimuli which would destroy it, it can use inhibition to avoid the endless fatigue of being alert to irrelevant and "small" stimuli. Normally, this inhibition seems to be very flexible: we can learn to concentrate on different kinds of things, and we can shift our attention and instantaneously change our pattern of inhibitions. Some psychoses apparently involve a failure of this kind of

inhibition, and it has been suggested that abnormal behavior may be an indirect way of defending oneself against excessive stimulation (e.g., Hoffer). This need for selectivity is apparently what accounts for the development of a system in which weak stimulation promotes inhibition. The kind of inhibition produced by weak stimuli is very different from that produced by excessive excitation: it represents a state of heightened (rather than impaired) readiness.

We can think of two zones of inhibition, separated by a state of activity: The "lower" zone somewhat resembles lower forms of life, and borders on death (the "parabiotic" state), while the higher zone of inhibition is a highly structured state with higher energy reserves even than the active state--it is a state of "high readiness." (There may be another active state between "lower inhibition" and death, since exhausted and unconscious people and animals frequently regain consciousness briefly just before dying.)

The various states of the nerve cell can be appropriately thought of as different degrees of "tightness" of the protein gel structure of the cell substance. Mild mechanical or chemical stimulation (e.g., small doses of caffeine) will inhibit the nerve tissue, and in doing so will make the cells impermeable to penetration by foreign substances such as dyes, and will improve their resistance to oxygen deprivation. On the other hand, excessive stimulation increases their permeability to dyes. This so-called "blood-brain barrier" is an illustration of this resistance to foreign materials by cells in their normal "tight" condition.

Extending the hours of sleep each day (for example, with a mixture of soporific drugs) can almost cut in half the time required to recover reflex functions after spinal damage (Asratyan and Simonov). Sleep, a state of extensive

inhibition, apparently accelerates the cells' recovery of their energy reserves.

By controlling our perceptions, selective inhibition is obviously participating in the control of our behavior. Just as concentration is necessary for clear perceptions, patterned inhibition is necessary for controlled behavior. The discovery that coffee (or amphetamines) will control hyperactivity in children seems to relate to caffeine's ability to produce inhibition, as well as excitation--the effect depends both on the dose and the prior state of the tissue.

Examining our experience, we can see some of the interesting aspects of inhibition--these processes are things we can feel and see, not just a mysterious something happening in a mysterious somewhere. When we close our eyes, the level of blackness we see is one indication of the amount of "readiness" or primary inhibition in our visual system. Without good visual blackness, we are analogous to a fogged photographic film: We lack contrast and vividness, unless the highlights can somehow be made brighter. When we are ready to go to sleep, and primary inhibition is setting in, our visual blacks are very pure, and we see very clear "hypnagogic visions." If we go too long without sleep, this clarity is replaced by a buzzing confusion and an unsatisfying kind of half-sleep: We have apparently built up the low-energy condition in our nerve cells to the point that our primary inhibition is defective. Continued too long, brain activity will pass into the inhibition of exhaustion.

Sleep, by restoring the "high energy" state of readiness, affects all the tissues of the body through the effects of the nervous system. Many people who have migraine headaches, for example, have discovered that just a few moments of sleep--just drifting into the dreamy forgetful state--can interrupt the regular progression of

symptoms, if it comes before the pain is so intense that it make sleep impossible. Some women have discovered that a short nap can interrupt their monthly cramps. Since the "cause" of menstruation is the disappearance of progesterone while estrogen is still at a high level, these cramps can probably be attributed to estrogen's promotion of an excited state in the cells of the uterus, equivalent to the epileptic seizures that can be produced by higher quantities in the brain. Exactly how sleep and its state of primary inhibition can manage to offset the uncontrolled activity of cramping muscles isn't clear: It might be a direct inhibitory effect of nerves, or an indirect effect such as an increased concentration of blood sugar.

The fact that women have migraine much more often than men, and that it is usually related to the menstrual cycle, suggests that an estrogen imbalance may be involved some way in migraine, which makes the effect of sleep on both cramps and migraine especially interesting. Migraine is often considered to be an uncontrolled dilation of blood vessels in the head (very much like hemorrhoids except for the location) possibly resulting from depletion of a substance which constricts vessels. Blood sugar also seems to be low in migraine, so that some people find that eating a large amount of ice cream can interrupt the symptoms. This observation might be what we need to understand the role of sleep in health. We all know how hard it is to sleep when we are hungry (low blood sugar), and how sleepy we sometimes get after a big meal. Low sugar levels in the blood can literally starve some cells into malfunctioning: This is how insulin shock causes convulsions and hallucinations. The hallucinations that occur in cancer may also indicate cell starvation. (Shapot, et al., have demonstrated that cancer always disturbs sugar metabolism.) Usually, a cell emergency will cause

surrounding blood vessels to dilate, to allow more blood to be delivered to meet its needs. The adaptive release of transmitter substances is probably part of this process, and increased production of carbon dioxide and lactic acid will cause the vessels to dilate locally. Additionally, mere exhaustion from sugar-starvation is a factor in causing the blood vessel muscles to go slack and cause localized symptoms. How would estrogen be involved in this kind of process? Something I noticed in my work with hamsters may be relevant: Estrogen in excess causes wastage of both oxygen and sugar. If sleep inhibition can merely restore enough stability somewhere in the body that the wastage becomes manageable, adequate cell nutrition would again become possible. Since "migrainoid" people typically have very high levels of brain electrical activity, the brain itself might be a significant energy drain. (It has been estimated that the brain uses 25% of the body's energy, and it is almost completely dependent on glucose for its energy.) "Plugging" this drain could cause a sudden rise in blood sugar and other nutrients, allowing the exhausted cells to recover their energy and their stability. A state of "high readiness" seems to be an efficient state, in its use of oxygen and food.

Disturbed intestinal absorption of sugar might also be a factor in this energy problem. And reflexive distribution of tension in the autonomic nervous system is definitely involved. The entire nervous system is "meaningfully" interrelated, so that, for example, stretching of (or pressure on) the rectum will decrease diuresis (urine formation) causing the organism to retain water (N. A. Miasoyedova), and intestinal muscle tone will change, blood pressure will be altered, etc. If the stimulation of an organ (for example, the rectum) is extreme, relative to the resistance of the organism, a pathological condition may

appear, such as a disturbance of heart rhythm. Even epileptiform convulsions can be induced by such stimulation--for example, irritation of nerves in the lungs is a factor in the convulsions produced by breathing excessively high concentrations of oxygen (Chernigovskiy, *Interoceptors*, 1967). This shouldn't be surprising, since it used to be common knowledge that intestinal worms cause dogs to have fits, and caused children to cough--but since penicillin became more popular than worm-medicine, many people seem to have forgotten their folk-wisdom. Even something as simple as inflating a balloon in the stomach can cause changes in the cellular composition of the blood. Obviously, toxic or allergenic materials in the digestive tract will have similar effects. "Allergenic" means anything which irritates by way of the immune system, and will vary according to the excitability of the individual. Excitation is increased when blood sugar is low, and when this state was induced by insulin, it was found that a slight stimulation of the intestine provoked strong, disorganized motor activity in the animal, including asthma-like reactions. Other studies show the same association of blood sugar with allergic reactions.

These are just some samples of the ways inhibition and excitation interact in the organism's behavior and physiology. In the U.S., most thinking about "inhibition" is either on a moralistic and Freudian level (control of impulses), or on the microscopic level of synapses. In Russia, the organism is the central phenomenon, so integrated studies of metabolism, behavior, and environment are the rule. Far from considering the "visceral nervous system" as a nearly autonomous thing, the Soviets have found that the internal organs are "represented" in the cerebral cortex, with both "sensory" and "motor" components. They are less sharply localized in the brain

than are the analyzers of the "external" senses. Since brain localization of the external senses increases with evolution, as a nucleus is developed where increasingly fine discrimination and analysis is performed, we might guess that increasingly fine discrimination of our visceral senses hasn't been desirable--since their functions are fairly standardized, gross coordination might be best.

In my study of estrogen and aging, I found that the effects of excessive estrogen and of aging itself are practically indistinguishable on the level of cells and tissues. If sleep is so effective in blocking the "acute" symptoms of an energy disturbance which is largely attributable to estrogen, what would it do to the energy disturbances which constitute aging? It is generally known that old people sleep less than young people, and it is also known that the old brain tends to be in an "alarm" state, lacking inhibition. Several years ago, some Russian physiologists maintained a 17 year old dog on "electrosleep" with intravenous feeding for six months--because of the toxicity of chemical anaesthetics such a long sleep required the new method. When they wrote their report, the dog was 20 years old but no longer suffered from his former senile condition. This suggests how important sleep and inhibition may be in the various degenerative diseases. A proper balance between excitation and inhibition seems to be a factor in recovery from most diseases.

NOTE TO CHAPTER 10

Nasonov's staining method gives us a key to understanding stress, nerve function, and cell activation in general.

The common Soviet view (evidence reviewed by Troshin) is that the concentration of substances in cells is regulated not by a "cell membrane," but by the adsorptive state of protoplasmic proteins, and by their solubility in the cell water or gel. Through evolution, protoplasm presumably develops a more and more highly refined selectivity. Nerve and skeletal muscle cells have highly variable selectivity for ions, and high sensitivity. In their so-called "resting state," nerve cells have very high selectivity, but this is an equilibrium process--the excluded substances enter and leave the protoplasm at nearly the same rate, rather than merely being excluded by the surface. The "blood-brain" barrier may be an example of such exclusion (Verzhbinskaya). In the "activated" state, nerve cells admit "extracellular" ions, such as sodium, but "recovery" of the exclusive state occurs instantaneously. The state of proteins momentarily resembles denatured proteins. With excessive stimulation, recovery is incomplete and, with the proteins and gel structure in a partly denatured state, foreign molecules (dyes) introduced experimentally can be observed inside the cells.

Szent-Gyorgyi's description of the "staircase" phenomenon (in which the strength of the heart-beat increases with its rate of beating) indicates how a certain amount of stimulation can *maintain* the native structure. The stimulation can apparently be either physical (electricity, etc.) or chemical (caffeine, transmitter substances, digitalis, etc.) He described this as "function building structure." (Isn't it odd that people who advocate exercise think a slow pulse is good, because it allows the heart to work less?)

The effects of stress and stimulation have been studied by Nasonov's dye method, as well as by more conventional biochemical analysis (Palladin). For example, the brain's ATP content was found to increase with evolution and with the degree of alertness.

The fact that small doses of caffeine help in some cases of schizophrenia may be the result of this restorative process of mild stimulation.

This effect of stimulants is probably also involved in their inhibition of cell division in cultured cancer cells (ephedrine and theophyllin, for example), and the ability of caffeine injected into the brain to retard tumor growth elsewhere in the body (Kavitskii).

Incidentally, this view implies that there are at least two general mechanisms for anesthetics or narcotics--those which block by stabilizing at the high energy level (this group probably includes progesterone) and others which block by preventing recovery.

DMSO apparently introduces some "hydrophobicity" into water, because of its strong hydrogen bonding oxygen and its methyl groups--at least it seems to lower the effective activity of water (Berezin, Ugarova, and Silaev, 1973). This may mimic the resting state of protoplasm to some extent, since it seems to improve metabolic efficiency: Reducing inflammation and treating mental retardation are its best known (apparent) effects. The disappearance of cataracts in the eyes of retarded children is another suggestion of improved oxidative efficiency (dinitrophenol, an uncoupler of oxidative phosphorylation, produces cataracts, as does age, which also involves oxidative inefficiency).

CHAPTER II HYPERACTIVITY

The various tissues of the body can function acceptably at different levels of nutrition. For example, the skin, with its low energy requirements, seems to remain alive for many hours after the death of the body in general. The brain, with its extremely high energy requirements, is usually the first to suffer from energy deprivation. At slight levels of deprivation, the brain will simply lose functional efficiency, but more serious or prolonged deprivation can produce lingering modification, or even structural damage which is relatively permanent (and may even have transgenerational effects).¹

Just as the skin (or muscle) has a lower energy requirement than the brain, the various parts of the brain have different requirements. The parts which are most resistant to damage are the "lowest" and "oldest" parts of the brain, the parts we have in common with frogs. These parts regulate physiological processes, such as breathing, and so it is biologically useful that they should be most resistant to damage. When a person is given an anesthetic, the first parts to stop functioning, or to go to sleep, seem to be just those parts that have the highest energy requirements, and which are least resistant to damage. The anesthetized person keeps breathing, for example, until very high doses of anesthetic are given, but other functions disappear one by one as the dose increases.

The front part of the brain, which is most uniquely human (and "newest") but which doesn't have "specific" function, in the usual sense, is one of the most sensitive parts of the brain. It is a very large piece of tissue, and it seems to be involved in planning and choosing, in governing

the other more specific functions (This part of the brain, as well as the cerebral cortex in general, gives us the ability to "disregard" stimuli, to use Lendon Smith's term.)

The famous Russian neuro-psychologist, A.R. Luria, has described the behavior of dogs when this tissue is damaged or removed:

...destruction of the frontal lobes leads, not so much to a disturbance of memory as to a disturbance of the ability to inhibit orienting reflexes to distracting stimuli: ...such an animal cannot perform tasks involving delayed responses under ordinary conditions, but can do so provided that irrelevant, distracting stimuli are removed (if the animal is kept in total darkness, if tranquilizers are administered, and so on).

The role of the prefrontal cortex in the synthesis of systems of stimuli and the creation of a *plan of action* is manifested not only in relation to currently acting stimuli, but also in the formation of active behavior directed towards the future.²

Various theories of what causes hyperactivity, e.g., low blood sugar, weak radiation from fluorescent lights and TV,³ or food additives,⁴ and the observation that drugs which stimulate the sympathetic or adrenergic nerves (ephedrine or caffeine, for example) will relieve the symptoms, are all consistent with the idea that not enough energy is being supplied to permit this tissue to function properly. Low blood sugar will starve the nerves; food additives or any low-level poison can serve as a stressor of nerve tissue, leading to increased energy requirements;

many forms of very weak radiation⁵ can lower the efficiency of metabolism, increasing the tissue's energy requirement, and brain tissue is the most sensitive to at least some kinds of radiation.

Intestinal irritation can cause disturbances of the nervous system,⁶ and should be considered as a possibility in "disorders of attention." Toxins produced by intestinal bacteria can affect the brain directly, but more often act by damaging the liver's ability to regulate blood glucose.

The commonest cause of hypoglycemia is hypothyroidism, and a thyroid deficiency increases the tendency toward a high-adrenaline state, but more importantly, thyroid hormone is the basic regulator of efficient energy production. Memory and attention are impaired by even a slight thyroid deficiency. The Russian paradigm, with its emphasis on energy and inhibition, suggests that thyroid function should be carefully examined in cases of hyperactivity. Too often, western physicians think only about hyperthyroidism in hyperactivity.

1. A.E. Needham, *The Growth Process in Animals*, Van Nostrand, Princeton, N. J., 1964.
2. A.R. Luria, *The Working Brain*, Basic Books, N.Y., 1973.
3. J. Ott, *Health and Light*, Devin-Adaire, Old Greenwich, Conn., 1973.
4. B. Feingold, *Why Your Child is Hyperactive*, Random House, N.Y., 1975.
5. A.H. Frey and S.R. Feld, "Avoidance by rats of illumination with low power nonionizing electromagnetic energy," *J. Compar. and Physiological Psychology* 89(2), 183-188, 1975.
6. V.N. Chemigovskii, *Interoceptors*, American Psychological Association, Washington, 1967.

CHAPTER 12

IMPLIED THERAPEUTIC APPROACHES

The biophysical theory argues that altered consciousness (and the behavior it produces) is a question of both bioenergetics and "bio-microstructure," and implies that a therapy should attempt to create the desirable state of structure and energy by intervention at crucial--and possibly numerous--points.

I don't know whether ATP has ever been used therapeutically for psychosis, but since it is one of the central points in both energy metabolism and structure, its use is definitely suggested by the theory. Of course, creatine phosphate, which is in equilibrium with ATP, might be an alternative way of raising ATP concentration, since it is at a higher energy level and would not introduce additional adenosine, thus allowing a higher ATP/AMP plus ADP ratio, if not an absolutely higher concentration of ATP. ATP has been found to improve the functional state of the brain (vestibular analyser) when used with pyridoxine, increasing its stability and shortening postrotatory nystagmus (Lapayev, et al., 1971) (Also, it promotes healing of corneal wounds at high altitudes, when applied locally with 4-methyluracil, Vovsi, 1972.)

Other "orthomolecules" besides niacin would be potassium, vitamin E (improving oxygen supply, facilitating cell retention of proteins), inositol (stabilizer of cells and proteins against denaturing or "dehydrating" influences, Webb, 1965) the other B vitamins, vitamin C, anabolic steroids (for example, the androgens, and progesterone, ginseng, eleutherococcus) to promote protein synthesis and retention of potassium and creatine and ATP. Progesterone

may be particularly important in female schizophrenics, since it commonly seems to promote emotional stability and even has an anesthetic function in large doses. (Selye, 1967.)

The electronic aspect of the cell's energy charge suggests that cysteine or reduced glutathione might be desirable, especially if there is evidence that glutathione is being destroyed by something like adrenochrome. (Sulfhydryl blocking can impair glycolysis, as can a niacin deficiency.) The theory of donor-acceptor interaction might eventually lead to a specific understanding of the "electronic leak" and how best to intervene, though it might not be such a discrete problem as some theorists have hoped.

The glutathione peroxidase which is released when mitochondria swell might be involved in the "electron leak," and so things which cause uncoupling of oxidative phosphorylation and mitochondrial swelling, such as unsaturated fatty acids (Racker, 1965) should probably be controlled in the diet.

Since the normal person has sharp diurnal cycles of brain activity (reflecting a proper concentration of the "brain" amines) and many psychotics have flattened cycles, involving disturbed sleep as well as disturbed waking consciousness, cyclic light stimulation of skin and head might be desirable to support regular cyclic activity of the pineal gland and brain. This would also tend to increase sex hormone production by the gonads (Kinson and Peat, 1971). The brain's "background activity:" might have what in the heart is called the "staircase" effect, in which structural readiness seems to leak away if the tissue doesn't become active often enough--"function builds structure, and structure produces function" (Szent-Gyorgyi, 1972).

Hyperbaric oxygen therapy has been used in relieving psychotic symptoms (Kondrashchenko, et al.,

1971), but this doesn't seem appropriate for creating lasting improvement. The opposite condition, i.e., high elevation, has caused lasting improvement in psychosis (Mirrakhimov, 1972) and many somatic and psychosomatic conditions, and the mechanism (according to the animal studies of F.Z. Meerson, 1972) is the adaptively increased number and efficiency of mitochondria in the brain, resulting in improved learning ability. Also, MAO activity decreases at high elevation while respiratory effectiveness increases (according to Khvatova, et al., 1973).

The changes Meerson's group has seen in high altitude therapy resemble the changes that occur during supplementation with thyroid and antioxidants. The lower concentration of oxygen in tissues at high elevation would increase the antioxidant reserves of the organism, making it more resistant to stress. Decreasing the use of dietary unsaturated fats similarly protects against oxidative stress. These changes, including thyroid supplementation, increase the proportion of useful oxygen consumption in relation to harmful oxidation of tissues, and increases the useful stores of tissue energy.

Optimizing the production and storage of energy will have the effect of tightening the control systems of the organism, improving mental, hormonal, and immunological functions. These changes are probably involved in the greater effectiveness of cancer therapies at high altitude.

In a pharmacological approach, reduced expenditure of glycogen, ATP and creative phosphate (Dardymov, 1971) combined with increased protein synthesis (Rozin, 1971) and increased resistance of cells and organisms to stress, can be achieved with ginseng, eleutherococcus, and 2-benzyl-benzimidazole (Rusin, 1971), used singly or in combination. Piracetam, an analog of GABA, improves learning, increases resistance to toxins or oxygen

deprivation, and increases bilateral symmetry of function in the cerebral hemispheres. The oldest, most basic therapies, sleep and nutrition, have the same function of restoring energy reserves. Pavlov worked with the simplest stimulants and sedatives, for example caffeine and bromide, to restore normal nervous functions, and of course always considered sensory stimulation essential to maintaining and restoring normal functioning.

The importance of improving protein synthesis is implied by the observation that serum from schizophrenics inhibits protein synthesis in rat cerebral hemispheres, hypothalamus, and cerebellum (Us and Bozhko, 1971).

Several people (e.g., Manukhin and Turnayev, 1971) have suggested an identity of acetylcholine, epinephrine and serotonin "receptors," and this structural-energetic theory similarly would suggest that "specific receptor" psychopharmaceutical approaches lack a proper physiological basis. But studies of psychoactive agents can contribute to a general understanding of cell and brain function, and can possibly support an orthomolecular approach. For example, when excessive cholinergic activity is involved in nervous dysfunction (and excessive acetylcholine can *block* cholinergic synapses, Ilyuchenov, 1971), cholinolytic cell stabilizers (e.g., acetylcholine or tetraethylammonium with the adamantyl radical substituted for the N-methyl group (Kharkevich, 1971) might be used to stabilize nerve function while actual repair processes occur under orthomolecular therapy. The adamantyl radical is also useful in treatment of Parkinsonism and viral infections (Il'icheva, 1973), again suggesting a general biophysical structuring effect, as in cholinolytic processes.

The Russians have two electronic techniques that may serve as alternatives to ECT (electro-shock) and which may in fact give some insight into the effects of ECT on the

brain. Electrosleep (produced by 5-100 Hz pulses, with peak current of 5-8 mA applied to the eyes--negative pole, and mastoid process--positive pole) has been used in treating "functional disorders of the CNS," autonomic and endocrine functional disorders, etc. (Studnitsyna, 1972.) High frequency (5000-6000 Hz) currents have been found to stimulate the brain (Rubakov, 1973).

In embryonic muscle cells, when the "depolarizing fast acetylcholine receptors" are blocked by snake venom, then the cell's "slow polarizing acetylcholine receptors" are revealed (Patrick, et al., 1972). This type of receptor may be responsible for the trophic influences which maintain high polarization and which seem to be involved in such things as the "Bowditch staircase." Electrical stimulation may act on similar "receptors" in neurons.

Vitamin B₆ is a coenzyme in carboxylation reactions and as such is involved in the synthesis of serotonin from 5-hydroxytryptophan, and also in the formation of GABA (gamma-aminobutyric acid) from glutamic acid. In the "resting" state, cell water seems to be more orderly, as if it had a lower "structural temperature." Some enzymes are inactivated by cold and presumably would be inactive in the resting state. GAD (glutamic acid decarboxylase) has been found to be among these peculiar enzymes, and this is the enzyme which decarboxylates glutamic acid, producing GABA. GABA has been shown to be a mediator of nervous inhibition on the basis of several criteria, including heightened GABA liberation in sleep and near-sleep (Sytinskiy, 1973). This would seem appropriate if the physical state of cell water is participating in brain regulation. During brain "activation" or exhaustion, this enzyme should become more active, producing more GABA and presumably thereby promoting rest and restoration. (Since hydroxylamine is an inhibitor of GABA degradation,

it would be interesting to see what effect it has on psychoses, though it may be too toxic to be practical; the same might apply to hydrazine, which is used with considerable success in inoperable cancer, and often induces sleep as well as preventing cachexia.) The natural anesthetic steroids would probably be the first choice for a chemically induced state of sleep if they could be administered conveniently.

Another enzyme that should be investigated from this point of view is NADase, since it too shows what may be a sensitivity to structure: In cell homogenates, it is sufficiently active to destroy NAD and thus stop glycolysis at the triose phosphate stage (Florey, 1966). It is inhibited by nicotinamide, but is also relatively inactive in the intact brain, at least in nonschizophrenic brain.

Magnetic fields presumably act biologically by acting on the structure of water, and Kholodov has established that a continuous sinusoidal magnetic field has a sedative and inhibiting effect, modifying the EEG and raising the level of GABA in the brain (Speranskiy, 1973). The activity of oxygen increases in magnetically treated water (Speranskiy, 1973), so there might be a direct effect on energy production.

Harmful types of radiation are generally thought to act only by ionization, and many researchers believe that the only harmful effects of such ionization are direct chemical changes in the genetic material. But there are hints in the "Russian paradigm" that small amounts of radiation can have a catalytic or chain-reaction type of effect in materials other than the genes, and that the effects of radiation on cell water might have important consequences for development, enzyme activity, and nerve function. They have demonstrated that microwaves with energy that is "too low" to affect cells according to western paradigms, actually have

clear effects. For example, S. N. Yevseyeva (Voprosy Kurortologii Fizioterapii i Lech. Fiz. Kult., No. 6, pp. 536-540, 1972) reported that decimeter wave treatment normalizes adrenal function and improves breathing in asthma patients. The structure of water appears to be the only aspect of the cell which is sensitive enough to account for the observed effects. Since non-ionizing radiation has these unexpected effects, we should consider whether "ionizing" radiation might also have effects on cell water at unexpectedly small doses.

The Russians have sustained the interest in light therapy that was current in many countries several decades ago, but their research in photobiology is just beginning to get interesting, and hasn't reached the stage of practical therapeutic application yet. Older work had suggested that exposure to red light selectively activates the parasympathetic part of the nervous system, so it is reasonable that Soviet physicians would be especially interested in the types of lasers (helium-neon) which produce pure red light.

V. M. Inyushin has discussed the use of the red laser for therapeutic stimulation of tissues in various diseases involving problems with circulation--"disruption of neurovascular trophic processes"--(Helium-Neon Laser Light in Biology and Medicine, Alma-Ata, 1970. P. R. Chekurov used this type of red light to treat obliterative endarteritis, poly-arteritis, and osteo-arthritis.

The old tradition of Russian medicine, "nervism," which reminded physicians that the brain must always be considered to have a role in sickness and recovery, has been enriched by the work of Pavlov and his successors. The tradition's most valuable lesson for American medicine might be its optimism, based on the idea of plasticity, and especially its recognition that cells (especially nerve cells)

which have stopped functioning might just be in the low-energy state of protective inhibition ("parabiosis"), and able to recover when their energy is restored. Rest, nutrition, and appropriate stimulation are at the center of scientific medicine.

Extracts of glands and other tissues have been used for generations to treat nervous diseases (e.g., Filatov, 1945). Thyroid, with or without gonadal extracts, has been widely used to treat nervous and mental disease. L. V. Polezhaev (*Loss and Restoration of Regenerative capacity in Tissues and Organs of Animals*, Harvard Univ. Press, 1972) has remarked that some of these treatments for neuropsychic diseases also promote regeneration, growth, and multiplication of nerve cells. Filatov, Polezhaev and others have clearly demonstrated regeneration of nerve tissue in the brain, cerebral cortex, and optic nerve.

I think it was around 1950 that I first read of Polezhaev's work with stimulated regeneration. Ever since then I have not only admired the scientific intelligence of his work, but I have followed with dismay the way most scientistists ignore, suppress, or ridicule his important basic discoveries. Regeneration relates so closely to aging research, it seems to trigger the same anxious and hysterical response. Apparently, in repressing the fear of death, many people develop a displaced fear of the possibility of solving the riddle of aging and death. When work of this nature becomes acceptable to our culture, I predict that its history will be reinvented, and its nature somehow transformed so as to isolate its fearsome origins, and keep them repressed.

Ultimately, therapy for the mind implies therapy for the body and the world.

CHAPTER 13

IDEAS ON ELECTRONS IN CELLS

The downfall of Gurwitsch and his mitogenetic rays seems to have been a result largely of his proposal for overcoming the criticism that such weak rays couldn't penetrate so far through living tissue: What he suggested was strange sounding to people who knew a little physics. He proposed that the radiation was comparable to a chain reaction, in which the products of the first reaction initiate a second, etc., except that all the reactions and their products are the same. An adequate unit of radiation striking a cell may either cause that cell to divide, or enable the cell to release a radiation or both." What otherwise would be a barrier to the radiation may, by resonance, emit a "secondary radiation." The properties of the secondary radiation are essentially those of the primary radiation. "In this way the original stimulus from the external source can be propagated through the interior of the culture or tissue." (Crile's discussion of the rays.) "...it was found that the radiation emanating from the root tip originated in the onion sole. The transmission of these rays lengthwise through the root apparently did not impair their power to stimulate cell division, even beyond the tip of the root." But "the root in cross section was only slightly transparent to the radiation." In the early 1930s the Gurvitsches (A & L) studied the spectrum emitted by nerves and by chemical solutions subjected to mitogenetic rays from an external source:

Substances which, in undergoing decomposition by fermentation or hydrolysis, emit at that moment a radiation of a definite spectrum, respond to irradiation by an identical spectrum, by emitting the same spectrum, as a secondary radiation.

In case of irradiation with a different spectrum, the secondary radiation is absent or at any rate very weak.

This fact, unexpected enough by itself, becomes more difficult to interpret if one considers the results of monochromatic irradiation. It is not merely the band in question which reappears in the secondary spectrum, but the latter in its entirety, in infraction of Stoke's law. If we take, for example, the band 2170-2180 Å of the glycolytic spectrum as irradiator for a solution of glucose, the secondary spectrum emitted by the latter contains also the shortest band (1900-1920) belonging to the glycolytic spectrum.

(From *L'analyse Mitogenetique Spectrale*, Paris, Hermann, 1934.)

O. Glasser and M. Schott conclude that the behavior is "paradoxical" and the theories are "difficult to accept." Others proposed a diffusible substance that would account for the induction of mitosis, but this conflicted with Gurwitsch's original observation, as well as later experiments; He noticed that the mitoses appearing around a wound in the cornea could be blocked on one side in a way that resembled a "shadow"--the borders were straight, which would not be the case if molecular diffusion were the inducer. This was what led him to postulate mitogenetic radiation. Later, a cellophane membrane was used to separate the source and the receiver, but opponents showed that the film was permeable to gases. So Gurwitsch used a quartz sheet for the separation, since this would allow u.v. radiation to pass, but his opponents continued to insist that even the quartz must be permeable to a chemical inducer.

In a symposium (Naval Research Lab, Washington, D.C., Oct., 1973) A. L. Schawlow (Stanford) predicted that

laser light will be used to control chemical reactions by tuning in on the energy levels of particular molecular bonds. If Gurwitsch had used these terms to describe his phenomenon, it could have been more easily accepted as a kind of catalysis, releasing chemical energy (or biological energy), rather than as a kind of fluorescence which would violate Stoke's law. (Even conventional theorists recognize cases in which thermal energy can contribute slightly to the excitation process of photoluminescence. Schawlow also commented that "anything will lase if you hit it hard enough," and demonstrated with a picture of lasing jello.

Lasing gelatin may be more than a joke. The unique photoelectric properties of protein are recognized in the use of gelatin in photographic emulsions. Szent-Gyorgyi has written a few books arguing that the properties of life depend on the electronic or photoelectric properties of the protein-water gel. Fluorescence and resonance have been proposed as a possible basis for nerve function. The fact that water is ordered in cells, and appears to be arranged longitudinally in nerves would seem appropriate if the gel structure is involved in the longitudinal conductivity of nerves. The observation that the gross conductivity of the brain is decreased by exhaustion (Crile, p. 200) and that the brain's electrical gradient is lower in fatigue led me to consider an electronic approach to consciousness, which relates the "Hopkins- Szent-Gyorgyi-Racker electron pool" to the states of consciousness, as well as to mitosis.

Telkes found that the protein fraction of tissues produced chemiluminescence when oxidized, especially in the presence of an added fluorescent molecule such as fluorescein, eosin, or rhodamin. Commercial gelatin also produced some light. Using filters, u.v. frequencies were demonstrated. Some organs consistently produced higher or lower intensity of light. The significant observation,

though, was that exhaustion of the animal, or adrenalectomy, diminished the chemiluminescence of some tissues. *

For the luminescence to be altered by a procedure such as surgical shock, it seems that the source must be in electrons that are much more labile than those in ordinary chemical bonds of the protein. (The electrons of free radicals are relatively active, but chemiluminescence produced by free radicals would be expected to increase as a result of injury.) Szent-Gyorgyi has proposed some likely sources for the electrons which are able to reduce large amounts of glutathione when only protein seems to be present as a reductant. It might be possible to determine whether these are the same "kind" of electrons in both cases by oxidizing with glutathione first, then using Telkes' procedure and seeing if luminescence is less. Also, the "laseability" of a protein solution might be altered after it has donated its electrons to glutathione: If so, this would increase the reasonableness of Gurwitsch's idea that light-resonance in tissues stimulates cell division, since Szent-Gyorgyi and others have already implicated the electron-pool and sulfhydryls in mitosis.

Crile's observation that exhaustion, conductivity and tissue fluorescence are related suggests that Pavlov's idea of "transmarginal inhibition" resulting from over-stimulation, and being involved in psychosis, could be another aspect of the same cellular event. It is now known that this kind of inhibition involves high levels of ammonia and other metabolites in nerve cells, a low level of energy-rich substances, and changes in proteins resembling denaturation. Niacin's role in schizophrenia (Hoffer and Osmond) might result from its involvement in reducing glutathione, which is in equilibrium with the "loose" electrons of cell proteins.

The existence of long-range order in water has opened up a new way of viewing effects of "low energy" light on chemical reactions: Solvent modifies reactions, solvent has memory, solvent can respond to energies too low for the reacting molecule itself to respond to. The long-range "domains" in the solvent system can act as a sort of antenna, absorbing energy that isn't strong enough to directly act on chemical bonds. Also, the existence of laser technology is forcing people to recognize a little more complexity in physical-chemical processes: Stokes' law and the conservation of energy aren't being threatened if we suggest a laser powered by metabolic electrons.

In "On distant intercellular interactions in a system of two tissue cultures connected by optical contact," V. P. Kaznacheev, et al. (Transactions of the Moscow Soc. of Naturalists XXXIX, p.224, biol. ser., section of biophysics and radiobiology) have reported effects much more specific than Gurwitsch's ("morphological manifestations"), transmitted through quartz. It's time now to give up the absurdity of claiming that inductive molecules are crawling through the quartz window. (The doctrine that molecules and large atoms can go through glass is a *dens ex machina* that is used with disturbing frequency by supposedly rational established "scientists," to dispose of facts that would force them to change their dogmatic beliefs.) If there are cellular changes induced by events on the other side of a window, we should start investigating the mechanisms by which such rays might act. The main reason for not investigating such problems is that our scientific culture is still tied to old ideas of atomism, reducing everything to simplified local interactions.

*George Crile, The Phenomenon of Life, a Radio-electric Interpretation, W. W. Norton & Co., N. Y., 1936.

CHAPTER 14

THE BRAIN AND MAGNETIC FIELDS

When two subjects such as the brain and magnetism--both still very open to speculation--are combined into a new field of research, we can expect the subject to be both imaginative and controversial. Fundamentally new processes, materials, and interactions can be expected to separate the past-centered from the future-centered scientists, provoking bitter disputes. In such circumstances, it is probably best to begin with an aspect of the subject that has at least some acceptance in the West, and to work from there toward the more general picture held by Soviet investigators of the effects of magnetism on the brain.

It is universally accepted that water has structure, that it is not an "ideal liquid," and that this structure is responsible for some of the peculiar properties of water. But this structure is usually thought to be only on the level of "flickering clusters," lasting about a millionth of a millionth of a second, and involving only a small group of molecules in each cluster. In 1926, Shereshevsky (an American) discovered that water and other liquids in small glass tubes behaved as if their structure had increased, that is, their vapor pressure became much lower than normal so that the liquid would condense in the tube at pressures that should cause it to evaporate. In Russia, Boris V. Deryaguin was demonstrating that even flat glass surfaces alter the behavior of water at a considerable distance from the glass. (It showed structural elasticity at distances under 900 Angstrom units.) After many years of experience in the study of water, Deryaguin discovered another important phenomenon: water could "remember" having been in the

frozen state for as long as a day after being melted (it had different properties between vibrating glass plates).

Several years ago in an industrial process which involved "floating" ore with magnets to refine it, the water which had been magnetically treated was found to be more capable than ordinary water of holding in solution the minerals which are deposited as "scale" inside water tanks and pipes. This led to many investigations of the properties of magnetized water, and to reports that its density, surface tension, and possibly its refractive index are higher than ordinary water's. It is interesting that in the 19th century, the Baron Charles von Reichenbach claimed that magnetically treated water had biologically detectable properties, as did water containing ice. Reichenbach believed that there was a common ("Odic") energy underlying the function of crystals, magnets, electricity, life, etc. Popular culture in the United States has been assimilating some of these ideas recently. The results of Soviet science parallel those ideas in many ways.

There has been speculation lately regarding a possibly new state of water discovered by Deryaguin. The material forms when water condenses at low pressure in capillary tubes. It resembles a dense, syrupy glass, suggesting that its structure is molecular, probably the result of additional substances dissolved from the glass tubes. It shouldn't be confused with "magnetized water." (Deryaguin's group has recently discovered another phenomenon of condensation at low pressures, in which carbon vapor grows into diamond crystals.)

One response to these observations might be "if we don't even understand water very well, we might as well disregard it and study biochemistry as if water were just a solvent, just a convenient medium in which the crucial chemical reactions take place." Another way of responding

is to say "the more complex water is, the more chances we have to find a really adequate description of what an organism is and why water behaves as it does in the living material." The difference is whether we treat strangeness as a threat, or as an opportunity. Unfortunately, many biochemists feel threatened by the assertion that "there is no biochemistry distinct from biophysics," and that particles can't properly be considered in isolation from their environment.

Starting--as many Soviet scientists do--with the recognition that both water and organisms are sensitive to magnetic fields, many questions present themselves. What will treated water do to various organisms and tissues? Which organisms and tissues are most sensitive to magnetism? What does temperature do to the magnetic sensitivity of a tissue? Does an alternating field have a special effect? How did the earth's magnetic field affect evolution? Does the geological record of periodic changes in the earth's magnetic field have something to do with the sudden appearance of new phyla of plants and animals? Can we be aware of changes in magnetic fields? Do animals orient themselves by the magnetic field? Can magnetism be used in medicine? Some of these questions have been partly answered, and others are just now starting to be investigated.

In animals, the most obvious trend in evolution is that of "cephalization," the increasing centralization of nervous processes in the head, and the growing complexity and size of the brain. At the same time this anatomical centralization occurs, there is also a metabolic tendency toward a higher efficiency of energy production. This change of efficiency apparently represents an increase of structure in the cell, and structure in general corresponds to the electrical potential of the cell. It has been known since

the end of the last century that a magnet will delay a nerve's response to an electrical stimulus, as if its structure had been preserved momentarily. If we think of the magnetic field as stabilizing the "head state," it occurs to us that the earth's magnetic field must have been an important factor in evolution, supporting or promoting "cephalization."

Yuri Kholodov has found that higher organisms tend to be more sensitive to magnetism than lower ones, and that the most sensitive tissue is nervous tissue, especially the brain and the glial cells, which are thought to be involved particularly in memory processes, and to provide some kind of metabolic support for the neurons. He found that the glial cells enlarge under the influence of magnetic stimulation. Recently, another magnetobiologist has found that the testes are also exceptionally sensitive to magnetism. Ordinarily, we don't think of testicular tissue as being uniquely "structured" in the sense that nerve and muscle are. However, in higher animals the testicles are carried in a scrotum, which keeps them slightly cooler than the rest of the body. At normal body temperature, the testes are unable to function properly; neither hormonal nor sperm-forming processes are normal at the higher temperature. Besides slowing the rate of chemical reactions slightly, this small amount of cooling would tend to increase the structuring of cell water. So the two peculiar tissues, testis and brain, apparently have unusual structural requirements for functioning normally, and they are the two tissues most sensitive to magnetism.

To emphasize the importance of cell structure in magnetic sensitivity is not to imply that electronic or free radical processes may not be crucial factors in that sensitivity--magnetic fields do cause measurable changes in electronic processes such as oxidation. Rather, what is being suggested is that there is a reciprocal relation between

structure and these electronic processes, and between both of these and the magnetic environment.

Many fish, which aren't normally considered to be "electrical," generate a very weak electromagnetic field around themselves, and are able to use this field to detect even small objects in the water around them. How they sense the changes in the field isn't known. Similarly, sharks can detect incredibly weak fields, such as those created by a minnow buried under sand, even at considerable distances. (It is apparently the electrical field of a wound which attracts them, rather than just the smell of blood.)

In Mexico and Central America, where earthquakes are common, it has been recognized that animals can in some way sense a coming earthquake. It has been suggested that they are detecting alterations in the electrical or magnetic conditions of the earth which precede the shaking. In Mexico, "everyone knows" that thunder and lightning (or colored flashes of light) precede or accompany earthquakes, and similar but earlier disturbances might be what animals sense. For years, Soviet geologists have been studying the ability of dogs to "smell" minerals. Some of them believe that the dogs are actually detecting some electromagnetic property of the material, since they can find ore which is covered by several meters of other minerals. Dogs have been trained to recognize the "smell" of a gold ring, and are then able to pick out samples of ore which contain even small amounts of gold.

The same increase in the efficiency of energy production which Verzhbinskaya (see chapter on the orienting reflex) found to occur in the brain in evolution and in the state of mental alertness, has also been found to occur in many tissues under the influence of a magnetic field. Of course, high efficiency energy production will have survival value in many ways, but if the metabolic gradient is the key

to cephalization, and if the brain is the most sensitive to this kind of stimulation, it is clear that magnetism will be an environmental support (or a "selective pressure") for bigger and better brains.

This observation might also suggest a new approach to the fact that the appearance of new phyla coincides with the appearance of a new geological magnetic polarity (found in rocks from deep borings), after a short period (a few thousand years) in which the polarity disappeared from the geological record. The standard view has been that, since the magnetic field protects the earth from intense radiation, these periods without magnetism allowed mutations to occur as a result of radiation. However, the new phyla that appeared were of a higher complexity than those which preceded them, meaning they contained *more* information, and we know that radiation produces mutations by the destruction of information. (But the idea that the magnetic field protects the earth from radiation is itself questionable.) If magnetism stabilizes the higher functions and structures of the brain, then we have at least the beginnings of a sensible interpretation of the fact that the earth's magnetism has some correspondence to major evolutionary advances.

If we could fill those gaps of thousands of years with a special *magnetic* event, other than the disappearance of the earth's magnetism, we would have a better argument for the importance of magnetism in the development of brains. N. A. Kozyrev has provided a theoretical reason for believing that planets and stars, including the sun, are evolving toward higher energy states, rather than dying down, and of course such evolution would include changes in magnetic field, as well as other changes, such as volcanic action.

Kozyrev proposed time as a real participant in physical processes, contrary to the dominant 19th century

idea that it is only an abstract framework in which events happen. As such, time would be a source of energy or order. He first proposed it in relation to some problems of stellar energy, saying that time could contribute energy to stars. He calculated the amount of energy time could add to a smaller body like the moon, and predicted that there should be some volcanic action on the moon. When he obtained photographic evidence of red eruptions on the dark moon in 1959, he was generally ridiculed--for example, an eminent American astronomer years later was still referring in his lectures to "that Russian's drunken hallucinations." Nevertheless, his observations have been duplicated by many others, and also have been supported by the unexpected discoveries made by instruments placed on the moon. Reviews of astronomical records have subsequently found that there were previous observations of red lunar eruptions, but without photographic proof.

Kozyrev has turned his attention to the larger planets, finding further verification for his theory of evolving planets, internal energy, and magnetic fields. One of his strangest predictions relates planetary spin to the "heart shape" (flattened top, bulging bottom) of planets. On the level of organisms, he suggests that biological form and "time-energy" may interact. This would be a direct mechanism promoting the evolution of higher order, but his theory also fits nicely with the known facts suggesting magnetism as a link between cosmic evolution and the evolution of life forms.

Accepting Kozyrev's general theory, we might be able to interpret the magnetic gaps in the geological record as periods of instability in either the earth's or the sun's magnetic field, and to suppose that the actual field experienced by organisms was very high, though it failed to

be recorded in the rocks because, for example, of the earth's constant movement through the sun's field.

There is a very practical problem that grows out of the interaction of brain and geological and solar magnetism, namely, the fact that solar "magnetic storms," or sunspots, are followed by magnetic disturbances on the earth, which result in high rates of nervous and emotional diseases, accidents, suicides, strokes, and heart attacks. At present, all that can be done on a mass scale in the Soviet Union is to have nationwide medical and safety alerts in the days following sudden bursts of solar activity. Experimentally, however, special isolation chambers are being used to protect patients from these magnetic storms. (It's important to remember that their scientific culture, which is so advanced in many ways, exists in a culture that is still economically backward, making the application of scientific discoveries especially difficult. Besides the slow bureaucratic processes, most physicians don't have the resources to apply modern knowledge.)

Since it is a fundamental principle of Russian medicine that the brain must be considered as a possible factor in all diseases and recovery processes, the magnetic environment is also being considered as a general factor in health. Its action on the brain is very important, but its direct effect on other tissues, such as white blood cells and the liver, etc., is also being studied. It is known that the weak fields of interplanetary space can cause reduced phagocytic activity of white blood cells, but it isn't known yet how much this effect is mediated by the brain.

Although what is now known suggests that a stronger magnetic field might contribute to improved brain function, the present emphasis in the field of "brain improvement" is on techniques that can be immediately implemented on a mass scale with the greatest benefit to the

public, for example to avoid brain deterioration resulting from work conditions.

Western scientists--basing their opinions on studies done in the 1940s in which animals exposed to radio waves showed no gross tissue changes when they were sliced up--said it was foolish to worry about possible harm from the "very low energy" waves of radio, television, and microwave ovens (except when tissue was actually cooked), since there was "no known mechanism" by which they could act on living tissue. The energy was not sufficient to cause a nerve to "fire," they argued, and so it could not possibly act on the brain. Meanwhile, since the Russians tended to think of nerves as complexes of water, macromolecules, and adsorbed small molecules rather than as "bags full of chemicals," they looked for more subtle effect, and found them. For example, they found that microwaves could relieve epilepsy in animals. As usual, the response in the U.S. was that they couldn't have achieved such a result, because it wasn't possible. As a result of such studies workers are protected from all kinds of electromagnetic waves, not just from high energy x-rays and nuclear radiation. Incidentally, a similar policy exists in regard to sound, since equally "impossible" effects of sound on body chemicals and structures have been observed. Long-range ordering of water and solutes is the mechanism which makes these effects possible, but such order doesn't exist as far as most American scientists are concerned. (The reasons given for dismissing evidence of such order are ultimately so flimsy that, to an independent observer, the motivations seem palpably extra-scientific. Because of the dependent nature of the science student, observers are seldom able to be independent.)

Recently, it was found that boiled water in the diet allowed blood cholesterol levels to become much higher

than when structured water--either magnetically treated or from ice--was used exclusively. Coffee itself doesn't raise blood cholesterol, or even necessarily blood pressure, so people with abnormally high cholesterol might find it helpful to use unboiled water. (But elevated cholesterol is almost always just a sign of low thyroid function.)

The best results in brain improvement, at present, have been achieved by conditioning mice to reduced air pressure, equivalent to an elevation of 10,000 feet. Brain function and its metabolic efficiency improved. The mechanism responsible for the improvement might have been both a simple adaptation (multiplication of mitochondria, as occurs in increased thyroid function) and an increased structuring of the protoplasm which might be expected at slightly reduced pressure. High pressure apparently causes a sort of "melting" of the protoplasm, and extremely high pressures inhibit oxidation.

When more has been learned about magnetism, water, and the structure of protoplasm, so that long-range safety is assured, we can probably expect to see the establishment of regular brain improvement resorts, using the combined effects of structured water, mountain air, electrons, and environmental magnetism. It is possible that the optimum conditions already exist in some regions, and account for the unique vigor of the inhabitants.

The brain is so important in the aging process, magnetic stimulation might lengthen life by intensifying brain function, causing sounder sleep, and improving repair processes. Light therapy is probably very important for sustaining and restoring optimum brain function, and I plan to write about current Soviet research in photobiology in the future.

If even pure water is capable of magnetic and structural "memory," then the more complex, stable, and

variable structures composed of water and biological materials would seem to be an ideal basis for the rich storages of consciousness. Soviet nerve biologists are investigating these subtle inner changes of nerve cells. In the new science that is emerging, everything is taking on an integral kind of meaning, and things become easier to understand as they become more complex.

CHAPTER 15 THE "EFFECT OF PERSON"

Someone noticed that when a person enters a room where a dog is hooked up to recording devices, the dog's pulse and respiration become slower and deeper. People respond the same way to the approach of another person. This response is called "Effect of Person." The changes are similar to some of those occurring in sexual excitement.

Slowing of the heart beat is produced by acetylcholine, which is released by the parasympathetic division of the nervous system. Reich and others have described parasympathetic function as being "expansive," in contrast to the "shrinking" function of the sympathetic nerves, as in fear. Both of these functions are meaningfully related to the central nervous system, the cerebral cortex, and to the perception of outside events.

To understand the Effect of Person, and sexual excitement, and love, we need some better perspectives on the meaning of nerve functions and on the nature of their integration with each other and with the experienced world. To get these new perspectives, we will have to work with both our perceptions of ourselves and our "objective" observations.

In the feeling of love, our inner body-space seems to expand, and we seem to be filled with the other. At the same time, we see the world with the perspective of the other, as if the world were enclosed in the other:

And within it opens into a World
And a little lovely Moony Night.

Another England there I saw....

Another Maiden like herself,
Translucent, lovely, shining clear,
Threefold each in the other clos'd--
O, what a pleasant trembling fear!

O, what a smile! a threefold Smile
Fill'd me, that like a flame I burn'd; I
bent to Kiss the lovely Maid, And
found a Threefold Kiss return'd.

In this process, the body's pace changes as the feeling of space is altered. The cerebral hemispheres are important for the perception of space, and they also are involved in "setting the reflexes," probably largely by stabilizing individual nerve cells at a certain energy level, raising the "thresholds," for example, by raising the ATP level. Each hemisphere has a trophic influence on the other, involving a similar raising of the energy level. Sleep (via GABA) also tends to raise the energy level. (Chemicals which elevate GABA -- hydroxylamine, piracetam, for example--improve learning; piracetam is known to increase bilateral balance of the hemispheres.)

Lowering the energy charge (exhaustion, some psychoses) apparently causes a perception of shrunken space; if we could relate energy charge to the two aspects--shrinking and expanding--of the autonomic nervous system, we would have a simple way to understand their effects. Since high activity of ATPase could lower the energy charge, chemicals altering this enzyme might have these general effects on perception and function. (ATPase seems to increase in the "melted" state.) Adrenaline--the chemical characteristic of sympathetic activity--decreases

the activity of ATPase. This is one way of looking at the connection between the sensation of space and the shift of physiological pace.

Another way of looking at the same interaction of space and pace: Big things always seem to have a more leisurely pace than little things--stars and atoms, elephants and mice. It may be that perception of space and regulation of motor rhythms are part of a single process. Bashkova and Zakharyants described a boy's symptoms following an attack of malaria that illustrate the connection of pace and space:

Objects began to seem much smaller in size. The patient's perception of speed was no longer correct: Everything seemed to him to be taking place faster (people, for example, did not walk, but ran). For this reason he too began to do everything very quickly. After treatment with quinine, these aberrations disappeared. (Pages 173-174, *Space and Time Perception by the Cosmonaut*, Leonov and Lebedev.)

In the anxious sympathetic state, nerve threshold would be lowered, and reflexes would be triggered more easily: This would increase the pace of activity, but since the energy charge wouldn't return to the highest level, the action would be smaller. This would presumably apply not only to heart-beat and respiration, but to other reflex actions such as orgasm.

The thyroid hormone keeps the cellular energy high, the adrenaline low, and reflexes strong. It undoubtedly has an important effect on both perception and responses.

In the high energy, expansive state, with thresholds raised, a strong stimulus could evoke a strong response. Things are bigger, possibilities are greater.

The events following orgasm--fusion of worlds and sleep in particular--are where "Effect of Person" or the first stage of love becomes transformed.

CHAPTER 16 RESOLUTION AND TRANSFORMATION

In mutually stimulating interaction, the hemispheres of the brain seem to be generating perception of space (and continuity through time) at the same time that they are "setting reflex thresholds," creating the conditions for integrating emotions with the world.

Enlargement of perceived space corresponds to dominance of the parasympathetic part of the vegetative nervous system (among other things).

Both loving and sleeping produce this "expanded," parasympathetic dominance. In loving, in any mutually affirming human interaction, there is an interaction of perspectives on the world. In each brain, the interaction of two hemispheric perspectives helps to generate and amplify our consciousness of the world. In the loving interaction of perspectives, a similar generation and amplification of consciousness can occur.

As we feel that we are being affirmed and loved by another, we feel that the other person is expanding us, and filling us; our body shifts toward parasympathetic dominance, skin gets pink, eye-lids and gaze may drop-- Marcel Proust described the feeling:

...filling me with a precious essence; or rather this essence was not within me, it *was* me. I had ceased to feel myself mediocre, contingent, mortal....

(Swann's Way)

At the same time, we begin to see the world with their perspective. This centering on the other person probably

happens to some degree every time we understand something new presented by another person--the process of forming a dominant, in Ukhtomskii's language. If our brain "forms a dominant for" the other person, that person has really come into us, and we can see the world from their perspective.

Structurally, this process could be practically the same as that of using the two cerebral hemispheres to intensify awareness. We would have two perspectives on the world, and we would try to synthesize them into one world. Difference is potential, and would "rouze our faculties to act," increasing energy level, or tension. Every "message" is a problem, leading us toward resolution.

The sudden turning of perception at orgasm seems to involve a transformation of both people, each achieving a synthesis of the two dominants. In "The Crystal Cabinet" Blake described another less satisfactory kind of outcome:

I strove to sieze the inmost Form
With ardor fierce & hands of flame,
But burst the Crystal Cabinet, And
like a Weeping Babe became--

A weeping Babe upon the wild,
And Weeping Woman pale reclin'd,
And in the outward air again
I fill'd with woes the passing Wind.

In this case he came out where he had been "caught" in the first place, "upon the wild." He had been "lock'd up," and felt a "pleasant trembling fear." I think he meant this as a caution against a certain kind of love-making, in which you end the same as you began, only worse. What fails to happen is the transformation from one world to another--I

think because of the attitude of trying to "seize the inmost Form," being locked up, etc.

Every real action causes a certain amount of growth. Being filled by another person can be thought of as "contracting with yourself" for a large amount of growth. If we are afraid to become someone new, instead of making the transformation we have to fall back to the old self and the old world; we fall slack. Crying involves a strong parasympathetic reaction, and is a way of discharging the expectant expansiveness, but is also an expression of the loss, of the shrunken possibility. (Blake's analysis of consciousness involved distinctions that haven't yet been fully developed in the scientific work of the Pavlov tradition. The Crystal Cabinet doesn't explore the solution to the problem, which Blake believed involved the active creative Fourfold consciousness.)

Although the orgasm involves some kind of turning of perception (and sometimes brings an urge to start playing or making something) it usually turns to dreamy sleepiness. A pattern of cortical excitation tends to become inhibited, according to Pavlov. In sleep, tension is low and parasympathetic dominance is strong. The pattern of the dominants, and of the resolution would remain in the cortex, probably relating to dream activity, possibly with an inverted or "halo" relation to the original form of the perspective-dominant. The resolution and transformation would continue to develop during sleep.

Healthy children always wake up with an eagerness to get back to the world--the world seems new and fresh.* Salvador Dali has studied sleep and dreams more than most people, and has some useful insights:

Men have attempted to interpret dreams,
and even to guide them, but never yet have men

attempted to use sleep to guide and to control artistic creation which is to be executed in a waking state.

...you guide yourself hypnotically toward the concentrated objective of synthesis....

Every enforced inactivity, before the impatience to act, becomes accumulated into creative force which, so to speak, is purified, directed. The essences separate into their hierarchies, and sleep, oriented in the direction of the realization of desire, ferments, sparkles, miraculously resolves itself and selects. What you prevent yourself from doing and force yourself not to do, the dream will do with all the lucidity of desire and without any of the blindnesses consubstantial with your champing gluttony.... But in order to enable your dream to work in peace you must cretinize yourself by the "hypnotic doubt" of your sensations, and the infantile game of discrediting the evidence of your senses by means of the three sea-perch eyes suffices, even for the most adult spirits, to encourage it to seek the most natural paths to an effective oniric solution.

(50 Secrets of Magic Craftsmanship.)

What Dali has perfected as a practical technique for achieving a new synthesis is probably a basic natural function of the sleeping brain: To transform multiple perspectives into a single new perspective. Dali says that Plato described the last sleep of dawn as "the sleep of truth." Good sleep does promote true perception.

I think this is an important part of what happens to the person following orgasm: The old self, the old world are transformed by interaction with the loved person. The assimilation is probably completed and stabilized by sleep.

Sleep and an active learning state are both fostered by elevated levels of GABA, the nerve-quieting substance, and the functionally related hormones, progesterone and thyroid.

The depth of transformation hasn't been investigated, but it seems likely that it includes even the cellular trophic influences.

*At puberty the slack can accumulate--children advanced by regular increments, but after puberty culture inhibits change and growth, while the Effect or Person becomes huge. Sleep problems, rigidity & apathy could result.

CHAPTER 17

DREAM ENERGY

Where do you draw the line between living and dead, between conscious and unconscious? Much of Western Christian thought has been concerned with this question--"was Jesus a man or a god?" "What distinguishes man from the animals?" etc. The tendency has been to draw the dividing line higher and higher: First, the human soul separates us from the beasts; then, our reason; next, language, use of tools, etc.; next, grammatical use of language; finally, some people are even refining the sense of "grammatical use of language," so that chimpanzees won't share our humanness when they create original sentences.

Another, "underground," line of thinking has existed in the West: Paracelsus, Behmen, Blake and G. W. Crile. These people have seen sympathies among the substances, a common life in the diversities of nature. Feeling themselves to be fully alive, they see all the material world as being alive in its own way, and knowable because of its inner similarity to human life.

Those who have asserted that nature is only mathematical, that the material world is empty and dead, eventually come to the "Behaviorist" conclusion that people, who are just part of the natural material world, are also empty and dead. They (e.g., Monod or Stent) assert that our historical, cultural and mental (or rather, "mental") life must become empty and dead. A similar doctrine was promoted by kings and priests in the 18th century, to suppress the aspirations of the people.

In 19th century Russia, materialist thinking had a tendency--probably from the influence of Aristotle--to see

matter as being full of possibility, to be intrinsically creative. The plant physiologist, Kliment Timiryazev, could ask the question:

Does a plant possess consciousness?
Let us answer this question by posing another:
Do all animals possess it? If we accept that all animals have it, why should we deny it to plants? And if we deny it to the simplest animal, where, at what rung of the organic ladder, does this threshold of consciousness lie? Where is the line drawn beyond which object becomes subject?

Out of this materialist philosophy of life and matter came the great Russian discoveries of the 20th c.: Oparin's coacervate theory of the origin of life; Deryagin's work on long-range structures of water; the "sorption theory" of Vvedensky, Nasonov, Troshin and others, in which cell structure and physiology are unified; and the Pavlovians' work in the nature of consciousness and the brain.

These two philosophies are ultimately a metaphysics of fullness and a metaphysics of emptiness, respectively. (Or we can call them assumptions about the nature of particular things, to emphasize their potential, or not.) We can think of these different attitudes as differences in brain function. We normally have, throughout the day and the night, regular cycles of alternating dreaminess and "motor" activity. These cycles usually last about 90 minutes each. We can think of the active part of the cycle as being a focus of excitation, as described by Pavlov, which is surrounded and defined by areas of inhibition. Discrimination is achieved by this process of selective suppression. The focus of excitation and discrimination exists in the brain as an

actual center, analogous to the "centers" or "analyzers" for various abilities, which become more sharply refined in evolution.

With prolonged discriminative learning, Pavlov noticed that the point of excitation becomes fatigued, and shifts to inhibition--this can lead to a hypnotic state, or to normal sleep. This center of inhibition then, according to a law described by Pavlov, becomes surrounded by excitation in a reversal of the previous pattern. Since the discriminative inhibition was structured by the learning experience, the excitation which replaces it must have a similar structure. This seems to explain the indirect way in which dreams relate to the preceding experiences. What was purposefully ignored is now attended to; awareness becomes expansive, and works over the background material, unifying it, strengthening the focus which was established in the preceding phase. Distant and seemingly trivial aspects of the background can now be re-evaluated, and put into a new structure, which may reveal the importance of certain images. Each image, of course, is itself a center of excitation, a "dominant," and as such exists in our memory as an organizing influence. Working from a certain strong center--the core of the dream--we approach and test other image centers for their relevance. Thus, the insight with which we began to dream may be small compared to the discovery that is established during dreaming. This is a kind of recruitment--of image, of dominant, of excitation, of information.

The incorporation of another person, the formation of a dominant for that person, forms a very strong center for this kind of recruitment. When resolution between self and other is achieved, as in sexual orgasm, the delivery of information can be great. We have another kind of gesture, the other person's dominant, with which to scan our own

background of experience--so that the achievement of understanding of "what the other person is" is a real expansion of our own world of possibilities, throwing the light of dream energy into the little-used corners of our life experience.

We can think of the active focus as the peak of a mountain, resting on the background of a dark landscape. A symbol, such as a word, can represent a complex image or concept by becoming attached to this peak. If we do our philosophizing only in this active mode, it is possible to just skim over these mountain peaks, ignoring the dark landscape below, taking the symbols and thinking we have everything. Of course, the geography of the peaks is dependent on the whole. But this mode of thought, seeing symbols as the only reality, can lead to the metaphysics of empty matter, mathematical nature.

If we do our thinking in the other mode, in which the active focus becomes inhibited, and exists as the dark pit of a valley, then what we see is the unifying landscape, and we have suppressed the verbal and symbolic flags that were associated with the peaks. Thought then becomes expansive, and synthesizes rather than analyzing. This dreamy mode of thought always tends toward discovery and newness, while the symbolic mode is limited to deduction and sameness.

These differences of thought are differences in brain function: some people are literally trapped in the verbal-symbolic mode, and their science must conform to their life. If their inner world is only words and emptiness, then it is reasonable that nature for them should be empty and dead. Western science (in its dominant Cartesian form) has based itself on this hollow metaphysics. Fortunately, the Russian tradition, a kind of spontaneous materialism, has produced a different and livelier kind of science. But if

Western scientists find the Russian conception of matter threatening, what must they think of the Russian physiology which criticizes their entire worldview as a brain dysfunction?

CHAPTER 18

THE FLOW OF ENERGY INTO THE WORLD

We can think of psychopathology in terms of energy being given to the perceived structure of self in the world. Generality and intensity are eupsychic, verbalism and vagueness are at the pathological extreme.

How is it that effectiveness and control lead to an alert, energetic, efficient state, and a sense of having no control leads to depression, a neuro-inhibitory state?

When we assert that consciousness is a hologram of body/world we mean that our meanings are like windows, and that the whole is present in, represented in, any part. When we suggest that the hologram has a finer texture than Pribram's model, based on synaptic interference, could give, and suggest that the gel structure of the brain tissue is the location of the hologram, we are suggesting that all of our meanings are present in systems that relate directly to metabolism.

If we think of consciousness as a flow of electrons scanning through a structured, conductive gel, we can see that the flow could be both focused and energized by events in the gel.

When we see a flow of visual dots on the retina (when we look at a repeating pattern, or flashing light, or visualize depth) we are likely to say "there must be an invisible scanning mechanism, activating cells in an appropriate way," because we use the language of cellular mechanisms for mental processes. What I am suggesting is that the "mechanism" is directly visible as the flow of

consciousness, and that the "tissue" component of the mechanism is experienced as resistance or framework. One of the retinal processes looks a lot like the pattern made by water streaming over the surface of a slightly dirty plate: The flow tends toward symmetry despite the random placing of the points of interference, or in other words the structure is largely a matter of energy processes.

If generalization is insight into the relationships among many particular experiences, this kind of insight will be facilitated by the kind of energetic imagination that allows many experiences to be held in relationship and compared. We can think of a generalization as a kind of "tube" through which we perceive related experiences, and through which we project ourselves when acting intelligently, or making a discovery: This new thing, previously not done, is possible because it relates meaningfully to other events.

Generality is like a lever: An intelligent action is one that has the desired consequences, and we hope a little action will go a long way. Failure to understand when acting means that the consequences won't occur where we expect them to, so it's as if all the lever is on our side of the fulcrum, reaching nowhere, doing nothing. The lever image can be changed to a telescope, looking through it both ways: When we have great insight and effect, we and world seem to be expanded; when we achieve no effect, we feel diminished. *

Our "tubes" of generality are some kind of connection we make among things in our mental space and

*I suspect that this corresponds to the degree of tissue conductivity, energy charge, tissue structure.

time, in our consciousness "field," the flow through structured gels. If we project ourselves effectively and intelligently into the world, it is because our consciousness is able to structure itself sensitively into the world. To be simple--both inside and out--our structures must be extensive, pervasive.

A certain amount of traffic, on many devious roads, becomes a torrent when a direct freeway is built--the surge of mental energy when insight into a generality is achieved seems to result from the same kind of process. In the same way, much less energy will be needed for ordinary functioning when the structure is simple. It's like a long lever, magnifying our action, saving energy.

Internally, the highly structured micro-world is doing the same thing. In alertness, animals use oxygen more efficiently to produce energy (Palladin, 1964), which facilitates uptake of potassium, indicating an increase of order in the micro-structure. Conductivity is higher between front and back of the head when a person is alert or dreaming. Brain amines seem to support these ordered states--clarity of waking experience, as well as soundness of sleep, require sufficient amines. In rats that are made hypoxic, activity of monoamine oxidase decreases and respiratory effectiveness apparently increases adaptively (Khvatova, Rubanova, and Zhilina, *Voprosy Meditsinskoy Khimii* 19(1), 3-5, 1973. Administration of monoamine oxidase inhibitors improves resistance of mice to hypoxia (Piskarev, et al., *Farmakologiy i Toksikologiya* 36(1), 48-54, 1973). Adaptation to high elevation not only increases the number of mitochondria (giving a better oxidative capacity), but it can also produce improvement in bronchitis, bronchial asthma, Basedow's disease (obviously oxygen related), schizophrenia, and manic-depressive

psychosis (Mirrakhimov, *Klinicheskaya Meditsina* 50(12), 104-109, 1972).

Contrast--not only the temporal contrast of sleep-waking--is very important for the quality of our experience. In the "fizzly" dream state of exhaustion/depression, black can't be experienced, because of diffuse background activity. The same amount of energy or activity could produce more intense and pleasant experience if it could be properly distributed according to meaning patterns. An interesting analytic point is that this fizzly state *is* a meaning; the world is flattened and garbled, and we are disturbingly committed to that kind of world, even though we may know it isn't right--it feels terrible, but the meaning is right there. In this sense, the "normal" person is committed to this world, because its meaning is intrinsic, and he probably has never experienced a more intense consciousness. I want to emphasize that the experience is always meaning, and that we *mean* garbled if that's what we experience, in the sense that Merleau-Ponty said that we "are doomed to meaning."

The hologram idea implies that the fine structure is meaningfully ordered with regard to the represented world: This is its window-like quality. Its degree of order will correspond to the order which it images, and this order will increase with generality, and decrease with compartmentalization or so-called concretization (actually, what is most general is most concrete). Energy flow and intensity will change as the nature of the field changes. Both energy production and energy flow become more efficient with insight/control. Convolutional flow, like lobotomy, cuts off the perspective, verbalizes and concretizes, but stays open to energy, in a fizzly, soggy way.

Both metabolic and social events (and development, which is both social and metabolic) can influence the wholeness and intensity with which we interact with the world, and can promote an energy-wasting state, or a condition of growth towards greater wholeness and intensity.

CHAPTER 19
ABOUT OBJECTIVE CONSCIOUSNESS
(NO DUALITY)

We have a body gradient which becomes more intense with alert consciousness and with higher evolutionary levels. The body has its completion in the environment that it chooses or creates to live in.

A high consciousness, supported by, and probably constituting, a high body gradient, relates more flexibly to its environment, and so has a different environment, a "faster" one. That is, a flexible instrument has a higher "resolving" power for time. This is clearly the case for complex sound perception, particularly language (e.g., see Pribram, *Plan* etc.). In my experience, it's also true for visual patterns that exist only as a development through time--the pattern is visible only when a certain span of time can be held as "present." Twinkling lights, and the little splashes of raindrops hitting the ground are situations where meaningful (wind) patterns can be seen in what "momentarily" seem to be random events.

An inner stiffness slows down the way consciousness resonates with the world, and so results in a kind of skimming of slow patterns from the world.

When we think of "resolving" or discriminating as an actual material resonance process, in which living material resonates in forms corresponding to forms in the world, we have a concept in which the body-mind problem disappears.

Phenomenologists, like Merleau-Ponty, have wrestled with the dualistic interpretive system of our culture, and have made real progress in moving those old categories toward a new, synthetic or unifying

understanding, but as long as the old cultural forms persist, the problem is going to reappear. Even in Merleau-Ponty's later work (*Visible & Invisible*) the holding together he achieved in his more biological writings is only weakly present in an idea like "chiasm."

In science, the concept of resonance has existed for a long time, though it apparently has never been well generalized. Energy, structure, and interaction are essential parts of its definition.

Sonic and electronic resonances are increasingly recognized as being biologically important. The Gestalt idea of spatial representation of images within the brain is gaining strength with the realization that the brain is hologram-like. The vibratory theory of smell and the "fluorescence" theory of vision reveal another aspect of the idea of consciousness as resonance. The hologram model helps us to visualize a many-leveled energy interaction of organism and environment, a resonance. The mind-body problem is thus a scientific problem, and the paradigm is already available in the physical concept of resonance.

The scientists who refuse to touch the problem are bowing to the old cultural interpretive system. Western philosophy has been duped for centuries by the foolish question of subjective illusion and delusion. The "public knowledge" reaction to this idealistic trick (to say that private knowledge is impossible) has thrown out superior perceptions along with the delusions. The common knowledge of what is delusive, the existence of an ordinary language category, "illusion," shows how unnecessary it has been for philosophers to struggle with the idea. History is full of cases of superb perception (e.g., Helmholtz's description of controllable left or right eye function) which were ruled out because they weren't common in some sense. The ridiculous extreme of this sort of thing is the aging

neurology professor who says that the upper limit of human hearing is 14,000 cycles per second, because he tested it himself.

When we can accept consciousness as a material and objective thing, then we can see new meaning in Mach's "there is no illusion." Certain illusions are diagnostic: "The world is always dark," for example, diagnoses blindness.

More importantly, we will have achieved a basis for a better science, in which high generality and high flexibility perceptions are no longer rejected as "merely subjective." They may be diagnostic of a sick paranoia, or they may be diagnostic of a superior perceptual functioning which is strictly empirical.

Recognizing material, objective consciousness forces us to realize that generality is full and experiential, and that generality exists objectively, to be discovered. It empties of meaning the philosophies of abstraction, the idea that "nature is mathematical," and all of the traditional cultural dualities--even the matter-energy distinction is demystified.

CHAPTER 20 END OF SCIENCE?

And the chief characteristic of the opposite of affirmation-consciousness -- I suppose one might call it depression-consciousness--is that when you are in it, it seems *totally convincing*; like a very brilliant liar, it can account for everything in its own terms. Colin Wilson

The scientists of empire are announcing the end of science and art, and of all cultural progress. Their argument is simple: The knowable world is finite, and our knowledge of it grows at an increasing rate. The end must come soon. Some of them say that physics and chemistry are already finished, and that biology will be completed when a few puzzles are solved in genetics--and the general form of these solutions is already known.

For German idealists--like Hegel or Hitler--"our world, our own time" tends to be seen as "the last stage in History." The Golden Age, or the 1000 year Reich, is always just now arriving. At the end of the last century, many physicists were certain that their science was complete, except for a few details.

Idealists see "pure knowledge" as the source of technology, and so technology must come to an end too, a little later than science.

Materialists are more likely to see our time as being near the beginning, not the end. For example, Marx (who borrowed so much from Hegel) said that "real history" couldn't begin until capitalism has been overcome.

I think this observation is more tautology than perception. The term "materialism" describes the attitude that likes to begin with "the matter at hand," "idealism" describes an approach that emphasizes the importance of established ideas. One's place in the world obviously influences judgments as to where truth and value can be found.

Ever since Heraclitus, materialists have emphasized change, while idealists emphasize stasis. "Pure knowledge" is a source of technology, but technology is also a basis for the development of new formalized knowledge. The steam engine was already in common use when Carnot and Joule formulated its basic theory.

What the idealists are saying is that *their* science is nearly complete, and there is no other science. What they imply is that there can never be technologies which conflict with *their* laws. In the Golden Age, science must achieve certainly, otherwise it wouldn't be perfect. Hegel's version of this was: "...the laws of *real* Freedom--demand the subjugation of mere contingent Will."

German idealism has been influential in western science for most of the 20th century, but now scientists in capitalist countries are letting it guide them into cultural fascism.

Geneticists have been the worst offenders. Genetics is popular among bourgeois racists and elitists, and many geneticists have eagerly formulated genetic theories of intelligence on the flimsiest evidence. But seemingly decent "liberal" geneticists are pushing the idealist doctrine about the end of science. The reason for this must be that genetics has so little real subject matter that theoretical formalisms can generate the desired conclusions with little interference from the material world. There is a collection of papers by the great founders of genetics, which is about all that

contemporary geneticists know about the history of genetics. Looking at the data published there, and interpreting it with different assumptions, one can see the breath-taking mystical guidance those men must have had--it wasn't even necessary for them to try to dispose of alternate interpretations, their faith was so great or their vision so narrow. (Nuclear physicists and mathematicians sometimes become geneticists without bothering to study organisms. The engineering approach of molecular biologists can get results of a sort, but the worrisome thing is that some of them don't appreciate the differences between bacteria and people. If a mechanic tried to sell a farmer a "new carburetor for his horse," the farmer wouldn't buy it, but we often buy similarly irrational "solutions" to our problems.)

That narrow vision serves the geneticists as well in political matters as in academic work. They can reach very definite conclusions about the future of science and society without having to study other theories of history and human nature than the one they can derive from their philosophy of science.

In one of these books in which scientists reveal the implications of their philosophy (*The Corning of the Golden Age*), Gunther Stent said "My general argument will follow more or less Hegelian (or, for all I know, Marxist) lines." He proudly admits that he has no understanding of Marxism at all. The real importance of his argument is that it is a central core, the armature, of the dominant segment of Western European and American science.

Stent believes that the "will to power" is what creates progress, by being sublimated into creativity. "...natural selection favored those proto-human genes which produce a brain in which the will to power concept is innately latent." He continues:

This argument bears some considerable affinity to Noam Chomsky's theory of the origin of linguistic capacity. For, Chomsky proposes that the structure of the human brain embodies within it a "universal" grammar on the basis of which the "particular" grammars of all natural languages have been generated.... From this point of view, the acquisition of language is the product of an interaction between received particular ideas and an innate general logical system.

Here we have touched on a special feature of human evolution.

In having fostered the cultivation of such attributes as curiosity, ambition and imagination, the will to power provided man with the psychological wherewithal to gain ascendancy over his fellow creatures.

The conclusion of Stent's book is reminiscent of (Harvard psychology professor) Herrnstein's argument that class distinctions based on genetic differences of intelligence are going to be intensified with time. He discusses the outcome of the will to power:

...the distribution of its intensity among individuals will have been drastically altered. At one end of this distribution will be a minority of the people whose work will keep intact the technology that sustains the

multitude at a high standard of living. In the middle of the distribution will be found a type, largely unemployed...whose prototype is the beatnik.

At the other end of the spectrum will be a type largely unemployable.... His prototype is the hippie.

Stent compares these classes with Huxley's Alpha, Beta, and Gamma classes in *Brave New World*, which of course were maintained by special genetic techniques.

Not all American scientists are so ignorant and presumptuous: I remember hearing a physiologist express dismay when he heard the "science is finished" line. Physiology is less formalistic science than genetics--could this be because the idealists haven't worked in it? Many geneticists are thinking of applying their talents to brain physiology when they have brought genetics to a close. Stent assumes there are no important physiological problems left outside the brain.

Stent's present profound understanding of the brain includes ideas like these:

a genetically determined wiring diagram;
mental limits expressed as the number of
nerve cells;
the brain was not selected for handling deeper
problems such as the nature of matter or of
cosmos;
epistemological aspects place consciousness
beyond the realm of scientific research; it can
never be explained.

With the U.S. government cutting science funds, the idealistic nonsense of these influential scientists is especially destructive. Because their line coincides with that of the ruling group, they can probably count on good funding when they move into other fields.

When that happens, what will happen to more materialistic or objective lines of research, such as those that have found that early experience shapes brain development, or that freedom literally makes the brain grow?

I think they will suffer the same distortion and suppression that some inheritance experiments have received from the idealistic and arbitrary geneticists. The inheritance of "acquired" alterations in brain size, such as produced by Zamenhof (transgenerational effects of diet) must appear unnatural and perverse to the idealists.

At a lecture, Professor Stent cited and praised as the basis for his projected work on brain function, two little-known papers in a German publication. These papers were created for the Nazi party as the explicit genetic rationale for killing inferior varieties of people. Stent didn't attempt to distance himself from their political implications.

If a new, freedom-tolerant culture ever comes into being, we can expect a new science and technology to appear, and even new brains allowed to develop in freedom, adequate to "deeper problems" like the nature of matter and of cosmos.

The Soviet theoretical physicist, Kirill Stanyukovich, has used formal information theory to argue against the idea of a "heat death" of the universe, and related anti-materialistic, pessimistic and skeptical ideas. He sees the possibility, the necessity, of endless "upward" evolution of the universe:

It is impossible for all processes to be reversible. In the long run changes in quantity must lead to changes in kind and a transition to a new state.

Man is still very young. His recorded history spans less than ten thousand years from the most ancient civilizations. Less than fifty years have passed since there emerged on earth a social system throwing open boundless opportunities for man's creative powers, once shackled with social chains.

This optimistic view is an official part of Marxist doctrine, but I think much of it derives from a cultural optimism that has been recurrent in Russian history. Marxism without the rich Russian culture can be a relatively sterile branch of Hegelian philosophy, or a relatively abstract economic theory. Marxism on a foundation of Aristotelian attitudes is less abstract than a marxism that is grafted onto Cartesian and Hegelian ideas. Optimistically, I think this minor aspect of western culture, the belief in an intellectually richer future, can be recovered and expanded into a humane and scientific culture.

CHAPTER 21

MORE GENEROUS PERCEPTION

Only he who is able to restore the interior
magnitudes awakens a resolute will to liberty.

Robert Creegan

It indeed appear'd to Reason as if Desire was
cast out; but the Devil's account is, that the
Messiah fell, & formed a heaven of what he
stole from the Abyss.

William Blake

I have tried to show how another culture's knowledge can give us insight into our own, and it happens that science and personality are two of the areas in which our culture needs some new understanding. Our mass media, including the schools, have discouraged the critical attitude of wondering why a particular person says a certain thing, and they have actively suppressed the idea that our science and psychology could be tainted by hidden political or financial motives. When a member of the President's Science Advisory Committee expresses an opinion on new sources of energy (e.g., "wind power is for the birds"), we could better evaluate that opinion if we knew he worked as a consultant for General Atomic and Avco. Other "scientific opinions" should also be treated with suspicion, but sometimes the hidden motives will be extremely hard to discover. "Culture" might be defined as a system of hidden motives, and in this case the only way to criticize it will be by getting outside it. Each culture will have special blindnesses and also some areas with great amplitude and richness of vision. Our job, in our own culture, is to open

whatever is closed, to generate possibilities by working on what has been neglected.

Two of our Anglo-American culture-problems--the subject-object dualism and the meaning of time--are given new dimensions by seeing how differently the Russians think about consciousness. If we can learn to be curious about disturbing facts--such as a visual after-image of motion--we can let these simple but peculiar events guide us into new patterns of meaning, new ways of being. For example, by continuing to pay attention to a motion after-image, we are not only learning to see a brain process in itself, but we are forcing ourselves to think of the brain as an energy storage system. Our culture has given us nothing useful to do with the perception, so we learn to ignore it. A culture which centers on time and motion, and which describes consciousness as a reflection of the world will more likely find something to do with that sort of perception.

Understanding ourselves in the light of Pavlov's tradition can be liberating and simplifying, while revealing an unsuspected richness and complexity in psychology and biology. Just seeing that there are observable brain processes that are similar in everything we do--sex, education, research, work, conversation--gives us a sense of orientation towards other beings that could hardly be achieved otherwise.

The Soviet cultures can give us some new questions, and we need new questions in psychology and in other sciences. But beyond learning what they know, we have the more general job of trying to make our culture more humane, trying to discover all the systems of hidden motives. Robert Creegan, referring to such hidden motives in our culture, said:

Either we shall have more generous order, wisdom-imbued and boldly marshaling all the sciences for healing and for constructing, or we shall have planned disorder, cunningly rationalized, and marshaling deteriorating science, to break personalities and to enslave, or to obliterate, thoughtful peoples.

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