"Ordinary" Consciousness:

A Personal Construction

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SEEING DOUBLE

A father said to his double-seeing son, "Son, you see two instead of one."
"How can that be?" the boy replied. "If I were, there would seem to be four moons up there in place of two."

We can begin the study of consciousness with ourselves. Consider your own normal consciousness, and reflect for a moment on its contents: you will probably find it a mixture of thoughts, fantasies, ideas, and sensations of the external world. Objects appear, such as trees, books, chairs. We are aware of people, as bodies in space, as personalities, as voices. We move in tridimensional space and actively manipulate perceived objects - we may turn the page of a book, sit in a chair, speak to someone, listen to a lecturer. Normally, our personal consciousness is our whole world, and this equation can be considered successful to the extent that it enables us to survive.

But although we are sure that the world we experience has some physical validity, we usually go a bit further. At each moment of each day, we make the same mistake as the double-seeing son—we consider that our own personal consciousness *is* the world, that an outside "objective" reality is perfectly represented by our experience. Most people never realize there is an issue here, since for ordinary purposes our experience is reality.

Some early Walt Disney cartoons portrayed such an understanding. In some episodes a Little Man at a switchboard in the brain projected physical "pictures" of the world on a Consciousness Screen. The pictures, of course, were a perfect reflection of the external world.

A moment's thought, though, will show that the idea of a personal consciousness as a perfect mirror of an external reality cannot be true. If there were a Consciousness Screen, who could see it? Does the Little Man have another Little Man inside him? And sometimes we do experience objects which are not physically present. We hallucinate, imagine, distort. Each night we dream and experience events and objects which are totally produced by ourselves.

Consider also the enormous variety of physical energies which impinge on us at each moment. To take one instance, "the air," or more properly, the geophysical environment, carries energy in the electromagnetic band: visible light, X-rays, radio waves, infrared radiation. In addition, there is mechanical vibration of the air, containing the information of sound; the constant energy from the gravitational field; pressure on the body; gaseous matter in the air. We also generate our own internal stimuli-thoughts, internal organ sensations, muscular activity, pains, feelings, and much more. These processes all occur simultaneously, and continue as long as we are alive; yet we are certainly not aware of each process at each moment. Our personal consciousness, then, cannot fully represent the external world or even our internal world, but must consist of an extremely small fraction of the entire "reality." We do not even possess the sensory systems to receive many energy forms.

Many questions arise once we realize that our personal consciousness is extremely limited. "How do we ever manage to maintain a stable consciousness in the face of all the stimuli which impinge on us?" "What is the nature of our experience of the world?" "Why is it necessary for our personal consciousness to be limited?"

Personal consciousness is outward-oriented, involving action for the most part. It seems to have been evolved for the primary purpose of ensuring individual biological survival, for which active manipulation of discrete objects, sensitivity to forces which may pose a threat, separation of oneself from others, are very useful. We first *select* the sensory modalities of personal consciousness from the mass of information reaching us. This is done by a multilevel process of filtration, for the most part sorting out survival-related stimuli. We are then able to *construct* a stable consciousness from the filtered input.

If we can realize, from the outset, that our ordinary consciousness is something we must of necessity construct or *create* in order to survive in the world, then we can understand that this consciousness is only one possible consciousness. And if this consciousness is a *personal* construction, then each person can change his consciousness simply by *changing the way* he constructs it. The psychologist William James compared this process to that of a sculptor carving a statue out of marble —the process largely involves selection and limitation, but each sculptor's statue is unique, as is each person's consciousness.

> We see that the mind is at every stage a theatre of simultaneous possibilities. Consciousness consists in the comparison of these with each other, the selection of some, and the suppression of others, of the rest by the reinforcing and inhibiting agency of attention. The highest and most celebrated mental products are filtered from the data chosen by the faculty next beneath, out of the mass offered by the faculty below that, which mass was in turn sifted from a still larger amount of yet simpler material, and so on. The mind, in short, works on the data it received much as a sculptor works on his block of stone. In a sense, the statue stood there from eternity. But there were a thousand different ones beside it. The sculptor alone is to thank for having extricated this one from the rest. Just so the world of each of us, however different our several views of it may be, all lay embedded in the primordial chaos of sensations, which gave the mere *matter* to the thought of all of us indifferently.
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> We may, if we like, by our reasoning unwind things back to that black and jointless continuity of space and moving clouds of swarming atoms which science calls the only real world. But all the while the world we feel and live in will be that which our ancestors and we, by slowly cumulative strokes of choice, have extricated out of this, like sculptors, by simply rejecting certain portions of the given stuff. Other sculptors, other statues from the same stone! Other minds, other worlds, from the same monotonous and inexpressive chaos! My world is but one in a million, alike embedded and alike real to those who may abstract them. How different must be the world in the consciousness of ants, cuttlefish, or crab! (William James, 1890)

How, then, do we take the chaos and "make sense" out of it? Each of us selects and constructs a personal world in several ways. Our sense organs gather information which the brain can modify and sort. This heavily filtered input is compared with memory, expectations, and body movements until, finally, our consciousness is constructed as a "best guess" about reality.

THE SENSES AS DATA-REDUCTION SYSTEMS

We normally consider that our senses are the "windows" to the world—we see with our eyes, hear with our ears. But such a view, though it is certainly valid, is not entirely true, for a primary function of sensory systems taken as a whole is to discard "irrelevant" information, such as X-rays, infrared radiation, or ultrasonics. Aldous Huxley most elegantly stated this idea. In *The Doors of Perception*, Huxley quotes C. D. Broad:

> The function of the brain and nervous system is to protect us from being overwhelmed and confused by this mass of largely useless and irrelevant knowledge, by shutting out most of what we should otherwise perceive and remember at any given moment, leaving only that very small and special selection that is likely to be practically useful.

And then Huxley comments:

> According to such theory each one of us is potentially Mind at Large. But insofar as we are animals our business is at all costs to survive. To make biological survival possible, Mind at Large has to be tunneled through the reducing valve of the brain and nervous system. What comes out at the other end is a measly trickle of the kind of consciousness which will help us to stay alive on the surface of this particular planet.
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> To formulate and express the contents of this reduced awareness, man has invented and endlessly elaborated those symbol-systems and implicit philosophies that we call languages. Every individual is at once the beneficiary and the victim of the linguistic tradition into which he has been born—the beneficiary inasmuch as language gives access to the accumulated records of other people's experience, the victim insofar as it confirms him in the belief that reduced awareness is the only awareness, and as it bedevils his sense of reality, so that he is all too apt to take his concepts for data, his words for actual things. That which, in the language of religion, is called "this world" is the universe of reduced awareness expressed and, as it were, petrified by language. The various "other worlds" with which human beings erratically make contact are so many elements in the totality of awareness belonging to Mind at Large. Most people most of the time know only what comes through the reducing valve is consecrated as genuinely real by their local language. Certain persons, however, seem to be born with a kind of bypass that circumvents the reducing valve. In others temporary bypasses may be acquired either spontaneously or as the result of deliberate "spiritual exercises" or through hypnosis or by means of drugs.
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> Through these permanent or temporary bypasses there flows, not indeed the perception "of everything that is happening everywhere in the universe" (for the bypass does not abolish the reducing valve which still excludes the total content of the Mind at Large), but something more than, and above all something different from, the carefully selected, utilitarian material which our narrow individual minds regard as a complete, or at least sufficient, picture of reality.

Consider the most important avenue of personal consciousness, the eye. It responds to radiant electromagnetic energy in the visible spectrum. If we consult a chart of the electromagnetic spectrum, we note that the "visible" spectrum is but one tiny slit in the entire energy band. The entire spectrum ranges in wavelength from less than one billionth of a meter to more than a thousand meters; yet we can "see" only the tiny portion between

400 and 700 billionths of a meter. In addition to electromagnetic energy, many other forces arrive at the eye-pressure, mechanical vibrations in the air, gaseous matter, etc.-but the eye is "by design" ignorant of these.

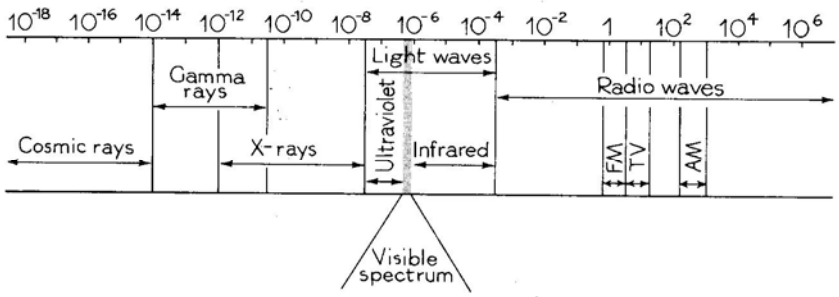

FIGURE 2.1
The electromagnetic spectrum.

We cannot possibly experience the world as it fully exists - we would be overwhelmed. We are restricted by our physical evolution to only a few sensory dimensions. If we do not possess a "sense" for a given energy-form, we do not experience its existence. It is almost impossible for us to imagine an energy-form or an object outside our normal receptive range. What would infrared radiation or an X-ray "look" like? What is the "sound" of a one-cycle note? Or, as in Zen, what would be the sound of one hand clapping? These questions may be difficult to grasp. It may be easier if we descend a bit on the evolutionary scale and examine an animal whose sensory systems, evolved for its survival, limit even more than do ours, ignoring dimensions of the external world which are a part of our own experience.

Perhaps the clearest relevant research has been on the visual system of the frog. The eye of the frog was studied by Lettvin, Maturana, McCulloch, and Pitts at the Massachusetts Institute of Technology. They were interested, essentially, in the same point made by Huxley, that sensory systems serve mainly for data *reduction*.

They devised an experiment in which visual stimulation could be offered to one eye of an immobilized frog. The frog was so situated that its eye was at the center of a hemisphere seven inches in radius. Small objects could be placed in different positions on the inner surface of this hemisphere by means of magnets, or they could be moved around in the space inside the hemisphere. The investigators implanted microelectrodes into the frog's optic nerve to measure, as they called it, "what the frog's eye tells the frog's brain"-the electrical impulses sent to the brain by the eye. Since the frog's eye is somewhat similar to our own, these investigators hoped that electrical recording from the optic nerve would discriminate the different kinds of "messages" that the eye sends to the brain, and reveal the relationship of the evoked patterns of electrical activity to the different objects displayed on the hemisphere.

There are thousands, millions, of different visual patterns that one could present to a frog—colors, shapes, movements, in various combinations - choosing them from the almost infinite richness of the visual world of which humans are normally aware. However, in presenting many different objects, colors, movements to the frog, the investigators observed a remarkable phenomenon: from all the different kinds of stimulation presented,

only four different kinds of "messages" were sent from the retina to the brain. In other words, no matter what complexity and subtle differences are present in the environment, the frog's eye is "wired up" to send only a very few different messages. The frog's eye presumably evolved to *discard* the remainder of the information available.

The structure of its eye limits the frog's awareness to only four different kinds of visual activity. Lettvin and his co-workers termed the four related systems *sustained contrast detectors; moving-edge detectors; net dimming detectors; and net convexity detectors*. The first provides the general outline of the environment; the second seems to enhance response to sudden moving shadows, like that of a bird of prey; the third responds to a sudden decrease in light, as when a large enemy is attacking. These are systems which have presumably evolved to extract information relevant to survival and to discard the rest, in the manner described by Huxley.

The fourth type of "message," conveyed by the net convexity detectors, is the one most obviously related to the frog's biological needs and is the most interesting system. The net convexity detectors do not respond to any general change in light or to contrast; they respond only when small dark objects come into the field of vision, and move quite close to the eye. It is quite clear, then, how the frog gets its food, how it can see flying bugs even with its limited visual system. The frog has evolved its own subsystem, which is wired up to ignore all "irrelevant" information, and to notice only that of bugs flying around close to it - a very specialized "bug-perceiving" sub-system.

So, out of the complexity and richness of the information presented to the eye, the frog seems to select only four different classes of events. Higher-level animals exhibit similar selectivity, but in a much more complicated way. This type of electrophysiological analysis has been extended to cats and monkeys by David Hubel and Torsten Weisel at Harvard University, and now by many other investigators, who have determined that different cells in the cortex of mammals respond to different types of sensory stimulation. They found that certain cells detect edges and corners, others respond to movement on the retina, etc. Although vision has been the sensory system most often studied (since it is relatively easy to record from the visual system and to specify the stimulus dimension), one would also expect other sensory modalities to show the same kinds of relationships.

It is the function of sensory systems, then, by their physiological design to reduce the amount of "useless and irrelevant" information reaching us and to serve as selection systems. The information input through the senses seems to be gathered for the primary purpose of biological survival. The frog is a clear physiological demonstration of this highly evolved selective system.

All human beings are similarly evolved to select certain common aspects of the physical universe: we possess eyes which receive radiant electromagnetic energy; ears which receive mechanical vibrations; a nose; touch sensors; taste. It is easy, then, to assume that these exhaust the extent of the real known world. After all, there is "consensual validation" - friends agree that there is a tree "out there," a bird in song, a dinner on the table. It is important to realize that this kind of "validation" is limited to the consensual - with the senses. Our "agreement" on reality is subject to common shared limitations that evolved to ensure the biological survival of the race. All humans may agree on certain events only because we are all similarly limited in our very structure as well as limited in our culture. Like the double-seeing son, it is very easy for us to confuse our

common agreement with an external reality. If everyone "saw" double, for instance, we would believe that two moons existed. As can well be imagined from the limited nature of our senses, our agreement covers but a small portion of what actually exists, as the noontime is to an entire day-night cycle.

HIGH-LEVEL SELECTIVITY "TUNING"

Ascend the evolutionary ladder from the frog, and consider more and more complex organisms. The avenues of sensation become more complex, multimodal. More importantly, though, the flexibility of the sensory systems themselves becomes much greater, because of the increasing programmability of the central nervous system. To make use of familiar machine analogies, the sensory systems of some animals are like permanently wired-up, simple machines. In a mousetrap or a pencil sharpener, or even in a telephone or an automobile, a change in one part throws everything else out of adjustment, since the machine has no built-in capacity for internal reorganization. As we consider more complicated animals, more and more advanced all the way up to man, their nervous systems seem to be more computer-like—machines, to be sure, but ones that can alter the relationship between input and performance by a change in the program. The higher mammals can be regarded as machines that are capable of reprogramming themselves in accordance with alterations in the external environment. This is not to say that there are no limits to their performance. Even the most sophisticated current computer has its physical limitations. No matter how the computer alters its own programs, it will never learn to fly all by itself - it has no wings. But a computer can alter itself within the limits of its own structure, as can we.

We can personally experience this computer-like, higher-level selectivity and tuning. At a party (or someplace) where several people are talking at the same time, close your eyes and listen to just one person speaking, then tune him out and listen to another person. Perhaps you will feel surprised at how easy it is to tune your attention in this way. Actually, we have little reason to be surprised at this ability, since we tune ourselves continuously to suit our needs and expectations, but the surprise comes because we are not usually aware of such self-tuning. The selection process is programmable, within the fixed sensory limits. When we perspire during the summer, we like the taste of foods that are more salty than usual. We don't think consciously that we need salt, and that we should take more salt in our foods; we *simply like* foods that at other times we would consider quite oversalted. Also, we continuously "set" ourselves to see objects. The character in the middle of Figure 2.2 can be seen either as a number or as a letter, depending on the context.

FIGURE 2.2

Many contemporary psychologists have investigated our programmability. Some have

used the tachistoscope, which allows figures, objects, pictures, to be presented for short and measurable periods of time. One interesting series of experiments with the tachistoscope demonstrated that we recognize familiar objects or words in less time than unfamiliar ones. A coherent sentence, for instance, is recognized much more quickly than a random sequence of words. Our past experience "tunes" us to have some idea of what should follow what, and we need much less information to construct an image. Jerome Bruner calls this "going beyond the information given."

One naive view of the brain and nervous system has stimulated some useful research in psychology. (Recall first that the lens of the eye reverses input light energy from left to right and up to down). A common question reflects this view: "If the eye reverses the input, then why do we see the world right-side up, when the image on the retina is upside down?" The answer, of course, is that "right-side up" and "upside down" have no meaning biologically. Since we do not see *what exists*, the question is meaningless. All we need in order to "see" is for a consistent relationship to exist between the external object and the pattern of excitation on the retina. In man, this pattern can be "upside down," "reversed," or any other consistent transform of the stimulus.

If the visual world of a goldfish is inverted by surgical rotation, it never adapts to the alteration in input, swimming in circles forever. It may even starve, unable to reach food. In contrast, if a human being or monkey's visual world is optically altered, adaptation is quite quick. In a few weeks, a man can pedal a bicycle through a crowded town wearing specially designed inverting lenses. Our naive view cannot be correct. We never see the world *right-side up*; we select from the input, and construct our personal consciousness from what we have selected. So, if the visual input is inverted, there is of course an initial disturbance in the input and output systems of the brain. The normal and consistent relationship between external objects and the pattern of sensation on the retina is upset. It takes some time for us to learn the new correspondences. In reaching toward an object, we may move in the wrong direction initially, then overreach, then hit it. But gradually, in the same manner as we initially learned to see, we begin to learn the newly appropriate correspondences between input and objects. The consistency of the selection is once again restored, and we are able to ride a bicycle and see objects "right-side up."

Our eyes are also constantly in motion, in large eye movements (saccades) as well as in eye tremors (nystagmus). We blink our eyes almost every second, move our eyes around, move our heads and our bodies, and follow moving objects. The view of an object is never constant, and the very receptive fields on the eyes are changing all the time; yet our visual world remains quite stable. If we walk around a horse, for instance, our view is constantly changing - we sometimes see the tail, sometimes the back, or a side view, or a three-quarter view, or a straight front view - yet we always see the same horse. If we "saw" an "image" on our retina, the visual world would be different each second, sometimes one object, then another, sometimes a blur due to the eyes moving, sometimes darkness due to blinks. We must then *construct* a personal consciousness from the selected input, and in this way achieve some stability of awareness out of the rich and continuously changing flow of information reaching our receptors.

AUTOMATIZATION

If at each moment we were aware of each quantum of energy reaching us, we would probably be overwhelmed by the flood of irrelevant information. We might not be able to

discriminate enough to notice impending dangers, a tree about to fall, a truck approaching. Because we must discriminate between continuous, "safe" stimuli and survival-related ones, we have evolved sensory systems which respond primarily to alterations in the external environment. The cells in the visual cortex and the retina, for example, are specialized to detect *changes* in input and to ignore constancies (see Figure 2.3).

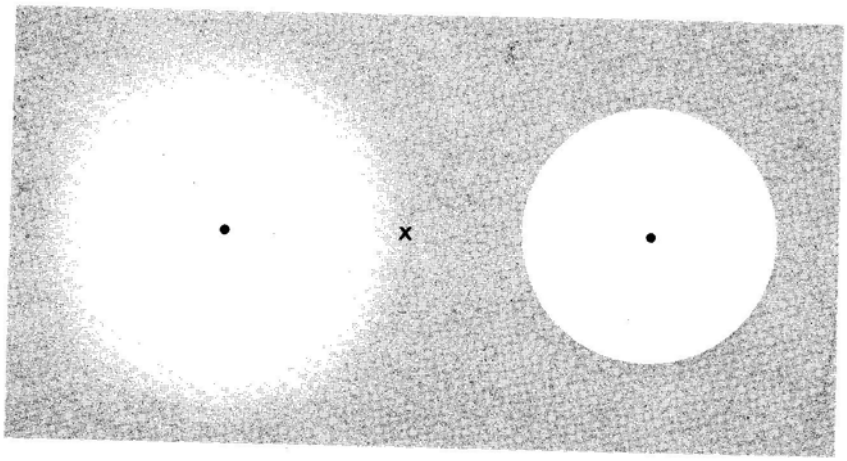

FIGURE 2.3
Look steadily at the left dot; the light circle disappears. You can make it reappear by looking at the X. The right-hand circle will not disappear if you stare at it, although it is as light in the center as the other circle. The visual system, like other sensory systems, is maximally sensitive to sharp changes.

FIGURE 2.4
To find the blind spot, close your right eye and stare at the circle. Hold the book 10 to 12 inches from the eye, and move it toward you and away until the square disappears. Notice that this "hole" is *always* present in your visual world.

To take another example: there is a spot in our visual field which we can never "sense" because of the anatomy of the eye (see Figure 2.4). At the exit of the optic tract, no light energy can stimulate the retina. There is a "hole," always present in our world; our little exercise in Figure 2.4 merely makes it explicit. But since this gap in perception is always present, we never notice it, since we are specialized to notice change.

Further back in the central nervous system, higher levels of brain organization allow us to respond automatically, "unconsciously," to the more complex constancies of the environment. Let us consider several examples of such constancies.

First, try this: say the word "need" over and over to yourself one hundred times. It becomes "strange," loses meaning, and it no longer seems like the same word. That is, mere repetition of a stimulus will cause a change in consciousness.

While we are learning a new skill, like skiing, all the complex adjustments and motor movements are somewhat painfully in our awareness. As we progress, as skill becomes "automatic," the movements no longer enter consciousness. Compare the first time you tried to drive a car, especially one with a gear shift, with how it feels to drive a car now, after you've learned.

After you have learned to drive, when you travel along a road for the first time, everything appears quite new and interesting - a red house, a big tree, the road itself - but gradually, as you drive the same route over and over, you "get used" to everything on the way. You stop "seeing" the trees, the bridges, the corners, etc. You have become automatized in your response to them.

When you enter a room and a fan is turning, creating a buzzing sound, you are aware of it for the first few moments, but then the sound disappears from your awareness; you have stopped paying attention to it.

We quickly adapt to the constancies of the world; hence we constantly need new stimulation. When we buy a new phonograph record, we play it over and over again for a while, then leave it on the shelf unplayed. We get bored with it; the record no longer seems "new"; it is out of our awareness, on "automatic." Most consumer products are periodically changed slightly (automobiles, for instance), so that we begin to notice them once again, and presumably buy them.

In psychology and physiology the phenomenon we have been describing is termed "habitation." It is one of the physiological components of the "orienting reaction" to new stimuli, the reaction that is involved in our registering of input. The physiological indicators of such reaction often include a blocking of the alpha rhythm of the electroencephalogram, an increase in heart rate, and a drop in skin resistance. Suppose we measure the resistance of the skin, for example, and repeat a click every five seconds. The first click will cause a sharp drop in skin resistance. A smaller drop will be caused by the second click, still less by the third, until, depending on the parameters of the particular experiment, the skin resistance no longer drops with each click. The response of the skin to this stimulus has been habituated. After we hear the sound of a clock ticking, when the sound is turned off, we no longer show the orienting or registering reaction. This is not merely a simple process of raising the threshold for stimuli entering into awareness and thus tuning the click out. Our nervous system is capable of a more sophisticated selective tuning. It is true that if we substitute a louder click, we will begin to hear it again. But if we substitute a *softer* one, the orienting reaction also returns, and we will hear it again. If we change the interval between the clicks—if a click appears a little later than we expect or a bit sooner - it returns to awareness, and the orienting reaction reappears.

Karl Pribram has pointed out another example of this phenomenon, which he called the "Bowery El" effect. An elevated railroad once ran along Third Avenue in New York City. At a certain time, late each night, a noisy train ran. The train line was torn down some time ago, with some interesting aftereffects. Many people in the neighborhood called the police to report "something strange" occurring late at night - noises, thieves, burglars, etc. The police determined that these calls took place around the time of the former late-night train. What these people were "hearing," of course, was the *absence* of the familiar noise of the train. We have such an experience, although often a much simpler one, whenever a noise

that has been continuing suddenly stops.

If we look at the same object over and over again, we begin to look at it in the same way each time. We do this with the constancies of our world, our ordinary surroundings, such as the pictures in our house, or the routes we drive every day. Charles Furst has studied the effect of repeated viewing of the same picture on the way we look at it. He found that eye movements tend to become more and more stereotyped as the same visual stimulus is presented. When we see a new image, our eyes tend to move in a new pattern around it, but as we see it again and again, as we see the rooms in our house, we tend to look in a fixed way at fixed portions of it and ignore or tune out the rest. The "Bowery El" effect, the "Furst" effect, and other studies on habituation suggest that we tune out the recurrences of the world by making a "model" of the external world within our nervous system, and testing input against it. We somehow can program, and continuously revise or reprogram, our models of the external world. If the input and the model agree, as they do most often for the constancies of the world, then the input stays out of consciousness. If there is any disagreement, if the new input is recognizably different, slower, softer, louder, different in form or color, or even absent, we become aware of the input once again. This programming forms an additional, active selection process imposed on the data that gets through the relatively fixed reducing valves of the senses. In everyday situations there is more tolerance than in these laboratory demonstrations; much more discrepancy can be tolerated, although how much depends on the situation.

OUR ASSUMPTIVE WORLD

Perhaps the clearest and most striking trend in the psychology and physiology of perception in the past few years has been our increasing understanding of the interactive and constructive nature of ordinary awareness. One of the leaders in this field of investigation, Jerome Bruner, has emphasized that perception involves acts of categorization. As we mature, we attempt to make more and more consistent "sense" out of the mass of information arriving at our receptors. We develop stereotyped systems, or *categories*, for sorting input. The set of categories we develop is limited, much more limited than the input. Simple categories may be "straight," or "red." More complex ones may be "English," or "in front of." In social situations, the categories may be personality traits. If we categorize a person as "aggressive," we then consistently tend to sort all his actions in terms of this category.

Previous experience with objects and events strengthens personal category systems as it does a scientific paradigm. We expect cars to make a certain noise, traffic lights to be a certain color, food to smell a certain way, and certain people to say certain things. But what we actually experience, according to Bruner and others, is the category which is evoked by a particular stimulus, not the occurrence in the external world.

The anomalous-card experiment that Bruner and his associates carried out was an attempt to demonstrate the effects of our well-learned categories on the contents of awareness. Our past experience with playing cards evokes categories in which the colors and the forms of playing cards are "supposed" to fall. The import of these and others of Bruner's demonstrations is that at each moment we construct a model of the world, expect certain correspondences of objects, colors and forms to occur, and then experience our categories.

THE TRANSACTIONALISTS

About the time Bruner was studying the effects of categories, another group of psychologists, led by Adelbert Ames, was exploring the nature of awareness. Ames characterized ordinary awareness as a "transaction" between the perceiver and the environment. In spite of the overflow of information available to our sense organs at any given time, *relevant* information is often lacking. Color information, for instance, is directly present on the retina, but we cannot determine tri-dimensionality directly. We cannot immediately know whether a room is "really" rectangular or not, or whether a given chair is physically closer than others, since we do not possess a direct monocular sense of distance. There are, however, perceptible dimensions usually associated with closeness of objects. If we assume that two objects we are looking at are the same size, then the one that looks larger would be closer to us. That is, if we are trying to determine closeness, we "bet" that the "larger" object is the closer. However, this "bet" is not a conscious process of correction. We *directly* experience the larger object as closer. The Ames group set out to demonstrate the nature of the "bet" we make with the environment.

By manipulating "unconscious inference," as Helmholtz called it, we can become aware of the bets or, in Bruner's term, the categories that constitute our awareness. To give another example, when we see a line drawing of a room as in Figure 2.5,A, we "bet" that in a top view it would be shaped like Figure 2.5,B, a rectangle. But a rectangle is only one of the many possible forms that could be derived from the two-dimensional drawing. One side may not be parallel with the other; so the top view might look like Figure 2.5,C, or 2.5,D, or might be some other shape entirely. We bet that the room is rectangular because almost all the rooms in our experience have been rectangular. But if the room is in fact not rectangular, our bet causes us to "see" objects or people in the room in a very strange way (see Figure 2.6).

George Kelly pursued a similar line of investigation, concerned more with the psychology of ordinary experience and with clinical psychology. His conception was that each person creates his own world by means of his "personal constructs." He considered these "constructs" similar to scientific hypotheses, in that they are generated on the basis of our past experience and are applied to new experiences as long as they seem to work. So, for Kelly, our experience of the world consists of our constructs, as it consists of categories for Bruner and of transactions for the Ames group. Kelly was a psychotherapist, and his therapy was based on the belief that a patient's problems were in large part due to his poor construction of the situation. The treatment involved a "prescription" of new constructions that the patient could apply to his life.

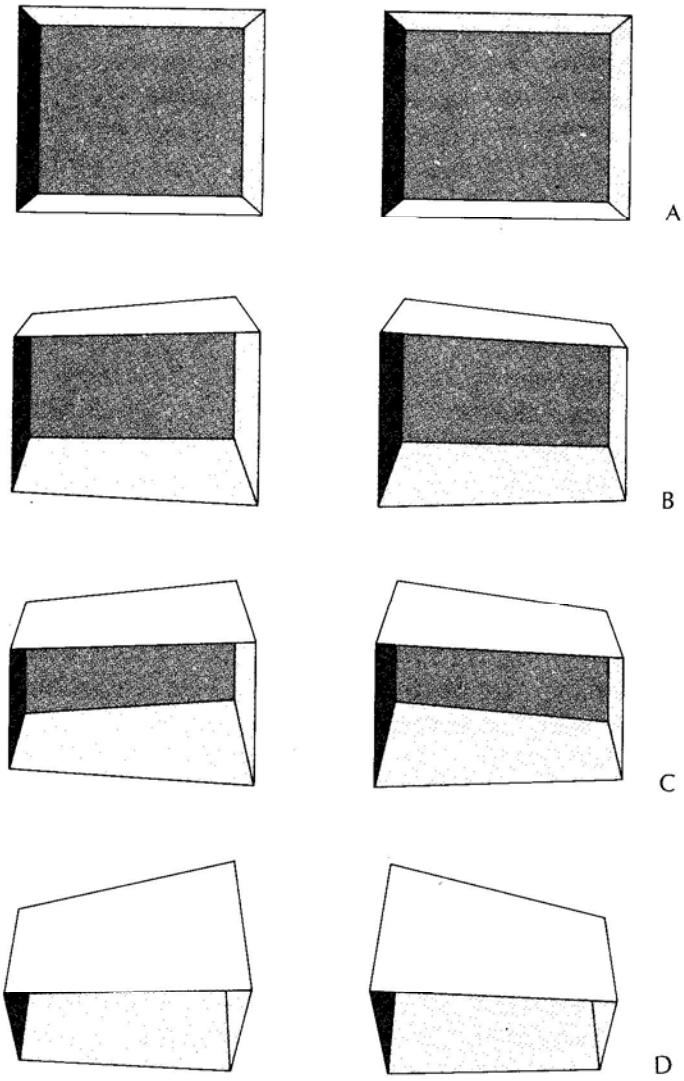

FIGURE 2.5
If we look at the top figures, we immediately assume that they are rectilinear. However, many shapes can give rise to the impression of rectilinearity, as this drawing illustrates: as the front of each box tilts downward, we can see that they are not rectilinear at all.

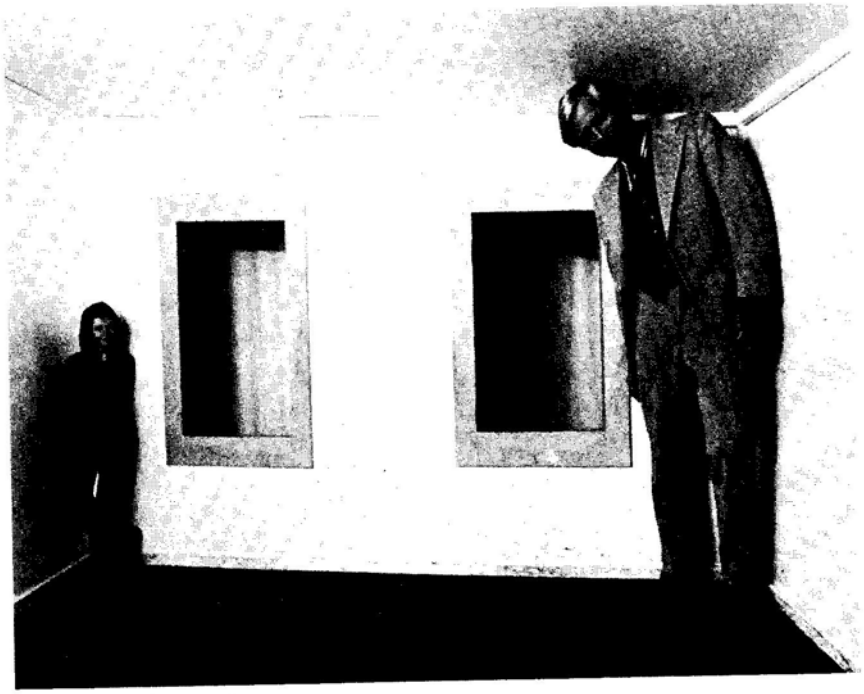

FIGURE 2.6
A photograph of the "distorted room" at the Exploratorium, San Francisco.

HOW THE BRAIN CONTROLS ITS INPUT

Since we can tune ourselves in terms of our category systems, there must be physiological mechanisms that allow this tuning to take place. Karl Pribram and Nico Spinelli have set out to demonstrate a physiological analog of this process. They recorded from cells in the frontal cortex of the brain while stimulating the retina, and showed that the patterns in which the receptive fields of the retina respond to external stimuli can be altered by the brain. That is, the way in which stimuli are received, even on the retina itself, can be reprogrammed from moment to moment, and this ability can be demonstrated physiologically. These and other experiments demonstrate that the motor-output system of the brain (efference) has an effect on the input (afference): the brain "selects its input."

The investigation of the active role of the brain's output in determining the contents of awareness has been a recent major trend in the psychophysiology of perception. The work of Bruner, of the transactionalists, and of Kelly demonstrate this active role on a psychological level; that of Pribram and Spinelli on the physiological. Some investigators have been explicitly concerned with how the relationship between the input processing and the output systems of the brain affects the contents of awareness. There is a test we can try: Close one eye, and push the other eye gently from the outside corner. The visual world seems to shake a bit, to jump about discontinuously. But if we move the eye in the usual manner over the same space, the world does not seem to shake. This difference indicates that in constructing our awareness we must also take our own movements (motor output of the brain) into account and correlate them with the changes in input. If we did not possess records of our efference (in this case, our eye movements), the visual world would be constantly jumping around.

Some researchers have even argued that consciousness depends *solely* on the output of the brain, no matter what the input is that keys off a given output. Roger Sperry has emphasized this point, and after him Leon Festinger and his associates have provided some experimental demonstrations of this idea. Their contention, that awareness depends solely on output regardless of input, is consistent with Bruner's contention that the category activated will determine awareness. For example if you are "ready" to see a black ace of spades or a red ace of hearts when a red ace of spades is shown, you will see one of the two choices you have set for yourself. Or, if you are "ready" to make a straight eye movement in response to a curved line, you will see the curved line as straight.

TRANSITORY CHARACTERISTICS OF PERSONAL CONSCIOUSNESS

The very physiology of our senses and central nervous system in large part determines the characteristics of our personally constructed worlds. However, we have further limitations on our perceptions. We are each subject to moment-to-moment changes in our personal worlds. We each have a specific personal history, and have undergone training which can partially program consciousness (schooling, jobs, special interests, etc.). Moreover, all of us, within a given culture, share a set of "unconscious" assumptions given us by the very organization of the culture and by our possession of a common language.

Individual consciousness is not wholly stable: biases and assumptions shift, as do our needs and intents. We are sometimes hungry, sometimes full, sometimes sexually attracted, sometimes sated, sometimes tired, sometimes alert. Our consciousness is constructed differently on these occasions. When hungry, we seem to notice food, aromas, and restaurants more than when we are full. Awaiting the arrival of a friend, we may immediately tune ourselves to notice anyone who remotely resembles him or her. When we are interested in the opposite sex, we perceive them differently than when we are not. The thirteenth-century Persian poet Jallaludin Rumi noted this phenomenon when he wrote: "What a piece of bread looks like depends on whether you are hungry or not."

For this area, as for many other important dimensions of personal consciousness, some of the most relevant psychological experiments have been performed by Jerome Bruner and by the transactionalist group. In one experiment, Bruner studied poor and well-to-do children. Noting that need may alter the characteristics of consciousness, Bruner found that children from poor homes tended to think a given coin larger than their more fortunate peers did. In addition, the poor children thought nickels were worth more than dimes. What money looks like depends on whether you are poor or not.

Albert Hastorf and Hadley Cantril studied an event at a Princeton-Dartmouth football game. A football game is a suitable place to observe the transitory influences on consciousness caused by the extreme biases which may be called up by an emotional involvement with one side or the other. In this particular game, the star quarterback of the Princeton team was injured. Hastorf and Cantril asked two groups of spectators to record their experiences at the game on a questionnaire. The Princeton fans reported undue violence and aggressions directed unfairly toward their quarterback; the Dartmouth fans experienced the game as rough, but fair. What an injury looks like depends on whether you are from Princeton or not.

THE STREAM OF THOUGHTS

Our thoughts are transitory, fleeting, moving from one idea, object, image to another; yet it is always the same consciousness that flows from experience to experience. More than any other factor, thoughts are the foundation of normal consciousness. We maintain and refresh our personal construction through continued thoughts. William James presents the most suitable metaphor.

> Consciousness then does not appear to itself chopped up in bits. Such words as "chain" or "train" do not describe it fitly, as it presents itself in the first instant. It is nothing jointed, it flows. A "river" or a "stream" are the metaphors by which it is naturally described. *In talking of it thereafter, let us call it the stream of thought, of consciousness, or of subjective life.*

ENDURING CHARACTERISTICS OF PERSONAL CONSCIOUSNESS

Each person is a unique individual, with a certain family history, training, profession, interests. These background factors deeply influence the differences in our personal consciousnesses. Any given event of "spacetime" is infinitely rich in itself; but this richness will be perceived variously, depending on the perceiver. Consider a scene in a park on a Sunday afternoon. An artist walking through may note the quality of the light, the colors of the leaves on the trees, the geometric forms of the landscape. A psychologist might notice the people present, their mannerisms, interactions, speech patterns. A physician, looking at the same people, might notice not their interactions, but their body structures and their health. A botanist might ignore the people, to focus on the flowers. One woman may remember words, another gestures. One man may be fascinated by a particular smell in the air, while another may be too immersed in his own thoughts and fantasies to register anything about the external environment.

Whole lives can be spent directing personal consciousness to one small portion of the world. One person's attention can be occupied by sailboats, becoming an expert on the winds, rigging, hull design; another is concerned with taste and smell, learning to discriminate a 1947 red Bordeaux wine from a 1949 of the same chateau.

It seems that one of the most basic differences between individuals is between those who tend to employ the linear, verbal mode and those who are less verbal and more involved in spatial imagery. The scientist, the writer, the mathematician are examples of the culturally "dominant" verbal-rational mode. The visual artist, the craftsman, the musician, the teacher of body movement may be examples of another mode. Of course, each of us works in both modes: almost everyone speaks and reads; we all move in three-dimensional space. However, some people are more specialized in one mode of operation than others, which often makes communication difficult between, say, husband and wife, if one is a scientist, the other an artist.

Cultural Characteristics

A primary motivation in life is biological survival, both of the individual and of the species. To survive individually, man adopts a mode of active manipulation of the external environment. This mode could be considered an analytic position toward the world, involving an attempt to separate oneself from other people, other living organisms, and other objects. At times this separation may be essential for an individual's survival. If many

had put up no boundaries between a personal identity and the remainder of creation when, say, a wild animal approached, the race might not have survived.

This mode of individual survival is active, geared to the consciousness of external events, to analysis, and to linearity. By linearity, I largely refer to the consciousness of events enduring in time, in sequence, of causes and effects. Such linearity is essential in the development of an organized culture. It is necessary for planning into the future, for taking the lessons of past history into account.

Language and science can be considered quite refined aspects of this mode. They allow us to dissect, discriminate, and divide the external environment into consistent segments which can be actively manipulated. They enable us to record experience cumulatively, to transmit information at a distance, and even to partake of the wisdom of those long dead.

To use a language is to use a set of ready-made categories that must help shape individual consciousness. Contemporary Americans possess only a few words for snow, the Eskimo many. We use one word for love, the mystic many. According to Benjamin Lee Whorf, language is an organ of the mind. Within a linguistic community, the common language provides an almost unconsciously agreed-on set of categories for experience, and allows the speakers of that language to ignore experiences excluded by the common category system: "Is there any number higher than 100?" Similarly, our eye allows us to perceive radiant electromagnetic energy in the band between 400 and 700 billionths of a meter, but forces us to ignore everything else.

Science as a Mode of Knowing

Personal consciousness is a continual process of selection and construction, at each stage becoming more and more conservative. As a refinement of the active, personal mode, science is one of the most restricted and sure forms of knowledge available to man. Our senses limit; our central nervous system limits; our personal and cultural categories limit; language limits; and beyond all these selections, the rules of science cause us to further select information which we consider to be true. By a slow, conservative process of construction, science gradually builds a stable core of knowledge. Science is the very essence of the analytic mode, one of meticulously charting causes and effects, of radically restricting the conditions of observation in order to attain precision. It constitutes another highly specialized development of consciousness, at once its most conservative, yet its most reliable.

Most cultures are fundamentally based on this active, linear mode-the way of language, science, and history. Ours is so thoroughly based on it that many have almost forgotten that other constructions of individual consciousness, other cultural styles, are even possible.

The anthropologist Dorothy Lee studied the people of the Trobriand Islands and reports that their lack of linearity is evident even in language. In lieu of a sequential construction, the Trobrianders have a total present-centeredness, in which every action exists only in the present. Lee contrasts our dominant mode with this alternative.

The line is found or presupposed in most of our scientific work. It is present in the

induction and *deduction* of science and logic. It is present in the philosopher's phrasing of means and ends as lineally connected. Our statistical facts are presented lineally as a *graph* or reduced to a normal *curve*. And all of us, I think, would be lost without our diagrams. We trace a historical development; *we follow the course* of history and evolution down to the present and *up from* the ape. . . . Our psychologists picture motivation as external, connected with the act through a line, or, more recently, entering the organism through a lineal channel and emerging transformed, again lineally, as response. . . .

When we see a *line* of trees, or a *circle* of stones, we assume the presence of a connecting line which is not actually visible. And we assume it metaphorically when we follow a *line* of thought, a *course* of action, or the *direction* of an argument: when we *bridge* a gap in the conversation, or speak of the *span* of life or of teaching a *course*, or lament our *interrupted* career. . . .

But the Trobrianders do not describe their activity lineally; they do no dynamic relating of acts; they do not use even so innocuous a connective as *and.* Here is part of a description of the planting of coconut. "Thou-approach-there coconut thou-bring-here-we-plant-coconut thou-go thou-plant our coconut. This-here-it-emerge sprout. We-push-away this we-push-away this-other coconut-husk-fiber together sprout it-sit together root." We who are accustomed to seek lineal continuity, cannot help supplying it as we read this; but the continuity is not given in the Trobriand text; and all Trobriand speech, according to Malinowski, is "jerky," given in points, not in connecting lines.

THE PROCESS OF PERSONAL CONSCIOUSNESS

Our normal personal consciousness is not a complete, passive registration of the external environment, but a highly evolved, selective, personal construction that is aimed primarily at individual biological survival. But if this consciousness is something we each personally construct, how is it that we seem to agree on events? Personal consciousness has been called an "illusion" in the Yogic tradition. This may be far too strong a word, but, to adopt it for a moment, we could say, "Yes, personal consciousness may be an 'illusion,' in that only a 'measly trickle' of the available external information is ever present in consciousness. But if it is an illusion, it is a *constrained* illusion." The constraints are that we select the *appropriate* survival-related objects and events to be the contents of personal consciousness. Alternative illusions have (presumably) disappeared in the course of evolution. Further, the constraints make consensual validation possible. All humans have evolved with identical sense organs, which select only certain aspects of the flux of available stimulation.

Let us trace this process. The sense organs discard most of the input information reaching us. The brain further limits input, by selectively inhibiting the sensory activity, sending down efferent signals which can modify stimulation even in the receptor itself. Our senses and central nervous system select by responding primarily to changes. We quickly learn to "habituate" to the constancies of the world. Further, we sort the input into categories that depend on transitory needs, language, our past history, our expectations, and our cultural biases. Finally, we must *construct* a stable consciousness from the heavily selected input, as does James' sculptor.

We do not, for instance, "see" with our eyes. More properly, the eyes participate in the

whole process of visual experience. There is no image or copy of the external world on the retina, nor is one transmitted to the brain to be seen by a little man.

The experience of an infant, according to William James, is a "blooming, buzzing, confusion!" It is so partly because the infant lacks a suitable category system in which to sort experience consistently. As we learn to construct a socially acceptable personal consciousness, we learn to consistently associate, say, the experience of light with external objects. As we mature, this correlation is reinforced. Whenever a particular pattern of excitation is produced in the nervous system, we become more and more likely to be conscious of light energy from outside events. Our world becomes relatively stable; we become able to avoid danger successfully and to manipulate objects. We survive.

But it is quite important here to consider that "light" is a dimension of human consciousness. In physical fact, the only difference between "visible light" and the nearby portions of the electromagnetic spectrum is in wavelength. Nothing sacred occurs in nature between the electromagnetic wavelengths of 390 and 400 billionths of a meter, yet we can perceive one and not the other. It is only the receptive characteristics of our eye which give a special place to a wavelength of 400 billionths of a meter, but not to one of 390.

Furthermore, we do not even need the presence of external light to "see." If "seeing" is a certain pattern of excitation in the central nervous system, then anything which produces that pattern will result in visual experience. Obviously, the vast majority of visual experiences occur in the normal way: light enters the eye, which then sends electrophysiological impulses through the optic tract to the brain, contributing to the construction of a certain visual experience. However, this system can be interrupted at several points. Close your eyes, and press your eyeball for a moment. You will experience a greenish flash of light. No light energy, but merely the pressure of the finger, was transmitted to the retina. Here we have "tricked" the visual system, causing the retina to fire by means of pressure rather than stimulation by light. Any stimulus which causes the retina to fire will give rise to the experience of light, be it pressure or some more subtle form of electrical or chemical stimulation.

Wilder Pentield, among others, has demonstrated that the experience of vision can also be evoked by electrical stimulation of the central nervous system. Penfield performed brain surgery on patients with epilepsy and, as part of this procedure, electrically stimulated various areas of the brain; his patients often reported conscious experiences without any other input at all. For instance, many surgeons have found that electrical stimulation of the occipital cortex usually leads to the experience of vision. We can understand, then, that seeing is a process which takes place not in our eyes, but rather *with the help* of our eyes. It is a process that is constructed in the brain, one largely determined by the category and output systems of the brain.

At other times, hallucinations may be caused by unusual functioning of the nervous system, for example, if the brain is stimulated by drugs which alter the normal relationships between external input and consciousness. Also, we dream each night and enter visual worlds which do not exist outside personal consciousness. Similar analyses would hold for other senses as well. Ordinary consciousness is each individual's own private construction. This insight has been more elegantly expressed by philosophers and poets. Alfred North Whitehead said:

> Nature gets credit which in truth should be reserved for ourselves, the rose for its scent, the nightingale for his song, and the sun for its radiance. The poets are entirely mistaken. They should address their lyrics to themselves and should turn them into odes of self-congratulations on the excellence of the human mind. Nature is a dull affair, soundless, scentless, colorless, merely the hurrying of material, endlessly, meaninglessly.

The poet T. S. Eliot, similarly: "We are the music while the music lasts."

THE NATURE OF ORDINARY INDIVIDUAL CONSCIOUSNESS

Ordinary consciousness is an exquisitely evolved personal construction, "designed" for the primary purpose of individual biological survival. Sense organs and the brain serve to select the aspects of the environment which are most relevant for survival. Our ordinary consciousness is object-centered; it involves analysis, a separation of oneself from other objects and organisms. This selective, active, analytic construction enables us to achieve a relatively stable personal world in which we can differentiate objects and act upon them. The concept of causality, linear time, and language are the essence of this mode.

And yet this individual, active mode is not the only mode in which consciousness can operate, as the daylight hours do not constitute an entire day. If ordinary consciousness is a personal construction, then other constructions and other consciousnesses are potentially available to us. William James (as usual) put it best:

> Our normal waking consciousness, rational consciousness as we call it, is but one special type of consciousness, whilst all about it, parted from it by the filmiest of screens, there lie potential forms of consciousness entirely different. We may go through life without suspecting their existence; but apply the requisite stimulus, and at a touch they are there in all their completeness, definite types of mentality which probably somewhere have their field of application and adaptation. No account of the universe in its totality can be final which leaves these other forms of consciousness quite disregarded. How to regard them is the question, - for they are so discontinuous with ordinary consciousness. Yet they may determine attitudes though they cannot furnish formulas, and open a region though they fail to give a map. At any rate, they forbid a premature closing of our accounts with reality.

For further reading

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