Kennetic Inquiry

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KENNETIC INQUIRY is a name proposed for organized investigation into the problem of human knowings and knowns, where this is so conducted that the full range of subject matters—all the knowings and all the knowns—form a common field. Such inquiry is to be undertaken under express postulation, and without specific allegation or assurance of ultimate factual status. The postulation deals with concrete instances of knowings and knowns instead of with purported faculties, powers, or realities; and under it every specific instance of a knowing is taken along with its specific known as a single *transaction* in the field. It abandons, root, branch, and fruit, the conventional severance of detachable knowers from detachable knowns. To it the word "epistemological" rates as a historical curiosity, stripped of all pretense to authority in research, and ripe only for the museum. The words "philosophical" and "metaphysical" become similarly irrelevant to our inquiry: as irrelevant as they are in physical laboratories today when actual research is in progress. Even the word "knowledge" itself is, at least for the time being, discarded, since it is steeped in vagueness, and unable to qualify technically as purveyor of determinable fact. The words "knowing" and "known" remain, however, usable, if properly provided with plural forms, and thus made able to stand for concrete instances of organic-environmental action in behavioral space and time.

Thus organized, knowings and knowns together become events in process in a cosmos, system, or field of fact, such as postulation projects and anticipates. The inquiry is then on the way, or believes itself on the way, toward becoming science. It is science in the making if, by science, is understood a procedure of observation and postulation, with all observation recognizing that it takes place under postulation, and with all postulation recognizing that it arises out of observation; and if freedom for inquiry is secured through the smashing of the old blockades so long maintained under the dominance of inadequate speech forms of barbaric origin and overripe habituation, peculiarly those proclaiming purportedly particulate sense-data.

Although the name "kennetic" has not heretofore been in use, inquiry along these suggested lines has already been undertaken, and report thereon has been made, in a book *Knowing and the Known* (*22*) by John Dewey and the present writer. To form the name "kennetic," the Scottish "ken" or "kenning" has been preferred to any word in the groups centering around "cognition," "gnosis," or "epistemology," since the latter have long since become fixated beyond recall in implications hostile to present purposes. "Ken" has a further advantage over these other roots in recalling the early Teutonic "can," which signified the activity of knowing, inclusive of "know-how" and of "be able." Using "kennetic," we may, with minimum risk of distortion, deal with active knowings as found among men who are known phases of a cosmos, which is itself in process of being known.

We here proceed to take men as in nature, to take their behaviors of whatever kind as "natural," and to take all their knowings as naturally behavioral, along with their other activities. We then strive to discover what observation may yield under the employment of such new namings as we may attain when freed from the interference of the old hostile terminologies.

The Kennetic Procedure

Kennetic inquiry, as already indicated, omits from its proceedings all facultative action of "minds" or otherwise individuated "knowers" on the side of the knowings, and all dogmatically proclaimed or otherwise individuated "ultimate reals" on the side of the knowns. I have never myself made observation of any such "pure knowers" or "pure reals;" I know no one who has; and I believe no claim to such observation has ever yet been made in a way to conform with modern scientific standards free from linguistic hypnosis. I assert that *it is easier literally to observe—to see—man-in-process with environs,* and to see

this full process as one transaction, than *it can possibly be literally to observe a "soul," a "spirit," or a psychic "mind"* (this last, a lineal descendant from the two others), or to see a "thing" as a "real" substratum apart from all our knowing and from conditioning thereby. What we find to observe under our postulation is the organism and its environs in natural presence and process together, linguistically still unfractured, or otherwise schizophrenic. Permitting observation to run free within its framework of postulation, and putting all the concentrated attention we can behind it, we secure reports on the unfractured knowing-known events. All such observation and such reports and such events-reported we style *trans*actional, in contrast with the *inter*actional reports obtained under mechanistic inquiry, and with the *self*actional reports under conventionally "psychic" presumptions. In so doing we require the "selves" and the "mechanisms," equally with the "transactions," to present themselves in postulatory form, free from pretense to underlying authoritative status. We shall adopt the word "behavioral"[1] to apply to those events involving organisms and environs which, as events, are not technically physiological or physical, nor directly covered in physiological or physical inquiry. To repeat: All behavioral events are by postulation transactions; all knowings and knowns as subject matters of inquiry belong among transactional behaviors.

Before undertaking to locate the knowings and the knowns definitely among the behaviors, let us briefly characterize the setting of the behaviors themselves as *naturally* viewed within the vastly wider field of all that is "known-to-modern-science."[2] Many differences in viewpoints as to the range of scientific inquiry are still offered us, and many different classifications of the sciences are given. We need here give attention solely to the three great technical fields recognized as basic under all classifications, and perhaps best styled Physical, Physiological, and Behavioral (where Psychological may be used as a possible alternative for the third, if strongly preferred). We treat the distinctions as those of subject matters of inquiry-in-growth (i.e., of science) and not in the older way as marking off, or resting on any assured differences in the "kinds" of "materials" that "exist."[3] It is indeed true that "physiological" and "behavioral" belong alike under "biological" when this is brought into contrast with the "physical," since they both have to do with the organic. But under present-day observation, and in the status of current inquiry and for it only, the *differentiation* of *techniques* between physiological and behavioral research cuts as deep as that between physical and physiological, and this should be technically recognized in all appraisal as of today.[4] Physical research cannot adequately advance its own technical form of description and report across the full physiological field, nor can technical physiological research in the general case be advanced to portray the behavioral field. The "languages" of report remain for the present noninterchangeable. No examination of brain or nerves or of muscle or viscera can report that "an election was held," nor even that "a cow was seen." The central cores of the three great regions are natural; the bands of transitional vagueness between them are to be taken as natural; the inquiry into them is natural. But for present-day guidance with respect to the knowings of the knowns and to the knowns as undergoing knowing, the technical differentiation as above set forth remains in effect.

The Behavioral Background

As between physiological and behavioral subject matters, the differentiation can be stated in terms of a comparative directness of process in the former, which shows itself in contrast with a certain typical indirectness in the latter (*22,* Chap. VI). Soon after Jacques Loeb at the beginning of this century published his—at that time world-exciting—reports on dominant physical processes within and across the skins of organisms (*28*), H. S. Jennings (*26*) noted a characteristic in low organisms different from that

[1] Anyone who prefers "psychological" may substitute it for "behavioral," provided he holds it to the given postulation, and adequately rejects the introduction of every form of disconnected "psyche." Those who prefer the word "cultural" would find it necessary to make that word expressly include the full range of the "psychological."

[2] An appraisal of the organization of scientific knowing with common-sense knowing will be found in Chapter X of the book referred to (*22*). Other recent papers by John Dewey make further development. A recent comment by E. U. Condon, in which he notes "the doubtful speculation which has characterized most of the philosophic absorptions of modern science," speaks of Dewey in the following terms: "One of the rare exceptions, one who has in a significant and profound way understood and used both science and the scientific method is John Dewey. He points out clearly that the growth of rational thought processes may be considered as a response to the biological necessity of adaptation to the environment. Its ultimate function, he says, is that of 'prospective control of the conditions of the environment.' It follows then that 'the function of intelligence is not that of copying the objects of the environment, but rather of taking account of the way in which more effective and more profitable relations with these objects may be established in the future'" (*19*).

[3] The word "exist" occurs in two other passages in this paper but there, as here, it is set off by quotation marks so as not to involve the writer in any claims conventionally made with respect to its range of application. If here brought into the discussion, the word would be treated transactionally within the range of designational behaviors. Signalings are too immediate, vivid, and hard-hitting to pause for existential reference, whereas symbolings have passed beyond the need for it and are even beginning to overcome the desire. (For this terminology, see the section on "Specific Positions Attained.")

[4] For a strong warning against "biologism," see Bertalanffy (*10*).

of any immediate direct physical or chemical excitation and reaction. This was found in the sea urchin, for example, when an enemy cast a shadow, and the organism moved to evade, not the shadow itself, but the on-coming, hostile shadow-caster. The present investigators, reporting in *Knowing and the Known* (*22*), have employed the word "sign" to name this technically characteristic "indirectness," as it is found across the entire behavioral field. They chose this word, not so much despite its enormous variety of current applications, as perhaps on account of them, and because none of these applications has succeeded in ruling the field in which dozens of applications are needed to work in harness. The range of "sign," understood *always* as *trans*actional sign-process, was made coincident with the range most generally of behavior itself. This was to make, in effect, sign-actings (which include sign-knowings) the characteristic, technical process in the behavioral field, as distinct from the physiological and, of course, also from the physical processes.

Within the range of sign, the word "signal" was chosen to name the underlying sensori-perceptive level; the word "designation" for the next higher evolutionary level—namely, that of linguistic sign operation; and the word "symboling" for a still higher range in the evolutionary sense, to which specific differentiation was given—namely, that of mathematics, inclusive of a comparatively small, but very important, part of modern symbolic logic that is itself rigorously mathematical, rather than a still-confused survival from the older logical attitudes.[5]

The words "know" and "known" are applied in current writing at almost any point across this range of behavior, from protozoa to the purest of pure mathematics. An insect is said to know its way around, and a mathematician (it is said), his technical business. Without objecting to other uses or attempting to set up a program of naming for others, attention here will be centered closely on the range of knowings that occur in the central regions, those of designation. This knowing is by naming,[6] and its implications are of the general type "knowing-to-exist." Common procedures in these regions are of the type that seem all the more dogmatically satisfied as to *what* they assert to "exist," the less assured they are as to what is meant by the *exist* portion of their assertion.

The word "signal" was adopted for the lowest stratum of behaviors largely because of Pavlov's increasing employment of it as his skill and breadth of vision increased (*24, 31, 32*). It is used to cover the entire complex of perceivings, inclusive of the sensory, the locomotive, and the manipulative. It covers them as action in living organisms. It covers them—and this must be continually reiterated—transactionally and not otherwise. It presents organisms and environs in process in system. It does not have to do with something organic or superorganic taken on its own. It permits no such fictional "third" item as a "percept" of the kind one finds still accepted in many current texts, despite William James' brilliant identification and rejection of such "intervening thirds" fifty years ago (*25*). If a dog's bark scares a rabbit, the signal as here viewed is neither a bark in a world of its own, nor is it a dog as such, nor is it a specialized process of rabbit's nerve and brain, but always an aspect or phase of the situation seen in full.

The word "designation" is used as the name for the next higher level of behaviors. It would be better if we could speak always, as is here done occasionally, of "name" directly. "Designation" is substituted only because "name" is still so desperately involved conventionally with presumptive, external, static "things named"—the kind out of which word magic grows—that almost inevitably conveyance of meaning is distorted or destroyed. Designations are subdivided into cue, characterization, and specification, as stages in evolutionary growth; the first of these still in process of emerging from signal behavior; the second, comprising ordinary common-sense naming; the third, demanding ever-increased accuracy and, at its highest level, representing modern science itself—not as static, but as living growth, and with the old expectant certainties gone for good. This great expansion of designation not only arises out of signal, but operates, no matter what slips and falls it has by the wayside, to increase the efficiency of signal. This can be vividly shown under transactional postulation, although under the traditional constructions it is only partially and crudely apparent. In the old form observation breaks into fragments that cannot well be patched together again. In the new form, organisms-environs, know-

[5] Fifty years ago a typical classification of the behavioral (psychological) was into sense, intellect, and will—all "faculties." Josiah Royce's sensitivity, docility, and initiative, covering physical contacts, social setting, and individual going-power, might have brought a great advance, if factually developed (*33*). Present-day psychologists' organizations are all, or almost all, "capacitative"—that is to say, merely weakened forms of the "facultative." Our proposed distribution into signaling, designating, and symboling is, we hope, fully freed of the capacitative. In the ordinary conventional organization of behavioral subject-object, where "subject" appears we are to understand "environed organism," and, where "object" appears, "known-named-environs." Lacking, however, in the present exhibit is treatment of emotional events, which, from the crudest to the most refined, are handled by assigning all direct pain components and comparably direct "liking" components to physiological inquiry, stripping out the blurred knowing-naming effects for transactional study, and thus readying oneself for further inquiry into the unclear physiological-behavioral marginal regions.

[6] For a single instance of temporarily widened application of the word "know," see part (*g*) of the section on "Specific Positions Attained." For the word "exist," see footnote 3.

ings-knowns, namings-nameds, can be seen in operation and studied without putative knowers or putative *reals* behind them as guarantors or guarantees.

Symbolings evolve out of designatings and operate to increase the efficiency of designatings, much as the latter evolve out of signalings and work to increase the efficiency of signalings. The symbolings have learned in long experience that, for best results, they must forfeit the right to use their own components as names. This forfeiture is no loss; it strips the symbolings down for action. The surviving logics of the past and their reconstructions of today, including most of symbolic logic, still operate under a confusion of symbolings with designatings and even with signalings as well. The struggle, dating mainly from Frege and Russell, to put "logical foundations" under mathematics without seeking any foundations for the reliability of the "logic" relied upon, makes the confusion all the worse. Under the transactional approach a great simplification occurs, with exactness of symbol coming definitely and explicitly to the aid of accuracy of specification.

A Reminder

Let us summarize with respect to observation of behaviors in a scientifically transactional background, within which background, in turn, definite examination of knowings and knowns may proceed. We accept the cosmos as before us in knowings, and at the same time we accept all our knowings as its outgrowth. We regard this cosmos as no better assured in our knowings of it than our knowings are assured by reference to it. We are satisfield with this basis for our research. The cosmos is our realm of fact, where "fact" requires both knowings and knowns, but makes no claim to be either of them by itself, whether today or in extrapolation into the future. Darwin brought first animal life, and then human life, under evolution called natural. Driblets of behavioral interpretation have followed his course, but little more. Efforts are here being made to bring knowings-knowns, as themselves behaviors, into system with the rest of fact in a factual cosmos. They are not in system now. The psychologists toss all such issues to the "dogs of epistemology" they seem to find whining under their banquet table. The epistemologists officiate proudly at a high altar of their own persuasion.

Specific Positions Attained

Kennetic inquiry is still regrettably compelled to spend a good part of its time in delivering itself from old philosophical-linguistic bondage. It has, however, already acquired positively a number of footholds that it regards as safe for future use. However bizarre at first sight some of the reports thereby secured may seem, they will as a body, we believe, establish their reasonableness as acquaintance grows.

For this outcome, however, free development of the extensions and durations of behavioral events must be permitted in behavioral, rather than in Newtonian, forms. To postulate events outside spatial and temporal characteristics altogether, as was the older "mentalist" procedure, would be absurd today. Newtonian clock ticks and foot rules, however, are far from sufficient. When physicists needed greater freedom in this respect, they took it; but even adjustments under Einsteinian relativity will not alone suffice for our needs, nor are the various suggestions of recent physiologies adequate to reach across the behavioral field (*8*). Behavioral *pasts* and *futures*—histories and goals, habits and purposings—are before us descriptively in behavioral *presents*. Descriptively factual knowings-knowns hold fars and nears together under their own specializations of action. Without at least the beginnings of appreciation for this possible need in behavioral inquiry—without, at least, tolerance for experiment under it—grasp of the following positions will not be gained.

a) Word-meaning and word-embodying are not separates but occur together as one behavioral transaction. No locus in the cosmos can be found either for verbal "meaning" by itself, or for verbal "embodiment" held in separation. On the one hand, word-meanings as severed from man's linguistic activity are not observable, nor are they attainable as subject matters of independent inquiry, despite all the reams that have been written purportedly about them. On the other hand, sounds and graphs apart from their meaningful appearance as man's living activity are not "words" at all for anything beyond a surface inquiry. Physics and physiology are, of course, justified in their special inquiries into their respective aspects of verbal activity, but as aspects only. To use the ancient academic labeling, what they offer is of the character of anatomy and is not an analysis of the full event. For adequate behavioral analysis a full and fair field must be open.

b) More broadly inspected, no field of events identifiable as "language" can be accurately established and brought separately under inquiry in severance from another field alongside known as the "meanings" of language. Without life-in-process neither language nor linguistic meanings can survive any more than could other behavioral events, of whatever kind.

c) In the region of designations the namings and the knowings are one process, not two. Where the naming is taken transactionally at its level of behavioral advance, it itself is the behavioral knowing. Knowing through naming is a phase of human organism-in-action. In organism-in-action the know-

ing is the naming; so postulated; so observed; so investigated.

d) Once able to see word-meaning and naming-knowing as living processes of organism-in-environs, we may next advance to observation of the knowing and the known as transactionally comprised in common event. An organism, a rock, and a tree remain before us as heretofore, subject to such physical or physiological inquiry as we may wish. Insofar, the scientific situation remains unchanged. But when rock flies and dog dodges and tree is evaded in flight, the situation becomes one in which subject matters are on a further level of complexity. Here it is but crude and imperfect presentation, an affair of casual, practical report rather than of scientific procedure, when rock and dog and tree are taken as separates, and when independent initiatives or resistances are attributed to any or all of them separately in the style of the older days, when "actualities" were presumably certified to the scientist as "given" to him in advance of his inquiry. Physicists faced a *similar* transformation in the case of the electron. To say today that the electron is an "entity" known to be such on its own, outside of and apart from the processes of its being known, would be to misrepresent modern scientific report. The electron is "known" under specialized knowings, and in highly specialized technical manners. The electron accepted in physical research is one that "works," not one that claims "reality;" it is dealt with, this is to say, as fact within the frame of existing research, not as assured for eternity. The gene in physiology more and more comes to occupy a similar position (*23*).

e) What is the case for the knowing-known is the case also for the naming-named. We have a single event such that without both phases—both the namings and the nameds—we would have no event at all. What here most seriously interferes with full technical observation is the old set of verbal fixations which sunder name, named, and namer. The evil of reliance upon severed name, out of organized contact with namer and named, is illustrated, perhaps at its historical worst, in many of the procedures of professional logics today.

f) These steps lead to a radical outcome with respect to *what* it is that is *named* by a naming, and so *known* linguistically, within an event of naming-knowing. This "what" no longer enters as if it were a "thing" outside the range of behavioral activity. Instead, "the named" is, in the primary case, itself a behavioral transaction: a signaling or perceiving that requires the joint action of its two presumptive "ends"—roughly, the intradermal and the extradermal—if it is to have any "middle" of factuality at all. This "what" that is named, therefore, neither rests upon some demand made by a "thing" upon an "organism;" nor does it enter as the determination of an "outer" thing by an "organism acting *solo*." The designational processes of organism-environs grasp the underlying signaling processes and bring them into increased behavioral organization. We not only say that a knowing without its known, or a known without its knowing, is an incoherence, but that a knowing-in-naming that pretends to know and name something outside of, or beyond, all signaling—or other organic-environmental contact—is equally incoherence. The known-in-naming is primarily what is already being perceived or is otherwise in transactional process.

g) Even more radical may seem a further assertion, again one to be taken strictly under transactional postulation. It is that the characteristic behavioral process is the process of knowing. Knowing—the naturalistic knowing-contact between organism and environs—is that which must receive basic examination and expression the moment the effectiveness of physiological techniques has been left behind, and the behavioral field has been entered. Its study constitutes the primary behavioral science. Knowing is not some wonder perched on top of organic life; it happens as process in and of the world; it is to behavioral science what radiation and gravitation are to physics, and what blood circulation and neural transmission are to physiology.

In this statement we are temporarily changing our form of expression from the technical manner established above, where "sign" was made the general name for behavioral process, and in which "knowing," as a special form of "signing," was limited to the range of "knowings-by-naming." The present passage is the only one in this paper in which this deviation occurs.[7] The deviation is made deliberately: first, because current uses make the word "knowing" run loosely and irregularly, as previously indicated, over almost all phases of behavioral organic-environmental contact, from the most primitive to the most subtly mathematical; and, second, because these same current uses subordinate "knowing" in one way or another to almost every other manner of psychological inquiry. Given this conventional looseness of expression and neglect of fact, which is found as much in professional psychology as in common speech, we accept it for one moment in order to secure the impressionistic report that is lacking at first view under the technical statement in terms of "sign."

In this background of expression, then, the knowing contact is the typically behavioral process; it is what must be inquired into first, instead of being

[7] See footnote 6.

evaded and slurred. For such inquiry it must above all things be brought fully into the "natural" frame of scientific observation. Here it is that kennetic inquiry brings the situation out into the light, and literally lays it on the laboratory table for detailed examination. In curt expression we may say, if we wish: "World flows, Life grows, Behavior knows, yet with the knowings and the knowns always components of the flow and of the growth." Most generally, then, the behavioral contact points are know-points in differentiation from physical and physiological contact-points. In kennetic inquiry, under the terminology of "sign," the crude particulate reports are passed over, on the one hand, and the wide sweeping generalizations are passed over, on the other. Transactional presentation is secured as observation gains strength. Translations into "minds," whether of moron or of mage, cease to enter. Use of the techniques of other sciences can be made without forced subordination or pretense of dominance—all of which means that the prospect improves for inquiry and report of the type we today call scientific.

With respect to the above positions (*a*) to (*g*), we may recall the various freedoms insisted upon for inquiry at one or another stage of the discussion. These freedoms are indeed at times as much in demand by physiologists as they ever are by behavioral investigators, since the best physics may at times constrict physiological progress, just as the best physiology may at times constrict behavioral; though, of course, in the latter case, protection against the old "psychical" and "mentalist" fixations is the primary need. The freedoms required are: Freedom of postulation; freedom of observation under postulation; freedom from conventional speech-forms insistently surviving from prehistoric cultures; freedom for linguistic, as well as for laboratory, experimentation; and, finally, freedom for the establishment of new systems of nomenclature in the open daylight of inquiry.

A general theory of language should become practicable in this framework, perhaps one such as John Dewey has forecast in the preface to his *Logic* (*21*). No such presentation exists. What we have, instead, is ever-renewed divagation about minds and things, all fictional, with a fictional "language" as hare to both hounds. Leonard Bloomfield's linguistic study (*11*) is probably the only work to be mentioned as differentiated from the old line, and his construction was hampered by his use of a comparatively early form of psychological behavior*ism*, something not here employed in any phase.

Status with Respect to Modern Science

The above program of observation and interpretation is not one of speedy recent development, but instead one of slow growth. It is definitely not in favor with—often not even in the field of vision of—metaphysics or other standardizations of the traditional psychological-philosophical terminologies. John Dewey laid the foundation for it in his famous essay "The Reflex Arc Concept in Psychology" in 1896 (*20*)[8] and has carried it forward through studies in almost all lines of cultural development, culminating in his *Logic, the Theory of Inquiry* (*21*). The present writer approached it in his study of group pressures in *The Process of Government* in 1908 (*4*), an inquiry much wider in scope than any study of pressure groups, the "discovery" of which is occasionally attributed to, though emphatically not claimed by, him; and he followed it later with studies of cross-sectional process in society (*5*), types of linguistic coherence in society (*6*), and communicational psychology (*7, 8*). Probably the best sociological construction undertaken from this direction is that of George Lundberg (*30*). In psychology the earliest and most important effort to see perceptions in terms of interactions between organisms and environs was that of J. R. Kantor (*27*). The ecologies are well known in all biological lines. Specialized cultural inquiries have in many cases almost reached the transactional form, though without, in any case that I am aware of, having made the necessary generalized formulation.

The greatest strength of the transactional approach at the present time is given it by the advances of physics following the initiative of Einstein, as this rested upon the observation of Faraday and its mathematical presentation by Clerk-Maxwell (*22,* Chap. IV). Newton had achieved the construction of the interactional in its region of greatest usefulness. In the last generation, in place of the interactional, physics has secured envisionments of particle as wave, of mass as energy, and of gravitation as conformation of space-time. All these changes involve widened observation and are transactional in their orientation in the sense of that term as here used. The present procedure falls into line, though at a proper respectful distance, with Einstein's long-concentrated effort to secure a unified field theory for physics.[9] Any physical field theory of most general scope will, we believe, when once soundly secured, show itself to be

[8] At the time of the celebration of the fiftieth anniversary of the *Psychological Review,* this paper was judged by a vote of several hundred leading American psychologists to be the most important paper ever published in that journal. Even yet its values are only partially realized.

[9] Although the word "field" has repeatedly appeared in this paper, its use has been casual, and it has nowhere been specifically adopted, despite its apparent superficial advantages. This is partly because certain problems as to its application are not yet standardized by physics, but more because the word has been so widely abused by overly optimistic appropriators in other than physical regions. On this point see a discussion by Ivan D. London (*29*).

a process of knowing, as clearly as it shows itself to be a system of the known. The impress of the physical knowing will be upon the physically known, and the status of each will depend upon that of the other. In this case the need of a kennetic theory on the knowing side, as correlate to the field theory on the side of the known, will make itself strongly felt. Einstein's personal attitude, as is well enough known, will not tolerate anything comparable to kennetic theory on the side of the knowing, but the observation of Bohr, and of others, is clearly in line for it. Einstein, amidst the efflorescence of German philosophical terminology—the most resplendent in the world—maintains, largely in the Kantian tradition, all the ancient self-actional treatments, inclusive of the wholly redundant, entitatively personalized knower, at the very time that he has been the greatest of all leaders in overcoming the rigidities of the old "knowns" by expelling that sort of reification from the physical range. Bridgman, who has been the world leader in interpreting Einstein's work as human progress (*14*), holds in his latest discussion that the traditional metaphysical bias in Einstein is now at work where it may be positively hurtful to the results Einstein secures. Bridgman's comment is that "in Einstein's yearning for absolute information and meaning it seems . . . that the ghosts of Newton's absolute space and time are walking again, ghosts which Einstein himself had apparently exorcised in his special theory of relativity" (*15*, p. 19); and again, more specifically, that Einstein "believes it possible to . . . sublimate . . . the point of view of the individual observer into something universal, 'public,' and 'real'" (*16*, pp. 349, 354).

Recent Transactional Approximations

Several papers have appeared in Science within the past year outlining scientific development on lines sympathetic to, and in some cases directly comparable with, kennetic treatment. Cantril, Ames, and their associates expressly accept transactional observation and construction under that name for psychology. Bertalanffy proposes regions comparably transactional for physiological inquiry. Bohr sharpens his long-maintained stress on physical complementarity as opposed to the epistemological type of "reality" toward which he, as well as Bridgman, sees Einstein still straining. Dobzansky's discussion of "basic concepts" in the genetic field sees openings for ever-greater observation and research into "system" free from patterns and methods, the enforcement of which earlier workers demand.

Bohr's paper (*12*) is supplemented by his extended contribution to the volume dealing with Einstein's philosophical cerements in the *Library of Living Philosophers* (*13*). Where Einstein still holds to man-the-predictor as the test of whatever "element of physical reality" there is to be found, Bohr asserts the rights of verified observations as they come (the issue of "indeterminacy" being central to this discussion); he permits the contrasts of observation to stand undisturbed within the system of the known, asserting that in them "we have to do with equally essential aspects of all well-defined knowledge about the objects;" he finds here growth, not confusion; and he insists that "causality" will not be lost, but will in the end be better understood. Outstanding is his demand for the clarification of the many ambiguous terms, ambiguously standard to all the philosophico-scientificoid rummagings. Above all, the word "phenomenon," he declares, should be confined to "observations obtained under specified circumstances including an account of the whole experiment." Such a demand runs side by side with Bridgman's requirement (*14*) that the "operations" involved in any naming be made known, and with our present insistence that "observation under postulation" should be companion to "postulation derived from observation." With strictly practical intent Bohr quotes the ancient saying that men are both actors and spectators in the drama of existence.

Bertalanffy (*9, 10*) appraises the intraintegumental organism taken as subject matter of general observation and description, and finds it inadequate as a system. He then considers a wider system of organism-plus-environment and develops its import. His attention is not directed to the specialized range of behaviors-in-environment, such as we have been discussing "transactionally" in the still more specialized case of knowings-knowns, but instead covers the underlying field of physiology in general, and covers it in such a manner that, if he so happens to wish, he could readily apply to it the word "transactional" in a sense not in conflict with that in which Clerk-Maxwell employed the word three quarters of a century ago, or with that in which we have been using it here. Bertalanffy makes his main differentiation run between "closed" and "open" systems. Most physical systems are closed systems. The organism by itself is an open system. In the technically closed system no material enters or leaves, reversibility is in most cases practicable, and an equilibrium-state in which entropy is at a maximum must ultimately be attained. In the open system, in contrast, there is a continuous flow of components from without, their flow and ratio are maintained constant, irreversibility appears in great degree, growth is characteristic, a steady-state characterized by minimum entropy-production may be approached, and, finally, when disturbance occurs, "self-regulation" operates to restore balance. The status of Bertalanffy's distinction of the physiological

from the physical is akin to our present distinction of the behavioral from the physiological in that in neither case are sharp borders set up; in neither case are "existential realities" pretended to; in each case future studies may reduce or eliminate unexplored border-areas; and, more important than all, in each the differentiation rests jointly upon the techniques of inquiry established and upon the main systems of the knowns that appear as the outcome of inquiry. Under this approach Bertalanffy anticipates that biology may advance toward being an exact science, and physics itself will have new pathways open to it. It might comparably be considered assured that, if a sound working basis for the differentiation of knowings and knowns in system is sometime attained, all branches of scientific inquiry will benefit thereby.

Dobzhansky's paper (*23*) is throughout an exhibit of advancing freedom in genetic research. A transactional attitude, though not in specific development, is seen replacing the earlier interactional stresses deriving from common speech and physical formulation. Priority of research for physics is, of course, maintained here as in the other papers mentioned, and in kennetic inquiry as well. Terminology is not developed, and interactional expression is still largely employed. But whatever components are introduced as particulate quickly reappear in broadened system. The chromosome is an organized system. The genotype (except for viruses) "is an integrated system of many kinds ('loci') of genes." The genotype is in system with the environment. The environment of the moment "is only a component of the environmental complex that determines the mutation." The development of the individual "is an orderly sequence . . . in which the genotype and the environment are involved." The geneticist's growing freedom from the patterns with which he began is manifest in all this; and it is manifest as widening interconnection of the factors, not as their mechanistic application, one to another.

In three papers under the general title "Psychology and Scientific Research" (*18*), Cantril, Ames, Hastorf, and Ittelson argue in favor of a transactional approach for psychology, adopting that name as it is established in the book *Knowing and the Known* (*22*) and believing that they are justified in anticipating revolutionary developments when psychology comes to be investigated from such a viewpoint. The solid strength behind their position lies in the work Professor Ames has carried on for more than twenty years in his laboratory at the Dartmouth Eye Institute, and as elaborated more recently in conjunction with psychologists at Princeton through the Institute for Associated Research. One of his exhibits, that of the distorted room, in viewing which ordinary perceptive processes default, has become well known through widely circulated accounts in newspapers and magazines a year or so ago. An even more startling exhibit, dealing with motion rather than with objects at rest, is that of the revolving windows, the report on which, at the present moment, is still in manuscript (*2*). A rectangular window of conventional appearance can be seen slowly revolving on its vertical axis. A trapezoidal window, comparable in size, and similarly revolving alongside, cannot be seen to revolve, and cannot even be plainly seen as a trapezoid. Persistent efforts by experimenters to see complete revolutions of the entire frame have failed. Even when a long rod touching the window is used as an aid by the observer, he makes little progress, and that little is lost by the following morning. Headaches and nausea may mark his disturbance. What the observer "sees"—or, perhaps, "seems to see," depending on what meaning one gives the word "see"—is an apparently rectangular window of changing length, oscillating at changing speeds to right and then to left in a total arc of about 100° (if degrees of arc can be injected at all in a case like this), and then returning to its starting point, just as the rectangular window completes its full observed revolution.

Professor Ames' workshops offer some fifty interrelated exhibits of persistent perceptions or, more properly, perceptual processes, that are out of agreement with the commonly accepted approaches to the physiological and behavioral interpretations of vision. We have here not simply illusion in the ordinary sense, but illusion so pronounced that doubt is cast on the apparent "actualities" or "realities" of ordinary visual report, and the need arises for an ever more rigorous inquiry into the conditions under which such observation takes place. This is closely akin to Bohr's requirement, quoted above, for the word "phenomenon": that its use in physics should be confined to "observations obtained under specified circumstances including an account of the whole experiment" (*12*). Professor Ames would hardly make as radical a statement as this. Nevertheless, in summary, he holds that perceptions as they come cannot be referred flatly to outer objects, nor to inner capacities as producers; and no more to the latter when neurologically postulated than when taken in the old slipshod form of the "psychic" (*2, 3*). Perception, to him, tends to become frankly and openly a "transaction" involving organism and environment in union, in the presentation of which both what he styles "assumption" and what he styles "purpose" or "value" must be included; namely, the past history of individual and race, and the advancing objectives of living man and group. "Prognostic directive" is a name he favors as best characterizing this perceptional

activity of the organism. He has sketched the organization of the neural processes involved, and has proceeded with patience, ingenuity, and steady attention to openings for further test. In an address to architects a few years ago (*1*) he summed up: "While in no way denying the existence of the 'external world' our disclosures apparently show that the only aspects of it man can know anything about are those aspects which are either helpful or thwarting in carrying out his purposes."

In harmony with Ames' work is that of Hoyt Sherman at Ohio State University in which unexpected abilities have been aroused in students by a drawing technique that organizes the total visual field with the muscular requirements of the procedure under way (*34*).

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Technical Papers

Prolongation of the Fertilizing Capacity of Sea-Urchin Spermatozoa by Amino Acids

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The life span of sea-urchin spermatozoa can be prolonged by addition of various agents to the sea water in which they are suspended (*1*). Hayashi (*2*) found that dilution of the sperm with seminal fluid instead of sea water extends the fertilizing capacity considerably and that the effective agent is most probably a protein. Chang (*3*) has obtained a similar effect of seminal fluid on spermatozoa of rabbits. Metz (*4*) noted that addition of hen's egg white increases the fertilizing power of starfish sperm. Wicklund (*5*) found that bovine serum albumin, trypsin, and chymotrypsin maintain very well the fertilizing power of dilute suspensions of sea-urchin spermatozoa, whereas glucose and fructose are somewhat less effective.

We have confirmed the effect of these proteins on spermatozoa of the sea urchins *Lytechinus pictus* and *Strongylocentrotus purpuratus*. In addition, we find that various amino acids give more marked extension of the functional life of the spermatozoa. The amino acids thus far tested include glycine, alanine, valine, leucine, and lysine, and all are found to be active in this regard. The peptide glutathione was also tested and found to be effective.

The tests were made with both relatively dilute (*ca.* 0.5%) and relatively concentrated (*ca.* 5%) sperm sus-