INTRODUCTION TO DEVELOPMENTAL AND HISTORICAL STRUCTURALISM

Klaus F. Riegel

University of Michigan

Introduction to Developmental and Historical Structuralism

Klaus F. Riegel

The following essay introduces structuralism from several different angles.
In the first section of this introduction, the concept of <u>structure</u> (and in
extension those of schema, pattern, gestalt, etc.) will be contrasted with
that of <u>function</u> (and in extension those of activity, interaction, transforma-
tion, etc.). Such a comparison will not merely reconfirm the old dichotomy
as introduced into psychology by James and Titchner, but will emphasize the
mutual dependency of structure and functions. In this attempt we rely on
Piaget's interpretations and, thus, emphasize genetic aspects. Reference
will also be given to recent trends in linguistics, especially to Chomsky's
transformational grammar.

In the second section, we trace the origin of these ideas to some reformu-
lations in mathematics proposed during the second half of the 19th century by
Dedekind, Frege, Russell and others. The new emphasis stressed the analysis
of relational orders and classes and thus contributed to the foundation for
structural interpretations.

Further steps in this direction were taken in Carnap's early work, which
is represented in the third section. Carnap provides explicit descriptions of
structural interpretations, by relying on some positivists of the late 19th
century, especially Mach, Poincaré and Avenarius, whose contributions--
unfortunately--have frequently been viewed in clear antithesis to structural
descriptions. Carnap's interpretations come closest to those held by Avenarius;
Mach relates to the psychologism of Wundt, and Poincaré to the early positivism

of Comte. Poincaré, in turn, influences the school of French sociology with
Dürkheim, Mauss, Blondel, Halbwachs, and Levy-Brühl, which finally leads to
the structural anthropology of Levi-Strauss and to the genetic structuralism
of Piaget.

In the fourth section we question, in alliance with modern sociologists
and anthropologists, the role of the psychic self as a primary base of knowl-
edge and of psychology as an independent science. Piaget has been criticized
for viewing development as emerging, essentially, from within the individual
and for failing to give equally strong emphasis to the interactive changes
of the socio-historical conditions. Rubinstejn's theory, with which we
conclude our presentation, proposed such a dialectic interpretation of a
changing organism in a changing world.

Psychology and Linguistics

Early Structuralism

The distinction between structure and function gained its directive
influence upon psychology through Titchner. Although previously discussed by
James (1890) (see also Ruckmick, 1911), Titchner (1898) elaborated this distinc-
tion in detail and thereby, paradoxically, helped his adversaries in founding
functionalism in America (Boring, 1957, p. 555). Titchner, by drawing an
analogy from biology, proposed a threefold distinction.

> We may enquire into the structure of an organism, without re-
> gard to function--by analysis determining its component parts, and
> by synthesis exhibiting the mode of its formation from the parts.
> Or we may enquire into the function of the various structures which
> our analysis has revealed, and into the manner of their interrelation
> as functional organs. Or, again, we may enquire into the changes of
> form and function that accompany the persistence of the organism in
> time, the phenomena of growth and of decay. Biology, the science of
> living things, comprises the three mutually interdependent sciences
> of morphology, physiology, and ontogeny [1898, p. 449].

Titchner delineates this distinction not only in regard to the individual organism but also in regard to the species, the "collective life." He continues:

> Corresponding to morphology, we have taxonomy or systematic zoology, the science of classification. The whole world of living things is here the organism, and species and sub-species and races are its parts. Corresponding to physiology, we have that department of biology—it has been termed "oecology"—which deals with questions of geographical distribution, of the function of species in the general economy of nature. Corresponding to ontogeny we have the science of phylogeny: the biology of evolution, with its problems of descent and of transmission [1898, p. 449].

Titchner's contrastive description of structuralism and functionalism (under exclusion of the third major possibility for scientific psychology, geneticism) has had a formative influence upon the development of American psychology or, at least, for its historical description (especially through Boring's work, 1957). Nevertheless, his view of structure, being atomistic and mechanistic, was an exceptionally unfortunate choice. More appropriately, his approach ought to be called the "psychology of content," a denotation commonly reserved for Wundt in distinction to the "psychology of act" by Brentano. Titchner's structuralism emphasizes the analytic identification of psychic constituents (sensations, ideas and emotions). Organizational aspects enter into the discussion only secondarily.

Gestalt Psychology

Structural considerations were firmly introduced into psychology by the Gestalt movement of Wertheimer, Köhler and Koffka. Here, organized patterns become the foundation of scientific inquiries as well as of the phenomenal experience of subjects. The identification of constituent elements attains

negligible importance if any importance at all. As for Titchner, genetic

aspects remain neglected. Gestalt psychologists analyze psychic conditions

from an "a-historical" point of view. They are concerned, however, with

functional aspects which, as introduced by the forerunner of Gestalt

psychology, von Ehrenfels (1890), are implied in the so-called "second law

of Gestalt."

As commonly expressed, the "first law" states that a Gestalt is more

than the sum of its parts, i.e., organizational, structural properties are

implied. The "second law" concerns transpositions or transformations through

which all parts may lose their absolute positions, though the structural

properties are retained, i.e., are kept invariant. Convincing cases of the

"second law" are the transpositions of a melody into different keys, or in

a more general sense (i.e., keeping fewer properties invariant), the variations

upon a musical theme. In regard to spatio-visual conditions, the perception

of a simple object, e.g., a suspended triangle, is subject to ceaseless trans-

formations. Not only does the location, illumination and color of the object

change relative to the observer, but also the sensory organs of the observer

himself undergo ceaseless transformations produced by their gross and fine

movements. Thus, the scientific exploration of perceived patterns is as

much an abstraction from the ongoing physical and psychic activities as was

the abstraction of constituent elements from these patterns by the pre-

Gestalt psychologists. What underlies both these abstractions, and therefore

ought to be of main interest to the psychologist, are ceaseless sequences of

transformations.

Gestalt psychologists recognized this issue, especially through their

investigation of the phi-phenomenon. The phi-phenomenon is produced by

switching two light sources on and off. Dependent upon the rate of switching, the lights are either perceived as alternating discrete stimuli, as two continuously lighted stimuli, or as a connecting lighted line. These investigations have primarily been used in refutation of earlier atomistic viewpoints in that they question the identifiability of discrete sensory elements. They could be used equally well to criticize the preponderance of stimulus patterns. The investigations of the phi-phenomenon clearly support a transformational or transactional interpretation. The opposite dominated, however, through Köhler's (1920) analysis of the isomorphism between external physical and internal neurophysiological patterns with its implied priority of the former in the tradition of philosophical realism. A convincing argument for transposition as the key principle has been published by Witte (1960). More recently, Henle (1972) has thoroughly reviewed Wolfgang Köhler's contributions to this discussion.

Cognitive Developmental Psychology

Among present-day psychologists, only Piaget (1970) has drawn a conclusion similar to the transformationists, and has, thereby, reversed the order of the laws of Gestalt psychology. The "law of transposition," now, gains priority over the "law of the Gestalt." As an organism engages physiologically and psychologically in ceaseless transformations, it attains patterns during its internal transitions and attends to patterns as transitional conditions. These patterns represent momentarily objectified states of equilibrium, the organism moves forward through a stream of transactions. In his considerations, Piaget is willing to conclude that "transformations may be disengaged from the objects subject to such transformation and the group defined solely in terms of the set of transformations [Piaget, 1970, pp. 23-24]."

Piaget is, of course, best known for his "stage theory" in which he proposes a fixed sequence of synchronic structures for the characterization of developmental progression. If we take the above quotation seriously, however, development should be characterized by groups of permissible transformations rather than by fixed forms or schemata. Such a notion implies that the freedom of transformation is never unlimited. In regard to mathematical systems, e.g., measurement scales, it implies that basic properties have to be kept "invariant," e.g., in metric systems the relative distances between points. In Piaget's theory of cognitive development, conditions of invariance are represented as temporary states of equilibrium from which the individual will constantly divert, but to which he will always return.

With this emphasis on transformational processes Piaget, at the same time, inverts the meaning of structure and function as originally conceived by Titchner. Now structures emerge through continuous transformational activities; they are, in other words, determined by functions. Moreover, structures emerge from within, whereas for Gestalt psychologists they originate from without. In further contrast to these and to most other structuralists, Piaget relates both the concepts of structure and function to genetic interpretations. Structures do not only emerge through transformations but are subjected to continuous changes. The individual's development is characterized by shifts in structures brought about by transformational activities. Thus, Piaget relates all three aspects of Titchner's outline to one another; his theory is structural, functional, and genetic. Development is not characterized any longer as a sequence of synchronic schemata, but by diachronic clusters of transformations.

Linguistics

Piaget's emphasis upon the connection between structures and transfor-
mations directs our attention to some recent developments in linguistics.
More distinctly than in psychology, two major schools in linguistics have
been called "structuralists" and "transformationists." The former adopted
the methodology of the behaviorists in order to determine the major form
classes and their arrangements in the natural language. With their emphasis
upon methodological rigor, they share with the behaviorists a disrespect
for any notions about underlying organizations, forces or meanings. They
initiate their inquiries from and on the surface of the linguistic corpus.
Quite paradoxically, of course, the denotation of these linguists as
"structuralists" cannot be transferred to their allies, the "behaviorists,"
who, from Titchner's point of view, were regarded as "functionalists." He
reserved the label of "structuralism" for his own school of introspective
elementarism.

Structuralism, as proposed by Bloomfield (1933), dominated American
linguistics for many decades. Although objections were expressed repeatedly--
for instance, Jesperson (1937) claimed that the purpose of a linguistic analysis
is "to denote all the most important interrelations of words and parts of
words in connected speech . . . . Forms as such have no place in the system
[1937, pp. 13 and 104]"--a major revision was not undertaken until the appear-
ance of Chomsky's transformational grammar.

As for Piaget, Chomsky's (1957, 1959) publications reveal some major
changes in his own thinking. He started out with describing alternative
models of syntactic structures (1957) and by polemizing against behavioristic

interpretations (1959). Then he elaborated his syntactic theory (Chomsky, 1965, 1968) which is of primary interest for our present discussion. His most recent interpretations, nevertheless, are not as radical as those by Piaget (1970). In contrast to Piaget's transformationism, Chomsky argues at two distinct levels: for grammars of the surface structures of the natural languages and for an underlying universal deep structure. Most of his efforts are directed toward the delineation of the latter. As this is achieved, attention can shift toward the specification of transformation rules by which the former are derived from the latter. Transformations are thus performed upon given structures and do not attain the priority that Piaget is willing to assign to them. Instead of considering these transformations as the universal basis, they merely operate upon the deep structure to which such a priority is assigned. Not surprisingly, therefore, some of his followers (Lenneberg, 1967; McNeill, 1968, 1970) have identified these universal forms of the deep structure with innate schemata of the organisms, and thus have revitalized the nativism of 19th century psychology. What needs to be done is to relate the transformations to intrinsic activities of the organism but not to their forms.

The concept of "transformation," as used by modern linguists, creates as many difficulties as the concept of "structure" as used by Titchner. Transformations have their well-defined place in the logic and mathematics of numerical systems. As first elaborated by Hölder (1901) and discussed in many different treatises in the behavioral and social sciences (see Stevens, 1951; Coombs, 1964) measurements can be based upon numerical systems of varying complexity, i.e., upon cardinal, ordinal, rational systems, etc.

As their complexity increases (and with it the number of operative pre-
requisites that have to be fulfilled), the complexity of the transformations
that can be imposed upon these systems decreases. Thus cardinal numbers can
be subjected to a wide range of transformations, rational numbers only to
a few. In other words, with increasing complexity, larger sets of properties
have to be kept invariant unless the structure of the whole system is to be
invalidated.

Whereas the structure of these numerical systems and their sets of
permissible transformations can be specified with precision, the use of the
latter term in linguistics is rather ambiguous. Linguistic transformations
do not only change the order of items within strings but also basic features
of expressions--for example, they change declarative statements into negatives,
questions, passives, and vice versa. Since the dimensions of linguistic
expressions are difficult to determine and vary from investigation to
investigation, linguistic transformations also lack descriptive rigor. In
particular, the invariant properties are not spelled out. Indeed, mathemati-
cians seem to emphasize the invariances; linguists point to the modifications
brought about by transformations.

Mathematics

Theories of Numbers

In discussing some reformulations in mathematical thinking which contri-
buted to the development of modern structuralism, we direct our attention to
the work of Cassirer (1910). As implied in the German title of his book,
The Concepts of Substance and Functions, early philosophizing relied heavily

upon the concept of smallest, substantive elements. With the objective basis of these particles taken for granted, the task for philosophy and sciences consisted in analyzing the systematic connections between them. In opposition to such conceptualizations, Cassirer argues for the priority of functional relations or operations, a switch in thinking which characterizes structural interpretations. This shift in conceptualization also occurred in mathematics.

During the early historical periods, at least up to Descartes, mathematics was seen as a reflection of or an ideal abstraction from the real world with its substantial particle properties. A major reformulation was brought about by Leibniz for whom the basis of knowledge did not lie in the reflection and abstraction of ideas themselves but in the relationship between ideas. As a general example of this change in thinking consider the notion of geometrical points and lines. Traditionally, points were taken for granted and, there-after, notions about their shortest connections, i.e., through straight lines, were derived. Thus, the solution was achieved through operations performed upon these points. Similarly in algebra, the natural numbers, as experienced by counting real objects, were taken for granted. Whenever problems arose, e.g., when a larger number was to be subtracted from a smaller one, extensions of the system were introduced, in this case, an extension into the domain of negative numbers. In many other cases, new numbers were interspersed between the natural numbers, such as fractional, irrational, and imaginary numbers. Thereby, the notions of the infinity in extension and in partition of the domain of numbers emerged. But at the same time, it became even more apparent that the prerequisites, which made these developments possible, lie in our full use of operative capabilities rather than in better and better

approximations of the range of real objects. In other words, mathematics

began to be seen as a system of operations rather than as a reflection of

substantive conglomerates. Since the full range of these operations has

been hardly explored, many new forms of mathematics could emerge. Develop-

ments since the second half of the 19th century have confirmed this possi-

bility, leading to non-Euclidean geometries and to some of the number

systems mentioned above.

Related to these developments are changes in the concepts of time and

space (Cohen, 1972; Riegel, 1972c). Traditionally, time had been regarded

as finite and discrete; thus, the concept of time was similar to the concept

of substance. As the natural number system was extended and as the slots

between numbers were filled to a greater and greater extent, the notion of

infinity was introduced through induction. Now, instead of emphasizing the

periodicity of time, its beginning and its end, an abstract continuum was

derived. To Cassirer, however, the question of whether time is discrete or

continuous, finite or infinite, relative or absolute depends solely upon

the operations selected by the observer and not upon external, nonintellectual

criteria.

Cassirer relates our conception of time to the theories of numbers and

algebra. Geometry, on the other hand, he relates to the simultaneity and

coexistence of several such number systems. Subsequently, also our concept

of space can be continuous or discrete, absolute or relative, Euclidean or

non-Euclidean. Originally, according to Cassirer, the concept of space was

discrete and bound by the three dimensionality of our experience. Through

inductive generalizations the notion of a continuous space was derived and

attempts were made to shift from the three dimensions of the experienced space to non-Euclidean interpretations. Although this has been intellectually achieved, Cassirer insists that our conception of space ought not to be regarded as a generalization from objective, substantive conditions of the real world, but rather as a fuller elaboration of our intellectual operations which enable us to generate these notions as well as many others not yet proposed.

Dedekind, Frege, and Russell

Cassirer's views, which occasionally have been called "logical idealism," are shared by the mathematician Dedekind (1893) who argues that our concept of numbers, being a representation of pure laws of thinking, is independent from our conceptions of space and time. Quite to the contrary, only through the logical derivation of a theory of numbers and the attainment of a mono-tone domain of numbers have we become able to explicate our conceptions of space and time. If, in the pursuit of these explorations, we try "to determine what we are doing when counting a class or a number of things, we are bound to recognize the capability of the mind to relate things to things, to compare one thing with another, or to map one thing upon another; without this capability thought would not be possible at all [Dedekind, 1893, pp. III-IV, author's translation]."

According to Dedekind, our basic conception of numbers is relational. Through implicit mental comparisons we derive ordinal numbers. By explication we become able to categorize numbers or items. For example, we might, within a given range, group all those items into a class which are below a certain value a. Items above that value are assigned to a different class.

Following this procedure (the well-known Dedekind "incision"), the criterion itself, a, cannot belong to either of the two classes which it defines. Therefore, we need to elaborate other operations that will lead to a new numerical system and include the criterion a, i.e., the system of irrational numbers. By applying these deductive procedures step by step and thereby extending the domain of numbers encompassed, Dedekind and the following generation of mathematicians succeeded in deriving the whole field of mathematics from this basis.

For this purpose it was first necessary to deduce the system of ordinal numbers. This was done by applying Dedekind's procedure repeatedly, thus generating the classes A and B, on the one hand, and C and D on the other. If there is an element which belongs to the class A of the first incision and to the class D of the second incision, then we would call the first categorization larger and let it follow the second one in a sequence. Thus, a criterion is given which, when applied repeatedly, generates a completely ordered system of numbers.

Dedekind's procedure is based on ordinal judgments. For the derivation of cardinal numbers and categorizations in general--it has been argued by Frege (1903) and Russell (1903)--judgments of equivalence are more fundamental. Contrary to the traditional conception, according to which numbers are con-sidered as given and, subsequently, judged as equivalent or not, it is the goal of their approach to determine an operation of equivalence first, and then to derive sets of equivalent and nonequivalent numbers on the basis of such an operation. As stated by Frege, "It is our intention to form the content of an operation which can be expressed in an equation in such a way

that there is a number on each side of it . . . . Thus, by means of the
familiar concept of equivalence we are to obtain what we have to consider
as equal [1903, p. 27]."

In comparing the approach by Dedekind and Cassirer with that by Frege
and Russell, their similarities and dialectic interdependencies need to be
emphasized. First, both camps rely on relations—the former, in general,
on asymmetric relations of different kinds, the latter on the symmetric
relation of equivalence. Second, both emphasize operative, constructive
aspects through which complex structures are derived. They neither regard
these structures nor the equivalences and relations as given in the external
world but as founded in the operations of the organism. Thus, their inter-
pretations are closely in line and anticipate Piaget's cognitive developmental
theory. They are at variance, however, with sociocultural theories which
assign, at least in part, these operative, constructive or transformational
activities to society which, in turn, will determine, at least in part, the
activities of the individual. Before we discuss these modern trends, a brief
overview will be given of some recent philosophical developments which parallel
those in mathematical theory. In particular, we will refer to Carnap's (1928)
early work.

Philosophy

Positivism and Conventionalism

The philosophical roots of modern structuralism lie in rather unusual
grounds which, at first sight, we might not at all connect with such an inter-
pretation. This is due to some common misconceptions about these schools,

especially those of French and German positivism and, to a lesser extent,
phenomenologism.

The German positivism of the late 19th century became instrumental and
supportive for a scientific psychology of which Titchner was one of the late
representatives. Contrary to frequent statements, especially expressed by
American writers, positivism of this type was not at all supporting a blind
search for "facts" but would argue against the notion of "facts" as a form
of evidence independent of the observer and solely determined by external
conditions of "nature." To Mach (1886), for example, there were only sensory
impressions; all knowledge had to be derived from them and, thus, was in the
mind. He strongly supported the "psychologism" of the late 19th century--
which epistemologically subordinated all other sciences under psychology--
and emphasized, though timidly, the constructive aspects of scientific
efforts in maintaining that "facts" are merely theories to which we have
become sufficiently accustomed.

Quite similar in orientation, though with much stronger emphasis on the
sociocultural basis of knowledge, Poincaré's conventionalism leads us far
back in the history of philosophy, at least to Locke's critical realism.
The notion of sociolinguistic conventions was introduced in order to account
for the agreement between different observers in regard to secondary qualities,
i.e., those qualities that do not directly reflect properties of nature
(primary qualities) but depend upon the observers' interpretations, such as
his impressions of warmth, redness, brightness, etc. Poincaré carries this
interpretation to its conclusion by considering all our impressions (not only
those representing secondary qualities) as dependent upon sociolinguistic
conventions. Each individual has his subjective experiences; in order to

make general knowledge possible, certain agreements have to be reached on
how to talk about these impressions. Subsequently, knowledge is not only
dependent upon the sensory impressions and observations but upon the con-
structive efforts on the part of the observers to state their experience
in communicable terms.

The last issue receives focused attention in the work of Avenarius
(1894/5) who, for the first time, emphasized logical and syntactic organi-
zations as a necessary prerequisite for the acquisition of knowledge. While
previously the agreement on communicable concepts was stressed, Avenarius
pointed to the need for consensus about logical and linguistic structures.
To Avenarius these structures are arbitrarily selected in about the same
way in which rules of a game, such as chess, are being set up. There is
neither intrinsic nor extrinsic validity in these systems; their value is
dependent upon criteria such as internal consistency, simplicity, and
comprehensiveness.

Constructivism

Avenarius' interpretations failed to have a major effect upon the
philosophy and the execution of the behavioral and social sciences. His
ideas gained considerable importance, however, through the extensions by
the early Carnap (1928). Accepting the shift from substantive to functional
conceptualization (Cassirer, 1910), Carnap elaborated structural interpreta-
tions with a strong nominalistic and constructivistic emphasis. He traced
his interpretations to Russell's (1903) theory of relations and to the
"reduction of 'reality' to the 'given' [1928, p. 7]" as successfully performed
by Avenarius, Mach, Poincaré, Külpe, Ziehen, and Driesch. The "givens" have

to be sought in the unmediated, phenomenal experience. Rather than halting

at such contemplative state, Carnap asks that out of these experiences

constructive steps have to be taken. Knowledge does not so much consist

in introspective apprehension but in active construction. At the beginning,

he would agree with Cassirer (1910), that it is not the sensory impression

but the sentence ("Satz" as related to "setzen," "proposing") which alone

generates knowledge by making it communicable, social, and human.

There are two basic components upon which individual and scientific

knowledge is based: property description and relation description.

> A property description indicates the properties which the
> individual objects of a given domain have, while a relation
> description indicates the relations which hold between these
> objects, but does not make any assertion about the objects as
> individuals. Thus, a property description makes individual or,
> in a sense, absolute, assertions while a relation description
> makes relative assertions [Carnap, 1967, p. 19].

While the present author would take exception to the notion that property

descriptions are nonrelational (see chapter VIII), Carnap's main attention,

anyhow, centers around the relation descriptions. Construction of knowledge

consists in transforming relation descriptions (which ultimately might have

been generated from property descriptions) according to construction rules

or constructional definitions.

> ....to construct a out of b, c means to produce a general
> rule that indicates for each individual case how a statement
> about a must be transformed in order to yield a statement about
> b, c [Carnap, 1967, p. 6].

The development of constructivism has been prepared by Poincaré's emphasis

that knowledge cannot be based upon the "givens" alone, e.g., sensations, but

that "only relations between the sensations have an objective value [Poincaré,

1902, p. 198." For Carnap, this move, although in the right direction, does

not go far enough. Scientific knowledge becomes possible only through the
systematic explication of the interrelation of relations, i.e., through the
study of structures. Ultimately, all knowledge is structural and is removed
and separated from its base, the property descriptions or, in Poincaré's
sense, the relations with objective value.

Within a system of structural description, Carnap distinguishes two kinds
of definitions: Ostensive definitions and definite descriptions. The former
resemble property descriptions but are stated in relational terms.

> Here, "...the object which is meant is brought within the
> range of perception and is then indicated by an appropriate
> gesture, e.g., 'That is Mont Blanc'...definite descriptions...
> list...essential characteristics, but only as many...as are
> required to recognize unequivocally the object which is meant
> within the object domain under discussion," e.g., "Mont Blanc
> indicates the highest mountain in the Alps," or..."the mountain
> so many kilometers east of Geneva [Carnap, 1928, p. 24]."

While empirical sciences have to incorporate ostensive statements in
order to relate to their specialized fields of observations, science will,
ultimately, remove itself from this basis through purely formal, structural
descriptions. Scientific disciplines differ in the degree to which such
transformations have been accomplished. Physics, in certain areas, can be
removed from its ostensive basis. Psychology has not reached such an
advanced status. According to Carnap, such "de-subjectivization" will
always result in formal structural descriptions. "Each scientific state-
ment can in principle be so transformed that it is nothing but a structural
statement [Carnap, 1928, p. 29]."

An Example of Structural Description

Carnap provides a simple demonstration of structural descriptions, the
example of a railroad schedule. From such a record sufficient specifications

can be deduced in regard to any point (in this case, station) without going

outside of the system. Our own analysis of language and meaning--we believe--

represents an equally strong demonstration (see Riegel, 1970).

Contrary to common as well as to scientific conceptions, meaning is a

relation (or rather a set of relations); concrete experience consists of

such relations; elements and words are abstractions. Early in life and in

unfamiliar situations, meaning is introduced through ostensive or, more

generally, extralingual relations, i.e., by pointing toward labeled objects

and qualities, or by directing or performing requested actions. These

extralingual relations represent, however, exceptional circumstances for

depicting the meaning of objects, events, or qualities. Regularly, such

information will be substituted by intralingual relations. We will, for

example, explicate the meaning of ZEBRA by saying that it "is an ANIMAL,

has STRIPES, is found in AFRICA, is like a HORSE, etc." rather than by

pointing at one.

Such explications presuppose that the listener has already acquired a

repertoire of relational expressions so that he may insert the new information

into the network available to him. This is achieved, for instance, by both

relating and differentiating ZEBRA from other ANIMALS, by grouping ZEBRA

into its spatial location, by recognizing the criterial attributes of ZEBRA,

etc. Undoubtedly, the meaning of ZEBRA, as explicated through these rela-

tional statements, is incomplete (e.g., for zoological purposes) and subjective

both in regard to the speaker and the listener. There is no assurance but,

in principle, doubt that both will imply precisely the same understanding of

the term. ZEBRA for one might denote a dangerous beast, for the other a

handsome creature.

In spite of these idiosyncratic interpretations, communication is possible as long as, within a limited group of speakers, major sections of such a relational structure are being shared. Individuals will communicate within the boundaries of such networks by attending to subsections, such as those included in our example above. Under still more limited conditions (e.g., if only the information "ANIMAL with STRIPES" is transmitted leading in turn to multiple interpretations, such as ZEBRA, TIGER or HYENA), the need may arise to extend the subset within the relational network by including references to specific locations, i.e., AFRICA or INDIA, to types, i.e., HORSE or CAT, etc. In other words, the domain of the relational structure will vary along numerous dimensions, such as individuals (abilities, age), groups (language, sex, occupation), situations (school, job site, cocktail party), etc. Theoretically, the structure can always be extended to make a disambiguation possible. The repertoire of linguistic expressions is rich enough or can always be enriched to make identifications possible.

Our last remarks call attention to the fluctuating and shifting state of relational structures. Such conditions are characteristic, in particular, of languages. The example used by Carnap (1928, pp. 25-27), i.e., that of a railroad network, is less convincing in this regard, because it seems unreasonable to consider this structure, i.e., the system of railroad tracks, as anything but fixed. To depict this structure by activities, i.e., by the moving trains, would be unusual. Language, however, might well be regarded as a system of activities. Its underlying neuroanatomical organization is known only in its grossest features and any particular nervous impulse may reach a cortical destination simultaneously along many alternative tracks.

Moreover, neither the source nor the destination are firmly fixed. Thus, neither the tracks (relations) nor the intersections (elements) are firmly fixed. In most psychological and sociological interpretations, however, the notion of fixed structures has been given preference. Traditionally language, too, has been regarded as a system of elements (words) and connections (associations), but rarely as a system of transformed energies. Language has always been regarded as an objectified product but not as transformational labor. With this example, we are also led, once more, to our earlier contrastive comparison between the major trend in Gestalt psychology and Piaget, the former emphasizing the priority of organized structure, the latter the transformational activity.

Sociology and Anthropology

French Sociology

The contributions of the three positivists of the late 19th century have supplemented one another. Mach, in his analysis of sensory impressions, explored the foundation of the experimental psychology of Helmholz, Wundt, Külpe and Titchner. His French counterpart, Poincaré, in following the tradition initiated by the founder of positivism, Auguste Comte, emphasized the conventional and communicative basis of knowledge and thus gave main attention to sociology and linguistics. Finally, Avenarius explored the logical structure of knowledge and thereby synthesized the trends explored by Mach and Poincaré. In the present section, we elaborate further the contributions by French sociologists and anthropologists.

Because psychic processes could become an object of scientific explorations only if the objective conditions were observed which cause their

occurrence and progression, Comte, in his classification of the sciences,

did not assign a separate place to psychology. The requested observations

would either have to focus upon the anatomical and physiological basis of

the organism or upon the conditions and development of the social milieu.

During his later years Comte paid increasing attention to these sociological

aspects. This tradition was continued by Poincaré and led to the foundation

of the French school of sociology.

In contrast to their British counterparts who like Taylor and Fraser

would insist upon the universal permanence of human traits, French socio-

logists, led by Dürkheim (1912), regarded psychic functions as a product

of social conditions and therefore as variable. Perhaps even more important

than such a sociologization of psychology, sociology became psychologized.

This trend is most clearly expressed in Dürkheim's concept of "collective

images" and "collective mind," both of which are psychological terms

generalized to sociology. Everything social consists of images or is the

product of images. Although these images cannot be reduced to physical

conditions, man exists, at the same time, as a physical being. Thus,

Dürkheim supports a distinct dualism: Man is both an individual physical

and a communal social being. If one were to approach a study of psychology

at all, it would have to consist either of psychophysiology or of psycho-

sociology. The object for sociology, on the other hand, the collective mind,

is independent of the individual and his consciousness.

Dürkheim, together with Mauss (1903), applied this conceptualization to

the study of intellectual functions. Logical categories were seen as origi-

nating from social relations. The concept of space, for example, was derived

from the notion of social territory and forces. Similarly, Halbwachs (1925, 1950) analyzed the social conditions of memory by explaining that in recall we reconstruct past events by connecting them with conditions of the social life. Blondel (1928), finally, combines interpretations of the collective mind with Bergson's idea of an individualistic élan vital. In his analyses of such psychological constructs as volition, affects, and perceptions, he transcends Dürkheim's formulation. Instead of eliminating psychology in favor of biological and, especially, sociological interpretations, he proposes individual psychology as a third approach. For example, the study of perception has to be concerned with collective aspects insofar as it deals with general concepts, such as "book," "table," etc. On the other hand, it has to be concerned with neurophysiological and anatomical conditions, equally general and common to all human beings. But finally, the study of perception also has to be concerned with experiences that are unique for an individual. It is on this last issue that Blondel deviates from Dürkheim's dualistic conception and reintroduces psychology as a third form of exploration.

Blondel's deviation from Dürkheim was criticized by Halbwachs (1929) for failing to recognize sufficiently the formative role of social customs, habits, and concepts. An individual outside of society, Halbwachs maintains, would not be able to function generatively. The discrepancy between these two ways of thinking becomes most apparent in Blondel's analysis of volition. On the one hand, volition originates from biological reflexes, on the other, it represents an act which is distinctly social in nature. Although genetic connection does not exist between these two forms of volition, there exists, in between, an individual will which is psychological in nature and free.

Of course, most people do not develop such a tendency; they are solely directed
by collective volition to which they subject themselves "obediently" and by
their biological drives to which they submit themselves in an equally
"obedient" manner. Only the intellectual "elite" is capable of developing
individual volition.

Blondel's interpretations share basic features with the cultural anthro-
pology of Levy-Brühl (1922) and, although they are nongenetic, they are
similar to the cognitive developmental psychology of the early Piaget (1928).
Levy-Brühl adopts from Dürkheim the concept of the collective images. But
while Dürkheim postulates a "collective subject" as the carrier of these
images, Levy-Brühl rejects such a metaphysical construct. For Levy-Brühl
"collective images," although they are determined by the society, are
conceptions of and located in the individual. Closely in line with Blondel's
distinction, Levy-Brühl investigates different levels of the collective mind.
He is known for his study of the "primitive mind," which he contrasts sharply
with that of modern man without emphasizing--as Dürkheim did--the continuity
in the development of the human race and human consciousness.

In more recent years, these different trends--as convincingly shown by
Leach (1970)--merge into the functionalism of anthropologists like Malinowski
(1926) and the structuralism of Levi-Strauss (1958). It is also at this
juncture that one of Piaget's (1928) early contributions attains significance.
Piaget tries to resolve the conflict between Dürkheim's emphasis of the
continuity in the development of man and Levy-Brühl's emphasis upon qualita-
tive differences by elaborating his famous distinction between functions
and schemata. Functions remain the same throughout the stages of human

evolution and individual development; schemata change, like organs in the

evolution of species, or forms of logical operations in the development

of the individual. In both cases, functions and schemata complement one

another; functions do not exist without schemata and schemata do not exist

without functions.

In his early writings, Piaget (especially 1923, 1924) reveals the

influence of the social psychology of Blondel and the anthropology of Levy-

Brühl. Indeed, he succeeded in fusing the sharp dichotomy created by

Dürkheim between the inner biological and the outer social nature of man.

These were also the years when he contributed his interpretations of the

development of language functions in terms of egocentric and socialized

speech which were rebutted by Vigotsky (1962). In his later writings, Piaget

abandoned his emphasis upon the impact of social conditions, however, and

increasingly focused his attention upon psychic structures and functions.

Thus the antithesis to the viewpoints emerging from the followers of

Vigotsky grew stronger. The latter came to represent the new interpretations

of Soviet psychologists.

Dialectic Psychology

Recent thinking in the Soviet Union about the philosophical foundation

of the behavioral and social sciences seems to follow the viewpoints expressed

by French sociologists. In regarding psychic activities as the joint outcome

of inner biological and outer sociocultural conditions they too reject a

central and independent role for psychology. In contrast to the reductionism

of French sociologists, they do not merely split these conditions apart but

emphasize interactive processes through which psychic activity and consciousness

emerge. Moreover, they consider these interactions in their temporal dependencies and thus provide dialectic interpretations. Similar to Piaget, changes in psychic activities may produce changes in inner biological conditions and these, in turn, may change psychic activities. In contrast to Piaget, however, there exist also active interventions from the outer sociocultural to the psychic conditions and vice versa.

Soviet psychology has its roots in two separate movements: The reflexology of Sechenov, Bechterev and Pavlov and the dialectic materialism of Marx, Engels and Lenin. The first foundation is sufficiently known and does not need to concern us in detail. It is, however, important to emphasize that in contrast to the behaviorists, who mechanistically split the reflex arc into its superficial external components, i.e., the stimulus and the response, Pavlov regarded the reflex as a functional unit. Only an extended conditioning history will enable the organism to separate out the stimulus from the response. In the Soviet conception, at this stage, the response becomes a reaction to the stimulus but, at the same time, the response reflects upon the stimulus. This anti-mechanistic notion became a fundamental ingredient of the Soviet interpretations and is referred to by Rubinstejn as "constitutive relationism." Interestingly enough, the same viewpoints were expressed in one of the founding articles of American functionalism, i.e., in John Dewey's (1896) treatise on the reflex arc, which, often misunderstood, was soon discarded from consideration by American psychologists.

The first foundation of Soviet psychology relates psychic activities to their inner biochemical material basis. The second foundation relates

them to their outer cultural-historical material basis. This conceptualiza-
tion builds upon the historical and dialectical materialism of Marx and
Engels that was injected into Soviet psychology through the posthumous
publication of Lenin's (1929) philosophical notebook. The discussions
emerging after this event elaborated, in particular, two notions, the
dialectic interpretation of opposites and dialectic leaps.

By emphasizing the interaction between psychic and cultural-historical
activities, Soviet psychologists recognized the social dependency of the
former. As psychic activities emerge (and their emergence is, of course,
codetermined by their interaction with biological activities), the social
conditions are being changed as well. Through his own labor--as Marx stated--
man transforms the conditions around him which, in turn, will change him
(or at least, the generations following him). Thus, man creates himself
through his own labor. For instance, by inventing a tool, by generating
unique conceptual or linguistic expressions, man produces a lasting effect
which "backfires" upon him and the following generations of individuals,
who thus, will emerge under changed conditions. At least in regard to its
psychosocial implication, the notion of dialectic interpenetration explains
the superficiality of the thesis that ontogeny recapitulates phylogeny.
Both sequences are bound to coincide because both are the product of human
efforts.

The principle of progression by qualitative leaps is closely related to
that of dialectic interpenetration. It resembles Piaget's description of
cognitive development, though it emphasizes the interaction between psychic

activity and outer, material cultural-historical conditions rather than intra-psychic shifts captured by Piaget's dialectic contrast of assimilation and accommodation. As our previous examples imply, dialectic leaps are brought about by human activity. Thus, the invention of tools, of linguistic expressions, or of language in general, changes dramatically the sociocultural conditions under which human beings are growing up. Inversely, as these sociocultural conditions have come into existence during the history of mankind, they will induce upon the organism stepwise changes, each reflecting basic reorganizations of the oeprations which the individual will be able to perform, e.g., to speak, to write, to formalize, etc.

Our last statements indicate, once more, the intimate connections between functional changes produced by human activities and the structural shifts representing the products of these activities. Thus, our discussion returns to the interpretations advanced by Piaget. The interactive process of shifts is not restricted to the activities of the individual, however, but embraces all other individuals in his social world, nay, all individuals who through their ceaseless efforts over generations have created the cultural-historical conditions under which any present-day descendent grows up and, thus, lives.

During the third and most recent period in the short history of Soviet psychology, a double interaction theory has been proposed by S. L. Rubinstejn (1958, 1963; for English discussions see Payne, 1968; Riegel, 1972a,b; Wozniak, 1972). Rubinstejn's dialectic interpretation deviates from the dichotomizing attempts of French sociologists. He agrees with them, however, in assigning to psychology a secondary role. Both biology and sociology, because of the

material foundations emphasized by Soviet psychologists, rest upon more fundamental bases. Psychology is a construct and could not exist without them.

Of course, these evaluations also indicate an intrinsic strength of psychology. Psychology, more than biology and sociology, is or ought to be concerned with activities rather than with products. This conclusion, once more, returns our attention to the comparison of structure and function. Rubinstejn agrees with Piaget by emphasizing the mutual dependence of both; he disagrees with him (at least with Piaget's writings during the forties and fifties) by emphasizing that the structure-function relationship ought not to be limited to the activities of the separate individual but ought to be extended to the interactions within his cultural-historical world. He disagrees, furthermore, with Piaget by trying to trace the two interactions to their material foundations.

Concluding Remarks

In our last section, Piaget's developmental structuralism was submerged within Rubinstejn's double interaction theory. Such an interpretation seems to handle all those issues proposed in opposition to the traditional mechanistic viewpoints of American psychology, i.e., issues which focus upon the active organism in an active environment. However, in contradiction to their dialectic foundation, Soviet psychologists have emphasized the material bases of psychic processes. Thus, they have emphasized the products rather than the activities that generate them. In concluding our treatise, we will direct our attention to alternative interpretations and review, once more, the trends and options of modern psychology.

Western psychology found one of its most authentic representations in
William Stern's (1935) <u>Psychology on a Personalistic Basis</u> which, appropri-
ately, has been criticized by Vigotsky (1962) as individualistic and
intellectualistic. Stern exemplifies a trend which derives from the British
philosophy of Locke, Hume, and Berkeley (especially the latter) and continues
to dominate Western thinking in the behavioral and social sciences. In
extension it led, as we have seen, to the positivism of Mach, to the
psychologism of Wundt, Helmholz, and Külpe and to the phenomenologism of
Husserl. In spite of their wide differences, all of these scholars built
their interpretations upon sensation and perception as the basis for knowledge.
The world around us came to be regarded as a mere outward projection of the
mind. Psychology became the most fundamental of all sciences.

While for the first group of scholars knowledge was to be gained through
sensory experience and contemplations based upon them, a second school of
thought, associated with the advances in the natural sciences, began to
emphasize the constructive aspects of knowledge. According to Russell and
Carnap, physics and astronomy, for example, represent prototypes of con-
structive sciences whose founding components, unlike psychological sensations,
are not directly accessible to us but are intellectually generated. From
this point of view, knowledge is founded upon the "sentence," in its German
sense of "Satz" and "setzen." Knowledge is gained by proposing sentences
rather than by receiving sensory information in a passive state.

Although related viewpoints were expressed early in psychology--for
example in Brentano's Act-Psychology (1874)--they never attained an apprecia-
tion comparable to those based upon a sensory basis of knowledge. However,

philosophers have paid increasing attention to this issue as revealed in the work of Russell and Carnap as well as in such antiscientific movements as existentialism. More recently, Holzkamp (1972) has interpreted sciences in general, and psychology in particular, as an activity and, therefore, as a movement concerned with and dependent upon social conditions and historical relevance. Most influential, however, is Piaget's (1950) notion of the individual's intellectual development and of the growth of knowledge in society, of genetic epistemology, based upon the premise that progress can only occur through spontaneous, generative activities of the organism.

Finally, science and knowledge represent forms of organization and structure. Again, these organizations may either be seen as existing outside the individual recognizable through sensory experience or as generatively produced by the individual imposed upon the outside world through his interpretations. Regardless of this choice, organizational aspects have received increasing attention through the work of Avenarius, Russell, Carnap, Piaget and, finally, Rubinstejn. Because of the complexity of the structures, these theories have shown a strong tendency toward formalism, at least among the Western scholars. This trend is clearly exemplified in the progression of Piaget's research and theory. He advanced—in terms of his own theory—from an operative to a figurative psychology. His early studies of early developmental periods consist of rich but ambiguous interpretations of children's operations. Next he produced equally rich displays of imaginative, though less than fully standardized, experiments coupled with formal descriptions of the children's logic. In discussing the

highest stage of development, he provides little else than an abstract model

of intellectual operations, essentially a theory on what these operations,

logically, ought to be. Supportive evidence is not supplied and, apparently,

not intended to be supplied. All that such evidence could consist of any-

how would be some superficial demonstrations which are neither sufficient

to confirm the consistency of the theory nor to suggest important extensions.

Piaget's theory ties structuralism to the perceptionism of the earlier

psychologists. Structures are confirmed by observations; structures organize

experience. Soviet psychologists go beyond such a perceptionism and consider

their evidence as originating from the material world outside of the observer.

In contrast to earlier materialistic interpretations, they insist, however,

that these conditions are not independent of the human organism; they are

as much the product of human labor as they are forces impinging upon the

human being. While Soviet psychologists opt for constructive theories,

they abandon these theories all too soon by emphasizing the objectified

material products rather than the activities by which these products are

generated. Piaget, on the other hand, while emphasizing activities rather

than material products, restricts himself to the developing individual under

exclusion of the cultural-historical activities within which the individual

grows.

A synthesizing extension would have to emphasize perception, action, and

organization both in the individual and in the society. By emphasizing the

products, this theory would be structural; by emphasizing the activities, it

would be transformational. This theory would relate psychic activities both

to their inner biological and their outer sociocultural foundations without

exclusive emphasis upon their material nature. These foundations become material if the products and structures are emphasized; they remain psychological if the activities and transformations are emphasized. Development proceeds through dialectic interactions between psychic activities and their inner biological and outer sociocultural foundations. Again, if we look at the objectified conditions, development represents, both for the individual and for the society, a sequence of temporarily stable schemata; if we look at the activities, development represents a constant flux of transformations.

Bibliography

Avenarius, R. Bemerkungen zum Begriff des Gegenstandes der Psychologie.

   Vierteljahresschrift für wissenschaftliche Philosophie und Soziologie,

   1894, 18, 137-161, 400-420; 1895, 19, 1-18.

Blondel, C. Introduction à la psychologie collective. Paris: Colin, 1928.

Bloomfield, L. Language. New York: Holt, 1933.

Boring, E. G. History of experimental psychology, (2nd Ed.). New York:

   Appleton-Century-Crofts, 1957.

Brentano, F. von. Psychologie vom empirischen Standpunkt. Leipzig: Meiner,

   1874.

Carnap, R. Der logische Aufbau der Welt. Hamburg: Meiner, 1928. (Logical

   structure of the world. Berkeley, California: University of California

   Press, 1967.)

Cassirer, E. Substanzbegriff und Funktionsbegriff. Berlin: B. Cassirer,

   1910. (Substance and function and Einstein's theory of relativity.

   Chicago: Open Court Publishing Co., 1923.)

Chomsky, N. Syntactic structures. The Hague: Mouton, 1957.

Chomsky, N. Review of B. F. Skinner's verbal behavior. Language, 1959, 35,

   26-58.

Chomsky, N. Aspects of the theory of syntax. Cambridge, Mass.: MIT Press,

   1965.

Chomsky, N. Language and mind. New York: Harcourt, Brace & World, 1968.

Cohen, D. Time as energy: On the application of modern concepts of time to

   developmental sciences. Unpublished manuscript. Gerontological Center,

   University of Southern California, Los Angeles, 1972.

Coombs, C. H. Theory of data. New York: Wiley, 1964.

Dedekind, R. Was sind und was sollen Zahlen? (II Aufl.). Braunschweig:
Vieweg, 1893.

Dewey, J. The reflex-arc concept in psychology. Psychological Review,
1896, 3, 357-370.

Dürkheim, E. Les formes élémentaires de la vie réligieuse. Paris: Alcan,
1912. (The elementary forms of religious life, a study in religious
sociology. New York: Macmillan, 1915.)

Dürkheim, E., & Mauss, M. De quelques formes primitives de classification.
L'Annés Sociologique, 1903, 6, 1-72.

Ehrenfels, C. von. Über Gestaltqualitäten. Vierteljahresschrift für
wissenschaftliche Philosophie, 1890, 14, 249.

Frege, G. Grundgesetze der Arithmetik. Jena: H. Pohle, 1903. (The basic
laws of arithmetic. Berkeley, Calif.: University of California Press,
1964.)

Halbwachs, M. Les cadres sociaux de la mémoire. Paris: Alcan, 1925.

Halbwachs, M. La psychologie collective d'aprés C. Blondel. Revue
philosophique de la France et de l'étranger, 1929, 54, 444-456.

Halbwachs, M. La mémoire collective. Paris: Presses Universitaires de
France, 1950.

Henle, M. (Ed.) The selected papers of Wolfgang Köhler. New York:
Liveright, 1972.

Hölder, O. Die Axiome der Quantität und die Lehre vom Mass. Berichte der
Sächsischen Gesellschaft der Wissenschaften, Leipzig, mathematische-
physikalische Klasse, 1901, 53, 1-64.

Holzkamp, K. Kritische Psychologie. Frankfurt/M.: Fischer, 1972.

James, W. The principles of psychology. New York: Holt, 1890.

Jesperson, O. Analytic syntax. London: Allen & Unwin, 1937.

Köhler, W. Die physischen Gestalten in Ruhe und im stationären Zustand.

Braunschweig: Vieweg, 1920.

Leach, E. Claude Levi-Strauss. New York: Viking Press, 1970.

Lenin, V. L. Philosophical notebook (Collected Works, Vol. 29). New York:

International Publishers, 1929.

Levy-Brühl, L. La mentalité primitive. Paris: Presses Universitaires de

France, 1922. (Primitive mentality. New York: Macmillan, 1923.)

Lenneberg, E. The biological basis of language. New York: Wiley, 1967.

Levi-Strauss, C. Anthropologie structurale. Paris: Plon, 1958. (Structural

anthropology. New York: Basic Books, 1963.)

Mach, E. Analyse der Empfindungen und des Verhältnis des Psychischen zum

Physischen. Jena: Fischer, 1886. (The analysis of sensations, and

the relation of the physical to the psychical. New York: Dover, 1959.)

Malinowski, B. Myth in primitive psychology. London: Kegan, 1926.

McNeill, D. On theories of language acquisition. In T. R. Dixon & D. L.

Horton (Eds.), Verbal behavior and general behavior theory. New York:

Prentice Hall, 1968. Pp. 406-420.

McNeill, D. The development of language. In P. H. Mussen (Ed.), Carmichael's

manual of child psychology. New York: Wiley, 1970. Pp. 1061-1161.

Payne, T. R. S. L. Rubinstejn and the philosophical foundations of Soviet

psychology. New York: Humanities Press, 1968.

Piaget, J. Le langage et la pensée chez l'enfant. Neuchatel: Delachaux &
Niestlé, 1923. (The language and thought of the child. New York:
Harcourt & Brace, 1926.)

Piaget, J. Le jugement et le raisonnement chez l'enfant. Neuchatel:
Delachaux & Niestlé, 1924. (Judgment and reasoning in the child.
New York: Harcourt & Brace, 1928.)

Piaget, J. Logique génétique et sociologie. Revue philosophique de la
France et de l'etranger, 1928, 53, 167-205.

Piaget, J. Introduction a l'epistemologie genetique. (3 vols.). Paris:
Presses Universitaires de France, 1950.

Piaget, J. Structuralism. New York: Basic Books, 1970.

Poincaré, H. Wissenschaft und Hypothese. Leipzig: Lindemann, 1902.
(Science and Hypothesis. New York: Dover, 1952.)

Riegel, K. F. The language acquisition process: A reinterpretation of
selected research findings. In L. R. Goulet & P. B. Baltes (Eds.),
Life-span developmental psychology: Theory and research. New York:
Academic Press, 1970. Pp. 357-399.

Riegel, K. F. Developmental psychology and society: Some historical and
ethical considerations. In J. R. Nesselroade & H. W. Reese (Eds.),
Life-span developmental psychology: Methodological issues. New York:
Academic Press, 1972 (in press). (a)

Riegel, K. F. The influence of economic and political ideologies upon the
development of developmental psychology. Psychological Bulletin, 1972,
78, 129-144. (b)

Riegel, K. F. Time and change in the development of the individual and
society. In H. W. Reese (Ed.), Advances in child development and
behavior, Vol. 7. New York: Academic Press, 1972 (in press). (c)

Ruckmick, C. A. The use of the term function in English textbooks of
psychology. American Journal of Psychology, 1911, 24, 99-123.

Rubinstejn, S. L. Grundlagen der allgemeinen Psychologie. Berlin: Volk
und Wissen, 1958.

Rubinstejn, S. L. Principien und Wege der Entwicklung der Psychologie.
Berlin: Akademie Verlag, 1963.

Russell, B. The principles of mathematics. Cambridge, England: Cambridge
University Press, 1903.

Stern, W. Allgemeine Psychologie auf personalistischer Grundlage. Den Haag
Nijhoff, 1935. (General psychology from the personalistic standpoint.
New York: Macmillan, 1938.)

Stevens, S. S. Mathematics, measurement, and psychophysics. In S. S. Stevens
(Ed.), Handbook of experimental psychology. New York: Wiley, 1951.
Pp. 1-49.

Titchner, E. B. The postulates of a structural psychology. Philosophical
Review, 1898, 7, 449-465.

Vigotsky, L. S. Thought and language. Cambridge, Mass.: MIT Press, 1962.

Witte, W. Transposition als Schlüsselprinzip. In F. Weinhandl (Ed.),
Gestalthaftes Sehen. Darmstadt: Wissenschaftliche Buchgesellschaft,
1960. Pp. 406-412.

Wozniak, R. H. Verbal regulation of motor behavior: Soviet research and
non-Soviet replication. Human Development, 1972, 15, 13-57.