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ON CLASSIFICATIONS, RANKING AND MEASUREMENTS IN THE SOCIAL SCIENCES

Ephraim Ben-Baruch

This paper examines and compares the three major procedures for distinguishing between objects or phenomena, but focuses mainly on classifications and their uses in the social sciences.

A. Procedures Correspond to Properties

Classifications, rankings, and measurements correspond to three basic types of properties that objects or phenomena may possess[1]. The first type of properties is an "either-or" type, and is labeled as *dichotomous*. Such a trait an object either possesses or does not; the trait cannot be possessed "in degrees". Dichotomies can be binomial, when there are only two possible states for the "either-or" attribute (for example, dead or alive), or *multinomial*, when several such states are possible (such as nationality, color, etc.).

If a trait is established as certainly dichotomous (which is often not easy), whether binomial or multinomial, then measurements and ranking procedures are not applicable to it, at least not in the direct form. "Either-or" attributes are usually handled by classifications.

In order to classify elements of a domain, we need :

— *criteria* for discriminating between the elements regarding the "either-or" traits;

— *observations* on the elements to be classified.

The criteria will determine the classes, which will be "mutually exclusive" (either-or), and the observations will fill them up or leave them empty. An adequate classification is expected to be "jointly

exhaustive" of the domain of elements; that is, every element in the domain should "fit" into some class.

The second type of properties is labeled *variable*. Examples of this type are size, weight, and income. These attributes can be measured through the use of established units of measurement. If the intervals between any two such units of measurement are equal, and if an absolute zero-point exists in the measurement system, then mathematical and statistical tools are fully applicable to the system. When the zero-point is not absolute, but rather an arbitrary one, then some of these tools are only partly applicable. While classifications require criteria, measurements require units of measurement. Classifications end up with classes; measurements end up with cardinal, numerical values assigned to the measured traits.

The third type of properties belongs conceptually between the other two, and is called *serial* or *ordinal*. Serial traits can be graded or ranked, but they do not have an absolute zero-point, nor can the intervals between the grades be certainly established as equal. Serials permit only relative comparisons of one grade to the other in terms like "A is more ..... than B".

Examples of serials are the order of softness of minerals (A is softer than B since B scratches A) and I.Q. scores. In order to rank such properties we need to perform some tests (as compared with establishing criteria or with applying units of measurement) and these tests produce *scales*. However, the scales will not be metric ones, but will only indicate the relative position of each result to the other results. The difference between variables and serials is analogous to the difference between cardinal and ordinal numbers.

When we attempt to express one of these types of properties in terms of the others, we notice that a one-way relationship exists among them : any variable can be presented as a serial and any serial as a dichotomy, but not vice versa.

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Type of Traits	Cichotomies		Serials		Variables
Procedures	Classification	←	Ranking	←	Measurements
Technique Used	Criteria & Observations	←	Tests	←	Units of Measurement
Final Product	Classes	←	Relative (ordi-dal) Values of Attribute	←	Numerical (cardinal) Values of Attribute

Let us examine the classification procedure in more detail.

B. Arbitrariness in Classification

From a logical point of view, classification is an intellectual activity (as compared with measuring, which requires a practical aspect of actually applying the units of measurement) of making distinctions according to two rules : exclusiveness and exhaustiveness. Logically, we can create as many different classifications for a universe of elements as we have criteria for distinguishing among their traits. Which criterion will be chosen, then, for classification and why ? Furthermore, logically speaking, we may create any imaginable classes, regardless of whether observation will assign any elements to them. While we can measure only objectively existing elements, we can classify everything, from concretely existing objects to man-made abstractions. In these senses there is a facet of *arbitrariness* in the process of classification; that is, it is possible to be arbitrary in the activity of creating classes and of choosing the criteria. This arbitrariness is constrained and guided by two factors : theory and practice.

C. Classes as Concepts

How are criteria for classification selected ? Any classification orginates from one or more of our concepts related to the universe of elements to be classified. These concepts are "translated" into operational criteria used to discriminate among the individual elements. A class is, therefore, first of all a concept[2]. Such concepts may be theoretical or practical[3]. One or several attributes of the elements serve as criteria, and the elements possessing these attributes are assigned as members of the class or the classes. The

aspect of arbitrariness is thus shifted to the concepts, whether they are theoretical or practical. In any case, both theory and practice are selective and as such guide classifications (and measurements, as well). What does this selectivity mean ?

Objects have many properties, but we classify them according to one, or several of them, selected as relevant. This means that we disregard, deliberately and temporarily, all their other properties. Since the selection of the relevant traits as criteria for classification is guided by either theory or practice, it is the responsibility of theory or practice to explain and justify why and how criteria are chosen.

Is arbitrariness a weakness for classifications ? Logically, not at all. From a logical point of view all classifications are arbitrary or may be seen as such, since any criterion can be used in an attempt to classify elements of a domain. In practice, as a matter of fact, classifications are seldom, if ever, "wildly" arbitrary.

Churchamn and Ratoosh said that measurements are "decision-making activities" and, as such, should be evaluated in terms of decision-making criteria[4]. "Decision-making activity" means that we do not measure for the sake of measuring. The possible number of variables that could be measured is infinite, yet nobody measures everything all the time. Measurements incur costs. We measure in order to obtain some unknown aspects or properties of the element(s) which, we believe, will help guide our actions or thoughts. "Decision-making" is, thus, perceived not just in the narrow sense of a particular, practical choice, but in the broad sense of guidance in action and thought. What are these "decision-making criteria" for the evaluation of measurements ? Churchman and Ratoosh have not specified them, but they are answers to questions like these :

a) What purpose(s) is a measurement expected to serve ?

b) Is it clear how the results of a measurement will serve the purpose(s) ?

c) What are we measuring and how ? Are we measuring what we intend to ?

d) How precise should the measurement be in order to satisfy the purpose(s) ? How often should we measure ?

e) Are our measuring instruments reliable ? Are the findings valid ?

f) How do we interpret the findings ?

These questions (decision-making criteria) are applicable not only

to the quantitative distinctions called measurements. They are applicable, as well, to the qualitative distinctions named classifications. These are decision-making activities that should be evaluated according to the same decision-making criteria.

D. Why do We Classify ?

At the level of individuals, classifying is an intellectual construct of generalizing that has become a habit. We classify at every step of our day-to-day behavior. The origins of this construct can be traced back to the need for economy of words. No language provides enough words to cover all possible occurrences (such as separate words for each drop of rain) or all possible objects (separate words for each pine tree in the forest). The need to avoid an impossible and, indeed, unnecessary load of words ended up with grouping objects into classes, with words that represent categories. Classifications also serve our inner and external needs for order, which help us to organize and deal with the apparently chaotic world.

At the level of society, we classify in order to meet some needs, perform some tasks, or provide some answers. For example, in the economic and legal realms, we classify persons according to their income for taxation and according to their age for determining who will go to school, who will retire, etc.

At the level of sciences, we classify, again, to discover order and to answer questions that may guide our thoughts and action. Scientific theories are concerned with classifications. Griffiths goes so far as to suggest that :

> In fact, one could probably make a very good argument to support the contention that any science begins with a taxonomy[5].

Theories, as one of the main paths for the advance of science, are expected not only to expand our knowledge, but also to create a more secure basis for our present practice. In Homans' words :

> Any science has two main jobs to do : discovery and explanation. By the first, we judge whether it is a science, by the second — how successful a science it is[6].

If "discovery" is the expansion of our knowledge, "explanation" is the more secure basis for our practice.

In which of these two realms is the main contribution of classifications to the sciences — in discovery or in explanation ? The history of sciences has provided many examples of classificatory-explanatory attempts that have ended up with major discoveries (Mendelev's table of chemical elements) and vice versa (Darwin's theory on the origin of species).

Hempel's requirement for a fruitful scientific classification is :

> The property taken as criterion for classification should be associated, universally or with high statistical probability, with clusters of other properties[7].

This sole requirement does not appear to be elaborated enough. In the context of scientific theories (as distinct from logical contexts not related to theories) a classification could be seen as 1) justified (rather than arbitrary) and 2) scientifically fruitful, if it meets all three of the following conditions :

1) The classification brings some *order* in a universe of elements in a way that
2) contributes to our *knowledge* of the universe, that is, provides for more subtle descriptions, points out more subtle similarities and differences among the elements and their traits, and
3) contributes to our understanding of the phenomena or elements and to our ability to make more valid *generalizations*, based on the attained knowledge; that is, it points out relationships and interactions within the scope of "here and now." On the basis of the generalizations we may attempt to go beyond the "here and now" — to make *extrapolations* and *predictions*.

The first two conditions are implied in Hempel's requirement. Here they are more explicit and stated as links of a chain, one leading to the next. The main difference from Hempel is in the third condition, the contribution to making more valid generalizations and extrapolations. This condition exceeds Hempel's requirement. Why is it necessary ?

It appears that it is possible to bring some order (condition 1) to a universe of elements, and even to describe it (condition 2), without the process being theoretically fruitful. In order to be theoretically fruitful, the condition of generalization is essential. That is, conditions 1 (order) and 2 (knowledge) are necessary but not sufficient conditions for theoretical fruitfulness. The third condition (generalizations) provides the link between a classification and a theory of causal relationships. It makes the order and the information related and meaningful.

In the social sciences, as compared with the natural sciences, it is very difficult to identify *one* property that is universally or with high statistical probability associated with clusters of other properties. Most often no one such property can be identified. Hempel's requirement for satisfactory classification suits the social sciences less well than it suits the natural sciences.

The three conditions suggested here are not only stated with more specification, they are equally applicable to the natural and social sciences.

Elsewhere[8] we examine several attempts to classify organizations. We claim there that the single criterion chosen for each of these classifications meets, at most, conditions 1 and 2 only. Since none of them meets condition 3 they have not been scientifically fruitful.

E. Superior (more precise) and Inferior (less precise) Procedures for Distinguishing Among Attributes

The major recent efforts to increase the predictive ability of the social sciences have been oriented toward the development of more precise and sophsticated statistical techniques and tools; that is, toward measurements. In this trend social sciences have followed the natural sciences for decades. However, according to Kuhn's three stages in the development of sciences, the social sciences are still in the "pre-paradigm" stage, i.e., pre-science[9].

The shift of emphasis to measurements and ordering procedures is felt to be a sign of maturity for the sciences.

> Classification, strictly speaking, is a yes-no, an either-or affair... In scientific research, however, the objects under

> study are often found to resist a tidy pigeon-holing of this kind. More precisely : those characteristics... often cannot well be treated which a given object *either* has *or* lacks; rather, they have the character of traits which are capable of gradation, and which a given object may therefore exhibit *more* or *less* markedly.
>
> Recent typological systems have, in effect, replaced a strictly classificatory procedure by an ordering one... The advantages of orrdering over classification can be considerable. In particular, ordering allows for subtler distinctions than classification; furthermore, ordering may take the special form of a quantitative procedure, in which each dimension is represented by a quantitative characteristic. And quantitative concepts not only allow for a fineness and precision of distinction unparalleled on the levels of classification and of nonquantitative ordering, but also provide a basis for the use of the powerful tools of quantitative mathematics : laws and theories can be expressed in terms of functions connecting several variables, and consequences can be derived from them, for purposes of prediction or of test, by means of mathematical techniques[10].

There is no doubt that this has been a very important trend. We will not ask here why the results have been so poor (still prescience) or whether Kuhn's stages in the development of sciences are less valid for the social sciences. But as a result of the shift toward quantitative techniques in the social sciences, typological efforts have been neglected. Moreover, they have also been degraded. Are, indeed, qualitative, classificatory distinctions inferior to measurements ? An affirmative answer to this question affirms that we assign greater value to variables and lesser value to dichotomies. Why should some of the attributes an object has (the dichotomous ones) be seen as inferior to others of its attributes (the variables). Why should the fact that weight is measurable be sufficient to make one's weight more significant than, say, the color of his eyes ?

Another claim is that measurements are more precise than typologies. But "precision" is a term derived from, and related to, measurements. Since dichotomies are unmeasurable, the term "precision" is not appropriate for use in both cases.

Objects and phenomena possess *all* three types of attributes.

In the social sciences, in education and in the humanities, these objects and phenomena are replete with nonmeasurable traits, with traits that we don't yet know how to measure, and with traits we don't know whether we really measure when we attempt to. In these cases classifications and any other qualitative distinctions cannot be replaced by measurements. Each of the three basic types of traits requires its specific technique and procedure. Discarding information that cannot be measured could be, in some cases, a greater loss than the gain of measuring what can be measured. What we need, therefore, is to fully utilize what each procedure can provide. We need to restore some of the dignity to classification. Moreover, we need, especially in the social sciences, to find ways *to combine* the three procedures; to take advantage of what each can do and compensate for what each cannot do.

F. How do We Classify ?

We have answered the question "why" classify : to meet needs for better order and knowledge, for more valid generalizations and ultimately — predictions. The next question is "how" do we classify ? What do we begin with ? How do we proceed ? Two main, contrasting approaches have offered answers to this question :

The *inductive* (Cartesian) approach claims that we begin with gathering observations. Facts constitute the building stones. Our observations constitute the gathering of the building materials. When an adequate quantity of observations is acquired we analyze what is common and different in the observed elements. From this analysis criteria for classification are set forth and the classification established. If all this makes sense, a theory might be suggested, postulating some laws, principles, and causal relations pertinent to this universe of elements. According to this approach, classifications and theories are constructed from facts as a house is erected of stones. Our imagination and skills give shape, wholeness, and beauty to both.

The inductive approach assumes that this process starts "from scratch"; that is, that our observations are amorphous and unstructured. The activity is an "exploratory" one that requires a fresh approach, or what some have even called an "innocent eye", to the observed universe. Why is it so, or why should it be so ? The rationale given is the need to secure maximum independence from any previous concepts, biases, and beliefs. Hempel says that this

approach characterizes the early, somewhat primitive stages of scientific inquiry, and he calls it "The Natural History Stage" of sciences[11].

The inductive approach is often taken in cases when our inquiry faces a completely new and unknown domain — where we have difficulties importing concepts from other, better known domains or sciences.

The inductive approach is impossible to carry out completely. There are very few domains today so new and unknown that we cannot import to them concepts from other domains.

At the level of individuals, people can go through a purely inductive process, at best, only once in their lives — during the early childhood. After that, all human experience is coined in concepts, i.e. — generalizations. These cannot be simply put aside upon request or at will. They participate actively in all mental processes, including observations and theory construction.

At the level of scientific theories, our concepts interact and influence each other constantly, as they do at the level of individuals. Import and export of scientific concepts from domain to domain is a most common practice.

The *deductive* approach claims that we always begin the process of classification (and of theory construction) with some concepts, with a hypothesis or a set of interrelated hypotheses (a theory). We turn to observations for support, modification or rejection of these hypotheses. Our observations are not at all independent of our concepts; in fact, they are determined by them. We observe from a point of view, for some purpose(s), and all our expectations are shaped by our concepts. All the experience and knowledge coined in our concepts has contributed to the removal of the "innocence" from our eye.

According to the deductive approach, truth is not outside of our minds. We reach it by reasoning, as in mathematics. What we seek by observations, outside of us, is not the truth, but the proof or disproof of what is in our minds.

For this approach the link between a classification and a theory exists from the beginning. This, however, does not imply that the

concepts are tenable, the classification, scientifically fruitful, and the theory, valid. These have yet to be proved.

The deductive approach, as powerful as it appears, has its weak points. It fails to explain, for example, why, at times, we are surprised. Mathematical thought, the paradigm of the deductive approach, perceives new knowledge (say, a new theorem) as actually implied in our previous assumptions and theorems. We prove a new theorem by proper reasoning and use of the known ones. In this sense no theorem is new; it "was" there, if only we had reasoned properly. The deductive approach leaves no place for surprise; but at times, we experience it.

We are surprised when an observed phenomenon does not meet our expectations. These expectations are derived from, or accord to, our concepts, knowledge, and hypotheses. Surprise means that we realize that we might have been wrong at some point. This leads to the need to examine, restructure, or alter our concepts, laws, etc., in order to incorporate the new observation.

Surprise does not necessarily imply an "innocent" eye, but it certainly implies some independence from our concepts. The fact that we are able, at times, to restructure our concepts and knowledge means that our observations are not totally and not always determined by our conceptions. This ability, limited and rare as it may be, is actually the definition of how we learn new things. In the extreme deductive approach, our learning ability is circumscribed by what is already implied in our previous knowledge.

Returning to our specific theme — classifications — the argument against the deductive approach is that if observations are totally determined by our conceptions (that is, why, what, how, when, etc., should be observed) then classifications have no impact on the determining concepts and are of little or no value.

It appears that neither the inductive nor the deductive approaches are acceptable when carried out to their extremes. They both have weak, as well as strong sides. In the philosophy of science this is known as the "paradox of categorization." Scheffler describes it as follows :

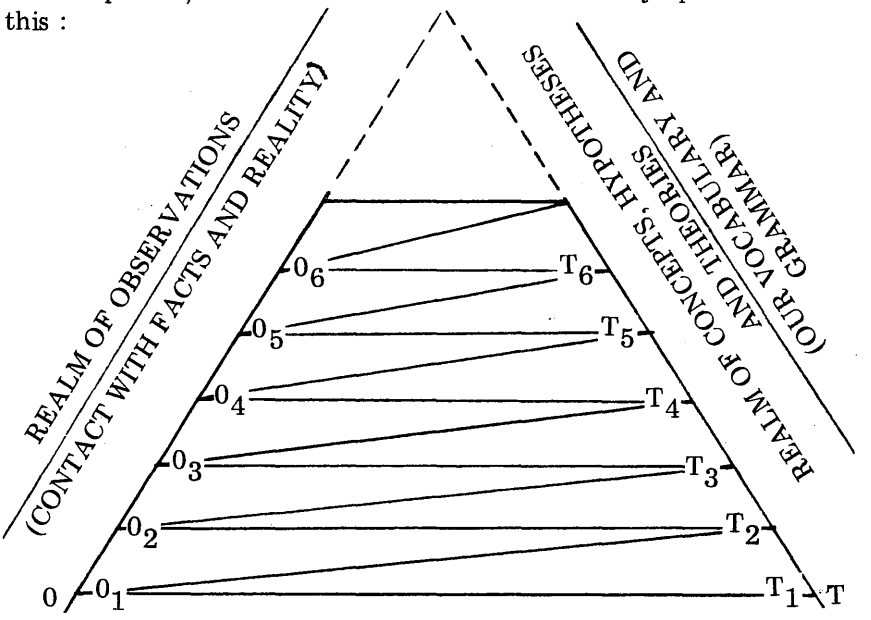
> If my categories of thought determine what I observe, then what I observe provides no independent control over my

> thought. On the other hand, if my categories of thought do not determine what I observe, then what I observe must be uncategorized, that is to say, formless and nondescript — hence again incapable of providing any test of my thought. So in neither case is it possible for observation, be it what it may, to provide any independent control over thought[12].

Scheffler points out that the paradox is an apparent one. "Categories of thought" are, in his words, like "vocabulary and grammar".

> Without a vocabulary and grammar we can describe nothing; having a vocabulary and grammar, our descriptions are not thereby determined[13].

The same logic applies to the controversy between the deductive and the inductive approaches. Moreover, our behavior and ways of thinking and learning are not solely inductive or solely deductive. We use both ways. How is this done ? The explanation, at least as far as classifications are concerned, is as follows : Scientific classifications are a *continuous process of intellectual oscillation between two realms :* one realm is *conceptual* (our vocabulary and grammar, with which we hypothesize, verify, reason, deduce, etc.). The second realm is *practical* (observations, experiments, applications, etc.) In the oscillation, each realm may feed and contribute to the other. Oversimplified, the idea could be schematically presented like this :



Axis O represents our practical, observational activities. Axis T represents our conceptual, theoretical ones.

Note that according to the scheme they are far apart at the beginning (bottom) and come closer as we proceed (top). Also note that there are lower and higher order of observations and conceptualizations, and that some observations are of higher order (say, 0_5) than some lower-order conceptualizations (say, T_2). For example, the observations of a well-trained specialist such as a physician are of a higher order than the conceptualizations of a layman in the same field. The higher we climb on the observational axis, we bring to our observations more of the richness of concepts, theories, etc., from axis T. As this happens (in reality, not always and not in full scale), the distinction between observations and conceptualizations gradually loses significance. Some persons (Einstein ?), at some instances, may reach the point where the two activities cease to be separate.

Scientific classifications start from concepts or hypotheses (axis T) since, as earlier explained, our experience is condensed in them[14]. From the concepts criteria for classes are suggested. Then we oscillate toward observations (axis 0). Although observations are conducted from a certain point of view, our eye is neither totally determined, nor, of course, innocent. Some independence from the concepts exists. If the classification is not working (what that means will be explained in the next section) we might realize that changes in our concepts or hypotheses are needed. The oscillation back to axis T at a higher point represents such changes, which are chosen using the characteristic tools of this realm : reasoning, restructuring, questioning, and negation.

If the constant oscillation between the two realms is also an ascent — that is, an enrichment and sophistication that each realm brings to the other — then we have escaped from the paradoxical controversy between the inductive and the deductive approaches. They are both wrong and right; wrong when seen as an either-or explanation and right when seen as a process of constant oscillation and ascent.

G. Relevant and Crucial Attributes as Criteria for Classification

Classifications are concerned with the common traits of the objects to be grouped in a class. The logic is clear : if they have no

common trait — they do not belong to the same class. Any attempt to select one such common trait as criterion for classification poses problems.

Consider, for instance, that we have chosen the characteristic of "living in the sea" as a criterion and have grouped into a class three elements : a fish, a crab, and a dolphin. For the fish and the crab, the trait "living in the sea" is universally or statistically associated with clusters of their other traits, while for the third element, the dolphin, this is less true. Then, for the needs of this classification we can call "living in the sea" a *crucial* characteristic for the first two elements. For the third element, regarding this classification, it is not a crucial characteristic and we can call it only a *relevant* one. Any attempts to make generalizations and predictions about these three elements based on this characteristic will be more valid for the first two elements and less valid for the third.

The degree of validity of our generalizations appears to be a function of the extent to which the common characteristic chosen as criterion for classification is *crucial* for *all* the objects in the class, that is, is a function of the universal and statistical association of this trait with clusters of others of their traits. Clearly, not every relevant characteristic for a classification will be also a crucial one.

Here we come to a practical basis for distinguishing between justifiable and arbitrary classifications. A justifiable classification is based upon crucial properties of ojbects and thus permits valid generalizations.

But how can we know, in cases in which we do not have data on the universal or statistical association of one trait with others, whether the trait we intend to use is crucial or only relevant ? The answer to this question requires a closer examination of the two terms.

The term "*relevant*" characteristic, as it is used here, has a connotation of relativity. A characteristic is relevant or not according to the point of view adopted. For instance, sex is a relevant characteristic from the points of view of biology or fashion in clothing, but not a relevant one from the point of view of, say, passengers in a train.

The degree of complexity of an organization is a relevant characteristic from some points of view such as flow of information, structure,

etc., but less so or not at all from the point of view of "who benefits" from it. It is meaningless, therefore, to speak of relevant characteristics without first determining the point of view for the classification. Thus, a relevant characteristic serves mainly, or only, a narrowly specified purpose for a classification.

"*Crucial*" characteristics are characteristics that are relevant from many points of view. The extent to which a characteristic crosses the boundaries of many points of view and still appears to be relevant determines the cruciality of that characteristic in the particular setting of those points of view. In other words, the information yielded by a classification that uses such a characteristic is significant for many different purposes[15]. For example, if the *young age* of the students in schools appears as a relevant property in many or most points of view regarding schools as formal organizations, then we may claim that this property is a crucial one[16].

Returning to the question posed earlier : if we do not have enough data on the universal or statistical associations of one property with others, how can we select a property to serve as criterion for a classification ?

The answer is : through the use of many points of view. If, and to the extent that, a characteristic appears relevant from many points of view, this is an indicator for its association with other traits.

The last aspect of how we classify deals with a dilemma that every classification faces, namely, *articilation.* Classes in natural sciences (flora and fauna, for example) are articulated differently from those for socially contrived phenomena such as organizations.

For simplicity a classifier prefers a small number of classes. This can be accomplished by grouping together in each class many elements that may not be so similar. The result is a loss of possible information and the ability to make subtle distinctions, as well as the creation of many borderline cases. Conversely, increasing the number of classes in order to maximize information and distinctions and to eliminate borderline cases leads to simple inventory, which is incompatible with the concept of classification.

This problem is usually solved by introducing additional levels

of classification; that is, by articulation. After the domain is divided into several broad classes (the first level), each class is further divided into other classes (the second level), and so on.

Thus, the appropriate level of specification can be chosen according to the particular needs. For each level, sets of criteria for divisions and subdivisions should be established, and the totality of these criteria and their interrelationships will constitute the theory of the particular classification or taxonomy[17]. The taxonomies in zoology and botany are examples, and they have served as prototypes for many others.

Botanical and zoological taxonomies have a clear hierarchical, pyramidal structure. In zoology, for example, the fundamental taxonomical units are the species, and there are six major levels in the hierarchy :

Phylum
Class
Order
Family
Genus
Species

The number of species is the largest and the number of phyla the smallest.

Thus, a species A can be a subdivision of only one genus, say, B, which can be a subdivision of only one family, say, C, and so on. No species can be a subdivision of two or more genera, and no genus can be a subdivision of two or more families. The chain of subdivisions goes from one level to the next through *a single path.*

This example shows that it may not make sense to use the taxonomical structure found in zoology for the social sciences, because of its single-path chain of divisions and subdivisions. The reasons for this rigid pattern in zoology are evolution and the impossibility of inter-breeding between different species. Organizations have no such parallels. Johnson[18] reached this conclusion after an attempt to derive a taxonomy of organizations that would follow the pattern of zoological taxonomies[19].

Zoological taxonomies are hierarchical structures because of

their articulation, but this does not imply that all taxonomies have to follow one pattern. As the zoological taxonomy fits the nature of its elements (evolution, the impossibility of interbreeding, etc.), so a taxonomy of organizations has to fit the nature of its elements.

H. Major Kinds of Classifications

1) Binomial or Multinomial Dichotomous Classifications

When the number of classes in the first level is two only (such as organic-inorganic materials) the dichotomy is binomial. When the first level of the classification has more than two classes (such as colors, books or nationalities), the dichotomy is multinomial. These could be, and usually are, articulated into several additional levels. The classes are mutually exclusive and jointly exhaustive for the universe of the elements, in most cases.

2) Serial (or Quasi-Dichotomous) Classifications

This type uses not a dichotomous property but rather a serial (or even a variable) one. A serial property x has two poles : least x and most x. If the distance between the poles is divided at one point (say, the average) then we may present the serial as two classes: below and above average; if it is divided at two or more points, we can have several classes in the scale. Such cutting points can be arbitrary, functional, or theoretical.

Often, one representative item in each interval is established as a "standard" (such as in I.Q. scores, or income). Later, for convenience, each class can even be defined in terms of such standards.

This procedure transforms a scale into a linear series of "standards-classes", each of them more X than the previous class. The mutual exclusiveness of the dichotomous classes is replaced here by a particular form of accumulation. That is, an element placed in, say, standard (class) 4 will possess a greater degree of the scaled property than elements in standards 1 to 3, but less than elements placed in standards 5 and higher.

3) Matrix Classifications

While the first two kinds of classifications use *one* property as criterion (whether dichotomous or serial), matrix classifications

use a complex or a matrix of properties[20].

Examples of this kind can be found in the selection of diets for hospitalized patients and the classification of drugs. These are characterized by use of a matrix of interrelated criteria which require simultaneous consideration.

Matrix classification has important and useful features for the classification of organizations. All known attempts to classify organizations use one criterion only (dichtotomous or serial). Elsewhere we attempt to apply matrix classifications to educational organizations.[21]

Matrices do not have to be a very complicated issue in practice. Their final form can be simplified. We often reduce multidimensional scales, or indices, into one-dimensional scales; the cost-of-living index is an example.

Furthermore, why must we think of classification, ordering, and measuring as exclusive procedures ? Why not think of some combined ways of use ? A combined use of them could reduce some of their disadvantages or enhance their advantages[22].

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NOTES

[1] See Hempel, 1939 (1970 ed.); Hempel, 1965; Lazarfeld & Barton, 1951, and others.

[2] In some narrowly practical cases, classifications may appear to stem not from concepts but rather from the criteria. In such cases the concepts beyond are implicit or hidden, but they do exist.

[3] Scheffler, 1960, pp. 19–34, wrote that in some contexts of practice the place of theory is sometimes taken by practical, such as legal maxims which he called "principles of action."

[4] Churchman & Ratoosh, 1962, pp. 83–94.

[5] Griffiths, D., 1959, p. 18.

[6] Homans, G., 1967, p. 7.

[7] Hempel, 1965, pp. 146—147.

[8] Ben-Baruch, E., 1980 (in press).

[9] Kuhn, T.S., 1970.

[10] Hempel, 1965, pp. 151—153.

[11] Hempel, 1965, pp. 139—140; p. 147.

[12] Scheffler, 1967, p. 13.

[13] Scheffler, 1967, p. 38.

[14] It is of paramount importance to make these concepts as explicit and clear as we can, so our experience can be shared and, if needed, replicated.

[15] What is implied here can be expressed by the following three questions :
1) Is it possible to classify objects for *one* very specific purpose ? The answer is a clear YES. Such are most of the practical classifications or the low-order scientific ones.
2) Is it possible to classify objects in such a way that the attained classification will serve *all* anticipated purposes ? The answer seems to be a clear NO.
3) Is it possible to classify so that the classification will serve *many* purposes ? The answer seems to be probably UES, if the criterion selected meets all three conditions for non-arbitrary classification.

[16] Indeed, schools, as formal organizations, are among the very few organizations deliberately designed for young persons.

[17] Classification and taxonomy are frequently used as interchangeable terms. They are not exactly so. They might be described as relating one to the other as the part relates to the whole. That is, a classification undertakes this task for parts of a universe such as, say, a part of the living organisms. For this reason, the logic behind a taxonomy is regularly more vigorous.

[18] Johnson, Norman, 1963 (unpublished doctoral dissertation, Ohio State University); a shorter version of the above is Haas, Hall & Johnson, in Graham and Roberts (eds.), 1972.

[19] Indeed, what is surprising is why one should hope to find such parallels.

[20] This is distinct from one-at-a-time successive classification, such as : first according to sex, then according to age, then according to weight, and so on.

[21] Ben-Baruch, E., "Multidimentional profiles of organizations and

schools" – (unpublished yet paper).

[22]See Lazarsfeld and Barton, 1951, for an example of such use in the field of social organizations.

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