THE PLACE OF ARISTOTELIAN LOGIC IN NON-ARISTOTELIAN EVALUATING: EINSTEIN, KORZYBSKI AND POPPER

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(After hearing Bob Pula's paper yesterday on Korzybski's origins, I realized there was a lot more I had to do on my paper. I had to Polish it.)

There is a subtitle to this paper: EINSTEIN, KORZYBSKI, AND POPPER. But there must be a fourth person in this cast of characters, to act as Devil's Advocate. I start with him: Walter Stuermann, who was Professor of Philosophy at the University of Tulsa, and also an Associate Editor of ETC. In 1962 he laid down a challenge to general semanticists: to reassess our theoretic foundations, particularly our claim to have a non-Aristotelian system. That claim, he said, is an oversimplification; what we need is to go back to formal logic. Hence the title of his article in ETC. was: "Science, Logic, and Sanity."[1]

He did not think that our usual attack on a two-valued orientation should be turned into an argument against a two-valued logic, because he believed that logic is "the indispensable tool by which the meaning and power of a scientific system is brought to bear upon human behavior and the world," a tool which is necessary to join the two aspects of science, the rational and the empirical. By the rational we mean theoretical, high-level abstractions, which have to be expressed in universal propositions, of the type: "For all x, if x is A, then x is B." "For all x, if x is a planet, then x has an elliptical orbit." The important thing about this is that it states something for all x's.

Take an example that philosophers of science seem to feel much more comfortable with: "For all x, if x is a swan, then x is white." Philosophers of science: somehow I get the feeling they wish that scientists would just restrict themselves to white swans and black swans to make the whole philosophy much simpler.

But you might respond that the most advanced science these days is highly mathematical. Even so, the mathematical formulas can be regarded as elaborations of this universal proposition form. For example, we can say "For all x, y, and r, if x and y represent the masses of two bodies, and r represents the distance between their centers, then there is a gravitational force which equals $x \cdot y/r^2$ times a universal constant, G." This may be considered a universal proposition, as saying something about all bodies at all distances. This of course is Newton's gravitational formula. G represents a number which depends on what particular system of units we're using, but it is the same all over the universe: $6.67 \cdot 10^{-11}$ $nt \cdot m^2/kg^2$. (That, by the way, is the only mathematical formula I was able to get into this paper.)

In contrast, the empirical side of science, the observations, the low-level abstractions, have to be expressed in existential propositions, whose form is: "There exists an x such that x is C and x is D." "There exists an x called Mars, such that Mars is a planet and Mars has an elliptical orbit." Or "There exists an x, such that x is a swan and x is white." Now that's quite different from saying "All swans are white." The universal proposition can be refuted or falsified very easily, if you can assert "There exists a swan which is black." (And there does; I've seen black swans.) We have only to see one black swan, and we have refuted the universal proposition. But it's much harder to refute a low-level existential proposition. If we have: "There exists a jabberwock which is white," how do we show that nowhere in the universe there exists a jabberwock which happens to be white? Refuting existential propositions is extremely difficult.

Well, this is the structure of science, according to Walter Stuermann: the universal propositions, the theories, lead to deductions: we can deduce from "All swans are white" that if there exist any swans at all, they have to be white. As soon as someone says "There's a swan," we know it must be white, according to our theory. But the existential propositions are tested against the facts; if we find there exists a swan which is black, then we know there's something wrong with the theory; it is refuted. That's the structure of science, which requires this two-valued logic.

Now Stuermann said that general semanticists' intense concern with phenomenal data, indexing, reports, etc., is a quite proper insistence on the necessity of existential propositions. It is a battle against the universals that are unrelated to existentials, against "abstractions uninformed by phenomenal content," as he put it; or against intension without extension. But it can not be a battle against all universal propositions, and it certainly can not be a battle against all high-level abstractions -- if we undertook that battle, that would quickly reduce this whole meeting to silence. Even the fight against universal propositions, is, according to Stuermann, "a venture in the direction of scientific suicide."

Sometimes we might have to rule out a two-valued logic, as inadequate for certain purposes, because of the "either-or" exclusion of a third possibility. Then we can use a three-valued logic. But if we do that, then we have an excluded fourth possibility. As

Stuermann followed this up, he asked: "Are there non-aristotelian systems, in the sense in which many general semanticists have been asking for them? No; for any n-valued logic will, as an ideal structure, fail to model precisely the phenomenal domain" -- that's an elegant way of putting it -- "and there will always be an excluded (n + 1)th. ... Any adequate scientific system requires the use of some precisely structured formal language in order to make deductions and predictions." Therefore his title, "Science, Logic, and Sanity."

Walter Stuermann died an untimely death three years later, in 1965, without having received any answer to his challenge. I'm taking it up now very belatedly. But this is an appropriate time, because to answer him I have to draw on the work of the two great men whose centennial we're celebrating this year: Albert Einstein, Alfred Korzybski; and the third man, a comparative youngster, Karl Popper, who is still productive at 77.

First, let's consider this idea of existential propositions that express the "facts." Popper puts the matter beautifully, in a paper delivered to the Aristotelian Society in 1946 answering the question: "Why are the Calculi of Logic and Arithmetic applicable to Reality?" What Popper says is:

> "The same philosophers who oppose a naïve realism with regard to things are often naïve realists with regard to facts. While perhaps believing that things are logical constructs (which, I am satisfied, is a mistaken view) they believe that facts are part of the world in a sense similar to that in which processes or things may be said to be part of the world; that the world consists of facts in a sense in which it may be said to consist of (four dimensional) processes or of (three dimensional) things. ... And they sometimes even believe that sentences are something like pictures of facts, or that they are projections of facts. But all this is mistaken ... Facts are something like a common product of language and reality; they are reality pinned down by descriptive statements. They are like abstracts from a book, made in a language which is different from that of the original, and determined not only by the original book but nearly as much by the principles of selection and by other methods of abstracting, and by the means of which the new language disposes. New linguistic means not only help us to describe new kinds of facts; in a way, they even create new kinds of facts.[2]

Now Sir Karl Popper does not think of himself as a non-Aristotelian, but that sounds pretty non-Aristotelian to me. I would say "Welcome aboard!"

I think he would agree with Korzybski that first, we do not see what '<u>is</u>'; we are much more likely to see what we expect to see; and second, our definitions and classifications do not inhere in Nature; we put them there. Let me give a quote from Korzybski at this point: "No 'facts' are ever free from doctrines: so whoever fancies he can free himself from 'doctrines', as expressed in the structure of the language he uses., simply cherishes a delusion, usually with strong affective components."[3]

A so-called 'simple proposition', like "There exists a swan which is white," loses its simplicity when we try to decide whether some large bird should or should not be called a swan, or whether that bird is still white if we hear it trumpeting in a pitch-black cave. Being white is not just a predicate for a swan, but it's a relation between the swan, the light, and our eyes. So let me pronounce what I'll modestly call Mayper's Dictum: "No fact is simple." We live in a complicated world of infinitely interrelated processes, not just existential propositions.

Well, we try to make the world understandable, with our theories, our high-level statements, the universal propositions of logic and mathematics. Bertrand Russell (his centennial was seven years ago), who has certainly done his part to advance these high-level propositions, said at one point: "... the Law of Excluded Middle" (the law that establishes a two-valued logic) "is true when precise symbols are employed, but it is not true when symbols are vague, as, in fact, all symbols are." And a little further on he said: "All traditional logic habitually assumes that precise symbols are being employed. It is therefore not applicable to this terrestrial life, but only to an imagined celestial existence." (Good thought for a Sunday morning.)[4]

Einstein, in his famous essay on "Geometry and Experience," made the pronouncement: "Insofar as the statements of mathematics apply to reality, they are not certain, and insofar as they are certain, they do not apply to reality."[5] Popper echoes these same views in regard to the calculi of logic and arithmetic, in the article I quoted.

And as Korzybski puts it, logical and mathematical deductions -- the way we're going from our universal propositions to existential propositions -- these work perfectly only when, or only <u>because</u>, they have no physical content. Even Stuermann himself said: "Whether the logic is two-valued, three-valued, or n-valued, it will, as an ideal structure, fail to model precisely the complexities of the phenomenal domain." (That beautiful phrase). Incidentally, it is very appropriate to speak here of these n-valued logics, in the Polish Institute, because the Polish logicians are the ones who invented them.

But this fuzziness of logic and mathematics, this uncertainty when dealing with the 'real world', leads me to a conclusion the opposite of Stuermann's. For how can we find sanity in anything but a non-Aristotelian orientation? Only when we are conscious of abstracting, when we recognize that the strongest statements we should make are of this type: "For nigh all x, if x is nigh definitely a planet, then x will have a nigh elliptical orbit," only then can we put our cautiously limited trust in them.

(Now you'll notice my idiosyncratic vocabulary here. I believe that general semanticists, or any people who claim sanity, need to have a short, noticeable word to express the idea: "almost but not quite entirely," a very useful idea, so that we can make strong statements without falling into allness. I am trying to promote the word "nigh" for this purpose. I chose it because although it's archaic in most of its uses, as a contraction of the presently used phrase "well-nigh" -- when we say something is "well-nigh impossible," that doesn't mean it's impossible, it means it's almost but not quite entirely impossible -- it does the job and it does stand out in a sentence.)

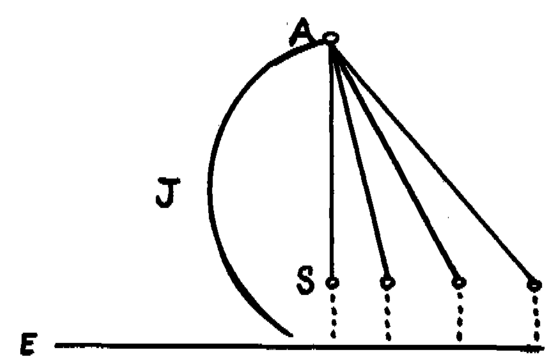
Well, what does this fuzziness do to our scientific structure? Even the strongest statements, as long as they have a "nigh" in them, can not lead to exact deductions. Korzybski was fond of writing about "infinite-valued probability logic," and he offered this as a replacement for a strict two-valued logic. But it has the defect that it can only give us probabilistic conclusions. And the way probability reasoning works, the longer the chain of reasoning the less sure we are of the conclusions. We lose something in every step. If our whole scientific structure has to be this vague and wobbly, what virtue is there in our claims to have a scientific orientation?

There is a place, in non-Aristotelian evaluating, for a strict, two-valued Aristotelian logic. It has a limited role, not the dominating role that Stuermann visualized for it, but it is necessary. Acknowledging this place and using this logic does not keep us from having a non-Aristotelian system, and assuredly we should not give up that claim.

To show this, let me turn to Einstein's model of thinking, as set forth in this summer's issue of the <u>American Scholar</u>, by Professor Gerald Holton of Harvard.[6] Like everyone else here, I am deeply indebted to Charlotte Read. It was she who called my attention to this article. As soon as I read it, I knew that the main work on this present paper had been done; all that remains now is to take Einstein's model and display it suitably surrounded by a lot of words. (That's called putting it in context.)

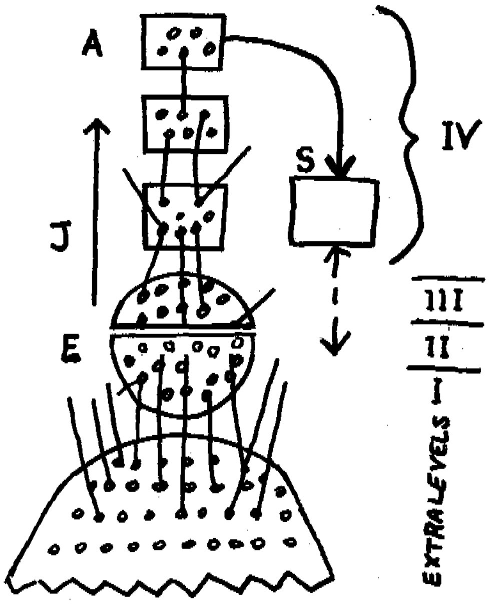
Einstein's clearest exposition of his model comes in a letter he wrote to an old friend, Maurice Solovine, in 1952. This is a model not just of scientific thinking, but of thinking in general. Like Korzybski, Einstein believed that "science is nothing more than a refinement of everyday thinking" -- at least of Korzybski and Einstein's everyday thinking; the kind of everyday thinking that the rest of us <u>should</u> perform, but because of the bondage of our culture and its language structure, usually don't.

Einstein illustrates his model this way: first, a horizontal line labeled E, which represents experience, the world of experience, sense data. Somewhere above this line there begins an ascending curve, which Professor Holton has labeled J, for "jump," that's what Popper would call a "conjecture" -- not a product of logical reasoning, but of the imagination. This leads to a point at a high level, labeled A: our Axioms, our Assumptions, our postulates, the theories which correspond to the high-level universal propositions that Stuermann took to represent the rational aspects of scientific method. From this A point, the axiom system or assumptions, some straight lines come down to a number of Statements marked S, statements which are deductions from the theories; they would correspond to Stuermann's existential propositions. The last step is to relate these S statements to experience, testing the theory that way. The whole process we could sum up as E J A S and back to E.



Now in this scheme, the only place where logical deduction occurs is in this slide from A to S; that's where we have two-valued logic. The formation of the conjecture J is, as I said, not a logical process. Karl Popper has demonstrated very thoroughly that there can be no such thing as a "logic of induction."[7] Philosophers have been arguing about that for a long time, but there is no such thing. The formation of theories must be a work of the creative imagination, an artistic process (for which scientists are honored more than for anything else they do). Yet Einstein, who understood this process as well as any man who ever lived, pointed out that the art-work, the creation of a theory, has to be guided by the logical process that it is hoped will follow from it. One is looking for the universal statements that have the greatest logical power; but the process of arriving at them can not be analyzed by logic.

Note also a subtle point: J begins <u>above</u> the line E. There has to be an <u>abstracting</u> from experience before we can begin to talk, or even think, about it. Einstein recognized that experience is a much more complicated affair than is suggested by the single line E, but he didn't want to get involved here in what lies below it. We might compare this diagram with another view, which represents this overwhelming variety of experience by a parabola, extended out to infinity. And then sense impressions are abstracted from this parabola, and further abstracting leads to language, which can develop into the swoop of J, up to where we arrive at our theories A. We deduce from our theories some more statements S about what we expect to find in the world, and then test them against experience. Korzybski too emphasized the circularity of the abstracting process.



In one of his last papers, Korzybski outlined four levels of the abstracting process.[8] I have suggested that we call these "extralevels," since they are outside of, they encompass, the levels and metalevels of language. Extralevel I comprises the "unspeakable" processes of the world, mostly outside of our skins, the parabola; Extralevel II refers to our initial sensations and responses (taking up about half of this first abstraction level); Extralevel III represents our higher-level organismal reactions, thoughts, feelings, responses to our initial sensations, etc.; and Extralevel IV the language which expresses (but of course is not the same as) the other three. Everything in Einstein's model above the line E refers to this Extralevel IV.

Let us look at the process of comparing S and E. It's not a matter of logic, because E represents experience, observations, data, below the level of statements. Logic only examines language, not things.

The statements S give you expectations of what you will observe, once the experimental conditions are established: that is, what sensations you will have or what numbers you will read from your instruments. You judge whether or not the expectations match the sensations. This is not as two-valued as it sounds, because every observation is subject to error. There has to be agreement beforehand between scientific adversaries on what will be considered an acceptable match, and what will be a definite mis-match; and, what will fall into the doubtful range in between, because some experiments give inconclusive results. Since this prior agreement is necessary, the matching procedure could best be characterized not as objective, but as inter-subjective; something different subjective agreements have to be made to. If there is not agreement, then the observation can be subjected to more analysis. There are no final statements of observations; remember: "No fact is simple."

As Karl Popper put it, the scientific edifice is not built on solid rock, but on a swamp; we put down piles into this swamp until we have a foundation just strong enough to hold up the superstructure, the theory. If it begins to founder, then we have to sink more piles more deeply, but only as much as we have to. We never reach a solid bottom -- there isn't any solid bottom.[9]

The purpose of this matching operation is to test the adequacy of our theory A. The function of logic, then -- here is where we use our two-valued logic -- is not to convey truth from our axioms to our deduced statements, because we never know that our axioms are true, and we never know that we will have a perfect match between our statements and experience. Another quotation from Popper:[10]

> The old scientific ideal of episteme -- of absolutely certain, demonstrable knowledge -- has proved to be an idol. The demand for scientific objectivity makes it inevitable that every scientific statement must remain tentative for ever. It may indeed be corroborated, but every corroboration is relative to other statements which, again, are tentative. Only in our subjective experiences of conviction, in our subjective faith, can we be 'absolutely certain'.

So the function of logic is not to convey truth, but to convey falsity, from S to A. A failure of S to match E, of our statements to match our experience, asserts not-S, which then by standard logical processes implies not-A. If we can assert "There exists a black swan" we are disproving the assumption "All swans are white" -- that's what the logician calls modus tollens, proof by taking away. If we assert "A implies S," and we find not-S then we have to assert not-A. That's the function of logic.

This is Popper's description of scientific theories, and he uses it to demarcate science from metaphysics. A theory which is capable of being disproved -- that is, where there is a conceivable situation where you may not find what the theory is predicting, is a scientific theory. You've heard of Occam's Razor. Well, this distinction of science from metaphysics is known as "Popper's Chopper." Einstein had the same idea; he said "To our experimental tests of theories, Nature answers No or Maybe."

But, if Nature must have a chance to answer No, if the theory A is to be potentially deniable, it must be two-valued, and S must be derived from it by two-valued logic! Because a postulate or an assumption that is couched as a probability cannot be denied, except by a very extensive, comprehensive study of an enormous number of situations. A two-valued postulate, "All swans are white," can be refuted by observing a single black swan. Two-valued predictions are much riskier, and this makes them much better theories. Good theories, according to Popper, are theories which take risks, which run the chance of finding their predictions are wrong. And this makes the testing process much more efficient.

Of course, even when we disprove a theory, we sometimes continue to use it. For instance, Newtonian physics is still very useful for slow speeds, compared to the speed of light, and it still makes up most of every elementary physics course. But as Korzybski said, as a general principle it is now unsatisfactory; it's only a special case of Einsteinian relativity.

So the part played by Aristotelian logic is to convey falsity from our observation statements to our assumptions, our theories; and that is the only part of the cycle where it is of benefit to be two-valued, where we can make the best use of mathematics, which is based on two-valued logic. Everywhere else in the cycle, we have to apply all the non-Aristotelian cautions, use probability inferences, and distrust the ability of our language to, as Stuermann says, "model the phenomenal domain."

Yes, Virginia, there is a non-Aristotelian system. Not all the people who have been immersed in this system have used a general semantics vocabulary. Popper, as I said, denies being a non-Aristotelian; and Einstein, when asked his opinion of Science and Sanity, is reported to have said: "Dot's a crrrazy boook! " But the model of thinking, of a non-Aristotelian nature, is agreed on very substantially by Albert Einstein, the greatest scientist of the century; by Karl Popper, the greatest philosopher of the century (yes, I know this was the century of Russell and Whitehead and Dewey and Heidegger and Husserl and Wittgenstein and Gödel and so on, but I repeat that: Popper's the greatest); and by Korzybski, the greatest system-builder of the century.

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