Seminar 2
The Roots of Logical Positivism and the Early Vienna Circle

In August of 1929, a group of scientifically and mathematically inclined philosophers identified itself as the Vienna Circle in a proclamation dedicated to Moritz Schlick entitled "The Scientific Conception of the World." It was written under the auspices of the Ernst Mach Society by Hans Hahn, Otto Neurath, and Rudolf Carnap. Announcing what it took to be a new, scientifically based conception of philosophy, it ended with a list of the members of the Vienna Circle plus an acknowledgement of three luminaries—Albert Einstein, Bertrand Russell, and Ludwig Wittgenstein – labeled *leading representatives of the scientific world-conception.*

The existence of the circle stemmed from Ernst Mach's tenure as Chair in Philosophy of the Inductive Sciences at the University of Vienna, 1895–1901. His tenure was followed by regular meetings of thinkers who had been influenced by Mach, Duhem, and Poincaré. In 1922, Moritz Schlick was appointed to Mach's old chair. Schlick was a leading epistemologist who sought to interpret Einsteinian physics and draw lessons from it about human knowledge. His early work combined strains of verificationism and scientific realism existing in an uneasy tension with one another. He later evolved into an ardent verificationist under the influence of Carnap's 1928 *Logical Structure of the World,* and his own reading of the *Tractatus.*

The term "positivism" inherited by the circle names an intellectual tradition emphasizing the practical nature of science and its importance in human life. Dating back to the French philosopher Auguste Comte (1798–1857) whose multi-volume work *Positive Philosophy* traces the history of human thought as progressing through three stages—the theological, the metaphysical, and the positive (scientific) stages. The goal of the first two was to attain knowledge of first and final causes of "phenomena" by postulating either agents or forces. Regarding this as fruitless, Comte saw the final scientific sage as giving up

> the vain search for Absolute notions, the origin and destination of the universe, and the causes of phenomena, and applies itself to… their invariable relations of succession and resemblance.

This shift in subject matter—from the unknown and putatively unknowable to the humanly discoverable—is characteristic of positivism. For the positivist, the goal of science is to identify the most encompassing true generalizations about "phenomena" under investigation, as opposed to unearthing hidden, but metaphysically real, causes. Comte's other major idea was that science should be thought of as a single unified inquiry. Although individual sciences may deal with different classes of phenomena, he took their aims and methods to be the discovery of regularities by observation, hypothesis formation, and test. Not having a set of phenomena of its own to study, abstract mathematics was seen not as a special science, but as an essential tool of all sciences. Geometry was the exception for Comte, who viewed it as the abstract study of physical space.

Mach was the most important figure connecting logical positivism to Comte's early positivism. A distinguished physicist and philosopher of science, he was also involved with evolutionary biology, psychology, and psychophysiology. His early criticism of Newton's absolute space and time won praise from Einstein and Max Planck. But his verificationism and anti-realism about unobservable entities, illustrated by his anti-atomism and initial opposition to the kinetic theory of heat, was scorned by Planck. Like Comte, he believed in the unity of science, which was for him an instrument of human advancement.

Just as Comte saw science as studying regularities among "phenomena," Mach saw it as studying "sensations," which in the case of vision were cognitive events or products resulting from light on the retina. This may sound physicalistic, with cognitions conceived as neural events, but physicalism wasn't the whole story, since the retina itself was, for Mach, simply a complex of sensations. Indeed all science, including psychophysiology, was about these cognitive events or products. According to Mach, sensations are the simplest constituents of sense experience—visually experienced color, shape, size, tactilely experienced shape, size, and texture, auditorily experienced sound, motor sensations of effort and force, plus pains, pleasures, and emotions. The properties of these elements always depend at least in part on the experiencer. But for Mach, these elements were intrinsically neither mental nor physical. Instead, they are assigned to these categories only in inquiries that relate them to one another either (i) as constitutive parts of a single stream of consciousness, in which case they are called "sensations" and regarded as psychological, or (ii) as constitutive parts of complexes not all the elements of which need belong to a single stream of consciousness, in which case they are called "physical."

In short, Mach was a neutral monist in the sense explored by Russell in the final chapter of *The Philosophy of Logical Atomism.* His basic elements, out of which reality is constructed, are, like those of Berkeley, cognitive events or products. Unlike Berkeley, he takes these elements to be the building blocks out of which not only the physical world, but also "the self," are constructed. Because Machian elements are experiences that are conceptually prior to the experiencing subject, they are not modifications of an antecedent consciousness, but free-floating cognitions, of which the subject is merely a collection or construction. Psychology studies this construction; physical science studies the construction of physical things out of the very same elements; psychophysiology studies the connection between mind and body. This, for Mach, was the ultimate unity of science.

With an unintended irony all-too common in philosophy, Mach combined his revisionary metaphysics, based on an a priori conception of sense experience, with a professed rejection of all a priori metaphysics not unlike similar professions made two decades later by Russell in defending phenomenalism. Both began by eliminating the supposedly superfluous metaphysical element of hypothesis in our conception of ordinary objects as existing unperceived, and persisting through time and changes in their observable properties. Having done this, they characterized ordinary observable objects as constructions out of sensations. This cleared the way for treating unobserved entities in science as mere constructions as well. Though the logical positivists who succeeded Mach differed from him in many ways, his central themes eventually became theirs, including the unity of science, the centrality of observation, the desire to overcome psychophysical dualism, the temptation of phenomenalism, a tendency toward verificationist anti-realism, the rejection of absolute space and time, and the rejection of geometry as the a priori study of physical space.

By the turn of the twentieth century, two familiar Kantian ideas were under attack—that geometry must be Euclidean and that it is the a priori study of physical space. By then, non-Euclidean geometries had been around for decades, prompting speculation that physical space might itself be non-Euclidean. Frege remained a Kantian about it, exempting geometry from his logicist reduction and regarding Euclidean geometry as the synthetic, a priori truth about experienced space. But many others—including Mach, Hilbert, Poincaré, Duhem, and Schlick—didn't follow suit.

In 1899, David Hilbert demonstrated that formal reasoning in axiomatized geometric theories need not appeal to any intuitive conception of space. Viewed in this way,

geometry is purely abstract and mathematical, whether Euclidean or not, and so has no intrinsic relation to intuitively experienced or physical space. Poincaré agreed, claiming that when a geometry is incorporated into physical theory, its role isn't to represent any aspect of reality, but to facilitate correct empirical predications. The geometry of a theory was a convention for getting from one data point to another. Since there may be alternative conventions that would yield equivalent empirical results, none is uniquely required to achieve scientific truth. Thus, he thought, the proper choice among empirically equivalent alternatives is the one that achieves the greatest theoretical simplification.

In treating hypotheses about the unobservable as conventions, Poincaré likened them to stipulative definitions His contemporary, Pierre Duhem, who shared Poincaré's positivistic conception of scientific theories, had a different view of scientific hypothesis that don't state directly testable facts. Instead of taking them to be definitions, he took them to illustrate the general point that non-observational statements of a theory are never individually falsifiable, because they always require subsidiary hypotheses to generate observational predictions. For Duhem, it was theories, not individual hypotheses, that may be confirmed or disconfirmed by observational evidence. Still, like Poincaré, he divorced geometrical theories from any form of spatial intuition and thought of them as interpretable only via embedding in a physical theory. Hence, they weren't presumed to be either Euclidean or non-Euclidean.

Mach, Poincaré, and Duhem influenced the early Vienna Circle. But the most powerful scientific influence was Einstein, whose theories of special and general relativity relativized Newtonian notions, while also making room for non-Euclidean geometries. One can get an idea of the change he wrought by considering how the temporal simultaneity of two events is established. In daily life we judge nearby events in our visual field to be simultaneous when we see them at the same time—when light coming from one impacts our eyes at the same time as light coming from the other. Since the distances are typically so short in relation to the speed of light, this works well for everyday purposes. But when the distances of the events from each other, and from the observer, are allowed to get arbitrarily great, we need a method for determining the time it takes light to reach our eyes. Einstein's 1905 paper deals with this, modifying our understanding of temporal simultaneity.

The central idea can be illustrated by imagining synchronized clocks present at the sites of two events A and B located at arbitrary distances from each other and from an observer. Each clock starts when its paired event occurs. The clocks are then transported to the observer through different spatial paths at different speeds. If the speed of their transmission through space didn't affect their running, then an observer who knew how far they traveled could simply check their readings when they arrived. If one went twice as far but moved twice as fast, the events would be simultaneous if and only if the clocks registered the same time when they reached the observer. According to relativity theory, however, the clocks' behavior is affected by the speed of their transmission through space. If that sounds incoherent, it is probably because one is thinking of clocks as *metaphysical know-not-what's* that, by definition, track the passage of time, which, by definition, exists independently of any physical phenomenon. But it's not true *a priori* that time *must* be this way. The clocks imagined in the example are physical mechanisms, and so are subject to physical laws. Thus, we can't simply assume that their behavior will be unaffected by the speed they move through space. Relativity theory maintains that their behavior is affected.

Call events at a distance *physically simultaneous*, if there can be no causal connection (e.g., by light from one reaching the other) between them. Einstein shows that

although physical simultaneity is symmetric, it is not transitive. Consider a sequence of events—A, B, C, and D— occurring in that order at point 1, Z be an event occurring at some spatially distant point 2. A ray of light travels from A to Z, with Z later than A, and a ray of light travels from Z to D, with D later than Z. Because the transmission of light is not instantaneous, events B and C, which occur at point 1 after A but before D, can't be connected by rays of light to the occurrence of Z at point 2. (Since B follows A, light from B can reach point 2 only after Z has occurred, and since C precedes D, light from Z can't reach point 1 before D occurs.) Thus there are no physical relations capable of causally connecting Z at point 2 with any events at point 1 after A and before D. So events B and C are both *physically simultaneous* with Z, even though B precedes C. (B is simultaneous with Z and Z is simultaneous with C, but B isn't simultaneous with C.)

If we don't want one event to be simultaneous with two temporally nonoverlapping events, one of which is later than the other, we must adjust our understanding of these relations. We could let the relations *simultaneous with, before,* and *after* be undefined for pairs one of which is Z and the other of which is any event in the temporal interval from A to D at point 1. If we do this, then temporal relations will be physically grounded, but only partially defined. We could also choose a unique event in the range of indeterminacy at point 1 and stipulate that it is to count as the event at point 1 that is simultaneous with Z at point 2. To do this is make the simultaneity relation partially conventional. This seeming disadvantage is offset by the fact that when one considers not a single inertial system but all points in all inertial systems, the simplicity achieved by having a uniform rule is significant. Thus, Einstein offered a conventional synchronization rule for simultaneity at a distance for all relevant pairs of events at a distance.

The chief early influences on the founding figure of the Vienna Circle, Moritz Schlick, were Planck, who supervised Schlick's dissertation in physics, and Einstein, whose theories he interpreted and drew epistemological lessons from. Schlick knew that the spatial and temporal concepts of the new physics were independent both from our ordinary ones, and from those labeled 'intuitive' by Kant. "Intuitions," in the continental philosophy of Schlick's day, referred to conceptually unstructured sensory inputs, which are structured by "pure forms" of spatial and temporal "intuition." Kantians took our constructed "intuitive" space to be both Euclidean and physically real. By contrast, Schlick took real Einsteinian space to be more abstract than either Euclidean or non-Euclidean space. For Schlick the contents of physically real spatial and temporal concepts are holistically determined by their role in physics. We don't grasp those concepts by first grasping "intuitive" concepts that apply to sense experience and then defining the physical concepts in terms of the intuitive ones. Rather, our grasp of the physical concepts is supposed to coincide with our understanding of the total theory in which they play significant parts. Before coming to Vienna, Schlick struggled, not very successfully, to make sense of these ideas.

After he published his book, *The General Structure of Knowledge,* in 1918, Schlick studied Russell's work in logic. Shortly after he took up Mach's old chair in Vienna, he attended a seminar given by Hans Hahn, which introduced him to the tractarian doctrine that logical truths are tautologies that make no claim whatsoever, and so constitute no threat to the idea that all knowledge is empirical. Taking this to be a breakthrough, Schlick and his Vienna colleagues devoted two academic years to analyzing the *Tractatus,* after which they initiated contact with Wittgenstein who, a few years later, spent time with them in Vienna.

The impact of the *Tractatus* on the Vienna Circle was profound. Its verificationist themes -- including its non-cognitive treatment of value and the meaning of life, its

denial that there are meaningful but unanswerable questions, its dismissal of *philosophical* theses as violations of the tractarian criterion of intelligibility, and its reconceptualization of the goal of philosophy as the dissolution of linguistic confusion – reinforced already strong anti-metaphysical tendencies of Schlick and Carnap. However, neither phenomenalism nor the repudiation of scientific realism leap from the pages of the *Tractatus.* Nor are Wittgenstein's metaphysical simples plausible candidates for phenomenal sense data or sense experiences.

Nevertheless, four tractarian doctrines did conspire to help push the logical positivists toward the combination of phenomenalistic verificationism with scientific anti-realism:

(i) All epistemic and metaphysical modalities are ultimately logical modalities.

(ii) Since all meaningful sentences are truth functions of atomic sentences, the truth values of all meaningful sentences are settled by the truth values of atomic sentences.

(iii) An atomic sentence S is true (false) iff the objects $o_1 \ldots o_n$ designated by its names stand (don't stand) in the relation R in which they are represented as standing by the linguistic relation in which the names in S stand to one another. This will be so iff there is (isn't) an atomic fact consisting of $o_1 \ldots o_n$ standing in R. Hence to know that S is true (false) is to know that $o_1 \ldots o_n$ stand (don't stand) in R.

(iv) Reality is the totality of atomic facts.

Imagine yourself in Schlick's shoes confronted with these doctrines. For you, physical space-time points plus objects occupying them and events occurring there, are not tractarian metaphysical simples but "constructions." These are the entities over which physics quantifies. When quantification is treated truth-functionally, as in the *Tractatus,* you (Schlick) are willing to take all statements of *physics* to be truth functions of what seem to be atomic statements about physical objects, events, and space-time points. But the *Tractatus* has convinced you that the process of analysis doesn't stop there. The properties and relations predicated of objects, events, and space-time points by the pseudo-atomic statements of physics are conceptually interdependent and holistically understood. Because these statements bear conceptual relations to one another, they are not independent in the way atomic statements are required (by the *Tractatus)* to be. Real atomic statements must be epistemically and metaphysically independent if relations of logical dependency are to replace conceptual relations of epistemic or metaphysical dependency (as dictated by (i)).

For this replacement to occur, all pseudo-atomic statements of physical theory must be understood to be truth functions (in the tractarian sense) of genuine atomic statements, the truth or falsity of which are independent of each other. Once this level is reached, one can determine the truth of each atomic statement independently of assumptions about any other statements. When atomic statements are thought of in this way, it is natural to think of their subject matter as nothing more than the momentary sense impressions of an agent whose apprehension of the sense data named by the constituents of an atomic statement is simultaneously the verification of that statement and the agent's understanding of it. Consider a use of *This is P* where 'this' designates a momentary sense datum d and 'P' is replaced by a predicate expressing a phenomenal property about which one cannot be mistaken. One can't apprehend the statement until d is perceived, at which point one will immediately know whether it is true or false, without having to rely on any assumptions about other atomic statements. With this Schlick's journey from his earlier reconstruction of Einsteinian physics to phenomenalistic anti-scientific realism

was complete.

There is no doubt that his reading of the *Tractatus* played a central role in Schlick's transformation. Another member of the Vienna Circle, Viktor Kraft, explain this conception of the relationship between meaning and phenomenalist epistemology.

> Definitions are ultimately reducible to ostension of what is designated. One can point only at something which is immediately given, and thus only at what is perceivable. In this way, what assertions can possibly mean is tied to experience. No meaning can be given to that which is not reducible to experience.
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> Wittgenstein identified [atomic propositions] with the propositions he called "elementary propositions." They are propositions which can be immediately compared with reality, i.e. with the data of experience. Such propositions must exist, for otherwise language would be unrelated to reality. All propositions which are not themselves elementary propositions are necessarily truth functions of elementary propositions. Hence all empirical propositions must be reducible to propositions about the given.

Carnap's *Aufbau*

The *Aufbau* tries to show that it is possible to construct a system that unites all scientific knowledge in a reductive framework in which all scientific concepts are defined from a small base of primitive concepts, and all claims expressing scientific knowledge are translated into claims involving only logical concepts plus the primitives. The required Carnapian definitions pair each formula containing an expression to be defined with an *extensionally equivalent* formula in which the expression doesn't occur. Because only extensional equivalence is required, significant conceptual revision may result. This raises questions. (i) Is there reason to think that our scientific knowledge can be so revised, explicated, and unified? (ii) Does the fact that we have scientific knowledge of some domains guarantee that theories expressing that knowledge must be reducible to theories of a single domain? (iii) If a theory of one domain is reducible in Carnap's sense to a theory of an underlying domain, does that show that can know the former by knowing the latter?

The *Aufbau* claims that reductions of all scientific knowledge to knowledge of three different physical bases is possible. Each requires one to "construct" everyday physical objects, human bodies, brains, and neurological events out of physically fundamental entities such as electrons or 4-dimensional space-time points. A fourth possible reduction is added in the preface (written in 1961) to the second edition. It envisions reducing all scientific knowledge to knowledge of everyday physical objects bearing observable properties and standing in observable relations to one another. To deal with the relationship between the psychological and the physical, it is necessary to establish correlations between (a) neural events and (b) thoughts, feelings, sensations, and the like, with the goal of correlating every type of psychological event or state with a corresponding type of neurological event. This is supposed to it make it possible to formulate a true universally quantified biconditional that "defines" each psychological type in terms of a neurological type, which, in turn allows one to replace all psychological language with physical language, thereby completing the reduction of the psychological to the physical. A further reduction of the cultural to the psychological is envisioned.

Although Carnap asserts the possibility of the physicalistic reductions in the *Aufbau,* they don't play a large role in the work. They are mentioned in order to shed light on the reduction he is most concerned with, which is phenomenalistic. Two types of psychological reduction are said to be theoretically possible. One starts from an *autopsychological* base, the elements of which are undifferentiated experiences of a

single subject. These are short, temporally extended cross sections of experience that may involve individual sensory modes—vision, touch, hearing, etc.—or any combination of them. The only primitive concept applying to these experiences is *recollected similarity.* Carnap uses this relation to extract phenomenal concepts whose extensions are classes of experiences known as "the given," which are seen as providing the basis for constructing a series of increasingly sophisticated definitions resulting in definitions of all objects of our knowledge.

The other envisioned phenomenalistic reduction is "the general psychological reduction." It too starts from undifferentiated experiences, only this time the base includes experiences of all subjects. In both reductions the physical is to be reduced to the psychological, but *in the autopsychological reduction human brains and bodies other than one's own are first "defined" in terms of the experiences of what will turn out to be the single subject that one is.* After that, experiences of other subjects, and then those subjects themselves, will be defined in terms of brains and bodies. The remainder of the physical is then supposed to be reduced to the psychological. No matter which form of psychological reduction is chosen, Carnap took it to be possible to translate statements about physical objects into statements about psychological objects, and ultimately into statements about undifferentiated experiences standing in relation to one another.

Why does Carnap think that his incredible autopsychological reduction is possible?

> Statements about physical objects can be transformed into statements about perceptions (i.e., about psychological objects). For example, the statement that a certain body is red is transformed into a very complicated statement which says roughly that, under certain circumstances, a certain sensation of the visual sense ("red") occurs. Statements about physical objects which are not immediately about sensory qualities can be reduced to statements that are. *If a physical object were irreducible to sensory qualities and thus to psychological objects, this would mean that there are no perceptible indicators for it. Statements about it would be suspended in the void; in science at least there would be no room for it.* Thus all physical objects are reducible to psychological ones. (Section 57)

Carnap thought the physical must be reducible to the psychological because if it weren't, we wouldn't have knowledge of the physical we do have. He thought we recognize and come to know physical things by recognizing and coming to know about our sense experience.

> It turns out that psychological processes of other subjects can be recognized only through the mediation of physical objects…[*T]he recognition of our own psychological processes does not need to be mediated through the recognition of physical objects, but takes place directly.* Thus, in order to arrange psychological and physical objects in the constructional system according to their *epistemic* relation, we have to split the domain of psychological objects into two parts: we separate the heteropsychological objects from the autopsychological objects. The auto-psychological objects are *epistemically primary* to the physical objects [i.e., the latter are recognized and known by recognizing and knowing the former], while the heteropsychological objects are secondary…Thus the sequence with respect to epistemic primacy…is: the autopsychological, the physical, the heteropsychological, and the cultural. [Section 58]

Carnap appears to believe that our evidence for claims about physical objects is, or results from, our knowledge of our own mental states, while our evidence for claims about the psychological states of others is, or results from, our knowledge of certain physical things. So, he thinks, knowledge of one's own mental states provides all one's evidence for any knowledge one has of propositions about the world. Suppose this is right. Then consider the possibility that there are no true, universally generalized biconditionals connecting formulas about one's sensory experiences with physical-object formulas one ordinarily takes oneself to know on the basis of those experiences. Without

such universal generalizations, Carnap would, I suspect, conclude that physical-object statements previously thought to be known would, in fact, not be known—either because they would be false (even if the statements expressing our sensory evidence for them were true) or they would be true but insufficiently supported by evidence. So, he would argue, without exceptionless correlations between the psychological and the physical, one wouldn't know statements one in fact does know. They would, as he vividly puts it, "be suspended in a void." Since we do know the relevant physical-object statements, reducibility must be possible.

This justification is unconvincing. Think of the vast range of potential knowledge to be covered by any proposed "reduction" of the physical to the psychological. If the aim is to "unify science," then the statements to be "reduced" to statements about one's own sense experiences must include those of theoretical physics, including those reporting the behavior of what we take to be the most fundamental physical objects—subatomic particles, say—throughout the universe. Surely it is impossible to reduce all these statements to statements about one's own sense experiences; the reductive base of sense experience is too meager.

What, then, explains Carnap's seemingly unquestioning confidence in reducibility? To answer this question, one must understand that in addition to the psychological reductions, Carnap was equally convinced that physicalist reductions must be possible, and that they are all *metaphysically neutral*, and in fact have the same content. Here are sample passages.

> We now have to decide whether our system form requires a construction of the psychological objects from the physical objects or vice versa. Because of their mutual reducibility, it is logically possible to do either. (p. 93)

> If it is not required that the order of construction reflect the epistemic order of objects, other systems are also possible…Since all cultural objects are reducible to psychological, and all psychological to physical objects, the basis of the system can be placed within the domain of physical objects. Such a system form could be called *materialistic*…However, it is important to separate clearly the logico-constructional aspect of the theory from its metaphysical aspect. From the logical viewpoint of construction theory, no objection can be made against scientific materialism. Its claim, namely, that all psychological (and other) objects are reducible to physical objects is justified. Construction theory and, more generally, (rational) science neither maintain nor deny the additional claim of metaphysical materialism that all psychological processes are essentially physical, and that nothing but the physical exists. The expressions "essence" and "exists" (as they are used here) have no place in the constructional system. (pp.94-95)

> The realistic language, which the empirical sciences generally use, and the constructional language have actually *the same meaning*: they are both neutral as far as the decision of the metaphysical problem of reality between realism and idealism is concerned…Let us emphasize again the neutrality especially of the constructional language. This language is not intended to express any of the so-called epistemological, but in reality metaphysical, doctrines (e.g. realism, idealism, solipsism) but only epistemic-logical relations. In the same sense, the expression "quasi object" [Carnap's term for objects defined in constructional systems] designates only a certain logical relationship and is not meant as the denial of metaphysical reality. It must be noted that all real objects (and constructional theory considers them as real to the same degree as do the empirical sciences) are quasi objects…*Once realistic and constructional languages are recognized as nothing but two different languages which express the same state of affairs, several, perhaps even most, epistemological disputes become pointless* (pp. 86-87)

The main points are (i) that various ways of unifying science by reducing all objectively knowable statements to different conceptual bases are possible, (ii) that the systems resulting from the different reductions are equally correct because they *stand for*

the same states of affairs and so *have the same* empirical (non-metaphysical) meaning, (iii) that the choice of a particular reduction for unifying science involves no metaphysical commitments, and (iv) that traditional metaphysical disputes such as realism or idealism are pointless, and may be empirically meaningless. For this way of thinking about Carnap's constructional systems to make sense, we need an external benchmark -- *standing for the same states of affairs* or *having the same empirical meaning* -- against which to test each system. Unfortunately, Carnap doesn't explain what this amounts to.

One could do so by taking the evidential base for objective empirical knowledge to consist of all possible sense experiences of human subjects. Presumably doing so would require using a notion of *possible experience* that goes beyond experience that can't *logically* be ruled out, and also beyond experience that can't be ruled out by *a priori* reasoning alone. What is needed are experiences human subjects are capable of having, perhaps those that are, as some today might say, metaphysically possible for us to have. This is not a notion Carnap recognized, but it may be one he needed.

Next, we identify the meaning, or knowable empirical content, of a unification of science expressed by a constructional system with the class of possible sense experiences of any and all agents with which it is compatible. On this interpretation, the *Aufbau* implicitly endorses a phenomenalistic version of holistic verificationism. According to this view, it is scientific systems as wholes that have empirical meaning or content. Consequently, two systems with different primitive bases employing their own "definitions" of Carnapian "quasi-objects" have the same content, and so express the same potential human knowledge, if and only if they fit the same possible sensory experience. In calling the objects posited by a theory "quasi objects," Carnap signals that reductions to different primitive bases generated by theory-internal definitions don't result in different philosophical ontologies. To think otherwise is to misunderstand the relationship between the theory and the reality it describes. Non-observational statements of a theory do not directly stand for any elements of reality; they merely contribute to the empirical content of the theory as a whole, which is the totality of its predictions about possible sense experience. Although Carnap doesn't explicitly acknowledge this way of looking at things, it provides him with what he needs.

A different version of holistic verificationism is possible in which the meaning or empirical content of a particular unification of science is given by the intersubjectively observable events predicted by the unified constructional system as a whole. What Carnap required for the metaphysical neutrality of his different imagined constructions was a common denominator involving observational predictions needed to assess them. He did, when writing the *Aufbau*, think of perception and observation phenomenalistically, but he didn't have to. Any notion of observation, would do, provided that it could be utilized no matter which reductive base—autopsychological, heteropsychological, or physicalistic—was chosen. In principle, either the possible sensory experiences of arbitrary human agents or the physical events observable by possible human beings could play this role.

Next we consider Carnapian definitions, which, he thought, were required to connect non-observational claims with observational claims. The Carnap of the Aufbau seemed to think of theories along the lines of a certain restricted version of the hypothetical-deductive model. On this conception, theoretical statements not containing observational vocabulary, sometimes together with observational statements, make observational predictions by logically entailing further observational statements. If these statements are true, the theory is partially confirmed; if they are false it is disconfirmed. When one thinks of theory and evidence this way, in terms of *logical* consequence, *definitions* of

the non-observational vocabulary in terms of the observational vocabulary—which could be thought of as conventions that don't themselves require verification—may seem to be mandatory, if the theory is to make any predictions, and so have any empirical content. Since Carnap had no doubt that science does make many testable predictions, he had no doubt when he wrote the *Aufbau* that definitions of the sort he took to be required must be possible.

In later years he realized that there is no need for the connection between theoretical hypotheses and observational predictions to be so tightly constrained. The non-observational parts of a theory must be connected with the observational parts, but the connection need not be made by definitions. For the theory to logically entail observational consequences it is sufficient that it contain universally quantified conditionals (rather than biconditionals) the antecedents of which contain theoretical vocabulary and the consequents of which contain observational vocabulary. Not having the epistemic status of definitions that replace one set of concepts with another, these bridge principles are just more theory—auxiliary hypotheses needed to endow the more abstract parts of the theory with empirical content.

This is what Carnap was talking about in his 1961 preface to the second edition.

> One of the most important changes [from the 1928 view] is the realization that the reduction of higher order concepts to lower level ones cannot always take the form of explicit definitions… The positivist thesis of reducibility of thing concepts to autopsychological concepts remains valid, but the assertion that the former can be defined in terms of the latter must now be given up and hence also the assertion that all statements about things can be translated into statements about sense data. Analogous considerations hold for the physicalist thesis of reducibility of scientific concepts to thing concepts and the reducibility of heteropsychological concepts to thing concepts… [In 1956] I considered a method which was already used in science…namely the introduction of "theoretical concepts" through theoretical postulates and correspondence rules… The correspondence rules connect the theoretical terms with observational terms. Thus the theoretical terms are interpreted, but this interpretation is always incomplete. Herein lies the essential difference between theoretical terms and explicitly defined terms. The concepts of theoretical physics and other advanced sciences are best envisioned in this way. At present I am inclined to think that the same holds true of all concepts referring to heteropsychological objects whether they occur in scientific psychology or in daily life.

Finally, we need to understand the significance Carnap attached to the autopsychological reduction. First, he took it to explain how each individual's knowledge -- not only of theoretically foundational physical objects, but also of non-fundamental physical objects, other persons, and their sense experience -- is grounded in the individual's own sense experience. *To say that it is grounded is not to say that the content of the autopsychological construction of science is restricted to the individual's own sense experience*. As with all constructions, the content of the autopsychological system of science is the set of observable predictions it makes—either about possible sense experience of human agents or about intersubjectively observable physical events. Crucially, however, *Carnap thought that the extent to which any individual does know this content is the extent to which the individual's own sense experience justifies believing those observational truths.*

Second, Carnap saw the autopsychological reduction as providing a way of abstracting general content—graspable by any agent—from the private, idiosyncratic, sensory content of an individual agent. *It is this abstracted content that is needed when characterizing the contents of all Carnapian reductions either in terms of possible sensory experience or in terms of intersubjectively observable events*. Carnap thought that objective knowledge shared by different agents cannot include phenomenal contents

of any particular sense experiences. His strategy was to eliminate reference to such particularized contents by identifying the place particular types of sense experience occupy in the sensory systems common to human beings—visual, auditory, tactile, etc.

For example, when I have a phenomenally red sense datum, I have a visual experience that stands in various abstract relationships to other visual experiences of mine, and to my experiences arising from other sense modalities as well. Call a visual experience that stands in these relationships to my other experiences one of my R-experiences. Recognizing the impossibility of comparing my phenomenally red sense datum with anyone else's sense datum, Carnap plausibly maintained that there is no such thing as objective—i.e., sharable—knowledge of phenomenal content. But he did seem to think that different agents could have R-experiences. It was sensory experience in this sense—with specific phenomenal contents abstracted away—that he took to be capable of being intersubjectively known, and thus to provide the ultimate contents of all human knowledge. This abstraction is one of his chief concerns in setting out the framework for the autopsychological reduction.