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The Integration of knowledge Thesis: Ontological Rationale

1- The Integrative Turn In Western Academia

“The 21st-century is a radically new era, unprecedented in human geo-history, marked by deep and complexly interrelated global crises: ecological, economic, political, moral, and existential, to name but some of pertinence. These complex problems or crises present extraordinary dangers and pitfalls, as well as great opportunities and potentials. Due to their profound interdependencies and feedback loops, these complex and intractable crises can best be understood as a singular socio-ecological crisis, or what we call the metacrisis. Clearly, this metacrisis is the most complex and urgent challenge of the 21st-century. It is a ubiquitous, real-world phenomenon, whose unprecedented complexity profoundly transcends the boundaries of our traditional academic disciplines and specialized research methodologies….

- *…Indeed, the metacrisis is a complex, multifaceted totality which is far more complex than can adequately be addressed by piecemeal, mono-disciplinary approaches and methodologically restricted research programs. Such approaches fail to account for all its facets and their dynamic, non-linear interrelationships and are therefore incapable of providing adequate holistic accounts of the metacrisis" (Hedlond et al- On The Deep need for Integrative Theory for The 21st Century-2015).*

- Comprehensive and sophisticated *integrative* frameworks are needed for three main reasons:

1- Complex 21st-century problems and the metacrisis at large demand frameworks that go beyond the proliferating fragmentation of knowledge and ‘grasp the big-picture’; that is, support us to effectively account for the intricate multidimensionality and dynamism of the metacrisis, foster coordination and integration across disciplinary boundaries and knowledge domains, and ultimately help generate transformative praxis that can optimize the conditions for planetary flourishing.

2- Integrative metatheory can serve a crucial emancipatory function by helping us to identify the real causes of social pathology, oppression, and alienation.

3- To resolve the metacrisis we need to expand the purview of our vision and imagination to develop ideas about what human beings are capable of and what are the conditions for their universal free flourishing; and metatheory is well placed to assist with this by articulating an integrated descriptive, normative, and aesthetic vision of a concrete utopian, eudaimonic world and a coherent program for global transformation in the coming decades. Without such a vision we cannot even ‘see’ what kind of planetary society is possible.

Ontological Rationale-Biraima

- The “metacrisis” is not just a poly-crisis in the sense that it is multifaceted or there are many interconnected objective or “exterior” crises or wicked problems occurring (e.g., political, economic, and ecological). These interconnected crises are also situated in a(n) (inter)subjective context of “interior” meaning making (semiosis), construal and response that includes philosophical, scientific, religious, existential, worldview, and psychospiritual dimensions that are essential to include in an adequate understanding of the complex dynamics in play in order to facilitate more effective responses. In other words, what distinguishes the metacrisis from the poly-crisis is that, while the latter highlights that there are many different crises occurring simultaneously and recognizes that many of these are interconnected, the former goes a step further and uses integrative metatheoretical frameworks and distinctions to reveal the subjective as well as objective, semiotic as well as “material”, “interior” as well as “exterior” dynamics in play.

- Whereas poly refers to ‘many’ crises and their objective interconnection, meta refers in addition to their higher-order unity as a complex totality or singularity that includes human construals and interventions and the possibility of a more adequate metaview that grasps real future possibilities. Meta implies an overarching unity or identity that holds and operates on the differences in their subjective as well as objective complexity. The notion of the metacrisis thus challenges the idea of an exclusively technological set of solutions to our global challenges. Because, in a context of generalized (power-over) relations both construals and responses will be contested, resolution of the metacrisis will involve among other things ‘*hermeneutic* hegemonic/counter-hegemonic struggles’.

- Metatheory is needed inter alia to orient and support the coordination of these struggles globally. Its metaview offers an integrated perspective of the human subject in relation to the world. Without it, we can’t even ‘see’ the poly-crisis, let alone construe it adequately or relate to it effectively; with it, new realities and leverage points for impact are highlighted. Metatheories have co-evolved or co-emerged with the metacrisis. On the one hand the metacrisis demands and in part drives the emergence of integrative metatheory. On the other hand integrative metatheories allow one to see and engage the metacrisis in its full holistic complexity. They thus present us with unprecedented opportunities for helping to effect a transition to a new sustainable form of life. They can help empower us to make it through the collective rite of passage that the metacrisis necessitates.

- The world itself seems to be demanding transformation to new intellectual formations and structures of consciousness that can support new modes of praxis and engagement, apt for our contemporary context. Such formations can not only avert biocatastrophe but also actualize the world’s evolutionary potentials and profound opportunities for human development and spiritual maturation on the way to the emergence of a freely flourishing Earth community.

- Integrative metatheory can contribute to a ‘lifeworld transformation’ wherein illusory modes of thinking and acting are shed and a deeper understanding of who we are as a species and our place in the field of nature is cultivated. The way we understand ourselves in the world powerfully informs how we relate to and shape the world in and through the activities that reproduce or transform our social structures. That is, metatheories tend to undergird our collective modes of thought and vision around which we organize our societies. Metatheories can be viewed as the formalized intellectual expression and rationalization and/or reconstruction of larger cultural worldviews that are in resonance with social structures.

- While there are some countervailing trends, much of the contemporary academy remains hypnotized by either the hyper-analytic, hyperspecialized, fragmented gaze of late modernity, or the sliding scale of postmodern relativism and its antipathy to integrated knowledge and meta-level understanding. Together these two orientations offer inadequate understanding(s) of our many complex problems and their root causes, let alone the socio-ecological crisis at large. Without being able to adequately illumine such root causes, the academy remains largely impotent to address and help transform them. This point is underscored by the fact that, to date, the dominant metatheories of modernity, such as positivism, have not only failed to alter fundamental trajectories of human-induced ecological degradation but are in fact deeply implicated as underlying causal forces contributing to such trends, as has been widely argued by philosophers and social theorists alike.

- There are many important approaches that have contributed to the integration of knowledge in the face of widespread disciplinary and methodological fragmentation emerging across the planet. These include inter-, multi-, cross- trans, and mixed methods approaches. These integrative approaches are being developed within a single discipline or knowledge domain, or between a limited selection of them. A much smaller number of approaches attempt to “include” or encompass in some sense all the general domains of human knowledge—from the arts and humanities to the social and natural sciences. These are the ‘heavyweight’ integrative metatheories of our time: the philosophy of critical realism, founded by Roy Bhaskar (1944-2014), and its cognate social theory; integral theory founded by Ken Wilber (1949-); and complex thought, founded by Edgar Morin (1921-). They represent some of the most advanced expressions of macro-level integrated knowledge that encompasses, and/or articulates an orienting metatheory for, all domains of human inquiry.

- Integrative metatheory as represented by “Critical Realism”; “Integral Theory” and “Complex Thought” can be defined as a form of big-picture or integrative theory grounded in the following criteria or principles: methodological transparency and judgemental rationalism, epistemic reflexivity and relativity, ontological realism and comprehensiveness, and integrative pluralism. Methodological transparency refers to the reflexive disclosure of the methodology and methods (or injunctions) from which knowledge claims are derived. Thus, metatheory adheres to a procedural rationality or methodological transparency that is open to ongoing rigorous assessment or criticism in terms of clearly defined validity criteria. Moreover, it sustains the possibility of judgemental rationalism, which will in general depend on ethical reflexivity and responsibility, in the context of the actuality of epistemic relativity and the necessity of ontological realism.

- In addition, metatheory engages a robust epistemically reflexive inquiry in relation to the assumptions and salient epistemic structures of the research—a kind of researching the researcher- so as to both situate one's knowledge claims therein and potentially mitigate problems of inter-individual variability and subjective bias. Both methodological transparency and epistemic reflexivity enrich the dialogical process connected to the final stage of the research process—that of social validation. Given our epistemic fallibility as embodied personalities engaged in epistemically relative inquiries, one function of such practices is to enhance the peer-review process surrounding the relative validity, utility, strengths, and limitations of the knowledge claims of a given researcher.

- Ontological realism is the critical realist view that the object of inquiry is existentially intransitive in relation to the investigator and relatively or absolutely intransitive causally. Ontological comprehensiveness refers to the inclusion of all key dimensions, planes or contours of reality known to humans —including real generative mechanisms and structures in the subjective, social, and natural domains—in the purview of one's metatheorizing. This does not necessarily mean that one is integrating theory from all of these domains per se, but rather that all these domains are considered and one's metatheorizing situated within this context.

- Finally, metatheory is an expression of integrative pluralism, as opposed to an integrative monism. Integrative pluralism has two dimensions, epistemological (emphasized by integral theory) and ontological (highlighted by critical realism). In regard of the problem of theoretical pluralism (for example, in the social sciences), the monistic approach attempts to assert a singular, totalizing, abstract, and universal overarching theory that does not account either for competing perspectives or the real depth and diversity of the world. In contrast, integrative pluralism in its epistemological mode retains an appreciation for the multiplicity of perspectives while also developing new knowledge that connects their definitive elements to build more expansive, ‘roomier’ metatheoretical frameworks.

2- The Integrative Turn in General Ontology

- The epistemological questions such as “how we provide scientific knowledge” should not be prioritized over the investigations into the (transcendentally) necessary conditions of science. It is the ontological question of “what the world must be like for science to be possible” that should be dwelt on. We should not confuse “what is” with “how we know,”. Idealists and empiricists reduce the reality to our ideas and perceptions.

- All theoretical positions are dependent upon particular assumptions about **ontology** (theory of being: what is the world made of? What objects do we study?), **epistemology** (theory of knowledge: how do we come to have knowledge of the world?), and **methodology** (theory of methods: what methods do we use to unearth data and evidence?).

- Ontology does not have as its subject matter a world apart from that investigated by science. In as much as investigators in all branches of science are delving into the *composition*, *properties* and *change* of the *furniture of the world* ontology should become a *conceptual science* firmly grounded in and derived from current scientific knowledge about reality.

- What’s involved here is the essential distinction between the *intransitive* (the object of scientific knowledge) and *transitive* (fallible scientific knowledge) dimensions of knowledge proposed by critical realists. the distinction between *intransitive* and *transitive* dimension of science implies that the world should not be conflated with our experience of it. Only on the basis of such a realist point of view can there be room for factual error, that is, discrepancy between idea and fact.

- *Ontology* itself should be kept distinct from the nature of the reality under investigation, because the latter is intransitive, while the specific ontological theories put forward by investigators are transitive. The term ontology refers to the *study* or *theory* of being, not to being itself. To have an ontology is to have a *theory* of what exists.

2.1- Integrative Scientific Ontology (IT & CT)

- I take the scientific ontology of Mario Bunge as representative of the integrative ontology of the two metatheories of Integral Theory (IT) and Complex Thought (CT).
- Mario Bunge defines ontology as *"the branch of philosophy that studies the most pervasive features of reality, such as real existence, change, time, causation, chance, life, mind, and society."* His views on ontology may be summarized as follows:

1. Ontology can be classed into "*general*" ontology and "*special*" ontology; the former studies all existents, and the latter addresses a certain genus of thing or process such as those in physics, chemistry, biology and society.

2. It follows that "*general*" ontology probes into the concepts of time, space and event, and *social ontology* (as a special ontology) studies such general sociological concepts as *social system*, *social change*, *social relations* and *social structure*.
3. There are three approaches to the study of ontology: *Speculative ontology*, which may contain insights but is remote from scientific knowledge. *Exact ontology* draws explicit support from formal tools, but may neglect the philosophical tradition or contemporary scientific knowledge and thus become nothing short of applied logic. *Scientific ontology*, by contrast, is both exact and congruous with science. Logical or mathematical in form, it learns from formal and factual sciences, fixes unresolved problems, and poses new ones.

4. The significance of ontology lies in the facts that:

(a) all scientific research has to proceed by dint of some ontological hypotheses (e.g. “the world exists independently of the researcher”), and ontology can both facilitate and hinder interesting research questions and designs;

(b) every *world view* and *ideology* is a combination of ontological and value systems. Therefore, after the advent of modern science, *scientific ontology* becomes all the more important: science only makes nonscientific ontology obsolete.

5. Ontological statements, like scientific ones, are fallible. Ontological and scientific questions differ only in scope.
6. Formal sciences (logic, mathematics and semantics) study conceptual objects such as set and category, while factual sciences (natural and social science) and ontology deal with concrete objects. Therefore, ontology cannot be built merely on logic, since logic does not describe, represent or explain any factual items. However, any robust and exact ontology presupposes logic: deductive logic and pure mathematics are ontologically neutral, and hence instrumental in building ontological theories.

7. Scientific ontology deals only with the *real world* in light of the findings of science.

8. Scientific ontology has to start with the concepts of *things* and their *properties*. Furthermore, to be in line with contemporary science, it should regard concrete things as changeable (i.e. material or having energy).

9. The main objectives of scientific ontology are to analyze and to systematize the ontological categories and hypotheses germane to science, and to clarify whatever idea science takes for granted or leaves in the twilight.

10. The two major families of ontology are *materialism* and *idealism*. Further distinctions can be made and primary among them is the distinction between the *static* and *dynamic* ontologies. The static ontology is characterized by the belief that change is only a momentary departure from equilibrium or harmony, which would be the ideal state of affairs. By contrast, the central thesis of the dynamical ontology is that stasis is a particular and ephemeral case of process: that every state of a thing is either the initial, intermediary or final phase of a process. All factual sciences focus attention on change or the laws/trends of change.

11. Like extremely general scientific theories, ontological theories cannot be tested directly, but should be tested through the checking of more special theories gotten from the general ones by conjoining them with subsidiary assumptions.

- On the basis of the above ontological principles Bunge established a comprehensive, cogent and robust ontological system, which he called "***systemism***".

❖ *General Characteristics of Bunge`s Ontological System*

1. *Exact*: every concept used is exact or exactifiable;
2. *Systematic*: hypotheses or definitions belong to hypothetico-deductive systems;
3. *Scientific*: hypotheses are consistent with contemporary science;
4. *Materialist*: every entity is material (concrete), and every ideal object is ultimately a process in some brain or a class of brain processes;
5. *Dynamicist*: every entity undergoes changes;

6. *Systemist***:** every entity is a system or a component of one or more systems;

7. *Emergentist*: every system possesses (emergent) properties that its components lack;

8. *Evolutionist*: every emergence is a stage in some evolutionary process.

- Bunge's ontology is centered around "things" and "systems" rather than events, processes or facts. Such a system is science-oriented, not only compatible with but conducive to the development of contemporary science.

- When philosophers and social scientists choose facts, events or processes as their research objects, they tend to neglect that every fact involves some *concrete* or *material* thing in that the fact is the state or change of state of something. *Static* facts are things in a given state, while *kinetic* facts are changes of state of things. Swift changes can be called *events*; if prolonged, we may refer to them as *processes*. In other words, facts do not exist independently of things.

- Bunge identifies *materiality* with *concreteness*. All things are material and thus concrete, and they may be imperceptible like an electron or biosphere, or tangible like a stone or a plant. He insists that there are no *properties* in themselves, because every concrete or substantial property, such as moving, reacting, or remembering, is the property of some thing or other—bodies, reactants, brains ...et cetera. One of the tasks of science is thus to *identify* and *interrelate* the properties that things possess, as well as the patterns of the associations and changes of these properties.

- The distinction between *things* and *facts* are *analytical* rather than *ontological*, because there are neither states nor changes of state in themselves. Nor are there things that fail to be in some state or other, or that undergo no changes. It follows the question is not to choose between *ontology of facts* and *ontology of things*. Instead, it is necessary for any careful researcher to *combine* these two ontologies into one single *ontology of things involved in facts* or *of facts involving things*.

- As regards scientific research, the adoption of a thing-based ontology implies that the analysis of any fact should start by identifying the thing(s) involved, such as reagents in the case of a chemical reaction, and brains in that of a mental process.

- Every object is either a material, concrete thing, or a conceptual construct, and none is both. *Therefore the three tenets of Bunge`s emergentist materialism are:*

(1) the world is exclusively constituted by concrete/material things;

(2) conceptual (abstract) objects, such as diagrams, hypotheses or theories, do not exist independently of the brain(s) that figure them out;

(3) *emergentist materialism* is not to be confused with physicalism or vulgar materialism, since it leaves sufficient room for supra-physical things—characterized by emergent properties—such as organisms and social groups.

- All things undergo changes. Bunge adopts a broad concept of matter, pointing out that *x is material* is tantamount to *x has energy* and *x is changeable*. In other words, “change is universal … Mutability is the one property shared by all concrete things, whether natural or artificial, physical or chemical, biological or social, perceptible or imperceptible”. Shorter: *to be (material) is to become*. In contrast, *conceptual (abstract) objects* do not possess energy, undergoing no changes. What changes are not conceptual objects, but the material processes in the brain.

- When things interact intensively in a specific way, they *combine* into *novel systems*, namely, complex things structured in a definite (though not immutable) fashion. By contrast, *simple associations* (e.g. the formation of a sand pile or the coalescence of droplets) are not characterized by specific structures, but by a low degree of cohesiveness or lack of strong bonds, and thus may break up relatively more easily owing to internal rearrangement or external forces.

- Complex combinations result in systems with *emergent properties* that are absent from its components. For example, a proton and an electron combine to yield a hydrogen atom; two hydrogen atoms combine to form a hydrogen molecule, and so on. These combined systems differ from mere aggregates (associations) in at least three respects:

  (1) the original items alter in the process, so that they are precursors rather than constituents of the whole;

  (2) combinations … are more stable … because they are more cohesive;

  (3) combinations take more energy, longer time, or rarer circumstances, as the case may be.

- Formally, *a system is a complex object whose parts or components are held together by bonds of some kind*. These bonds are logical in the case of a conceptual system, such as a theory; and they are material in the case of a concrete system, such as an atom, cell, immune system, family, or hospital. The collection of all such relations among a system's constituents is its structure (or organization, or architecture).
- Depending on the system's constituents and the bonds among them, a concrete or *material system* may belong in either of the following levels: *physical*, *chemical*, *biological*, *social*, and *technological*. The *semiotic systems*, such as *texts* and *diagrams*, are *hybrid*, for they are composed of material signs or signals, some of which convey *semantic meanings* to their potential users. *Mechanisms* are involved in the communication of such systems.

- Such an ontological system, which can be called *emergentist systemism*, rests on the following postulates:

1. Every object, whether material or conceptual, is either a system or an actual or potential component of one;

2. Every system, except the universe, is a *subsystem* of some other system;

3. Every system has *systemic (emergent) properties* that its components lack;

4. All things at each level are composed of things belonging to lower levels;

5. Every problem ought to be approached in a systemic (rather than sectoral) fashion;

6. Every idea ought to be put together into systems, preferably theories.

- The *ultimate goal of theoretical research*, be it in philosophy, science, or mathematics, is the *construction of systems*, i.e. theories … because the world itself is systemic, because no idea can become fully clear unless it is embedded in some system or other.

- *Events* and *processes* are what happens in, to, or among *concrete systems*, while the process or processes that *make a concrete system tick* could be termed a *mechanism*. Consequently, to place systems theory on a firmer ontological footing, it is necessary to address a number of crucial aspects of a *System worldview*, such as the *components* of a system and *their interactions*, the *level structure* of reality, *emergence*, *mechanisms*, and so on.

The Level Structure of the World

- In any given system (molecule, organism, family, school, factory, etc.), at least two levels can be discerned: the *macro* and the *micro*:

  The macro-level is the kind itself, that is, the collection of all the systems sharing certain peculiar properties. The corresponding micro-level is the collection of all the components of the systems in question. There may be more than one micro-level.

- For example, the atomic level is the collection of all atoms, while the molecular level is that of all molecules. Generally speaking, *an n-th level system is composed of things on level n-1*. The individuals may be the components of several types of systems, such as the family, school, or firm. And the individuals are in turn composed of subsystems like the central nervous system.

- It is of crucial importance to recognize that all *factual sciences* are confronted with the problem of *micro-macro linkage*, because all of them study systems, and *all systems under investigation have components (the micro-aspect) as well as systemic, emergent properties (the macro-aspect)*- see Fig. 1.
- Equally important is that *levels are collections of things*, and hence are concepts, not concrete things. Therefore, levels cannot act upon one another. In particular, the expression '*micro-macro interaction*' … does not denote an interaction between micro and macro levels but an interaction between entities belonging to a micro-level and things belonging to a macro-level.

Fig-1 Self-organization of Material Systems

- An ontological hypothesis involved in and encouraged by modern science is that *reality, such as known to us today, is not a solid homogeneous block but is divided into several levels, or sectors, each characterized by a set of properties and laws of its own …*

- A second, related presupposition is that *the higher levels are rooted in the lower ones*, both *diachronically* and *synchronically*: that is, the higher levels are not *autonomous* but depend for their existence on the subsistence of the lower levels, and *they have emerged in the course of time from the lower in a number of evolutionary processes*. This rooting of the higher is the objective basis of the possibility of partially explaining the higher in terms of the lower or conversely.

- One lesson to be learned from all this is that, while the various sciences do occupy different levels, they form part of a single connected structure. The unity of that structure is cemented by the relations among the parts. A science at a given level encompasses the laws of a less fundamental science at a level above. But the latter, being more special, requires further information in addition to the laws of the former. At each level there are laws to be discovered, important in their own right. The enterprise of science involves investigating those laws at all levels, while also working, from the top down and from the bottom up, to build staircases between them.

- ***Bunge Views on Levels***

  1. The world can be construed as a level structure. That is, things group into levels of organization. Every real (material) existent belongs to at least one level of that structure. At least five qualitatively different levels of entity may be distinguished: *physical*, *chemical*, *biological*, *social and technical*. Every level may in turn be subdivided into as many sublevels as needed. For example, the *biological level* may be split into at least seven sublevels: *cell*, *organ*, *organ system*, *multicellular organism*, *biopopulation*, *ecosystem*, *and biosphere*.

2. A level is a *collection of things* sharing a cluster of properties and relations among one another. In other words, it should be kept in mind that levels are *concepts* instead of concrete things.

3. Every concrete thing (system) on any given level is composed of lower level things (systems), and is characterized by emergent properties absent from these components.

4. The systems on every level have emerged in the course of some *process of assembly* of lower-level entities.

5. All processes of assembly are accompanied by the *emergence* of novel properties and the *submergence* of others. For example; the social level is composed of humans but is not an organism itself.

6. The process of assembly can happen either spontaneously (naturally, such as biological and cultural evolution) or artificially (man-made or man-guided, such as that in a laboratory). *Such a process is one of self-organization if and only if the resulting system is composed of subsystems that are not in existence before the very process* (e.g. the formation of an embryo's organs).

7. Every level, both of the world and of science, has autonomy and stability to some degree.

8. The level structure of the world is far from being static but changes over time, tending to become more complex.

- The above ontological description of levels has the following epistemological and methodological implications:

1. Begin by studying the class of facts that concern us on their own level(s), and introduce further levels as required.

2. Do not skip levels.

3. When investigating inter-level relations, do not ignore the intermediate levels and sublevels, if any.

4. Try to explain emergence while acknowledging the ontological novelty at every level. Reduction is desirable and fruitful in scientific research, but reduction does not imply levelling: it relates levels instead of denying that they exist. Reduction, then, is a theoretical question that does not alter the level structure of the world.

5. Try to investigate the *genealogy* of emergent higher levels, since material emergence is emergence from precursors.

6. Try to integrate all the fields of knowledge that study the same objects.

- The following should be considered in substantive research:
  1. How individuals interact (micro-micro);
  2. How they combine to form systems with emergent properties (micro-macro);
  3. How (being part of) a system influences the individual component (macro-micro);
  4. How systems interact and affect one another (macro-macro);
  5. How individuals affect the system, which in turn exerts influences on the individuals (micro-macro-micro);
  6. What the impacts the system has on individuals, the resultant actions of which in turn bear on the system itself (macro-micro-macro).

2.2- Integrative Philosophical Ontology (Critical Realism)

- What follows is a brief summary of the ontological position of Critical Realism expounded by Holland, D. (2014) as a rationale for "Integrating Knowledge Through Interdisciplinary Research".
- For most of the twentieth century, mainstream philosophy of science – in its positivist and interpretivist guises – had been concerned largely with questions of epistemology. However, the accumulation of intellectual anomalies and antinomies arising from the development of orthodox positivist philosophy, principally those relating to the monistic account of scientific development and the deductivist theory of scientific structure, paved the way for a fundamental reorientation of the philosophy of science, from questions about how knowledge is possible to questions about what must be the case for particular forms of knowledge to be possible.

❖ *Critical realism* posits a range of assumptions, some of the most important of which are:

1- *in the realm of ontology: transcendental realism*, standing in contrast to the empirical realism and actualism presupposed by both positivism and interpretivism and allied to a qualified, *critical naturalism*, which overcomes the basic split between a naturalistic positivism and an anti-naturalistic interpretivism;

2- *in the realm of epistemology*: *judgmental rationalism*, presupposing *epistemic relativism* and entailing *epistemic fallibilism*, in place of the judgmental relativism of the interpretivist tradition and tendencies towards fundamentalism, reductionism, monism and endism characteristic of positivism and interpretivism alike; and,

3- *in the realm of methodology*, *methodological unity-in-diversity*, replacing the scientism, monism and naturalism associated with the positivist tradition, and the historicism, relativism and anti-naturalism associated with the interpretivist tradition.

- Critical realists argue that reality has an "*ontological depth*" that can be understood as three overlapping domains, which reflect the vertical dimension, or *stratification*, of reality. The domain of the '*real*' embraces the *structures* and *mechanisms* that generate actual events and states of affairs, which we may experience in different ways and which we may not experience at all. The domain of the '*actual*', which embraces the events and states of affairs we may or may not experience, is therefore a *subset* of the '*real*', and the domain of the '*empirical*', which embraces what we do experience is therefore a *subset* of the '*actual*'. But, in addition to the vertical dimension of reality, there is also an equally important *horizontal* dimension.

- The nature of some *structures* and *mechanisms* may be such that they can be isolated from their structural context by means of *scientific experimentation*. Activating the mechanism in a *closed system* will generate a regular pattern of events that will be the *empirical ground* for the identification of the mechanism as a real object. However, in the absence of human intervention in the causal order of nature, events and states of affairs will be generated by a multiplicity of different mechanisms (physical, chemical, biological, social, etc.) in what is known as an '*open system*', so that the effect of the operation of one mechanism may not be manifest as an *empirical regularity* if, say, its operation is counteracted by the effects of the operation of another mechanism.

- The possibility of differentiating between *open* and *closed* systems, therefore, presupposes the second feature of ontological depth – the *trans-factuality* of generative objects – that is, their existence independent of any particular sequence or pattern of events detected empirically. It follows that *causal laws* refer not to patterns of events detected at the level of the *empirical* but to the operation of structures and mechanisms at the level of the *real* and that these must be analyzed, not as *regularities* but as *tendencies.*

- Thus we can make sense of the human intervention in nature required to produce a constant conjunction of events and state of affairs only if we assume that there is both vertical and horizontal ontological depth. Because the constant conjunction we produce is the empirical ground for the existence of a structure we have not produced, if we take constant conjunctions as given, as positivists do, we inevitably commit ourselves to the absurdity that, in scientific experiments, we are producing, rather than discovering, the laws of nature and, furthermore, we become unable to explain how we manage to apply our knowledge of nature in technological achievements.

- Similarly, if we are to make sense of the possibility of social practices, we must assume that society also has both vertical and horizontal depth. social structures and casual mechanisms are the pre-existing and necessary conditions for the exercise of human agency but they exist only by virtue of human agency (which both reproduces and transforms them). Indeed, scientific inquiry (of which laboratory experimentation is but one aspect) is no different from any other social practice in this respect, for the production of knowledge would simply be impossible in the absence of a pre-existing social context.

- The interpretivist tradition, in assuming that social reality is entirely a construction of thought and discourse, once again denies the possibility of ontological depth and becomes embroiled in judgemental relativism. In other words, the interpretivist tradition denies the existence of a realm of social objects, which have causal powers and liabilities which are *real* and of which we can have fallible knowledge *through* thought and discourse. The interpretivist tradition, then, in presupposing an ontology of empirical (and conceptual) realism, is unable to make sense of scientific – indeed, more generally, social – conflict, just as the positivist tradition is unable to do.

- The possibility of scientific conflict, which presupposes the possibility of intellectual error, points to the third feature of ontological depth: *intransitivity*. Critical realists argue that we need to distinguish clearly between the intransitive domain of science (which encompasses the objects of inquiry) and the transitive domain (which encompasses our knowledge of those objects); for, only if we see thought as contained within, yet emergent and so distinct from, being can we make sense of the possibility of changing knowledge of an unchanging reality, and so of reconciling epistemic relativism and fallibilism with judgemental rationalism (that is, rationally comparing rival theories).

- But, in collapsing the distinction between thought and being, positivism and interpretivism entail a series of related philosophical mistakes: the *empirical fallacy*, or the reduction of events and states of affairs to our experiences of them, which contains within it the *actualist fallacy* or the reduction of causal laws to constant conjunctions of events and states of affairs and which implies that statements about being can be reduced to statements about our knowledge of being – that is, the *epistemic fallacy*. The epistemic and actualist fallacies, in turn, presuppose and are presupposed by the *ontic fallacy* or the reduction of knowledge to natural, which implies that our knowledge of being can be reduced to being alone.

- But, if what exists is equivalent to what we can know, not only must knowledge determine being but being must also determine knowledge. Hence, we can speak of the *epistemic–ontic fallacy*, which in the social domain also entails the *linguistic fallacy* or the reduction of being to our discourse about being and which is underpinned by a more fundamental error, the *anthropic fallacy* or the reduction of being to *human* being.

- In turn, these errors support and are supported by a range of additional, more specific, errors. Thus, in assuming that scientific inquiry is limited to the passive recording of naturally occurring atomistic events and states of affairs, we are effectively assuming that knowledge is accumulated gradually; that is, that science is monistic in its development, that it has certain foundations (in sensory experience) and that it is absolute (since there is nothing more to do than record a scientific fact accurately). In other words, in treating facts as things, we reify, naturalize and eternalize science and turn it into an asocial (and atheoretical) process.

3- The Ontological Rationale for Integrating Knowledge

- Methodological diversity and similarity in science implies ontological diversity and similarity. Clearly, then, we need to develop an ontological framework that can show that it is by virtue of the similarities of the properties of different objects of inquiry that the integration of knowledge from specialized sciences is possible and that it is by virtue of the differences in the properties of similar objects that specialized modes of inquiry are possible. Critical realism offers such a framework; that the concepts of vertical and horizontal ontological depth and the concepts of stratification (through emergence) and trans-factuality (through differentiation) deriving from them can justify scientific differentiation and integration.

- *Stratification of reality*: From the practical successes of science that the logic of scientific discovery is characteristically open ended, in the sense that it involves a continual backwards movement in which structures and causal mechanisms lying at successively deeper layers or strata of reality are discovered. Hence, once one set of objects lying at one level of reality has been identified and shown to explain objects lying at a higher level, it in turn becomes something to be explained at a lower level. An example of this process is the ‘historical development of chemistry’, which has involved the discovery of structures and causal mechanisms lying at progressively lower levels of reality.

- However, social entities are an exception in the sense that they are both ontologically higher than what they presuppose – that is, human agency –*and* epistemologically higher, because knowledge of social forms can come about only through the prior conceptualization of human agency.

- *How exactly, then, are the strata of reality related?* Critical realists argue that, if one stratum is to explain another stratum without explaining it away, each stratum must be rooted in, emergent from, and so irreducible to and unpredictable from, the one below it. Let us consider this idea in more detail because it is the concept of *emergence* that gives us a way of understanding how *levels of reality* may be both *differentiated* and *interconnected* and hence how the *sciences* may be both *differentiated* and *interconnected*.

- The concept of *emergence* is inherently *compositional*. By this is meant that any *higher-level* entity (and its emergent properties) is dependent upon a collection of *lower-level* entities in the sense that *(a)* they are the necessary component parts of the higher-level entity; *(b)* the emergent property is dependent upon (but not eliminatively reducible to) the properties of these parts; and *(c)* the emergent property, in the sense of a power or tendency, is not dependent upon the properties of other entities that are not such parts (although it may be so dependent for its realization). Consider the following example of a water molecule.

- A *water molecule* can be considered to be a *higher-level* entity in the sense that its *lower-level* parts are *hydrogen* and *oxygen* atoms, which, in turn, can be considered to be higher-level entities in the sense that their lower-level parts are *electrons*, *protons* and *neutrons*. However, it is crucial to recognize that it is only from a *particular structure* of hydrogen and oxygen atoms that water (or hydrogen oxide) emerges (just as it is only from particular organizations of electrons, protons and neutrons that oxygen and hydrogen atoms emerge). *Chemical bonding* is the *mechanism* that describes the way the structure of oxygen and hydrogen atoms works, such that the water molecule possesses *properties*, that is, *causal powers* and *liabilities*, *dependent* on, yet *irreducible* to, the properties of hydrogen and oxygen.

- Hence, it is the fact that hydrogen and oxygen atoms have the power to combine in a certain way – that is, that they can form covalent bonds – that explains why hydrogen oxide (water) possesses its own set of *causal powers* and *liabilities*, such as *solvency*, *electrical conductivity*, *non-combustibility*, and so forth. But the properties of water could not have been predicted from knowledge of the properties of oxygen and hydrogen considered separately because oxygen and hydrogen – as gases, for example – are highly combustible whereas water, in any state, is not. In short, *the properties of water amount to something more than the sum of the properties of its parts*.

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- *Emergence* could also have a *causal* dimension beside the compositional one mentioned above. The *synchronic* relationship between two adjacent strata of reality can involve *causation* as well as *composition*. Consider again the emergence of water. The conditions for the emergence of water, as we saw above, are oxygen and hydrogen gases, a *stimulus* that causes them to react and *ambient* conditions. If the two gases react successfully, water molecules will form; in other words, the oxygen and hydrogen atoms will bond together in a particular arrangement. The oxygen and hydrogen atoms had to possess the property that they could combine – the property they possess in virtue of their sub-atomic structure. However, when this causal power is activated in a reaction such that chemical bonding occurs, it does not stop operating after bonding is complete…..

- Even though a new substance that possesses its own causal powers and liabilities has emerged, the combining power of the oxygen and hydrogen atoms continues to be exercised; that is, the oxygen and hydrogen atoms continue to be attracted to each other. What has happened is that the properties of the hydrogen and oxygen atoms have changed. Before they react with each other, they are highly unstable so that, as gases, they are combustible but, after they react, they become stable so that, as the components of water, they are no longer combustible. Yet, the oxygen and hydrogen atoms still possess the power to combine, which must continue to be exercised if water is to exist.

- Given the above reasoning we can now say that an emergent property pertaining to a higher-level entity is caused by the emergent properties of its lower-level parts. But there will also be additional causal conditions that bring the new entity into existence and that allow the new entity to continue to exist; the "*synchronic*" dimension of emergence. Therefore, we need no longer restrict the meaning of "*cause*" to *diachronic* accounts of emergence; causation is involved in the emergence of entities, whether we analyze this phenomenon from either a *synchronic* or *a diachronic* perspective.

- *Reality* consists of *partially interconnected hierarchies* of levels, in which any element e at a level L is in principle subject to the possibilities of *causal determination* by and of *higher-order*, *lower-order* and *extra-order* (extraneous) effects, besides those defining it as an element of L (including those individuating it as an e). The concept of "*causal determination*" is crucial to understanding both the *differentiation* and *interconnection* of objects of scientific inquiry. In the light of the theory of emergence outlined above *causal determination* can be thought of as encompassing two distinct types of *causal process*. The ***firs****t* type can be called *causal interdependence*, which refers to the *internal relationship* between causal objects lying at: *(a)* different yet adjacent levels of reality; and *(b)* the same level of reality. Consider, as an *example*, the emergent entity, *water*. The oxygen and hydrogen atoms of which water is composed are subject to lower-order determination by sub-atomic particles and are subject to higher-order determination by their very arrangement or structure, which is what gives rise to water.

- The fact that the causal powers of oxygen and hydrogen atoms are modified by the structure in which they are arranged means that there is *intra-order* causal determination– that is, an internal relationship between causal objects lying at the same level of reality (because the oxygen and hydrogen atoms mutually determine each other) and that there is *inter-order* causal determination– that is, an internal relationship between causal objects lying at different yet adjacent levels of reality (because the causal powers of water depend on the exercise of the modified causal powers of oxygen and hydrogen and *vice versa*). Similarly, if we move *down* a level, we can see that the higher-level, modified causal powers of oxygen and hydrogen depend on the lower-level modified causal powers of *sub-atomic* particles and, *vice versa*, that the sub-atomic particles mutually determine each other.

- We also find *causal interdependence* when we consider the relationship between *social structure* and *human agency*. By virtue of their *biological constitution*, people possess *causal powers and liabilities*– what we call human agency. But, the fact that the causal powers which people possess are modified by the structure of which they are part means that the (modified) causal powers of human agents– the lower-level parts– depend on the causal powers of social structure – the higher-level entity; while the causal powers of social structure depend on the causal powers of human agents because it is only by virtue of the particular way in which people are related that a higher-level entity– that is, social structure – emerges.

- The concept of *causal interdependence*, therefore, describes the internal relationship between different causal objects. It involves both *inter-order* causal determination – that is, causal determination between entities lying at different yet adjacent levels of reality – and *intra-order* causal determination – that is, causal determination between entities lying at the same level of reality. *In short, causal interdependence may have a vertical as well as a horizontal dimension*.

- The ***second*** type of causal process I call *causal influence*, which refers to the *external relationship* between causal objects lying at any level of reality. The *colour* of *moths* is an example of this sort of causal determination. Although the colour of moths is a biological property, it is nevertheless affected by social mechanisms – such as industrial production – whose effects interfere with the mechanism of natural selection. This is an example, not of causal interdependence but of causal influence, because the social mechanisms, even though they exist '*higher up*' the order of being than biological mechanisms, are not emergent from moths: they are emergent from relations between people.

❖ The concept of *causal determination* is *different* from the concept of *ontological dependence*, which refers to the way in which the existence of a given entity at a given level of reality presupposes the existence of all the entities lying in the strata below it. But, the concept of ontological dependence involves a *one-way relation of necessity*, because the entities lying at a given level do not depend for their existence on higher-order entities – only on lower-order entities. This does not contradict the concept of causal interdependence. When we examine entities at a given level of reality, either we can look at how they become the parts of higher-order emergent entities– that is, by considering how their causal powers and liabilities are modified through the principle of multiple causal determination– or we can treat the entities at our chosen level as wholes– that is, in abstraction from any entities they may constitute as parts – and ask what must be the conditions of their existence.

- A refined theory of *integrative pluralism*, therefore, offers us a way of understanding how it is that the sciences can be different yet still connected. *Reductionism* is an untenable thesis because, given the *stratification of reality*, it is impossible to explain the nature of an emergent entity solely in terms of the properties of more fundamental entities and to deny its status as a causal object in its own right. For *example*, we cannot explain why *water extinguishes fire* by referring only to the properties of hydrogen and oxygen, because these elements, when they exist as gases, are *combustible*; we have to refer to the properties of the water molecule as a *particular chemical structure* possessing properties – such as non-flammability – distinct from those of oxygen and hydrogen.

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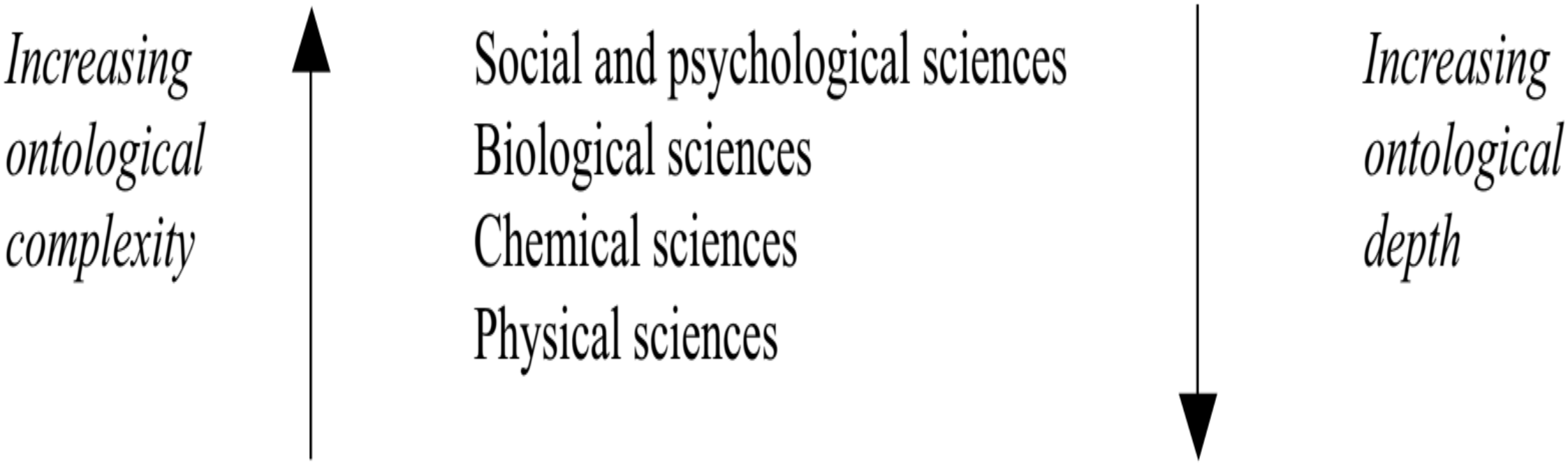
- For the same reason, *eclecticism* is untenable. If the levels of reality were completely unconnected, so that we could not in fact talk of a *hierarchy* of ‘levels’, scientists would not be able to explain the properties of one entity (the whole) as the outcome of the operation of the properties of another set of entities (the parts). In other words, the historical pattern of discovery in science as one of increasing ontological depth would not make sense, if reality were simply a random flux of diverse things having no relationship to each other. We can represent the stratification of the sciences as shown in **Fig. 2**.

Fig. 2 The ladder of the sciences



- A *movement down the ladder* of the sciences in Fig. 2 represents an *increase in ontological depth* as scientists discover entities lying at successively deeper levels of reality, whereas a *movement up the ladder* represents an *increase in ontological complexity*, in the sense that entities higher up ontologically presuppose a greater range of types of causal mechanism. Thus, *social structures* and *mechanisms* are governed not only by *biological* but also by *chemical* and *physical mechanisms*. We can now appreciate why many concrete entities – such as people – are so complex; for a person is not only a structured entity but also a '*laminated system*'– that is, *an entity whose elements are necessarily bonded by an irreducible plurality of structures.*

- Fig. 2 is a highly simplified representation of the stratification of the sciences. It must be recognized, for example, that there is stratification within each science as well as between sciences. Thus, the ‘chemical sciences’ will reflect more than one level of reality– as the subdivisions of biochemistry and physical chemistry demonstrate. Similarly, each of the subdivisions within the ‘biological sciences’– molecular biology, cell biology, physiology, anatomy, and so on– deals with a different level of reality.

- What, though, of the social sciences? Given that social science is subdivided into various disciplines – economics, political science, sociology and anthropology are the ones usually identified – can we explain these subdivisions in the same way that we can explain the subdivisions within biology and chemistry? In other words, can we identify *vertical* relations between the social sciences such that they constitute distinct, emergent levels of reality?
- The category '*social*' should be differentiated according to '*aspect*' rather than level of reality. The different aspects of *social structure* are not emergent from each other; rather, the categories economic, political, legal and ideological refer to entities emergent at the same level of reality; therefore, they must be regarded as designating particular types of *horizontal ontological depth- dependence* and *interdependence*.

- However, we must also recognize that *higher-order social entities*, such as *totalities*, can be *differentiated* according to the *types* of social (and natural) structures constituting them; for it is by virtue of the possibility that social and natural structures may be *internally related* to each other that higher-order entities may emerge. Consider the *social structure* of *tenancy*. This structure will be *causally dependent* on other types of structure. For example, the *landlord's* right to demand *rent* from the *tenant* for occupation of the property presupposes a *structure of property ownership* because the landlord must be the owner of the residence if he is to accept tenants.

- We must also recognize that higher-order social entities, such as totalities- systems of internal relations- can be differentiated according to the types of social (and natural) structures constituting them; for it is by virtue of the possibility that social and natural structures may be internally related to each other that higher-order entities may emerge. Consider the social structure of "*tenancy*". This structure will be causally dependent on other types of structure. For example, the landlord's right to demand rent from the tenant for occupation of the property presupposes a structure of property ownership because the landlord must be the owner of the residence if he is to accept tenants. In turn, the structure of property ownership (in this case housing) is internally related to the market for owner-occupied housing because such a market could not exist without it. The structure of tenancy is internally related to the market for rented housing because, again, such a market could not exist in the absence of tenancy agreements.

- What makes a particular set or *conjuncture* of relations between structures a *totality* (*system*) is that the *internal relations* between the structures give rise to *holistic causal properties*. To say that an entity is characterized by *holistic causality* is to say that it is characterized by *multiple control* because it involves interconnected causal processes at multiple levels of reality. But, multiple control is only a species of '*multiple determination*' because different types of structure may simply interact with each other (that is, may be externally related) – in which case the combination of structures will be determinative of actual events and states of affairs but will not have emergent properties.

- Because the structures within a conjuncture may be internally as well as externally related and because reality is always changing, we need to think of totalities as being open, incomplete and partial. We must also recognize the possibility of internal and external relations between totalities and thus the possibility of new, higher-order entities emerging. Consider the complexity of the causal relationships between marriage, the family, the labour market, employment, education and training:

- The relationship between the labour market and marriage is external because what is necessary for the existence of a labour market is a supply of labour power and it is contingent upon whether or not the people who supply their labour power are married. In the past, it was expected that husbands would enter paid employment while wives would engage in unpaid work at home. Today it is generally expected that both husbands and wives will be in paid employment. Therefore, we have a relationship of *causal interaction* between marriage and the labour market.

- Marriage affects the working of the family in the sense that changing expectations about the length of marriages and the acceptability of divorce have influenced the structure of the family; for example, the increase in the number of remarriages has led to an increase in the number of extended families involving ‘step children’ and ‘step parents’. So, the relationship between marriage and the family is one of *causal influence*.
- Changes in the nature of employment may also affect the working of the family in the sense that increases in work intensity may have an adverse effect on parents’ ability to raise their children well. So, the relationship between employment and the family is one of *causal influence*.

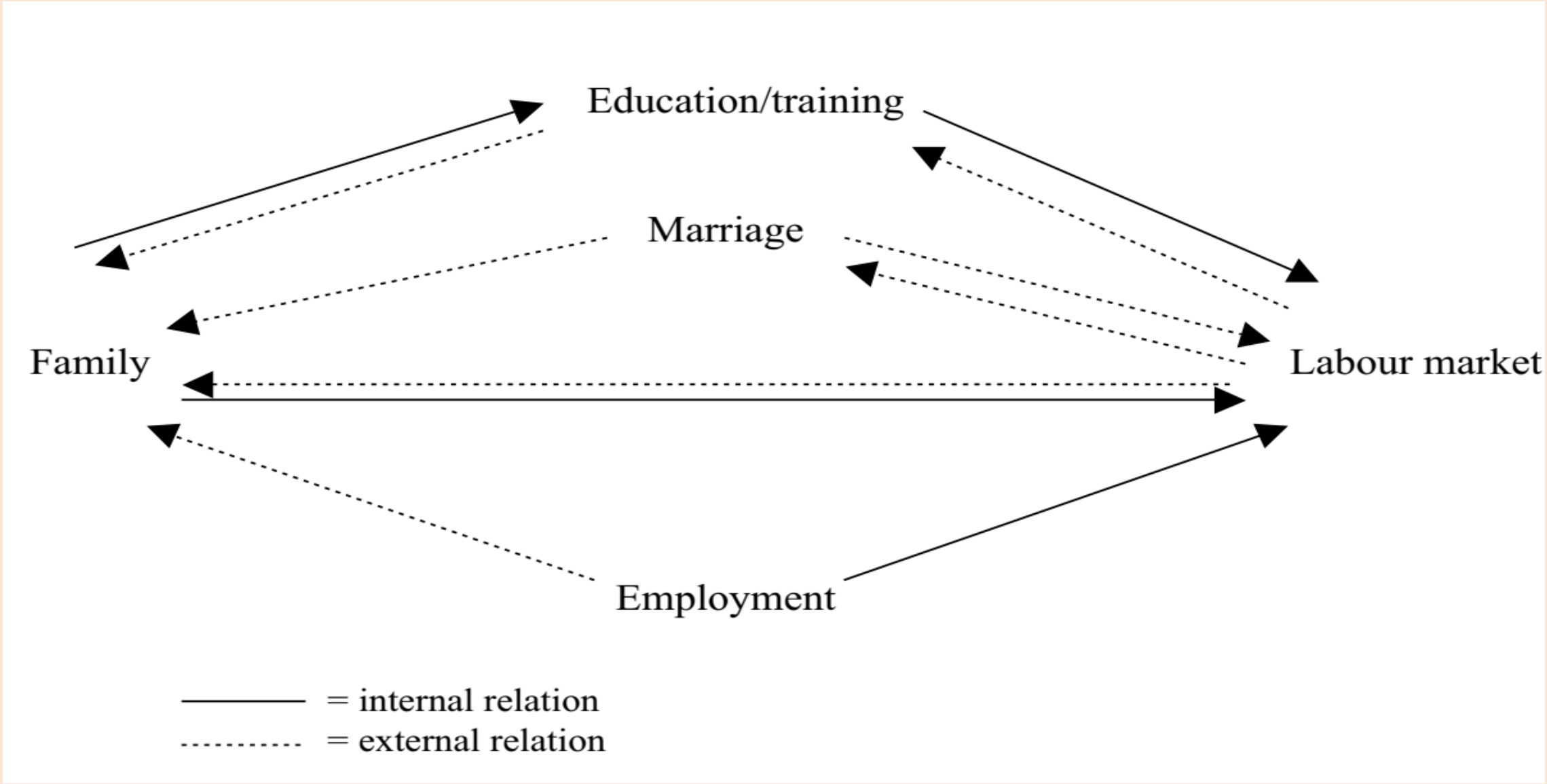
- Because a supply of labour power is essential to the existence of a labour market and because the family is the means by which new labour power is created (through human reproduction), the labour market is *causally dependent* on the structure of the family. But, the working of the labour market also *affects* the working of the family in the sense that changes in the availability of paid employment may influence people's decisions about whether or not to have children and may affect the ability of existing parents to ensure an adequate upbringing for their children. So, the relationship between the family and the labour market is one of both *causal dependence* and *causal influence*.

- The labour market is *causally dependent* on the structure of paid employment because the different instances of the employment relationship are the basis on which people compete against each other as buyers and sellers of *labour power*.
- Relationships of both *causal dependence* and *causal interaction* also exist between the labour market and education and training. For example, a supply of *skilled* labour power presupposes a structure of education and training, while changes in the demand for skilled workers of different types may affect how people are educated and trained.

- Similarly, the relationship between education and training and the family is one of both *causal dependence* and *causal interaction*. For example, the existence of the teacher–student relationship depends on a supply of people to be taught, which the family provides, while changes in the education curriculum, for example through the introduction of parenting classes and comprehensive education, may affect people's ability to be good parents and their view of marriage and family life.

- Fig. 3 gives a summary of the above relationships between social structures. What we have in Fig. 3 is an example of a partial totality. The structures identified as its parts are by no means exhaustive of the range of structures that may be connected to it; the inclusion of the structure of employment and the labour market points to connections with structures of ownership, production and exchange. The point of this example is to illustrate the complexity of social objects and the need to think carefully of the distinctions as well as the connections between their parts.

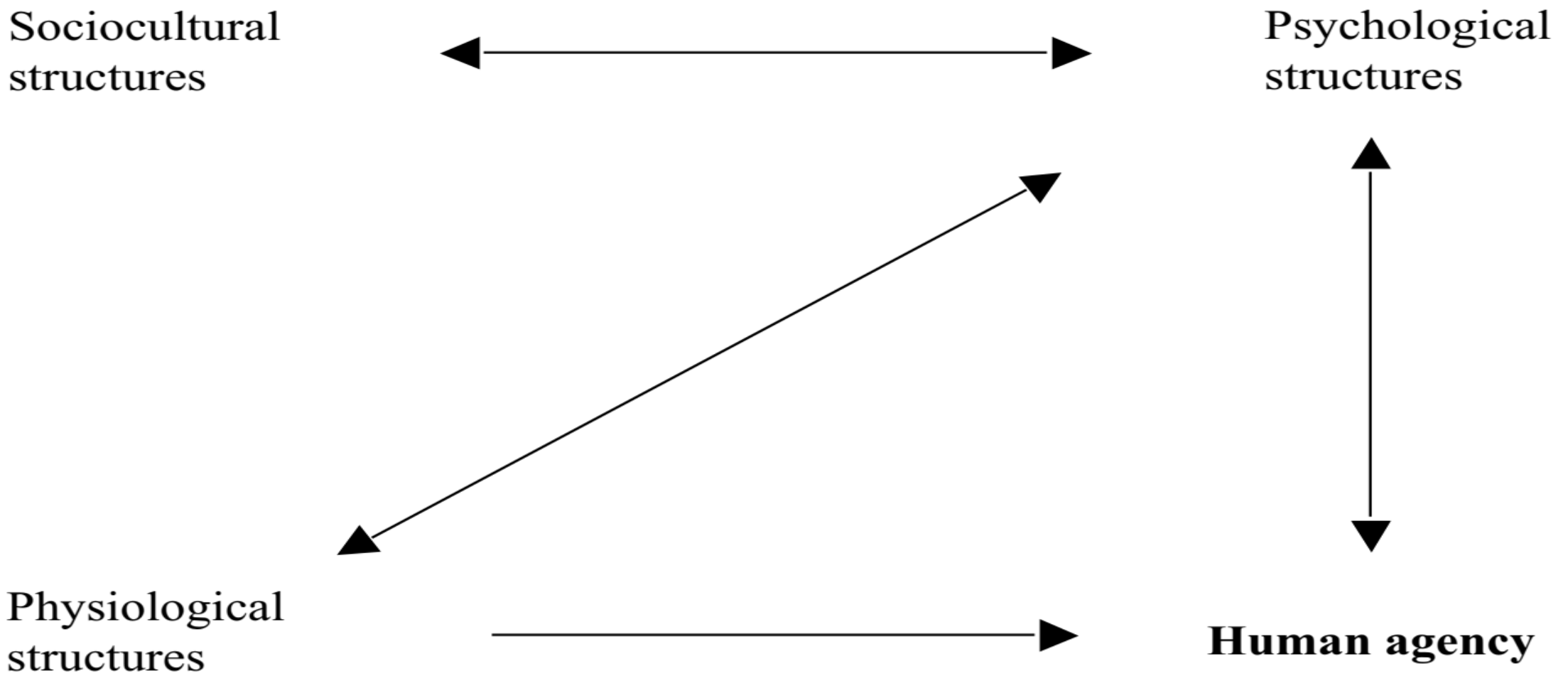
Fig. 3 Causal dependence and causal interactions between social structures



- *The role of science is to uncover specific configurations of structure*. Herein lies the *justification* for the *integration* as well as the *differentiation* of science, for we need *specialized forms* of scientific inquiry to understand the essential nature of different types of causal object – whether these different types of object pertain to the *vertical* or *horizontal* stratification of reality – and *integrative forms* of scientific inquiry to understand the precise connections between the different types of causal object.
- Abstract social sciences (such as political science and economics), therefore, can take us only so far in our understanding of social objects: we also need 'intermediate' abstract sciences, such as political economy if we are to understand the connection(s) between the political and economic aspects of social reality.

- The multiple determination of events and states of affairs, then, implies that we need to draw on theories from different scientific fields to understand how different types of causal object work together to generate phenomena of interest. Take the *example* of a '*noise-induced hearing impairment*' which involves *physiological* structures, which determine a person's ability to hear; *psychological* structures, which determine a person's experience of the hearing impairment; and *sociocultural* structures, which determine how *deaf* people are received in society. We can represent the relationships between these different *mechanisms* and the particular aspect of human agency of interest– that is, the ability to hear– as shown in Fig. 4.

Fig. 4 Preconditions for human agency



- In Fig. 4 we have three different types of structure, all of which are the preconditions for *human agency*. The *sociocultural* and *psychological* structures *presuppose* each other – that is, they are *existentially interdependent* – and so emerge at the same level of reality. *Sociocultural mechanisms* enable us to use our *minds* because they give specific content to human *consciousness* and it is through our consciousness of the social and cultural world that we can act. Hence, human agency is causally dependent, via the operation of *psychological mechanisms*, on sociocultural mechanisms. However, sociocultural mechanisms are causally dependent, via the operation of psychological mechanisms, on human agency because it is through the exercise of human agency that we reproduce and transform the social and cultural world.

- Yet, human agency also depends on the operation of physiological structures – for example, the delicate apparatuses that give us the power of sensory perception and the ability to move – while human consciousness also depends on the operation of the brain; and, *vice versa*, the operation of physiological mechanisms depends on the exercise of human agency in the sense that we must feed ourselves to survive. So, we can see that human agency is embedded in, and so emergent from, a (partial) system of causal mechanisms of different types – social, psychological and physiological.

- Consider the example of *deafness*, even if deaf people regain some of the functions they have lost, this does not mean that they will not be disabled because the very fact that they cannot communicate in the normal way or find it difficult to communicate with able-bodied people, will mark them out as different and may set off a sociocultural process of stigmatization; and the lack of understanding that deaf people receive from able-bodied people may trigger psychological mechanisms causing deaf people to become depressed. In other words, a physiological impairment, such as hearing loss, is mediated socio-culturally and psychologically.

- Hence, if we want to understand the problems that disabled people face in society, we need to understand the relationships between the different types of causal mechanism relevant to their disability and its effects and so we will have to draw on and integrate knowledge of *biology*, *psychology* and *sociology*. If we try to overcome the problem of hearing loss simply by supplying a hearing aid, we will be implicitly assuming that deafness is a biological problem and thus will be guilty of *scientific reductionism* – of assuming that concrete phenomena can be explained by the theories of only one branch of knowledge. But, if phenomena in open systems are subject to multiple determination, we will need to use different methods of inquiry and we will need to develop different theories of causal mechanisms in respect of the range of causal objects that may be involved in the generation of the phenomenon in question.

- We will also have to understand how the different *causal mechanisms* involved are interrelated– how they form a *partial totality*- partial system. Of course, we may not know which causal mechanisms are involved so that we may have to begin our inquiry from the perspective of one science. However, the results of practical experience– that is, the unintended consequences of our investigations of, and practical interventions in the world – will help us to determine whether or not we need to draw on the knowledge of more than one science. For example, if we find that deaf people do not use the hearing aid they have been given, and if we find that they appear withdrawn or aggressive, we will be alerted to the possibility that *deafness may be a social and psychological as well as a biological problem.*

The End