Summary of the course C.9-3 Scientific Cultures,

General Overview

This course offers a philosophical and epistemological exploration of how knowledge is constructed within the humanities (alpha sciences), the natural sciences (beta sciences) and the social sciences (gamma sciences).

The course examines how the divide between the humanities, natural sciences and social sciences can be bridged through complex methodologies, critical rationalism and logical-formal structures.

It then analyses fundamental scientific themes, ranging from abstraction and syntax in mathematics and logic to the objective dynamics of chance, cybernetic feedback and computer science.

Finally, the course addresses the specific nature of the natural and life sciences, the definition of deterministic chaos, human evolution in relation to the great apes, and the various explanatory models used in the human and cognitive sciences.

1: Scientific Cultures, Epistemology and Methodology

The course begins with the historical debate about the fragmentation of knowledge, known as C. P. Snow's "two cultures" debate, between the alpha culture (the humanities) and the beta culture (the natural sciences).

A third branch was subsequently added: the gamma culture, or social and behavioral sciences.

To transcend this fragmentation and narrow disciplinary thinking, the French sociologist Edgar Morin introduces the complex method. This approach rests on three pillars: the hologrammatic principle (the whole is contained in the part, and vice versa), the recursive loop (effects feed back into their causes) and the dialogical principle (opposites coexist without disappearing into a simple synthesis).

With regard to the formation of opinions, Charles Peirce argues that the scientific method is superior to tenacity, the method of authority (tradition) or mere discussion, because science relies on testing against objective reality and external permanency.

Within the philosophy of action, Hans Albert's critical rationalism examines the search for a "final reason" for our behavior and values. Albert demonstrates that every attempt at ultimate justification leads to a trilemma:

an infinite regress (*regressus in infinitum*), circular reasoning (*circulus vitiosus*), or the arbitrary termination of the argument.

Finally, a distinction is made between methodological materialism (the deliberate restriction of research to material aspects) and ideological or metaphysical materialism (the reductionist claim that nothing other than matter exists).

2: Mathematics, Formalism and Logic

Mathematics is traditionally defined as the science of quantity and space, but in the modern conception it is primarily a system of symbols and the theory of sets.

Within mathematical thought, the course warns against deceptive summative induction, as illustrated by the classical paradox of the heap of grain: ignoring the qualitative leap that occurs when a quantitative change accumulates.

François Viète's historical breakthrough brought about the transition from numerical calculation (*logistica numerosa*) to literal or symbolic calculation (*logistica speciosa*). This shifted mathematics away from eidetic or semantic signs (with direct substantive meaning) towards syntactic or operative signs (rules determining how signs are to be manipulated). This formalized approach transforms mathematical and logical operations into a mechanical, combinatorial process governed by clear syntactic rules.

In axiomatic-deductive systems, unproven basic concepts and axioms are posited as starting points, from which all further propositions are derived strictly deductively. According to Aristotle, such systems possess ontological objectivity. From the mid-nineteenth century onwards, logistic logic (formal or mathematical logic) developed through thinkers such as Boole, Frege and Russell. Carnap subsequently introduced his principle of tolerance, according to which everyone is free to construct their own logical syntax.

3: Chance, Cybernetics and Computer Science

The course discusses chance according to Antoine Cournot's definition: the coincidence of two or more mutually independent processes. From a philosophical and ontological perspective, absolute chance does not exist, because everything obeys the principle of sufficient reason (everything has a sufficient reason). Something is called "accidental" when our human

knowledge is limited and we cannot survey the entire situation; chance is therefore a cognitive category rather than an objective property of reality.

The control of processes is central to cybernetics. The ancient conception was based on cosmic harmony according to the cycle: order – disorder – restored order. In modern cybernetics, founded by Norbert Wiener, this order is maintained through feedback and self-regulation, as demonstrated both by mechanical regulators and by biological homeostasis and reflexes.

In computer science, a computer is defined as a dynamic system that processes information through algorithms. An algorithm is a logically correct sequence of elementary steps and may have iterative, sequential or selective structures. In addition to traditional computers and algorithmic synthesis, neural networks are discussed. These simulate the human brain by operating with artificially created neurons whose connections can vary, rather than relying on rigid programming. The chapter concludes with the historical emergence of the World Wide Web, created by Tim Berners-Lee, which brought about a global revolution in communication.

4: Physics, Models and Chaos Theory

Physics studies repeatable phenomena in the material world. Its method is characterized by extensive mathematization and abstraction, whereby complex facts from everyday experience are reduced to mathematical models. Physical theories are tested through experiments, but observations in modern physics (such as X-ray crystallography or particle physics) are almost always indirect observations that also depend on theoretical assumptions.

A crucial component of modern physics is chaos theory, or chaology. In physics, “chaos” does not mean random disorder but refers to deterministic chaos: physical systems that are extremely sensitive to their initial conditions. A very small change in the initial position can lead to a dramatically different course of events, as in the motion of three interacting celestial bodies or in meteorology. The process is objectively determined but cognitively unpredictable for human beings. Many scholars in the human and social sciences mistakenly interpret this physical concept of chaos as a rejection of determinism.

5: Life Sciences, Human Beings and the Human Sciences

Within biology, the definition of life has evolved from classical physicalism (mechanicism) and vitalism towards modern organicism, in which the concept of organized complexity is central. Vladimir Solovyov logically demonstrated

that the evolution of life forms is accompanied by the emergence of higher types of sufficient reasons at different levels of existence (inorganic, plant, animal and human). Furthermore, all living things display the unique ability to overcome physical forces such as gravity and to harness them for their own biological and conscious purposes.

In paleoanthropology, Yves Coppens demonstrates that human beings are biologically and genetically closely related to the great apes. Although apes use tools and exhibit protocultures, human beings are characterized by a qualitative leap. Humans possess reflective self-awareness ("knowing that one knows"), continually invent new technologies, develop complex systems of social legislation, create art and ask profound, unsettling metaphysical questions about their origins and destiny.

The human sciences emerged from the ancient ethical and political sciences. They employ a variety of explanatory and interpretative models:

- *Hermeneutics and the search for meaning:* human life as a continuous process of experiencing and creating meaning through lived experience (*Erlebnis*), expression (*Ausdruck*) and understanding (*Verständnis*) (Dilthey, Schleiermacher, Kruithof).
- *Sociological and conflict models:* Gabriel Tarde's interpsychological model based on imitation, René Girard's theory of mimetic conflict and Michel Foucault's critique of power.
- *Psychoanalysis and psychology:* the role of the unconscious in Freud, Lacan's rhetoric and Diel's motivational psychology, focused on introspection.
- *Cognitive sciences and economics:* the study of the mind as a knowledge-processing machine and of brain modules, the scientistic eliminativism of the Churchlands, and Friedrich von Hayek's neoliberal market model, in which the free market functions as a decentralized neural network.

Finally, the course emphasizes that scientific models (such as those used in psychiatry or physiology) risk becoming dogmatically imposed when sight is lost of the immediate lived world and the phenomenological experience of human beings.