The categories of qualitativeness and individuality in logic, ontology and physics

Metaphysics of science is part of philosophical investigations that poses some fundamental questions regarding proper interpretation of our best scientific theories. In a nutshell, metaphysicians of science ask the general question of what the world should be like if our scientific theories were true. One particular problem that has occupied philosophers for millennia is the relation between two basic categories of entities: particular objects (such as tables, chairs, electrons) on one hand and properties and relations (such as the property of having such and such mass, or the relation of being larger than) on the other hand. Science tells us a lot about the properties of objects and their mutual relations. Physics identifies fundamental forces between material bodies and predicts their behavior given certain interactions. Chemistry analyzes various properties of chemical compounds and elements, while genetics discovers connections between gene sequences and different properties of living organisms. One characteristic feature of all these scientific discoveries and theories is that they are in some sense general – they virtually never refer to individual, specific objects, but rather use general descriptions in terms of properties and relations and speak about whatever objects display these properties and relations. Science does not reach to the category of pure individuals – entities that exist independently from the structure of properties and relations they enter into.

This project aims to analyze the category of individuals and individual facts from the perspective of ontology (metaphysics), taking into account scientific practice. The working hypothesis is that science does not require postulating and endorsing any individual facts – science is strictly general. A radical version of this hypothesis states that science does not need any individual objects at all, since every scientifically interesting statement can be expressed in a language involving properties only. A more modest anti-individualistic position retains reference to individuals as bearers of properties, but repudiates individualistic facts. A simple example of an individualistic fact can be the fact that some object named “*a*” possesses the property of being red, while an object referred to as “*b*” is yellow, as distinguished from the fact that *b* is red while *a* is yellow. These two facts are empirically indistinguishable, and yet it may be claimed that they are ontologically distinct. One of the main questions of this project is whether science supports the existence of such distinct states that differ only with respect to the “permutation” (swapping) of individual, bare entities.

There are some arguments pointing out that even in the context of scientific theories non-qualitative differences regarding “which object is which” should be endorsed. As an example we can imagine a process during which exactly one of two identical particles is certain to decay at a given moment, but it is not determined which. In such a situation it seems that we should distinguish two possible ways the process of decaying can occur, even though these ways are entirely indistinguishable and differ only with respect to individualistic facts. More arguments similar to this one can be given, and they will be extensively analyzed in this project. It is characteristic that all examples showing the apparent need for individualistic facts and distinctions rely on the assumption of some form of symmetry of the considered system. This prompts us to discuss the role and meaning of symmetries in science, and in particular physics. Symmetries of a physical system are transformations that do not change important features of this system. A perfect sphere for instance has a rotational symmetry. Philosophers of physics often assume that if one model or solution can be transformed into another by a symmetry, this means that essentially these models are identical, and any difference between them is superficial and does not reflect any deeper reality. Typical examples of such symmetries are so-called gauge symmetries. For instance, a gravitational or electrostatic field can be characterized by defining an appropriate potential at any point of space, but we can add to this potential any constant number and this will describe the same physical situation.

Some symmetries in physics specifically connect states of affairs that differ only with respect to individualistic facts. An example is the permutation symmetry of states of quantum particles of the same type. This project will pose the question whether all symmetries encountered in physics can be interpreted in the same way. If that’s the case, then we can give an additional argument for the ontological stance of non-individualism, since differences between states connected by a symmetry are supposed to be ontologically irrelevant. Thus it may be argued that ultimately our world is a world of qualitative, non-individualistic states of affairs.