Erschienen in: Matthias Paul (ed.), Nancy Cartwright. Laws, Capacities and Science. Vortrag und Kolloquium in Münster 1998, Münster: LIT 1999 (= Münsteraner Vorlesungen zur Philosophie 2).

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A messy world? No limit for science!

One of Nancy Cartwright's claims is that systematic science presupposes a systematic world or at least a systematic corner of the world: "The world as it comes, unengineered by us, is both messy and arbitrary and not the sort of thing about which the kind of knowledge we call scientific is possible." (Cartwright 1998, p. 1) But is this really true? Has the ontological claim about the messiness of the world[1] any influence on scientific endavour? And, moreover, is this claim compatible with Cartwright's own view that science mainly consists of the ascription of capacities which remain the same outside the laboratory where they are normally meassured? In answering this question I will touch on, first, psychology, second, epistemology, third, philosophy of science, and, fourth, metaphysics.

1. Psychology: Looking out for order

Let's assume for the sake of argument that there are indeed both messy and tidy corners in the world. Given one of the messy corners, messiness can only influence scientific practice, if the scientist realizes that the situation is to messy to be dealt with.

In order to clarify this point I want to draw attention to a psychological experiment designed in the 1950s by Stanford psychologists[2] (which could be dubbed "the Stanford Messiness Probe" ...). Here is the setup: A subject has been asked to operate some kind of maschine by pressing a number of buttons such that she scores as many points as possible. Of course, in the beginning the subject does not know which sequences of buttons pressed by her will be rewarded and thus will increase her score. But her task is to find this out during the test by trial and error, or so the test person will be told. Actually, scores are rewarded or not rewarded totally independent of the test persons behaviour. Not a regular automatism but some chance mechanism is responsible for distributing the points, e.g. a hidden person who will distribute the points arbitrarily for the first 250 attempts. Then this hidden person distributes no points

[1] On this "extreme metaphysical possibility" cf. also Cartwright (1983, p.49) and (1994).

[2] Cf. Wright 1960 and 1962; cf. also Watzlawick 1976a, pp. 51-4 (resp. Watzlawick 1976b, pp. 64-7).

for the next 50 tries and finishes with a series of 25 points distributed at the end of the test; all this is done totally independent of the subjects' behaviour. Surprisingly the result, after running the test, was that the subjects were deeply convinced that they had discovered an appropriate strategy for scoring the points: They claimed to have found a strategy purported to influence happenings that have been entirely independent from their behaviour in terms of causality.

Now, what is to be learnt from this psychological experiment? The first lesson to be learnt is that human beings form strong beliefs about the existence of some order even in situations where there actually is none: There was no causal relation whatsoever between the subjects' behaviour and the scoring. Nevertheless the subjects not only believed in the existence of such an order, but also claimed to have discovered it.

2. Epistemology: How not to tell the tidy from the untidy

But there is a second point hinted at, which is far more important. Up to now my point was psychological: Human beings tend to see order where there is none. But there is also an epistemological issue involved: How do we know whether there is order in some situation or not? Of course, we who know the experimental setup described above regard that situation as an arbitrary and unordered one. But the tested subjects were not only deeply convinced of the existence of order, they also developed detailed theories about the patterns of that purported order. Now, when it comes to science, the scientist has the subject's perspective. Although scientists claim to know a lot about nature's order-patterns (and although pupils learn these theories in school), we cannot know whether we only project some fancy onto our observations, like the subjects in the psychological experiment. There is no criterion for determining whether there is order or not: We cannot tell the messy from the tidy.

Here is my argument for this: Think of some corner of the world which is perfectly ordered up to a certain time. An observer, who claims to have discovered certain regularities in this corner, might describe this order with some mathematical function F. (This is a rather simple sketch, but it should be sufficient for our present purposes.) How could disorder infiltrate this tidy region? Well, from the observer's point of view, disorderly behaviour will not fit the previously established function F. Nevertheless there exists another function, F*, fitting the previous observation as well as the purported disgression. Then how do we know that F and not the more sophisticated F* represents the corner's order? Maybe that corner was ordered from the beginning acording to F* and only our insufficient oberservational data prevented us

from seeing this. As there always exists a rational function of degree n which fits any (n+1) observations, we can never be sure whether the missing fit is due to an error of the scientific observer or a deviation of the world, i.e. due to untidiness; for any observation there will be a function covering it. But, of course, if there is no way to distinguish between messy and tidy regions of the world, doubts arise, whether there is a point in drawing this distinction in the first place.[3]

To put it the other way round: Even if there are both tidy and messy corners in the world, our epistemological situation in case of disgression is the same in both cases. We cannot tell between an occurrence in a tidy corner, the order of which is not yet known to us, on the one hand, and an occurrences in a messy corner, on the other. Thus, even if there are messy corners in the world, our epistemological and thus scientific situation is the same in messy corners as it is in unknown tidy corners. Therefore, messiness cannot have any impact on our scientific practice. And indeed, it is difficult to conceive of a physicist foregoing his research funding because his purported laws are falsified. Instead, she then would be justified in running an even larger research project to discover the more sophisticated laws which "really" underlie the phenomena.

3. Philosophy of Science: The world ordered by capacities

Thirdly, philosophy of science: The other question I raised at the beginning concerned Cartwrigth's own account of science as a project of capacity ascription and its compatibility with Cartwright's claim that science is limited by the borders of the tidy regions of the world. Cartwright's own view of science differs from the law-seeking picture of the previous section. Rather, in her "How the laws of physics lie", Cartwright argues at length that most of the laws scientists are most proud of, are false, i.e. are known to disgress from the actually observed data. Thus, Cartwright has to deny that the function of a law is to fit to the data. Instead, the function of the fundamental laws of science according to Cartwright is the ascription of capacities or tendencies.[4] These capacities are discovered under especially prepared laboratory conditions, but they are thought still to apply outside these special conditions.

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[3] For the same reason I think that the notion of God breaking laws of nature, e.g. in cases of miracles, is both ungrounded and unnecessary. It is ungrounded, for there is no way of distinguishing between breaking the laws and having established more sophisticated laws from the beginning. And it is unnecessary, because these more sophisticated laws allow already for the deviation from the usual, which is customarily called a miracle. But this point has to be elaborated on elsewhere.

[4] This is the new empiristic picture of science Cartwright (1989) develops. It was already hinted at in the third essay of Cartwright (1983), esp. pp. 61-2. For her view about what capacities are, cf. Cartwright (1997).

Now Cartwright conceives the laboratory conditions, engineered by us, as especially tidy corners of the world; recently she has called these corners "nomological maschines" (cf. Cartwright, 1997). What is of interest for scientists scrutinizing the order of these corners, must be, in Cartwright's eyes, the capacities of the things involved or the capacities of the properties of those things.[5] But these very capacities are to remain the same outside the laboratory. If the aim of science is to discover capacities, these capacities might only be discovered inside the lab. But they remain to be the object of science even when we talk about the world outside the lab, for the capacities are thought to remain the same there too.

Moreover, the specification of the capacities involved may be highly precise. The elementary charge, for example, many decimal places of which are known, indicates the capacity of electrons to be attracted by a positive charge with a certain force. And such quantification is also possible in other sciences, for example in psychology. For example, an intelligence quotient measures a person's capacity to solve certain tasks sucessfully in a limited time. Thus, capacities may well be described with quantitative methods: Looking for capacities does not hinder science to be quantitative and exact.

4. Metaphysics: Natural order realism

Last, but not least, let's sidestep to metapysics: Sure, we do not only want to discover the capacities of the individual objects under inspection in the experiments. We are not satisfied by stating, that the electrons we saw in the experiment have such and such properties and capacities, but we want to say that all electrons in the world share this or that capacity. For such an inference to be justified, we have to presuppose that the world outside the lab resembles the world in the lab in certain important respects. E.g., scientists might say that there are certain natural kinds in the world, the inspection of some specimen of which is sufficient to ascribe properties to all members of the kind. Of course, the "real" world's order-pattern might be different from that of the artificial world of the laboratory. But, nevertheless, it is an order-pattern, built up among others by the capacities discovered in the laboratory but remaining the same outside the lab. This transfer of capacities presupposes a certain kind of

[5] Cf. Cartwright, 1989, p. 141. For my taste, talk about capacities of properties has a strong metaphorical ring, if all inferences to the capacities of the individuals having that property are blocked. Of course, assuming that "the propertiy of being an aspirin carries with it the capacity to cure headaches", one could ask: Would an aspirin tablet having materialized in the paleozoicum have had the capacity to cure headaches, although no intelligent bipeds were around? Instead of blocking the inference, one could as well answer affirmatively or revise the assumption to the effect that the capacity to cure headaches is carried by the property of being an aspirin plus certain other properties or background conditions.

tidiness. Thus, transfer of capacities implies transfer of tidiness: If the lab is tidy in a certain respect, the world is. Even though this tidiness does not necessarily allow the prediction of certain future events,[6] one thing seems to be clear: If science can produce statements about capacities in the lab, science can produce statements about capacities in the outside world. And this is all that is needed for science to be about the world. Thus, science does indeed tell us how the world is, even if this cannot be discovered without artificial laboratory conditions engineered by us.

[6] For arguments cf. Cartwright (1983), e.g. the case of the camellias, pp. 51-52.