

# THE INTERVENTIONIST THEORY OF CAUSALITY AND ARISTOTLE'S CONCEPT OF CAUSE: AN ILLUMINATING METAPHOR FOR EPISTEMOLOGY

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## Abstract

My aim in this work is twofold. On the one hand I want to show that the interventionist account of causality is fully in line with philosophical tradition and recalls the intuition which led Aristotle to propose an analysis of natural becoming through the employment of the four causes and the isolation of portions of becoming through the correlation of potency and act; on the other hand, I will point out that the strong insight about natural becoming, which Aristotle and the interventionism share, sheds light on what causation is and on what its meaning and usefulness are. Moreover the discussion on the interventionist account and its metaphorical origin will allow me to find arguments against some classical anticausalist positions (e.g. Hume and Russell).

### 1. *Introduction: the interventionist theory of causality and the birth of causal thought*

The interventionist theory of causality claims that there is a connection between causality and human intervention in nature: the idea of a causal relation between two events (one which causes and the other which is caused) has, as its presupposition, the concept of intentional action and it is generated by the reflection of man on his/her own free operating with aims in the reality. Though it is an archaic aspect, unacceptable among the contemporary views of science, in the second book of *Physics* Aristotle conceives of the natural becoming (of living organisms, as well as of non living matter) as an "operating" with aims. Moreover the *causa efficiens* is theorized by Aristotle as the active element (ποιεῖν) which gives rise to the movement and imposes the form, in analogy with the active element that in τέχνη is the craftsman, who operates the production. This analogy suggests that Aristotle conceives of the efficient cause on the basis of the human ability to modify the environment, in agreement with the contemporary interventionist theory of causality [cfr. Licata 2015]. As we will see in the following Sections, the Aristotelian pre-scientific conception of nature as an "operating with aims" will throw light on the sense of interventionist account of causation. The interventionist conception of causality, theorized for the very first time by Dingler [1938] and Collingwood [1940] and strongly deepened by Von Wright

[1971, 1974, 1980, 1989 and 1993], argues that the human ability to intervene and modify the development of natural events is the epistemological basis of the concept of cause. The idea of a causal relation between two events is conceived, even from a psychological point of view, on the intentional and free human action and comes from the man's self-conscious reflection on his own operating on the surrounding reality. In *Explanation and Understanding* von Wright [1971: 64] points out that: "In the idea of putting systems in motion the notions of action and of causation meet. [...] It is natural to speak of the causes of phenomena as factors which 'produce' or 'bring about' their effects". Von Wright has emphasized the fact that the causal explanation of natural events is grounded on the experimental practice and on the free acting of the experimenter. The experiments, indeed, can be interpreted as free executions of repeatable actions which are aimed to alter intentionally, and in a reproducible way, independent variables of a phenomenon, in order to determine and detect the consequences of such alterations on the related dependent variables. These systematic variations, due to an active intervention in natural processes, allow to obtain a "response from nature" in the same terms of those concepts which were originally established by theory<sup>1</sup>. Therefore, the free action, guided by the basic theoretical conception and executed on the experimental apparatus – an empowering of the scientist's body – is the necessary prerequisite to obtain scientific knowledge. Thus, the interventionist conception of causality poses the experimental practice at the core of scientific method as a *theoretical activity*, avoiding the breaking between experimental moment and theoretical moment from which epistemological relativism (e.g. Kuhn) and "new experimentalism" (e.g. Hacking) suffer. The interventionist conception of causality leads to a more coherent view of scientific research because, from an interventionist standpoint, theoretical activity and experimental activity are aspects of the same operating in which the active solicitation of nature is theoretically projected to obtain a *feedback* which is part of the theoretical explanation. In this framework it is possible to avoid the separation between scientific and natural truth and the totally conventional and artificial character of the *object* of science, which entails the complete independence of the laboratory results with respect to the real development of the events of nature. Well, this complete independence of laboratory results cannot be accepted because the laboratory results explained and predicted by theories, as technology shows, are largely applicable to reality.

The interventionist account of causation grounds the concept of cause on the perception that the man has about his/her operative relation with the world. This conception is very similar to the Aristotelian conception of cause, and in particular with the efficient cause, called by Aristotle ἀρχή κινήσεως (principle of movement): the active aspect of "becoming" that imposes a form

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<sup>1</sup> See Buzzoni [2014: 377] for this conception of scientific experiment.

to a matter, in order to accomplish a goal. The words employed by Aristotle to refer to what nowadays we call “cause” are, above all, αἴτιον and αἰτία, which are cause in the sense of the human author of an action; these two terms are indeed etymologically linked to the term of legal/juridical meaning αἴτιος, which indicates the responsible of an action, the guilty of a crime. In the artificial process of production of τέχνη (art), which involves the four causes like the natural becoming (φύσις), the efficient cause is the craftsman, the man who employs his knowledge to produce in the right way<sup>2</sup>. Aristotle poses a strong connection between τέχνη, the art of producing the artificial objects and devices, and the ἐπιστήμη, the demonstrative knowledge which regards the universal concepts and can be applied to particulars. Clearly the Aristotelian philosophy is very far from the aware employment of experimental practice as ineliminable part of demonstration of scientific hypotheses, but the Aristotelian connection between τέχνη and ἐπιστήμη, in *Physics B*, is an important background, and almost a forecast of the employment of experimental practice, introduced in the methodology of science by Galileo. The operative behaviour of man in the environment has two important features which Aristotle (and all philosophy after him) noticed and theorized in the *Ethica Nicomachea*: teleology and freedom. It is clear that the philosophical concept of cause was born, with Aristotle, in a close relation with the concept of human action and it is very interesting to notice that this conceptual structure of cause, as I pointed out in a previous work [Licata 2015], is still fundamental also in the contemporary interventionist theory. In von Wright’s version of the interventionist theory a form of teleology is implicit<sup>3</sup>: the aware action, i.e. the intervention in the environment, is always done in order to achieve an aim. According to von Wright, to explain scientifically an event means to describe it as if it would be the result of our intentional action. This is an “experimentalist” view of knowledge: the action with goals, guided by theoretical assumptions, selects in nature real causal chains that without the intervention of the experimenter would remain indeterminate.

In the work at hand I have two goals. On the one hand I want to show that the interventionist account of causality is fully in line with the philosophical tradition and that it recalls the strong intuition which led Aristotle to propose an analysis of natural becoming through the employment of the four causes (αἰτία) and the isolation of portions of becoming through the correlation of potency and act; on the other hand, I will point out that the strong intuition about natural becoming, which Aristotle and interventionism share, sheds light on what causation is and on which is its meaning and its usefulness for scientific research; moreover the discussion on the interventionist account and its metaphorical origin will allow me to find

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<sup>2</sup> Cf. *Ethica Nicomachea*, Z 4.

<sup>3</sup> As in Aristotle’s theory of “becoming” [cf. *Physica*, B 8; *Metaphysica*, Θ 1-8].

arguments against some classical anticausalist positions (e.g. Hume and Russell). After the introductory considerations of Section 1, in Section 2, through the employment of the language of necessary and/or sufficient conditions and of concrete examples will be discussed the counterfactual reasoning, the interventionist theory of causation (with special reference to von Wright's version) and the fundamental position of free will with respect to counterfactual and interventionist approach to causality. In Section 3, some important objections against interventionist theories, taken into account and refuted by Menzies and Price [1993], will be discussed; in Section 4, a new point of view on natural causation, achieved through the reference to the Aristotelian doctrine of causes and of becoming, will consent to dissolve the objections against interventionism. In Section 5, the metaphorical sense of intervention for causation will allow me to defend the concept of cause against too much empiricist and reductionist positions, like that of Russell [1912], which propose to eliminate it from the language of science.

## *2. Counterfactual reasoning, interventionist approach and von Wright's account of causality*

This is von Wright's main thesis on causality: to say that "*p* causes *q*" is identical to say that "*p* makes happen *q*" or that "by doing *p* we could bring about *q*" and that if *p* doesn't happen even *q* doesn't [von Wright 1971: 70]. Even though causal relations could have objective status in the world independently of human awareness, knowledge of causal relations depends on our ability to make things happen. This ability is also bound to our attitude to consider counterfactual state of affairs<sup>4</sup>. We can express a thesis on causality in a counterfactual way and in language of necessary and/or sufficient conditions, a language often employed by theorists<sup>5</sup> of interventionism:

- (1) "*p* is a cause, as necessary condition of *q* if, and only if, preventing *p* from occurring would prevent *q* from occurring; *p* is a cause, as sufficient condition of *q* if, and only if, in the case in which *p* occurs then *q* would also occur".

Counterfactual reasoning will be very relevant in our argumentation but to speak about conditions, necessary and/or sufficient, in a discussion on causality can be useful and also misleading: the language of conditions borrowed from mathematics brings in itself a weakening of causal theory that

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<sup>4</sup> Cf. the essay by D. Lewis *Causation* [1973].

<sup>5</sup> Cf. Woodward [2003: 59] and Baumgartner [2009].

could take analysis away from the problem of causality. Let us make an example. John suffers from fever; what are the necessary conditions of this pathological event? Logically speaking an infinite and undetermined number of circumstances could be necessary conditions of John's fever: the fact that John was born, the fact that he was in a precise place at that precise time, the hard work that lowered John's immune system, the cold wind that lowered John's immune system, the formation of planet earth, etc. From close events to very far events, logically speaking the entire history of universe can be considered a set which contains necessary conditions of John's fever. Moreover, what are the sufficient conditions of John's fever? Maybe the fact that the group  $\alpha$  of H1N1 viruses won the immune defences of John at the time  $t$  and in the place  $l$ ? We can say, with an identical claim of truth, that at the time  $t$  and in the place  $l$ , with a lot of different groups of H1N1 viruses ( $\beta$ ,  $\gamma$ ,  $\delta$ , etc.), the weakness of John's immune system ( $c_1$ ), due to the hard work done by John ( $c_2$ ), is the real sufficient condition of John's fever; or else that ( $c_3$ ) for a day of high nervousness, from the moment  $t$ , the body of John has undergone a rise in temperature of two degrees. Here we have three sufficient conditions: ( $c_1$ ) the weakness of John's immune system, ( $c_2$ ) the hard work done by John and ( $c_3$ ) the high nervousness of John. We cannot decide which one among these four sufficient conditions is more relevant [cfr. Buzzoni 2014: 381-382]. Maybe, given the complex and holistic network of natural phenomena it is better to leave the language of necessary and sufficient conditions to mathematical realm. A necessary condition (k) for four segments to form a polygon is that they lie on the same plane; the sufficient condition for forming a polygon is that, given the necessary condition (k), the segments are joined to the vertices so as to form a closed broken line; necessary and not sufficient condition for a polygon to be a parallelogram is that it has four sides, necessary and sufficient condition for a polygon to be a parallelogram is that it has four sides two by two parallel, a sufficient but not necessary condition for a polygon to be a quadrilateral rectangle is that such a polygon is a square. The language of necessary and/or sufficient conditions and of connectives like "if and only if" works very well in mathematical and logical definitions, because it is a good device to ascertain the classification and the relations between conceptual parts of the simple items of geometry, of arithmetic and of logical rules, but it is mostly inadequate and too much rigid to study a pathological phenomenon like a fever. In the case of John's fever we face the indetermination for complexity of holistic causal networks in nature. Anyway, maybe it is possible to say whether causation for intervention is more similar to a necessary condition or to a sufficient condition.

Let us try to express the counterfactual proposition (1) weakening the rigid language of conditions and eliminating mathematical logical expressions like "if and only if"; so I will speak about "preconditions" instead of necessary conditions and about "determining causes" instead of sufficient conditions:

- (2) “ $p$  is a cause of  $q$ , as precondition, if preventing  $p$  from occurring would prevent  $q$  from occurring;  $p$  is a determining cause of  $q$  if, in the case in which  $p$  occurs, then  $q$  would also occur”.

In everyday life we contrive counterfactual argumentations in a very efficient and successful way, even if preconditions and determining causes can be sometimes confused in a not scientific way. John’s mom knows, for her everyday experience, that immune system of her son is not so strong; above all in winter the cold can weaken the defences of John, so when her son goes out in a cold day she gives him an advice: “Take with you the coat, because if you will not ‘be undefended from cold’ ( $p$ ) you will not ‘take the fever’ ( $q$ )”. Of course, we can analyse the correlation between ‘to be undefended from cold’ ( $p$ ) and ‘take the fever’ ( $q$ ) telling that  $p$  is a precondition of  $q$ ; but we can also analyse the correlation between  $p$  and  $q$  telling that  $p$  is a determining cause of  $q$ . It depends on our point of view and on what we consider relevant for our analysis. Anyway the ordinary reasoning of John’s mom is successful because it is based on her experience: in her memory about the health of his son, many times she has done many abductive inferences<sup>6</sup> in counterfactual way like “If John would have defended himself from cold, he would have not taken the fever”. Through these examples I want to underline that counterfactual reasoning is a very important and successful tool to orient ourselves in life and that the work that interventionist theory of causality wants to do is to establish what is the “determining cause” quoted in proposition (2); thus the causation for intervention is more similar to a sufficient condition than to a necessary condition. Moreover, as we will see, the counterfactual reasoning, being a causal reasoning (maybe the origin of causal reasoning), is a causal hypothesis on our active possibility to intervene in the world and to alter it: John’s action to dress the coat determines his health. From the counterfactual inferences regarding our intervention in the world, we extend the counterfactual reasoning to the events of the world, so we make hypothesis like “if the global warming wouldn’t have been, the disastrous fire of 17<sup>th</sup> June 2017 near Pedrogao would have not happened”. The counterfactual reasoning is already the isolation of a portion of becoming, the choice of a point of view on the succession of events and the individuation of a means-end relation. Incidentally we also can ask what is the relationship between counterfactual reasoning, the concept of cause and the interventionist account?

Interventionist interpretation of causality, actually, is useful to disqualify accidental correlation from causal status and to exclude from causal status

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<sup>6</sup> The classical form of abduction is  $q \wedge (p \rightarrow q) \rightarrow p$ . The counterfactual reasoning can be considered a negative form of abduction:  $q \wedge (p \rightarrow q) \rightarrow (\neg p \rightarrow \neg q)$ .

the simple regularities of associated events to which Hume refers in his famous criticism. Interventionism helps us to understand how sunset and sunrise, although they are always associated and the one always follows the other, cannot be cause and effect. Von Wright's account of causality satisfies a classical *desideratum* of a theory of causation, i.e. the asymmetry of causal relation, for which the effect depends on the cause and not *vice versa*; the notion of "bringing something about" is asymmetrical, in a way that does not rely simply on the asymmetry of temporal succession. Actually, the interventionist account points out that the conceptual core of causation, missed by Hume, that is the "geneticity": an event *p* can be considered "cause" of another event *q*, which is the "effect", when *p* is principle of generation of *q*, that is – in interventionist language – when *p* makes happen *q*. With regard to this fundamental aspect of causation, and from an historical point of view, it is useful to notice that the "geneticity" of causality is directly bound to Aristotelian concept of cause, and in particular to the kind of cause that Aristotle calls ἀρχή κινήσεως. G. Keil (2009: 12) writes, about von Wright's version of interventionism, that "The notion of making something happen has an affinity to Aristotle's *causa efficiens*". So the interventionist account has the power to identify and clarify the deep meaning of causation, but, at the same time, it has been criticized for the weakness that it gives to the epistemological employment of the concept of cause. Indeed, although causation must be employed to explain natural phenomena, it has an evident anthropomorphic character: to tell that *p* "makes happen" *q*, or that "by manipulating" *p* we could bring about *q*, ascribes to nature an unacceptable anthropomorphism and to causation the character of human action. Thus it seems that a general notion of interventionist causality (and maybe of Aristotelian efficient causation) can succeed only if causal efficacy is confined to human agents and to events caused by human beings; how it is possible to attribute causality to natural phenomena if causation is conceived on the basis of intentional (human) action?

A first step to solve this problem is to distinguish clearly between "agent causation" and "event causation". As we will see, this discussion leads to see the "cause" as a very important "epistemological metaphor" and to change point of view with respect the alleged weakness of the interventionist approach. When, following the interventionist account, we say that the expression "*p* causes *q*" is identical to "*p* makes happen *q*" or to "by doing *p* we could bring about *q*" [von Wright 1971: 70], we are not saying that the cause is an "action" accomplished by a (human) agent while the effect is, as it must be, an "event". An acceptable theory of causation requires that the cause *p* be an event, as well as the effect *q*. Von Wright, aware of this problem and of the necessary distinction between agents and causes, writes [1974: 49]:

I am anxious to *separate* agency from causation. Causal relations exist between natural events, not between agents and events. When by *doing p* we *bring about q*, it is the *happening of p* which *causes q* to come. And *p* has this effect quite independently of whether it happens as a result of action or not.

So it is clear that von Wright employs intentional (human) action only as a “metaphor” that explain the geneticity of causal relation; i.e. the fact that the event  $p$  has caused the event  $q$  is “understood in the same way” in which a human agent does  $p$  to bring about  $q$ . So  $p$  has  $q$  as effect independently of whether it happens concretely as a result of an action or not (i.e. *as if* it would happen as a result of an action). It is clear that von Wright conceives of the interventionist account as an analysis of ordinary event causation (and the accusation of anthropomorphism is not totally well addressed). Now we can ask, what is the real reason and the usefulness to involve, in an account of causation, the metaphor of a human agent who does  $p$  to bring about  $q$ ? In the answer to this question we find the importance of the interventionist theory of causation and a certain way to solve Hume’s scepticism on the concept of cause<sup>7</sup>.

Hume claimed that under the idea of causation there is nothing but mere regularities of succession of couples of events: we say that  $p$  is cause of  $q$  because we (almost) always observe that (events of the kind)  $q$  follows (events of the kind)  $p$ . But this sort of regularities might be accidental and it does not account for the necessity of the relation between cause and effect. In order to distinguish regular succession from causation, von Wright calls into question the counterfactual explanation of events. If causal laws must be “nomic” and they must account for “geneticity” of  $p$  with respect of  $q$ , they must support counterfactuals. When, according to everyday language and *forma mentis*, we explain in causal way the development of events, we employ expressions regarding what would have been the case under conditions which are different from reality. So, when we speak about real world, we also make modal claims about possible worlds, abductive inferences which hypothesize possible antecedents for actual consequents and we tell that if that antecedent had not happen, the actual consequent would have not happened either. So we can ask: why the description of events, in everyday life, has counterfactual implications? (*Question 1*). When we *explain* how the water in a pot has been artificially brought to the boiling point, it is implicit in our explanation that the water would have remained at its natural temperature, if no one had intervened to heat the water (putting the water in the pot, turning on the stove, and so on). But, von Wright asks, how is it possible to verify or to check the validity of the counterfactual conditions if they are not real? (*Question 2*). A scientist cannot observe counterfactual conditions<sup>8</sup>, and this impossibility is a problem for causal explanations from an empiricist point of view, but I think it is not a destructive objection for the epistemological employment of the concept of cause. The answers to these two questions and the solution to

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<sup>7</sup> Cf. D. Hume, *A treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects*, London, John Noon, 1739.

<sup>8</sup> Cf. von Wright [1971: 71].



the problem of counterfactual account of causal events is the key of the significance and of the usefulness of the interventionist theory of causality. Von Wright [1974: 39] writes, on this problem, that we can “interfere with the course of the world, thereby making true something which would not otherwise (i.e., had it not been for this interference) come to be true of the world at that stage of history”. We are not inactive observers who merely attends the spectacle of nature and of becoming without the possibility to intervene in the events. So we observe that, in our behaviour, some of our actions produce perceptible changes in the environment, changes that would not occur if our actions would not be done. Hence it is clear why counterfactual explanation give the philosopher and the scientist more than mere regularities *à la* Hume: the counterfactual explanation is connected to causal explanation because it speaks about the connection of an *antecedent* event with a *consequent* event, and it claims that the *consequent* would not occur in the case in which the *antecedent* does not happen<sup>9</sup>. Counterfactual accounts are already, somehow, causal explanations based on the perception of our own acting. Counterfactual reasoning entails also an isolation of the fact posed under analysis (a beginning and an end of the fact), a point of view of the analysis and an “aim” of the fact. The problem is now moved on (*Questions* 1 and 2 and on) counterfactuals.

Aristotle, the first philosopher who employed the notion of cause, felt so strongly the active intervention of man in the world that he conceived the natural becoming (γένεσθαι) like an acting which operates in order to achieve aims. In *Physica*, B 8, 198b 10-199a 20 the φύσις is viewed as a continue production (a natural ποίησις similar to technical ποίησις) which lacks the human character of aware choice and deliberation but maintains the teleological character of acting with aims. On this similarity, based upon the “acting”, Aristotle can argue his analogy between φύσις (nature) and human τέχνη (art). This seems to be the sense of the interventionist account of causation, even if counterfactuals cannot be accepted by a rigorous empiricist. Interventionist account could be the basis to have causal laws in nature, because natural laws can be verified through counterfactual analysis, but counterfactual events cannot be observed because they are not real. As Keill [2009: 16] writes:

interventionism does not reject the cause-law thesis, rather it fills a gap in the nomological account. Nomic truths, it is said, support counterfactuals, but the very notion of a counterfactual condition is indigestible by empiricist analyses. What *would* have been the case is not part of the observable world. Interventionism demonstrates

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<sup>9</sup> This is the view worked out by von Wright and the fact that counterfactual hypotheses cannot be verified is not a real problem [1971: 73]: “this does not mean that causal laws, nomic connections, can be ‘conclusively verified’. But it means that their confirmation is not a mere matter of repeated lucky observations. [...] One could say that we can be as certain of the truth of causal laws as we can be of our abilities to do, and bring about, things”.

## The interventionist theory of causality

where science has to go beyond mere observation, and has to take agency and experimentation seriously.

The interventionist conception of causation allows to go beyond the mere (Humean) succession of events of kind  $q$  after events of kind  $p$ , whose general formula, for natural laws, would be:  $p \rightarrow_F q$  ( $q$  follows  $p$ ). Interventionism allows to formulate laws like  $p \rightarrow_C q$  ( $p$  is cause of  $q$ ), because interventionism allows, as I have stated, to determine the geneticity of  $p$  with respect to  $q$ . The problem is that the mere observation is not enough to ascertain this kind of laws, because the counterfactual situations which would be evidences of these laws are not observable. The only way to confirm (or falsify) a causal law is the experimentation<sup>10</sup>. It is clear that in the experimentation there is an important element that allows to go beyond the observation, and von Wright was aware of this “experimentalist” character of his theory of causation [von Wright 1971: 72; Buzzoni, 2014: 376]. This element is the free action, the possibility to make the correct intervention in nature to cause a precise effect, or to avoid making the same intervention and notice that that effect is not caused. That means that only the free action, and not the mere observation, allows the scientist to interact with objective reality and obtain from nature the answers to “questions” posed to reality by experiments: only a direct intervention in nature becoming (in an isolated and controlled portion of nature) permits to highlight certain causal chains, which are like natural “actions” evidenced by human experimental actions [Menzies and Price, 1994: 187; Buzzoni 2014: 377].

Von Wright [1971: 81 ss.; 1980: 78] is perfectly aware of the importance of free will in agency: the presupposition of free will (of human free will) cannot be conceptually distinguished or separated from action, precisely in the interventionist account: when the interventionist account of causality claims that affirming that “ $p$  causes  $q$ ” means that “by doing  $p$  we could bring about  $q$ ”, in “our doing  $p$ ” is fully assumed that our doing is free and open to alternative possibilities (like: not doing, differently doing and so on): that is the base of counterfactual reasoning. Counterfactual reasoning puts the human action in a causal way and shows the origin of the concept of cause from free action. It is our ability as free agents who intervene in the world and change it that allows us to build counterfactual inferences figuring alternative realities, where the absence of certain antecedent facts (which in reality happened) brings with itself the absence of certain consequent facts (which

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<sup>10</sup> Keill [2009: 15-16] writes that: “Von Wright rejects the regularity account of causality, [...]. Mere regularities are too weak, because they might be accidental. – So he invokes causal laws, which support counterfactuals. He seems to accept [...] the principle of the nomological character of causality. – The nomological analysis, however, cannot be the whole story about causal relations, since it leaves open the question as to how to confirm causal laws. – This is where agency comes into play. Our ability to interfere with the course of events, and to make the actual and the non-actual ‘change place’ hypothetically, enables us to confirm causal laws”.

in reality happened). Thus counterfactual reasoning is already a causal reasoning, it arises from our ability to produce effects in the environment and after it is extended as *translatum* to antecedents and consequents facts of reality (like “if it would have not been the global warming, it would have not happened the disastrous fire of 17<sup>th</sup> June 2017 near Pedrogao”). So counterfactual reasoning is due to our free will and it clearly shows that we are not mere observers of reality but active operators who influence the world, like John when he dresses the coat to protect his health, following the counterfactual reasoning of his mother. Therefore, it is just the counterfactual reasoning that allows us to understand that the everyday causal reasoning is bound to free will and to human action. As Keill [2009: 24-25] points out

The counterfactual account yields truth conditions for causal statements, but it cannot by itself explain why counterfactual claims have truth values in the first place, nor why we are capable of counterfactual reasoning. This is where free agency comes into play. Causation is not directly linked with agency, but in a more roundabout way. And it is not linked conceptually with agency as such, but with libertarian freedom, with our ability to do otherwise in given circumstances.[...] If it is supposed to be literally true that we are able to act thus or otherwise in given circumstances, then the world must contain open possibilities.[...] In performing an action, “under the idea of freedom”, as Kant puts it, believing that our arm would not have gone up had we not decided to raise it, we *become aware of* a range of alternative possibilities. We do not *create* these possibilities, however. They are real enough, but we would not be in a position to “see” these possibilities were we mere observers of regularities or irregularities. The picture that emerges is that our experience of choosing our actions is the *ratio cognoscendi* for the real possibility of alternative courses that the world can take.

I don't know whether Keill is right when he claims that causation is not directly linked with agency as such, and that it is firstly linked with free will and with our ability to do otherwise, in given circumstances. This is not important from my point of view. In a way, we have nothing but our action as witness of our freedom to do as we prefer, and I assume – as Aristotle does in *Ethica nicomachea* [Z, 1-9] in his analysis of *πρᾶξις* (moral action) and of *προαίρεσις* (conscious choice) – that human action is free to choose consciously. Causation, as the interventionist account claims, is linked with our aware and free action, and our aware free action is the origin i) of our counterfactual reasoning (which is already a causal thinking in everyday life), ii) of the philosophical employment of the concept of cause and, ultimately, iii) of the scientific employment of the causation, that I consider unavoidable in the explanation and in the prediction of phenomena.

Aristotle, who first linked the causal analysis of nature with human action, in his theory of causality considers the counterfactual reasoning very important and the source of causal thought. At the very beginning of *Metaphysica* [A, 1, 980b 25-981a 30] he brings back the human idea of cause to the active experience and hence to counterfactual reasoning of the physician. The counterfactual reasoning allows to form a universal knowledge from the particular active experiences to give the right therapy to patients. The craftsmen and the scientists have a better grounded knowledge,

with respect to experienced people, because they are able to employ causes in conceptual way, but also in them – Aristotle claims – the conceptual knowledge comes from operative experience<sup>11</sup>. The birth of the scientific concept of cause from active experience, in *Metaphysica A*, is perfectly coherent with the Aristotelian idea, in *Physica B*, that the efficient cause in nature, as well as in art, is a productive doing (ποιεῖν).

### 3. Three relevant objections to Interventionism

Menzies and Price [1993] proposed a version of interventionism, the “agency” theory of causation, where the connection with human action is even more evident and the relationship between causes and free will is explicitly stated [Ivi: 187]: “an event *A* is cause of a distinct event *B* just in case bringing about the occurrence of *A* would be an effective means by which a free agent could bring about the occurrence of *B*”. They also discussed and rejected the most important objections to the interventionist account. I want now to take into consideration three objections of the four discussed by Menzies and Price, because I consider these three objections decisive for this theory and, in some way, intertwined and linked to each other: (a) circularity, (b) unmanipulability and (c) anthropocentricity.

Menzies and Price [Ivi: 188; 195] considered, as possible criticism, that (a) agency theory is circular: telling that to cause an effect means to “bring about” an effect, is to use causal language to define the cause. Circularity could be a hard problem for interventionist approach, and it has been strongly criticized [Cf. Hausman 1986]. The response of Menzies and Price [1993] to circularity is bound to human learning and to the “use” of concepts: causality is a secondary quality like the concept of colours (and tastes). Just as a person may learn the use of “red” by being shown samples of red surfaces,

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<sup>11</sup> *Metaphysica*, A 1, 980b 25-981a 30, my translation: “Well, while the other animals live with representations and memories and have little participation in the experience, the humankind live through art (τέχνη) and reasoning. In men the experience (ἐμπειρία) arises from memory; indeed many memories of the same fact arrive to constitute the power of a specific experience. And it seems that experience is quite similar to science (ἐπιστήμη) and art, indeed science and art are formed in men through experience. Indeed, as Polos tells, the experience has generated the art while the inexperience has generated the fortune. The art is generated, when from many observations of experience it is formed a unique and universal judgement, on the similar cases. To have the judgement that to Callias, which is suffering from a certain disease, has benefited this medicine, and that this medicine has benefited also to Socrates and to many others, it is experience; instead that all these people, defined as one for the form, which are suffering from a certain disease, has benefited this medicine [...], that is art. [...] In conclusion, we believe that the knowledge and the understanding belong more to the art than to experience and we consider the craftsmen more sapient than the experienced men, because in everybody the wisdom increases with knowledge; and that happens because the craftsmen know the cause (αἰτίαν) while the experienced men do not. The experienced men know the fact and not the reason of the fact, while the craftsmen know the reason and the cause of the fact”.

so also a person may learn the use of “cause” and “effect” by doing one thing and achieving another. So “the notion of causation thus arises not, as Hume has it, from our experience of mere succession, but rather from our experience of success” [Ivi: 196]. With respect to this reply, which is the second presented by these Australian philosophers, Menzies and Price regard the first defence that they formulated against the objection of circularity as weaker and less important. From my point of view, instead, the first response is more interesting:

A possible defence against this kind of criticism is to argue that the theories in question are not meant to be reductive analyses which reduce the concepts of causation and colour to their atomic constituents. Circularity is admittedly a decisive flaw in an analysis, so conceived. But if all that these theories attempt to do is to state some interesting interrelationships between concepts, then the circularity objection is not decisive: for even a circular account of a concept can be informative as a statement of how the concept is intertwined with others, so long as it is not trivial. The dispositional theory of colour and the agency approach to causation could then be defended as non-trivial, albeit circular, accounts of their respective concepts [Ivi: 195]

The interventionist theory of causality is not a logical analysis of causation nor it is a demonstration of how or when causes must be distinguished from (necessary and/or sufficient) conditions. It fills a gap that is different and maybe more epistemologically interesting than the gap that a logical analysis of causation tries to fill. Interventionism tells us *what* is causation, how it works in natural phenomena and how it works in scientific explanations of phenomena: agency theories of causation tell us a lot about the features of science. This is why Menzies and Price claim that agency theories state interesting interrelationships between concepts and that the circularity objection is “not decisive” for them.

Another objection discussed by Menzies and Price that I want to consider is (b) that of unmanipulability:

An agency account cannot make sense of causal relations between events which are outside the control of any agent. For example, it is argued that such an account cannot make sense of the claim that the earth’s revolution around the sun causes us to experience the seasons [Ivi: 188].

The following is the answer to the objection of unmanipulability given by Menzies and Price [1993: 199]:

For we would argue that when an agent can bring about one event as a means to bringing about another, this is true in virtue of certain basic intrinsic features of the situation involved, these features being essentially non-causal though not necessarily physical in character. Accordingly, when we are presented with another situation involving a pair of events which resembles the given situation with respect to its intrinsic features, we infer that the pair of events are causally related even though they may not be manipulable. Once more, this inference relies on the principle of analogical reasoning noted above. The agency account can be weakened to allow for the application of this principle in much the same way as the dispositional theory of colour was weakened above. In its weakened form, the agency account states that a pair of events are causally related just in case the

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situation involving them possesses intrinsic features that either support a means-end relation between the events as is, or are identical with (or closely similar to) those of another situation involving an analogous pair of means-end related events. Clearly, the agency account, so weakened, allows us to make causal claims about unmanipulable events such as the claim that the 1989 San Francisco earthquake was caused by friction between continental plates.

To reject the counterexamples of the earth's revolution and of the movement of continental plates, it is enough to consider them as mental experiments in which the "cause" events are figured to be manipulable by human beings or to imagine a free agent so powerful to produce, as human do, the "cause" events.

The third objection against interventionism that I want to consider is (c) that of anthropocentricity. This is the formulation of the problem of anthropocentricity in Menzies and Price [1993: 188]: "Agency accounts make causation an unacceptably anthropocentric phenomenon. Agency accounts are said to imply what is obviously false, namely that there would be no causal relations if there were no human agents." The following is the answer, to this problem, proposed by Menzies and Price [Ivi: 199-200]:

This form of the objection is easily deflected. It is important to bear in mind that agency theories do not say that causal relations exist only when agents have actually performed the appropriate experimental manipulations, any more than dispositional theories of colour say that colours exist only when observers have actually experienced colour sensations. The point is that both kinds of theory, being dispositional in character, are properly understood as having counterfactual breadth. Thus the dispositional theory of colour is to be understood as stating that an object is red just in case it is true that if a normal observer were present and were to observe the object under standard conditions, it would look red to her; and an agency theory of causation is to be understood as stating that a causal relation exists between two events just in case it is true that if a free agent were present and able, she could bring about the first event as a means to bringing about the second.

The answers given by Menzies and Price can be accepted, but I suspect that in the case of (b) unmanipulability and (c) anthropocentricity, as well as for (a) circularity, there are more important reasons to reject the objections in charge to interventionism. It is useful to consider the answers given by Menzies and Price even if, I think, they take these three objections more seriously than necessary: they answer well but in a very complicated way and they miss the point of the question.

These three objections are very important to understand the sense and the place of agency theories of causation in philosophy of knowledge, and to highlight important features of this kind of theories. They are, in my opinion, closely linked and depending on the anthropomorphic character of interventionism: the fact that the discussion on causes derives metaphorically from a discussion on human actions. When, in everyday life as well as in science, we speak about causes or we reason in a counterfactual way, we are assuming the point of view of human thought and we are considering nature as a "humanized nature", in which the salient joints of the

development of a phenomenon (the ones that are relevant for us) are like productive human actions. This means that the experiment is, in some way, a *substitution* in which the experimental apparatus is projected to find the joint point in which the researched and isolated phenomenon happens and in which the free action of the experimenter tries to take exactly the place of (the specific causal element of) nature. If the apparatus, projected in the light of a specific theory, is able to give to the free experimenter the power to influence correctly the phenomenon, i.e. to produce a precise effect, the theory at issue can be declared true (for the range of phenomena that it takes into consideration). This does not mean that nature is a free agent, but that our theory has selected and isolated a causal chain and that experimental apparatus allows the experimenter to *bring about* a single effect (an observable event) by *doing* a single cause (an action on the apparatus that is free in the sense that the action could be avoided or done in a different ways). So here we find a clear application of von Wright's theory, according to which "by doing  $p$  we could bring about  $q$ " is the correct way to explain that " $p$  causes  $q$ ". As we will see in next Section, Aristotle's analysis of causes and of becoming is very useful to reinforce this idea of interventionism, to give a well-grounded view of causation (also against Hume's scepticism) and to reject the three objections to agency theories more radically and more satisfactorily than how Menzies and Price do.

#### 4. *Answers to the objections against interventionism in the light of Aristotelian doctrine of causes and of natural becoming*

These three objections, in my opinion, are not a real problem for von Wright's interventionist theory of causation. Other writers considered them more seriously because, I think, they have misunderstood the real sense of the interventionist account. Baumgartner [2009: 175] claims that interventionist theories, as those advanced by Collingwood [1940], Gasking [1955], von Wright [1971] or Menzies and Price [1993] are "reductive" in the sense that they reduce the notion of causation to a non-causal notion of intervention or manipulation, while other theories would be "non reductive" in the sense that they (i) analyze the notion of intervention in terms of causation, which is considered as a primitive and unanalyzed concept [cfr. Spirtes et al. 2000; Pearl 2000] or (ii) conceive of causation and intervention as two *interdefined* concepts (these versions maintain a conceptual interdependence between the notions of causation and intervention, cfr. Hausman [1998], Hausman and Woodward [1999] and Woodward [2003]). Baumgartner [2009: Ivi] also claims that the "reductive" accounts have been criticized for their anthropocentricity and circularity, so they had a marginal role in the debate of last decades, while "non reductive" accounts, which would escape anthropocentricity and circularity, have gained increasing popularity. From the point of view of the work at hand, it is clear that only the "reductive"

theories like those worked out by von Wright and by Menzies and Price are real interventionist accounts. The main task of my study is to analyse the conceptual contribution of (human) intervention to the cause: this is the move done by Aristotle and by von Wright. To analyze the notion of intervention in terms of causation, considered as a primitive and unanalyzed concept, is a “causal theory of Intervention” rather than an “interventionist theory of Causality”; maybe the “non reductive” theories have some success in the analysis of causation, but defining intervention in terms of causation, or conceiving causation and intervention as two *interdefined* concepts, cannot be considered interventionist accounts in the original sense. Moreover I don't think that the objections considered by Menzies and Price are so destructive for “reductive” accounts and, finally, I disagree with Baumgartner on the fact that “reductive” theories have played a marginal role in the debate of last years. The position of Baumgartner gives me the occasion to claim that I believe in the reductivist view because the main conceptual move done by von Wright, by Aristotle and others is to show how the causation is suitably analysable in terms of human intervention. On the one hand, I believe in the answers given by Menzies and Price on the basis of the comparison between the dispositional theory of colours and the agency theory of cause: the cause, as colour, is a secondary quality and it is working, say, within the subjective side of knowledge. On the other hand, the three objections discussed by Menzies and Price highlight anthropomorphic features of the interventionist account that clarify the link between interventionism and Aristotle's doctrine of causes and of becoming. Aristotle's doctrine of the four causes gives us a conceptual basis to reject the counterexamples and the three objections that I took into consideration following Menzies and Price. Therefore, through an analysis of Aristotle's conception of cause, it is possible to have a wider view of agency theories and to give deeper reasons to refute the objections of circularity, unmanipulability and anthropocentricity commonly charged to interventionism.

As I pointed out in Section 1, the terms which Aristotle employs to refer to causes, αἴτιον and αἰτία, are etymologically linked to the term of legal/juridical meaning αἴτιος, which indicates the responsible of an action, the guilty of a crime. In *Physics* B 1-3 Aristotle theorizes that in the natural transformation (φύσις), like in the technical-artistic production (τέχνη), we can identify four responsible entities: the matter (material cause), the form (formal cause), the aim (final cause) and the principle of movement (efficient cause). In the case of a hammer, the matters will be the wood and the iron, the form will be the particular form of the hammer, the aim will be the ability to plant the nails and the principle of movement (the responsible in most genuine sense) will be the craftsman who builds the hammer, giving the right form to the right matters in order to obtain a device able to plant the nails. This scheme is valid also in natural becoming: the matter of the man (considered as biological entity) will be the feminine menstruation, the form will be form of the man in act (contained, in Aristotle's opinion, in the semen



of the father<sup>12</sup>), the aim will be the mature and perfect form of man and the principle of movement will be the paternal movement which impresses the form of man on the matter. In the naïve Aristotelian biology, following a distinction that the Stagirite applies to the whole nature, the father is the active side (ποιεῖν) of the becoming while the feminine menstruation is the passive and receptive (πάσχειν) side of becoming. One of the most important difference between natural transformation and technical-artistic production is the fact that in nature (φύσις) the principle of movement is contained inside the becoming entity (think about paternal movement which is internal to the semen of the man), while in the art (τέχνη) the principle of movement, the *causa efficiens*, is outside the becoming entity (think to the craftsman who is external to the hammer or to the statue).

The entire book B of *Physics* is a deep study on natural transformation based on the comparison between nature and art; this comparison is an analogy in which the features of art are studied in order to understand nature, according to the principle that states that art imitates nature [*Physics*, B 2, 194a 21]. The chapters 3-7 of the book B are devoted to the study of the chance (αὐτόματον) and of fortune (τύχη), in order to understand whether natural becoming is dominated by chance, like Democritus and the philosophers who follow him think, or whether natural becoming is ruled by an order which dispose the generation of living entities and the transformation of natural world in the right way. The solution to the problem is given in the chapter 8 of book B of *Physics*: natural transformations are not at the mercy of the chance. The bodies of living organisms, and the alternation of seasons in order to produce the harvest, are evidences that a very complicated and meaningful project is at work in nature, and that the final cause, as it is in the operations of the craftsman, is very important in natural becoming. It is clear that contemporary science cannot accept a so heavy form of anthropomorphism and this is an archaic aspect of the Aristotelian view of nature, but for the sake of my discussion it is important to notice that Aristotle conceived of the natural becoming like an “acting”, an operating which is in movement towards goals. Indeed, this Aristotelian conception increases our understanding of how, in experiments, nature can be framed into the point of view of human action. The comparison between human acting and natural becoming is so tight that Aristotle claims:

Thus in the things that are generated and are by nature there is the aim. More over in the things in which an aim is present, what is done (πράττεται) before is done in order to achieve what is done after. Therefore, as it happens in the case of acting (πράττεται) in the same way it happens in nature (πέφυκε); and as it happens in nature (πέφυκεν) in the same way it happens in every acting (πράττεται), if nothing prevents it. Now, if the acting acts in order to achieve an aim, so the aim is also in nature. [*Physics*, B 8, 199a 7-12, my translation]

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<sup>12</sup> Cf. Berti [1989-1990: 8-44].

Aristotle usually conceives of natural becoming as an acting with aims, in which the final cause is important as well as the efficient cause; the acting of natural becoming is a voluntary acting similar to that of animals, with aims but without aware free choice. But in this piece Aristotle even refers to natural becoming as to a πράττειν, and πράττειν is the verb of πράξις, the aware and responsible choice of human being. It is clear that when Aristotle calls αἴτιον and αἰτία the joint points of becoming, i.e. the beginning of natural transformation, he is thinking about the αἴτιος, the human responsible of a free action, in a very meaningful way. The πράττειν is the verb of free will, the action which needs to be deliberated and consciously chosen after the interior agreement between the (rational) knowledge of the right behaviour and the (irrational) desire of the right behaviour (cf. *Ethica Nichomachea*, Z 1-2). All these argumentations and this conceptual network are involved in the Aristotelian metaphor of αἴτιον/αἴτιος. Now we know that the interventionist account of causality is a genuine Aristotelian position and that the metaphorical thought can be a good device to understand the world and to study phenomena. The meaning of the Aristotelian metaphor is perfectly highlighted by Searle [1983: 135] when he claims that “there is just one kind of causation and that is efficient causation; causation is a matter of some things making other things happen”.

Let us consider again the three objections to agency theories from our renewed point of view. *Illuminating circularity*. With regard to a), Aristotle's doctrine of causes shows that the interventionist account of causality is not a logical foundation of causality but an enlightening metaphorical discussion on what the cause is and how it works in sciences. Here it is not to pretend a logical analysis in more primitive terms – in which what is on the left side of relation is required to do not appear in the right side –, but only a meaningful discussion on what causation is and on how it works in nature (in the network of the other concepts). To state that “to cause” means “to make happen” or that “*p* causes *q*” is identical to say that “by doing *p* we could bring about *q*” is a useful clarification on how causation should be considered in scientific explanation and prediction. Therefore the circularity, due to the fact that the expression “to bring about” is semantically similar to the expression “to cause”, not only is “not decisive”, as Menzies and Price [1993: 195] claim, but also illuminating because it sheds light on the fact that the event effect *q* is brought about by something which is *like* a human doing the event cause *p*. Without the aims implicitly assumed in human actions it would be impossible to isolate a causal chain, because, as also Aristotle underlines with his doctrine of final cause, there is no causal chain without direction and conclusion of the portion of becoming considered [cfr. Buzzoni 2014: 377], and this is evident also in counterfactual reasoning. *Harmless unmanipulability*. With regard to objection (b) of unmanipulability, it would be a problem to conceive of causes as (human) actions, because it is impossible to conceive that the movement of continental plates caused the

earthquake, in the way in which a human agent can manipulate the continental plates to bring about an earthquake. Actually the interventionist account points out that the movement of continental plates ( $p$ ) caused the earthquake ( $q$ ) *as if* a powerful enough human being would move continental plates ( $p$ ) to bring about the earthquake ( $q$ ). With regard to criticisms b) and c) it is important to distinguish between a factual explanation (“something happens”) from a metaphorical explanation (“something happens *as if*”). We cannot accept the Aristotle’s anthropomorphism, in which the nature is conceived as a voluntary acting with aims, but we can better accept the metaphor of the interventionist account grounding it on Aristotle’s insight and on the usefulness for science of this metaphor: to conceive of the causal chains in nature is a way to understand the “behaviour” of nature under certain conditions, to explain phenomena and to make predicitions. So, from the point of view of Aristotelian doctrine, the unmanipulability is a problem only if one does not understand that to consider causation as a human action is only a very useful metaphor. *Obvious anthropomorphism*. With regard to c), as von Wright emphasizes, the reference to human action of interventionist theory is not a way to conceive of the natural causation as a human attitude with human features, but only a way to highlight the fact that when philosophers and scientists create causal explanations of phenomena, as it is natural, they attribute features of their relation with external world to natural events: from this viewpoint, the criticism about the “anthropomorphism” of the interventionist account is correct, but obvious and meaningless, because it is true of all concepts, explanations and scientific theories created by human thinking<sup>13</sup>. It is clear that the move done by the theorists of the interventionist approach is to pose natural becoming within the point of view of human acting, it is the same move which gives birth, with Aristotle, to causal conception of phenomena and to the concept of cause *tout court*. Also for the objection c) we can claim that the anthropocentricity is an obvious and harmless feature of interventionism, and under this light the problem of unmanipulability loses completely its sense.

##### 5. *Conclusions: some remarks on the epistemological usefulness of the concept of cause grounded on interventionism*

The objections to causality proposed by Russell [1912] and, in general, the ones coming from a radically empiricist point of view, are a good test case for the interventionist approach. Maybe Russell [1912] is telling the truth about

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<sup>13</sup> That is the “inescapable anthropomorphism” of scientific research [cf. Buzzoni 2014: 385-386].

the impossibility to find real causal laws in physics i) for the impossibility to generalize the necessity of the happening of couples of events (in succession or in ontological dependence) bound by “causal” link, ii) for the impossibility to check by observation counterfactual events and iii) because the most important laws of physics are, allegedly, laws of functional dependency (following Mach’s [1872] idea to replace the concept of cause with the concept of function). But with respect to what I called the “indetermination for complexity of holistic causal networks in nature”, Russell choses to do the easy task: it was easy to attack the notion of cause, above all in the years of the collapse of classical and deterministic view of phenomena. Actually, the causal language and the causal reasoning, in the explanation of how physical laws rule concrete phenomena is unavoidable and is very important to understand how experiments and technology work<sup>14</sup>. Maybe Russell had a too narrow concept of science, too much dependent on the example of mathematics and of mathematical physics, and he employed, I think, Occam’s razor more frequently than it was necessary. Russell finds a lot of difficulties in classical causal thinking referring, for instance, to the “necessity” in causal laws [1912: 387-389] and to the impossible contiguity or separation between the event ‘cause’ and the event ‘effect’ [1912: 391]. But it is clear that Russell’s objections are meaningful only against the determinism of classical conception of science. Furthermore, when the interventionist account claims that by doing the movement of continental plates ( $p$ ) we could bring about an earthquake ( $q$ ), it is evident that no one is neglecting that the movement of continental plates and the consequent earthquake are actually one and a whole event, so Russell’s discussion on the time interval  $\tau$  [1912: 389-391] could appear otiose and pointless.

It is evident that the rational analysis of reality, and hence also the science, needs to isolate salient events to orient itself. Free will and counterfactual reasoning, as Aristotelian philosophy and interventionist account of causality show, are the most direct assumptions to isolate events, and causal chains. Moreover, almost every criticism addressed by Russell to the “law of causality” is conceived under the idea that only mathematical functions, with their features, can tell us something true and something useful about nature. Also in this case, philosophy about causality has often considered the causes as conditions and the language borrowed from mathematics of “necessary and/or sufficient conditions” has given a relevant contribution to studies on causality, but the main point here is that where there is a cause there is always the selection and the isolation of a precise causal chain and the elimination of all other chains, considered as “noise”. It is the counterfactual reasoning due to our free will, as we have seen, that

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<sup>14</sup> So I understand why Russell [1912: 1] claims that “The law of causality [...] is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm”, but I disagree.

allows us to isolate a precise causal chain and to establish (as Aristotle did) a “beginning” and an “end” of becoming. Maybe it is true that the law of causality “is an empirical generalization from a number of laws which are themselves empirical generalizations” [1912: 396], but the strong Aristotelian insight on the fact that when we discuss about events we consider nature like a productive force, which acts in a similar way to a human agent, is a more fundamental truth. The interventionist account of causation share with Aristotle’s philosophy this truth and confirms us that causality is an irreplaceable epistemological concept which arises from an obvious and fundamental anthropomorphization of nature. The (Aristotelian) idea that nature is a “force which acts” is connected to the interventionist account. As in the operational-counterfactual everyday life reasoning, scientists conceive of nature like a “force which acts” and which “produces” effects, in order to identify and to isolate causal chains, which are relevant for us and for our technological intervention. The importance of causal reasoning – and this is clear in the light of agency theories – is due to the fact that experimentation is a specialization and an extension of everyday counterfactual reasoning; and the experiments, projected in the context of theories, are often a way to find causes for an effect or vice versa. In Newton’s law of gravitation  $F_g = K \cdot Mm/r^2$ , as Russell points out [1912: 395], only quantitative-functional dependencies are shown, e.g. between the force  $F_g$  and the square of distance  $r^2$ , or between the force and the masses ( $M$  or  $m$ ), but it is impossible to explain and understand this law, or to make technical applications on gravity, without causal language and without calling into question events which are considered as causes and correlative events which are considered effects. Actually, the expression “ $F_g = K \cdot Mm/r^2$ ” is not Newton’s gravitation law, but the sign of quantitative dependency between the force, the mass and the distance of two bodies considered as exemplary to obtain the simplicity and the isolation of the phenomenon in which the quantitative dependency of Newton’s gravitation law is measurable at ideal the time  $t_0$ . In the quantitative dependency expressed by the formula, indeed, it is not considered the flowing of time and the succession of events in which the causation is realized. Newton’s gravitation law is, more correctly, a complex theory which describes a certain class of phenomena in natural and mathematical language, under certain conditions, and which refers to experiments that cannot be explained without the concept of cause. This observation is valid, I think, for a lot of physical laws that Russell considered nothing more than mathematical functions.

In conclusion, what about the employment of causality in human sciences like history or medicine? How would it be possible to describe the events of a political revolution or the clinical history of a disease without the concept of cause? And in everyday life, when we avoid a behaviour which causes us to get sick, is it not this already a causal and a counterfactual reasoning? When in the famous observation of 29<sup>th</sup> of May 1919, in the islands of São Tomé and Príncipe, Arthur Eddington confirmed, thanks to a solar

eclipse, that a star appeared more far from sun than it was in reality for the “action” of the gravitational field of the sun, this observation was considered an important evidence of General Relativity. Well, how is it possible to explain what happened, and how light and mass interact in General relativity, if we don't say that the mass of the sun curved space-time causing the ray of light to bend? Also in this example of causation in a scientific phenomenon, we can notice a point of view (the General Relativity), the isolation of a precise causal chain in the complex causal network (the mass of the sun curves the space-time nearby the sun, the curved space-time bends the ray of light of the star, the curved ray of light of the star impresses the image of the star in the photographs done by Eddington), the beginning and the end of the phenomenon to analyse, and the “aim” of the causal chain. It is not a bad anthropomorphism, but a way to clarify the phenomenon, if science conceives of these causal events *as if* they would be free actions done by an ideal powerful free agent. This does not mean that nature is this powerful free agent, but that determined and precise causes and causal chains exist in nature and can be known only if there is a free agent who analyses facts in a causal way.

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