1. What is innovation?

Søren Harnow Klausen

This chapter addresses the very general question of what should be understood by innovation, and how innovation relates to phenomena like creativity, entrepreneurship, commercialization, learning and invention. The question is treated mainly by means of the sort of conceptual analysis typical of a philosophical approach. However, this is done with an eye to both sociological theories and results pertaining to innovation, and to possible applications to practice and empirical research. The guiding idea behind the chapter is that conceptual clarification and unprejudiced reflection is needed in order to move forward on the more specific challenges of understanding and furthering innovation in practice.

Conceptual and theoretical work on innovation has been relatively sparse, not least as compared to the extensive and still rapidly growing collection of literature on the neighboring notion of creativity. In his comprehensive review of the field, Fagerberg rightly noted that even though innovation has been dealt with by economics, the innovation process itself has been treated more or less like a "black box" (Fagerberg 2005: 3). Schumpeter's (1934) groundbreaking analysis still remains unique in its depth and scope, even though it was confined to a few pages. It has been commented upon and applied extensively, but hardly developed further or revised. Most extant studies go on very rapidly to analyze specific *forms* of innovation (for example, Von Hippel (1988), who is particularly concerned with end-user innovation), and sometimes very specific forms or aspects (for example, Christensen and Overdorf 2000, who emphasize so-called "disruptive" innovation).

This tendency is understandable. Most scholars, even of a more theoretical orientation, are obviously interested in pushing innovation by identifying particularly attractive paths and strategies. In a way, they are trying to be innovative themselves; this makes them naturally selective. A more disengaged, bird's-eye perspective on innovation may seem almost like a contradiction in terms. But it really is not. Among the many, many sources of innovation, stepping back and taking a fresh and broad view may not be the least fecund.

1. CONCEPTUAL CONFUSION AND CLARIFICATION

One need not know what one is doing in order to do it properly. Ever since Socrates questioned his fellow Athenians on their deepest assumptions, it has been clear that people, even the cleverest and most successful, rarely know the precise content of the notions they employ – at least not explicitly. It has also become clear – perhaps contrary to what Socrates thought – that this need not matter greatly. There is strong evidence from the history of science that evading fundamental questions about definitions can be outright conducive to practical success. Modern mathematics took off when it abandoned the traditional attempt to understand what mathematics is really about and concentrated on making it work. Nobel laureate Richard Feynman is said to have quibbled that "philosophy of science is of as much use to physics as ornithology is to birds", and while philosophers have, with some justification, protested that birds might have benefited from ornithology if they had been able to acquire such knowledge, he was surely on to something.

Knowing what one does and talks about can, however, still be of considerable practical importance. Innovation will no doubt take place regardless of whether we understand it or not. But the many current attempts to further innovation will no doubt have a bigger chance at succeeding if they are informed by a sufficiently clear grasp of what exactly they are aiming at. Understanding innovation as such is also a precondition for both raising and discussing urgent questions about the importance and value of innovation relative to other goals and concerns. At present, it is almost universally taken for granted that innovation is always a good thing and a neat and obvious solution to all sorts of problems. This naive stance can and should be corrected. The benefits of innovation come at a price. A more precise understanding may turn the otherwise trivial belief in the unsurpassed value of innovation into a more controversial, interesting and perhaps even empirically testable hypothesis.

As a first rough cut, it can be noted that the term "innovation" is used in two different ways, one broad and the other narrower. According to the broad usage, "innovation" is roughly synonymous with "creativity" – both expressions referring to the production of something which is (1) novel and (2) useful or meaningful (see Klausen 2010a for some amendments of this definition of creativity). This is reflected in utterances like "she's a very innovative musician", which indicates that the person in question is capable of playing or composing in new and interesting ways, but does not ascribe to her any special ability to achieve popularity or practical success. An innovative musician can be very inept at translating her musical ideas

into something popular or commercially useful; the poor but gifted artist is not just a cliché, it is a definite possibility.

With this characterization I have already hinted at the other, narrower meaning of "innovation". Often innovation is understood as the translation of ideas or inventions into something which is more or less immediately useful (McKeown 2008). It is far from unusual to narrow it even further, requiring that innovation should lead to something which is *commercially exploitable.* Innovation is, according to this understanding, the development of something which someone would like to pay for. Sometimes innovation is said to consist in, or at least to comprise, ideas or products "being brought to the market" (or at least being "marketable"; see, for example, Höfer 2011: 78). Innovation is assumed to involve, or point directly towards, *commercialization.*

The relationship between the broad and narrow notions of innovation is complex and often misunderstood (see section 2 below). But it is generally assumed that whereas creativity refers to the very act of producing something new and meaningful, innovation is a process of *modification*, *conversion*, *translation* or *application*, in which the creative product is made concretely useful (see Fagerberg 2005: 5). Often the innovation process is depicted as consisting of two discrete stages: first, some impractical researcher or artist gets an original and imaginative, yet inapplicable idea. Later on, less profound, but practically smart and cunning individuals manage to modify this idea so as to make it practically useful and eventually marketable. This is a cliché, not an accurate picture of the typical innovation process, but at least it captures a widespread way of thinking about innovation.

It should be emphasized that the narrower, practice-oriented notion of innovation is still quite broad. Further subdivisions are in place. In particular, it is important to distinguish the notion of practice-oriented innovation in general and *technological* innovation. The latter, which is really only one type of practice-oriented innovation among others, is often considered the paradigm example of innovation. Talk about innovation is likely to evoke images of computers, iPads, molecular medicine or hydrogen vehicles. Sometimes innovation is equated with technological invention, and both expressions used in a product, rather than a process sense: the expression "an innovation" is used to refer to a particular gadget (see for instance the list of important "innovations" that come from university research compiled by Marquis (2012), which comprises only concrete objects like fluoride toothpaste and e-ink). This fixation with technology – understood mainly as technological devices – has caused scholars and laypeople alike to overlook the many other important kinds and manifestations of innovation and thus to the fact that even the narrow notion of innovation is actually quite inclusive.

Innovation in the narrow, practice oriented sense should also be distinguished from *entrepreneurship.* It suffices that being innovative you can come up with sufficiently practical ideas (whereas for you to be creative, or innovative in the broader sense, your ideas need only be meaningful or potentially useful). You mustn't be able to actually implement them successfully yourself. In particular, you don't need to have the business acumen or the courage to take the financial risks, which may be necessary for their eventual commercialization. The latter is required for entrepreneurship, but not for innovation per se. (This does not mean that entrepreneurship is not itself a form of innovation – more on this, and some slight qualifications, in section 6 below).

This shows that commercialization, contrary to a widespread assumption, is not a part of even the narrow, practice-oriented notion of innovation. Another reason for this distinction is that innovation is not confined to private enterprises. It has become popular to speak of *social innovation*, which is aimed not at creating more profit, but, for example, at improving public services or empowering social groups (see, for example, Mumford 2002; Goldsmith 2010). While this notion is sometimes stretched too far, and the difference between innovation in the private and public sector might be overemphasized, it seems obvious that innovation is not confined to the sphere of market economics. For example, the development of a new and more efficient (and/or more just) system of organ transplant allocation should clearly be considered an innovation, even if it has no commercial impact.

Critical intellectuals have lamented the rise to dominance of the narrow notion of innovation. They have rightly pointed out that the etymology of the word is broader; the Latin *innovare* merely means "to renew" or "to change", and the term was introduced in the sixteenth century as a pejorative expression for a revolutionary attitude which was considered problematic at the time, the attempt to transgress existing norms and conventions (Godin 2008). This seems to indicate "innovation" and "creativity" should be treated as synonyms. But two things speak in favor of the narrow notion: first, we do not need two words for the same phenomenon – we can do with the excellent and well-established term "creativity" as a name for the production of new and meaningful ideas and things in general. Secondly, it is very difficult, if not outright futile, to try to change the linguistic tide. The narrow notion of innovation has caught on and is currently an integral part of all sorts of societal debates and activities. Whether one likes it or not, one had better adapt to this usage if one wishes to be heard and understood at all. The critical intellectuals' case is served best by insisting that other forms of idea development (for example, creativity) are also important, and by arguing (as I do here) that

innovation should not be defined *too* narrowly, that it comprises more than technological development and commercialization.

Broad notions of innovation have been accused of being too vague and opportunistic. There is indeed something to this charge. It is common to slide more or less inadvertently between the broad and narrow meanings of the term, for example when advertising courses or study programs. The narrow, practice-oriented notion is invoked because it promises employment and economic benefits, the broader, which comprises unconventional thinking, imagination and artistic creativity, is invoked because it has a more sexy and adventurous ring to it. But I suppose that these effects are seldom sought deliberately; most people assume, quite sincerely, that the two notions are closely linked. While this does show a need for clearer distinctions, and perhaps also indicates that many innovation-prompting initiatives lack a clear direction, it has a more positive explanation as well, since it is quite possible that the two notions are indeed quite intimately connected. Some of the most striking examples of recent successful innovations (for example, the famous Apple gadgets) do seem to rely on a mixture of technological sophistication, business acumen and creative thinking about more intangible features like design, aesthetic qualities, hitherto unrealized user needs and preferences and so on. Even when the focus is on innovation in the narrow sense, the broader notion of creativity is still lurking in its vicinity.

2. CREATIVITY AND INNOVATION

There is thus much to be said for the view that while creativity is not sufficient for innovation, it is nevertheless a necessary condition for it (as claimed by Amabile et al. 1996). This is roughly correct, but needs some qualification. It is correct in the sense that innovation is itself an instance of creativity – it involves, by necessity, the production of something new and useful or meaningful. Often, albeit far from always, innovation is a process of translation or conversion. But even then it is not just a mere transfer of intellectual value; the translation makes something new happen or come in to being (viz. the really useful product) – it adds something and so creates new value in its own right.

This is one of the reasons why the popular two-step model described above is grossly inadequate: the model suggests that all the creativity is located at a prior, preparatory stage (often depicted as romantic, wild, unconstrained, even serendipitous), whereas nothing really new is happening at the later stage, which is characterized by a rather trivial smartness not worthy of the label "creative". But this is plainly wrong – and it is

surprising that so many scholars and professionals who are well acquainted with, and have a heart for, genuine innovation, have fallen for a myth which celebrates the detached and impractical intellectual. For clearly modifying and converting an idea into something that serves a wholly new purpose, or greatly enhances its utility, can be just as creative as coming up with the idea in the first place – after all, inasmuch as the original idea wasn't readily applicable, it was only "useful" in a very hypothetical sense and, on almost any account, immature. There are many examples of the innovator, rather than the original inventor, being credited with the really creative contribution: James Watt is widely known for having *improved* the steam engine, whereas fewer have heard of Newcomen's engine, and very few of the still earlier patent of Thomas Savery. A somewhat parallel example from the artistic sphere is the work of Mozart, who is hailed as a creative genius, but whose contribution consisted in using and further developing musical forms already invented by his predecessors or contemporaries, for example C.P.E. Bach, J.C. Bach and Haydn.

Moreover, in quite a number of cases innovation does *not* feed on preconceived ideas. Very often, innovators have themselves come up with the crucial idea. And it is not unusual for the conception of the idea and the development of the practical solution – and even the process of construction or implementation – to go hand in hand; ideas are often formed as the inventor goes along. Insofar as such processes can still be said to involve knowledge and reflection, they seem to be an example of what Schön has termed "reflection in practice" (Schön 1983), rather than of work issuing from prior deliberation or of the use of an existing knowledge base.

The two-step model is closely related to the equally popular – and equally inadequate – so-called *linear* model of scientific and technological development, according to which unconstrained, completely disinterested basic research lays the foundation for special and applied research, which in turn provides the means for technological development, which eventually leads to commercially successful products. There are many examples of deviations from this scheme. Sometimes intermediate steps are bypassed. Quantum physics has shown to have unexpected and fairly direct practical applications (for example, for purposes of cryptography). Biophysics applies very general physical laws to biological systems. More significantly, sometimes technological inventions or applied science come first and only later give rise to problems and theorizing of a more fundamental kind. The development of steam engines inspired modern thermodynamics; practical chemistry preceded the invention of the periodic table and the discovery of the quantum foundations of chemical processes. Powered human flight, which had been "proven" impossible by Newton and d'Alambert, was carried out by the Wright brothers without

any scientific basis, and the succeeding attempts at providing a theoretical foundation for it by Kutta, Prandtl and others turned out to be embarrassingly incorrect – and so on, and so on. (For further criticism of the linear model, see Kitcher 2001; Pielke 2007; with regard to innovation Kline and Rosenberg 1986; Fagerberg 2005: 8f.)

It is further worth noting that the two-step model applies best (when at all) to so-called incremental innovation, the more or less moderate and continuous improvements of existing devices or practices. Radical innovations can of course also exploit existing, but hitherto neglected or insufficiently understood ideas, but they will often be more markedly creative. There are many examples of what appear to have been technological "eggs of Columbus", devices and solutions emerging more or less out of the blue, without any traceable theoretical anticipations or prototypes – for example, the printing press, eyeglasses, the windmills of the middle ages and barbed wire (Mokyr 1990: 138; 294).

3. THE MANY FACES OF INNOVATION: SCHUMPETER REVISITED

Innovation might necessarily involve creativity. But the relationship is complex in still further respects, and more qualifications are needed. In fact, it appears possible to be innovative in a practical, commercially relevant way without being creative in any but the most theoretical sense. This follows from one of the most influential definitions of innovation, the one suggested by the famous Austrian economist Joseph Schumpeter. His definition is also well suited for highlighting forms of innovation other than the technological ones. Schumpeter has, quite unfairly, come to be seen as an exponent of a "technocapitalist" ideology, whereas his theory is, in fact, much more widely applicable and actually emphasizes the economic importance of "soft" aspects of innovation.

In *The Theory of Economic Development* (first published in German in 1912), Schumpeter defined innovation (or, to be more exact, "development") as the "carrying out of new combinations" (1934: 66). This has a counterpart in creativity theory, where creativity has been explained as resulting from a combination of "previously unconnected matrices" (Koestler 1964: 230). New ideas do not arise out of nothing; their novelty usually consists in the rearrangement of already existing materials and practices – and creativity is not so much a matter of completely transcending the given, but rather of being able to see new patterns and possibilities in that which is already at hand. Schumpeter did not say, but clearly presupposed, that the new combinations in question are useful

and can be the basis of commercial success (since not any odd recombination will be advantageous).

Schumpeter (1934) went on to distinguish five types of innovation:

1. The introduction of a new good – or of a new quality of good.
2. The introduction of a new method of production or a new way of handling a commodity commercially.
3. The opening of a new market.
4. The conquest (that is, making available) of a new source of supply of raw materials or half-manufactured goods.
5. The carrying out of the new organization of any industry, for example monopolization.

With regard to number 2, Schumpeter made the pertinent observation that a new production method "need by no means be founded upon a discovery scientifically new". He did not succumb to the linear model, and he was well aware that innovation may be based on ideas or products that are not novel themselves, and which may even appear dated from the point of view of science and the history of technology (think of current attempts at reviving steam technology, Zeppelins, Stone Age diet and so on, the popularity of mechanical watches, or the recent surge in microfinance in Asia and Latin America).

Three further points deserve emphasis. First, Schumpeter defined innovation in a blatantly unromantic, non-idealistic way – which is why his notion of innovation only involves creativity in a very theoretical sense. Creativity is usually thought of as a real creation of something new and valuable; it is expected to be a genuine *enrichment*, to add real value to and thus improve the existing state of affairs. Innovation in Schumpeter's sense does *not* have this implication. To him, monopolization is a prime example of innovation, though it arguably stifles competition and so hampers the development of really smart and cheap solutions. It is nevertheless innovation, because it improves the position of the innovator; and inasmuch as this can be described as the production of something new and valuable (again, to the innovator, not to society or the world in general), it is also an instance of creativity. Another example of such unconstructive, unromantic innovation is the infamous practice of certain mobile phone companies of buying new patents not with the intention of actually using them, but merely to prevent the competitors from running ahead and making their own products obsolete. Further examples include price dumping, price fixing (for example, collusion) and negative advertising.

These examples highlight the fact that although innovation requires the bringing about of something new and useful, the notion does not specify to

whom it has to be useful and does not require an improvement of *general* utility, that is, "making the world better". As has been noted in connection with "pragmatic" definitions of other notions, for example truth (which has been equated with expediency), "useful" is a highly context-sensitive expression. What is useful to the one can, quite literally, be fatal to the other – think, for example, of the invention of the atomic bomb.

Second, technology is not essential to innovation in Schumpeter's sense. Innovation comprises new ways of handling commodities and new forms of organization as well. Schumpeter was thus clearly aware that innovation can take place at every stage in the value chain, and that no single stage can be said to be of special importance. This is consistent with recent findings indicating that often most value is added in the later stages of the innovation process, and that the greatest economic benefits are gained not from product development, but from the development of new business models, branding and so on (Rosted 2005).

Of course, one can insist on defining "technology" so broadly as to cover cases of "organizational innovation" as well (cf. current Foucault-inspired talk of "technologies of power" (Rose 1999), which are often exemplified with new management styles). There is no need to deny that the notion of technology is, or ought to be, quite inclusive. But in the present context, stretching it far proves unhelpful. It blurs the important point that innovation is not confined to, and should not be modeled on, the production of mechanical or electronic devices or chemical substances. Certain forms of spectacularly advanced technology in the narrow ("hardware") sense continue to function as the paradigm example of technology in general. Hence any strong linking of innovation with technology is likely to give rise to false associations and hamper the recognition of structural, contextual, procedural, social and humanistic aspects of innovation.

Schumpeter's definition has also been criticized for being narrowly economic or "capitalist". Obviously his examples are taken from the realm of private enterprise and presuppose some kind of market economy. And it is as least true, as noted above, that he considers innovation a matter of improving one's position relative to that of others (who could, but need not, be thought of as market competitors). But the "capitalist" bias of Schumpeter's theory should not be exaggerated. Writing before "the end of history", at a time at which socialist economic models were considered serious contenders or even expected to become dominant by a kind of historical necessity, Schumpeter also envisaged an important role for innovation in a socialist economy. He noted, for example, that in such an economy, creative destruction need not have the dramatic and often disastrous economic and social consequences which are typical of a capitalist system. Viewing the emergence of greater business combines and consortia

as comparable to the rise of a socialist economy, he also noted, quite prophetically, that innovation will increasingly become the *internal* concern of "one and the same economic body" (1934: 67), thus anticipating problems of organizational innovation and the internal economy of companies.

Quite generally, one should not understand "economy" too narrowly and endow it with specific political meaning. The original meaning of the (Greek) word was simply "household management", and questions of the most rational use and distribution of the available resources – of all kinds, material as well as immaterial – are pertinent to all forms of life and political organization. So although Schumpeter's understanding of innovation does, to a certain extent, make it an "economic" concept, this need not reduce its applicability, nor does it make it politically suspect.

Third, and perhaps most noteworthy, Schumpeter points out that innovation is not primarily a question of finding new ways to meet existing needs and demands. This is a very important insight and a major improvement over classical economics, which assumes that producers must adapt to consumers' wishes. According to Schumpeter, it is rather the producers who create new needs by bringing new products to the market and if necessary by *educating* consumers, by teaching them to want new things (1934: 65). This again might sound politically suspect – one is reminded of the manipulation of hapless consumers by unscrupulous advertisers, of attempts to trick people into buying things they could easily do without. But although such cases are indeed covered by Schumpeter's analysis, which is, once again, blatantly unromantic, it should be pointed out that the notion of "educating consumers" can have a more positive meaning. Many "macroinventions" have led to real improvements in people's lives – but due to their unpredictable nature, people were not able to even dream about them beforehand and so had to learn about their benefits and overcome their own initial skepticism (many will be familiar with the problem of persuading their elderly relatives that some piece of contemporary technology or some new arrangement or practice would actually make their life so much easier).

Schumpeter's point about inducing needs and demands through education is also pertinent to non-commercial forms of innovation. Many political organizations and social movements have not merely attempted to provide an underprivileged group with something which it has, all the time, craved for. They have just as often attempted to create a consciousness among the members of the group of what they might reasonably demand and could eventually get if they were to fight for it. A good example of this is the women's movement, which did not proceed on the assumption that all women immediately wanted emancipation, but instead assumed that many of them were victims to some kind of "false

consciousness" and therefore had to be taught about this option and learn to appreciate it.

It might seem that this emphasis on the role of the producer clashes with the currently popular idea of "user-driven" innovation. But this conflict is merely apparent. What does *not*, according to Schumpeter, drive innovation is what consumers presently and concretely *demand.* For this will mostly be limited to "microinventions", that is, improved or cheaper versions of already well-known items (see Mokyr 1990). So-called user-driver innovation aims at transcending the already known and articulated needs of consumers and finding out what they would *really* like to have. It aims at an improved understanding of the situation of the users, not of meeting wishes they have already formed (this has also been noted by Rosted, who speaks aptly about disclosing "unknown user needs" (2005: 35ff.). This applies both to the most common cases, in which the process is firmly controlled by the producer, who employ users as guinea pigs and sources of inspiration, and to the still rare examples of genuinely user-driven innovation, where the process is initiated and managed by the users themselves.

4. PARADOXES AND PROBLEMS: INTRACTABLE INNOVATION?

That innovation is not just about meeting already existing needs, but also about changing the context and perhaps creating new tasks and need, makes it at once particularly important and fascinating, but also potentially intractable in both theory and practice. In this respect innovation again resembles creativity, even though it might have been expected that innovation, due to its practical orientation, would be somewhat easier to predict and control.

Innovation is plagued by what I have termed the *creativity paradox*: the very idea of creativity (and of innovation as well) harbors a fundamental tension between *novelty* and *norm.* It is about creating something novel, and so about *transcending the norms*, but it is also about creating something useful or at least meaningful, and so still about *meeting* a broader set of expectations or norms (Klausen 2010a: 355; 359). This is not just an abstract philosophical problem. Those who have done assessments of student work will know the difficulty of justly weighing the more conventional qualities against originality, independence and flexibility of mind. Of course this problem almost always finds a pragmatic solution. But many retain a feeling that they could not avoid doing some kind of injustice to the work assessed (or disregarding the established norms), that conservatism

and creativity are both fundamental, but irreconcilable virtues. A strongly norm-conforming paper doesn't really add something new, but a very original paper often borders on the conventionally unacceptable. Thomas Kuhn pointed to a similar problematic in the development of science, which he aptly named "The Essential Tension" (Kuhn 1959).

The creativity paradox is related to the better known *learning paradox* espoused by Plato in his dialogue *Meno*: we cannot meaningfully search for what we know – since, per hypothesis, we must then possess it, that is, have found it, already. But neither can we search for that which we do *not* know – for in that case we will not know *even* what to search for (*Meno* 80d–e). Again, this is hardly an insurmountable problem in practice. Learning, the acquisition of new knowledge, does seem to be possible. We are often able to envisage the *possible* solution to a problem without yet being able to actually solve it, for example, because we only know the *outline* of the solution and still have to work out the details or find a way to implement it concretely. We can imagine, and work at realizing, a cheap and effective electric car, a 100 percent renewable energy supply or an educational system which ensures that 98 percent of all students graduate, while acknowledging that we still don't know the exact means to attain this goal. Yet the learning paradox still points to a fundamental problem with all attempts to achieve significant progress: we are bound to understand our options and form our wishes from what we already know, and consequently we have difficulties appreciating, let alone striving for, something which deviates radically from what is already familiar. We can try to overcome this limitation by deliberately going against the norms, but that will be merely a shot in the dark, since we are then left with no clues as to what to do or what to look for.

A very manifest expression of the creativity paradox is the fact that most creativity tests – and most assessments of practices for stimulating innovation and so on – make crucial use of *expert judgments* when it comes to deciding what is to count as genuinely creative or as a significant innovation. Experts are, per definition, representatives of a specific *domain* (for example, art, design, motorcars and so on). This seems extremely reasonable, but has the consequence that the results will be judged according to fairly conservative standards; products will be measured against known *paradigms* from the domain in question. This effect is well known from peer-review of scientific papers, an institution which no doubt serves the purpose of ensuring a high quality of the published work, since the immature, the dilettante, the faulty, the obscure is sorted away with great skill and reliability – but which also tends to stifle scientific creativity by being intolerant of very original contributions, which often challenge the existing norm and sometimes even aim at altering the very domain in question

and changing the rules of the game (cf. the difficulties faced by inter- and transdisciplinary research).

A popular way of handling the creativity paradox invokes the two-step model mentioned in section 2. The creative (or innovation) process is divided into two distinct stages: at the first stage, it is all about "thinking out of the box", of dispensing with all traditional constraints and paying no attention to the actual utility or practicability of ideas. This will assumedly produce a "gross pool" of ideas sufficiently large and varied for it to be likely that some of them will, when scrutinized at a later critical stage, prove to be practicable or at least capable of being developed in a more practical direction. Whereas the first stage in the process corresponds to the novelty requirement, and only this, the second stage of selection and adaption thus corresponds to the usefulness requirement, and only this; it is the place where norms, which are first transcended or set aside, re-enter the process.

The inspiration for this model comes in part from evolutionary biology, which takes the raw material of evolution to be a random (that is, directionless) creation of a diversity of traits (through mutation), which is then subjected to a merciless selection process in which they are tested for their fitness or "adaptability". The model provides the basis for the popular method of *brainstorming*, that is, the notion that the first stage in an idea-generation process should consist in dispensing with conventional constraints and "let a thousand flowers bloom" (for relevant group psychological criticism of this notion, see Paulus and Brown 2003).

It should not be denied that the two-step model has something to be said for it, especially as a way of facing the creativity paradox (if we are too focused, from the outset, on finding the exact practical solution, we will probably keep too closely to existing models and remain stuck with incremental innovation). Yet as I have already pointed out, the model is hardly empirically adequate, and it also has some theoretical flaws. Human innovation is not a "blind" process like biological evolution – if it were, progress would have been very much slower. Innovation processes are ways of consciously boosting or surpassing evolution, by virtue of their more deliberate, focused and economic character. A completely unconstrained, disorientated production of ideas and prototypes will not only be immensely wasteful, it will hardly provide sufficient material for the subsequent selection process to work on. Although the very first stages in an innovation process are often characterized by a relatively high degree of openness, boldness and imagination, usually there will already be an awareness, if only implicit, of practical goals, possibilities and constraints. Eminent innovators generally excel in their mastery of the "art of the possible"; they have a sense, however inarticulate, of

where to head, and do not waste time on pursuing dead-end paths. They do not let themselves be bound by conventions, but they do take into account known constraints and difficulties. (This is not contradicted by the finding that innovators often have an outstanding ability to persevere in the face of opposition and difficulties (Klausen, forthcoming)). The point is not that innovators take the line of least resistance; it is just they opt for something which they take to have a real chance of succeeding, even though others might see it otherwise and considerable challenges will have to be met.

This alternative model, which sees the incubation of an idea and consideration of its viability or practicability as integrated, is supported by several other pieces of theoretical reasoning and empirical evidence. One piece of support comes from creativity theory. I have argued that it is a mistake to separate the novelty and usefulness requirement: creative products are valued for being novel in useful ways and useful in novel ways (Klausen 2010a: 356). Merely being novel *and* useful is not sufficient; a completely new kind of vehicle would not be considered a genuine innovation if it were less useful than the existing ones. This speaks against relegating novelty and usefulness considerations to separate phases in the innovation process.

The integrated model is further supported by insights from the philosophy of science. Popper's view of the scientific process, which he distinguished into a romantic, irrational phase of discovery, where "bold hypotheses" were supposedly generated at random, and a subsequent process of rigorous testing, has now been abandoned for a historically and psychologically more realistic picture (Popper 2005). New hypotheses do not emerge out of nowhere. On closer inspection, alleged revolutions and radical breakthroughs almost always turn out to be more continuous with the earlier developments than was first assumed (see, for example, Bird 2008). Scientists rarely engage in mere guesswork; they make *qualified* guesses based on their prior training, experience and background assumptions.

Last but not least, the integrated model fits nicely with the point that innovation is about grasping inherent possibilities, and with the view that creativity typically consists in the combination of hitherto unconnected matrices. This view actually provides a sort of solution to the creativity paradox. Since a new idea will, on the recombination view, still be located within a "matrix", it remains subjected to norms and constraints, and so meets the usefulness constraint. But since this matrix is a *new* one, a novel and original mixture, those norms and constraints will not simply be the old ones, even if they can be traced back to, and are continuous with, the norms and constraints of the old matrices. To a certain extent, the recombination view solves the tension by sketching an appropriate balance, and

a positive relationship, between novelty and usefulness (that is, conformity to norms).

Yet although it is possible to handle and live with the creativity paradox, it cannot be eliminated. There will always be a significant risk of overlooking the really new and smart solutions (this risk will remain significant precisely because we *must* pay attention to norms and actual conditions, in order to make any headway under time and other resource constraints). What makes creativity and innovation so marvelous and important also makes it notoriously difficult to control and fathom. The philosophers of romanticism were on to something with their – arguably exaggerated – notion of the "product of genius": an object which appears meaningful and almost *necessary*, though it could not have been planned in advance on principles already known (Schelling 1800: 283; cf. also Kant 1790: §49). On encountering such an object, one reacts by thinking "just so!" A product of genius appears *obviously right*; in retrospect it appears to one that anybody, including oneself, might – indeed *should* – have had this very same idea, though one must also admit having never actually thought of it before. The product of genius itself establishes the set of norms according to which it is to be judged (cf. Schelling 1800: 291).

These – admittedly somewhat lofty – notions turn out to have a surprisingly wide and practical application. They are not confined to the sphere of art, nor need there be anything particularly "romantic" about them, except for their origin. The idea of a product which, so to speak, carries with it its own standards of excellence connects closely with Schumpeter's insight that innovation is not so much about meeting existing demands, but rather about changing the context. Radical innovation usually consists in formulating a whole new task or creating a new demand, by teaching consumers what they might possibly want. It is often said of the iPad that it was a device nobody asked for or even dreamed about; it had to be invented before people could see that they might want it and start judging devices in the category "tablet" according to clear standards.

Although the two-step model exaggerates the role of randomness in the innovation process, it must be admitted that luck – or, to put it more neutrally, contingent factors – also plays its part. An innovator may have the luck of producing something which suddenly, due to a change of circumstances, becomes much more useful and thus more in demand. Howard Gardner has pointed out that Einstein's scientific mindset matched the premises and challenges of early twentieth-century physics perfectly, but turned out to be less appropriate when quantum mechanics came to the fore (Gardner 1983). Similarly, stronger environmental regulations have given manufacturers of otherwise uncompetitive products a commercial advantage.

There's a clear parallel to evolutionary biology. The traditional "adaptationist" view came under attack from Gould and Lewontin, who argued that organisms not only adapt to existing conditions or occupy existing "niches". They often *create their own niches* by actively shaping their environment, making it match their abilities and limitations rather than evolving to match the prior conditions. Humans are a particularly striking example that organisms are not merely objects, but also subjects of evolution (Lewontin 1983). And there's a further possibility (parallel to the examples of "luck" above) that the environment changes independently of the organisms' own behavior, thus changing the function and value of their traits (for example, through climate changes, continental drift and so on).

This means that "evolution" cannot be thought of as a single well-defined process, as a distinctive "mechanism" underlying all evolutionary changes. It is now widely acknowledged that evolutionary explanations are largely backward-looking ("retrodictive") and "narrative" (Fodor 2008). They tell a selective story about how a certain kind of organism came to look as it currently does, without implying that organisms will generally evolve in the same way, or that specific initial conditions will necessarily lead to a certain result. Jerry Fodor has drawn an instructive analogy to the feats of *winning battles* or *getting rich*. There are countless ways in which this can be achieved, depending on how an individual interacts with the circumstances. As Fodor notes, Genghis Khan and the heirs of Andrew Carnegie became rich in very different ways, and there obviously is no recipe for getting rich, the many "How to get rich?" books notwithstanding (Fodor 2008: 24).

Applied to the case of innovation, this means that there may be specific strategies and qualities which are conducive to innovation in specific circumstances, and with regard to specific tasks. There may also be certain more general traits and habits (for example, openness, flexibility of mind, perseverance) which increase the likelihood of coming up with innovations even across different circumstances. But much of what leads to innovation in one context will not work in another; and individuals or organizations which have difficulties solving a certain task competitively will still be able to come out on top if they are able to redefine the task or teach consumers to want something new, which they themselves happen to be able to deliver. As a musician, you can of course try to trump Bach, Beethoven or Brahms by beating them in their own ballpark. But you can also get into (a new) character as the Beatles and put other skills to use. Even if you cannot really sing or play, on any mildly standard account, you can still be successful (to varying degrees) by inventing yourself as Bob Dylan, Yoko Ono or Kanye West – just as an apparently inferior biological

organism can migrate into another environment or specialize in tasks that have been neglected by its competitors.

This doesn't mean that there are no objective standards of good or bad (though innovation is, to a larger extent than creativity, linked to the appreciation of audiences, and thus more "subjective" (cf. Klausen 2010a: 352ff., for an argument that creativity, by contrast, is not tied to social acceptance). It could perhaps be argued that innovations likewise only need to have a *propensity for* being practically useful. But I think that the notion should be understood as requiring innovations to be fairly *immediately* useful, not having to await later changes in the environment or people's knowledge or taste). It is just that there are endless possible genres, endless tasks to be solved and endless demands to be made. Within each genre, or with regard to each task or demand, there are surely better and worse solutions. But resorting to objectivity does not help to narrow down the complexity.

Again, this is what makes innovation both so valuable and fascinating and so difficult to predict and control: it is not just about being – or becoming – the best; there are endless ways of changing the game so as to make one's assets count for more. This is comforting news to many, but not to those who are keen on developing innovation policies or recipes. We might work at optimizing nanotechnology, developing hydrogen vehicles or supporting new trends in film and art. But the future might just as well belong to other and yet unknown product types and genres – flip-flop-music, neo-neo-film-noir, hyperspaceships or what have you. This is no argument for *laissez-faire*; after all, incremental innovations, which are much more predictable, can do a lot of good before eventually being rendered obsolete by more radical ones – and no one knows how long this might take. The motor car, for example, has held its ground for more than a century, in spite of perennial fantasies of its rapid demise, whereas the telefax turned out to be almost stillborn. But it does give reason for caution and humbleness: we should be wary of identifying certain fields, technologies or product types as particularly "innovative", since this is an attribute they can have only on loan, relative to specific circumstances which might suddenly change.

5. INNOVATION AND LEARNING

Innovation and *learning* are widely held to be closely connected. For example, Pavitt (2005: 88) notes that the unpredictable character of innovation makes it crucially dependent on either individual or collective learning. Yet most research literature on innovation has focused rather

one-sidedly on the organization types, commercial arrangements and business policies which might support or hamper innovation (see, for example, Jaffe and Trajtenberg 2002 and most of the papers in Fagerberg et al. 2005). There has been surprisingly little interest in the individual or organizational learning processes that presumably lie at the heart of innovation. (A small, but notable exception is Lam 2005. Edquist 2005 (191ff.) also emphasizes different kinds of learning, but from a systems perspective, which means that his focus remains on the institutional framework rather than on learning processes per se.)

In fact it is possible to argue that the relationship between innovation and learning is *very* intimate indeed. To put it bluntly, all innovation involves learning, and all learning exemplifies innovation. Learning is, by definition, learning something *new*, and this also has to be useful or at least meaningful (acquiring bad habits or reducing one's performance does not really count as learning). And innovation likewise seems to be almost always an example of learning: when it has been carried out successfully, someone will be able to do something he or she was not able to do before. (Possible exceptions are those cases where innovation is due solely to a change of circumstances. One might rightly require of learning that it involves a certain "subjective conditioning", that is, an improvement in the capacities of the learner. See Paulsen 2009: 49.) We might also add an *intentionality* condition which rules out cases of purely accidental discoveries as genuine examples of innovation. An innovation must depend at least partly on an intention to create something new and useful, even though the eventual product may turn out to be markedly different from how it was intended, or its success depends on other features than expected (see Klausen 2010a, 357ff. for a parallel argument regarding creativity).

It might be objected that all learning may exemplify *creativity* but not necessarily innovation. This is formally correct. It is possible to learn without improving one's practical position. One can learn something that is quite meaningful, but that nevertheless happens to be of little use under current (or sometimes under almost any) circumstances. Some of the verses learnt by heart in Sunday schools or *madrasas* hardly alter the learners' practical position significantly (in fact, such examples call even the connection between learning and creativity into question, since a creative product is required to be meaningful in a novel way). It would, however, be insensible to deny that the learning of religious verses can be said to give the learner access to a meaning which is genuinely new to him or her. Depending on one's worldview, it might also be said to improve one's general position in the world; and in any case, it might prove useful for passing certain examinations. The latter point again shows how

considerations of the infinity of tasks one might possibly have to confront inevitably stretch the notions of creativity and innovation.

Still, the connection remains quite close. Especially on modern conceptions of learning as consisting in the acquisition of competences, it follows more or less directly that successful learning will also be an example of innovation, although often on a very small scale. Apparent counterexamples can be dismissed by insisting on a more critical and exclusive notion of learning, which requires more than the mere amassing of knowledge; or, as with the above example of religious rote learning, by insisting on a broad and liberal understanding of "competences" and "tasks" (though one should avoid trivializing the notion of innovation by equating "useful" with "meaningful" or countenance tasks that have little to do with actual, practical human concerns).

A further striking parallel between innovation and learning is that both are typically brought about through the carrying out of novel *combinations* (cf. the theories of Schumpeter and Koestler). According to the dominating taxonomies of learning outcomes, in particular the SOLO-taxonomy (Biggs and Collis 1982), the highest forms of learning are those that involve a move beyond the already appropriated, individual items of knowledge by restructuring and linking them – the ambitious objectives are characterized with notions like *synthesis* and *extension* and verbs like "apply", "relate", "compare", "generalize" (to a new domain), "create" and so on.

There is a further interesting parallel between innovation and *knowledge*, especially *knowing how*, which also stresses the centrality of learning. According to Gilbert Ryle's classical analysis, knowing how differs from mere *habitual behavior*. A skillful person is more than merely "well-drilled"; she is "ready to detect and correct lapses, to repeat and improve upon successes, to profit from the examples of others" and so on (Ryle 1949: 28f.). This means that a real competence, or practical knowledge, necessarily involves a constant willingness to learn, a sensitivity to problems and shortcomings as well as to possibilities for improvement – this obviously relates knowing how to innovation (for some doubts, however, about whether the set of dispositions described by Ryle is really an absolutely necessary requirement for acting skillfully – it might be too strict and "intellectualist" – see Klausen 2010b).

By focusing on the connection between innovation and learning, we are made aware of a kind of innovation which is extremely common and of immense importance, but often seems to be neglected, though it has probably been acknowledged implicitly by many. I am thinking of innovation that does not manifest itself directly in new *products*, but primarily in improvement *processes* which can lead to improved production in a

broad sense (including services, for example). Ryle's highlighting of the difference between habitual behavior and competent, knowledge-based practice points to a well-known phenomenon: there is a difference between merely doing one's job, of satisfying the criteria laid down in advance, and permanently adapting and developing one's routines so as to better match the task, taking into account the inevitable, though mostly very small and gradual, change in the circumstances, and thus the exact task at the present moment, exploiting small possibilities of improvement wherever they occur.

With an expression that, unfortunately, might be misunderstood (as referring to a certain kind of technology, which is not intended), I shall call such a very small and process-immanent improvement *nanoinnovation* (since it is much smaller than micro-inventions or incremental innovation; another possible name, which more strongly emphasizes its diminutive character, is *picoinventions*). The notion has some affinity to Kaufman and Beghetto's notion of "mini-c creativity" (2009), though the latter is defined in terms of meaningful experiences. Nanoinnovation can play an important role even when the overall product or competitive situation is not improved, since it can be crucial for *maintaining* product quality or competitiveness under hardening circumstances. The partial truth behind Ryle's self-criticism and self-improvement requirements for skillfulness is that in most real-life circumstances mainly doing one's job alright in the same habitual way is not sufficient for *really* doing it alright, since performance will sooner or later deteriorate. Tasks, even of the most humdrum sort, are usually moving targets; to keep matching them, one must keep on the move oneself.

It is difficult to determine the exact significance of nanoinnovation, which can vary greatly depending on the background conditions. An educated, "smart" and adaptable workforce is often mentioned as an important asset for countries or companies, whereas a lack of ability to work independently and responsively is considered a major disadvantage, which might cancel out otherwise strong competitive advantages like, for example, low wages, reliability and steadiness. Nanoinnovation can, however, always be outsmarted by more radical innovation (that is, macro-inventions being put to use), which renders obsolete the very processes that the smaller continuous innovations aim at sustaining and improving. Even very responsive and adaptable makers of horse carts soon had to give in to trains and cars, even though it took quite a time before the latter were produced in an equally refined and skillful manner. In areas and periods where macroinventions are relatively scarce (like parts of the twentieth century arguably were, cf. Mokyr 2002: 105ff.), nanoinnovation may be just as important as the microinventions

themselves, which are often spread quickly and cheaply; the real race is for developing and maintaining competitive ways of slightly improving, producing and marketing them. This holds not just for innovation in the commercial sphere, but also for social innovation (where "marketing" should be understood as a metaphor for bringing services and practices to the target group).

By focusing on nanoinnovation, we are led to see how innovation is connected to *organizational* learning. Innovations are solutions to tasks, or the simultaneous creation and matching of new tasks. But tasks are not only posed to individuals, they are also posed to organizations, which are generally defined and delineated according to a specific task or set of tasks. Organizations can thus rightly – and not merely metaphorically – be described as more or less innovative. The innovative potential of an organization is not just the sum of the individual abilities of its members. The distribution and coordination of subtasks and the allocation of individuals with task-specific innovative potential to appropriate within the organization are crucial. It is possible to compensate for deficiencies in the abilities in individuals by creating appropriate organizational structures: an individual may be unable to solve a problem by him- or herself, and unable to learn it in the situation, but knowledge of and easy access to relevant experts within the organization might do just as well. It is likely, however, that even the most cleverly designed organization will need a continuous "bottom-up" adjustment and a certain responsiveness from its members, who must remain sufficiently perceptive and motivated in order to properly use and sustain the organizational arrangements. This again shows the importance of nanoinnovation.

A final striking parallel between innovation and learning concerns Schumpeter's point that innovation often involves the *education* of consumers, who must be taught to desire the products that the innovator intends to bring to them. This applies to teaching, learning and education in general: it is seldom merely about teaching students something they don't know, but clearly want to know. More often, teaching aims at expanding the students' horizon and thus teaching them something which is not only unknown to them, but which they do not even desire to know, that is, which they do not see the point of learning. There is a clear parallel to user-driven invention as well: if one wishes to make one's teaching centered on students and their particular needs and interests, one should look to their general situation, background and experiences, but *not* simply give them what they presently desire.

Again, Plato's learning paradox is lurking in the background. One of the most fundamental problems of teaching is that students need an initial interest in a subject in order to learn it properly – but that, in a way, they

cannot have such an interest before they have got to know the subject. Its full significance, and thus the basic motivation for learning it, only shows after it has been learned (cf. Goldman 1999: 350). The good teacher copes with this problem much like a talented innovator: she produces a desire for the goods she has on offer as she goes along, by stimulating curiosity, providing stimulating glimpses of the future benefits and meaningful challenges that await the students beyond their present horizon.

6. CONCLUSION: WHAT INNOVATION IS AND IS NOT

Let me sum up the results of my analysis and try to deal with some of the tensions that it might have left unresolved. First, I suggest that innovation (in the currently standard, somewhat narrow sense, in which I recommend that the word be used) should be defined as follows:

> Innovation occurs if and only if there is an *intentional production of something which is new and fairly immediately useful* (to a novel degree) *to a person or* (preferably) *a larger group*.

That the product must be "fairly immediately useful" means that it must either (1) be able to actually solve an existing task or meets an existing demand, or (2) be able to actually solve ("match") a new task or meet a new demand which was created identified or created simultaneously with the creation of the product, and which was quickly and easily recognized as such. (It is not required that the product actually *solves* the task, since it can happen that an innovation is not implemented due to various external circumstances.)

Innovation in this sense will often consist in the "translation" of an existing, yet still not practical idea or invention into something concretely useful. But it can also be a more integrated process which comprises the conception of new ideas, invention and innovation, all three elements being interrelated and simultaneously present at each stage in the process.

"Production" should be understood very broadly. It is not restricted to the creation of concrete "products", that is, technical devices and the like, but also comprises business models, procedures and organizational arrangements, forms of communication and so on.

Innovation must be an *intentional* production. Though a clear and conscious prediction of the actual outcome and its specific utility is not required, an innovation must at least stem from an intentional effort to innovate, and the outcome must have a certain (albeit not very great)

similarity to that which was originally intended. Pure serendipitous discoveries do not count as innovations.

It follows from the definition that innovation must *not* necessarily lead to a general improvement of the state-of-the-art in the field in question. It does not imply maximization of (and not even an increase in) overall utility, since what is useful to a certain group can make other and larger groups worse off. A car with extremely high fuel consumption may count as innovation if it is able to find its buyers among a few super-rich, though its production and use may be a waste of resources and do damage to the environment. This is one reason why innovation is not necessarily a good thing seen from a moral point of view. Some might want to build moral standards into the notion of innovation, but this would conflict with actual usage. It is more convenient and perspicuous to speak simply of *responsible* and *irresponsible* innovation.

Innovation must be distinguished from *entrepreneurship*, though the latter is clearly a special case of the former. An entrepreneur must be capable of *making things happen in the social sphere*, something which is not required of an innovator. But I favor a definition of entrepreneurship that does not tie it closely to business tasks or aptitude for commercial success, since it should be possible to countenance *social* entrepreneurship as well. A social entrepreneur will need *managerial* skills, but these are not identical with *business skills*, even though most real-life projects in social innovation will require skillful handling of economic issues as well.

When innovation is distinguished from entrepreneurship, it becomes more difficult to separate it from *invention*. In fact I have no definite proposal for a definition of invention, and I think we will have to live with an ineradicable overlap between the two notions. I take it, however, that invention is closer to the broad notion of *creativity* than innovation, that it lies somewhere in the middle between the two. An invention need not be *immediately useful.* It must, however, be more than merely a meaningful idea. An invention must be potentially useful; it must be able to serve some practical purpose (though this is itself a rather vague and context-dependent notion, as a practical purpose does not have to be generally acknowledged as such in advance). We might gain some clarity by saying that an invention will often be merely a *prototype* (albeit of a kind that eventually proves, or could be, successful), whereas innovation aims at producing a "full design", ready to fulfill actual practical purposes. Typical examples from the business literature include the microprocessor, which was itself an invention, but had to await subsequent innovations in order to become concretely useful, and the iPod, which was itself not an invention, since the handheld MP3-player had been introduced several years earlier, but counts as a major innovation, due to its improved design

and user-friendliness. However, these examples also show the arbitrariness of the distinction, since the characterization of innovations as successful combinations of already existing features also apply to many so-called inventions. (Some argue that Watt *invented* the (modern) steam engine precisely because he added additional features to the original, inefficient design. The fact that it was just as much due to the financial support and marketing talent of Watt's partner Boulton, a typical *entrepreneur*, that his design became the epitome of a steam engine, highlights the interwoven nature of real life invention and innovation processes.) The difference between invention and innovation seems to be, at best, a relative one: earlier innovations are conceived, retrospectively, as inventions, on which further innovations can be based.

Of course, "invention" also means the *creation*, that is, the *very first* instance of a product of a certain type. This does not really distinguish it from innovation, which is also subject to a novelty requirement. But it does indicate a difference as to how much emphasis is put on questions of origin, uniqueness and ownership. Inventing is about a creator being *the very first*; innovation is about making things useful, with less regard **to** the question of credit and originality.

On the proposed definitions, Leonardo was extremely creative, but less innovative, since his visionary devices were not really able to work. They cannot even count as *inventions*, as they were too far from being actually useful. Enrico Bernardi, who prototyped the petrol combustion engine at the same time, or perhaps even earlier, as Karl Benz, was clearly an inventor, and also an innovator, though he was insufficiently successful in – and too little concerned with – producing and marketing his vehicles to count as an entrepreneur. By contrast, apart from being an innovator (and maybe, but only maybe, an inventor), Karl Benz was clearly also an entrepreneur, who attained commercial and organizational success beyond what could be expected due to the performance of his automobiles alone.

Finally, what are the main lessons to be learned from this analysis? Most importantly, innovation should be conceived neither too broadly nor too narrowly. It is a narrower, more specific notion than creativity, inasmuch as it is concerned with immediate usefulness. On the other hand, innovation is still a much broader category than is often realized. It is not merely found in certain fields and product types (for example, currently fashionable high-tech or the commercial sphere). It can occur everywhere, and especially radical innovation is likely to occur in new and unexpected fields – this is almost a definitional truth, but far from trivial – and will often go hand in hand with the development of whole new tasks and demands. Though this is no argument against supporting emerging technologies or further development of currently existing ideas,

which may prove sufficiently rewarding in the short run, it does warn us against clinging on too tightly to our pet projects and concentrating our efforts too narrowly. Both the history of human civilization and conceptual analysis of the very notion of innovation strongly indicate that we should remain open to alternative pathways. So while my analysis has aimed at distinguishing innovation from creativity, and stressed its connections with immediate tasks and concrete solutions, it does, in the end, forge a link between the two and reminds us of the practical potential of radical new ideas.

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