Reducing Ethical Hazards in Knowledge Production

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Abstract This article discusses the ethics of knowledge production (KP) from a cultural point of view, in contrast with the more usual emphasis on the ethical issues facing individuals involved in KP. Here, the emphasis is on the cultural environment within which individuals, groups and institutions perform KP. A principal purpose is to suggest ways in which reliable scientific knowledge could be produced more efficiently. The distinction between ethical *hazard* and (un)ethical *behaviour* is noted. Ethical hazards cannot be eliminated but they can be reduced if the cultural ambience is suitable. The main suggestions for reducing ethical hazards in KP relate to the review process. It is argued that some defects of the current, largely anonymous, review process could be ameliorated by a process of comprehensive, open and ongoing review (COOR). This includes partial professionalisation of the work of reviewing. Review at several stages is a vital part of the long filtering that incorporates some claims into the canon of reliable knowledge. The review process would be an acknowledged and explicit part of KP - a respected, public and rewarded activity. COOR would be expensive but cost-effective. The costs should be built explicitly into research culture. Finally, the considerations about a more 'KP friendly' culture lead to advocacy of a 'long-term, short-term' synthesis; that is, of the synthesis of long-term vision, such as a more cooperative and less competitive culture, with incremental changes which may be implemented in the short term.

Keywords Knowledge production Ethical hazards Ethos of science Peer review Comprehensive review Openness

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1. Introduction

When the ethics of scientific research, and more generally of knowledge production, are addressed, the discourse is frequently idealistic. Scientists and other knowledge producers are commonly expected to adhere to demanding standards, expressed by Robert Merton in 1942 (see for example Merton 1996a) as four norms of the ethos of science, namely communalism, universalism, disinterestedness and organised scepticism (CUDS). While Merton's ideas have long been criticised and transcended by philosophers and sociologists of science (Jasanoff et al. 1995, Sismondo 2010, Mitroff 1974, Anderson 2010), the norms remain durable in the thought of scientists, engineers and a wider intellectual public. And, indeed, if these norms were to mean nothing, it is hard to imagine any knowledge at all of the kind that we call scientific. Would-be knowledge producers who are found to defy these norms in any important way receive heavy criticism and redemption is hard, albeit not impossible, to achieve (Redman and Metz 2008).

In the preceding sentences I have deliberately followed a widespread practice of focusing on individuals - a focus that is no doubt natural to humans. People are interesting as individuals, as are their achievements and frailties. Yet personalised accounts lacking adequate social context are not sufficient as contributions to a serious study of knowledge and how it is produced. It is here suggested that loading the burden of adherence to the demanding CUDS norms mainly on individual scientists and engineers and other knowledge producers may be counterproductive. If we wish for a high standard of integrity in knowledge production it is desirable to be even-handed in giving attention to the individuals, the groups, the institutions and the culture within which KP is practised. This line of thought leads to an emphasis on the *ethical hazards* to which individuals, groups and institutions are exposed. Such hazards are a part of the culture within which any particular KP activity takes place. Ethical hazards cannot be eliminated entirely but they can be reduced if the ambient culture changes so as to reduce motives for unethical behaviour. An important source of such motives in KP at the present time is a strong belief in the advantages of

competition - between individuals, between groups and between institutions - compared with cooperation. It is argued here that scientific knowledge production, dependent as it is on communalism, universalism, disinterestedness and scepticism, would benefit from a shift away from the currently dominant ideology of competition and towards an ideology of cooperation. In any debate about the kind of culture best suited to KP, long-term, visionary proposals and short-term, incremental proposals are sure to be advanced. This article ends with brief remarks about the need for both and the relation between them.

2. Knowledge Production and its Values

Although knowledge in general is broader than scientific knowledge, and can, for example, include implicit knowledge (Tirosh 1994), I will restrict the discussion in this article to scientific knowledge (Ziman 1978), which is specially systematic and reliable, characterised by empiricism, systematic theory, falsifiability and organised scepticism.

I emphasise the *production* of knowledge in order to focus on the long trail from initial ideas and speculations to incorporation into a corpus of generally accepted reliable knowledge. The phrase knowledge production (KP) also emphasises the complex social process whereby reliable knowledge comes into being. It is far more complex than what is suggested by a 'eureka moment' account of a (supposedly) discrete discovery. The process involves many more actors than an individual discoverer or inventor, or even a group of such. Peers, performing formal and informal peer review; administrators; policy advisers and politicians; editors; journalists; opinion leaders in wider society - all of these play significant parts. And the development from speculative half-formed idea to generally accepted reliable knowledge takes time, especially if the idea requires that society give up other deeply internalised assumptions.

2.1 The ethos of science

I will begin the discussion of ethical norms that are important in

knowledge production with the norms of science given by Robert K. Merton over seventy years ago (see Merton 1996a for one of numerous reprints of a classic paper). He argued that science had an institutional ethos, described by four norms

- Universalism (the acceptance or rejection of scientific truth claims does not depend on the personal or social attributes of their protagonists)
- "Communism" (the findings of science are assigned to the entire human community)
- Disinterestedness (scientists' motives, or interests, may affect their individual actions and claims but a rigorous collective filtering removes such interests from the canon of accepted scientific knowledge)
- Organized Skepticism (new scientific knowledge claims are subjected to detached scrutiny according to empirical and logical criteria).

The four headings and their order are those given by Merton, who gave an eight page gloss on their meaning. Despite all later criticisms and sophistications (see, for example, Jasanoff et al 1995, Sismondo 2010), these norms - when correctly understood - remain at the heart of the production of reliable knowledge. I will add remarks about other values relevant for KP in the next sections.

Merton's paper (1996a) on the ethos of science is especially relevant for the present work because it emphasises science as an institution rather than scientists as individuals of a special kind (see, in particular, pages 274-275). It is usual nowadays to replace Communism (bearing clumsy scare-quotes) with the term Communalism, which is less open to misinterpretation. It is also usual to re-order the norms to provide the memorable abbreviation CUDS.

The tension, passion and drama of ethical issues arises from the difference between behaviour that is considered right and actual behaviour. Merton presents his work on the norms mainly as descriptive of an ideology that scientists learn, internalise and enforce on each other. It is clear, however, that he does not adhere solely to a sociologist's descriptive programme. He

evidently identifies with scientists in their approval of the ethos of science and he considers it culturally valuable. Merton himself, in later work, recognised the ambivalence of scientists towards the idealistic norms. See, for example, Merton (1974), first published in 1963. Mitroff (1974) found evidence that a group of scientists believed, in an ambivalent manner, in the force of the Mertonian norms but also of counter-norms which are more-or-less direct contradictions of the norms, for example, interestedness against disinterestedness. Mitroff's study comprised extensive interviews with scientists connected with access to the earliest rock specimens brought back to earth from the moon. It is worth remarking that this episode was not typical of all science, being intensely competitive and having a high public profile.

Anderson et al (2010) have studied the degree to which scientists subscribe to the Mertonian norms and to corresponding counter-norms, which they name individualism, particularism, self-interestedness and organised dogmatism. They find (see especially their Figure 1, p386) a much higher subscription to all of the Mertonian norms than to the counter-norms. This is not surprising, even though the cultural, especially economic, setting within which science is practised has changed much since the 1940s to 1960s period. A general dominance of the counter-norms would undermine the credibility of science as a whole.

2.2 Originality and innovation

Many humans (but not all) are attracted to the new. By its nature the consequences (and even the validity) of the new is not immediately apparent. Here are extensive grounds for ethical hazards. Is the risk of entering uncharted territory justified? Who or what bears the risk of adverse consequences and who or what stands to reap the possible benefits?

The term originality is generally used in connection with science and scholarship - intellectual inquiry. Ideas, observations and experiments with a high level of originality generate much interest. Of all new truth claims, only a small fraction stand the

test of organised scepticism and make it into the canon of reliable knowledge. Such cases are justly celebrated.

'Originality' has occasionally (see, for example, p.177 of Ziman 1994) been added to the Mertonian norms to produce the acronym CUDOS (Communalism, Universality, Disinterestedness, Originality, Scepticism). This appears to me not to be an improvement on Merton's formulation. It is true that originality, or creativity, are important for the vitality of reliable knowledge, but it is possible to imagine a culture that valued many small contributions and did not celebrate disproportionately the most original contributions. The basic four Mertonian norms are, by contrast, essential to the institution of science (and, more broadly, reliable knowledge) as we understand it. The practice and management of KP has changed since the norms were proposed but they were never a description of how knowledge is actually produced. They were and are a description of the *ideals* of the individuals, groups and institutions in their role as practitioners of KP, no matter how much they compromise with other exigencies in their actual behaviour. In this paper we are considering the tensions between the ideals and other calls.

The term innovation is widely used in the context of a new process or device, especially if it has commercial potential. Again there is a race but this time for patent protection rather than for prestige. Again, ethical hazards arise. There is a general tension between the ethos of science (Mertonian norms) and the ethos of commerce, where the good tends to be measured in monetary terms.

2.3 Beauty

One can imagine a universe in which reliable knowledge gained by intelligent beings had no specially attractive structure. The beings discovered knowledge piecemeal and accepted it in each case with an 'ah well! this is how it is'. That universe would be nothing like our universe, or at least those beings would be nothing like us. The structure of reliable knowledge is striking and most people, to a varying extent, find it beautiful. To many engaged seriously in KP, this sense of beauty is strong and

durable. But even this has its ethical hazard, since it is possible to be seduced by beauty, become blinkered and not see important hazards such as the risk that one's output may be mis-used.

2.4 Utility (public good and private profit)

It is possible to argue that everything that humans value is of use. Then even beauty would be said to be useful to those who valued beauty. This would however be contrary to normal usage and I have therefore separated *utility* from the values *ethos of science, originality and innovation,* and *beauty*. Utility is an important justification for the pursuit of KP, and especially when KP practitioners bid for large funds or other resources (from businesses, governments or philanthropic foundations). Sometimes the initiative comes from the other side - businesses, governments or philanthropic foundations commissioning KP projects in the expectation that the knowledge produced will be useful. Here the anticipation is that the results will probably support the commissioner's mission - which might be economic, or desire for prestige, or of some other kind. From the account given so far one can see that utility is not (and should not be) one of the Mertonian norms, because it generally fails to meet the norm of disinterestedness.

3. Ethics in Knowledge Production

One standard dictionary definition of 'ethical' gives "relating to moral principles or the branch of knowledge dealing with these" and, as a subsense, simply "morally correct" (Oxford English Dictionary Online 2014). The question therefore shifts to 'what is the meaning of moral?'and Soanes and Stevenson (2003) answer "concerned with the principles of right and wrong behaviour" together with the subsense "concerned with, based on or adhering to the code of behaviour that is considered right or acceptable in a particular society rather than legal rights or duties". We note the use of the term *behaviour*, which is often, although not exclusively, associated with individuals. The present paper turns the spotlight from individuals to culture. The word *behaviour*

therefore should be understood here in a general way, applying equally well to a person, a group of persons or an institution.

4. Ethical Hazards for Knowledge Production

I use the term *ethical hazards* in an everyday sense, namely

> *situations which present danger that a person, group of persons, institution or society may fall into unethical behaviour.*

Ethical hazards are not unethical *behaviours* but rather the *risks* of such. Some kinds of ethical hazard in knowledge production are

- risk of eliciting the fabrication or falsification of data
- risk that anonymous referees may abuse their anonymity
- tunnel vision risks (investigators and institutions may neglect to ask questions about the ethical consequences of their work)
- risk of malicious, false 'whistleblowing' claims being made
- risk of reprisals against genuine whistleblowers
- risk that sponsors assert control over publication and allow only their preferred findings to be published
- risk that powerful institutions or individuals may influence knowledge production in unethical ways
- risk of exaggeration of claims
- corner-cutting risks (arising from, for example, an impatient desire for the rewards of KP achievement)
- risk of unfair conditions for female knowledge workers.

Some of these kinds of risk will be apparent in one or more of the examples discussed in Section 8 *Examples* but I will not attempt an exhaustive identification of all the kinds existing in each example. Often there is a synergy between various kinds of risk, so that an environment may be overall conducive to ethical behaviour, or it may be overall conducive to unethical behaviour. Some ethical hazards are specific to KP, or else have a particular meaning in that context; and others are general - that is, are risks of producing behaviour that is unethical in the ambient culture. Perhaps the ethical hazard that is most clearly of the KP kind is the risk of eliciting the *fabrication or falsification of data*, which strikes at the heart of KP. The practice of

plagiarism, on the other hand, has only an indirect connection with KP and is about the theft of credit, something that is considered generally unethical in many cultures. Consequently, hazards that increase the incidence of plagiarism, such as unbridled competition or lax supervision, are general ethical hazards.

Two connected ethical hazards to which culture in general is exposed but which affect knowledge in a particular way are *inattention to consequences* and *denial of responsibility*. An example from an important chapter of knowledge production occurred in Italy during the rise of fascism in the 1930s. Enrico Fermi built a brilliant nuclear physics research group and one member, Emilio Segrè, wrote in his biography of Fermi

> Having solved one problem, we immediately attacked another, without a break. 'Physics as soma' was our description of the work we performed while the general situation in Italy grew more and more bleak ... In Aldous Huxley's novel Brave New World soma pills ... were taken by men of the year 2000 to fight despondency.
>
> p.90 of Segrè (1970).

In another field, mathematics, a striking example of the use of soma occurs in the life of Paul Erdős, 'The man who loved only numbers' (Hoffman 1998). And of engineers, Albert Speer, German armaments minister during World War II, wrote

> Basically, I exploited the phenomenon of the technician's often blind devotion to his task. Because of what seems to be the moral neutrality of technology, these people were without any scruples about their activities. The more technical the world imposed on us by war, the more dangerous was this indifference of the technician to the direct consequences of his anonymous activities.
>
> page 212 of Speer (1970)

One may question Speer's superior tone in this passage but the description of blind devotion as an ethical hazard is compelling. By way of a contrast, the engineer Meredith Thring showed a devotion to the ethical pursuit of the engineering profession that was unusually consistent and clear-sighted. His book (Thring 1980) *The Engineer's Conscience*, although possibly expressed in quite

old-fashioned terms for some tastes, reveals his practice of engineering to high ethical standards and his early understanding of the ecological problems to which engineering may contribute, positively and negatively.

Two other ethical hazards which exist for culture in general but have a specific significances for KP may be mentioned. One is *exaggeration of claims*. In general discourse this is often no great deal and easily discounted. In KP it is more significant because the winnowing of ideas and truth claims proceeds more efficiently if they are presented judiciously at every stage. The other such hazard concerns the *social conditions of women*. That women should have a fair, or just, place in society, and not be second-class citizens, is a major part of the accepted norms of most contemporary cultures. This ethos does have a special weight in science and in KP generally because the Mertonian norms obviously demand it. Nevertheless, the struggle for justice in this matter is arduous, prolonged and far from over. It is plausible to attribute the slow progress in the domain of KP to the lengthy and demanding apprenticeship that is necessary before a scholar or other KP professional, of either sex, may make a recognised contribution. With current cultural arrangements it is more difficult for women to complete this apprenticeship because of societal norms about family and child-rearing.

The *high esteem that originality commands* creates ethical hazards, for the big prize may tempt some (individuals, groups or institutions) to place winning the prize ahead of the Mertonian norms. In particular, credit goes to the first to publish. This leads to several hazards - incentive to rush results out; incentive to abuse refereeing anonymity by rejection or by theft; incentive to allow precursors to remain obscure.

Anonymity in KP is an issue which exercises knowledge producers mightily. Anonymity may take more than one form. Anonymous reviewers may judge signed submissions for funding or for publication; or there may be double-blind review in which the applicants' names are redacted (although in specialised fields the provenance of the application is often guessable). Unsurprisingly,

there is an enormous amount of speculative comment on whether the ethical hazards obviously intrinsic to the various uses of anonymity do in fact translate into actual unethical behaviour. That is, are the risks small or so large as to undermine the integrity of those uses? A few decades ago, useful real data started to be published. There now are numerous studies by editors and scholars with access to editorial and research funders' archives. The level of *consistency of reviewers* was studied systematically and likewise many other parameters, such as the possible influence of the *prestige* of the submitting authors' institutions. *Nonsense papers* were deliberately submitted. Important early studies include Harnad (1982) and Garfield (1989). The proliferation of such studies was propelled by several factors. Large data sets became available and they could be analysed more easily. And governments and large corporations funded KP on an increasing scale while also requiring grant-holders to be more accountable. *Signed review* also carries ethical hazard. There is risk of sycophancy and risk of timidity. Much more discussion, however, surrounds the ethical hazard (as well as the practical advantage) of anonymous review.

5. Ethical Hazards are not the same as Moral Hazard

The phrase *moral hazard* is widely, but not exclusively, used as a technical term in economics and insurance, meaning "the effect of insurance on the likelihood of the insured event occurring; the lack of incentive to avoid risk where there is protection against its consequences, e.g. by insurance" (Oxford English Dictionary Online 2014). This technical phrase is intended to be value-free and to have essentially no connection with morality. In recent years the expression moral hazard has also been popularly used in ways that are closer to its obvious everyday meaning. In the following the technical concept is not needed, so in view of the overall imprecision and confusion I will not use the term moral hazard.

6. Conditions for Reduced Ethical Hazards

6.1 Attainable Standards

This article is about *reducing* ethical hazards because it is not possible to remove them entirely. In a section *The Ills of Excessive Standards* Joseph Agassi wrote

> The current view of standards is moralistic and pedantic ... this situation creates a neurotic vicious cycle of an unresolved tension between standards of conduct and actual conduct ... I suggest to view all standards that are unattainable and tension-creating as undesirable. I recommend that we make our standards as realistic as possible, ie just comfortably above current usage. This would enable people to relax, be undefensive, learn to raise the level of their conduct to the standard, and permit the raising of the standard again by just a little so as to cause further improvement with no excessive tension.
>
> page 493 of Science and Society, (Agassi 1981)

An emphasis on the institution of science, more than on scientists as individuals, helps one to avoid the simplistic moralism that Agassi identifies as counter-productive. Science is about the production of reliable knowledge. The cognate subjects, such as engineering, that this this paper includes also contribute to and depend on reliable knowledge. The possibility of conforming to the ethos of science, or something like it, depends on the ambient culture. This article will suggest some features of an ambient culture that encourage ethical knowledge production. What is positive may be made more clear if it is contrasted with an example of an environment that is distinctly not conducive to the production of reliable knowledge, namely war. This is an institution where deception is central - truth is the first casualty. Louis Begley's novel *Wartime Lies* (2007) is about refugees caught up in war, persecuted and surviving by assuming false identities - the only strategy open to them. The novel subtly contrasts this false existence with 'normal' life, in which such radical and corrosive deception is not necessary. Although this is not stressed in the novel, one can think about war as an institution. This institution creates an environment in which being truthful is simply incompatible with survival. For a reader to be moralistic about the tissue of lies created by young Maciek

and his aunt Tania would be absurd. I mention this example in order to distance us from a moralistic attitude to individuals, groups or even KP institutions who, in the course of their KP work, fall prey to ethical hazards. The approach of this paper is to avoid being judgemental. Instead, I identify some of the ethical hazards that exist in our current culture and suggest how to reduce them.

Another reason for avoiding moralism is that individuals, groups and KP institutions have divided loyalties. It would be moralistic and pedantic, as Agassi puts it, to insist that a scientist give undivided loyalty to the ethos of science. Virtually everyone has loyalty to friends and family and, most of all, to themselves and their own survival. This has been enshrined in the maxim 'you can't love someone (or, we may add, something) better than you love yourself'. 'Divided loyalty' is a phrase commonly used in a context suggesting that undivided loyalty is expected, yet such expectation usually bespeaks manipulation. Undivided loyalty is at the least narrow and may often, as suggested by Agassi's analysis, be neurotic.

The Mertonian norms are idealistic and this has been the focus of criticism (for example, at various points in Jasanoff et al. 1995 and Ch 3 of Sismondo 2010). Practical ethics, however, *is* idealistic. Understood correctly, that is, as being in tension with counter-norms (Mitroff 1974), the Mertonian norms did and still do describe the *ethos* of science (Anderson et al 2010) and, by extension, of KP. The norms are important but for any individual, group or institution to attempt to apply them with complete rigour would stifle creativity and productivity.

> the setting of goals and patterns of behaviour, which are imposed mechanically or externally, and without understanding, produces a rigid structure in consciousness that blocks the free play of thought...
>
> p 231 of Bohm and Peat (1989)

Scepticism alone, if taken to an extreme (corrosive scepticism), is destructive of the creativity and productivity of oneself and of others. In day-to-day practice it is necessary to start from

where our KP culture now is: well-intentioned but part of a struggle for resources and recognition.

6.2 Openness

In recent decades much has been written about openness in science (see, for example Cottey 2010, de Roure et al. 2010, Eamon 1985, Gibbons and Wittrock 1985, Meyer and Sandøe 2012, Nielsen 2009, Peters 2014). Perhaps the clearest way to see the importance of openness is to consider its converse. If the basis of a knowledge claim cannot be fully examined, there is no way, short of attempting to reproduce the work, of applying organised scepticism. An institution that was not open to external scrutiny could have a system of *internal* scrutiny and organised scepticism. Indeed, if it did not have some such internal criticism, it could not function. On the basis of such thoughts, I introduced (in section 'C*b Open Science and Ring-fenced Science' of Cottey 2009) the concept of the fence and the ring-fencing of knowledge claims. If there is a fence around an institution which prevents outsiders from fully testing its knowledge claims then that fence must also prevent the export of those claims into the canon of public reliable knowledge. It is easy to assert this as a principle. It is much less easy to apply this principle if power and influence lie primarily with institutions that are not open. Conscious and courageous effort is required to avoid unreflective acceptance of apparently authoritative assertions.

There is another sense of openness, namely being receptive. The first sense is open to letting ideas and information *out.* The second sense is being open to letting ideas and information *in*. This is less discussed, because it is less problematic in KP. It is a hazard for older scientists (or other knowledge producers) who have long received great acclaim.

6.3 Openness, Confidence and Trust

In Cottey (2010) I identified openness, confidence and trust as essential conditions for science (and, by extension, KP) to flourish. Openness, confidence and trust are linked attributes of

human activity, including KP. Confidence here means 'self-confidence' and it can be an attribute of groups and institutions, as well of individuals. Trust means 'trust in others' which likewise can be an attribute of individuals, groups and institutions. This trust is not naive or unconditional trust but is rather 'trust but verify', which is perfectly compatible with organised scepticism. It allows openness to new untested ideas to work together with critical examination.

An overarching quality that nourishes openness, confidence and trust is *integrity,* in the sense of wholeness or unity. With this usage, integrity is not the same as honesty. For example, in *Wartime Lies* Maciek and Tania are for a time, and of necessity, totally dishonest, but they show a high degree of integrity in that they consistently do what they must in order to survive.

6.4 Cooperation

Accounts of KP as being performed by heroic individuals or small groups are appealing. Such accounts are simple, dramatic and human. Our propensity to create heroes, and the strong desire of many to achieve something heroic, leads to a winner-take-all culture, which I address in Section 7.2, on *Just and Proportionate Rewards*. In fact, nearly all KP is more complicated. In Cottey (2014) I discuss how KP is a long, complex process, with many actors. They work together to achieve a successful outcome. The cooperative nature of projects is under-reported in today's culture, dominated by a neo-liberal, individualistic ideology. A corrective may be found in the work of Elinor Ostrom and others (Ostrom 1990, Ostrom and Ahn 2003, Poteete, Janssen and Ostrom 2010) on 'the commons' and 'social capital'.

7. Means of Reducing Ethical Hazards

7.1 Exhortation, Propaganda, Penalties, Punishments

These are all ways in which unethical *behaviour* is discouraged. Various opinions are expressed about their appropriateness and effectiveness. The general perception is

- that KP practitioners suffer severe penalties if deemed guilty of certain infractions of the ethos of science (and KP)
- that fraud, especially the fabrication or falsification of data, results in effective banishment, if it comes to be generally believed
- and that there is little or no opportunity for redemption.

There is little systematic research in this area but Redman and Metz (2008), in a study based on the records of the U.S. Office of Research Integrity (ORI), have shown that the professional and personal consequences for individuals found guilty of misconduct are indeed severe, although not always as totally shattering as may have been popularly thought. It should be noted, however, that individuals are much more exposed to sanctions of this type than are groups and, especially, institutions. Indeed, it is by now well known that individual whistleblowers presenting an ethically powerful exposé often suffer unconscionable reprisals. This is an element in a case in medical research which I discuss in Section 8.3 *Obstacles to Honesty in Science*. Sanctions of the kinds discussed so far, from the court of opinion, are so severe that contested scientific advice is rarely brought before the civil or criminal law. An unusual case of this kind occurred however with the prosecution of scientists in connection with advice they gave ahead of the 2009 powerful earthquake at L'Aquila, Italy (Abbott and Nosengo 2014).

In general, the approaches of this section are aimed at deterrence, control or repression, so that KP individuals, groups or institutions resist any incentives from existing ethical hazards. This article is more concerned with reducing the hazards at source and the following sections suggest some means whereby this can be achieved.

7.2 Just and Proportionate Rewards

Since the Enlightenment period an ethos of democracy has spread around the globe. Like the Mertonian ethos of science, the ethos of democracy is idealistic and normative. It sets out principles

that are widely advocated and, to a meaningful extent, internalised. The Preamble to the Charter of the United Nations declares

> We the peoples of the United Nations determined … to reaffirm faith in fundamental human rights, in the dignity and worth of the human person, in the equal rights of men and women and of nations large and small …
>
> United Nations (1945)

During the seventy years since then, genuine movement in the direction of these ambitious aspirations has occurred. For example, oppressive racist and sexist assumptions and behaviour are widely considered unacceptable. The change in respect of economic equality, however, is more complex. This is linked with an ideology, sometimes called neoliberalism (Steger and Roy 2010), contrary to that which underlies the UN Charter. In this ideology, words like *competition, aspiration, excellence* and *wealth* are part of an anti-egalitarian world-view. In this view, human culture benefits from the self-interested hard work of a small number of talented, ambitious, striving people, groups and institutions. It is argued that the prospect of great rewards, especially economic rewards, strongly motivates these individuals, etc. Their achievements benefit all. In this way, inequality is justified. It does not matter how extreme are the rewards to the winners as long as there is some benefit to all who are deserving (for example, those who may lack talent but at least work hard).

A culture in which rewards for success are disproportionate is sometimes described as a *winner-take-all* culture (Frank and Cook 2010). Strong inequality of rewards occurs in KP as well as in commerce. Even in highly specialised areas of scientific research, where reputation is supposed to be built up fairly among a peer-group of cognoscenti, the contributions of the obscure are under-recorded in favour of a simplified account naming one discoverer, or at most a few. This phenomenon was studied by Merton (a reprint is available at Merton 1996b) and dubbed the Matthew Effect, after the biblical passage "For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath." (Matthew 1953).

Ethical hazards in KP deriving from *winner-take-all* are of two main types. One is the incentive to depart from communalism - to deviate from the spirit of cooperation which nourishes enquiries beyond what can be achieved by a single person. The second type occurs mainly in the production of knowledge that is useful for private gain. In the neoliberal commercial ethos which dominates human culture at present, strong patent and copyright laws and trade agreements give advantage to the most powerful individuals, groups, institutions and nation-states (Bettig 1996, Halbert 2014). The advantages of being the winner in the commercial exploitation of new knowledge are so great as to exacerbate existing ethical hazards, which would be reduced if the *winner-take-all* culture were reined in from its present extreme level (Cottey 2014).

7.3 Comprehensive, Open and Ongoing Review (COOR)

In this section I will take a broader than usual look at the process of filtering that may be considered to start with a speculative idea and end, in a few cases, with incorporation into a canon of reliable knowledge. The process of filtering involves much more than simply the contributions of the referees of a funding proposal or of a paper submitted for publication. I have described the long process on pages 475-477 of Cottey (2014). The process is secretive and unaccountable at many stages. Over the last half century there has been intense interest in the process with an enormous amount of comment. There are contradictory trends - on the one hand efforts to promote the Mertonian norms and on the other hand a shift from public ownership to private property. Formerly discreet steps of the filtering process have in some cases been opened. Many statistical analyses of public domain information or of information voluntarily made available to investigators have been conducted. Undercover investigations have been made, with the true motive revealed later. Experiments with different ways of filtering have been performed and some are turning into long-term changes of practice. It is not the purpose of this paper to review the many parts of this huge area but rather to look at the whole of the filtering process from a distance. This permits us to consider what may be possible in the

long term as well as incremental suggestions and experiments.

The COOR idea starts from the observation that the production of established knowledge is a long, complex process, in which many people, groups and institutions are involved. The traditional emphasis on one or a few creative individuals is understandable. It provides a simple and enjoyable narrative but is not satisfactory when we want to understand KP and its ethical hazards more deeply. For this, all of the many steps and the many actors in KP have to be taken into account. These steps can involve - private thought by one or a few individuals, consultation with peers, development of a project plan, negotiation with employing institution, application for funding, consideration by funding bodies, peer review of funding application, further negotiations with the institution, hiring of staff, purchasing and/or building equipment, conducting the project, preliminary reports (first to selected peers, then to a conference, then to a preprint repository), submission of formal report for publication in a recognised and archival journal, filtering by an editor, peer review, revision, publication. That is a natural endpoint of a filtering process but not the end of the (potential) absorption into the canon of reliable knowledge, which continues with further criticism, refinement, dissemination and use.

And even this long list has omitted everything to do with property, which is relevant in every case, if only as a copyright assignment. More usually, and increasingly so in recent decades, KP is connected with property rights - Who owns the findings and controls their publication or suppression? What property rights of others impinge on the project under consideration?

In this article, I focus, as far as possible, on the *production* of reliable knowledge and the associated ethical hazards; for the most part, I leave aside issues specific to the use of knowledge. Suppose, for example, that in an engineering project some managers, for business reasons, suppressed warnings from engineers which were based on reliable knowledge. There were business imperatives which conflicted with the production of reliable knowledge. There is ethical hazard for KP in this situation. It

does not matter whether the warnings relate to safety or to profitability or to something else. If the production of reliable knowledge is compromised, actually or potentially, then there is ethical hazard for KP. On the other hand, certain unethical business practices, such as false accounting, might not be especially connected with KP. These are not within the remit of this paper.

In COOR, the term *comprehensive* means that the review of a putative contribution to reliable knowledge covers all aspects of the work and involves all parties involved or affected. This means that review by experts in a specialised peer group is not enough. The fallibility of peer review has received extensive comment and research, mainly on account of its lack of openness and accountability (Bohannon 2013, Ford 2013, Garfield 1989, Harnad 1982, Herron 2012, Miller 2006, Nature Editorial 2014, Peters 2014, van Rooyen, Delamothe and Evans 2010). A point less often noted is that review by peers alone is bound to serve the interests of the peer group itself and cannot entertain possibilities that conflict with those interests. Knowledge today is highly specialised and every expert has personally invested decades of demanding effort into getting where he or she is. In a comprehensive review the collective interests of the peer group will of course be represented but so also, as appropriate and with their various due weights, may the interests of all the other players - scholars from adjacent specialities; administrators and politicians; ethicists; representatives of those who may be most affected by likely use of the knowledge. Only a few major projects would receive a full, heavy review. The aim is to make knowledge production more democratic and more oriented toward living with the earth and sustaining human culture.

Concerning *openness* in COOR, there is already a trend in this direction, ideologically and in practice (Atmospheric Chemistry and Physics 2014, Biology Direct 2014). The latter of these two journals says of its review system that it

> offers a novel system of peer review, allowing authors to select suitable reviewers from the journal's Editorial Board; making the peer-review process open rather than anonymous; and

> making the reviewers' reports public, thus increasing the responsibility of the referees and eliminating sources of abuse in the refereeing process.

This trend does however coexist with a trend towards the 'fencing-in' of knowledge that is commercially valuable or sensitive (Wilmshurst 2013). The present paper is more about what may be possible in the longer term. There could, in due course, exist a level of openness in KP that appears radical by today's standards. The fundamental condition for this is a change of cultural context, from a competitive society to a cooperative one. This requires a reversal of the current trend, something that cannot be ruled in or out. In a cooperative society, openness in KP would not be as alarming as it appears at present. If, for example, referees wrote open, signed reviews, and this was the normal practice, then such reviews would be frank but measured, and there would be no great need for embarrassment or fear by any party.

The *ongoing* element of COOR comes from the fact, discussed earlier, that a contribution to reliable knowledge is a long process. Much more is involved than the two elements of review (of funding application and of submission for publication) that command most attention. Especially if a contribution is to make it into a canon of core reliable knowledge, the reviewing continues long after publication, as the contribution is refined and used. An example of such ongoing review in medical research is known as *critical appraisal*

> the process of careful, transparent and systematic examination of research to judge its trustworthiness, and its value and relevance in a particular situation.
>
> page 12 of Wilmshurst (2013)

The review process must also start early. This is especially true of ethical review, as ethical concerns are unlikely to stop a project after funding approval has been provisionally awarded.

The COOR process is evidently heavy and it may be asked 'is this not over-the-top?', 'will it not slow KP?', 'is it not unreasonably expensive?' The response to these questions is that COOR is not proposed as a blueprint, as an elaborate programme

that would come into play for all KP projects. Rather, it is an overall philosophy, which aims to promote *integrity*, a concept that is seen to be valued already in the existence and work of the US Office of Research Integrity (2014). COOR foregrounds the long trail of KP but the full COOR apparatus would come into play only for large or problematic projects. Even with this qualification, it is clear that COOR would be expensive, whether measured in monetary or 'intellectual energy' terms. This reflects that COOR is a major and central part of the entire KP process and should be treated as such. Its funding should be an explicit part of any funded KP project. At present, funding of the review process is haphazard. A particularly unsatisfactory aspect is the reward (non)system for refereeing submissions for publication. Referees do not usually receive any payment for their reviewing work and it does not feed directly into performance indicators and thence, *one might suppose*, into career advancement. On the face of it, referees do this work out of an altruistic feeling for the advancement of knowledge. Upon a more careful consideration, however, those familiar with the refereeing process know that refereeing is an important part of becoming a recognised member of an expert peer group. In itself, this is a proper state of affairs. There are, however, serious problems of ethics and of efficiency, deriving from the lack of *explicit* recognition of the work and from the lack of public accountability. Some of the consequent ethical hazards were discussed in Section 4, *Ethical Hazards for Knowledge Production*.

There is a widespread perception and some evidence (Bohannon 2013, Garfield 1989, Harnad 1982, Herron 2012, Miller 2006, Wilmshurst 2013) that refereeing is performed unevenly - sometimes well, sometimes casually and sometimes unethically. Part of the COOR idea is that refereeing is important and creative and it should be an explicitly and publicly recognised part of KP. If this were the case, editors would be able to receive high quality reviews and would receive them promptly.

> Universities must change the traditional evaluation of academic editorship as ‘service’ and consider it as part of a faculty member’s scholarly research.
>
> page 444 of Gould (2010)

A Nature Editorial (2014) declaring "welcome efforts are being made to recognize academics who give up their time to peer review" is another manifestation of the growing interest in explicitly valuing review work. Open signed reviews would be a part of the public KP process and would be recognised in performance indicators. Recognising the contributions of those who assess primary truth claims would be an element in a general shift away from the winner-take-all culture in KP.

8. Examples

In this section I discuss briefly (more detail may be found in the references) some cases which expose various kinds of ethical hazard in KP. The discussions also suggest, explicitly or implicitly, ways in which such hazards may be reduced.

8.1 Open Signed Reviews

Van Rooyen, Delamothe and Evans (2010) conducted a randomised controlled comparison of signed and unsigned referee reviews for the British Medical Journal (BMJ). They detected no difference of review quality but nevertheless concluded that signed reviewing was the better way because of its transparency and this outweighed the disadvantages, namely a "high refusal rate among potential peer reviewers and an increase in the amount of time taken to write a review". The lack of increase of review quality would appear to reflect well on the normal review process of BMJ, a long-established and respected journal. A similar trial on some other journals might not provide such an endorsement; such a trial would, for an obvious reason, be harder to arrange.

8.2 The *Science* Sting on Open-access Journals

The rapid changes during recent decades in KP publishing have produced a Wild West culture, which will no doubt be gradually replaced by a more settled publishing milieu, so that authors, publishers and readers are able to exercise an informed trust. One may suppose that *Science*, one of the most renowned subscription journals involved in the KP process, was especially concerned at

the recent proliferation of journals with a different business model, being open-access for readers and gaining income from charges to authors. And, while these journals claim to maintain rigorous quality control by peer review, it is well known that this is far from uniformly true. *Science* performed a test (Bohannon 2013) by submitting (slight variations of) a minimally plausible nonsense paper, which should have been rejected at first sight, to 304 open-access journals. More than half of these journals nevertheless approved the submission for publication.

My conclusions from this are
- the sting by *Science* confirms that there is a significant problem of a certain kind of unethical *behaviour*, namely claiming that papers have passed a rigorous peer-review filtering when in fact they have not
- there is an ethical *hazard*, which derives from the incentive to gain the prestige of contributions to reliable knowledge, or to make easy money therefrom, without going through the demanding work and expense that is needed
- the hazard would be greatly *reduced* if this kind of short changing were harder to perpetrate, which would be so if the review process were open.

It is worth noting that in this example the virtue of openness has been 'contaminated' by association with a disreputable implementation of open-access, incentivised by a business model inconsistent with the norms of science. Open-access is an excellent way of disseminating knowledge but it needs to go together with openness and accountability at all stages of KP. As already pointed out in Section 7.3 on *Comprehensive, Open and Ongoing Review (COOR)*, this would be possible if the considerable expense of filtering knowledge claims were built into the core of KP funding.

8.3 Obstacles to Honesty in Science

A large part of the scholarly literature on ethics and KP is in medical ethics. This is not surprising, as ethics affects how we live and medicine can affect whether we live. Much of medical

research is currently undertaken by global corporations whose very existence, in the prevailing political and economic conditions, depends on profitability in a generalised market in which almost everything is tradable with almost everything else. This kind of performance, reflected in share price, is only remotely connected with the original purpose of medical research - to promote health. Thus medical research is conducted in an ethically hazardous terrain. Many of these hazards are indicated in Wilmshurst (2013). A few of them are

- risk that 'positive trials' get published and 'negative trials' do not
- risk of the offering and accepting of generous consulting terms in return for favourable reviews
- risk of reprisals against justified whistleblowers.

How to reduce these hazards? Medical research exists in a market but, if the primary purpose of the work is to promote health, that market is inefficient. It is necessary that the (cultural and organisational) institutions of medical research be linked more directly with health and less directly with monetary profit.

8.4 Fermat's Last Theorem

In Section 6.4, on *Cooperation*, I mentioned the cult of the heroic individual in KP. An instructive example is provided by the proof of a famous mathematical conjecture of Pierre de Fermat (Singh 2005). For three and a half centuries this result, so easy to state and understand (ibid. page 32), eluded proof by the world's mathematicians. In 1994 Andrew Wiles, after late help from referees and from Richard Taylor, produced a proof that withstood the close critical examination of mathematicians. Heroic deeds are hazardous in various ways. Wiles worked in secret for seven years, to the detriment of collective progress (ibid. page 229; also page 183 of Hoffman 1998); he worked obsessively, apparently neglecting any deep connection with his family (Singh pages 230 and 259); he deceived colleagues about what he was doing (ibid, page 229); and he used graduate students by putting on a course with a private agenda (ibid. page 264). These observations are offered here, not in a judgemental spirit but rather to demonstrate the price paid

for an heroic deed. The emphasis here is on the social conditions that surround such deeds and their costs. In this example the main social factor creating ethical hazard is the winner-take-all culture. The questions of interest for this paper are
— is cutting ethical corners more acceptable from an individual (or a group) doing (or judged to have potential for) exceptionally important work?
— if so, how are these elites to be identified?
— what ethical hazards come with such identification?
—would a cooperative society that was more just, at least as creative, and less heroic be possible and desirable?

8.5 The *SpaceShipTwo* and *Challenger* Accidents

The managers of high-profile large engineering projects are often under great pressure to deliver according to a pre-determined schedule. Some of this pressure is transmitted to engineers on the project and it creates ethical hazards. As discussed in Section 7.3 on *Comprehensive, Open and Ongoing Review* (*COOR)*, we are concerned in this paper only with ethical hazards relating to KP. If reliable knowledge is to mean anything, the reports of engineers of a factual nature about technical problems must be frank even when the news may be unwelcome. In October 2014, shortly after take-off on a test flight, Virgin Galactic's *SpaceShipTwo* disintegrated, killing its co-pilot and seriously injuring its pilot. It is too recent to permit full conclusions. This is evident from three very different accounts - Garside and Sample (2014) point to pilot error but also mention criticism of the programme; Mendick, Malnick and Crilly (2014) report numerous warnings from engineers which were ignored; and Witze (2014), under the headline *Fledgling space industry resolute after fatal crash,* gives an upbeat account. Even at this early stage, the account of ignored warnings does appear to be measured and not inconsistent with the apparent direct cause of the accident (pilot error). What is known so far about the *SpaceShipTwo* crash echos the sorry tale of engineers' warnings being overridden over a long period leading up to the 1986 disaster when the NASA Space Shuttle *Challenger* broke apart, shortly after take-off, killing all seven of its crew. In a lengthy study of that accident, Vaughan (1996)

argues (p xiii) against "the idea of wrongdoing by NASA middle managers" and for "an incremental descent into poor judgement". Thus the focus is shifted from individuals to institutions and organisational arrangements.

Our questions are, what are the ethical hazards relating to KP and how may they be reduced? The hazardous zone that relates to KP in the *Challenger* case and probably also in the *SpaceShipTwo* case lies between reliable knowledge and contestable judgement. The hazard itself is the incentive to use uncertainty in this area in a tendentious way. Of the means of reducing ethical hazards presented in Section 7, *Means of reducing Ethical Hazards*, openness is especially relevant in these cases.

8.6 Clara Immerwahr

As an historical example of gender injustice which bore heavily on a talented female scientist I mention the suffering of Clara Immerwahr, the first woman to earn a doctorate (PhD in physical chemistry, in 1900) from the University of Breslau. She briefly followed a research career and expected to balance this with a family role when in 1901 she married the brilliant and driven chemist Fritz Haber. He however expected her to be his career assistant, not an equal life partner. Matters were made worse, after the outbreak of the First World War, by Haber's enthusiasm for gas warfare, which Immerwahr called a perversion of the ideals of science. After a furious argument Clara shot herself dead with Fritz's pistol. She was almost completely written out of history and only gradually did some of her tragic story become known (see for example Meschel 2012). Probably a complete account will never be known.

9. A Change of Culture in the Common Interest

This paper looks at reducing ethical hazards in KP from a wide and a long-term point of view. It is therefore interested in changes of the entire culture within which KP occurs, as well as incremental changes. The former are needed to guide the latter and the latter are needed if actual and desired changes are to happen.

Neville-Sington and Sington (1993) discuss the role of visionary thought. In the long term, radical change does occur. There is no point in trying to prevent it and there is no need to force it. It is however possible and desirable to guide it by thought. From the arguments and examples in this paper it is concluded that the principal big changes in our culture which would reduce ethical hazards in KP are

- change to a more cooperative society, especially in the economic area
- a general shift away from the winner-take-all culture in KP
- introduction of Comprehensive, Open and Ongoing Review (COOR) as a general principle for filtering knowledge claims.

These changes in KP would be possible if going hand-in-hand with enhanced levels of openness, confidence and trust.

9.1 Achieving Openness, Confidence and Trust

Many changes in KP have occurred over the last half-century, strongly influenced by developments in information technology. Experiments and changes of practice have occurred which seemed utopian as recently as the 1970s. We have scholarly journals using new economic models and new peer review methods. Two notable examples are Biology Direct (2014) and Atmospheric Chemistry and Physics (2014) both of which are open access and have publication processes that are innovative and more open than the traditional 'anonymous reviewer' ones.(An extract from Biology Direct's self-description was given in Section 7.3 *Comprehensive, Open and Ongoing Review* (*COOR)*.) The success of innovations like these shows that openness of the filtering process need not be feared in the way it was when it was merely a fringe proposal. The possibility, provided in recent decades by IT, of storing a large amount of detailed comment on truth claims, and of searching discriminately, permits an enhanced level of confidence in consensuses reached by experts. And trust, without which all knowledge would be dissolved by corrosive scepticism, can be applied discriminately. It can, when necessary, be followed up by 'and verify'.

9.2 Vision and Incremental Steps

Especially in the present times, when many recognise the ecological dangers of recent global trends but are unable to take appropriate action (Hulme 2009), it is necessary to consider a range of visions. In 'best practice', visionary thought should include the following elements

- ideas about where we would like to be in the longer term future
- thought about what may be possible and what impossible
- recognition that we are unlikely to find any silver bullets.

Contributions to this kind of long-term perspective include - Cottey (2014), McKibben (2007), McNutt (2013), Maxwell (2014), Neville-Sington and Sington (1993), Nielsen (2009), Peters (2014), and Thring (1980).

Our present culture has been shaped by visionary ideas of earlier times (Neville-Sington and Sington 1993), though no-one knows ahead of time exactly which ideas will survive and in what modified form. Radical changes do not usually occur as great leaps forward. Rather they are the cumulation of incremental changes. Even when there is rapid and decisive change, it follows prior incremental changes. An example is the introduction of the world wide web, following more gradual developments of the internet and of hypertext. Especially in ethical matters, lasting changes are gradual - the slow diffusion of ideas until they become normal. The ethical hazards that we have considered in this paper derive largely from a deep cultural mismatch - between, on the one hand, the enlightenment idea of valuing equality (of rights and opportunities), justice and peace, and, on the other, a belief that self-interested individualism and unrestrained market exchange bring net benefit even though there must be losers. Both of these ideologies remain influential today. In general, 'ethical' is associated with enlightenment values and market values are associated with an amoral pragmatism (which its proponents justify as providing net benefit). This paper has been based on a modernised version of enlightenment values. It identifies as hazardous those unethical practices that threaten

equality of rights and opportunities. It advocates, in the field of knowledge production, such long-term changes as

- promoting cooperation
- comprehensive, open and ongoing review
- just and proportionate rewards.

Many incremental changes have occurred which take us in the desired direction and some have been mentioned in this paper, for example, innovations in the process of filtering knowledge claims. These changes appear to be part of a ground swell, a long-term trend that will not decay. At the same time, neoliberal beliefs and practice continue with a strong following. The state of antithesis between enlightenment and neoliberal values looks likely to persist until changed substantially by ecological instability. In this stressful situation, visionary ideas guiding incremental practice may reduce the ethical hazards on the path of knowledge producers.

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