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IS THERE EPISTEMIC JUSTIFICATION FOR SECRECY IN SCIENCE?

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ABSTRACT

Empirical evidence shows that secrecy in science has increased over the past decades, partly as a result of the commercialization of science. There is a good prima facie case against secrecy in science. It is part of the traditional ethos of science that it is a collective and open truth-seeking endeavor. In this paper, I will investigate whether secrecy in science can ever be epistemically justified. To answer this question, I first distinguish between different sorts of secrecy. Next, I propose an account of what it is for a practice to be epistemically justified, with the help of work by Alvin Goldman and Philip Kitcher. I then discuss motivations for secrecy in science that are found in the literature to see whether they amount to, or can be turned into, epistemic justifications for secrecy. The conclusion is that, although some forms of secrecy – particularly those motivated by universal moral concerns – are epistemically justified, secrecy that arises from special, often commercial, interests is not.

1. INTRODUCTION

Contemporary science is big business. A lot of research is carried out in private R&D departments. Companies have all sorts of financial ties with research undertaken at academic institutions, ranging from occasional sponsoring of individual research projects, to long-term public–private partnerships involving multiple projects, research institutes or research facilities. Universities themselves, too, promote an entrepreneurial spirit, by encouraging scientists to obtain intellectual property rights or start up their own companies, or by securing financial support from private investors in return for privileged access to research results (Etzkowitz 2008; Geiger 2004; Slaughter and Leslie 1997; Slaughter and Rhoades 2004).

Various concerns have been raised about these increasingly intimate connections between private money and scientific research (Krimsky 2003; Resnik 2007; Washburn 2005). Private money has been shown to skew the research agenda, it tends to have negative effects on the scientific quality of research and it can corrupt academic culture. I will be concerned with one effect of the commercialization of science in particular: *secrecy*. I want to investigate whether secrecy in science can be epistemically justified, i.e. (roughly) conducive to the growth of knowledge. The traditional normative ideal of science supports a strong prima facie case against an affirmative answer to this question. It is part of this ideal that scientific knowledge is public knowledge and that the 'republic of science' – to use Michael Polanyi's term – is characterized by openness, unimpeded access to

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knowledge and free flow of information. Robert Merton famously argued that *communism*, i.e. the shared ownership of scientific knowledge, is one of the norms that make up the ethos of science: 'The substantive findings of science are a product of social collaboration and are assigned to the community' (1973a: 273). Many contemporary ethical codes for proper scientific conduct are heavily influenced by Merton's ethos and thus include norms promoting openness, disclosure of information and shared ownership of findings (Kourany 2008; Radder 2010a). Although I agree that this normative ideal contains much that merits defense, I will nonetheless argue that, under the conditions in which science must operate in our world, some forms of secrecy are epistemically justified.

In the next section, I review some of the evidence showing that secrecy is increasing as a result of commercialization and chart different kinds of secrecy. In sections 3 and 4 I develop an account of what it is for a certain practice or course of action to be epistemically justified, by drawing on Alvin Goldman's veritistic epistemology and Philip Kitcher's work on the role of science in liberal democracies. In sections 5 through 9, I discuss several rationales that are offered to justify secrecy and investigate whether they amount to epistemic justifications for secrecy. Section 10 concludes the paper.

2. SECRECY IN SCIENCE: AN OVERVIEW AND SOME DISTINCTIONS

Over the past decade or two, there have been a number of highly publicized cases involving egregious attempts by private sponsors to keep the results of scientific inquiries secret to protect commercial interests. Since these cases are well-known and information about them is easily available, I will not rehearse them here.[1] Such cases offer instructive examples of how things can go badly wrong under the influence of commercial interests, but we should not rely on anecdotal evidence for the claim that secrecy in science is increasing under the influence of commercialization. This general claim needs more empirical support.

Various recent studies suggest that secrecy is indeed increasing and implicate commercialization as an important contributing factor (Resnik 2007: 95ff.). One study (Hong and Walsh 2009) compares the fields of mathematics, physics and experimental biology over a period of 30 years, investigating whether secrecy (understood as unwillingness to share and discuss results with colleagues) has increased as a result of commercialization and increased competition. Analyzing survey results from 1966 and 1998, the authors find that secrecy has indeed increased considerably, mostly so in biology. Both commercial pressures and increasing competition contributed to this development.[2]

Another study, focusing on the biological research community working with the model plant *Arabidopsis thaliana*, also confirms that commercial pressures lead to increased

1 Interested readers can consult Angell 2004; Krimsky 2003; or Washburn 2005.

2 The authors found that industry *funding* is associated with more secrecy, while industry *collaboration* is associated with less secrecy. They suggest that industry collaboration may be part of researchers' strategies to share their findings with the broader scientific community. They did not investigate, however, whether industry collaboration is associated with other types of secrecy, such as publication delays or unwillingness to share research materials (Hong and Walsh 2009: 162). There is evidence that these types of secrecy do increase in industry collaboration settings, at least in biomedical science (Angell 2004; Krimsky 2003; Washburn 2005).

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secrecy (Evans 2010). Using a multi-track methodology that combines quantitative analysis of publication records with fieldwork in the relevant research community and interviews with scientists, the author finds that

> in academic *Arabidopsis* research, industry funding, and to a lesser extent collaboration, reduces the sharing of materials and increases its substitute, the interrogation of pre-publication manuscripts. By contrast, government funding tends to increase the sharing of both. ... Industry funding reduces the distance that ideas travel from industry-sponsored labs. (Evans 2010: 779)

As the author remarks, his findings provide a conservative estimate of the effect of commercialization on secrecy, since *Arabidopsis* research is relatively uninteresting from a commercial perspective. One should expect the effect to be bigger in fields that are more relevant to commercial purposes.

Recent books document that, in biomedical research pertaining to the effectiveness of new drugs, it continues to be common practice to withhold studies with unfavorable results from the Food and Drug Administration (FDA) when applying for official approval to market new drugs (Krimsky 2003; Angell 2004; Kirsch 2010; Whitaker 2010). Although measures have been taken to counteract this practice – all clinical trials in which new drugs are tested must now be officially registered – the FDA still does not require drug companies to submit *all* the available scientific information about new drugs in a request for approval (Kirsch 2010).[3] In sum, then, there is good evidence that secrecy in science indeed increases as a result of commercialization.

To facilitate further discussion of the question whether secrecy in science can sometimes be epistemically justified, it will be useful to distinguish different forms of secrecy. First of all, there is the subject matter of secrecy, or *what* is kept secret. Here we can distinguish between secrecy about aspects of scientific inquiry that are *intrinsically* epistemically relevant, and about aspects that are *extrinsically*, or *contingently*, epistemically relevant. Factors such as the evidence (data and/or research materials) on which conclusions are based, the conclusions themselves and the methods of inquiry and analysis are all directly relevant to the epistemic merits of the investigation. They have to do with how reliably the inquiry gets at the truth. To the extent that such information is kept secret, others are prevented either from using evidence or methods, learning about certain truths (or approximate truths), or from making their own estimates about the epistemic quality of the inquiry.

Other factors do not have an intrinsic connection with the epistemic quality of scientific inquiry, but do turn out to be fairly reliably correlated with epistemic goodness or badness in research – at least in the institutional and socio-economic contexts in which science currently operates: e.g. the sources of funding for a project, the identities of the authors of scientific articles, conflicts of interest of investigators and authors, intellectual property rights held by investigators, sources of the data and research materials that are used. Studies that are wholly or partly sponsored by private money and studies with authors

3 After having completed most of the current paper, I came across the excellent if disturbing book *Bad Pharma* (2012) by the British physician and science writer Ben Goldacre. This book presents overwhelming evidence that intentional, institutionally ingrained and systematic secrecy continues to plague much of biomedical science up to this very day and issues a strong warning call about the dangers this creates for public health.

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who have (declared or undeclared) conflicts of interest or with so-called ghost authors have repeatedly been shown to be biased towards private interests.[4] Unwillingness to reveal the sources of data can be an indicator of weak research (Wicherts et al. 2011), scientific fraud or other misconduct. These factors, then, are extrinsically epistemically relevant because they provide evidence about the epistemic quality of scientific research. Such evidence facilitates making adequate judgments about the epistemic quality of scientific claims, which enables researchers and the public better to identify good or bad science. This, in turn, is important to prevent science from taking wrong turns and is thus conducive to the growth of knowledge.

Another distinction is that between temporary and permanent secrecy. All else being equal, the latter will obviously hamper the growth of knowledge more than the former. Hence, it may be easier to justify temporary secrecy than permanent secrecy.

3. EPISTEMIC JUSTIFICATION

My main question is whether secrecy in science can be *epistemically justified*. To answer this question, we first need a working account of what it is for a practice or a course of action, such as secrecy in science, to be epistemically justified. Before I develop such an account, one caveat. The epistemic justification of *practices* is different from the justification of *beliefs*, which has been the topic of much mainstream epistemology. As I will understand the notion, the epistemic justification of practices is a practical matter in the following sense: it is determined by how effective and efficient the practice is at producing epistemically valuable outputs, such as knowledge. This is different from the (epistemic) justification of beliefs, which (according to most analyses) has to do with how likely beliefs are true. The epistemic justification of practices thus has an indirect relation with the justification of beliefs. An epistemically justified practice is a practice that is conducive to the production of knowledge. The two kinds of justification should therefore not be identified and what I say about the epistemic justification of practices does not apply straightforwardly to claims about the justification of beliefs.

To develop an account of the epistemic justification of practices, I take my starting point in Alvin Goldman's (1999) work on social epistemology. He advocates *veritism* in epistemology in general and in social epistemology in particular. This is to say that the overall epistemic goal is truth, or at least truth-oriented: we ought to believe truths and avoid believing falsehoods. Both individual and social epistemic practices have this aim. To evaluate social epistemic practices, we must therefore look at how well they realize this goal.[5] To this end, Goldman develops a measure of 'veritistic value', which he applies to investigate how well various social epistemic practices do in realizing the epistemic goal.

As Goldman notes (1999: 94ff), his initial characterization of the epistemic goal is too coarse. We don't care about all truths, but primarily about those that we have an interest in. Only their discovery is genuinely veritistically valuable. What's more, not all truths appear to be equal in this regard. Some are objectively or at least intersubjectively more

4 The latest study reconfirming this connection is a vast one carried out by the independent research collective the Cochrane Collaboration (http://www.cochrane.org). See Lundh et al. 2012.

5 Which is not to say that this is the only appropriate way to evaluate the practice. A practice may well be epistemically excellent, but all-things-considered bad because it is detrimental to other important goods.

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valuable than others. A person who spends her life in pursuit of trivia might seem to accrue lots of veritistic value by her own lights, but many would agree that she is missing out on veritistic value. This suggests that veritistic value is not solely determined by people's purely subjective interests, but also by objective or intersubjective standards which imply that certain (classes of) truths are objectively of interest to humans regardless of anyone's personal preferences.

In thinking about *social* epistemic practices, this point becomes particularly important, because in order to evaluate how well these practices do, we must look at whether they succeed in discovering truths that the group using the practice has an interest in. Doing this, however, requires an account of what it is for a group, such as a community of scientists or a society, to have interests. Only then can we evaluate how well a social epistemic practice serves the epistemic goal of discovering truths that *the group* has an interest in.

Here I want to draw on Philip Kitcher's (2001) work on the role of science in democratic societies. Kitcher, too, emphasizes that science is concerned with the discovery truths that people have an interest in. It aims to discover *significant* truths, as he puts it. He holds that there is no fully objective and timeless account of epistemic significance. Rather, significance is a function of both our natural curiosity and the practical and social concerns of our lives (Kitcher 2001: 63ff). It develops as we see new connections between theoretical issues and are confronted with novel practical and social concerns. The epistemic and the practical together determine what is significant.

Kitcher sketches an ideal deliberative procedure to make democratic choices about which truths are significant and which projects science ought to pursue (2001: 117ff.). He imagines a group of representatives for different groups in society, who are well-informed about possible lines of inquiry and their relevance to our natural curiosity and practical concerns. These representatives attempt to formulate a research agenda for science. Through deliberation they seek to achieve consensus about which projects would be most beneficial for society or the human species as a whole, given the various interests that they represent. If consensus turns out to be impossible, a majority vote decides. In setting the agenda, representatives also consider potential moral constraints on inquiry. Projects may be significant, but nonetheless impermissible because they affect certain (already disadvantaged) groups in society unduly. Decisions resulting from this procedure lead to what Kitcher calls *well-ordered science*. It is not part of his ideal that scientists or societies actually strive to implement the imagined procedure. If the scientific agenda conforms to what *would* have been decided, had such a procedure been followed, science is well-ordered.

Whether or not we agree with its details, this is the kind of account that we were looking for. Kitcher's notion of well-ordered science provides a model for thinking about what it is for a society (or other group) to have an interest in certain truths. And that is an important ingredient for an account of the epistemic goal of science. This goal then is to discover *significant truths*, in Kitcher's sense.

With this account of the epistemic goal of science, we can give an account of the epistemic justification of a practice. A practice in science is *epistemically justified* to the extent that it contributes to realizing the epistemic goal of science. We can further think of justification as having to satisfy a minimal threshold: If a certain practice or action makes it more likely than not that significant truths will be discovered, it is epistemically justified. For instance, since a ban on scientific publishing will hamper the discovery of significant

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truths, it is not epistemically justified. In contrast, using randomized clinical trials is a reliable method to discover truths about the effectiveness of drugs and is thus justified.

4. JUSTIFYING SECRECY: A PRELIMINARY CLARIFICATION

The question whether secrecy in science can be epistemically justified thus amounts to the question whether it leads scientists to discover more significant truths, or to discover them more quickly. Before I turn to various motivations for secrecy to investigate whether they can provide epistemic justifications of secrecy, I want to make a preliminary clarification.

It might appear obvious to some that secrecy can never be epistemically justified. My account of epistemic justification may well be thought to strengthen the prima facie case against secrecy. Imagine an ideal world, where people have no interest in harming each other in any way and care about the truth in a completely disinterested way. Scientists have no interest in personal recognition, money or glory, but are passionate seekers of truth for truth's sake; companies don't have any need for trade secrets, since intellectual property is always respected. In this ideal world the goal of science would never be served by keeping data, research materials, methods, findings or information about extrinsically epistemically relevant factors secret. After all, what could be more conducive to finding out the truth than complete and unhindered access to all the relevant information?[6]

This might explain why we are initially inclined to think that secrecy has no place in science. Even though it is a familiar fact that science is often an all too human undertaking, we are sometimes drawn in by a romantic image of science as an unadulterated truth-seeking enterprise, carried out by impartial scholars, in splendid isolation of the practical concerns of everyday life in broader societies. In this image, secrecy indeed has no place.

Our actual world, however, is unlike this ideal world. In asking whether secrecy can be epistemically justified, we must take into account *the actual circumstances under which science has to operate in our world*. Secrecy can be justified if it is a means to realizing the goal of science (better), given the way science actually has to operate in our world. Although this isn't always made explicit, I think such an assumption is in fact quite common, both in mainstream epistemological thinking and in more applied areas of epistemology. In thinking about perceptual knowledge, for instance, we consider whether human beings with normal perceptual abilities would be able to perceive certain things. That imaginary beings with X-ray vision might be able to see through walls is irrelevant to our theorizing. Similarly, when considering inferential knowledge, we take into account what people with our reasoning abilities can infer from what they already know. It is irrelevant that a logically omniscient being could infer much more. Furthermore, in literature in which epistemological theorizing is applied to real-world issues, this assumption, or something like it, is certainly in place. Two influential books, already cited above, provide examples. In thinking about the veritistic value of science, for instance, Goldman (1999: ch. 8) incorporates the facts that people are driven by many other desires besides

6 Perhaps identifying information about human research subjects would still need to be kept secret. Protecting privacy may be valuable even in an ideal world, although it would surely be less of a concern when no one ever uses personal information for malicious ends.

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an impartial interest in truth, that funding for science is limited, that journals cannot publish every paper submitted to them and that experts often give conflicting testimony. Similarly, Kitcher's (2001) central project is to explore how science is best organized, given the role it plays in liberal democracies, that funding for it is limited and that it is carried out by humans who are motivated in diverse ways. All such factors have to do with the way science has to operate in the real world, as opposed to how it might operate in some ideal world.

The condition that we should take real-world circumstances into account when considering whether secrecy can be justified does introduce complications, for how science has to operate in the real world is not a fixed matter. The social organization of science and its institutional contexts have changed over the years and will probably continue to do so. This affects whether the goal of science is served by secrecy. The question then is which of the actual circumstances we ought to keep fixed in considering possible justifications of secrecy. I don't think there is a clear-cut general answer to this question. But, surely, at least unassailable facts about human psychology must be kept fixed, as well as general facts about the (Western) socio-political context of science, such as that it operates in liberal democracies and that funding is limited and subject to public or private control. Whether further circumstances must also be kept fixed depends how plausible it is that they can change. I will return to this point below when we discuss various motivations for secrecy.

Someone could object that seeking to justify secrecy this way is unacceptable. Instead of compromising on the ideal of science as an impartial and disinterested search for the truth that has no room for secrecy, we ought to uphold that ideal by arguing for its importance and working to remove any obstacles that stand in the way of its realization. I disagree. Rather than arguing for an abstract ideal that disregards people's real motivations for doing science and the actual social organization of science, we ought to bring the ideal down to earth and think about what it would look like when real people in our actual world strive to attain it. I am all in favor of seeking to optimize the social organization of science with an eye to the realization of its epistemic goal, but we should do this while taking into account that science is a human affair, which operates in real social institutions in real societies.

5. COSTLY EVIDENCE GATHERING

Let's now investigate several prominent motivations for secrecy in science that typically come up in conversations about the topic or are mentioned in the literature (Bok 1982; Hull 1985; Resnik 2005).[7]

First, data and research materials are kept secret, or at least not shared outside a research team, because gathering, organizing and preparing the data or materials is an enormously time-consuming and costly process, for which the researchers want a fair 'return on investment' in the form of dissertations and publications. Making everything available to the scientific community right from the start opens them to the risk of scoops.

7 In a meeting discussing practices of data sharing in the sciences organized by the Royal Netherlands Academy of Arts and Sciences in Dec. 2011, most of the following motivations were mentioned.

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Researchers who haven't helped to create the data set can run their own analyses and could do so quicker than the original researchers, thus beating them to publish first about the findings.

For example, in psychology and social science, longitudinal studies of people's attitudes towards social developments, politics, their environment, religion, wellbeing and other issues will often take years and years of careful data gathering, coding, processing and administering. The same goes for many research projects in other fields of science.[8]

Practices differ across the sciences. Sometimes, data are made publicly available or available upon request after the initial research team has reaped the benefits of temporary exclusive access. Some journals require that data be made available upon publication, so that they will be accessible when articles appear in print.[9] In other cases, however, data are never made publicly available at all. Sometimes publicly funded researchers choose not make their data available – especially in areas where commercial interests loom large, such as biomedical research or food and health research – because by doing so, they would expose themselves to attempts by commercial firms to undermine their conclusions by reanalyzing their data and challenging their conclusions.

This form of secrecy is often temporary. It is typically motivated by considerations of fairness rather than epistemic considerations. This, however, doesn't mean that there isn't also an epistemic justification. At first pass, keeping data or research materials secret from outsiders is not conducive to the goal of science. If more scientists were given access immediately when the data become available, they could be analyzed more quickly by more people and that would lead to (quicker) discovery of more significant truths. There are, however, at least two 'real world' factors that make this infeasible: (a) human psychology and (b) the social organization of science, especially the emphasis on the importance of publishing original results. I'll argue that these two factors make temporary secrecy about data or research materials inevitable. If scientists weren't allowed a period of exclusive access, they couldn't make the required efforts to create costly and time-consuming data sets or exclusive materials in the first place and we would be deprived of those truths that can be discovered by analyzing and using them.

(a) Although it is dangerous to generalize about human psychology, scientists – like most people – care about prestige and reputation. In fact, some of them care about it a lot, for a scientist's reputation is perhaps the chief benefit that accrues to her in the community of science. Scientific reputation is strongly determined by a scientist's ability to discover original significant truths and publish them first. So if scientists did not have a period of exclusive access to newly collected data in order to analyze and publish about them first, this could easily take away their motivation for collecting the data in the first place. Such exclusive access is exactly what temporary secrecy provides.

(b) This mechanism is reinforced by the social organization of science. Scientists' output is often evaluated by their publications and their impact, measured by the quantity and quality of journal articles, books and their citation indices. Tenure and promotion

8 For instance, at my home institution biological psychologists investigate the genetic bases for various physical and mental traits. They use an enormous database with information about more than 75,000 pairs of twins, which has been collected over the course of more than 25 years: the Netherlands Twin Register, http://www.tweelingenregister.org/en.

9 This requirement, however, turns out to be frequently violated, even in journals with explicit data sharing policies, cf. Wicherts et al. 2006; Savage and Vickers 2009.

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decisions are based on these evaluations, the success of grant applications depends on them and scientific prizes are awarded to those who make important discoveries first. Although the focus on quantitative measures of scientists' publication records is a more recent artifact of the social organization of science, the importance of making original discoveries public and establishing priority has been part of modern science since its very inception (Merton 1973b; Hull 1985; McMullin 1985; Resnik 2005). It is a fixed feature of science in our world. Hence, a complete ban on secrecy would undermine the incentive structure of science, because it would become much harder for scientists to reap the scientific rewards of their efforts.

Given the above two fixed features of real world science, keeping data or research materials temporarily secret is epistemically justified. It is not clear that permanent secrecy can likewise be justified. Even if a data set is continuously expanding (as with the Twin Register), the goal of science would be better served by making the data – or at least subsets of them that have already been analyzed by the core research team – more easily available to other scientists. Permanent secrecy of data and research materials, then, is not epistemically justified.[10]

6. THE PRIORITY RULE

A second rationale also has to do with establishing priority for discoveries or inventions, but now it concerns secrecy about conjectures, methods, or (intermediate) results. By keeping these temporarily secret, scientists can buy time to develop ideas, subject them to further scrutiny, collect additional evidence, deal with worries and objections, etc. Once they go on to share their findings, they will have solid support and stand up to scrutiny. This is important, since, as I noted above, scientific recognition and rewards depend on success in making original contributions to their field. Keeping developing ideas secret prevents competitors from hijacking them and publishing on them before they can do so themselves.

A famous historical example is Charles Darwin's theory of evolution through natural selection, which he kept secret for a long time, until a manuscript by Alfred Russell Wallace prompted him to establish priority by publishing his own ideas first. Another example is the discovery of the structure of DNA molecules by James Watson and Francis Crick. It is often speculated that Rosalind Franklin might have discovered this herself under slightly different circumstances, and that Watson and Crick's success depended crucially on their learning about elements of Franklin's work, which she had attempted to keep secret.

This type of secrecy is temporary; that is the very point of it. As soon as researchers feel confident about their ideas, or fear that someone else might beat them, they will publish their work. We can be brief about this type of secrecy, because the same reasoning applies as in the previous section. Given human psychology and the organization of modern science in which priority in publishing new results is a basis for scientific rewards, it follows straightforwardly that this type of temporary secrecy is epistemically justified. Even

10 This general statement needs qualification for data and research materials that are dangerous, sensitive, or subject to privacy concerns. I will address this in section 8.

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apart from the fact that forbidding it is practically impossible, doing so would be at odds with the central incentive scheme of (modern) science.[11]

7. INTELLECTUAL PROPERTY RIGHTS

A third rationale for secrecy stems from the process of obtaining intellectual property rights (such as patents) on inventions.[12] Since patents can only concern *inventions* and not discoveries of naturally occurring phenomena, many results of scientific research are not eligible for patenting. But many others are. First, various areas of science are closely interwoven with technology and research in these areas aims at technologically applicable results. This holds for engineering disciplines, but also for biomedical research and more applied areas of psychological and social-scientific research. Second, during recent decades the notion of invention has been interpreted more and more broadly in patenting practice, so that nowadays genes are patented, as well as various other elements of the natural world that are useful for technological, medical, agricultural or other purposes (see the references in n. 12). Hence, in many scientific fields, patenting has become common practice. Universities stimulate scientists to apply for patents, because doing so is thought to be profitable. Patents are furthermore considered to be an indicator of scientific success. They strengthen a scientist's reputation and count in tenure and promotion decisions and grant applications.

Applying for patents leads to secrecy through the following route. To be eligible for patenting, an invention has to qualify as novel, non-obvious and useful.[13] Something that is already part of the 'state of the art' is not novel and hence cannot be patented. Once scientists have published about research that is directly relevant to an invention, they will no longer be able to patent it, because it is then considered to be part of the state of the art. Hence, scientists or their private sponsors who apply for patents have to keep their findings temporarily secret and delay publication.

Intellectual property rights in the form of patents, then, lead to temporary secrecy about research methods and results. The question whether this is epistemically justified amounts to the question whether a system in which academic scientists regularly attempt to patent their results leads to more discoveries than one in which they don't. This is a complicated empirical question, for which it will be difficult to obtain the relevant evidence. Since patenting is the norm in many areas of science, it has become impossible to compare the situation with a control situation in which there is no extensive patenting. What we can do, however, is investigate the default reasons given to justify the practice of patenting in academic science in order to see whether they provide building blocks for a possible epistemic justification.

First, the traditional justification for patenting is that it stimulates innovation.[14] If inventors weren't given the opportunity to reap the (economic) benefits of their creative

11 My argument here is qualitative, but quantitative evidence from formal models also shows that following the priority rule in science is an efficient way of realizing the goal of science (Strevens 2003).

12 For more on the theory and practice of patenting the results of academic research, see Shulman 1999; Sterckx 2000; Slaughter and Rhoades 2004; Koepsell 2009.

13 These are the US criteria. In Europe, the second and third criteria are formulated as involving a 'genuine inventive step' and being 'industrially applicable' respectively.

14 See n. 12 again and also Van den Belt 2010 for a thorough historical treatment of this argument.

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work, it wouldn't be worth their effort. Patents offer the protection needed to make this possible by granting the patentee an exclusive right to market her invention during a fixed period of time. If this is correct and the patenting system is indeed practically necessary to stimulate invention, this could be turned into an epistemic justification: without the possibility of applying for patents, inventors would have less motivation to engage in their creative work and we would miss out on various discoveries. But why think this reasoning applies to academic scientists? In modern universities, scientists already receive financial compensation for their research, primarily in the form of salaries paid by their institutions. So there's no obvious reason why they would need the further financial compensation that is made possible by obtaining patents. (And for scientists working in publicly funded institutions, it even seems inappropriate that they should use the results of their work for personal financial gain.)

Moreover, it is often the *university* rather than the individual scientist who obtains the patent. This observation is tied to a second argument, which is frequently used to justify contemporary academic patenting practices. It is claimed that modern universities need the income that patents generate to supplement their research budgets, because public funding for research has been steadily declining in the US and Europe. Two points in reply. First, we should note that, even if true, this claim is foremost an economic justification, which can only be changed into an epistemic justification by assuming that the declining public funding for research is one of the *fixed* features of contemporary science. This seems hardly plausible. Although the political climate in the US and many European countries might make it unlikely that governments will increase their budgets for academic research any time soon, this is clearly a political *choice*, and hence not a fixed feature. Second, even if we were to think of it as a fixed feature, the argument has an even more debilitating problem. It is based on the false presumption that obtaining patents is indeed profitable for universities. This is simply false. Summarizing several empirical studies, Sterckx (2010: 53) summarizes the situation in no unclear terms: 'For most universities, patenting and licensing activities are unmistakably *unprofitable*' (cf. also Greenberg 2007: 51ff.).

In the absence of empirical evidence comparing academic science with and without patenting, there remains a somewhat distant possibility that patenting is somehow conducive to the goal of science after all, but, given that the two arguments above fail as epistemic justifications, this seems unlikely. I conclude, provisionally, that there is no epistemic justification for secrecy that is prompted by academic scientists who try to obtain patents.

8. MORAL AND POLITICAL CONSIDERATIONS

Moral and socio-political considerations provide a fourth rationale for secrecy. In biomedical, psychological or social-scientific research it can be crucially important to protect the privacy, health, wellbeing or other interests of human research subjects by keeping certain sensitive information that subjects do not want to share with others secret. For that reason, strict measures have to be taken so that data are either anonymized if they are shared, or not shared without the subjects' prior consent. Contemporary codes of scientific integrity invariably contain rules about how to deal with information about human subjects. Often, research proposals have to be reviewed by institutional review boards or ethical committees to check for conformity to these rules (Shamoo and Resnik 2009: 236ff.). Naturally, this form of secrecy often extends over a considerable period of time or is permanent.

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Socio-political considerations about the public interest or (inter)national security can also motivate secrecy. Military research is often kept secret in the interest of national security (e.g. the Manhattan project). Research about dangerous viruses and chemicals for biological or chemical warfare, as well as cryptography and computer technology provide further examples. Recently, the Dutch government attempted to prevent publication of a scholarly paper about the potentially dangerous H5N1 avian influenza virus in the journal *Science* out of concern for public safety. Although it later reversed this decision, the government's actions stirred fervent debate.[15] Depending on whether and how soon potential threats to public safety or security have subsided, this type of secrecy may be temporary or permanent.

Common to these examples is that secrecy is supposed to serve an overriding moral or socio-political interest, which trumps the epistemic interest of openness. This doesn't mean, however, that such secrecy couldn't be epistemically justified. Often, when secrecy stands in the service of the interests of research subjects or the general public, the research would not or could not be done if secrecy weren't guaranteed. This is the case when research subjects won't provide personal information unless their privacy is guaranteed. Assuming (a) that this is a fixed feature of human psychology and (b) that this type of research uncovers significant truths – which seems perfectly plausible for a lot of biomedical, psychological and social-scientific research – there is epistemic justification for this type of secrecy.

With military technology and dangerous chemicals or biological entities the situation is different. First, it might be questioned whether such research really gives us *significant* truths. This will depend on whether and to what extent we think significance is determined by current socio-political concerns. Assuming that it does (sometimes) uncover significant truths, however, a second concern is that it is not obvious that research in these areas could not or would not be done if secrecy were not guaranteed. Perhaps the military will not provide funding for, say, encryption research if results are not kept confidential, but it's not implausible that money for it might be found elsewhere. The same goes for many other topics that are of concern to the public interest, (inter)national security, etc. Hence, secrecy does not seem to be inevitable to acquire knowledge of relevant significant truths of these kinds. But that means that there is no epistemic justification for secrecy here. To be clear, by saying so I am not denying that there could be all-things-considered justification for it. I fully concur that moral and socio-political reasons can sometimes trump epistemic ones.

9. COMMERCIAL INTERESTS

Private interests form a fifth and final rationale for secrecy. This might take various forms, as we saw in section 2. Industry-funded research may lead to trade secrets: information or materials that a company keeps confidential in order to have the exclusive opportunity to make money from them. When industry funds academic science, it frequently seeks to assert exclusive rights to claim commercially promising findings first. Scientists are often required to sign non-disclosure agreements, which contain more or less restrictive conditions pertaining to the sharing of data, methods, results or other elements of the

15 See http://www.sciencemag.org/site/special/h5n1.

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research. Such industry-funded research may then lead to trade secrets, patents, delayed publication or, in some cases, attempts to suppress findings that conflict with commercial interests. Similar arrangements are made in industry–university collaborations, when university scientists carry out research together with scientists working in industry. Sometimes, university scientists decide (on their own or on the instigation of their institutions) that their findings hold commercial promise and start up their own companies in order to market the products of their research. Often, this involves obtaining patents for the start-up company.[16]

The underlying thought here is that who pays for research decides if and how its outcomes will be shared or made public. Since companies primarily have commercial interests, they want to make sure that they can reap economic benefits from projects they sponsor and temporary or permanent secrecy is instrumental in achieving this.

This is for the most part an economic motivation, with no straightforward implications for the epistemic justification of these kinds of secrecy. Again, however, it is possible that the kinds of secrecy described here are inevitable for science as it has to operate in our world. If so, there could be epistemic justification for it after all. I don't think, however, that this is the case. First, there is plenty of privately sponsored research that doesn't aim at discovering *significant* truths. Commercial interests skew the research agenda towards research that might generate lots of profit, but is uninteresting from a scientific or public-interest perspective (Resnik 2007: 79ff.; Greenberg 2007; Musschenga et al. 2010). Even without a fully developed account of epistemic significance, it seems obvious that such science is not epistemically significant. Secrecy involved in the discovery of insignificant truths is clearly not epistemically justified, because the research itself isn't.

Second, it will in general be instrumental to the goal of science if data, materials, methods and results from privately funded research were to be made publicly available, as more scientists could analyze and use them – this is the prima facie argument against secrecy. To overturn this argument, a case has to be made that such research could not be done without the financial support of private sponsors. This is a tall order. It may be very difficult, given the current socio-political climate in Western liberal democracies, to increase public funding for science or to impose stricter regulations on interference of private parties in academic science. Nonetheless – as I emphasized above in relation to secrecy resulting from patenting – these are matters of political *choices*, albeit currently unpopular and difficult ones. They can hardly be considered as inevitable fixed features of science. With different policy decisions, much of the research that is currently done in close alliance with private interests could also be done with less interference from private interests.[17] I conclude that secrecy motivated by private interests is, for the most part, not epistemically justified.[18]

16 Commercial interests are also the chief motivation for secrecy about what I called extrinsically epistemically relevant factors, such as authorship, sources of funding, etc. Since this type of secrecy borders on deliberately misleading people and intentionally giving them incomplete information and seems in no way necessitated by any fixed features of human psychology or science, it hardly needs further argument that there is no epistemic justification for it.

17 Of course there may be exceptions. Perhaps some research projects do lead to significant truths, but would never be carried out unless privately sponsored. For these projects, secrecy would be epistemically justified. My point is that this will not *generally* be the case.

18 Again, this does not mean that there couldn't be all-things-considered justification for such secrecy. Perhaps economic and commercial interests sometimes trump epistemic ones.

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10. CONCLUSION

Partly as a result of the commercialization of science, secrecy in science has increased over recent decades. There is a strong prima facie case against secrecy in science, both from the normative ideal of science as a disinterested, collective and open truth-seeking endeavor and from consequentialist considerations about what is most conducive to the goal of discovering significant truths. I have argued that, nonetheless, some forms of secrecy in science are epistemically justified. In particular, temporary secrecy that is necessary to let scientists reap the epistemic benefits of costly research efforts and to establish priority are conducive to the goal of discovering significant truths. Secrecy required to protect the privacy or other interests of human research subjects is also epistemically justified. Secrecy motivated by public interests, such as safety or health, is not epistemically justified, although it may nonetheless be all-things-considered justified, since the relevant moral and political concerns plausibly trump purely epistemic ones. Secrecy arising from private interests or from the attempt to obtain intellectual property rights, however, generally lacks epistemic justification.

Reflecting on these findings, we see that epistemically justified forms of secrecy have in common that they are motivated by more or less universal moral concerns, such as fairness or the protection of privacy. Epistemically unjustified secrecy, however, arises from special – in the present social context of science, often commercial – interests. This holds an important lesson for societies that want to value science for its epistemic worth, rather than its potential economic role. Those societies should attempt to put policies in place that prevent special interests from intermingling with (academic) science as much as they can, since this intermingling leads to epistemically undesirable effects.

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