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SCIENCE AND INTERNATIONAL RELATIONS: BRAZIL AND THE GEOPOLITICS OF KNOWLEDGE

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Abstract: he article seeks to present a new approach to analyze Science and International Relations by exploring an interdisciplinary approach which includes Science and Technology Studies and Critical Geopolitics. The resulting framework is referred to as a Geopolitics of Knowledge. It is argued that this framework is urgently required due the current fragmentation in the ways in which International Relations approaches the issue of Science and Technology, two features which are increasingly conditioning how States generate and deploy power. For example, International Relations tends to relate questions on science to the notion of sovereignty, thus limiting research to the effect that science has on the ability of States to act. Science and Technology Studies tend to neglect the role of International Relations in the development of scientific endeavors, whilst Critical Geopolitics has not yet embraced the symbolic power that knowledge generation and deployment techniques have on the successful exploitation of strategic resources. Currently, the state of the art is such that no single methodology seeks to examine how knowledge generation and deployment techniques co-generate international social and political orders. The purpose of this article is to demonstrate how the Geopolitics of Knowledge, as a new approach, would seek to combine insights from the three disciplines so as to offer a richer account of how science and technology are applied to strategic resources in a context of power. The methodology is necessarily interdisciplinary and will refer mainly to Actor-Network-Theory (ANT) as a means to dissect interdependencies between Science, Technology, Strategic Resources and International Relations. Results include a first blueprint of how the Geopolitics of Knowledge would approach the Brazilian case, which is emblematic as an example of knowledge generation in the context of geopolitically relevant strategic resources (energy, food and forests, for example). The article concludes that through this new approach researchers can better grasp the richness of the International Relations – Science and Technology nexus, and that as such the approach should be widened to new case studies.

Keywords: Science; Brazil; International Relations; Geopolitics of Knowledge.

CIÊNCIA E RELAÇÕES INTERNACIONAIS: O BRASIL E A GEOPOLITÍCA DO CONHECIMENTO

Resumo: O artigo apresenta uma nova forma de estudar as conexões entre a Ciência e as Relações Internacionais que explora a interdisciplinaridade entre Science and Technology Studies e Critical Geopolitics. O resultado desta ferramenta interdisciplinar é o que chamamos de "Geopolítica do Conhecimento". O estudo argumenta que esta ferramenta torna-se necessária devido ao alto nível de fragmentação na forma como a disciplina de Relações Internacionais examina os conceitos de Ciência e Tecnologia, conceitos que

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determinam cada vez mais como o Estado gera e aplica poder. Por exemplo, a disciplina de Relações Internacionais atrela com frequência o conceito de ciência à noção de soberania, limitando assim as pesquisas ao entendimento de como a ciência afeta a capacidade de atuação dos Estados. Por outro lado, Science and Technology Studies negligencia o papel das Relações Internacionais no desenvolvimento da pesquisa cientifica, e a disciplina de Critical Geopolitics não analisa como o uso eficiente de recursos estratégicos depende do poder real e simbólico da ciência e da tecnologia. No momento, não existe nenhuma disciplina acadêmica que examina sistematicamente como a geração e a aplicação do conhecimento co-gera ordens políticas e sociais internacionais. O objetivo do artigo é o de demostrar que uma nova Geopolítica do Conhecimento pode usar conceitos de três disciplinas (Relações Internacionais, Science and Technology Studies e Critical Geopolitics) para gerar análises mais completas sobre como a ciência e a tecnologia afetam recursos estratégicos em um contexto de poder. A metodologia é essencialmente interdisciplinar e utiliza principalmente a Actor Network Theory de Bruno Latour para analisar a interdependência entre a Ciência, a Tecnologia, recursos estratégicos e as Relações Internacionais. Os resultados incluem um primeiro exemplo sobre como a Geopolítica do Conhecimento agrega conhecimento ao caso do Brasil, um exemplo emblemático de geração cientifica aplicada a recursos estratégicos geopoliticamente relevantes (energia, comida e flores).

Palavras-chave: Ciência; Brasil; Relações Internacionais; Geopolítica do conhecimento.

Introduction

This article is about developing an intellectual framework for the comprehensive study of the Science and International Relations nexus. Arguably, this kind of approach is urgently needed. Indeed, the academic discipline of International Relations (IR) has recently revitalised its focus on the broader relationship between science and foreign policy, to the extent that scholars have called for the establishment of a dedicated field of study:

> The mutual influences of science, technology and international affairs are so important and pervasive that the field should be recognized as an independent sub-discipline. Its present status as a relatively esoteric topic, to be entrusted to specialists and kept more or less isolated from the body of international relations, is a dangerous anachronism (Weiss, 2005, p. 295).

Whilst a shared preoccupation with the status of science as a 'relatively esoteric topic' within mainstream IR is a primary motivation of this piece of work, it is argued that before we start thinking about setting up independent sub-disciplines we need to thoroughly understand what these specialists who are 'more or less isolated' from the main body of the discipline are actually doing. In particular, we need to understand what techniques are used to analyse the socio-political dimensions of science in other disciplines, and what the 'international' dimension of the scientific endeavour is, so as to enable IR to make a difference in this context.

The current article will begin by presenting a historic overview of science and state formation, just to give a flavour of what a critical approach to the issue of Science and IR would look like. Such historical overview will be the basis for a subsequent analysis of how IR, Science and Technology Studies (STS) and Critical Geopolitics are currently handling the analysis of science. In particular, we will examine to what extent Actor-Network Theory (ANT), as a methodology that has emerged precisely in the context of STS, could be deployed in IR. In a final part, a synthesis presenting a proposal for the establishment of a Critical Geopolitic of Knowledge will be outlined – such synthesis will inform a number of research questions related to Brazil as a potential case study.

Historical Background

Thomas Hobbes, as the father of a modern theory of the State, is one of the pillars of Sovereignty-centred IR theory. However, Hobbes was also at the centre of one of the most famous episodes involving science and politics, an episode that saw the famous theorist call for the establishment of a proper regulatory environment for the emerging 'scientific'

community in Restoration England. Nonetheless, Hobbes wanted to do more than 'control scientists' – he wanted to control the very culture associated with the birth of the experimental method, a culture which he thought could be detrimental to the social and political order he advocated. As it should be clear at the end of the article, it is not a coincidence that a controversy on the nature of the State went hand in hand with a controversy on the nature of knowledge.

Nowadays, Hobbes is not often remembered for his qualities and views related to natural philosophy, or what we would now simply refer to as 'science'. Yet Hobbes did not see science (natural philosophy) and political theory as two separate fields of knowledge. On the contrary, the project of outlining the features of the modern State, the *Leviathan*, rests on the assumption that such State features could and should be based on the natural order of things, and, by extension, on an understanding of the natural world. Indeed, such perspective is outlined in the very first page of one of the founding texts of modern political theory:

> For seeing life is but a motion of limbs, the beginning whereof is in some principal part within; why may we not say, that all automata (engines that move themselves by springs and wheels as doth a watch) have an artificial life? For what is the heart, but a spring; and the nerves, but so many strings; and the joints, but so many wheels, giving motion to the whole body...Art goes yet further, imitating that rational and most excellent work of nature, man. For by art is created that great Leviathan called a Commonwealth, or State...which is but an artificial man... (Hobbes, 1998, p. 7).

Thus, technology (certainly engines and machines) was very much in Hobbes' mind as he proceeded to write about the State. It would be incorrect, however, to assert that views on the natural world simply influenced an understanding of the social world: the opposite was, if anything, just as true. As the outstanding *Leviathan and the Air Pump* (Shapin and Schaffer 1985) reveals, Hobbes – who was, at the time, respected as an important 'scientist' – was deeply concerned about contemporary experiments and debates regarding the evolution of the experimental method. His worries were based on the possible socio-political consequences the birth of science could have in the context of the English Restoration. This led him to vividly reject, for example, Robert Boyle's theory on the existence of vacuum and experimentation techniques involving air-pumps. Such objections were not only based on considerations related to the political significance of the notion of vacuum: the main concern involved the perceived political significance of the nature of scientific enquiry as such.

With regard to the notion of vacuum, Hobbes feared that advocating the existence of something other than physical matter may lead people to associate different forms of existence to different sources of authority, thus fragmenting legitimate sources of sovereignty.

For example, dangerous correlations such as 'the King derives his authority from the material realm, whilst the Church derives its authority from an essence beyond the realm of physical matter' could be made. This would undermine the authority of the King. For Hobbes, "the rejection of vacuum was the elimination of a space within which dissension could take place" (Shapin; Schaffer, 1985, p. 109). In other words, "the elimination of the vacuum was a contribution to the avoidance of civil war. The dualist ontology deployed by priests spoke of existents which were not matter: this made men `see double´ and resulted in the fragmentation of authority which led inexorably to chaos and civil war" (Shapin; Schaffer, 1985, p. 18).

To put this yet more concisely, "speech of a vacuum was associated with *cultural resources* that had been legitimately used to subvert proper authority in the state" (Shapin and Schaffer, 1985, p. 91). The definition of different approaches to knowledge as 'cultural resources' capable of substantiating or undermining social, political – and, by extension, *international-political* – order is an interesting notion that the present study will make extensive uses of. If Hobbes thought that the concept of vacuum was dangerous enough to undermine social order, it is legitimate to wonder what he may have thought of 'cultural resources' such as quantum mechanics, general relativity and complexity science – not to speak of human genomics, cloning and neuro-psychology. Looking at knowledge generation and deployment techniques in terms of their consequences for social order – including international order – is, as we will see below, something of a constant in the discipline of IR, which still limits its analysis of science to considerations over sovereignty.

The other big problem Hobbes had with the experimental method was that it introduced people to the notion of probability. This replaced the notions of certainty and precision (present in nobler endeavours, such as geometry and mathematics), which Hobbes thought should constitute the foundations of natural and civic knowledge. Experimentation leads to the observation of often contradictory facts in nature – nature is a lot messier than neat metaphysical categorisations. For Hobbes, knowledge production and related social orders must be logically consistent, must emerge from the genius of the human mind and these must be expressed in proper metaphysical language.

Thus, Hobbes was highly irritated by Boyle's insistence in labelling observed physical causes as only 'probable' (Shapin; Schaffer, 1985, p. 67). Worse, Boyle's experimental method was based on the assumption that free rational beings could meet, replicate experimental results and reach a decision on the 'truth' by consensus, completely sidestepping the proper authority of the State. Boyle's experimental space was private – a space where private citizens conjectured notions of truth through improper methods (experimentation as

opposed to proper natural philosophy) – whilst Hobbes believed that spaces where knowledge is produced ought to have a 'master', preferably some form of State authority (Shapin; Schaffer, 1985, p. 113).

This led Hobbes to attack Boyle and others who were forming themselves into a society for experimental research, namely, the Royal Society (the world's first 'scientific' society in the modern sense of the word). It is not an exaggeration to state that Hobbes regarded the Royal Society as a potentially revolutionary organisation which, by claiming to derive its authority from a source other than the King, could, at best, undermine the authority of the State and, at worst, undermine the cultural resources upon which such authority was based. This swap in transcendental frameworks (the Truth instead of God) meant that scientists could become the new priests and lead the way to yet another war of 'religion'. A possible fragmentation in sources of cultural authority had to be eliminated, or at least it had to be managed and controlled. Men 'seeing double' was dangerous.

Accepting Boyle's or Hobbes' method of knowledge production was, therefore, equivalent to accepting a social philosophy. In the context of the Restoration, this was a rather delicate matter: "the experience of the War and the Republic showed that *disputed knowledge produced civil strife*...Boyle's technologies could only gain assent within a secure social space for experimental practice... [while] Hobbes assaulted the security of that space because it was yet one more case of divided power" (Shapin; Schaffer, 1985, p. 283). Persistent arguments on the existence of vacuum and related assumptions on the merits of the experimental method could get people expelled from Universities (this was the case of Wilkins and Ward, see Shapin; Schaffer, 1985, p. 301). Understanding all too well that the way in which we generate and deploy knowledge is related to the way in which we establish social order, this was not a battle some 'knowledge warriors' were prepared to lose: "Sprat's *History of the Royal Society* (1667) labelled Hobbesian dogmatism as tyranny, and uncontrolled private judgement as enthusiasm. Such dangers were to be excluded from the community – otherwise debate would not be safe" (Shapin; Schaffer, 1985, p. 301).

Eric Hobsbawm has also noted the relationship that exists between forms of knowledge and social orders. In his *Age of Revolutions* (Hobsbawm, 2003) the author describes how scientific, social, economic and political histories are necessarily intertwined: "The main currents of general thought in our period have their correspondence in the specialised field of science and this is what enables us to establish a parallelism between sciences and arts or between both and socio-political attitudes" (Hobsbawm, 2003, p. 335). In the crucial period Hobsbawm analyses (comprising the French Revolution and the Industrial Revolution in

Britain) it becomes possible to see how, for example, "'classicism' and 'romanticism' existed in the sciences, and…*each fitted in with a particular approach to human society*" (Hobsbawm, 2003, p. 335).

Thus we have the equation of classicism (in intellectual terms, the rationalist, mechanist Newtonian universe of the Enlightenment) with bourgeois liberalism, and of romanticism (in intellectual terms the so-called 'Natural Philosophy') with its opponents. In this context, "such sciences as physics, chemistry and astronomy marched with Anglo-French bourgeois liberalism. For instance, the plebeian revolutionaries of the Year II were inspired by Rousseau rather than Voltaire, and suspected Lavoisier (whom they executed) and Laplace not merely because of their connections with the old regime, but for reasons similar to those which led the poet William Blake to excoriate Newton"(Hobsbawm, 2003, p. 335).

But for what reasons did Blake dislike Newton? In Blake's view, the real trouble with Newton was the birth of materialism, the separation of science from art and poetry (which is precisely that which seeks to go beyond the material), and the consequent emergence of determinism (Burwick, 1986). Determinism may sound very good if we, as Hobbes, are seeking to define a proper and single legitimate source of authority. However, if we are in the business of advocating social revolution notions such as determinism and 'fixism' do not sound very appealing, especially if we find ourselves at the bottom of the social pile. Thus, physics and astronomy were not seen as friendly disciplines by the Jacobin plebeian revolutionaries, who favoured natural sciences such as biology and natural history which, with an emphasis on evolution, adaptation and change, seemed more amenable to the revolutionaries' ends.[2]

It is not surprising, therefore, that the plebeian Jacobin dictatorship promptly dissolved the French Academy, an institution keen on promoting disciplines such as physics, chemistry and astronomy (Hobbes' favourite disciplines in Restoration England), as these were seen as Trojan horses for bourgeois liberalism. Indeed, "...important Jacobins were hostile to abstract, theoretical and mathematical science, but were favourable to natural history...the Terror prematurely ended the lives of several prominent scientists...but other natural scientists in educational institutions, government branches and other venues were actively recruited by the regime " (Gordin, et al. 2003, p. 37). As the Jacobins continued to undermine 'bourgeois' science, they founded no less than twelve research chairs botanical gardens (Hobsbawm, 2003, p. 335).

[2] Arguably, the introduction of determinism in biology though social Darwinism alters this scenario, but this is not something we could possibly explore here.

It was also in places where classical liberalism was weak that scientific approaches different from traditional (Newtonian) Anglo-French models took hold. This was the case of Germany and Natural Philosophy, a tradition that, contrary to Newtonianism, "was speculative and intuitive. It sought for expressions of the world spirit, or life, of the mysterious organic union of all things with each other, and good many other things which resisted precise quantitative measurement or Cartesian clarity" (Hobsbawm, 2003, p. 335). The emergence of unorthodox scientific practices, such as complexity science and chaos theory, are strongly correlated to and inspired by this strand of German Romanticism / Natural Philosophy (Hobsbawm, 1996, p. 542), as such, these have the potential to re-ignite that old philosophical debate related to the proper role Reason should occupy after the Enlightenment (Popolo, 2007).[3]

To summarise, advocating the existence of vacuum and divulgating the experimental method could make you a suspicious enemy of the State in Restoration England. In Jacobin France, as an astronomer or a physicist, you really must have thought that the knowledge you were generating was literally worth dying for. On the other hand, being a biologist or a botanist could get you promoted and handed over important functions within the new State. In Revolutionary Europe, your intellectual affiliations – or the *cultural resources* you chose to use – could be used to make judgments regarding your political ideology, your real or aspired class affiliation and your national or international sympathies (liberal-bourgeois France or aristocratic Germany, for example).

For example, Friedrich Nietzsche had no doubts about the links that existed between the birth of the experimental method (which is characterised by 'industrious carefulness' as opposed to, presumably, grand and profound thinking), the characteristics of Nation States and, consequently, conflicting relations between States. Consider:

> for scientific discoveries like those of Darwin, a certain narrowness, aridity, and industrious carefulness (in short, something English) may not be unfavourable at arriving at them...the English, with their profound mediocrity, brought about once before a general depression of European intelligence. What is called 'modern ideals'...that...against which the German mind rose up with profound disgust, is of English origin (Nietzsche, 1989, p. 123).

[3] To cut a long story short, it is argued that classical rationalist approaches regard Reason as that which provides humankind stable and certain grounds for the development of positive knowledge, whilst unorthodox approaches such as Natural Philosophy and complexity regard Reason as that which should enable humankind to cope with uncertainty, which is seen as an essential property of our world.

To Nietzsche, the opposition between Germany, France and England is characterised by different conceptualisations of knowledge, and consequent different social orders. Once again, bourgeois liberalism is seen to be associated to Anglo-French modes of knowledge production. To Nietzsche, the birth of liberal-bourgeois science implied the technicalisation of knowledge, the technicalisation of the human spirit and the inevitable technicalisation of society. Such waves of technicalisation were bound to undermine more desirable social orders, and would also lead to political disaster. The link between the triumph of modernity, the technicalisation of society and the emergence of fascism is something that has occupied German thinkers for some time, from Nietzsche to Habermas, via Husserl, Heidegger, Adorno and Arendt. For example, this is a view from Heidegger: "The wilful construction of a world-empire to last for millennia shows...a preference for quantity over quality that is alien to genuine creators like the Greeks. Empire-building stems not primarily from dictators and authoritarian states, but from the metaphysical essence of modernity, the will to mastery over nature" (Inwood, 2000, p. 35).

Air-pumps as agents in the formation of political order and botanical gardens as symbols of civic philosophies, which in turn characterise international conflict – these two stories call for a proper conceptualisation of the nexus that seems to exist between knowledge-formation, the State and, by extension, relations between States. In these historical examples we can see that Nations States – fundamental entities in International Relations – are inseparable from specific ways in which we understand the world. The relationship between knowledge formation, politics and international politics is however complex. It follows that science can tell us things about international politics; just as international politics can tell us things about science.

Science and International Relations

The first comprehensive effort to chart the relationship between science and foreign policy was conducted – with the use of relevant adjectives – by Eugene Skolnikoff in his *The Elusive Transformation: Science, Technology, and the Evolution of International Politics* (Skolnikoff, 1994). Although this is a valuable first attempt, the study is now inevitably outdated in matters of content and substance. In particular, one of Skolnikoff's central preoccupations seems to be the extent to which science and technology may be undermining the traditional notion of national sovereignty, a line of thought that was equally pursued in more recent publications (Skolnikoff, 2002). Whilst questions on science and sovereignty

may be of interest in specific contexts, such as, for example, the context of American foreign policy-making in the areas of nuclear proliferation towards the end of the last century, these issues are likely to be less interesting for a country like, for example, Brazil or China in 2015: in fact, the opposite question (to what extend does scientific development enhance national sovereignty?) probably make more sense from such standpoint. In the context of a rapidly changing international scenario, alternative conceptualisations that are more tuned to new realities need to be formulated.

Apart from Skolnikoff's work there are few other attempts at providing a generic account of the relationship between science and foreign policy from an IR perspective – others, as Weiss suggests, constitute fragmented efforts to be found in different areas of specialist expertise. Those efforts that do aim at providing an IR perspective suffer, however, from some serious limitations. Amongst these, Caroline Wagner's effort is probably the one that remains the most faithful to Skolnikoff's attempt of grounding generic studies on science and foreign policy firmly within the discipline of IR (Wagner, 2002). As such, it seeks to modernise Skolnikoff by providing a new taxonomy of international collaboration in science.

The research, however, remains centred on the alleged fundamental organisational differences that oppose the scientific endeavour (which Wagner argues is characterised by open, networked, peer-review communities that hold few traditions) to foreign policy making (which, on the contrary, is essentially hierarchical and based on history, protocol and tradition). The continuous opposition of the two areas goes a long way in substantiating the consequent question of whether one (science) is undermining the fundamental principle upon which the other is based (the notion of sovereignty in foreign policy). Apart from creating some improbable stereotypes (for example, there is much to be said about the strength of tradition in science) it is difficult to see how Wagner's effort can contribute in producing a comprehensive understanding of this complex relationship which could in turn inform sensible policy making. On the contrary, Wagner concludes her work with some highly dubious remarks.[4]

[4] For example: "Representatives of the scientific community would do well to acknowledge and understand the realities of accounting to the political system for the outputs and outcomes of investments in science" (Wagner, 2002, p. 416). And why exactly should that be so, when a defining feature of the success of contemporary Western science is arguably its independence from political pressures? There are reasons if scientific endeavours were granted a large degree of autonomy from governments to begin with, and these may have to do with the fact that it became commonly understood that politicians are generally not very good at managing research projects and related budgets.

Weiss' own account provides a more nuanced and useful starting point when it comes to developing an adequate methodology for the systematic study of science and foreign policy. Weiss argues that science impacts upon international affairs in essentially four ways:

1. by changing the architecture of the international system.
2. by changing the process by which the international system operates.
3. by creating new issue areas.
4. by providing a source of changed perceptions.

These are just headlines which Weiss comprehensively substantiates with detailed examples and sub-categories. Although this classification is useful, it also suffers from some important limitations.

In particular, Weiss fails to convincingly account for the other side of the relationship (that is, of how foreign policy is used to meet scientific objectives, rather than the other way round). Crucially, Weiss does not introduce geopolitical thinking in the relationship between science and foreign policy (that is, the way in which specific strategic concerns such as energy security, for example, shape the relationship) or to account for how science plays a fundamental role in developing what Joseph Nye famously named 'soft power' (Nye, 2004). Also, Weiss does not approach the broader cultural significance of scientific power, and the way in which this significance impacts upon inter-state relationships.

Skolnikoff, Wagner and Weiss represent three rather isolated attempts to develop a comprehensive study of the relationship between science and foreign policy, and to firmly locate such study in the field of IR. Other research is fragmented across the fields of applied policy making or the study of specific negotiations (Auer, 1998), the analysis of individual policy areas, such as conflict resolution (Ausubel, 2001), descriptive accounts written from a history of science perspective (Krige; Barth, 2006) and the internationalisation of science *per se* (Wagner; Leydersdoff, 2005). To these can be added ad-hoc Governmental reports focussed on particular policy areas (National Research Council, United States, 1999).

Critical Geopolitics

As we have seen, when people talk about Science and International Relations they seem to do so, contrary to Hobbes, on the assumption that these represent two different fields of knowledge, and that a perspective which combined the two might allow us to see connections

that were previously undetected and to formulate more nuanced considerations over the influence that one field has on the other, and vice versa. Inevitably, scholars in International Relations point out that we can know more about International Relations if look at the impact of science on their field of study (Skolnikoff 1994), whilst historians of science point out that International Relations have had a profound influence on the process of scientific discovery (Krige; Barth, 2006). These two communities do not seem to engage in much dialogue – as it is acknowledged by some of its members (Weiss, 2005) – and an impartial observer could point out that both approaches have their own merits, that the Science and International Relations nexus is probably dialectical, which means that focussing on the two sides of the equation separately will result in conclusions that will not tell us much about either.

One way out of this impasse is to go beyond both disciplines and to look at the single compound these two approaches form when looked at from a different level. Anthropology could be a good tool to do this, with its emphasis on culture and on overarching themes related to human endeavours. Another way to look at this could be through the lenses of Philosophy – after all, prominent thinkers such as Nietzsche, Heidegger, Husserl and more recently Nowotny have written extensively about the technological nature of modern societies and about their corresponding political natures. The recent emergence of Science and Technology Studies as an established field of research witnessed the birth of theoretically sophisticated concepts such as the notion of `co-production`, which promotes the view that "the ways in which we know and represent the world are inseparable from the ways in which we choose to live in it" (Jasanoff, 2004, p. 2).

'Inseparable' is a strong word, and it suggests that Science, International Relations and many other things (everything related to the way in which human beings generate and deploy knowledge) cannot be meaningfully studied as stand-alone disciplines. Yet, how are we to make sense of specific dimensions of our human condition for practical purposes, such as understanding the specific Science and International Relations nexus for the purpose of public policy making? Whilst Science and Technology Studies, Anthropology and Philosophy represent possible doors to a top-down conceptualisation of the Science and International Relations nexus, none of these seem to be close enough to the subject of International Relations to provide practical insights.

Critical Geopolitics is about understanding both the real geopolitical struggles occurring at the level of material immanence and the equally real geopolitical struggle unfolding in the collective imagination of populations. As the book *Critical Geopolitics* puts it, "Geography is about power. Although often assumed to be innocent, the geography of the world is not a

product of nature but a product of histories of struggles between competing authorities over the power to organize, occupy and administer space" (Ó Tuathail, 1996). As we have seen, knowledge generation is also far from neutral: it has been used, and it continues to be used, directly or indirectly, willingly or unwillingly, implicitly or explicitly, consciously or subconsciously, to create, establish and maintain specific forms of social order, political organisation and international political relations.

Importantly, Geopolitics is about resources, their strategic location, and the way in which their location in space impacts upon the relationships that exist between States. Critical Geopolitics is about understanding how seemingly value-neutral geographical resources (maps, the naming of space, and so on) are socially constructed, and how such constructions reflect power relationship in a particular place, at a particular time. We will define *Critical Geopolitics of Knowledge* as an attempt to combine the most relevant features of Geopolitics, International Relations and Science and Technology Studies for the purposes of understanding the ways in which scientific knowledge impacts upon relationships between States. In other words, Critical Geopolitics of Knowledge is about understanding how specific, knowledge-based cultural resources frame power relationships both at the level of the collective imagination and the level of material power distribution.

A Geopolitic of Knowledge would, for example, seek to understand simultaneously what cultural resources are behind the production of knowledge that allows some humans in some part of the world to turn sugar-cane into energy, how such cultural resources impact upon relationships relevant States may have with others, and the consequences that the resulting product – in this case biofuels – have on material power relations between States. Importantly, a Geopolitic of Knowledge would reveal the important link that exists between the two areas of struggle – the symbolic, or imaginary; and the real, or immanent, sphere of international policy making.

Such a conceptualisation rests on the understanding that knowledge is both a resource and a vehicle through which other resources (cultural or material, such as influence and energy) are understood, exploited and distributed. In the case of biofuels, the decision to generate and deploy knowledge with a view of turning arable land into a source of energy crops and hence of energy comes with an understanding of what a legitimate use of arable land is. Knowledge on the technical aspects of biofuels alone is not of much use if the associated *cultural resource* does now allow you to effectively exploit the material resource: for example, if some (or most) argue that efforts to deploy technologies related to food are

admirable, whilst efforts related to energy constitute a 'crime against humanity'.[5] Is there a relationship between the ways in which all of this knowledge is generated and the cultural resources which then ensure a successful application of such knowledge to strategic resources? This is one of the central research questions a Critical Geopolitic of Knowledge would seek to address.

Science and Technology Studies

The discipline of Science and Technology Studies has provided sociology with one of the most innovative approaches to the study of the social: Actor-Network Theory (ANT) which, as it has been recently pointed out, "surprisingly has not made a major impact on IR" (Wight, 2006, p. 181). Yet, if the major issues explored by ANT's main exponent, Bruno Latour, are considered, it will become immediately obvious that ANT can potentially revolutionise the way in which we understand the role of science in International Relations and Critical Geopolitics. In relation to IR, this is so not so much because of ANT's relevance in the context of the agent-structure problem, as Wight suggests, but because it forces a new conceptualisation of the very meaning of 'international'. When it comes to Critical Geopolitics, on the other hand, ANT reveals that anything that can be thought of as a 'strategic resource' – both at the level of immanence and at the symbolic, 'cultural resource' level – cannot be dissociated from either science or a specific technology.

First, how can we redefine the notion of 'strategic resource' in a national and international context, and why does 'technology' have anything to do with this? As Latour (2005, p. 69) seeks to introduce ANT and to explain why it is essential that the number of actors considered as having an agency in social theory is expanded beyond the human realm, he mentions a rather significant piece of research of Shirley Strum related to baboon society. Simply put, a sturdy analysis of baboon society demonstrates that the lack of violence is caused by the lack of coercion which is in turn caused by lack of *dependency*. In Strum's own words:

> It appeared that baboons had to work hard to create their social world, but the way in which they created it made them seem "nicer" than people...unlike humans, no member of Pumphouse [the name of the troop] possessed the ability to control essential resources: each baboon got its own food, water and place in the shade, and took care of its own survival needs...what I had discovered was a revolutionary new picture...for *any* animal society as yet described. The implications were breathtaking. I was

[5] As Jean Ziegler, the United Nations Special Rapporteur on the Right to Food, has argued (Borger, 2008).

> arguing that aggression was not as pervasive or important an influence in evolution as had been thought, and that social strategies and social reciprocity were extremely important. If baboons possessed these, certainly, the precursors of our early human ancestors must have had them as well (Strum, 2001, p. 158).

This insight allows for a very simple definition of a strategic resource. A strategic resource is something you need for your survival (or, in a milder version, to sustain your standards of living) but something you do not have direct access to yourself. Food, for example, becomes a strategic resource only when you depend on others to get to it. Usually, *the gap between you and the resource has been created and/or continues to be enforced by a technology*, in this case the discovery of agriculture. Once agriculture allows for the accumulation of surpluses, and humans reproduce on the bases of such surpluses, food becomes a strategic resource insofar it becomes impossible to feed all members of a group through non-agricultural means, hence the dependency towards agriculture is reinforced. If we could all simply wonder off and survive through non-agricultural means food would cease to be a strategic resource according to this definition.

Agriculture becomes a cultural resource once it conditions the way in which we interact with nature and with others, once it becomes so intrinsically embedded into a way of living that it becomes an assumed, or natural, element and once it conditions they ways in which we understand the world around us. An important but often overlooked fact is that agricultural research was key to the development of the modern science of statistics, with all the implications for theories on probability and the management of risk – "…the rigorous theory of estimation and statistical test that we owe to R. A. Fisher was worked out for the Rothamsted station for agricultural experiments, and has nothing to do with philosophical scepticism" (Hacking, 2006, p. 15).

It is not surprising then that the birth of the first 'international system' coincides with the emergence of agriculture, surpluses, the need to administer such surpluses and the supply of food more generally (Buzan; Richard, 2000). Indeed, if Pierre Clastres was right, South American Indians actively sought to prevent the emergence of monopolies and the means to achieve such monopolies precisely because they wanted to prevent the birth of the State. Again, the State is simply defined as the reduction of some members of society to a state of dependency on other members of society, who usually accumulate strategic resources on the bases of superior know-how, or technology. Science and technology are thus not simply things that "happen" within societies: they define human civilisation, and much of what goes on within human societies. Hence, science and technology also define international life, where

a number of political actors have different access to the means through which material and cultural resources are exploited and controlled.

According to Clastres, South American Indians prevented the birth of the State by ensuring that each individual in the community was able to gather his or her resources – and this was done through an equal access to key "technologies" and know-how. Hence the importance given to training from a young age – the average Tupi-Guarani tribe was able to live relatively long and healthy lives by working an average of three hours a day. When surpluses were accumulated these were immediately disposed of in ways determined by tradition: war, festivity or leisure. The prevention of the State was a deliberate and never-ending activity; such activity was based on the assumption that each member of the community was entitled to have equal access to strategic resources, also on the bases of an equal access to technology:

> If one understands by technology the set of procedures men acquire not to ensure the absolute mastery of nature…but to ensure a mastery of the natural environment suited and relative to their needs, then there is no longer any reason whatever to impute a technical inferiority to primitive societies: they demonstrate an ability to satisfy their needs which is at least equal to that of which industrial and technological society is so proud. What this means is that *every human group manages, perforce, to exercise the necessary minimum of domination over the environment it inhabits*…Hence there is no hierarchy in the technical domain: there is no superior or inferior technology. The only measure of how well a society is equipped in technology is its ability to meet its needs in a given environment. And from this point of view, it does not appear in the least that primitive societies prove incapable of providing themselves with the means to achieve that end… (Clastres, 2007, p. 209).

They key issue here is that every group has access to the elementary knowledge that makes one's own survival possible and independent from others. On the key issue of agriculture: "one notes that the discovery of agriculture and the domestication of plants occurred at about the same time in America and the Old World. One is forced to acknowledge that the Amerindians are in no way inferior – quite the contrary – in the art of selecting and differentiating between manifold varieties of useful plants." (Clastres, 2007, p. 210). But why did agriculture not have the same transformational effect (establishment of hierarchies, division of labour etc,) that it had in so many other places? According to Clastres, it was precisely the tradition of preventing the birth of the state by preventing the establishment of monopolies or oligarchies over key resources: "The capacity – which was equal amongst all members of the group – to satisfy all material needs…constantly prevented the private accumulation of goods, rendering the emergence of a desire for power simply impossible.

Primitive society – which was in fact the first society of abundance – leaves no space for the desire of over-abundance" (Clastres, 2007, p. 222). In other words, it was a more equal access to the 'science of' agriculture that prevented agriculture to become a cultural resource conducive to over-accumulation, and to the related need to administer surpluses.[6]

Thus, it is essential that science and technology is regarded as an element that is interwoven into existing cultural and civic spaces. Science and Technology Studies have concentrated much on the notion of co-production. Some scholars have gone even further, comparing civic epistemologies and analysing how scientific practice can have different effects across different contexts: "Sheila Jasenoff, in a comparative study of biotechnology in the United States, Britain, and Germany, shows how there are distinct national cultures of technoscientific politics" – such analysis led to the definition of different "civic epistemologies that shape the democratic practice of science and technology" (Sismondo, 2008, p. 24). One of the objectives of a Critical Geopolitics of Knowledge would be to analyse how such civic epistemologies do more than shaping specific practices within States – they also condition the way in which such States deal with each other. One of the ways to analyse how such "civic epistemologies" interact with each other is to look precisely at the different cultural resources they generate, and to examine how such cultural resources impact upon the exploitation of different strategic resources (consider examples related to Brazil).

Beyond Order and Progress: Brazil and Critical Geopolitics of Knowledge

In 2001, the Organisation for Economic Cooperation and Development (OECD) published a report entitled Science for Development: the Brazilian Experience, which affirmed that Brazil was still firmly on the wrong side of the knowledge divide.[7] Less than a decade later, evidence seems to suggest that Brazil's position in the global research context has significantly changed. Reports on Brazilian science and innovation now referred to the country as 'the natural knowledge economy'.[8] Bibliometric data indicated that in 2007 Brazil overtook established scientific communities in countries such as Israel, Belgium, Sweden and

[6] This 'discovery' led Clastres to dismiss orthodox Marxist economics and to argue that the emergence of the State is primarily a political – and not an economic – phenomenon. Clastres demonstrates how Amerindian tribes prevented Chiefs from exerting any real authority by forcing leaders to be affectively poor and to depend on the community for the provision of food.

[7] "Brazil's potential in the global knowledge economy remains largely unrealised. Its competitive position is weak and the country is definitely on the fragile side of the knowledge divide". Organisation for Economic Cooperation and Development, *Using Knowledge for Development: The Brazilian Experience* (Paris: OECD Publications, 2001), 7.

[8] Kirsten Bound, *Brazil: The Natural Knowledge Economy* (London: Demos 2008).

Switzerland to become the world's 15th largest producer of scientific publications – up from 23rd in 1999, due to an impressive growth of 8 per cent per annum since then. The data equally indicated that such an increase reflected quality (revealed by citations) as well as quantity (total output), and that the trend seems likely to continue, or even accelerate.[9]

Meanwhile, the emergence of Brazil as a rapidly expanding research base is being correlated to the emergence of Brazil as a world power in some increasingly important strategic areas. In a context of rising food prices and growing global concerns related to food security, it is significant that Colin Powell – a former Unites States Secretary of State – referred to Brazil as the world's agricultural superpower. As influential media have been quick to outline, such status if fundamentally related to Brazilian expertise in agricultural science, and to the status of EMBRAPA (the Brazilian Agricultural Research Agency, acronym in Portuguese) as a world-class research centre in tropical agriculture.[10] Indeed, according to a former Brazilian Minister for Agriculture (Reinhold Stephanes) Embrapa is responsible for having increased field production per unit of land in Brazil by 60 per cent, which grew by a total of 150 per cent in the last 15 years.[11]

Brazil is also being talked about in important international policy and science circles in the area of space technology. According to the prestigious Science journal, "Today, Brazil's monitoring system is the envy of the world. INPE [the Brazilian Institute for Space research, acronym in Portuguese] has its own remote sensing satellite, a joint effort with China launched in 1999, that allows it to publish yearly totals of deforested land that scientists regard as reliable."[12] The importance of such statement should also be put in the context of what the world scientific community refers to as a 'crisis in Earth Observation', which is related to the increasing lack of reliable data due to the decommissioning of relevant satellites and the failure to replace these.[13] This crisis constitutes an important stumbling block for the formulation of research – and policy – on tropical deforestation and climate change (not only in Brazil). In this context, the American Association for the Advancement of Science is warning US policy-makers that effective policies for climate change cannot be formulated

[9] Ibid, 29.
[10] Larry Rother, "Scientists are Making Brazil's Savannahs Bloom", *The New York Times*, 2 October 2007, http://www.nytimes.com/2007/10/02/science/02tropic.html (last accessed on 13 August 2008).
[11] Embrapa, "Embrapa festeja 35 anos de suceso da pesquisa agricola", 24 April 2008, http://hotsites.sct.embrapa.br/pme/noticias/embrapa-festeja-35-anos-de-sucesso-da-pesquisa-agricola (last accessed on 13 August 2008).
[12] Eli Kintisch, "Carbon Emissions: Improved Monitoring of Rainforests Helps Pierce Haze Of Deforestation", *Science* 316, no. 5824, 27 April 2007.
[13] A crisis indeed, as *Science* did not hesitate to call it – see the edition of 30 March 2007.

without reliable satellite data.[14] Meanwhile, the White House has already recognised that "even with immediate action, the US anticipates a gap in Landsat data for an unknown period of time", suggesting that "the China-Brazil Earth Resources Satellite might be a good source of useful data to substitute for the loss of data during this period."[15]

If food and space represent a substantial field upon which solid foreign policy advantages could be pursued, the brief analysis above excludes other areas of equal importance, from ethanol production and the current energy crisis to environmental science in the context the current global effort to tackle climate change. Brazil, as Rubens Ricupero argues, is a global environmental power on the grounds that no significant progress on climate change can be achieved without it.[16] Although this is probably correct, it omits the fact that the baselines that characterise international talks on climate – especially in the context of Intergovernmental Panel on Climate Change (IPCC) negotiations – are all science-based. Will Brazil content itself in using its forests as bargaining tools or will it seek to be a primary (or the primary) source of knowledge upon which baseline considerations on such forests will be made? In climate change negotiations, as much as in anything else, the basic principle: 'Knowledge is Power' still holds. And we have not even started to talk about the strategic expertise and knowledge related to the capacity to produce the enormous Pre-Salt resources in a very challenging environment.

These preliminary remarks automatically lead to a number of tentative research questions: does Brazil have a strategy for maximising the impact that its expanding science base could have on foreign policy objectives? If it does, is it consonant with the complexities inherent in both foreign policy and science, which is a highly international endeavour in itself, and whose interests may not always be easily reconcilable with national objectives?[17] If the country does not have such a comprehensive strategy, should it adopt one? What would it look like, and what would be the consequences on other parts of the world? What *cultural resources* would such strategy deploy?

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[14] See: http://www.aaas.org/news/releases/2007/0430eos.shtml

[15] Office of Science and Technology Policy (Executive Office of the President of the United States of America), "A Plan for a U.S. National Imaging Programme", August 2007, page 37. http://www.ostp.gov/pdf/fli_iwg_report_print_ready_low_res.pdf (last accessed on 13 August 2008). This is also ironic, considering the efforts of the US administration to disrupt Brazilian space activities on the grounds that its collaboration with China represents a technology transfer risk.

[16] Antonio Gaspar, "País tem que assumir que é potência, diz Ricupero", Terra: 15 January 2008, http://invertia.terra.com.br/sustentabilidade/interna/0,,OI2244115-EI10432,00.html (last accessed on 13 August 2008).

[17] See, for example, Elisabeth Crawford, *Nationalism and Internationalism in Science, 1880–1939: Four Studies of the Nobel Population*, (New York: Cambridge University Press, 1992).

Brazil, Soft Power and the Geopolitics of Knowledge

There are reasons why the standard notion of 'science and international relations' is too restrictive for our purposes. Fundamentally, the Brazilian case calls for an approach that is more firmly rooted in the niches of competitive advantage it has developed in key (geo)strategic areas. This leads to the objective of, for example, furthering knowledge on strategic assets so that the international relations Brazil chooses to pursue can be conducted from a position of strength in relevant crucial areas, as opposed to the approach of mixing an element of science in standard foreign-policy making. The very nature of Brazil's global situation, on the other hand, means that important strategic objectives essentially rely on advances in specific technologies. Such situation has led some commentators to "link Brazil's geopolitical prospects with the future of its environmental technologies".[18]

In sum, going beyond standard approaches is desirable because:

1. The nature of Brazilian expertise is highly specialised and related to particular areas of ever-increasing geopolitical importance.
2. Such specialisation can be effectively used to further Brazilian expertise in other areas of knowledge, and particularly in those that can maximise the use of existing Brazilian competitive advantages.
3. Current Brazilian expertise is particularly well suited for exercising a considerable amount of soft power.

As the paragraphs above suggest, the Brazilian foreign policy – international science nexus is more complex than current models developed in the academic discipline of International Relations may suggest. A Geopolitics of Knowledge approach would synthesise the cultural resources issues described in previous sections and apply related understandings to areas of increasing geopolitical and geostrategic importance such as energy, space, climate and food. Given the dynamics of the Brazilian relationship between international science and foreign policy what would suitable strategies for furthering Brazilian objectives in these areas look like? What would their impact be on other parts of the world? How could other knowledge intensive societies react in order to maximise the opportunities derived from Brazil´s emerging status? To what extent can Brazil use its international science endeavours

[18] Bound, *Brazil: the Natural knowledge Economy*, 113.

to catalyse foreign policy objectives and geopolitical needs? Such questions will be answered through the application of previous findings and through an extensive analysis of projected global scenarios in the relevant areas.

A Geopolitics of Knowledge approach would entail an understanding of the cultural significance of Brazilian scientific power and of its related Civic Epistemology, as described below. From this perspective, any agent that expands its influence globally – including scientific influence – brings with such expansion particular cultural understandings on the nature of such influence. Although these considerations may seem removed from the main objectives of the project they form an integral part of the effort to comprehensively understand the nature and consequences of the Brazilian science and foreign policy nexus.

A few considerations can illustrate such considerations. For example, what does it mean for the world to have Brazil's unique capability in space and Earth Observation distributed freely over the internet?[19] What would it mean to have a country with notoriously distinctive attitudes towards intellectual property – particularly well highlighted in the case of the World Trade Organisation's case on the production and distribution of retroviral drugs for HIV-AIDS – dramatically expanding its biopharmaceutical expertise as well as its own capability in plant, animal and human genomics? More importantly, how would this contribute to the enhancement of Brazilian soft power, particularly in the context of current South-centred foreign policy objectives? How does Brazil's international stance on Intellectual Property issues combine with the opinion of Brazilian academics, jurists and businesses keen to increase private spending in research and development, and how does this relationship influence Brazil's global position? Furthermore, Brazil is widely regarded globally as a multi-ethnic and multi-cultural society which, contrary to other emerging powers such as China, Russia and India (the famous 'BRICs'), has no 'glorious past' to rescue. How does this influence possible answers to the questions asked above? How does Brazilian notoriously positivist political culture affect its approach to – and therefore the deployment of – knowledge? What are the practical diplomatic consequences of having *"Order and Progress"* written on your flag? Can we talk of the emergence of different "BRIC Civic Epistemologies" and if so, are these similar, different but complementary, or different but ultimately destined to conflict?

Conclusion

[19] Brazil's open data policy is distinctive from most practices that have been adopted in this area.

This article sought to outline the importance of thinking International Relations in terms of knowledge practice and application. The importance of interdisciplinary research in this context was emphasised. Whilst Hobbes' considerations may seem to be firmly in a distant past, we contend that enquiries on the generation and production of knowledge are as important as ever – especially in the analysis of International Relations. This goes beyond an analysis of, for example, Chinese capability in space or in the production of technology-intensive consumer products like automobiles or IPhones. It goes beyond traditional concerns such as the proliferation of technological know-how conducive to nuclear weapons in places such as Iran and North Korea. Our Geopolitics of Knowledge approach seeks to understand what such scientific advances mean for the generation of Civic Epistemologies which are responsible for framing the ways in which knowledge is generated and applied. The case of Brazil is being introduced as a potential first case study for this approach. Brazil shows that strategic resources such as food, forests and energy depend on sophisticated knowledge-generation techniques. We content that such techniques are not value-neutral: they inform and shape social order at home, and International Relations abroad.

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