Scientific knowledge and higher education in the 21st century: The case against 'indigenous science'

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Abstract

The emphasis on 'indigenous science' is a recent phenomenon in higher education as elsewhere. There are several projects that underlie this idea: publicisation of the victimisation and exploitation of the areas of practice and research constituting 'ethnoscience', acknowledgement of their autonomy, and their inclusion in tertiary educational curricula. Appeals to indigenous scientific knowledge systems and indigenous knowledge production, therefore, have reclamation as their central focus. This article attempts to cast doubt on the plausibility of this enterprise. For anything to be called 'science', it necessarily involves reference to laws or regularities, observation, description, explanation, prediction and testable hypothesis. While practices, skills and beliefs, and the ascription or attribution of scientific knowledge may vary according to personal, social or cultural context, scientific knowledge and truth as such do not so vary as such. It is this insight, and not adherence to a questionable idea, that has profound implications for higher education and tertiary curricula.

COSMIC AFRICA

The film *Cosmic Africa*, by South African brothers Craig and Damon Foster and concept originator and key researcher Anne Rogers, documents the journey of South African astrophysicist Thebe Medupe. His mission is to connect occidental science and astronomy to the cosmological models of some of the oldest civilisations on earth. 'Astronomy' survives in these ancient societies despite the eroding effects of colonialism and its modern heir, globalisation. Medupe emphasises that 'astronomy' has never just been a science in these cultures. For them, it is an 'intimate tapestry merging into their prayers, their lives, their dreams and their deaths'. Occidental culture, on the other hand, has separated astronomy from daily experience and turned

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it into 'pure science'. Medupe's mission is stated at the very beginning of the film: 'I need to discover whether my science has a place in Africa, and whether Africa has a place in my science'. His journey leads him to the Ju/'hoansi in northeastern Namibia, the Dogon in Mali and finally to Nabta Playa in the southern Egyptian Sahara, to what is conceivably the site of the first solar observatory (see also Rogers 2007, 19).

During his visit to Namibia, Medupe learns not only of Ju/'hoansi reliance on the stars as to when to plant and to harvest but many of the stories connected to the sun, moon and stars:

> One memorable night, Kxau Tami and /Kunta Boo, two elderly shamans demonstrated how they would throw burning sticks in the direction of a very bright meteor – as they threw the sticks into the air, they uttered swear and curse words which they said would help to divert the meteor's path and thereby prevent its dangerous potential. They believe that bright shooting stars with fiery tails are invested with very powerful !nom (extreme potency) and that they have the potential to cause sickness. (Rogers 2007, 21).

Medupe's visit to the Ju/'hoansi coincides with a total solar eclipse. He worries about whether he should tell the people about what is going to happen but decides not to: they would want to know how he knows. Instead, he sets up his equipment. When the eclipse happens, people talk about the return of winter and blame the intruder and his equipment: 'The telescope is eating up the sun'. After the eclipse and subsequent reconciliation, Medupe says, 'For the first time I see how the stars affect the way people live. My science and my Africa are beginning to come together.'

This impression is deepened with the visit to the Dogon, whose knowledge of the stars is legendary. Their daily and seasonal activities, routines and customs are guided, for example, by the appearance of what we call Venus (for which the Dogon have 'a number of different names … , depending on its station in the sky'; (Rogers 2007, 21)), 'Toro Jugo' (the Pleaides; Rogers 2007, 20), etc. One of the elders, spiritual leader Annayé Doumbo, claims, 'In our Dogon way, the man who makes technology is the sorcerer of the sun'. Given the harsh conditions under which they live, to the Dogon knowing the stars can mean the difference between life and death. Does the elder know that human beings have walked on the moon? 'There is no gate to the moon', is the reply, 'It is not possible for anyone to go there, unless they are the little brother of God.'

The last leg of Medupe's journey is what is presented as the origin of astronomy, Egypt. (There is no mention of the innovations and discoveries of the Maya and Aztecs.) In the southern Egyptian desert, near the border of Sudan, he discovers what is conceivably the oldest observatory, conceived and constructed by the Nabtans, nomadic pastoralists, now long dead. Predating Stonehenge in England by almost 1000 years, it consists of countless stones emanating from a centre, in order to trace the rising and setting of the sun during the year, as well as the passage of the moon

and stars (Rogers 2007, 23): 'The origin of astronomy, its measuring and predicting, is in Africa … Stones took the place that my computer takes now'.

It is unfortunate that, throughout the film, Medupe and the research team never explore any of the tensions between traditional, indigenous and scientific world-views. They seem satisfied with just noting the different perceptions and appear to assume that there is no problem of reconciliation of myth or legend with scientific fact. At the end of the film, Medupe states that he has come 'full circle', that his journey has served to (re)unite 'his science' and 'his Africa', without so much as an attempt to account for the contradictions he has encountered between spirituality and astronomy.

One of Medupe's intentions is to create an African star chart. His long-term goal is to develop a database and to set up a formal ethnoastronomy research group. The pertinent questions, for present purposes, are: Does the idea of 'ethnoastronomy' make sense? What, if anything, distinguishes 'ethnoscience' from mainstream, academic science? Is it a spiritual, contextual, subjective or personal element? One response, emphasising the local and contextual character of scientific knowledge and truth, is the argument from social construction. Two related ideas in this regard are those of 'situated cognition' and 'personal knowledge'. I will briefly examine each of these in turn.

SOCIAL CONSTRUCTION, 'SITUATED COGNITION' AND 'PERSONAL KNOWLEDGE'

According to the National Curriculum Statement for the Natural Sciences, Specific Outcome 7, learners are expected to demonstrate an understanding of 'changing and contested nature of knowledge in the Natural Sciences'. It encourages learners to view scientific knowledge as 'socially constructed and subject to change and different interpretations' (Department of Education 1997; see also Dempster and Hugo 2005). In the Revised National Curriculum Statement for the Natural Sciences it is pointed out that biological differences among different ethnic groups do not indicate different innate capacities among these groups:

> Variations in human biological characteristics such as skin colour, height, and so on, have been used to categorize groups of people. These biological differences do not indicate differences in innate abilities of the groups concerned. Therefore, such categorisation of groups by biological differences is neither scientifically valid nor exact. It is a social construct. (Department of Education 2002, 64; see also Dempster and Hugo 2005).

This argument is plausible. Interestingly, it contrapositions scientific validity and exactness, on the one hand, and social construction, on the other. Yet, if *science* itself is 'social construct', then this clearly weakens the *scientific* case against race- and sex-based categorisation and biological differences. Scientific knowledge of the so-

cially constructed nature of classification and differentiation would itself be a social construct.

The 'social constructivist' position, I think, has more to do with beliefs than with knowledge and truth. Perhaps critical realism shares with constructivism the view that, without 'God's eye-view', objective reality and truth as such are impossible to access *in toto*. Yet, the former position maintains not only that one can get closer to such reality and truth (that is, by learning to avoid error) but to gain partial access – *without* in any ontologically significant way being the 'maker' of that reality and truth. The virtue of this position is that it does not make any logically and epistemologically dubious inferences along the lines of the latter. Finally, *unlike* constructivists, critical realists arguably *practice* what they preach.

Olugbemiro Jegede characterises 'situated cognition' as a 'strong relationship that exists between the prior knowledge and sociocultural environment' of the student. It is 'deemed primitive, inferior, and unscientific' by/ in the 'Western view, especially with regard to science teaching and learning' (Jegede 1999, 120, 123). No wonder, the cynic might think: the four fundamental features of the African belief and thought system enumerated by Jegede – belief in a creator/God, belief in life after death/ reincarnation, anthropocentrism or the idea that human beings constitute the centre of the universe, and the theory of causality, which 'is the sociocultural cloak the African child takes to the science classrooms' (Jegede 1999, 125) – have little to do with knowledge, cognition or science. In addition, Jegede's position gives rise to a logical problem. Who is the 'situated cogniser' making these claims and constructing these meanings, then?

In a similar vein, Lesley le Grange mentions the 'localness' of all knowledge systems: all knowledge is local, 'located/ situated and motley (messy situatedness)' (Le Grange 2004b, 87). I would suggest here that, while it makes some sense to say that 'all knowledge systems have localness in common' (Le Grange 2004b, 87), they also share objectivity and *trans*localness. Le Grange would probably concur with C. Shiv Visvanathan: 'Morality, like science, has to be invented individually' (Visvanathan 2002, 51). This view indicates a basic misconception. In fact, neither science nor morality is an individual invention. The individual is initiated into both and perhaps attains autonomy in one or both of these realms later. There is also a disconcerting relativism manifest in views like these, a problem I will elaborate on later. Some writers who favour an account of 'personal knowledge', like Michael Polanyi and Karori Mbugua, are aware of this problem. Nevertheless, according to Mbugua, Polanyi's 'personal knowledge' seeks to avoid relativism because of knower's commitment to universality (Mbugua 1998, 155; Polanyi 1958, 316). I suggest that this salvages the idea only if Polanyi and Mbugua (as 'knowers' and as 'makers of knowledge claims') share this commitment.

'WE SEE NATURE DIFFERENTLY AND SPEAK TO AND ABOUT IT DIFFERENTLY'

According to Zimbabwean novelist Chenjerai Hove,

> We have neither catalogued nature nor pinned it down and preserved it in formaldehyde. We see it differently and speak to and about it differently. (Grill 2003, 363).

Hove is arguably correct about one thing. Practices like large-scale dissection, vivisection and, generally, all scientific experimentation involving nonhuman animals appear to have been pioneered and exported all over the globe by monetarily inclined 'westerners'. The same goes for the so-called 'scientific' factory farming and mass slaughter of food animals. Of course, this subjugationist and expansionist mindset and drive claimed countless human victims, too – which may explain the accusations made by or on behalf of indigenous people, Africans, native Americans and Australian aboriginal people, accusations like Hove's. But is Hove correct when he claims, 'We see [nature] differently and speak to and about it differently'?

Hove's view is shared by many writers and theorists. Ladislaus Semali and Joe Kincheloe refer to the

> use of indigenous knowledge to counter Western science's destruction of the earth. Indigenous knowledge can facilitate this ambitious project because of its tendency to focus on relationships of humans to both one another and to their ecosystem. (Semali and Kincheloe 1999, 16).

Le Grange concurs:

> (South) Africa has to use the good of Western science and also recognize its negative side that has destroyed natural environments and denigrated the cultures of African people. Invoking the term indigenous knowledge can engage Western science deconstructively so as to overcome the binary opposition between Western science and indigenous knowledge. (Le Grange 2004b, 88).

Yet, not all authors share the idea of a possible synthesis. Madhu Suri Prakash, after mentioning the claim to universality and objectivity of modern science and its propagators (Prakash 1999, 157, 158), states that, given 'cultural and ecological damage being perpetrated by [modern science] on a global scale, critics have postulated the existence of two distinct and incompatible types of science or knowledge systems' (Prakash 1999, 160). He refers to the incommensurability and fundamental difference between modern scientific and other knowledge systems (Prakash 1999, 167, 168). It should be clear that, on this characterisation, there is no basis for comparing and evaluating different types of science and knowledge systems.

In terms of such a contrast, Catherine Odora Hoppers refers to traditional knowledge as

> the totality of all knowledges and practices … used in the management of socio-economic, spiritual and ecological facets of life. In this sense it can be contrasted with 'cosmopolitan knowledge' that is culturally anchored in Western cosmology, scientific discoveries, economic preferences and philosophies. (Odora Hoppers 2005, 3).

She continues:

> The relationship between people, the knowledge and the technologies for its application are under-girded by a cosmology, a world view. … Relationships between people hold pride of place, expressed in the various philosophies across Africa, and best captured by the African concept of *Ubuntu* … In the context of such a philosophy, IKS [indigenous knowledge systems] practice does not seek to conquer or debilitate nature as a first impulse. This can be contrasted, for instance, with … the mechanistic conception of reality … IKS stresses instead the essential interrelatedness and interdependence of all phenomena – biological, physical, psychological, social and cultural. Indigenous cosmology centres on the co-evolution of the spiritual, natural and human worlds. … Experiences from indigenous communities in other parts of the world emphasize the fact that knowledge is relationship, and relationship brings with it responsibilities and obligations and extends into ecological practice. (Odora Hoppers 2005, 4–6).

Given that *ubuntu* is essentially and explicitly anthropocentric, the difference between African knowledge systems and the 'Western', 'mechanistic', subjugationist conception of nature and reality is not radical but one of degree, not qualitative but quantitative. One is left to wonder whether, given comparable economic and military powers, so-called 'IKS practice' would not have led to a similar kind and extent of abuse and exploitation, in the name and for the sake of 'human solidarity' (Odora Hoppers 2005, 4). But what, exactly, is 'indigenous knowledge', in particular indigenous scientific knowledge, and what is the invocation of 'indigenous science' meant to accomplish?

THE IDEA OF 'INDIGENOUS SCIENCE'

The emphasis on 'indigenous science' is a fairly recent phenomenon, in higher education as elsewhere. Indigenous science is usually taken to cover indigenous astronomy, indigenous physics, 'ethnomedicine', 'ethnobotany', 'ethnozoology', as well as 'ethnopsychiatry'. There are several projects that appear to underlie this idea. First, publicisation of the suppression and exploitation of the areas of practice and research constituting 'ethnoscience': indigenous science or 'ethnoscience' has traditionally and historically been victimised, marginalised or exploited for the sake of colonialist promotion of occidental science. Second, acknowledgement of their autonomy: the fields grouped together under the term 'indigenous science' constitute or describe culturally specific and independent areas of practice and research. Third, their inclusion in tertiary educational curricula: insofar as these fields constitute

'valid' or 'legitimate' knowledge, the debate around indigenous scientific knowledge production has direct bearing on and should enter higher education. Indeed, they should be granted equal time and space alongside mainstream or academic science in tertiary educational curricula. Emphasis of indigenous scientific knowledge systems and indigenous knowledge production, therefore, has as its central focus that of reclamation.

Odora Hoppers states that 'the notion of indigenous knowledge systems (IKS) has been defined as the sum total of all knowledge and skills which people in a particular geographic area possess, and which enables them to get the most out of their natural environment' (Odora Hoppers 2005, 2). 'Categories of these traditional knowledges include agricultural, meteorological, ecological, … medicinal and pharmaceutical, … textile manufacture, metallurgy and food technology' (Odora Hoppers 2005, 3). Having provided Odora Hoppers with several of these categories, Ivan van Sertima (van Sertima 1999) and Sipho Seepe (Seepe 2000) emphasize the autonomy and cultural specificity of indigenous science, as does Odora Hoppers herself (Odora Hoppers 2002b, 14, 18; see also Visvanathan 2002, 49; Jegede 1999, 130, 131; Le Grange 2004a, on the 'cultural situatedness' and 'socially constructed nature' of science). Nonetheless, apart from 'knowledge' and 'science' remaining undefined, some knowledge systems appear to be more indigenous than others. If Africanist scholars are correct in their assertions that Africa is the cradle of humankind and the locus of the first great civilisations from which all others derive, as well as the birthplace of technology, metallurgy, astronomy, mathematics, agricultural science and medicine (van Sertima 1999; Seepe 2000), then all other 'knowledges' emanate from Africa and are 'indigenous' only in a derivative sense.

These kinds of assertions also lend a new, interesting dimension to the consideration that indigenous science has been, and continues to be, both suppressed and exploited in the process of colonisation (Odora Hoppers 2002a, vii; Grill 2003, 46, 47, 95, 96). Bernhard Dernburg, the first German colonial minister, provided a frank definition of the enterprise of colonial expansion: 'Colonisation is the harnessing of the soil, its natural resources, flora, fauna and especially of the people, all for the sake of the economy of the colonizing nation, which in turn is obliged to make a return gift of its higher culture, its moral concepts and its superior methods' (quoted in Grill 2003, 79). One could also express this more bluntly: subjugation, exploitation and re-education that, on the Africanist analysis, constitute violation of the 'birth-giver', if not a form of 'matricide'.

The inclusion in tertiary educational curricula of indigenous scientific knowledge systems and indigenous knowledge production and the ideas of reclamation and transformation are intimately linked. Thus Semali and Kincheloe:

> Our notion of an indigenously-informed transformative science is not one that simply admits more peoples … into the country club of science but challenges the epistemological foundations of the ethnoknowledge known simply as science. … A transformative science of education, for example, takes these epistemological and

> cultural dynamics into account as it reconceptualizes the way students are traditionally assessed. Rejecting the tendency of modernist educators to judge students on an arbitrary, allegedly neutral standard unconnected to them, the transformative educator develops personalized means of evaluating an individual's performance. . . . [Transformative analysts] are rejecting the universalisation tendency of modernist science, interrogating the power dynamics and cultural assumptions inscribed upon so-called universal propositions. In this manner they are valuing locality and the insights the process of "de-universalisation" can provide. (Semali and Kincheloe 1999, 45, 46; see also Le Grange 2004a; Le Grange 2004b, 88–90; Odora Hoppers 2005, 13–16, 28–34).

Before I go on to interrogate the notions of ethnoscience and of indigenous scientific knowledge, I want to state that in principle I sympathise greatly with the concerns that underlie advocacy of indigenous science projects. For one thing, occidental knowledge, science, technology and 'rationality' have led to, or have had as a significant goal, the subjugation of nature, and so far have been devastatingly efficient. The pursuit of nuclear energy (see Fig 2005), wholesale deforestation and the destruction of flora and fauna are arguably deplorable and – indeed – irrational. Similarly, apart from being ethically suspect, factory farming of nonhuman animals for human consumption and, especially, vivisection are also examples of bad science (see Horsthemke 1993, chapter 3). For another, the disparagement and belittling of indigenous peoples' practices, skills and insights has, to a large extent, been arrogant and of similarly questionable rationality. Finally, current attempts by industrial, first-world nations to (re)colonise or appropriate for commercial gain these practices, skills and insights (all in the name of globalisation) are exploitative and contemptible.

Having said this, however, I consider blanket appeals to the concept of indigenous science, and its 'legitimisation' or 'validation', as a remedy or countermeasure to be completely misguided. Any such appeal is inadequate, not least because of a general lack of appreciation of the semantic and logical problems involved in employing and applying the concept of 'scientific knowledge' beyond the sense of practice or skill, while still referring to the knowledge in question as 'indigenous' and – as such – as 'fundamentally different', 'unique' and 'incommensurable' or 'incompatible' with 'mainstream' science. As indicated earlier, there is almost a complete absence of definition, even of working definitions, of the crucial ideas of 'knowledge' and 'science' in the various accounts that have been presented over the years. Le Grange's is no exception, appearances notwithstanding, like when he claims that

> recognizing that all knowledges have localness in common decentres Western science and serves [as] a basis for comparing different knowledges equitably. (Le Grange 2004b, 88; amendment mine).

Shared 'localness' and 'messy situatedness', I submit, are not enough to render possible comparison, let alone an indication as to how 'Western science' and 'indigenous knowledge' can 'work together'. In what follows, I will attempt to indicate what a

requisite understanding essentially involves. This will serve not only as conceptual clarification but also as the basis for my misgivings about indigenous 'science'.

MY PROJECT

I argue in this article that 'ethnoscience' and 'indigenous scientific knowledge' have limited plausibility. As I see it, the dilemma for the 'indigenous science' apologist is the following. Insofar as the term 'indigenous' makes sense, it is not a matter of scientific 'knowledge', strictly speaking, but rather of 'indigenous scientific skills/ practices' or of 'indigenous beliefs'. Insofar as the terms 'science' and 'knowledge' are plausible in this context, in the sense of involving reference to truth and scientific evidence, this is not a matter of being 'indigenous', 'local', and so forth. It is a matter of 'science' and 'knowledge' *per se*.

SCIENTIFIC KNOWLEDGE AND THE ROLE OF THE UNIVERSITY

In this section, I attempt to cast doubt on the plausibility of the 'ethnoscience' or 'indigenous scientific knowledge' project. If anything qualifies as science, there are certain criteria that must hold. For anything to be called 'science', it necessarily involves reference to laws or regularities, observation, description, explanation, prediction and testable hypothesis. If it does not meet these criteria, it is not 'science', strictly speaking.

With regard to scientific knowledge, one generally distinguishes between two kinds: practical knowledge and theoretical knowledge. The former denotes skill or ability, frequently also a practice or custom taught or passed down from one generation to another. Apart from necessarily incorporating belief, the latter kind of knowledge involves commitment to truth and scientific evidence. In other words, a person knows that something is the case if she believes that it is; it is so (or it is true that it is the case); and she has adequate evidence for believing that it is. 'Adequacy', here, is determined by the kind, degree, as well as the context of evidence. Different kinds of evidence pertain to the different sciences, natural as well as social. They include observation, sense experience, oral and written testimony, deductive and inductive reasoning, and so on. As far as the requisite degree is concerned: minimal evidence is clearly not enough, while conclusive evidence is usually not available. Normally, that is, other than in mathematics and deductive logic, we accept evidence that is less than conclusive, that is, reasons that are nonetheless compelling.

Yet, what makes evidential reasons compelling has partly, and importantly, to do with context – not only the particular scientific context but also, for example, the environment, the cultural and social biography, and/ or the reasoning level of the person making a knowledge claim. Considerations of context determine leniency or stringency in ascription of scientific knowledge. Thus, we are generally more lenient in attributing knowledge (and, therefore, sufficient evidence) to a younger person, as opposed to an older, more mature and experienced person. Similarly, we

are considerably stricter (that is, we demand more, better, or additional evidence) when assessing the knowledge claims of an educated urban, cosmopolitan citizen, than we are when dealing with a person from a remote, rural area. It is important to note that, in terms of this definition, while belief and what counts as evidence may vary from individual to individual, society to society, culture to culture, truth does not. Truth provides the objective anchor for knowledge, and paradigmatically for scientific knowledge.

I want to focus briefly on two problems with 'indigenous science', in the light of this analysis:

- the problem of superstition and
- the problem of relativism.

In some instances, 'indigenous science' is taken to cover all kinds of beliefs, with little or no reference to truth or evidence. This elevates to the status of knowledge not only mere assumption and opinion, but also superstition (as in the case of belief in witchcraft, in the *tokoloshe* or *mantindane*, that sex with a virgin prevents or cures HIV/ AIDS, and the like), divination, soothsaying and the like. In the absence of any explicit mention of truth, then, the applicable idea would be that of 'indigenous beliefs'. Given the philosophical definition of knowledge, belief – even belief that is based on evidence – does not amount to knowledge. The major problem here is that, in the absence of truth, emphasis on 'indigenous science' does not appear to render possible a distinction between science and non-science.

Writers often also refer to the (need for) 'validation' or 'legitimisation' of indigenous science, or to 'warranted' and 'valid' scientific knowledge (see Semali and Kincheloe 1999, 35; Odora Hoppers 2002b, 7; Odora Hoppers 2005, 24), especially in terms of its inclusion in tertiary educational curricula. All these references are tautologies. Considering the centrality of evidence, scientific knowledge is necessarily valid, legitimate, warranted. There simply could be no other knowledge, knowledge that is invalid, illegitimate or unwarranted. It would not be knowledge then. This is not to deny that knowledge can be and often is subjugated. A pertinent consideration here would concern the impact of the first significant astronomic discoveries on a flat-earth, geocentric worldview, or of the theory of evolution on an orthodox, theocentric mindset, and the subsequent suppression of these views. But here the emphasis has changed, subtly, to incorporate truth. (It should be noted that reference to 'true knowledge', too, involves a tautology.)

In other instances, reference to truth is explicit, the underlying assumption being that there are multitudinous truths, that with a multiplicity of indigenous cultures and subcultures there exists a multiplicity of truths, none of which are superior to any other (see Semali and Kincheloe 1999, 27, 28; Odora Hoppers 2002b, 14; Odora Hoppers 2005). This kind of view leads directly to epistemological relativism and to relativism about truth, with all their attendant difficulties. Why is relativism problematic? Briefly, to be a relativist about knowledge is to maintain that there is no

objective knowledge of reality (or better: of *realities*) independently of cognisers or knowers from relevant social groups. The difficulty for relativists is to avoid the inconsistent claim that the relativistic thesis is itself an item of objective knowledge. To be a relativist about truth is to maintain that there is no universal truth, that there is only a multitude of truths. Again, the difficulty for relativists is to avoid the inconsistent claim that the relativistic thesis is itself universally (translocally and transculturally) true.

Relativism in science, in particular, is problematic in that one would not be able to compare and evaluate competing knowledge claims, theories and/ or hypotheses. Of course, many theorists would welcome this implication. Gilbert Onwu and Mogege Mosimege, for example, are worried about the 'gate-keeping' mechanisms set up by 'Western' science to determine 'what is to be included or excluded as science' (Onwu and Mosimege 2004, 4, 6, 11). If relativism were true, for the sake of the present argument, then there would be no epistemic or veritistic grounds for choosing between the claim that 'rain is the result of evaporation and so on and so forth' and the belief that 'rain can arise at will as a result of human action', that 'the rain bypasses the farm/ field of the person who stands while drinking the ploughing season' (Onwu and Mosimege 2004, 7). Second, one would not be able to speak of scientific 'progress', even within a particular society or culture. Most disturbingly, this kind of approach would thwart all scientific inquiry into, or curiosity about, phenomena for which there already exists a traditional, folkloric account or explanation.

On the present analysis, either 'indigenous science' refers to indigenous practices, skills or beliefs, whether or not these are 'scientific', or it is not characteristically or essentially 'indigenous'. Without doubt, scientific practices, skills and beliefs vary across history and across cultures and societies. It also makes sense to say that human values and expectations have an important bearing on scientific practice or procedure. However, the consideration that science is not 'value-free' or 'value-neutral' has nothing to do with whether or not science is universal. Scientific knowledge and truth are not culturally specific, or relative to particular social circumstances or cultural contexts. While the ascription or attribution of scientific knowledge may vary according to personal, social or cultural context, scientific knowledge and truth as such do not so vary. It is this insight, and not adherence to a questionable idea, that has profound implications for higher education and tertiary curricula.

If something is referred to as 'indigenous scientific knowledge' in the sense of factual or declarative knowledge, it must meet the requisite criteria: belief, evidential adequacy and truth. If it does, it is relevantly similar and, indeed, equal to 'non-indigenous' knowledge in a particular area or field. Thus, the traditional healer's knowledge would be as significant, epistemologically, as that of a general medical practitioner, and the knowledge of a naturopath or homoeopath. The insights into climate change, animal behaviour and plant life cycles of a Bushman, Inuit or South American Indian would be no less important than those of occidental analysts, climatologists and biologists. In fact, both could arguably learn from each other. Malegapuru William Makgoba points out, in this regard, that

> [w]e have not brought traditional healers into the system. … If our Western doctors were to interact more with traditional healers, we might learn a lot, and we might be able to teach them too. The point is that without the participation of these people, we'll never be able to institute the primary health care system we need. (Makgoba 1997, 194, 195).

It is important to bear in mind that there is no question here of different truths (different kinds and appraisals of evidence perhaps, different beliefs almost certainly), no question of (radically) different knowledges. Truth and reality are essentially not in the eye of the beholder.

Livingstone Mqotsi succinctly explains the distinctions between fact and myth, science and superstition. He contends that 'beliefs in witchcraft and sorcery' have 'social and psychological functions … [T]hey regulate human relationships' and also 'buttress the power of those in authority'. However, as 'a manner of adapting to the environment', these beliefs constitute 'an ineffectual technique, for it arises from a failure to understand the true relationship between cause and effect, and assumes an understanding of that relationship based on magic' (Mqotsi 2002, 168, 169). The kind of schism addressed by Mqotsi exists even in scientists like Makgoba who claims that his

> paternal uncles and aunties are experts in the art of fortune-telling and assessing outcome. They are in the old profession of traditional doctoring, popularly referred to as witch doctors. (Makgoba 1997, 1).

Makgoba nonetheless recognizes that

> [t]he laws of nature or science or for that matter scientific discoveries are not written in any particular language or culture, but transcend these. These discoveries are written in the minds of men and women across these artificial divides, hence scientific principles are in general universal. (Makgoba 1997, 15).

Speaking about the fundamental role of the university, in a tape recording made in Princeton in 1951, Albert Einstein said:

> The institution of universities is based on the ideal of *universality* in its widest sense, universality of the domain of enquiry, striving for *truth*, unaffected by extraneous aims, intentions or prejudices. Striving for universality of the spirit, unrestrained by national or other political motivations. In short, what matters is the striving for universality of mind and spirit. It is no secret that we have been far more successful in developing the mind than in developing the personality. It seems that even the quest for knowledge is threatened by lack of persons of a truly universal spirit. If the universities remain true to their fundamental task, they may contribute significantly to the solution of the crises which threaten us today. (Einstein 2003, CD 2, track 7).

What are the implications for (higher) education? Given Einstein's compelling point about striving for truth and universality, which aspects of so-called 'indigenous', 'local', 'alternative', 'informal' and – in our case – African scientific knowledge should be taught or included in the curriculum? Which should be left out? On what grounds? The question as to what should be left out is fairly easily answered. Not included in the curriculum, that is to say, not under the guise of 'science', should be mere beliefs or opinions unanchored by evidence and reason/s, bald assertions, superstitions, prejudice, bias – in fact anything that involves myth, fabrication and constitutes an infringement on the epistemic rights of students. For example, there is no place in biology classes for teaching ideas like creationism. However, it may be pedagogically and epistemically useful to teach these qua beliefs, opinions, assertions, superstitions, prejudice and bias.

The question as to which aspects of, say, African science should be included probably requires a more comprehensive response than I am able to provide here. Briefly, indigenous skills and practical knowledge are worthy of inclusion. Moreover, it follows from the account provided above that anything that meets the essential requirements for theoretical knowledge could in principle be included, like traditional African knowledge of agriculture and environment. A *sangoma*'s insight into the palliative and curative properties of plants and herbs constitutes an insight that may not be shared by many, but it has translocal value and application. There is a staggering amount of common ground between cultures, not only in terms of factual knowledge but also in terms of values (*contra* the implication in Le Grange 2004a). A rapprochement between so-called 'indigenous' and 'non-indigenous' insights is not only possible but also desirable – on educational, political, as well as scientific grounds.

CONCLUDING REMARKS

I consider the present analysis of science and scientific knowledge to be not only plausible but also indispensable for clearing up some of the confusions in debates around indigenous science. In other words, this account of the character of science and scientific knowledge may be used as a yardstick. Thus, the onus will be on anyone who is opposed to the analysis presented here to furnish an alternative and more feasible understanding, one that is sufficiently unambiguous and comprehensive to address the issues and problems raised here – including what constitutes *science* and distinguishes it from *non*-science.

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