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1. The Lives of Travelling Facts

1.1. Travelling Facts 1

What a clever idea to stick black silhouettes of birds of prey on windows to stop small birds flying into the glass! When Niko Tinbergen and Konrad Lorenz (Nobel prize winners for their work on animal behaviour) originally showed that certain species of bird on the ground instinctively take cover in the presence of overhead moving silhouettes of such predators, they had no reason to imagine those window stickers as an outcome. Yet, their facts travelled well enough to prompt owners of glass walls around the world, to take their own evasive action by sticking these birds of prey shapes on their walls. Years of experience later, according to other facts sent out into the public domain by reputable authorities (such as the Audubon Society), it turns out that those silhouettes don't work. Stationary "flying" predators do not scare away genuinely flying birds. (Separating the original scientific facts from their experimental context, and reversing that situation subverted that instinctual behaviour.) So, even while those scientific facts - still suitably qualified - have travelled well in the scientific communities (albeit with debates about how to interpret them), the efficacy of those black silhouettes turns out to be the scientific equivalent of an "urban legend". The facts travelled far, but not entirely well. [**Burkhardt**] [1]

1.2. Travelling Facts 2

St Paul's Cathedral dominates the City of London skyline and epitomises the arrival in England of a new aesthetic style from Italy and we might, reasonably, assume that construction methods just travelled alongside the new style. Both the extraordinary construction of the building and the career of its architect, Christopher Wren, are well studied, yet the details of how the technical facts required for its construction travelled to England, and from where they came (if indeed they travelled from abroad) remain opaque. So, the historian wonders: did the details of the construction design come through architectural treatises, or through travelling craftsmen, or through Wren's own visual inspections of such buildings elsewhere? And, how do the clues left by carpenters in roof beams, joists, and joints, tell

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[1] Chapters in this volume are signalled by a bold font for the authors involved.

stories about the facts of construction itself: was the roof built and assembled off site and reassembled on site like a giant IKEA flat-pack; or was it built *in situ*. This is the stuff of history, but a history dependent on the study of real stuff to reveal what facts travelled, raising interesting questions about the nature of facts that travel embedded in artefacts and technologies, and just what it means for such facts to travel well. The building stands - but do we yet understand the travelling facts of how it came to do so? [**Valeriani**]

1.3.   Travelling Facts 3

We all know about climate change from the scientists, but these facts did not travel easily to us. We all know now that the world climate is getting warmer, but for a long time, we were not very sure what facts we knew: how certain it was, how serious it was, how fast the change was happening, how different bits of evidence fitted together to form a consistent account, and how far different scientists were in agreement about it? And we still don't know much about how it will affect different parts of the globe. The facts did not travel easily, perhaps because the information did not form itself into the kinds of definite, separable, pieces of knowledge we think of as facts; perhaps because the implications of its human causes and its uncomfortable implications were too severe to be accepted; and perhaps because climate change itself became the subject of fictions in novels and films during this same period. But this is only part of the story, for climate scientists found their facts fiercely resisted by the interests of certain political and business circles, and even countered by facts produced by scientists in other fields. While it is tempting to imagine there is a free market in facts and that good facts will somehow travel freely of their own accord, maybe, just as "bad money drives out good money", bad facts (poorly attested, dubious, fictional) can drive good (well evidenced) facts out of circulation. Facts require a variety of charismatic companions and good authorities to travel well and those faced by competition, as in recent climate science, may fail to do so. [**Oreskes**]

1.4.   Travelling Facts 4

When several young men in New York consulted their doctors with an unusual coalition of symptoms in 1979, it was not clear what disease they had. But quite soon their condition came to be recognised as an early case of a new disease, the HIV-AIDS syndrome. Their facts travelled effectively through a system of medical case reporting which gives first notice of unusual combinations of facts about symptoms in conjunction with patient characteristics. By packaging the facts together, the case provided the means to recognise and define a new

disease, and gave early warning of a disease that would created a major world epidemic. [**Ankeny**] Another system of medical case reporting exists to carry facts about well-known, and highly infectious, diseases such as measles or flu. Like the "bills of mortality" of earlier times, which kept a head count of plague deaths, the individual cases of our current pandemics are gathered together and repackaged into statistical and mathematical facts that nowadays travel around communities of modellers and systems of simulations. From these, epidemiologists map and predict the spread and outcomes of such diseases, and public health authorities decide the best control, treatment or vaccination procedures. Our life expectancy depends on the careful packaging of such facts and their chaperoned travels around a variety of medical establishments. [**Mansnerus**]

These brief accounts sketch the life stories of certain facts, life histories which are told in greater depth and detail elsewhere in this book. As they suggest, the possibilities for facts to travel well is important to our lives. We depend upon systems, conventions, authorities, and all sorts of good companions to get facts to travel well - in various senses - and danger may lurk when these are subverted or fail to work. The fact that birds of prey silhouettes do not work to solve the problem of birds flying into glass windows tells us that a fact about the relationship between birds and their predators has not travelled intact, but it is not one (or at least, not so far as we know) that is dangerous in itself.   But if our medical reporting system had not picked up and set travelling some early facts about HIV-AIDS, this could have exacerbated the dangers from the epidemic - as we see in countries that have refused to recognise the travelling facts of the disease as legitimate facts. Constraints on the travels of facts may be seriously detrimental to our well-being. Yet the free market may be equally problematic. The internet is such a free market, but one in which - as is well known - it is difficult to recognise trustworthy facts from untrustworthy ones, an age-old problem of open (or free) product markets that has lead to their habitual regulation, for example to prevent the use of poisonous additives to make bread white, or, in the case of travelling facts, to regulate the claims made for the efficacy of medicines.

But this problem of getting facts to travel well should not be seen as only a question for the public domain of science. Humanists as much as scientists should beware the trickle down theory that they merely need to supply facts of good character, and those facts will find their way where they are needed, to new homes with honest and welcoming users, professional, amateur or public.[2]   Historians and novelists, as much as sociologists and

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[2] See Oreskes and Conway (forthcoming).

economists, or medics and climate scientists, should be careful of the ways that they package their facts for successful travel and, as far as possible, take care about the company they keep while they are in their charge. Once they have left home, it is more difficult to keep them safe. Historians and archaeologists for example often find themselves rewriting the past by retrieving lost facts that have failed to travel to replace better-travelled, but false, facts. Thus, the original construction of St Pancras Station in London did not have the useful side effect of clearing a slum as earlier generations have maintained, but of demolishing a respectable working class neighbourhood.[3]

The life histories of facts that turn out to be false, that become corrupted, or that die out make good short stories, stories that stick better in the memory than those accounts of facts which remain steadfast throughout successful careers.[4] This bias towards revealing falsehood in our histories of facts may be because we expect specific facts not to be forever facts, either through a natural skepticism about the category of facts, or because in our experience, some particular facts do turn out not to be facts after all. Not all facts travel well, some travel only to be found out and many hardly travel at all.

Yet, many facts do travel well, retaining their integrity when they do so, for we all regularly transfer and make use of facts - without subverting them - in new contexts, often without even noticing that we are doing so. The research project that created this book set out to look for those travelling facts that we do not normally notice. So that, when we asked "How well do facts travel?" and looked for answers in the travels of facts (rather than knowledge flows more generally), and focussed our attention on the facts themselves (rather than on the people and communities through which they pass), we found that many facts do indeed travel far and wide to new users and new uses.[5] And their trajectories were so extraordinarily varied and sometimes so completely unexpected that we feel justified in saying that, just like some experiments and models in science, some facts acquire an independent life of their own.[6]

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[3] See Swenson (2006).

[4] For example, the BBC Radio 4 programme "More or Less" about numbers in the public domain is full of such stories of misleading or mangled facts that travel well precisely because their falsity has made them more dramatic than they really are, for example, a misquoted fact about the proportion of women whose life is cut short by domestic violence (May 15th 2009: http://news.bbc.co.uk/2/hi/programmes/more_or_less/8051629.stm). The programme hardly mentions those straightforward stories of facts that travel with integrity, and also misses the kinds of extraordinary successful stories that we find in this volume.

[5] Information about the project funding is found in the Acknowledgement note. A full record of the research project can be found at http://www.lse.ac.uk/collections/economicHistory/Research/facts

[6] On the life of experiments, see Hacking (1983) and Shapin and Schaffer (1985); on the life of models, see Morgan (forthcoming).

Even so, as we found in our research, it is not always easy to figure out why those facts that travelled well did travel, nor indeed, what exactly travelling well means in any particular context, for the extent of such travel raises its own puzzles. In travelling to other spheres and in being used to address other questions, we found that facts may grow in scope, sharpen or become more rounded, they may acquire new labels and fulfil new functions, even while they maintain a strong hold of their integrity. It is through these processes that facts produced in one locality come to speak with authority to other questions, even to other fields, times and places. By following these independent lives of facts, we found answers not just to the question "How well do facts travel?" but to began to understand how it is that facts come to play foundational roles in situations beyond those of their production and original usage.

2.   'A fact is a fact is a fact'

Facts seem such obvious things. While individual or particular facts may be seen as important or striking within a particular field, considered as a general category, facts seem less problematic than the elements of evidence, theories, hypotheses, or causal claims that appear in both our humanities and sciences. and less colourful than the characters or cases that appear in our narratives, histories and philosophies. But facts are not quite so obvious as they seem.

First of all, our research lead us to take a generous view of what facts are, for we found that facts come in a bewildering variety of forms in those various communities of scientists and humanists that use them. Facts may be expressed in linguistic statements or as bits of digitized information; they may appear in pictures, diagrams, models, maps, documents, biographies or novels; they may be found as material facts located in artefacts such as mediaeval swords, or expressed in the behavioural characteristics of crowded rats, or the healthy growth of fertigated plants; they may be found in the fragments from ancient civilizations, in the fossils of long-dead nature, or as numerical constructions about the future of our over-heated planet. And we found that facts can be little (observations on the buds of a specific flowering plant, data points on an weather graph), big (the regularity of business cycles in modern economies), singular (the age of a particular person), come in crowds (infection rates), or be generic (the alpha-male in romance fiction or the exit pattern of firms in declining industries).

Indeed, facts come in so many guises and sizes that it proves difficult to produce a sharp description about what counts as a fact, certainly one that would cover the many times, places and fields that we studied. Nor did the presence (or absence) of the word itself give us

as any natural starting point for our investigations. In some fields, scientists are profligate in their use of the term (as in parts of the life sciences), while in others (as in parts of economics and physics) the term "data" is preferred for something we might label little facts, while still other scientists might refer to a well-attested "phenomenon" for something that we might label a big fact, or a generic fact. Nevertheless facts are a usable category for, in our experience, all communities have some kinds of things that they take to be facts, or fact-like, in the sense that they share the qualities of being autonomous, short, specific and reliable pieces of knowledge. These are the qualities that make us think 'a fact is a fact is a fact' - wherever it is, for what ever it is used. These are the qualities that enable settled pieces of knowledge to travel unproblematically into settings beyond their place of origin and to be used in those new contexts.

These qualities of the things that are taken as facts have historical roots of course. The notion of fact began in legal circles in the mediaeval period according to the account by Barbara Shapiro: so that by the early modern period, the events (the murders, frauds, etc) that occurred were referred to as "matters of fact", drawn in contrast to "matters of law" and thus making sense of the otherwise strange phrases "before/after the fact".[7] This sense of facts as deeds or actions seeped from law into history as the narration of well-evidenced facts - the deeds of history - in the sixteenth and seventeenth centuries, and thence into reports of newsworthy items.[8] (This idea of facts continued to hold sway into the nineteenth century at least, as we see in the contrast drawn between facts as deeds versus words found in: "Gracious in fact if not in word" (Jane Austen: *Emma*, 1815).) From law and history, the notion of facts moved into natural philosophy and modern sciences where, as Steven Shapin and Simon Schaffer (1985, Chapter 2) recount, "matters of fact" - properly witnessed experimentally produced events - came to be distinguished from their interpretation. Lorraine Daston takes up the story to recount how facts - as those noteworthy and particular "things" - grew, in scientific circles, into "a form of experience most sharply distinguished from 'hypothesis' or 'conjecture'".[9]

These historically formed qualities invade the current sense of facts in ways which are important for our project of understanding why facts can travel well. Facts are "independent"

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[7] Shapiro (2000), and her earlier shorter version of the argument (1994) argues for law as the field within which the notion of facts emerged into a mature idea. See also Poovey (1998) that grounds the notion in early accounting; and the collection of essays on the history of facts in Cerutti and Pomata (2001).

[8] Thus, spawning a genre of witnessed accounts (such as Defoe's Robinson Crusoe or Gulliver's Lilliput) - fictions that were passed off as facts.

[9] Daston, 2001 (quote from English unpublished version, p 2).

of their explanations - a quality that goes back to their legal sense discussed by Shapiro where "matters of fact" - deeds or actions - are established independently of their motivations. Just as in law and history, where facts were not to be conflated with the causes of those facts nor with the evidence advanced for them, facts in science were, as Daston tells us, "in principle, strictly independent of this or that explanatory framework".[10] These historical roots tell us why facts (in their various senses) are understood to be independent of their explanations, causes and motivations, and so free to travel without reference to them.

Facts are also "short" - an epithet that Daston (2001) uses to capture the particularity of facts in early science in a way that is still shared not just across the sciences but into the humanities. This recognisable quality of facts from those earlier times is described more fully by Ernest Gellner when he observes that we use the term to refer to "concrete" and "specific" events, objects and findings rather than to those things we describe in "abstract" terms.[11] This particularity has implications for the way that facts travel to find new uses, and the new uses to which they are put, but does not make them any less transferable than the abstract ideas, metaphors, stories or theories that also travel well between fields.

These historical notions of facts are clearly manifest in our modern views of facts, where current definitions rely on drawing definitional contrasts, just as earlier ones did.[12] Now we find:

* facts vs evidence and inference (in legal fields),

* facts vs fictions (in the humanities),

* facts vs hypotheses, theories or interpretations (in the sciences), and

* facts vs the untrue and surmised (in both everyday life and in philosophy).

(These are contrasts, but not necessarily opposites, as we shall see in what follows.) Common to all those contrasts, is the non-conjectural quality of facts. Facts are *not* fictions, theories, inferences, or the merely surmised. This non-conjectural sense that facts carry is captured more positively by describing them as 'useful and reliable knowledge' (a phrase from historians of technology). Of course not all facts are especially useful, and not all useful and reliable knowledge has fact-like qualities (for such a phrase equally captures rule-of-thumb

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[10] Daston goes on, "They can therefore be potentially mobilized in support of competing theories, and, again in principle, endure the demise of any particular way of explaining a phenomena" (Daston, 2001, p2). There is thus an intimate relation between 'fact' and 'evidence', yet the distinctions and relation of facts and evidence seem to be a matter of local usage varying over time, country and disciplinary usage. While Barbara Shapiro's (1994 and 2000) concentration on the legal framework in early modern times shows how evidence and witnesses were needed to attest to, and so establish, matters of fact, Lorraine Daston's (1991) writing about early modern sciences portrays facts as the jigsaw of pieces that create evidence for a hypothesis or conjecture.

[11] Gellner (1964).

[12] On OED evidence, Oxford English Dictionary, online version.

knowledge and more general or abstract knowledge). The point is rather that the sense of facts as 'useful and reliable' not only helps to rule out both superstition and opinion, as well as the conjectural aspects of knowledge, but also points to a certain steadiness, even sturdiness, in the quality of facts that makes them sufficient for people to act upon them or use them in support of their actions.[13]

Facts are a form of shared knowledge: they have a public or community aspect as it evident also from their historical roots.[14] Our taking something to be a fact for a particular community that we study should be understood not as an expression of that community's *belief*, or *opinion*, but rather that, according to their standards of evidence of discipline, time and place, that community has good reason to take those things as facts and will be likely to have the confidence to act upon them as facts. We have relied on the communities we study - that send, receive and use facts - to reveal what counts to them as facts (even where the word itself is not used).

Given that we are taking a community's view of what their particular, well-evidenced, facts are, we have not been (by and large) concerned with judging whether those community facts are facts according to any meta standards beyond their own ones. That is, our project *as a whole* did not set out to determine the truth of any particular facts, indeed we could not do so without sharing that same local field knowledge that would enable us, for example, to recognise the facts in a wiring diagram of a worm, or in the statistics of death rates. (Of course, individual authors in this book do have field knowledge and may make such judgements.) Nor did we set out to discuss the meaning of facts as a general abstract category - the province of philosophical argument. Rather we are interested in how facts - fact-like things taken by a community to be true - travel; and so our accounts of what makes some facts travel well cannot distinguish between those that are true facts and those that may later turn out to be false facts.

But this does not mean that we totally put aside all the interesting issues of true versus false facts. We recognise that in travelling freely from their original communities, over time, space and discipline, there are many chances for facts to be challenged. Some of those facts that travelled well initially, later turn out - on the judgement of their relevant communities - to be partly true facts, dubious facts, uncertain facts, or even false facts, and this changing judgement of a fact's status can be an important part of what happens to travelling facts. Thus, we include narratives in which travelling facts have been strongly disputed by others in

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[13] See also Mansnerus (2009).

[14] As pointed out by Weirzbicka (2006).

the community, as in the climate science case [**Oreskes**], or where facts established and carried along by one community that turn out much later after successful travels to be judged by a later community as false, as in the case of the remarkable longevity of Thomas Parr [**Haycock**]. We include accounts of facts that turn out to be misleading, such as the date written on a church roof suggesting it was a century older than the wood from which it was made [**Valeriani**], along with cases in which fictions declare themselves as facts and *vice versa* in modern science writing [**Adams**]. Scientists and humanists themselves have the knowledge to dispute and overthrow particular facts, just as it they who find, judge, and use travelling facts.

While facts may not be easily described except by their qualities as autonomous, short, specific and reliable pieces of knowledge, nor easily defined except by their contrasts, they are however quite recognisable in the field. Their life histories can be traced and documented, examined, explained and understood. Our primary interest in these life stories of facts needs to be remembered. It is not: How did they get to become facts? but rather: What makes some of them travel, and travel well?

3.   Travelling *Well*

While the travelling facts we study are defined and understood within their the relevant communities of usage, we, in our commentaries, are responsible for defining the natures of what it means for facts to 'travel well'. Our answers to the challenging question of our title are first, that facts travel well when they travel with integrity; and secondly, that facts travel well when they travel fruitfully.

"Travelling with integrity" captures the idea that the content of the fact is maintained more or less intact during its travel. Rather than worry overly much about what this means in abstract terms, it is better to think about it in mundane terms - if a fact changes so much during its travels that it is not recognisable as the same fact, or has lost its credibility as a fact, it would be hard to claim that the fact had travelled well. This quality is one of degree, and difficult to describe though quite recognisable in the field.

"Travelling fruitfully" refers to a fecundity in travel. The obvious aspect of this is that facts may travel far and wide in terms of time, and of geographical, and of disciplinary space, to find new *users*. More unusual perhaps are the ways in which facts find new *uses*: they gain new functions, coalesce in new patterns and make new narratives. Facts may even surprise us

by travelling someway across the space mapped out in those definitional contrasts above, towards fictions, interpretations, theories, and so forth.

3.1.   *Travelling with Integrity*

Late twentieth century debates about scientific and humanistic knowledge, or its impossibility, were concentrated on the production side, and gave us two ways to think about facts. On the one hand, facts are understood to be *found* or *discovered* only after much labour in laboratory, field, archive or museum. An alternative view focussed on the social networks and practical instruments by which - and with equally hard work - facts are *constructed*.[15] Yet, however relevant this dichotomy between *finding* and *constructing* (between an older tradition in sciences and humanities and more recent post-modernist views about both) has been for the emergence of facts, it is not so clear how far these positions prove salient for exploring questions about the subsequent travels of facts. They do form however the background to various notions, explored within the sociology of science community, of how knowledge circulates which offer revealing contrasts for our own discussion of the integrity of facts in their travels.

Two opposing positions on the travelling possibilities of factual knowledge are due to Bruno Latour and Ludwig Fleck.[16] In Latour's account, the 'marks' of science are highly mobile but travel well only if they are immutable, presentable, readable and combinable. From our viewpoint, it is their immutability that will ensure that these marks carry their integrity with them while they travel (though their potential fruitfulness when used in other contexts, seems dependent on the other qualities he cites). In contrast, in Fleck's account, facts are developed, owned and understood only *within* a community. As facts travel from one community to another, they have to be translated and in the process change their meaning so that, in our terms, they necessarily lose some of their integrity in travelling. Our sense of facts, and of what happens to them as they travel, fits untidily between Latour's marks and Fleck's community facts.

At first sight, our view of facts seems to share more of the qualities of Latour's immutable mobile marks than they do with Fleck's clustered and multidimensional kind of

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[15] While it might seem that in the former view, facts would be conceived as hard and objective, while in the latter plastic and subjective, this is not quite so. In the traditional history of science, hard facts are subject to revision over time while in the latter social studies of science, facts are treated as stabilized pieces of knowledge.

[16] See Fleck [1935]1979, and Latour 1986 (especially taken in combination with his 1999). There is of course a vast literature on knowledge diffusion (not just in science and technology studies); some items are referenced later while others are discussed elsewhere in the volume.

fact. Some of the things we might think of as little facts seem to be like Latour's marks, such as: data observations in economics or the digitized records of plants in bioinformatics. Certainly, facts share with marks the notion of being hardened, stabilized bits of knowledge wrested by humanists and scientists from their investigations. They also share the notion that they are not necessarily linguistic things. Moreover, some little facts, like marks, are often combinable, presentable and readable, but others are not: while the carpenters' marks in St Paul's Cathedral are obviously immutable marks, and are readable to the expert, they are not combinable nor mobile in Latour's sense. So our elastic sense of facts seems consistent with understanding some form of facts as marks. But many of the facts we are concerned with seem to be bigger kinds of things, less raw, more produced, and with more value added, such as: the profitability of an array of companies, the location of particular genetic material, or scale diagrams of a specific Greek temple. All of these seem to have more autonomous content than the notion of marks, enough certainly that our facts can separate off, travel well enough on their own, and be used elsewhere without having to be combined with other little facts.

On the other hand, even our largest facts seem much littler than the 'fact of syphilis', that Fleck discussed, which seems not to be a fact in our terms at all, but rather a whole set of notions about the disease. It includes the disease's symptoms, causes, and cures, and the concepts, theories and ideas which hold those elements together. Only some of these elements are facts in our sense of non-general, non-abstract, non-conjectural, separable bits of knowledge. Fleck's conglomerate fact 'syphilis' has the form of an integrated cluster of knowledge elements that have coalesced together within a local disciplinary community and - by his account - only makes sense within that community. Thus *any* travels of his fact beyond that community to another place and time inevitably involve translations that in turn change the fact's meaning. This makes Fleck's community facts excessively vulnerable, for if they cannot travel without loss of meaning, his facts cannot travel at all as facts.[17] Moreover, the metaphor that travel involves translation has a more basic connotation: it treats facts as linguistic objects, while, we, as suggested above, have a rather eclectic notion of the forms that facts take.

So we share Fleck's view that a community defines its own fact, but not his view that such a fact has that meaning *only* within that community. When we follow facts, we do find

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[17] Indeed, an outcome of his position is that we will only recognise or notice that a fact has travelled when it has changed its meaning, or perhaps it is the changing meaning of the fact itself that tells us that the fact has travelled.

them travelling across space, time and disciplines without major translation as they pass passport control and so without any substantial loss of integrity. **Alison Wylie's** chapter on archaeology offers the materials to distinguish between the facts found in the artefacts versus the facts that we infer or interpret from the artefacts. For example, skeletal remains found in the "eminent mounds" of Central North America were interpreted as evidence of violent funerary practices. The facts of the bones and the facts about the practices *may* both change over time, over space and over disciplinary travels too (for new techniques may reveal new facts previously concealed in the bones, and new comparisons cast interpreted facts in a new light). But we don't expect the facts found in the material artefacts, or the facts inferred from the artefacts to change *just because* they have travelled over time or across community boundaries. We also find facts being used in new ways after their travels, where this change of use does not go along with any radical change of meaning for the facts. The ways in which the alpha male character transferred from an account of animal behaviour into evolutionary psychology and thence into romance fiction, where he figured as the hero (and perhaps anti-hero) at the same time as being the subject of a feminist critique and rebuttal by such authors, offers a truly surprising story of the steadfast quality of the character. That this fictional avatar was then taken as evidence for his own factual character in his return home to the evolutionary psychology is even more surprising.[**Schell**][18] The travels of facts are, it seems, sometimes stranger than fiction.

Whereas Latour's little marks are hard enough to remain immutable in their travels beyond their site of production and into other communities, and Fleck's expansive community 'fact' mutates the moment it steps across the threshold, our experience of travelling facts lies somewhere in between. Our experience of facts is that they have sufficient autonomy and separability to be quite mobile without losing their integrity of meaning compared to Fleck's community, conglomerate, fact, but that they rarely carry the hard immutability of Latour's marks when they travel. We rather think of travelling facts as like rubber balls: they have a certain shape, they can be carried, rolled, squeezed, bounced, kicked and thrown, without harm to them, and used in many different ways and in different situations.[19] This analogy recognises the virtue of steadfastness or sturdiness, but also of a certain degree of mutability around the edges. A good example is found in the travels of the classical style of architecture from ancient Greece to nineteenth century America. Certain aspects of the style were altered in the process of adaptation, such as the nature of the materials, the addition of windows, and

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[18] See also Adams (2006).
[19] Thanks to Naomi Oreskes for suggesting this rubber ball metaphor.

the reversal of light and shade in the exterior. While the community of American architects and builders seemed to delight in their ability to adapt the stylistic details of classical architecture to their own contexts, they also seemed to observe certain boundaries. For, despite their additions, alterations and subtractions, there is no doubt that such buildings retained a recognisable integrity as examples of "the classical style" in their new domain. [**Schneider**] This is what we mean when we suggest that facts that travel well exhibit a strong degree of integrity, but they also have a degree of squishiness, a squishiness that may result in them getting their hard edges rubbed off, changing their surface elements, or gaining some additional covering, as they travel.

Facts may be more separable or modular than most bits of knowledge, but they are not usually born bald: they often have details that we might call "qualifications": circumstantial or contextual elements attached which may be shed on their travels so that they get smoother or rounded off. The nature of this smoothing turns out to be quite field specific. So, for example, Peter Howlett (2008), in his research on social science debates about the Green Revolution in Asia found that when economists imported facts from other social sciences, they tended to turn them into generic facts, sheering off the woolly details of time and place that they think hides the important body of the fact beneath. Anthropologists on the other hand like to carry over many of the details of content and context when they report case facts from other disciplines, indeed, they would hardly count as facts for their field unless they arrived fully coated. For anthropologists, historians, and archaeologists, such circumstantial details are not just the signs of authority that establishes the credibility of the author's knowledge, but are part of what it means for something to be a fact in the first place, so their facts tend not to get smoothed out or rounded off by their travels.

Facts may also pick up extra elements on their travels and get covered with additional elements or even sharpened in certain ways. For example, the set of facts that constitute the first case report of a new medical syndrome includes both a collection of symptoms and a collection of patient details. As the case moves though the medical system, it gradually emerges which of the original facts about symptoms are related and so become more firmly attached together, and which patient facts are really relevant and become more sharply defined, and which additional facts are needed to enrich and complete the case, and which facts are red herrings to be dropped off as irrelevant details. This process of defining the fact of a disease syndrome entails both smoothing off the edges and sharpening up with additional details at the same time.[**Ankeny**] A somewhat different process, but comparable in effect, happens when data facts travel around modelling communities: they may be sharpened by

specifying their numerical attributes more clearly, or have certain details of the process they present clarified to make them operational for simulations, both in ways which maintain the basic integrity of the facts (Mansnerus, 2009 forthcoming). **[Mansnerus]** A comparison of these two cases with the processes and outcomes of gossip and rumour illuminates this sharpening and enriching of the fact as it travels. Gossip is thought to gradually destroy any initial nuggets of facts that were involved in the first place: the content of the fact is changed each time it is passed along, just as in the game where children repeat a whisper a round a circle. Rumour, in contrast, is usually characterised as a process of additions: the claim gains the kind of detail we associate with the factual, but it is really a process of adding falsehoods, as in the wartime rumours of invasion.[20] So, either the original travelling fact disappears in gossip, or it collapses under the weight of additional false details in rumour. When we made such comparisons, we found many examples of travelling facts that do indeed maintain their reputation for integrity, even while they gained some elements, perhaps getting sharpened with qualifications or enriched with valid details, in ways that mirror the smoothing process.[21]

These comparisons with other accounts of travelling facts suggests that travelling well can be thought of as the maintenance of a certain basic integrity in the travelling fact, but it does not mean that nothing happens to facts as they travel. As we have seen, some get simpler and lose information while others add information and get more complex as they travel. Facts may not travel entirely intact without some kind of wearing down, or rounding off, or enriching and sharpening: processes which nevertheless enable facts to retain their original content. Facts are relatively hard, independent, things after all, though this does not mean that they are never subject to different interpretation, or to reformation in their travels. It is more challenging to understand how facts maintain this integrity when - in reaching new homes, adapting to their new environments, and finding new uses there they still manage to retain their basic content.

3.2.   *Travelling Fruitfully*

Travelling fruitfully offers another sense of travelling well, a complementary, not an alternative, to that of travelling with integrity. Travelling with integrity points to stability in the content of the fact, travelling fruitfully points to the scope of travel where three dimensions prove particularly rewarding to study: the ways that travelling facts find new

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[20] See Knapp (1944) and Buckner (1965).

[21] These processes of enrichment are parallelled in the historical account given by Hasok Chang of the facts about the temperature of boiling water (2007).

users, find new *uses*, and even begin *to invade the definitional contrasts* that we drew in defining facts in the previous section.

The most obvious dimension for facts to travel to find new users is that of travel over time and space. Just because this notion of travel is the obvious one does not mean that it should be dismissed lightly, for such dimensions provide some of the most interesting and unexpected accounts of fruitfulness in travelling facts, of which the travels of classical architecture is one. These travels (discussed above) were not quite what they seemed: it was not simply that the facts of ancient Greek architecture travelled over space and time to nineteenth-century America. Rather, it was the pictures of eighteenth-century reconstructions of such buildings: the German Romantics' vision of that architecture, and French and English scale drawings of those temples, which travelled to America (even while some of those original buildings were being destroyed). These were picked up by American master builders who created a nineteenth-century vernacular version of these eighteenth-century European views of the temples of that old civilization in their new country's official buildings, their banks and their homes. The fruitfulness of these travelling facts are there for all to see. [**Schneider**]

This focus on users points to the importance of the demand for facts in determining the fruitfulness of their travels. Most facts don't travel very much because no users find them or choose to use them. Demand is critical. Here the recent literature on co-construction of technology is suggestive, for it treats users, as well as producers, as active agents in both the production and usage of such artefacts, and it assumes that technologies may find new usages, or resist their intended usage, just like travelling facts.[22] While facts may be paired with artefacts in another definition, that pairing may be one that holds little contrast - for we can understand technologies as embedding facts, much as ancient pottery jars carry facts about the nature of the goods stored within them, be it wine or oil. Certainly our cases suggest that facts are carried in intimate association with technologies and find new users because of that association. The fertigation project in Tamil Nadhu studied by **Peter Howlett and Aashish Velkar** showed not just how the facts of the technology: a precision farming technique, that delivered water and fertiliser (fertigation) to scientifically established standards, travelled to farmers (and from those farmers to other new farmers) but that associated facts (both experiential facts about other aspects of farming, and institutional facts about marketing processes) were pulled along by the successful travels of the fertigation facts.

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[22] For example, see *How Users Matter* (Oudshoorn and Pinch, 2003).

An equally fruitful aspect of travels is when facts travel to find new *uses* in other disciplines. Here the case of Calhoun's rat experiments is most informative. How could it be that a set of experimental facts about rats - some with pessimistic, others with optimistic, outcomes - could set off a chain reaction in the many other fields to which those facts travelled. From the base field of animal behaviour these facts, about how rats behaved when they were crowded in pens, travelled to prompt parallel studies of human psychology and the nature of crowding, and thence to the re-design of prisons and college dorms, and into science fiction, most notably in the children's book and film *The Rats of Nihm.* No measure of travelling well is needed to be amazed at the disciplinary reach of these travelling facts and their fruitfulness of the new uses to which they were put.[**Ramsden**][23]

Travelling fruitfully in such ways might of course go so far that the facts might be in danger of losing their integrity; some users recognised this problem and set limits to the way that they used travelling facts. In the Indian agricultural scheme, the scientists set rules for the adoption of the technology package they offered in order to ensure that their facts travelled "precisely", that is, with integrity, but they allowed experiment, and potentially fruitful adaptation to the facts that they set travelling on other aspects of cultivation. Thus the farmers of Tamil Nadhu enjoyed experimenting with crop spacing, but were more cautious about taking liberties with the fertigation technology. [**Howlett & Velkar**] In the animal behaviour studies initiated by Tinbergen and Lorenz, the nature of this trade off between integrity and fruitfulness seemed to have been recognised explicitly in arguments between practitioners in the field about what constituted a legitimate comparison between the behaviour of different species, for example, between chickens and geese, or between other animals and humans. The limits of travelling were fixed by the limits of "meaningful comparison" which ensured that the facts retained their integrity in travelling to other sites. In other words, travelling well - with integrity - was recognised by commentators as a valid boundary to their fruitful use of imported facts. [**Burkhardt**]

These considerations and case histories points us to another element of the notion of fruitful travel. We can recognise that facts have travelled well not just when they are used somewhere else *by* someone else, but when they are used *for* something else. This entails another user act upon them or with them: in support of another claim, or as inputs or nodes of intervention, or for some new purpose not the one envisaged in their production. At its most

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[23] See also Ramsden and Adams (2009).

fruitful, the use of travelling facts creates a new pattern, a new coherence, a new narrative, or fulfils a new role.

A good example where a travelling fact creates a new coherence or pattern is found in the way that a single new fact, when added to a set of apparently disparate facts travelling together, produces an account of a disease syndrome. As we find in Rachel **Ankeny's** chapter, for example, it was not until the single, but overlooked, fact that most of the sufferers from a particular condition were menstruating teenage girls, that the cause of the toxic shock syndrome was located in the new materials in tampons. Once this quite ordinary fact travelled into the case report it created a new generic fact - about a quite extreme medical condition - that proved powerful enough to make the case travel through medical science. We see from such examples how a particular fact can sometimes pull other unconnected facts into a coherent account.

The ways that individual facts travel into and are thrown out of consideration in the process of medical diagnoses appears to have much in common with the way that detectives are thought to work. Dorothy Sayers suggests that particular "facts are like cows. If you look them in the face hard enough, they generally run away".[24] This claim comes within the genre of detective novels, in which the detective's task is precisely to show how some facts that travel into a case are either misinterpreted, or not really facts at all. While these insouciant heroes generally manage to make such facts run away - either into fictions, or into some other facts - they do not do so without using "the little grey cells", smoking opium, or other, more physically active, investigations. In this genre, such very particular facts stand inconveniently in the way of a narrative that will fit a series of other particular facts together so as to unveil the means and perpetrator of the crime. But the conventions here are clear: the reader does not know which "facts" are going to turn out to be true, though of course all the important "facts" of the narrative, true or false, are understood as fictional.

Such particular facts with the potential to make narratives also inhabit history where Carlo Ginzburg ([1986]1989) has famously aligned the mode of micro-histories with the detective novel. Here the historian - like the detective novelist - hopes that his or her particular clues, facts gleaned out of the dust of archives or the corners of buildings, will travel together to make a powerful narrative. These are not metaphors: Simona **Valeriani's** chapter considers the travels of the material facts embedded in buildings. Facts travel first of all, and most obviously, in the timbers and joists of the roofs she studies: facts demonstrated

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[24] Sayers ([1926] 1987).

in the materials and in their arrangements. But there is another level here, for when the roof structure or its design drawing, is in the 'wrong' time or place compared to the local ways of doing things, it sets off alarm bells for the historian to seek answers to how these "foreign" facts were embedded in such artefacts. Making a narrative account here requires not just detective work into the building record, but an encyclopaedic knowledge of other buildings and of what is typical at that time and place, so that the dissonance of a roof joint in a strange place and strange time - a travelling fact out of its normal place - crystallizes a new explanation of just why a particular roof is like it is (see Valeriani, 2008).

Other travelling facts move their attachment from the well-defined and perhaps small arena of their production to a wider space in which they play a broader function. Sometimes this is a straightforward process of aggregation of little facts. Facts about deposits and withdrawals collected by banks for their own set of purposes travel to the central bank to be assembled and re-calibrated into bigger facts about the aggregate amount of money in an economy on which monetary policy is made.[26] Archaeological facts about bones held in many museums travel together to become important facts in historical and anthropological debates about the standard of living of different peoples of time past.[27] These bigger facts carry a wider level of generality because they are built up on multiple observations or on multiple cases to describe a regularity or phenomenon, and so are already well connected to a body of other facts. These kinds of facts do not show the same tendency to run away or run together, indeed, they tend to stand their ground, although they too can prove vulnerable (for example, hitherto reliable facts about aggregate money may prove unreliable when individuals change their behaviour).

In other cases, a more unusual move occurs. The facts of Tinbergen and Lorenz's work on ducks, geese and chickens became critical in the arguments over whether certain animal behaviour is, in fact, instinctual or not (**Burkhardt**). And we have also seen how the facts of the behaviour of Calhoun's rats in his experimental set-ups came to represent the effects of crowding at a more generic level (**Ramsden**). Whereas philosophers have the notions of tokens and types and particulars versus universals, as ways to describe and analyse different levels of claims, and statisticians have rules of inference that relate specific findings to generalizations, the interesting problem here is to describe and explain how a fact about particulars turns into a representative fact or a generic fact during the process of travelling from one domain to another. This may occur because someone sees and labels the travelling

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[26] See Morgan (2007).
[27] See Steckel and Rose, 2002.

facts as having that wider scope. But such labelling in itself does not extend the scope without users appreciating the relevance of these travelling facts in the construction of other bigger or broader claims. When particular travelling facts come to stand as evidence for a wider claim, or to stand in for a more general class of findings, or to be seen as relevant about a further related field, all in ways which are legitimate and maintain the integrity of the facts within those communities of users, then we can say that such travelling facts have also travelled fruitfully.

A more speculative sense of this notion of travelling well takes us back to our set of defining contrasts. Some of the ways that we have found facts travelling is towards or away from their ostensible contrasts in various ways: for example facts travelling to fictions, or *vice versa*, or to and from hypotheses and models, and so forth. These kinds of morphing of facts happen quite often, and threaten the identity of facts as facts, even where their travels may prove fruitful.

The most obvious, and least problematic, of this morphing is the move between facts and evidence; there is after all an intimate relation between them. Some humanistic and scientific fields use a terminology in which facts are produced as evidence for claims, others that evidence is gathered to establish facts: two sides of the same coin. Facts constructed at one level in one domain, might serve as evidence at another, as facts established by forensic science become evidence for inferences about a crime. Sabina Leonelli (2008) discusses how little facts get used beyond their production locality as evidence to support bigger or wider claims and facts in biology. **Wylie's** chapter has these two levels separated off as facts of the record versus facts about the record, where the latter might be termed the inferred facts. This kind of move happens for example where little facts (pottery shards) serve not just as inputs for establishing bigger facts (about burial rituals) but for establishing facts about other locations (trade routes in ceramics).

Facts travel into fictions in many guises. Both the sciences and the humanities use folk-facts, factoids and fictions in a variety of ways to make facts travel more easily through narratives. Marcel Boumans has suggested that this fact/fiction ratio varies: sometimes it seems to be greater than 1: fictions, lacking the moral fibre of facts, prove less able to travel; and sometimes it seems to be less than 1: when facts need some extra 'colour' to set them travelling.[28] But it is not just a question of the use of fictional devices - such as narrative and character - designed to get facts to travel better. As **Jon Adams's** chapter recounts, the recent

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[28] I am indebted to Marcel Boumans for this formulation by which he summarized our two-day project workshop on the *Fact-Fiction Ratio*, held on 12-13th April, 2007.

explosion in science popularisations has blurred many of our normal distinctions between facts and fictions. We find fictions being constructed or disguised as facts in novels about climate science, and fictional stories being used as facts in polemics about population explosions. This has become such a slippery slope in modern writings that the reader may lose all sense of whether the claims are factual or fictional. This slipperiness is quite different from the way that scientific characters, such as the alpha male, come to be seen as inhabiting fictional domains such as romance fiction (see **Schell**), not as a popularizing or pedagogical device for science, but simply as a way of defending the quality and integrity of the life presented in novels.

Facts about the past are equally liable to turn into fictions about the past. The Eyam story of Patrick Wallis (2006) tells how the facts about the plague of 1666 in the Derbyshire village, Eyam, were transposed by early nineteenth-century Romantics whose poems both transformed the mining parish of those days into a rural idyll, and made a hero out of the rector who corralled the parishioners and quarantined their infection into the village during the plague. The slippage of fact into poetry and fiction turned a story of nasty disease into one of heroism that helped turn the village into a nineteenth-century tourist site, and thence into a twentieth-century heritage sight and the subject of a modern novel before a musical version at least returned the village to its industrial setting.

We can also see how science-based fictions - that is, predictions - become sufficiently fact-like to enable people to act upon them. For example, predictions about the future economy have to become not only sufficiently stable, but also congruent in a particular framework with facts about today and about the past - that is they have to be brought into a perspective relation with facts - before they can be acted upon on as facts. These perspectival frameworks in economics were first developed on the basis of conceptual descriptions of the economy and theories about its working behaviour. These important abstract elements have long since disappeared from users' views so that the GDP figures that are gathered and collated to measure all economies are now understood to produce a set of neutral accounts that join facts about the past with ones about the future (predictions) in order to provide the basis for economic policy (see Morgan, 2008)**.** More broadly, those GDP figures travel freely in the domains of political economy as the facts which align political ambitions with what it means to be a "modern" or "developed" economy in the latter half of the twentieth century (see Speich, 2008). Similarly the climate science account given by **Oreskes** tells a tale of a battle of predictions: the pessimistic predictions that required changes in behaviour had to be sufficiently well grounded with the facts of today and of times past to counteract the

optimistic predictions based on other theories and other experiments, that were peddled - with the help of market research - to make those "good news" predictions travel better than the "bad news" ones based on sturdier facts.

The more obvious travels of scientific facts over towards their contrasts might be found in the intimate practical links between facts and models. The career of "Manning's n", a factual measure of roughness of river beds, veers between being a set of numbers learnt through experience by hydraulic engineers, to a number chosen by less learned practitioners on the basis of photographs of typical rivers, to a number chosen by users to plug in to a computer software programme in flood defence models, to the outcome of a theoretically based equation which estimates the number on the basis of lots of other facts about water in a river system. Its multifaceted career as a fact reflects not just the difficulty of gaining information about a river bed's roughness, but its practicality to survive well enough from when Manning developed his formula in the context of nineteenth century Irish drainage systems into modern flood calculations. **[Whatmore and Landstrom]**

These more adventurous travels of facts, and their morphing into their ostensible contrasts, have to be carefully looked out for. Facts and fictions do not necessarily support each other anymore than facts and hypotheses do in ways which are consistent with our ideas about facts. The lines between facts that are popularised in fictions, or the fictions that are used to shore up facts, or between facts that are really masquerading as hypotheses, and hypotheses that are really established facts, are ones that have to be enquired into at each particular level and case to see how and where integrity of the travelling fact - that is, its status as a fact - is maintained. Even so, thinking about facts travelling over the bridges between these contrasts does illuminate another way to understand the notion of facts travelling well for, once again, these travels may be fruitful in both the humanistic and scientific domains, renewing tired genres of fiction as much as enabling governments to take action on climate change.

"Travelling well" has been constructed here in terms of two notions. The first is the idea that travelling well maintains a certain integrity in a fact even while it may have some change in shape, kind, or form: that is, it may not be reported or used exactly intact, but it has, in some sense, remained steadfast. Fruitfulness in scope is the idea that travelling well means that facts have been found by users who don't just report them, but act upon them or with them, and so use them to fulfil various other functions than those of their production and intended use. In the process, a well travelled fact may have travelled far and wide and may

even invade a definitional contrast. These successful travels are what we mean when we suggest that well-travelled facts are ones that have acquired and lived a life of their own.

4.   What makes facts travel well?

While the networks, community values, and instruments of a fact's production may provide it with an initial credibility, they by no means determine the independent, autonomous, quality we find in the life of facts. It is rather users, in different times, places, and different disciplines, with different questions and different purposes, who largely determine their uses at various destinations, and thus how well they have travelled to fulfill new purposes. Not all communities attend to each others' facts in a reciprocal way, as Howlett (2008) found when comparing the social scientists "listening tree" (the papers on the Green Revolution that a writer cites) to their "speaking tree" (the other papers that later cite that writer). Yet it is the tendency of facts to travel relatively independently to other users, without much reference to their producing context which may perhaps mark facts out from some other forms of travelling knowledge. Indeed, in many ways, facts turn out to be like children: their parents who found or fashioned them soon lose control of them, they leave home, their product marking become lost as they make their way into all sorts of other unknown communities and fulfil all sorts of unexpected purposes; and sometimes facts remain in limbo for centuries between production and use.

So why then do some facts travel so freely and others not? It seems that those facts which acquired an independent life of their own depended on a variety of 'good companions', and on the 'character' that they already have or acquire in their travels. These two aspects are not to be understood as necessary or sufficient conditions for facts to travel, rather they enable us to understand the unexpected and independent travelling lives of facts that form the subject of this book and thus throw light on why some facts travel well and others do not.

4.1.   Good Company: Labels, Packaging, Vehicles, and Chaperones

The immediate question to be asked and answered is: if facts are things that travel independently, why do they need good companions? Sociologists' studies on travelling knowledge have shown the need to track agents of travel and locations because all too often, what appears to be freely travelling knowledge is in fact dependent on tacit or expert community knowledge to make it transfer effectively; that is, such knowledge is not in

general separable from its base in techniques and expertise.[29] Historians have focussed on the importance of agents and networks, social and political, for their accounts of what they refer to as "circulating" knowledge. A good example are the circulation of specimens (insects, plants, and so forth) during the early modern period, when scientific and commercial interests intersected during the rise of European-based empires. We might even recognise such specimens as facts, as others have done before us: "Every specimen is a permanent fact".[30] Facts are relatively modular pieces of knowledge, they can be separated off and plugged in elsewhere: they are relatively more able to travel free from the techniques and expertise that produced them, or the people who circulate them. And facts that are less evidently material things than specimens in jars do not necessarily need identifiable people or communities to carry them (although they may indeed be involved), but they do need carriers of some kind (such as the internet). So we think of good companions as accompanying the facts rather than being an integrated part of that knowledge system. Good companions here support a fact's travels but are not part of the facts, and can be discarded when the fact reaches a new location.

What do we mean by travelling companions? They range from the mundane level of labels and packaging, to the more material vehicles of transportation, as well as to the people involved in chaperoning, and from the various kinds of institutional structures that support travelling knowledge, to the technical standards that carry facts with them.[31] Ancient artefacts carry facts embedded in them, as do modern statistical and mathematical models; old-fashioned narratives and fictions help facts to travel, as do the witnesses, authorities and celebrities who support them; and even the money that oils the wheels of travelling vehicles, can all be understood under the idea of companions. When we think of all these different elements explicitly as forms of companionship: chaperones, packaging, processes, carriers and vehicles for travelling facts, we focus not on the agency of the individual producers of facts, but on those who package facts for travel and onto the users or audiences who receive and unpack them, along with the network of people and things via which they travel and the social arrangements within which these travels are embedded.

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[29] Collins (1985) on getting lasers to work, offers a classic study.

[30] So says a plaque at the entrance to the Earth History Hall, American Museum of Natural History. Recent literature on the "circulation" of such items treats a variety of other levels of knowledge, as well as facts. Growing out of the literature on the construction of knowledge, and adding political to geographical spaces, it has focussed attention onto the co-construction of knowledge that comes with such circulation (see for example, Raj 2007).

[31] See Velkar (2009) on the way that industrial standards carry facts about the good with them, for example the sizes of wires.

Labels and packages are certainly one of these several elements that enable facts to travel safely. We can go back to Linnaeus and his innovatory indexing method, designed not just to classify the incoming facts of nature, but to make those facts retrievable again for his own and others' usage: a classic example of how labelling helps facts to travel.[32] Sabina **Leonelli's** chapter on the modern version of this process - bio-informatics - explores how small facts: data from specific experiments reported in one field of biology, are circulated around the broader research communities in biology. This is a travelling facts system in which 'curators' label data (so that receivers will see its relevance to their own fields), package the data with care to make sure that it is receivable by others (including the equivalent of a sealed envelope containing an account of its origin) and send it out in digital format by an electronic vehicle. Such packaging serves to ensure that the data travel well in the sense of retaining their integrity as they pass from producer to a holding bay where potential (but unknown) users may locate them. The labelling enables potential users to locate those data that appear fruitful to their own purposes in their own laboratories. Once there, the labels and packaging are discarded, and the curators are often not even recognised when those small facts are used to support larger facts, or facts about other species, in the new domain.

Bioinformatics is a highly organised and specialist version of good companionship, but it is important to notice that while there is a community of possible users in mind when the labelling is done, there are no specific users named on those careful labels, so that there are in effect, no addresses on those labels. Other facts of science are much more lightly packaged and labelled by their producers for presentation to an audience; they too are meant to travel within a community of users, and they too have no particular addresses on them. While the internet has rapidly increased the flow of some kinds of facts in some forms (those that can be read and searched for in internet terms), the labels identify contents and senders/producers not users - they tell us where facts came from not where they are going to. In contrast, the botanical and insect specimens that travelled by boat and cart across the empires of earlier centuries had clearly written addresses on them, even when the identity of the fact inside the box was not known.[33]

A different kind of companionship of packaging and labelling are found in Martina **Merz's** chapter on nano-science. Here the production technology that reveals the atomic structure also presents, already packaged, the important facts of the structure in the form of

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[32] See Müller-Wille and Scharf (2009).
[33] See, eg Terrall (2009).

visual images. And like many such facts of science, these images are accompanied into the community domain by descriptive labels, while the texts remain secondary. But these imaged-facts of nano-science don't like to travel without the company of other images which show various aspects of their character and means of production; indeed these collections of images are required to ensure effective travelling of the factual outcomes of the scientific paper. Facts may be found travelling in images in many fields: they cannot be easily portrayed as the linguistic objects treated by modern philosophers, but rather as the outcomes of either a revealing or of a representing technology. The form of these facts seem closer to the earlier notion of deeds or actions or the "matters of fact" of legal circles. Here, words and texts form the travelling companions to the facts in the images.

It seems that modern science is full of such vehicles that transport and sometimes transform facts. Facts, in the form of data strings or parameter values, are sent into models which then calculate other facts from those raw materials. Facts are fed into measuring instruments and other facts are sent out. From Manning's equation to the models of epidemiology, from the computerized data traces of bioinformatics to the technologies of fertigation, the relations between travelling facts and the practical instruments of science and technology are intimate and varied.

History too is a carrier of facts: facts travel over long gaps, without labels, without much agency, or obvious channels of communication so here the idea of vehicles becomes especially important. The investigative practices of museum curators have long been concerned with all sorts of historical facts that travel in material objects. For example, careful examination with modern X-ray techniques can reveal how a Mediaeval sword was made, and thus whether it was made for fighting or as a sign of wealth and rank. The pottery of ancient civilizations carries the traces of contents which can often be analysed to tell of its habitual contents just as other investigators seek facts from the burnt timbers of buildings to understand what was in the building. We can tell much about the techniques of production from the goods themselves even when we don't know their origin (for example, whether they are hand- or machine-turned), or when their origin labels misleadingly imply a quality such as porcelain or china when those goods were neither porcelain, nor came from China.[34] The facts that travel in artefacts often turn out to be multi-layered, rich in both the level of detail

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[34] These examples come from wonderful sessions at the project workshop "Facts and Artefacts: What Travels in Material Objects?" (17-18th December, 2007) in which Marta Ajmar-Wollheim (Victoria and Albert Museum), Frances Halahan (Halahan Associates - restorers), Susan La Niece (British Museum) and Andrew Nahum (Science Museum) each talked about various museum or restoration objects and the facts that travelled in them and with them.

about the materials and about the societies in which they were made and survive, as **Valeriani** shows in her chapter on church roofs.

Sometimes the support systems provided by these various kinds of travelling companions are so extensive that they amount to "scaffolding" and when that support is removed, the fact falls down. In David **Haycock's** chapter we have a case of a fact that now seems to us a false fact, a fiction that could hardly be credited, namely the extraordinary longevity of Thomas Parr, who died in 1635 at the supposed age of 152. Yet, during its time it travelled with very good company in the form of associated facts, circumstances, narratives, and beliefs about old age. It was "attested" to by no less an authority than the first-class anatomist Dr. William Harvey whose good name chaperoned the fact of Parr's longevity through 250 years or so. This fact lost its status not because of the collapse of trust in the good companion, but because the rest of the supporting scaffolding not only collapsed but was replaced by a new scaffold supporting a new view of what counted as a credible fact. In the nineteenth century, credible accounts of old age came to be reconstructed in statistical terms replacing those earlier facts of particular lives. We can understand this scaffolding as a Fleckian conglomerate community fact about the nature of "longevity", and when the community scaffolding is taken down, the particular fact about Parr that it supported disappeared, though the traces of that well-travelled fact remain in pub names and signs, in a portrait by Rubens, and in his burial site in Westminster Abbey.

Chaperones - the people who act as knowing or unknowing companions come in many guises - as we find in this same old age case. They might be witnesses (Harvey, witness to Parr's health), general authorities (Bacon, who attested to general claims of longevity) or even celebrities (Lord Arundel, who brought Parr to London). While witnesses and authorities have particular claims to expertise, the celebrity need have no such expertise. They may all be equally good as companions in getting facts to travel, and to travel intact; and sometimes those roles are rolled up into one.

None of this means that facts always travel easily: however much useful packaging and honest labelling, nothing guarantees that travelling facts will travel intact. They might, after all, have bad companions, companions who alter the fact to subvert it, re-label it, cast doubt on it, and otherwise discredit it as they see it on its way. They might meet with hearty resistance as Naomi **Oreskes'** chapter shows in her account of how commercial and scientific interests worked together to resist the gloomy facts of climate change in the USA and spread an alternative good news message. Here the facts of the expert climate science community were heavily contested: with arguments over the significance of the facts, and indeed whether

they were facts at all, but more significantly for us, by the provision of alternative facts. The population eventually came to accept the facts of the expert community, though they did so believing that the expert community itself was divided. Strangely here, when the facts finally came to travel to the population, they carried with them a picture of bitter division on the part of their parent-producers.

4.2.   *Boundaries and Terrain*

Scenery matters too of course. The terrain and boundaries of travel are equally important to the possibilities for facts to travel well, particularly when we consider how facts travel not only across centuries in the humanities, but between natural and social sciences and from the scientific to the policy domains. The terms of terrain and boundaries offer a topographical metaphor which can be interpreted in a number of ways to make sense of travelling facts. We can construct the terrain in *sociological* terms, for example as a disciplinary landscape in which expertise, trust, and power form the features of the terrain and define the barriers to be overcome. Or we can construct it in terms of the *material elements* of the science or humanities in which models, instruments and experiments - or archives and previous historical authorities - constitute the terrain. A third possibility is to interpret the terrain and boundaries in *cognitive* and *epistemic* terms, where the requirements for a specific technical understanding, or a knowledge of historical period, limit the range of the travelling facts or their ability to remain intact as they travel.[35] These three spaces may be interconnected in the travels of facts. Peter **Howlett's** and Aashish **Velkar's** chapter investigates how precise technical facts are made to travel over a rather formal boundary between the experts in the university to the farmers working the fields, and how those facts, as facts of experience, are then passed over a more informal boundary from the participating farmers to other farmers. At the same time, the facts transported were integrated - some tightly and some loosely - to a technological process which required scientific and tacit knowledge to work together for the facts to travel well. Here is a case where - by design - money formed the necessary good companion to get the facts over the first border, but the subsequent geographical dispersion of the technical facts relied upon various nodes of transfer as well as the evident cognitive

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[35] The now classic genre of science studies that have integrated sociological, historical and philosophical aspects often included elements of travelling facts (even while the topic of travelling knowledge is not their main focus): for example, getting facts about vacuums to travel in early modern Europe (Shapin and Schaffer, 1985); the travels of facts in (and about) rocks and fossils in the early nineteenth century (see Rudwick, 1985); or the use of "boundary objects" as a focus for facts to traverse communities (see Star and Griesemer, 1989).

demonstrations in the fat healthy plants, and financial demonstrations in the new found wealth of participating farmers.

Disciplinary roadways may facilitate the travelling of facts, but at the same time, like rails, they may also limit the range of possibilities for travel. In Alison **Wylie's** chapter, we find attention to how artefactual facts travel along historical and geographical pathways that join communities of archaeologists to particular sites. Here the travelling of facts is inextricably part of their re-production, for successive generations of archaeologists study the same sites again and again, retrieving and recognising different facts, creating a series of historically dated and geographically located chains of reference. In some cases, where the original sites are shut or destroyed, the retrieval becomes an activity of trawling through previous archaeological notebooks and records. The old road map was decided by earlier members of the community and for archaeologists to make new accounts, they sometimes need to construct new maps with new pathways for their facts to travel on.

For cross-disciplinary travels, the terrain may often look forbidding, and the fences rather high. Yet despite this, certain facts seem to show a remarkable ability to travel well across these boundaries. We have already remarked how facts about the behaviour of rats when placed in crowded environments travelled to "speak to" the behaviour of humans in crowded spaces, and thus onto the design of prisons, college dorms and housing estates. Here **Ramsden** shows how the successful travels of the facts about crowded rats depended on some choice words: "the behavioural sink", which captured the imagination of American social commentators who saw the behavioural pattern of urban society as mirroring the behaviour patterns of the rats in their environments. In this case, facts were found capable of passing round or through the boundaries between disciplines and into the various public and popular domains: those boundaries seemed to be rather porous with respect to these facts, more like tennis nets than prison walls.

A much more unstructured sense of territory is found in history, which offers a repository of facts rather like the internet: full of facts that are made by producers and that may be found by users, but the links between them are ambiguous to say the least. While the historian can - by careful research and intuition and imagination - recreate the path by which a fact travelled through time (as the role of Harvey in chaperoning Parr's longevity) this does not mean that the facts of history are displayed ready to be picked up of the historical floor, any more those facts of biology are plainly seen by a biologist or the facts of society found by a sociologist. The facts that historians use have been addressed at some time past to other people, in other places: one of the tasks of the historian is to find and to reconstruct them even though those

historians are rarely the intended recipient. Whereas a sociologist of science will follow the travels of facts by seeking the community within which facts travel, and the human agency by which facts travel, indeed, will even define the travels of facts as being a social event, an historian expects to find and make sense of long lost and unattended facts by inserting themselves into a past environment in which the social is not absent, but in which that past society does not purposely make the packaging by which those facts travelled. Some historical facts do travel well over the vast countries of time, but they do so because it is the historians' specialist expertise, craft and aim, to find them in the clutter, pick them out, and pull them forwards.

4.3.   *Character: Attributes, Characteristics, and Function*

This brings us to the character of facts. Here we are referring to the particular character of specific facts, not with the generic qualities of facts versus other kinds of knowledge. Without pushing the metaphor too far, we want to indicate that facts, like people who have a certain amount of character to start with, will travel well, and those that travel well may tend to acquire more. That is, we can think of facts as having a certain inherent character, something immutable and unique perhaps, but with a potential to develop their scope, to acquire additional roles, or fulfil new functions, to become interpretable at different levels, or become more generic. This takes us back to the wellness issue of travelling since explaining how character helps certain facts to travel well also gives insights into the notion of travelling well, both with integrity and for fruitfulness.

It is often thought that facts as a category - whether they are understood to be found or made - are usually considered as rather bland kinds of things: either because they are understood to have the transparent quality of objectivity or because they hold the reflective quality of the ever malleable. Yet, whatever their status at production, when we follow the travels of facts, they seem to gain colour. We have found that in explaining why some facts travel and some do not, in accounting for what happens to facts when they travel, and in analysing how facts have an impact when they travel, we need to add adjectives describing the way facts are understood and used by the communities in which they travel. Some of our adjectives were just descriptive, but most reflected characteristics or attributes that suggest why those facts travelled well for example, they were not just 'small' or 'big' but 'headline' facts; they were 'understandable', 'surprising', 'colourful', 'reproducible', 'adaptable', and so forth.

In the first place, we found ourselves with a set of adjectives indicating *the character that facts start off with:* these adjectives suggest why certain facts stand out amongst the crowd and so are more likely to be found and demanded by users. For example, a fact that goes against a particular community's assumptions will be found surprising within that community and this tells us why that fact was noticed and why it was immediately taken up by others and passed along further. This notion of inherent character maybe clarified by the example of two, internet-found, facts (both retrieved November 14, 2008) about Taiwan. First, a news report that the Taiwanese President announced the sale of 2,000 tons of oranges from Taiwan to mainland China. This seems a fact of not much interest or importance in the given circumstances: a bland fact of no character to make it travel. The second fact announced itself as "Taiwan's economy is 71% free"! For a social scientist, this is an immediately intriguing fact that asks to be passed on, and then raises questions when ever it is repeated: What could it mean to be only 71% free as opposed to free or not-free? What does it mean for an economy to be free? Who said it? How could such a measure exist or be produced?[36]

The second set of adjectives we found ourselves needing were those that are suggestive of the roles that facts play in their travels, or in their new homes. These alerted us to *the character that facts acquire in their travels*, for example, to become 'key' facts or 'logo' facts for a much bigger community (and this might be so, even if the fact later turns out to be a false fact, as in David **Haycock's** case of longevity of Thomas Parr). Potentially the most important aspect of these adjectives are those pointing to the functions that facts play in their new environments. We are used to thinking about facts having considerable causal impact - for example the social impact of the facts about climate change, or facts about scandals that have a political effect "like dynamite". But travelling facts also have functional importance which might be captured in various ways. Erika **Mansnerus's** research is on the circulation of facts around the various phases and co-operating communities that are jointly responsible for epidemiological modelling in a programme of public health vaccination. She has developed a set of terms for the role and functions of travelling facts in this context, some are resolutely 'stubborn' for they have to be accepted as they are, while others behave as 'chameleons' adapting to their new environments. (In effect, while some models have to be adapted to the stubborn facts, in other cases the facts are adapted to fit the models.) These characteristics are important for they imply something of the the functional roles facts play in

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[36] The measure was produced for the 2008 Index of Economic Freedom, and published by The Heritage Foundation and the Wall Street Journal.

their new homes, where some act as 'brokers', creating new possibilities; or 'mediators', reconciling items; while others are 'containers', carrying items along.

Our experience of proliferating adjectives caught the attention of Susan Hunston, whose analysis of the use of the word "fact" in a 10 year period of *New Scientist*, showed us that scientists too liked to attach adjectives to their use of the word "fact" and she grouped these adjectives as indicating disciplinary basis (scientific, historical, technical etc); aspects of relative importance/size and quality (crucial, small, obvious, etc); and something of its affect (illuminating, sad, amazing).[37] While some of the adjectives *used by the scientists* appear in *our own list*, our adjectives tend to fall into Hunston's latter two categories - adjectives which indicate size or qualities and those that denote affective aspects: our accounts of facts found them to be generic, small, large, surprising, awkward, key - all adjectives which proved usefully descriptive of character for our purposes of understanding why some facts are taken up to travel well, and to explain how facts with character come to travel well.[38]

Facts emerge, develop, mature and pass away, and whether the life of a fact is cut short, or lives a good life, is as much a matter of character and companionship as it is of context and contingency. It is not only those facts that travel intact and maintain their integrity, or those that extend their scope in fruitful ways, that might be said to travel well, for here, travelling well is signalled instead in the plethora of adjectives describing the character of facts that appeared during this study. These character adjectives initially suggest why certain facts are taken up, but then show how and why they are used in their destinations. They suggest how facts gain different identities, play different functional roles, and create different effects, during their travels. These adjectives point us to how facts make a difference to other elements in our histories, literatures and sciences during their travels across time and space. It is this ability to make a difference which constitutes a third sense of what we mean when we say that a fact has travelled well.

5.   Conclusion: How Well Do Facts Travel?

It is usually assumed that the sciences and the humanities have different ways of knowing things, yet our account of travelling facts suggests that we can tell the same sorts of stories about the travels of facts in both domains. Facts can indeed travel well, with integrity,

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[37] "'You can't deny the fact that...': An Application of Corpus Linguistics", Plenary Address, American Association of Corpus Linguistics, Brigham Young University, Utah, March 2008.
[38] The disciplinary aspect has for us another dimension for, as noted earlier, different disciplines like different kinds of facts (See Howlett, 2008).

fruitfully, and to make a difference in their new homes, though of course many do not - some will turn out to be false, or be mangled, or of little account. And of the many facts that do not travel at all, we have made no accounts - though we have seen how important demand is for facts to travel. We have demonstrated how various kinds of associates: stories, models, labels and good companions as well as a good dose of character, will help to set them off and keep them moving to some useful destination. That travel process however is quite unpredictable: it is dynamic, extended, and interactional.

As a result of this variety of experiences of travelling facts in our studies, we have come to see the nature of facts in a rather different light. Facts are not just a rather useful category of things that scientists and humanists produce and fit together to make more interesting narratives, arguments and evidence. Facts are of course foundational, they are building blocks for knowledge in the sciences and humanities, but their extraordinary abilities to travel well, and to fly flags of many different colours in the process, shows when, how and why, they can maintain their integrity and prove sufficiently rocklike to support further facts, ideas, theories in their new domains well beyond and away from their sites of original production and intended use. Facts prove to be, after all, useful travelling members of our sciences, humanities, and society.

Acknowledgement

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