



YOUR KINDLE NOTES FOR:

## Real Science: What it Is and What it Means

by John Ziman

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### 450 Highlights

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Highlight (Yellow) | Location 69

sociology has superseded philosophy at the theoretical core of 'science studies'.

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Highlight (Yellow) | Location 116

Science has always been under attack.

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Highlight (Yellow) | Location 134

Scientists are asked by their students whether they are being prepared for a vocation or for a profession.

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Highlight (Yellow) | Location 146

We know much more about science nowadays than can be put together into a comprehensive, coherent image.

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Highlight (Yellow) | Location 151

Individual acts of observation and explanation are seen to gain their scientific meaning from collective processes of communication and public criticism<sup>9</sup>.

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Highlight (Yellow) | Location 188

the social stability of scientific knowledge is a reasonable indicator of its objectivity.

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Highlight (Yellow) | Location 200

By its very nature, science is a complex system<sup>20</sup>.

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Highlight (Yellow) | Location 209

we should be taking a holistic view that covers 'the whole picture'. In practice, each discipline may still look at only one particular aspect of this picture, and report what it sees in its own particular language.

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Highlight (Yellow) | Location 220

It is much more profitable to start looking at science from a standpoint where it can be seen and depicted - however indistinctly - as a whole.

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Highlight (Yellow) | Location 236

The true strength of a discipline often resides in a highly specialized framework of concepts [8.4] which can only be mastered by a lengthy effort.

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Highlight (Yellow) | Location 278

it is a notable feature of the past few decades that many of the boundaries between the natural sciences and their associated technologies have been dissolving before our eyes<sup>6</sup>.

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Highlight (Yellow) | Location 290

Good science produces knowledge. But research is not just discovery [8.9]. It is conscious action to acquire a particular kind of knowledge for some particular purpose.

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Highlight (Yellow) | Location 293

In reality, science makes little progress by inspired improvisation or artistic doodling.

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Highlight (Yellow) | Location 296

the presumed purpose of research is to solve problems that can be formulated in advance.

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Highlight (Yellow) | Location 296

the societal function of science has always been thought of primarily in terms of the practical human needs that it might serve<sup>12</sup>.

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Highlight (Yellow) | Location 298

Projects are typical instruments of science policy<sup>13</sup>. They are handles by which governments, industrial firms, medical charities and other institutions endeavour to catch hold of science and bend it to their ends.

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Highlight (Yellow) | Location 303

the supposed role of research is to produce, by any feasible means, whatever knowledge is required, or seems likely to be required, to satisfy an actual, or envisaged, material need.

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Highlight (Yellow) | Location 354

Policymakers try to define basic research by exclusion, and then have to invent elastic concepts such as 'potential applicability' to bridge the gap that they have created<sup>2z</sup>.

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Highlight (Yellow) | Location 359

'primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts'.

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Highlight (Yellow) | Location 363

A widespread belief in reductionism is typical of modern science.

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Highlight (Yellow) | Location 375

It would completely sabotage our project to suppose that the practice of pure science is confined to this elite group.

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Highlight (Yellow) | Location 391

In the past, scientists would have said that this was work for the glory of God and the benefit of mankind<sup>31</sup>.

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Highlight (Yellow) | Location 413

They celebrate curiosity because it implies autonomy.

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Highlight (Yellow) | Location 424

In effect, academic science is a culture<sup>40</sup>. It is a complex way of life that has evolved in 'a group of people with shared traditions<sup>41</sup>, which are transmitted and reinforced by members of the group'<sup>42</sup>.

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Highlight (Yellow) | Location 436

Although academic science requires a very sophisticated social environment, it is cultivated arduously in tiny plots even in the poorest and least developed countries.

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Highlight (Yellow) | Location 438

A research scientist can move from university to university, or from a university to a research institute, or even from country to country<sup>46</sup>, without serious cultural hindrance.

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Highlight (Yellow) | Location 439

On the other hand, mobility between fields of research is severely restricted<sup>47</sup>, even within the same organization.

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Highlight (Yellow) | Location 454

In some traditions, 'scholarship'<sup>50</sup> - the enlightened re-formulation of existing knowledge - is preferred to 'research' - the generation of new knowledge.

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Highlight (Yellow) | Location 463

The word is used to mean 'all those people who subscribe to certain general principles of rationality and objectivity, and have such high standards of expertise and mutual trust that they can be relied upon to work together for the benefit of humanity in the attainment of truth'<sup>2</sup>.

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Highlight (Yellow) | Location 472

Every research laboratory is a miniature arena of individual opportunism and social conflict<sup>6</sup>.

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Highlight (Yellow) | Location 510

The moral order in any social system always involves a tense balance between its norms and the corresponding counter-norms<sup>31</sup>.

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Highlight (Yellow) | Location 523

This ethos is easy to debunk as a collective 'false consciousness' that conceals from scientists the true significance of their activities<sup>38</sup>, but it sustains their morale in what can be a very discouraging calling<sup>39</sup>.

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Highlight (Yellow) | Location 536

The norm of communalism [ch.5] requires that the fruits of academic science should be regarded as 'public knowledge'<sup>42</sup>.

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Highlight (Yellow) | Location 551

that academic science is closely associated with higher education, where students get from textbooks a suitably simplified-often sanitized - version of what is now supposedly known to science<sup>46</sup>.

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Highlight (Yellow) | Location 566

The scientific archive is not, therefore, just a repository of everything that has been written on scientific matters. Although its margins are often hotly disputed, it only includes material that has been filtered through a process of formal communication. This is how scientists proclaim socially the distinctiveness of their particular type of knowledge.

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Highlight (Yellow) | Location 593

However elitist and self-serving it may be to outsiders, the scientific community is enjoined to be democratic and fair to its own members<sup>57</sup>.

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Highlight (Yellow) | Location 611

The scientific ethos assumes that academic research is undertaken principally by 'academics', whose livelihood does not depend directly on the material outcomes of their activities.

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Highlight (Yellow) | Location 635

At the very least, this process should establish that the work is authentic - that it is not a slavish copy of another item in the archive, whether by the same or a different author. More rigorous scrutiny should eliminate purely imitative research, or material that has obviously been recycled from previously published texts.

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Highlight (Yellow) | Location 640

In practice, this usually means that they each restrict their research interests to relatively conventional problems in a limited domain - i.e. to 'normal' science within an established 'paradigm'<sup>72</sup>.

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Highlight (Yellow) | Location 645

In other words, the notoriously hyperfine specialization of academic science<sup>73</sup> is a rational personal response to the social imperative to 'be original'.

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Highlight (Yellow) | Location 654

science is a powerful and intensely normative institution, where people rightly feel that proper behaviour and outstanding achievement should be fairly recognized and rewarded<sup>78</sup>.

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Highlight (Yellow) | Location 668

the fact that most mature scientists have experienced its traumas from both sides helps to consolidate the scientific culture and its collective authority<sup>82</sup>.

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Highlight (Yellow) | Location 683

The fact is that there is no way of purging the formal archive of errors.

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Highlight (Yellow) | Location 706

The first experience of having one's work cited favourably can feel like getting a prize for a discovery, and spur one on to further effort. On the other hand, an immensely prestigious award, such as a Nobel Prize, may actually reduce the subsequent scientific productivity of its recipient<sup>94</sup>.

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Highlight (Yellow) | Location 709

The system is very vulnerable to the 'Matthew Effect', where honours and resources accumulate around those who already have them<sup>97</sup>.

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Highlight (Yellow) | Location 716

the continuous creation of interdisciplinary units for research and teaching is vital for the emergence of new disciplines<sup>101</sup> and other modes of scholarly progress

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Highlight (Yellow) | Location 725

each discipline is a distinct 'tribe', living out its particular version of the general scientific culture

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Highlight (Yellow) | Location 729

Disciplines, faculties and departments, however, are more significant for teaching than for research.

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Highlight (Yellow) | Location 734

Extreme specialization is the typical reaction of academic scientists to the tension between the norms of originality and scepticism

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Highlight (Yellow) | Location 737

for many highly committed researchers this is as far as they want to go in their desire to overcome their isolation and acknowledge the cooperative aspect of their activities<sup>114</sup>.

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Highlight (Yellow) | Location 745

Sturdy individualism in the cultivation of specialized areas of knowledge is not merely typical of academic science: it is one of its fundamental structural principles.

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Highlight (Yellow) | Location 750

Science was largely the avocation - the subsidiary calling- of people with other means of support.

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Highlight (Yellow) | Location 755

an academic scientist is an entrepreneur who makes a living by accumulating scholarly recognition and investing it in an academic appointment.

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Highlight (Yellow) | Location 761

tenure is also vital to the academic ethos, for it empowers disinterestedness and enables originality.

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Highlight (Yellow) | Location 764

An elaborate social apparatus of graduate education, doctoral studies<sup>122</sup>, post-doctoral fellowships, etc. has evolved to apprentice, select and recruit the most promising young people into the scientific community.

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Highlight (Yellow) | Location 771

Universities - even nations - compete passionately for scholarly esteem.

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Highlight (Yellow) | Location 776

institutional support for the advancement of knowledge is seen as a moral duty.

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Highlight (Yellow) | Location 790

all patronage, private or public, is channelled through communal filters.

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Highlight (Yellow) | Location 795

In spite of its individualism, science makes itself accountable as a collective enterprise to its patrons.

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Highlight (Yellow) | Location 798

Personal autonomy within the scientific community is linked with the autonomy of the scientific community in the world at large.

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Highlight (Yellow) | Location 819

In principle, the traffic is all one-way. The right to academic freedom is not counterpoised by an ethic of social responsibility<sup>143</sup>. The systematic utilization of research discoveries is not complemented by a counterflow of ideas for utilitarian research. The campaign for better 'public understanding of science'<sup>144</sup> is not balanced by an effort to achieve better scientific understanding of the public.

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Highlight (Yellow) | Location 831

the claim to be distinctive as a mode of knowledge production [10.6] is one of the most distinctive features of science as a social institution.

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Highlight (Yellow) | Location 858

academic research is something more than a particular cultural form. It is our ideal type of a 'mode of knowledge production'<sup>7</sup>.

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Highlight (Yellow) | Location 869

the credibility of science depends as much on how it operates as a collective social enterprise as it does on the principles regulating the type of information that this enterprise accepts and transforms into knowledge.

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Highlight (Yellow) | Location 879

In effect, academic research is being complemented or even superseded by a new `mode of knowledge production'<sup>13</sup>.

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Highlight (Yellow) | Location 883

It is quite clear that it is becoming more difficult for scientists to conform to the Mertonian scheme in their relations with one another.

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Highlight (Yellow) | Location 891

science is still to be believed, but not with quite the old fervour, or for quite the same ends.

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Highlight (Yellow) | Location 966

If this chronicle strikes you as grey and humdrum, that is how I meant it.

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Highlight (Yellow) | Location 976

And everywhere, in every subject, one can find individuals who manage to go on performing their roles as `scientists' and/or `scholars', as if in a timeless world.

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Highlight (Yellow) | Location 989

These changes are taking place in all epistemic institutions - universities, research institutes, government establishments and industrial laboratories<sup>24</sup>.

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Highlight (Yellow) | Location 997

the general argument of this book is that the epistemology of science is linked to its sociology primarily at the level of research practice.

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Highlight (Yellow) | Location 1018

It is precisely the undramatic character of this cultural revolution that has concealed it even from those of us who have lived through it.

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Highlight (Yellow) | Location 1031

Science has progressed to a level where its outstanding problems cannot be solved by individuals working independently.

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Highlight (Yellow) | Location 1042

truly multidisciplinary teamwork challenges the traditional structure at every turn, affecting personal autonomy, career prospects, performance criteria, leadership roles, intellectual property rights, and so on<sup>44</sup>.

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Highlight (Yellow) | Location 1043

Science has always been a growth industry<sup>45</sup>.

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Highlight (Yellow) | Location 1052

it was time to ask when the expansion would stop, and what would happen to science when it met its own limits to growth.

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Highlight (Yellow) | Location 1053

The ceiling that it is hitting is financial.

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Highlight (Yellow) | Location 1070

Many specialized fields of science have also entered a phase of 'finalization' [8.6], i.e. a phase where there is a reliable background of general understanding to guide research strategically towards envisaged and desired ends<sup>so</sup>.

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Highlight (Yellow) | Location 1073

Governments, commercial firms, citizen groups and the general public are all demanding much more systematic arrangements for identifying, stimulating and exploiting potentially useful knowledge.

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Highlight (Yellow) | Location 1082

The novel factor is the requirement that research should be explicitly targeted at recognizably practical problems.

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Highlight (Yellow) | Location 1093

The more generous the patronage, the more political activity it entails.

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Highlight (Yellow) | Location 1095

The emergence of science policy- more generally, science and technology policy- is a major factor in the transition to a new regime for science<sup>5</sup>S.

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Highlight (Yellow) | Location 1106

competition for grants reinforces competition for scientific recognition [3.8], since these are assessed by essentially the same criteria.

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Highlight (Yellow) | Location 1110

Competition for real money takes precedence over competition for scientific credibility<sup>6</sup>3 as the driving force of science.

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Highlight (Yellow) | Location 1115

considerable pressure is put on scientists to work on problems favoured by the government, rather than problems of their own choosing [8.7].

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Highlight (Yellow) | Location 1120

post-academic scientists relaunch themselves as technical consultants,

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Highlight (Yellow) | Location 1132

academic institutions are expected to undertake more research under industrial auspices, and to produce results of more direct commercial value?<sup>9</sup>.

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Highlight (Yellow) | Location 1145

industrial science is Proprietary, Local, Authoritarian, Commissioned, and Expert<sup>7</sup>3.

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Highlight (Yellow) | Location 1161

Competitive research grant systems necessarily generate a lot of paperwork and consume a great deal of the time of expert researchers.

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Highlight (Yellow) | Location 1183

academic science - 'the engine of modernity'<sup>8</sup>0 - exhibits many of the features of a 'pre-modern' social structure.

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Highlight (Yellow) | Location 1219

into the behavioural sciences<sup>14</sup>. This interdependence between the philosophical, psychological and sociological characteristics of science is at the heart of the present inquiry.

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Highlight (Yellow) | Location 1220

The norm of communalism requires scientific knowledge to be public property<sup>15</sup>.

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Highlight (Yellow) | Location 1225

most people believe that their most secure knowledge of matters of fact is derived from direct experience.

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Highlight (Yellow) | Location 1244

Much of the power of science comes from the specialized training of observers.

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Highlight (Yellow) | Location 1247

Serendipity [8.9] is a characteristic phenomenon of scientific life<sup>20</sup>, and plays a very important part in breaking the mould of received knowledge. But the dictionary definition, 'looking for one thing and finding another'<sup>21</sup>, indicates that it is not an entirely random process. It occurs in the course of a directed activity<sup>22</sup>, and is fruitful only for 'the prepared mind'<sup>23</sup>.

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Highlight (Yellow) | Location 1263

Even in the physical sciences, making an observation is an active process.

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Highlight (Yellow) | Location 1276

Standardization - qualitative as well as quantitative - is clearly a very effective epistemic strategy<sup>37</sup>.

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Highlight (Yellow) | Location 1282

The effort to extend the methodology of numerical measurement into the human sciences has met with even less success.

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Highlight (Yellow) | Location 1293

whatever the other virtues of quantification, it cannot succeed in eliminating social or personal factors from the human sciences.

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Highlight (Yellow) | Location 1306

It is a philosophical fantasy to suppose that a scientific `fact' can be freed from the context in which it was observed.

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Highlight (Yellow) | Location 1312

scientific specialists quickly learn to see and think `through' their instruments to the phenomena in which they are interested<sup>51</sup>. This is a professional skill that cannot be taken over by a lay person or an `expert system'.

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Highlight (Yellow) | Location 1316

scientific observations are necessarily sophisticated and contrived.

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Highlight (Yellow) | Location 1320

What scientists count as `empirical facts' may seem to a lay person extraordinarily artificial, conceptually heterogeneous, and entirely divorced from normal human experience

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Highlight (Yellow) | Location 1324

Elaborate practices have evolved, especially in the social sciences, to neutralize the psychological quirks, and political, moral, economic and career interests, of individual researchers.

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Highlight (Yellow) | Location 1334

an experiment can be thought of as an act of observation designed to yield a particular type of empirical knowledge.

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Highlight (Yellow) | Location 1347

the most effective way of projecting an experiment on to a particular theoretical dimension is to undertake it in carefully contrived circumstances where all other potential disturbing factors are eliminated<sup>57</sup>.

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Highlight (Yellow) | Location 1353

scientific knowledge is largely designed to account for what happens to carefully constructed artefacts in artificial circumstances<sup>59</sup>.

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Highlight (Yellow) | Location 1368

there are no absolute rules on what constitutes a scientific fact.

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Highlight (Yellow) | Location 1374

Scientific knowledge is a collective good, and a collective accomplishment<sup>64</sup>.

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Highlight (Yellow) | Location 1384

There is no real alternative to the academic practice of relying heavily on the findings reported by individual scientists - or small groups of scientists - working in private.

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Highlight (Yellow) | Location 1387

the acceptance of consistent, coherent and plausible testimony from knowledgeable, disinterested witnesses is an essential feature of all practical reasoning.

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Highlight (Yellow) | Location 1388

Knowing how to evaluate testimony is a basic requirement for membership of any cultured.

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Highlight (Yellow) | Location 1395

Trust amongst scientists may be unusually high, but it cannot rest entirely on cultural convention.

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Highlight (Yellow) | Location 1412

only a very small proportion of the experiments and observations reported in the scientific literature are actually replicated by other researchers.

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Highlight (Yellow) | Location 1423

even empirical scientific 'facts' seldom record precisely what actually happens to real organisms.

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Highlight (Yellow) | Location 1437

the particular skills that may be required to 'make an experiment work' in one laboratory may not be easily transported to another<sup>95</sup>.

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Highlight (Yellow) | Location 1446

all empirical 'facts' are embedded in theory.

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Highlight (Yellow) | Location 1447

Instead of being 'verified by reproduction', scientific observations are usually validated by triangulation<sup>99</sup>.

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Highlight (Yellow) | Location 1449

if the same empirical phenomenon can be observed by two different methods it must surely be genuine - and so also, incidentally, must be the background theory shared by the researchers and their peers<sup>100</sup>.

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Highlight (Yellow) | Location 1455

What can be known to science can only be what can be known to scientists

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Highlight (Yellow) | Location 1456

It cannot be entirely mechanized [5.5] or perfectly regulated socially.

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Highlight (Yellow) | Location 1465

Epistemology is as central to cognitive science as cognition is to epistemology.

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Highlight (Yellow) | Location 1507

from a sociological point of view it is not the existence and activity of individuals that make a culture, but their co-existence and interaction.

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Highlight (Yellow) | Location 1534

Research reports ascribing intentions, motives and emotions to human beings can be accepted intersubjectively by other researchers, and thus become part of the shared knowledge of a research community<sup>164</sup>.

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Highlight (Yellow) | Location 1544

a naturalistic approach via intersubjectivity breaches the traditional demarcation line between the 'sciences' and the 'humanities'.

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Highlight (Yellow) | Location 1551

In the broadest meaning of the word, all systematic human activity requires 'science'.

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Highlight (Yellow) | Location 1552

Academic science, however, differs fundamentally from 'ethnoscience' in that it produces codified knowledge

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Highlight (Yellow) | Location 1552

Research results do not count as scientific unless they are reported, disseminated, shared, and eventually transformed into communal property, by being formally published.

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Highlight (Yellow) | Location 1556

This has had the effect of grossly exaggerating the role of formal logic, mathematics and other modes of exact reasoning, even in the natural sciences

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Highlight (Yellow) | Location 1568

what is distinctive about a formal scientific communication is neither the medium nor the message: it is that it is published.

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Highlight (Yellow) | Location 1572

Ideally, it is fully and freely available for open criticism and constructive use.

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Highlight (Yellow) | Location 1583

The communal norm limits scientific knowledge to what can, in fact, be represented unambiguously in mutually intelligible words, gestures, symbols, pictures, etc.<sup>187</sup>

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Highlight (Yellow) | Location 1590

although a formal scientific communication is not explicitly addressed to named persons, it is really directed towards the relatively small number of research scientists who share the same paradigm

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Highlight (Yellow) | Location 1596

communications addressed to wider publics are excluded from the formal literature [9.3], and may even harm the scientific standing of their authors.

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Highlight (Yellow) | Location 1598

Just as 'community' is the keynote of academic science, so 'network' is the sociological theme of post-academic science

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Highlight (Yellow) | Location 1609

The epistemic quality of academic science depends very much on the existence of a public archive of historically dated and explicit research reports by named authors, who must take personal responsibility for their claims. This function cannot be performed satisfactorily by a collection of texts that are continually being updated and revised.

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Highlight (Yellow) | Location 1612

membership of a post-academic research network may be limited to recognized specialists on the subject. Even an electronic system for the exchange of 'preprints' - that is, research reports that have not yet been published - can be more like an exclusive club, or even a secret society, than an open-sided 'invisible college'

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Highlight (Yellow) | Location 1621

In academic science, intellectual property rights are strictly personal, and are limited in value to the esteem they earn as contributions to science<sup>200</sup>.

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Highlight (Yellow) | Location 1623

The transition to post-academic science has undoubtedly weakened the traditional mechanisms motivating prompt and full disclosure of research findings<sup>201</sup>, thus creating serious personal and institutional dilemmas in the scientific world.

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Highlight (Yellow) | Location 1631

it is often very difficult to make this type of distinction between 'science' and 'non-science'.

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Highlight (Yellow) | Location 1635

the knowledge appearing in public out of post-academic science is bound to be incomplete.

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Highlight (Yellow) | Location 1638

Secrecy in science is a form of 'epistemic pollution' to which post-academic science would seem all too open.

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Highlight (Yellow) | Location 1639

It also signifies increasing subordination to corporate and political interests [7.6] that do not put a high value on the production of knowledge for the benefit of society at large<sup>202</sup>.

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Highlight (Yellow) | Location 1641

in the long run, it is precisely the openness of academic science, its respect for the communal norm, and its grounding in reproducible empirical observation, that are the best guarantees of its practical reliability - for good or for ill.

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Highlight (Yellow) | Location 1644

The result is that science is primarily concerned with generalities.

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Highlight (Yellow) | Location 1648

In other words, the detailed facts must be interpreted and presented as specific elements of more general patterns? - typically as entities governed by theories.

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Highlight (Yellow) | Location 1655

In principle, the scientific community is totally meritocratic and multicultural

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Highlight (Yellow) | Location 1657

It thus bars the incorporation into science of ideas that are not acceptable to most human beings.

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Highlight (Yellow) | Location 1662

intellectual tension between universalism and specialization [3.9, 8.3] is one of the characteristic features of academic science.

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Highlight (Yellow) | Location 1663

Such systems are seldom strictly 'incommensurable'<sup>11</sup>[8.9, 9.6, 10.4] but their relative incongruities are not always decisively resolved.

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Highlight (Yellow) | Location 1665

Philosophers have largely concentrated on the explanatory, prescriptive or predictive theories typical of an analytical science such as physics, where it seems that an infinity of facts can be derived from a few simple 'laws'<sup>14</sup>.

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Highlight (Yellow) | Location 1666

They have largely neglected the problem of systematizing the specific and detailed observations obtained in a descriptive science such as anthropology's, where if there are any general 'laws' they must be nebulous and very complex<sup>16</sup>.

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Highlight (Yellow) | Location 1670

a well-founded taxonomy often functions as a predictive theory<sup>19</sup>,

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Highlight (Yellow) | Location 1672

unambiguous communication between researchers [5.12] is impossible unless they can identify to one another the entities that they are talking about.

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Highlight (Yellow) | Location 1680

It is not the possibility of abstract analysis that makes a taxonomy scientific. It is that it is sufficiently universal to be used consistently by a scientific community.

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Highlight (Yellow) | Location 1687

A glance at the scientific literature shows that the human capability for pattern recognition is deeply embedded in scientific practice<sup>29</sup>.

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Highlight (Yellow) | Location 1696

the classification schemes that people find 'natural' are often social constructs that have evolved along with other aspects of their culture<sup>37</sup>.

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Highlight (Yellow) | Location 1712

no argument that includes human mental operations can be completely proven by formal logic.

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Highlight (Yellow) | Location 1765

What is common to all theories, weak or strong, descriptive or analytical, is that they represent the world as structured.

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Highlight (Yellow) | Location 1768

Almost every general statement one can make about scientific theories is equally applicable to maps.

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Highlight (Yellow) | Location 1778

A whole new science, such as geology, may evolve out of a new way of mapping observational data<sup>67</sup>. The recognition of 'patterns' in such representations is one of the major sources of scientific theories [6.1]. Scientific concepts are often grasped and manipulated cognitively as 'mental models' of this type [5.14,10.1].

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Highlight (Yellow) | Location 1785

To be of any value, it must have sufficient structure to suggest unanticipated patterns of fact or inference<sup>69</sup>. There must be ways of, so to speak, 'getting around' blockages, observing objects from 'several different points of view'<sup>70</sup> or 'making connections' between previously unrelated entities or ideas<sup>n</sup>.

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Highlight (Yellow) | Location 1791

the 'network model' of science is only a special case of the map metaphor, emphasizing - often exaggerating<sup>76</sup> - its overall connectivity.

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Highlight (Yellow) | Location 1852

scientific theories are widely held to be primarily exercises in algorithmic compression.

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Highlight (Yellow) | Location 1854

imaginative writing about science is resented because it stimulates intuition rather than engaging reason<sup>106</sup>

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Highlight (Yellow) | Location 1855

Without question, analytical thought is the mainstay of the scientific culture

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Highlight (Yellow) | Location 1862

a formalism is a universal mode of representation, ideally suited to the exercise of criticism

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Highlight (Yellow) | Location 1864

the force of such critical practices depends on the assumption that logic transcends cultures - that logically sound reasoning can be communicated in any human language, so that strictly logical scientific ideas can be made compelling to any rational human being

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Highlight (Yellow) | Location 1873

diligence in defining scientific knowledge more precisely, in order to make it more uniform and more open to criticism, is taken to indicate strong commitment to the norms of universality and disinterestedness<sup>114</sup>.

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Highlight (Yellow) | Location 1874

The ultimate purpose of a theoretical formalism is thus to ensure unambiguous communication.

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Highlight (Yellow) | Location 1881

A theoretical contradiction is a scientific scandal, yet its discovery is often hailed as a significant contribution to knowledge.

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Highlight (Yellow) | Location 1884

Sometimes scientists simply do not appreciate the lack of coherence in a supposedly well-established body of knowledge<sup>126</sup>.

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Highlight (Yellow) | Location 1929

mathematics is a universal language [6.6], perfectly adapted for the communication of scientific observations and the presentation of scientific theories<sup>145</sup>.

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Highlight (Yellow) | Location 1949

What these diverse views suggest is that a mathematical argument has the same epistemological status as the scientific theory in which it occurs.

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Highlight (Yellow) | Location 1951

Mathematics is often thought to be completely logical, which it cannot be because of Godel's Theorem [6.5]. Like symbolic logic, it tells us nothing we didn't already know in principle about the symbols and abstract entities whose relationships it depicts and regulates<sup>156</sup>.

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Highlight (Yellow) | Location 1960

Nothing can be deduced mathematically from the sum of quantities symbolizing such different dimensions of reality, each with its own conventions of measurement and its own calculus for the representation of equivalences and differences<sup>157</sup>.

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Highlight (Yellow) | Location 1972

most of the entities that figure theoretically in the human sciences are not 'arithmomorphic'<sup>160</sup>, and are not at all amenable to formal mathematical analysis<sup>161</sup>.

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Highlight (Yellow) | Location 1974

wherever they can be used, near-logical modes of presentation and reasoning, such as mathematical analysis, are enormously powerful.

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Highlight (Yellow) | Location 1979

when we ask for a definition of rationality, we are either referred upstairs to the laws of logic, which are too strict, or back to the English word 'reasonable',

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Highlight (Yellow) | Location 1983

According to the circumstances, valid scientific reasoning may involve the evaluation of testimony, empathic understanding of human behaviour, pattern recognition<sup>165</sup>, category formation, classification, generalization, analogy, unification and, above all, the grammar of a natural language.

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Highlight (Yellow) | Location 1985

scientific rationality is no more than practical reasoning<sup>167</sup>, carried out as well as possible in the context of research

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Highlight (Yellow) | Location 1996

a passage of scientific reasoning is not easily separated from its knowledge context or its specialized vocabulary.

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Highlight (Yellow) | Location 1998

It is very unusual to encounter a research situation that is not amenable to ordinary ways of thought.

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Highlight (Yellow) | Location 2002

Any effective mode of translation between languages requires that their speakers have certain elementary modes of reasoning in common<sup>172</sup>.

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Highlight (Yellow) | Location 2007

the norm of universality limits scientific rationality to transcultural modes of practical reasoning<sup>178</sup>.

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Highlight (Yellow) | Location 2013

Cultural relativism [10.4, 10.7] is thus a very serious issue, which applies in principle to all sciences at all levels.

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Highlight (Yellow) | Location 2019

we learn most of what we know about what makes life worth living, and how to live it well, from non-scientific sources -biography, narrative history, serious journalism, and religious texts, not to mention novels, poetry, drama and the visual arts<sup>183</sup>.

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Highlight (Yellow) | Location 2033

Classcation is thus a generic feature of scientific theorizing, right across the board.

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Highlight (Yellow) | Location 2035

scientific understanding involves much more than observing 'phenomena', discovering their 'causes', and formulating general 'laws of nature'. Indeed, despite all the philosophical attention given to them, these traditional metascientific terms are scarcely to be found nowadays in genuine scientific discourse.

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Highlight (Yellow) | Location 2037

the grand strategy of research is not just to trace out itineraries of cause and effect: it is to represent 'schematically' those aspects of nature that can be grasped in principle and/or used in practice.

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Highlight (Yellow) | Location 2046

The system schema arises naturally in the scientific culture because it can so easily be communicated pictorially<sup>191</sup>.

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Highlight (Yellow) | Location 2056

despite philosophical objections<sup>200</sup>, the word 'model' is so widely used in scientific practice<sup>201</sup> that it has become almost a synonym for a 'theory'.

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Highlight (Yellow) | Location 2064

from a naturalistic perspective there is everything to gain from detailed studies of the behaviour of non-linear, irreversible, functionally irreducible models of the non-linear, irreversible, functionally irreducible systems [10.8] that we find in the real world<sup>207</sup>.

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Highlight (Yellow) | Location 2068

computer power is a Tertium Quid<sup>210</sup> that closes the gap between 'theory' and 'experiment' - a gap that has always seemed a fixed feature of scientific practice.

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Highlight (Yellow) | Location 2074

Outside the physical sciences, theoretical models are usually as 'soft' as the systems that they represent<sup>216</sup>.

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Highlight (Yellow) | Location 2085

even the most austere 'scientific' models operate through analogy and metaphor.

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Highlight (Yellow) | Location 2101

The transfer of themata between different disciplines - for example, the notion of a 'code' from information theory into molecular genetics - is often an effective recipe for good science<sup>229</sup>.

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Highlight (Yellow) | Location 2110

New 'facts' only become visible against old expectations.

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Highlight (Yellow) | Location 2110

The theoretical models of an advanced science are notoriously fragmented, uncertain and inconsistent. Nevertheless, they make up a 'big picture'<sup>234</sup> that is as elaborate, detailed, cross-connected and apparently coherent as the street map of a great city.

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Highlight (Yellow) | Location 2115

the norm of universalism drives the scientific enterprise towards the generation of elaborate general theories, typically embodied in conceptual models spanning abstract scientific domains.

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Highlight (Yellow) | Location 2117

It is not only a collective accomplishment, in that it is generated and sustained by the combined efforts of many individuals [8.13]: it is also a collective resource, in that it is designed and shaped to be shared by a research community<sup>237</sup>. It is not only a personal accomplishment, in that individual scientists contribute personally to its construction: it is also a personal resource, in that each of them carries it 'inside their head' as a guide to research, teaching and practical use<sup>238</sup>.

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Highlight (Yellow) | Location 2124

the maps and models in the scientific domain are much more sophisticated, and require much more interpretative effort, than the maps and models we use in everyday life.

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Highlight (Yellow) | Location 2143

Scientific progress that fosters the development and consolidation of each of these domains tends to reinforce the distinctive features that keep them apart.

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Highlight (Yellow) | Location 2145

Science thrives on the resolution of contradictions. The removal of frontiers of apparent incommensurability between previously independent disciplines is one of the major achievements of research.

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Highlight (Yellow) | Location 2148

In practice, moreover, the unifying impulse is inhibited by the mundane necessities of academic specialization [3.9, 8.3], which bear even more heavily on research careers and programmes<sup>259</sup>.

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Highlight (Yellow) | Location 2152

the actual group of people who are involved in accepting and sharing a research result is only a tiny sub-set of the universal, multicultural ideal.

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Highlight (Yellow) | Location 2161

Academic science therefore strives to attain consensual objectivity by merging these interests in a collective process.

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Highlight (Yellow) | Location 2168

The norm of disinterestedness, along with the rest of the academic ethos, functions to ensure that this cut can be made cleanly, without leaving loose ends of personal prejudice, injustice or mendacity by which the communal consensus might be unravelled.

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Highlight (Yellow) | Location 2174

science is 'interesting', not only because it arouses intellectual interests, but also because it can serve material interests.

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Highlight (Yellow) | Location 2184

when philosophers assert that scientific knowledge is validated pragmatically<sup>10</sup> they mean this in the broad sense of being 'coherent with experience'.

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Highlight (Yellow) | Location 2187

As a mode of knowledge production, science conceived as 'mastery over nature' - i.e. research for specific, temporary advantage - merges imperceptibly into science as 'the pursuit of understanding'-i.e. as if for eternal, universal use<sup>13</sup>.

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Highlight (Yellow) | Location 2190

the question is often asked - and not always answered convincingly - whether the human sciences have really produced knowledge that goes beyond the common-sense wisdom gained from thoughtful reflection on experience in practical life-world situations<sup>14</sup>.

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Highlight (Yellow) | Location 2193

The dynamism of a good scientific model is valued less for depicting a process correctly than for getting its outcome right.

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Highlight (Yellow) | Location 2209

Tenacity in presenting and defending one's ideas in public is one of the hallmarks of 'good science'<sup>20</sup>.

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Highlight (Yellow) | Location 2213

It is a sad fact of life that academic communities are prone to clannishness, careerism, nepotism and other worldly vices<sup>26</sup> -including downright fraud<sup>27</sup>.

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Highlight (Yellow) | Location 2217

The fact is that academic science could never possibly live up to its romantic image as a selfless quest for a Holy Grail of Truth

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Highlight (Yellow) | Location 2225

No one will listen to their case unless it respects outwardly the epistemic norms, rhetorical values, metaphysical commitments and other cognitive interests of the scientific culture<sup>36</sup>.

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Highlight (Yellow) | Location 2227

They are deeply embedded in webs of trust [5.7], both in their dependence on others and in the acceptability of their own contributions<sup>37</sup>.

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Highlight (Yellow) | Location 2230

academic science is a culture where a reputation for reliability - that is, credibility [5.10, 9.2] - is the prime personal asset<sup>38</sup>.

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Highlight (Yellow) | Location 2235

Through its ethos and its established practices, it transforms their conflicting personal interests and cognitive powers into a shared collective interest in the production of reliable knowledge and in the anonymous, institutionalized credibility of that knowledge<sup>40</sup>.

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Highlight (Yellow) | Location 2242

Academic scientists are taught to think of themselves as persons who know nothing, and care less, about social problems<sup>43</sup>, who solve intellectual puzzles without reference to their practical significance<sup>44</sup>, and who do good automatically by producing valid knowledge that sometimes turns out to be useful<sup>45</sup>.

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Highlight (Yellow) | Location 2249

research claims are scrutinized very carefully, and even rejected, if they might possibly be biased in favour of some external body, such as a commercial firm that has supported the research.

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Highlight (Yellow) | Location 2256

The academic ethos embodies the insight that science cannot be expected to 'speak truth to power'<sup>50</sup> unless power is forbidden to talk back.

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Highlight (Yellow) | Location 2272

The observable direct influence of social interests on `laboratory life' in the natural sciences actually seems to be quite limited<sup>52</sup>.

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Highlight (Yellow) | Location 2278

In these sciences, every effort is made to rest the communal acceptability of research claims on the exercise of these universal capabilities.

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Highlight (Yellow) | Location 2282

personal commitment to the scientific ethos requires at least a minimum commitment to the specific institutional and social interests in which scientific work is embedded<sup>54</sup>.

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Highlight (Yellow) | Location 2293

It deals with the influence of social interests on the outputs of science, but ignores their influence on its inputs. It justifies the decisions of the research community, but does not consider its agenda.

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Highlight (Yellow) | Location 2308

historians find it notoriously difficult to keep their own social interests out of their accounts of the past.

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Highlight (Yellow) | Location 2345

People in advanced societies now largely fashion their cultural maps out of the findings of academic research in the human sciences

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Highlight (Yellow) | Location 2360

Freedom to speak the supposed truth is prescribed by the norm of communalism; but does that include freedom not to speak out against evident untruths?

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Highlight (Yellow) | Location 2365

Ideally, academic scientists programme their research around `basic' problems - that is, problems whose solutions would be a significant contribution to knowledge, regardless of their practical implications.

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Highlight (Yellow) | Location 2368

In practitioner sciences this is seldom the case, and even in the purest of the human sciences many researchers are very conscious of the larger social values that motivate their research interests.

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Highlight (Yellow) | Location 2373

academic scientists typically neglect socially 'uninteresting' problems - that is, problems which relate to the welfare of relatively inarticulate social groups or whose answers might turn out to be embarrassing to strong vested interests in society at large.

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Highlight (Yellow) | Location 2378

There can be no doubt, therefore, that academic science is affected by external interests<sup>92</sup>. The real question is whether these interests are so influential and systematic that they turn science into their unwitting tool.

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Highlight (Yellow) | Location 2383

They see academic science as a self-regarding community devoted to producing knowledge 'for its own sake' and are highly critical of its lack of incentives and opportunities to transform this knowledge into profitable industrial products.

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Highlight (Yellow) | Location 2385

the charge of socio-economic irresponsibility attests to the reality of the institutional and epistemic autonomy that has long been enjoyed and celebrated by academic science.

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Highlight (Yellow) | Location 2386

The academic ethos uses the norm of disinterestedness to define the frontier between academic and industrial science.

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Highlight (Yellow) | Location 2390

post-academic science gains overall coherence and fitness for application<sup>95</sup> by drawing on, and generating, problems, techniques and research results from all parts of the conventional 'R&D spectrum'

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Highlight (Yellow) | Location 2400

public agencies such as research councils are instructed to favour projects with manifest 'wealth-creating' prospects, or with practical medical, environmental or social applications.

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Highlight (Yellow) | Location 2417

post-academic pragmatism reinforces cognitive objectivity.

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Highlight (Yellow) | Location 2439

the relative 'objectivity' of physics is not due to the fact that it describes the world 'as it really is'. It is because, as we have seen, physics has evolved as an epistemic culture devoted to the measurable aspects of the world.

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Highlight (Yellow) | Location 2443

It is considered perverse to challenge research results and theoretical inferences that apparently conform to their well-tried methods of observation and argument.

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Highlight (Yellow) | Location 2444

In general, therefore, post-academic natural scientists can usually be trusted to tell 'nothing but the truth', on matters about which they are knowledgeable.

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Highlight (Yellow) | Location 2445

unlike academic scientists, they are not bound to tell 'the whole truth'. They are often prevented, in the interests of their employers, clients or patrons, from revealing discoveries or expressing doubts that would put a very different complexion on their testimony.

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Highlight (Yellow) | Location 2450

The credibility of the scientists is thus tainted by the equivocations of their political or commercial masters.

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Highlight (Yellow) | Location 2474

a genuine scientific controversy [9.1] is not like a law suit that can be decided by the presentation of the case for each side to a neutral jury. The very notion that there are only two sides in such matters is not consistent with the scientific culture.

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Highlight (Yellow) | Location 2487

As a source of well-established, disinterested knowledge, science plays a unique role in settling factual disputes. This is not because it is particularly rational or because it necessarily embodies 'the truth': it is because it has a well-deserved reputation for impartiality on the material aspects of what is at stake.

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Highlight (Yellow) | Location 2489

The complex fabric of an advanced, democratic society is held together by trust in the claimed objectivity of scientific experts.

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Highlight (Yellow) | Location 2498

post-industrial research has no place for disinterested practices, and post-modern thought has no place for objective ideals.

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Highlight (Yellow) | Location 2499

It is no good telling post-academic scientists that they should adopt a 'scientific attitude' in their work. They have neither examples of disinterested behaviour to emulate, nor formal standards of social objectivity to live up to.

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Highlight (Yellow) | Location 2507

The human sciences complement the natural sciences in providing legitimacy and a rationale for our modern pluralistic society<sup>120</sup>.

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Highlight (Yellow) | Location 2511

By insisting on complete ethical independence [7.4], purely academic science produces knowledge that lacks social legitimacy<sup>121</sup>. Few would now doubt that post-academic science, being much more directly connected into society at large, has to share its larger values and concerns. But by completely compromising the relative societal independence of the human sciences, it could call into question the legitimacy of all the knowledge it claims to produce<sup>122</sup>.

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Highlight (Yellow) | Location 2517

But they can be credited with CUDOS [3.8] only for what they discover through research that they have themselves decided to undertake'.

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Highlight (Yellow) | Location 2519

Philosophers constantly insist that scientific knowledge is provisional, but they seldom remind us that, even though it is continually expanding, it is very patchy in its coverage.

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Highlight (Yellow) | Location 2521

at any given moment, what we know and how well we know it depends on what our predecessors decided to study in the past. What we shall know in the foreseeable future will depend on what research we undertake now.

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Highlight (Yellow) | Location 2541

Shrewd choice of a problem or problem area is often the key to success in research, and is widely regarded as one of the most creative of all the scientific talents<sup>9</sup>.

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Highlight (Yellow) | Location 2545

In principle, each researcher has to make up for herself the problems on which her performance will be assessed. The highest peaks of scientific genius are not for sheer virtuosity in 'solving problems'. They are reserved for the immortals who have posed these problems in the first place

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Highlight (Yellow) | Location 2565

This personal need for material resources obliges academic scientists to mobilize social support for their intended research<sup>26</sup> by disclosing its epistemic goals and explaining how they are to be achieved.

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Highlight (Yellow) | Location 2573

project proposals emerge at the nodal points of the modern scientific culture<sup>29</sup>, where its personal, material, social and epistemic dimensions intersect<sup>30</sup>.

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Highlight (Yellow) | Location 2576

as the medium through which projects are defined before selection by peer review<sup>34</sup>, they discourage risk-taking by favouring problems that can easily be recognized as such in the research community<sup>35</sup>

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Highlight (Yellow) | Location 2578

From an epistemological point of view, one of the striking things about research proposals is how closely they have come to resemble research reports<sup>38</sup>

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Highlight (Yellow) | Location 2586

From an epistemological point of view, this is a bizarre development.

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Highlight (Yellow) | Location 2588

there is a trend towards treating project proposals as if they were, to some small degree, contributions to science.

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Highlight (Yellow) | Location 2590

a confidential project proposal is now considered as much a target for plagiarism [3.6] as a manuscript of a research paper.

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Highlight (Yellow) | Location 2591

The whole system of allocating resources to academic science on the basis of project proposals obviously puts a great strain on the norm of originality.

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Highlight (Yellow) | Location 2595

The originality of the researcher is respected in principle but deeply compromised in practice.

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Highlight (Yellow) | Location 2596

The outright individualism of the academic ethos is no longer compatible with the need to mobilize large resources to do meaningful research.

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Highlight (Yellow) | Location 2601

They are quite ready to give up strategic autonomy in setting the goals of their research, provided that they have sufficient technical autonomy in framing the precise questions to be posed and answered<sup>46</sup>.

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Highlight (Yellow) | Location 2605

Many highly trained `scientists' off-load the burden of intellectual originality by perfecting their practical skills.

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Highlight (Yellow) | Location 2608

many aspects of the research culture tell of a tension between the austere ideal of individual autonomy and the human realities of intellectual and psychological interdependence<sup>49</sup>.

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Highlight (Yellow) | Location 2616

By the elimination of projects that do not satisfy orthodox criteria of rationality or practicality, science thus loses a lot of useless junk. But it also loses the occasional benefit [9.S] of quite unexpected results [S.9] from idiosyncratic projects that were strangled before they could be brought to birth.

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Highlight (Yellow) | Location 2626

Even the most learned `authority' cannot be expected to be completely knowledgeable about more than a few per cent of the subject matter of a typical academic discipline<sup>58</sup>.

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Highlight (Yellow) | Location 2631

Scientific knowledge thus tends to break up into self-contained problem areas, each evolving conceptually as if it were an independent discipline<sup>60</sup>.

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Highlight (Yellow) | Location 2637

academic science as a whole is stitched together by scientists whose research careers cross the boundaries between the conventional specialties<sup>67</sup>.

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Highlight (Yellow) | Location 2681

The concept of a discipline [3.9] thus has a strong hold on the mentality of every scientist, as well as a tight grip on their career.

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Highlight (Yellow) | Location 2687

Are the distinct categories that we seem to find in our knowledge about the world as genuine as the distinct species of objects and organisms that we find in the world itself?

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Highlight (Yellow) | Location 2716

paradigms and disciplines evolve together as 'epistemic institutions' where the social and cognitive elements are closely intertwined.

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Highlight (Yellow) | Location 2736

There is ample empirical evidence that scientists do, at times, honour the norm of originality by thinking the unthinkable, seeing the invisible, and taking serious notice of the exceptional.

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Highlight (Yellow) | Location 2739

Scientific paradigms often claim to be fundamental. But as we have seen, they are never epistemically complete or coherent.

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Highlight (Yellow) | Location 2745

the norm of scepticism [9.1] requires the co-existence of many schools of thought.

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Highlight (Yellow) | Location 2749

As earnest philosophers of science were quick to point out<sup>115</sup>, a paradigm is a foggy concept that rapidly evaporates in the sunlight of formal analysis.

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Highlight (Yellow) | Location 2758

physics is not typical. No other discipline claims to be near to the ultimate goal of having a 'grand paradigm' capping the whole hierarchy.

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Highlight (Yellow) | Location 2777

By committing themselves to certain theoretical authorities, to the reliability of certain instruments, to the imitation of certain exemplars of 'good science'<sup>127</sup>, they try to reduce these problems to puzzles requiring no more than the ordinary technical skills in which they are professionally trained<sup>128</sup>.

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Highlight (Yellow) | Location 2786

The 'normality' of a piece of research is not measured in terms of the tedium of its methods or the homeliness of its objects of study. It is measured by the quantity of 'me-too' research in a specialty, or by the proportion of papers whose citations are drawn from the same closed list.

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Highlight (Yellow) | Location 2789

Does every research field typically pass from pre-paradigmatic anarchy to orthodox normality, with a limited phase of exciting discovery and paradigm formation in between?

Highlight (Yellow) | Location 2798

Metascientists tend to see the advent of a master paradigm, such as classical mechanics, quantum theory, evolutionary biology, plate tectonics, molecular genetics or transformational grammar, as the End of History in its field. Most scientists see it as the beginning of a Golden Age of research.

Highlight (Yellow) | Location 2804

almost all research is to some extent 'finalized', in that it is directed towards a rational end.

Highlight (Yellow) | Location 2807

the research has a final purpose conceived in terms of what was by then well known.

Highlight (Yellow) | Location 2810

Epistemically speaking, finalization indicates the availability of knowledge that can be relied on (up to a point!) in the production of more knowledge.

Highlight (Yellow) | Location 2818

molecular biology became a finalized scientific discipline long before it spawned an effective technology.

Highlight (Yellow) | Location 2819

Scientists greatly value personal autonomy in research. The academic norm of originality calls for individual freedom of problem choice.

Highlight (Yellow) | Location 2824

Finalization thus opens the way to 'Mode 2' research [4.11], where problems typically arise 'in a context of application'.

Highlight (Yellow) | Location 2827

Even very basic research does not take place in a power vacuum. It has to be supported financially and administratively by bodies whose interests go beyond the mere production of knowledge

Highlight (Yellow) | Location 2829

All policy talk about foresight, priorities, accountability, etc.<sup>151</sup> is really focussed on 'problem choice'.

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Highlight (Yellow) | Location 2839

the elimination of wasteful effort on seemingly ill-conceived projects is to some extent offset by a concealed epistemic cost. It means that a few wild conjectures never get a chance to show their hidden capabilities, which are just occasionally revolutionary.

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Highlight (Yellow) | Location 2840

the effect of 'collectivizing' problem choice must be to limit the range of variation of research projects.

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Highlight (Yellow) | Location 2841

academic science can be considered an 'evolutionary' process<sup>156</sup>, whose long-run efficacy depends on having a highly diversified stock of variants, as well as a highly selective environment

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Highlight (Yellow) | Location 2847

Accountants and managers regard 'failed research' as totally uneconomic. But 'negative' results are an essential part of any evolutionary process

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Highlight (Yellow) | Location 2848

precisely because every research project is unique, it almost always spins off 'positive' scientific information.

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Highlight (Yellow) | Location 2849

The history of such projects demonstrates the impossibility of deliberately 'constructing' knowledge to suit even the most pressing of human needs

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Highlight (Yellow) | Location 2852

One of the major characteristics of post-academic science [4.11] is this structural convergence between the academic and industrial research traditions<sup>162</sup>.

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Highlight (Yellow) | Location 2857

the epistemic status of the final product is entirely pragmatic [7.3,10.7], and is not meant to be judged by traditional academic standards, which are often very different<sup>165</sup>.

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Highlight (Yellow) | Location 2858

it would be wrong to equate post-academic science with 'commissioned' research, where very detailed questions are set by authorities quite outside or far above the laboratory frame.

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Highlight (Yellow) | Location 2860

it seems that most scientific workers feel satisfied with a reasonable degree of technical autonomy<sup>1</sup> - that is, freedom to take an independent approach to a scientific problem that has only been posed in principle by others.

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Highlight (Yellow) | Location 2864

Mode 2 inhibits the individual exercise of the highest form of scientific 'creativity' - the construction of soluble research problems - by redefining it as a group phenomenon.

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Highlight (Yellow) | Location 2873

post-academic science makes progress by focussing on the regions around specific problems.

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Highlight (Yellow) | Location 2876

this striving for 'local' understanding, without preconceived notions of what might require explaining or be acceptable as an explanation [10.1], may even be more effective in closing the gaps in the knowledge map than a single-minded pursuit of general intellectual unity

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Highlight (Yellow) | Location 2880

difficulties in applying basic principles should always trigger off basic, academic research.

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Highlight (Yellow) | Location 2881

instead of advancing head on against entrenched paradigms or conceptual enigmas [9.5], post-academic science can often be satisfied with reasonably reliable pragmatic solutions to its problems, whether or not these solutions have a broader theoretical basis.

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Highlight (Yellow) | Location 2890

it regards formalized schemes of thought [6.6] less as strengthening skeletons than as potential barriers to understanding.

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Highlight (Yellow) | Location 2893

there is much to be said ethically for spelling out the practical goals of research [7.9] rather than referring vaguely to the material benefits from knowledge produced 'for its own sake'.

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Highlight (Yellow) | Location 2896

The urge to make scientists more 'socially responsible' in their choice of problems may not have the desired effect of producing knowledge that is more likely to be used beneficially<sup>177</sup>.

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Highlight (Yellow) | Location 2901

The actual trend is in the opposite direction. Even the most fundamental fields of academic research have become increasingly specialized, diversified and fragmented

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Highlight (Yellow) | Location 2903

the label 'interdisciplinary' attached to a research centre has come to mean little more than that it is the opposite of 'basic' in its research interests<sup>179</sup>.

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Highlight (Yellow) | Location 2903

Post-academic science is not merely transdisciplinary. It is defiantly post-modern in its phiralisin<sup>80</sup>. It welcomes wide definitions of knowledge, and decentred diversity, without fear of possible inconsistencies.

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Highlight (Yellow) | Location 2905

The knowledge that it produces is not organized around theoretical issues, and is not automatically subject to clear rules of coherence and credibility.

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Highlight (Yellow) | Location 2911

Post-academic science concentrates on reliability in specific applications: is its general reliability seriously compromised by this post-modern pluralism and incoherence?

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Highlight (Yellow) | Location 2914

Socially as well as intellectually, the post-academic scientific world mirrors the confusion and insecurity of the 'post-industrial' socio-economic order<sup>186</sup>.

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Highlight (Yellow) | Location 2915

As the maxim affirms, creativity is usually based on an infinite capacity for 'taking pains' - that is, for undertaking vast amounts of routine work over long periods of time

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Highlight (Yellow) | Location 2919

The problems that activate post-academic science are often deeply rooted in history, and are typically 'owned' by well-established institutions, such as pharmaceutical companies, arms procurement agencies, associations of

engineering and medical practitioners, environmental protection commissions, economic advisory councils, and so on.

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Highlight (Yellow) | Location 2923

`Disciplines' stand for stability and uniformity. `Interdisciplinarity' is a code word for diversity and adaptability.

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Highlight (Yellow) | Location 2927

from a cognitive point of view, `interdisciplinarity' is one of the major sources of mental creativity<sup>193</sup>.

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Highlight (Yellow) | Location 2931

The call for more interdisciplinarity in research is really a plea for more scientific originality! No wonder this call is so difficult to heed.

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Highlight (Yellow) | Location 2932

interdisciplinary research is abnormal [8.6]. It is radical in intention<sup>194</sup>, if not always revolutionary in outcome<sup>195</sup>.

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Highlight (Yellow) | Location 2957

The essential point is that a scientific discovery is not just a validated research finding. It is an unexpected, unforeseen, surprising finding<sup>205</sup>.

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Highlight (Yellow) | Location 2964

Only `facts' can properly be said to have been `discovered', as distinct from `theories', or `models', which are `proposed', or `constructed'

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Highlight (Yellow) | Location 2971

This notional link between discovery and empiricism is thus deeply entrenched in the scientific culture, and cannot be left out of a naturalistic epistemology.

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Highlight (Yellow) | Location 2981

However unexpected it may be at the time, a scientific discovery can be seen as `normal' in its larger context<sup>218</sup>.

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Highlight (Yellow) | Location 2995

there seems little doubt that true serendipity<sup>227</sup> - the accidental discovery of something not sought for - does play a major role in the production of scientific knowledge<sup>228</sup>

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Highlight (Yellow) | Location 3008

it is a matter of some concern that post-academic researchers<sup>234</sup> have much less freedom to undertake relatively modest investigations without formal approval

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Highlight (Yellow) | Location 3014

A scientific theory is essentially a mental construct [8.11]. However closely it may relate to empirical 'facts', it cannot be 'discovered' without at least a pinch of the magic ingredient of 'invention'.

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Highlight (Yellow) | Location 3030

induction is effectively an extension of pattern recognition [5.12, 6.2] into the time dimension.

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Highlight (Yellow) | Location 3034

The process of inductive inference is not 'irrational'<sup>246</sup>. On the contrary, from a naturalistic perspective<sup>247</sup> it stands out as one of the principal pillars of scientific rationality [6.8]. It is a universal human capability, honed by millions of years of biological evolution<sup>248</sup>. By linking theory with experience, it makes a direct epistemic connection between entities in the scientific domain and representative images of the life-world

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Highlight (Yellow) | Location 3048

Inductive generalizations are unaffected by confirmatory instances. On the other hand, a single deviation from the hypothetical pattern obviously renders the whole inference invalid.

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Highlight (Yellow) | Location 3063

Scientific research is rational action under conditions of uncertainty.

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Highlight (Yellow) | Location 3076

it must be said that the very idea of subjective probability is a challenge to rigorous epistemological analysis.

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Highlight (Yellow) | Location 3095

Bayesian reasoning supports a number of more complex principles of scientific inference that are often considered to be purely 'intuitive'<sup>273</sup>.

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Highlight (Yellow) | Location 3110

one of the general characteristics of an academic disciplines is its 'credibility threshold' for hypotheses.

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Highlight (Yellow) | Location 3119

Bayesian reasoning is often the underlying rationale in the choice of problems, the design of projects, the formulation of models, and many other epistemic practices in science.

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Highlight (Yellow) | Location 3123

there is nothing wrong with the conventional notion that predictive verification [5.8] can be just as important as falsification in the production of scientific knowledge<sup>283</sup>.

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Highlight (Yellow) | Location 3124

The psychological effect of a successful prediction<sup>284</sup> is obviously strengthened by the fact that one can rule out any possibility that the hypothesis has been contrived precisely to get the observed result.

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Highlight (Yellow) | Location 3130

the surprising information that valid empirical data can be deduced from a doubtful hypothesis forces us to take that hypothesis much more seriously.

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Highlight (Yellow) | Location 3132

it is argued<sup>286</sup> that a scientist should not even entertain a hypothesis from which it is not possible to deduce an observation that might fail to be confirmed.

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Highlight (Yellow) | Location 3150

Theoretical ideas are considered plausible on the basis of a diversity of tacit, even contrary, criteria. Scientists sometimes try to express their theoretical preferences in terms of 'generality', 'specificity', 'simplicity', 'parsimony', 'complexity', 'rigour', 'flexibility', 'symmetry', 'incongruity', 'communicability', 'subtlety', 'accuracy', 'scope', 'fruitfulness', or just 'elegance'

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Highlight (Yellow) | Location 3153

maxims<sup>306</sup>, rules of thumb, research strategies, methodological principles, phenomenological theories and other informal 'short cuts' in this space<sup>307</sup> are indispensable features of all scientific paradigms<sup>308</sup>.

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Highlight (Yellow) | Location 3168

we have found no reason to think, as is sometimes asserted<sup>318</sup>, that theories involving 'unperceived' entities are the quintessence of science.

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Highlight (Yellow) | Location 3199

Good scientific practice requires that hypothetical entities should not be given more complex properties than are needed for them to operate in the particular theoretical context where they were conceived<sup>337</sup>. As time goes on, however, they are often used in other contexts and acquire a variety of other properties. In this way<sup>338</sup>, they become less and less 'hypothetical' - that is, more and more credible - until, so to speak, we realize that they also are active characters in the narrative.

Highlight (Yellow) | Location 3242

constructivism challenges the Legend by raising the basic question whether scientific knowledge is 'found' or 'made'.

Highlight (Yellow) | Location 3258

For all practical purposes, all the knowledge coming out of science must continue to rely heavily on concepts and techniques made by people as fallible and venal as ourselves.

Highlight (Yellow) | Location 3271

Until the 1960s, metascientific thinking was dominated by the Legend, which depicts all the action in science as 'discovery'.

Highlight (Yellow) | Location 3296

scientists behave like 'mariners who have to rebuild their ship on the high seas, without ever being able to strip it down in dock and construct it afresh from the best available components'.

Highlight (Yellow) | Location 3302

In the structuration of science, however, every researcher must not only integrate the work of their predecessors and rivals into their own<sup>339</sup>. Each such cycle of 'deconstruction' and 'reconstruction' also requires the addition of genuine elements of originality and scepticism. This is all that is needed to turn it into an evolutionary process, giving rise, in due course, to novel epistemic structures which were never 'constructed' as such

Highlight (Yellow) | Location 3307

A naturalistic account of science must surely acknowledge that a great deal of the action is mental: it goes on in the separate minds of individual scientists

Highlight (Yellow) | Location 3314

it turns out that specialists who have built up large repertoires of relevant 'themas'<sup>389</sup> [6.10] are often just as innovative as 'migrants' who bring in new habits of mind and new ideas from other fields<sup>390</sup>.



Highlight (Yellow) | Location 3344

To think creatively, we have to be able to manipulate our thoughts about specific objects, relationships, concepts, people, etc. according to the same rules that those objects, etc. would have to obey `outside our heads'399.

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Highlight (Yellow) | Location 3373

A scientific theory presented in the form of a model is already well formed for reception and manipulation inside the `black box' of the living brain. Even before it is fully incorporated into the public `map' of a scientific domain419, it becomes a tentative part of the private `map' which every scientist carries around `inside their head'.

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Highlight (Yellow) | Location 3385

Expert scientists not only know what is going on in the domain of their research; they also map this domain internally with complex features which are usually quite different from those shown on the official maps430. These features often have previously hidden connections. Not suprisingly, the recognition of such a connection - sometimes below the level of conscious attention - is seen by the outsider as an `inspired guess', or a mental `short cut'.

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Highlight (Yellow) | Location 3393

`Scepticism' is a code word for those features of the scientific culture that curb `originality'.

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Highlight (Yellow) | Location 3402

An empirical fact or theoretical inference cited from a peer-reviewed scientific publication may be presumed to have stood up to at least this degree of expert scrutiny, even though it is not guaranteed to be `true'.

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Highlight (Yellow) | Location 3404

The critical process, being distributed over a whole community, is unsystematic and of variable quality, so that very weak results often slip through the net.

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Highlight (Yellow) | Location 3407

The decision to accept a research claim for publication does not make it immune from further scepticism.

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Highlight (Yellow) | Location 3412

The scientific culture is an institutionalized context for argwnentation15.

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Highlight (Yellow) | Location 3478

`Scientific' entities can only be discussed `scientifically' after they have been `objectified' - that is, taken out of the life-world contexts where they were found, and to which they supposedly refer<sup>82</sup>

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Highlight (Yellow) | Location 3484

a scientific controversy is typically a display of `Bayesian rhetoric'.

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Highlight (Yellow) | Location 3488

In most cases, for example, it is more powerful in attack than in defence. That is why disputing scientists often search diligently for small items of evidence against hypotheses they disagree with, rather than making the larger effort to obtain evidence confirming their own ideas<sup>91</sup>.

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Highlight (Yellow) | Location 3489

Although Bayesian logic does not make any distinction in principle between 'refutation' and `corroboration'<sup>92</sup>, this asymmetry is very evident in the practical rhetoric of scientific controversy.

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Highlight (Yellow) | Location 3492

a disputed knowledge claim should not be considered `scientific' unless it is capable - in principle at least - of being tested to `closure'.

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Highlight (Yellow) | Location 3498

the fundamental inability of science to arrive at complete certainty is a grave social embarrassment. It seems to license people like Creationists to dismiss its most secure findings on the grounds that they are `controversial'.

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Highlight (Yellow) | Location 3502

the demand for closure comes mainly from outside the academic world.

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Highlight (Yellow) | Location 3503

Nobody expects a group of lawyers, politicians, theologians or doctors to have identical expert views. But any outward sign of disagreement amongst scientists is taken as a grave weakness.

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Highlight (Yellow) | Location 3510

The norms of communalism and universalism envisage eventual agreement. But the norm of `organized scepticism', which energizes critical debates, rules out any official procedure for closing them. Consensus and dissensus are thus promoted simultaneously<sup>103</sup>.

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Highlight (Yellow) | Location 3513

Good science is not made by majority verdicts<sup>106</sup>. Discredited claims are never killed: they simply fade away<sup>107</sup>.

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Highlight (Yellow) | Location 3518

The bottom line for the 'truth' of a scientific proposition is its unquestioned acceptance by a research community<sup>113</sup>.

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Highlight (Yellow) | Location 3520

Every working scientist soon discovers that the archival literature is actually full of inconsistencies left over from disputes that were simply abandoned because they could not be argued to a convincing conclusion<sup>15</sup>.

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Highlight (Yellow) | Location 3541

it is not uncommon to find several apparently inconsistent theoretical models peacefully co-existing within the same subdiscipline<sup>123</sup>, not as rivals but as partial representations of distinct aspects of the same whole.

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Highlight (Yellow) | Location 3557

working scientists possess individually a great deal more knowledge of a scientific kind than gets into the official literature

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Highlight (Yellow) | Location 3563

the actual material stored in the archives is extremely heterogeneous in style and substance. In particular, the research findings claimed in the primary literature are of varying credibility [8.11]. This cannot be determined from the way they are presented.

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Highlight (Yellow) | Location 3566

specialist expertise is required to assess its credibility in the light of what is currently believed<sup>145</sup>.

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Highlight (Yellow) | Location 3574

'Expository science'<sup>150</sup> has a range of societal functions, from solemnly advising governments to lightly entertaining the general public.

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Highlight (Yellow) | Location 3579

research specialists often find they can only communicate with one another across disciplinary frontiers in an informal 'expository' mode<sup>152</sup>.

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Highlight (Yellow) | Location 3584

Research scientists must not only contribute all their findings to the communal store but also draw from it all the scientific knowledge they use in their research.

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Highlight (Yellow) | Location 3587

A show of humble deference to past achievements - and especially to eminent achievers - also enlists moral support for new claims.

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Highlight (Yellow) | Location 3590

it shows that the measure of the credibility of an item of scientific knowledge is its actual use in scientific practice

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Highlight (Yellow) | Location 3596

by linking the scientific literature backwards and forwards in time, citations make indirect connections between all the antecedents of a discovery, and also between all its consequences.

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Highlight (Yellow) | Location 3601

The essential point is that the scientific archives have this intrinsic textual structure that parallels the epistemic structure of the knowledge they contain.

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Highlight (Yellow) | Location 3607

The role of the secondary literature [3.3] is to set out the common features of these snaps and to suggest how discrepancies might be reconciled - or, very often, conveniently ignored.

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Highlight (Yellow) | Location 3609

Synoptic texts by responsible scholars are extensively cited by researchers, and are as vital to the scientific culture as primary research reports. And yet their production is not directly fostered by the academic ethos. In the natural sciences, wide-ranging review articles and monographs are valued as communal resources, but are not counted as 'original' contributions to knowledge.

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Highlight (Yellow) | Location 3612

It is rare for a research scientist to get to know enough, outside a very narrow field, to understand and write about a wider area from first-hand knowledge. And suppose that she has gone outside her acknowledged sphere of expertise, what 'peers' are there to review her work, except nit-picking specialists in those other fields into which she has foolishly ventured? There is very little career incentive to spend years on a project which is likely to expose one to damaging criticism and loss of personal academic credibility.

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Highlight (Yellow) | Location 3618

synoptic writing involves a great many personal choices, construals and simplifications which are not indicated clearly to the reader, and whose subjectivity is irreducible.

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Highlight (Yellow) | Location 3631

Even in the most traditional non-literate society, this 'map' is usually so much the same from individual to individual that it can be treated as a cultural invariant. But as anthropologists have amply demonstrated<sup>169</sup>, it does vary markedly from society to society

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Highlight (Yellow) | Location 3654

More pragmatically, the formal archives are no more than repositories for the research findings accepted as publishable by research communities.

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Highlight (Yellow) | Location 3667

the formal research record is full of erroneous 'findings', even about easily reproducible 'facts'<sup>186</sup>.

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Highlight (Yellow) | Location 3675

The scientific culture depends fundamentally on personal honesty and mutual trust

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Highlight (Yellow) | Location 3700

The whole argument of this book is that there is no way of ensuring that we have 'got things right' scientifically

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Highlight (Yellow) | Location 3721

An unexplained event can be tolerated and even valued as an 'anomaly'

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Highlight (Yellow) | Location 3726

But research communities tend to ignore an idiosyncratic conjecture<sup>219</sup> - until it is later honoured with a Nobel Prize.

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Highlight (Yellow) | Location 3727

such conjectures usually come from 'low status' scientists who reckon they have no reputation to lose, or else from those whose name is already so big that they can risk putting it on the line for a weird idea<sup>220</sup>.

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Highlight (Yellow) | Location 3744

an open mind towards the 'impossible' is an essential feature of the 'scientific attitude'<sup>235</sup>.

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Highlight (Yellow) | Location 3749

the distinctive features of parascience are social and psychological rather than epistemic.

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Highlight (Yellow) | Location 3760

Much `new' science may well be little more than a minor modification of what was previously known<sup>246</sup>.

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Highlight (Yellow) | Location 3761

the relentless barrage of `original' research claims is only partially offset by `sceptical' rejections, revisions, refutations and deletions.

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Highlight (Yellow) | Location 3773

The essence of the Mertonian scheme is that it postulates no `long-range' forces. Its norms operate almost entirely on a microsociolog- ical scale.

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Highlight (Yellow) | Location 3815

The norms of `origi- nality', `scepticism' and `communalism' are put into operation as processes of `Variation', `Selection' and `Retention' respectively.

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Highlight (Yellow) | Location 3823

they depict genuine episodes of epistemic change that are much more diverse and complex than can adequately be covered by the general term `revolution'<sup>282</sup>.

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Highlight (Yellow) | Location 3858

The neo-Darwinian model of modern evolutionary biology is only one of several bio-organic `selectionist' systems, including the immune and neural systems of animals<sup>298</sup>, each of which operates along different lines.

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Highlight (Yellow) | Location 3865

cultural evolution is not `Darwinian' but `Lamarckian':

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Highlight (Yellow) | Location 3880

A horde of relatively `blind' variants may hit on a solution that would be missed in a narrowly focussed search, even though very wasteful of resources in those variants that fail.

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Highlight (Yellow) | Location 3932

The question whether scientific progress has a 'natural' direction is either trivial, or much more obscure than it sometimes seems<sup>333</sup>.

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Highlight (Yellow) | Location 3942

Paradoxically, post-academic science could become so obsessed with accountability, performance monitoring, contractual scrutiny and other forms of 'quality control'<sup>336</sup> that it sacrifices the quality of the procedures themselves to their sheer quantity.

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Highlight (Yellow) | Location 3944

Quality control is then made to rely on surrogate indicators of performance, whose legitimacy may well be questioned on scientific grounds.

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Highlight (Yellow) | Location 3945

Mode 2 downplays the role of systematic intellectual criticism, which is the key to the validity of academic science.

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Highlight (Yellow) | Location 3946

in fundamental research, organized scepticism is the only real protection against the embodiment of serious errors in the knowledge that is produced. Perhaps a higher level of cognitive insecurity is a price that will have to be paid as post-academic science becomes more entangled with 'trans-epistemic' issues, involving societal, environmental and humanistic values.

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Highlight (Yellow) | Location 3975

At their best, however, scientific 'maps' [6.4, 6.5] are self-consistent, empirically reliable, effectively consensual, and well adapted for mental manipulation.

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Highlight (Yellow) | Location 3978

It sometimes seems as if only explanatory modes of understanding are to be considered truly scientific.

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Highlight (Yellow) | Location 3986

A disconnected 'fact', an anomalous phenomenon or a singular entity has no secure place in 'World 3' [9.3]. Somehow, it has to be joined up consistently - ideally by a feedback loop from consequences to causes - with what we already know, or suspect, or uncertainly infer<sup>8</sup>.

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Highlight (Yellow) | Location 4066

`Common sense' has many `unscientific' characteristics simply because it does not have to observe the CUDOS norms.

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Highlight (Yellow) | Location 4116

The cultural differences lovingly studied by anthropologists tend to conceal the degree to which all people have to be intellectually and emotionally alike to perform all the elementary interpersonal operations of social life - communicating, collaborating, mating, caring and so on<sup>73</sup>.

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Highlight (Yellow) | Location 4145

Any generalization about a particular type of social entity cannot be considered knowledge - even life-world knowledge - without an indication of its cultural scope.

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Highlight (Yellow) | Location 4196

As scientists, we can never possibly know everything, but we can at least get to know something about such difficult but fascinating matters.

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Highlight (Yellow) | Location 4199

To be rational at all one must have beliefs and be ready to act on them - however misconceived they may be.

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Highlight (Yellow) | Location 4213

The human mind is capable of sustaining complex belief systems, which are not closely coupled with on-going life-world action but which people need to obtain the straws of guidance or crumbs of comfort required to go on acting rationally in the face of the un- expected<sup>121</sup>.

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Highlight (Yellow) | Location 4239

It is notorious that the century-long labours of whole colleges of theologians tend rather to fragment than to consolidate their respective doctrines.

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Highlight (Yellow) | Location 4252

science has developed many of the institutional features of an established church<sup>129</sup>.

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Highlight (Yellow) | Location 4260

the relatively recent notion that `science' and `religion' are so different as to be incompat- ible<sup>133</sup> plays down the diversity and discord on each side of the divide.

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Highlight (Yellow) | Location 4263

Science is devoted to doubt, discovery and epistemic change [9.6], whereas religion emphasizes faith, revelation and orthodoxy.

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Highlight (Yellow) | Location 4282

the scientific culture supports a distinctive system of beliefs, but this is not privileged above, sharply differentiated from, or completely incommensurable with, the belief systems current in other cultural contexts<sup>143</sup>.

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Highlight (Yellow) | Location 4305

the cognitive norms that have to be satisfied - accuracy, specificity, reproducibility, generality, coherence, consistency, rigour, and so on - are all perfectly commonsensical: but they are seldom applied simultaneously outside science<sup>158</sup>.

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Highlight (Yellow) | Location 4307

`facts' [ch.5] really only acquire scientific significance through their connections with `theories'

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Highlight (Yellow) | Location 4317

What counts as `common sense' cannot be separated from commonly held belief systems of much wider scope<sup>162</sup>, even when these are in direct conflict with scientific beliefs of similar scope.

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Highlight (Yellow) | Location 4335

when we contrast a scientific belief with `common sense' we are indicating that we think we could define it precisely and give some coherent account of why it should be relied on, rather than just `taking it for granted' as an undeniable truth<sup>169</sup>.

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Highlight (Yellow) | Location 4339

In a naturalistic perspective, however, scientific realism signifies belief in public invariants. It implies that some of the features on the mental `maps' on which we individually base our actions are cognitively objective<sup>172</sup>. That is to say [7.9], they are not only shared in the thoughts of other people, but are also not affected by our (or anybody's) actions, perceptions or thoughts<sup>173</sup>.

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Highlight (Yellow) | Location 4342

The `reality' of this world is not something that we infer about it: it is an inseparable characteristic of our developing knowledge of it, as persons, as communities, and as an evolving species of conscious beings

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Highlight (Yellow) | Location 4346

For most people, reliable, well-tested scientific knowledge is the acme of `reality'.

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Highlight (Yellow) | Location 4359

This pragmatism<sup>181</sup>, often reduced puritanically to technological instrn- ,nentalism<sup>182</sup>, is so deeply engrained in the scientific culture that it is the `natural attitude' there.

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Highlight (Yellow) | Location 4378

It may have too much collective credibility to be wished away by any single individual, but it does not exist independently of human thoughts, perceptions, words, actions, values and dreams<sup>193</sup>.

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Highlight (Yellow) | Location 4384

It is abundantly clear that a generally realist orientation is basic to all the paradigms of rationality embodied in the scientific culture<sup>201</sup>.

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Highlight (Yellow) | Location 4399

it is a joint product of `nature' and `society', and like all scientific knowledge slowly evolves through its own inner dynamic.

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Highlight (Yellow) | Location 4404

The challenge to general philosophy is not to show how scientific realism differs fundamentally from, or negates, life-world realism but to investigate the close relationships between them<sup>210</sup>.

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Highlight (Yellow) | Location 4407

What is more, a scientific `map' can always be analysed more and more precisely, and traced further and further back into wider networks of representation. Post-academic science will be enlarged and enriched by this process of deconstruction - typically towards greater generality and abstraction.

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Highlight (Yellow) | Location 4409

But `Mode 2' research [4.8, 7.9] will also be more deeply rooted than Mode 1 in problems arising in life-world contexts of applica- tion<sup>213</sup>, where purely pragmatic reliability [7.3] is the principal criterion of validity.

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Highlight (Yellow) | Location 4414

the norms of communalism and universalism encourage research into all intersubjectively accessible aspects of the world, and the elimination of all apparent inconsistencies between the various ways in which they are represented<sup>218</sup>.

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Highlight (Yellow) | Location 4418

The projects, procedures, instruments, epistemic criteria and putative discoveries of specialized research communities are not coordinated in advance<sup>222</sup>, are often incompatible<sup>223</sup>, and are only rendered partially coherent by later social structuration and codification.

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Highlight (Yellow) | Location 4438

A 'systems analysis' of the natural world [6.9] can never be better than an approximation<sup>237</sup>.

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Highlight (Yellow) | Location 4486

Academic science, the spearhead of modernism, is pre-modern in its cultural practices [4.11]: and yet it turns out to be post-modern in its epistemology.

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Highlight (Yellow) | Location 4493

one of the defining characteristics of post-modernism is that it cannot be defined! It is not an '-ism', but a trenchant critique of all '-isms'.

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Highlight (Yellow) | Location 4499

By first building up a sociological model of science, we have been able to explicate its real philosophy.

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Highlight (Yellow) | Location 4520

By renouncing all transcendental pretensions to authority, and presenting science as an epistemic institution trading publicly in credibility and criticism, we establish a stable place for it in our culture.

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Highlight (Yellow) | Location 4527

In its post-academic mode, science can no longer evade all social responsibility by pretending that the production of universally valid, value-neutral knowledge is its only goal and only achievement

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Highlight (Yellow) | Location 4532

Bureaucratic 'modernism' presumes that research can be directed by policy. But policy prejudice against 'thinking the unthinkable' aborts the emergence of the unimaginable

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Highlight (Yellow) | Location 4537

post-academic scientists still formulate and try to solve practical and conceptual problems on the basis of their shared belief in an intelligibly regular, not disjoint, world outside themselves.

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