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5 The truth will out

Throughout the preceding chapters we have emphasised the variability of scientists' discourse. So far, however, we have not considered how, despite the marked degree of interpretative variation, scientists manage to maintain an adequate appearance of consistency. How is it that they manage to proceed without constantly generating apparent contradictions? Let us take this question as our point of departure in the present chapter. In order to make it more concrete and, therefore, more amenable to a clear empirically-based answer, let us reformulate the question in terms of the two interpretative repertoires identified above. Thus the question becomes: 'If scientists regularly draw upon and move between two quite different repertoires, how is it that potential contradictions between these repertoires do not require constant attention?'

As we saw in chapter three, when the repertoires *are* brought together by scientists, they tend to be treated as distinct and as incompatible. For example, we observed in that chapter how scientists, when discussing their own papers informally, sometimes noticed that the accounts they gave of laboratory practice in research reports were significantly different from the accounts they gave in interviews and we examined the attempts of two respondents to explain what they took to be inconsistencies between the two kinds of account. Thus we showed in chapter three that the juxtaposition of accounts involving the two repertoires does tend to generate interpretative work which focuses on potential incompatibilities. But we also showed that the contingent repertoire is largely excluded from the formal research literature and that, by implication, this contextual segregation of the empiricist repertoire serves to reduce the frequency of potential interpretative contradictions.

In informal talk, however, both the repertoires are regularly employed and the likelihood of interpretative inconsistency is accordingly increased. But even within informal talk there is a tendency for speakers to keep their use of the two repertoires separate. Informal talk proceeds with great rapidity and a pause of as little as a second is typically noticed as a significant hesitation.¹ Hence, the time lapse between different versions of action does not have to be particularly long for them to be heard as

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separate within ordinary conversation. Nevertheless, scientists' two interpretative repertoires are sometimes intimately combined during informal discourse. We have seen an example of this in the case of accounting for error. However, interpretative inconsistency is avoided there by the very structure of the account, each repertoire being applied systematically to distinct categories of action and belief.

These observations seem to imply that interpretative inconsistency may not be such a pervasive problem as might initially have been imagined. The structural features of informal discourse contribute to the meaning of its components in particular passages and tend to reduce the likelihood that closely juxtaposed elements will be heard as irreconcilable. Moreover, as we stressed in chapter four, the very flexibility of much informal discourse helps speakers to cope with the potential contradictions generated in their own speech. However, the preservation of consistency is not an automatic process; nor is it an inevitable outcome of participants'

interpretative work. Indeed, our discussion so far enables us to identify the precise kind of situation in which interpretative consistency is most at risk. It will be most at risk in situations where, as in accounting for error, the two repertoires are closely combined in one continuous passage, but where, unlike accounting for error, both repertoires are applied to the same events or to the same class of events.

In the light of our prior analysis, we would undoubtedly expect scientists to experience some kind of interpretative difficulty in circumstances of this kind. Yet, given the flexibility of everyday interpretative resources, we would not expect them to find these difficulties insuperable. What we would expect, and what in fact we find, is that when the two repertoires occur together in the course of ordinary talk, other than that of accounting for error, their potential incompatibility is often signalled by, as well as being resolved by, a specific interpretative pattern or device. We call this the 'truth will out device' (TWOD). In the rest of this chapter, we will concentrate on the TWOD. Our aim will be to show that our form of analysis and our earlier analytical conclusions can be extended in a way which improves our understanding of some of the fine detail of discourse in science. We suggest that the kind of data to be examined below would have no significance for other approaches at present available in the sociology of science. Although these approaches rely on scientists' discourse as the basis for their own analytical claims, they provide little in the way of detailed insight into the organised character of the discourse.

The TWOD is by no means such a recurrent device as asymmetrical accounting for error. Whereas the latter occurs more than 60 times in 34 transcripts, we have at present only ten cases of the TWOD. Nevertheless, the pattern is systematic and strongly linked to the coming together of the

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two interpretative repertoires. In the following sections we will examine in detail three instances of the 'truth will out device', and a fourth closely similar pattern. We expect that the TWOD will be one of a family of 'reconciliation devices' arising from scientists' movement between interpretative perspectives. We hope that its identification, as well as strengthening and extending the conclusions presented in previous chapters, will stimulate other researchers to look at their data with the possibility of such devices in mind. Because we are going to examine our material in greater detail than in earlier chapters, we have numbered the sentences in each quotation for ease of reference.

An example of the 'truth will out device'

The following quotation from an interview transcript illustrates clearly how the TWOD, which is formulated succinctly in the final sentence, is used to resolve interpretative difficulties arising from the speaker's use of a contingent as well as an empiricist repertoire. Before this passage the scientist concerned had been talking about his own and other people's adoption of the chemiosmotic hypothesis. He talked exclusively of the theory's capacity to make consistent sense of experimental evidence. He was then asked whether there were any general criteria which could be used in choosing between theories. He begins his answer by citing a criterion which, he

says, was favoured by the originator of the chemiosmotic theory.

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1 Spencer was always very fond of Occam's Razor and that's as good a starting-point as any, I think. 2 If you can get away with a few hypotheses, then it's useless having more. 3 It's not a guarantee of being right, of course. 4 Well, I think in the long run it *is* a guarantee of being right, in the sense that if you add everything together it's really the only basis for believing a hypothesis. 5 In fact, when you're struggling with a compendium of facts and personalities, it's a useful thing to bear in mind certainly. 6 But I think it would be dishonest to say that that's how it actually works. 7 One grows very much aware of science as a *social* system, especially in this area where things have never been very clear-cut and where there have always been areas in which the evidence itself was conflicting. 8 To quite a large extent, one's based the path one has followed as much on intuition, that is, a feeling that it's right, which obviously is only useful if you've got a pretty large body of working evidence mulling around in your head at the time. 9 So intuition based on experience and, secondly, on one's feeling for the honesty and capacity of one's colleagues. 10 I think that's a very important thing, which is very often unsaid in science, but I'm sure plays a very important determining

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role in the progress of ideas. 11 I know it's so in scientific meetings. 12 People will pay attention to some people and not to others. 13 And sometimes it's a very false sort of thing, because it also has mixed up in it the whole thing of charisma and how nice a person is rather than how competent they are. 14 So it's a somewhat unreliable guide, but I'm sure it plays an important part in determining the course of events. [Pause] 15 I think *ultimately* that science is so structured that none of those things are important and that what is important is scientific facts themselves, what comes out at the end. [Richardson, 12]

The speaker's use of an empiricist repertoire for talking about theory-choice largely precedes this passage. However, in this quotation, he begins in traditional fashion with Occam's notion of the right theory being the one which rationalises the evidence most economically. But then he wavers. Contradictory statements are proposed as to whether or not this criterion is a *guarantee* of being scientifically correct. He first of all says that of *course* it cannot be a guarantee. He then reverses this opinion and claims that in *the* long run it *is* a guarantee. This reference to 'the long run' prefigures his eventual use of temporality in the TWOD. However, at this juncture he does not develop the idea further. He returns to a conception of a scientist trying to choose between theories at one point in time, and once again he revises his prior statements about the certainty provided by Occam's Razor. In this third attempt to say how it operates, he ends up with a very weak formulation indeed. The principle of economy becomes merely something to 'bear in mind' when one is 'struggling with a compendium of facts and personalities' (5A5).

He then says that 'it would be dishonest to say that that's how it actually works' (5A6). It is unclear which of his previous claims is being modified here. It seems unlikely, however, to be his third interpretation of Occam's Razor, which could hardly be weakened any further (5A5).

Thus this sentence (5A6) seems to be an additional statement designed to correct his strong assertion that Occam's principle is a guarantee of truth (5A1-2). What we find, then, in the first six sentences of this passage is an oscillation between strong and weak assertions about the certainty furnished by a major criterion for assessing scientific theories. This opening sequence ends with the strong claim having apparently been abandoned and with the suggestion that the establishment of scientific knowledge involves the assessment of researchers' personalities as well as the explanation of biochemical facts. In terms of our analytical categories, this sequence shows the speaker moving hesitantly away from an empiricist conception of scientific action and belief, according to which relative certainty and factual substantiation are the dominant features of scientific knowledge, towards a more uncertain, contingent perspective, in which social and

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personal factors are allowed to have a significant influence on scientific thought.

Sentence 7 begins to develop a strongly contingent account of how science in general works, but this is immediately qualified by reference to the special experimental conditions found in bioenergetics (5A7). Nevertheless, he does appear to generalise his point to include to some degree the whole of science. The following sentence is also organised in terms of a strongly contingent assertion being modified by an empiricist qualification. The speaker begins by stressing that he has had to base his scientific judgements on such uncertain and idiosyncratic elements as feeling and intuition, but he then reintroduces the notion of experimental evidence and continues by emphasising that even intuition can be based on experience (5A8). Thus both sentences 7 and 8 begin with what looks like a strongly contingent assertion, which is immediately qualified by making the operation of the contingent factor to some unspecified degree dependent on experimental evidence.

In sentences 9 to 14, however, the speaker identifies a strongly contingent element, namely, judgements about honesty, capacity and charisma, which he says play an important role in determining the progress of ideas. This is the most sustained, purely contingent sequence in the whole passage. Furthermore, it does not explicitly refer to the possibly special case of bioenergetics. The speaker seems to be offering a contingent account of scientific action and belief in general which, he says twice, he is sure is correct. This sequence, unlike previous references to contingent factors, is not internally qualified.

It is immediately after this sequence that the speaker introduces the truth will out device'. What this device does is to reintroduce the time element, which had been briefly mentioned in sentence 4. All that has been said before is now to be seen in terms of a temporal development. Gradually, it is implied, the realities of the physical world will be recognised; and idiosyncratic, social, distorting influences will consequently be seen as such (5A15). The speaker's statements about the importance of contingent influences on scientific thought are not withdrawn. Social factors, personal judgements, intuition, charisma and so on are all allowed to play a part in science. But only in the short run. In the long run, it is scientific *facts* which are important. Thus the TWOD resolves any apparent contradiction between the speaker's constant reference previously to experimental evidence as the sole basis for theory-choice and his subsequent account of contingent factors, by separating the empiricist from the contingent elements over time. Both his empiricist and his contingent statements can now be taken as correct because, it is now implied, they referred all along to different phases of

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scientific development. Although empiricist factors are depicted as operating throughout the temporal sequence during which scientific knowledge is produced, they are treated as becoming increasingly effective over time. In contrast, contingent factors are portrayed as being influential initially, but as dropping away over time. The TWOD thus enables the speaker to re-establish an interpretative disjunction between the two repertoires after they have been intimately combined in one conversational passage.

In the full transcript, the use of the TWOD is followed by a partial change of topic. The speaker does not enlarge further on exactly how contingent factors are eliminated or how facts come finally to assert themselves. There is no attempt to specify the structure of science mentioned in sentence 15, which ensures that the truth *will* out. Instead, the speaker goes on to consider what *might* have happened if Spencer's theory had actually been introduced by a scientist already eminent in the field, rather than by an outsider'. He suggests that it would have been accepted much more rapidly. Thus once the TWOD has been asserted in this sequence, but in no way substantiated, it seems to be taken for granted in formulating the story which follows. It is assumed, for instance, that the same theory would have succeeded in the end. There is no consideration of the possibility that this other scientist might have developed 'the theory' differently and might have used his social position to gain its acceptance. Social and personal factors are no longer treated as playing 'a very important determining role in the progress of ideas'. The introduction of the TWOD enables the speaker to present these contingent elements as if they had merely a minor accelerating or retarding effect on the acceptance of the one truth. Clearly, not only does the TWOD resolve potential contradictions between the empiricist and contingent repertoires, but at least in this instance it works to re-establish the primacy of the empiricist perspective and to confirm the inevitable predominance of the speaker's own theoretical (in this case, chemiosmotic) views.

The TWOD as an interpretative accomplishment

So far we have referred to the 'truth will out *device*', even though we have given only one example. In order to deserve the term 'device', this pattern of interpretation needs to occur regularly, to be closely similar in its internal construction on different occasions of use and to be a response to an identifiable interpretative context. Let us look at another passage from a different transcript in order to begin to show that these requirements are satisfied. This quotation is taken from the very end of the interview, when the interviewers asked a final, open-ended question.

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Interviewer: 1 I think that's all. 2 Perhaps we could ask one further question. 3 Are there any things which you think are important about this field, but which we haven't

touched on?

Barton: 4 Yes, you haven't touched on personalities *very* much. 5 Spencer and so on. 6 I'm not sure I want to talk about them. 7 But I think they *have* contributed.

Interviewer: 8 Would you say something general without naming names?

Barton: 9 The thing of which I'm well aware is that the attitude that Mulhern took to anything Burrige published, which was of severe, critical, bitter opposition. 10 He didn't like him. 11 His bitterness has disadvantaged he, Mulhern, enormously. 12 Because it meant that other people distrusted his judgement. 13 And there have been occasions when people have said 'Oh, him' instead of 'oh, that.' 14 Sometimes people have been out to prove that somebody else is wrong, rather than [*unclear*]. 15 But I think that inevitably things were seen in that way. 16 I've seen other fields where things have been much more bitter. 17 But science generally does progress very well and objectively, despite the subjective element. 18 I think there *is* a subjective element.

Interviewer: 19 Do you have any idea how this personal element gets eliminated?

Barton: 20 Only because a sufficient number of experimenters try to make the position clear. 21 If other people are interested enough, if it's important enough, then the work will be done again or, more likely, its ramifications will be pursued. 22 Predictions will be followed up, more experiments done, and in the fullness of time a much clearer position will become apparent. 23 Just as happened with the chemiosmotic theory. 24 And then, any personal rivalry will be seen for what it was, in relation to the facts, as they become more fully established.

Interviewer: 25 So the experimental evidence . . .

Barton: 26 At the end of the day solves everything [*general laughter*].

Interviewer: 27 Overwhelms these private antagonisms.

Barton: 28 That's right. [62-3]

Once again, we have not quoted the extended sequences in which this scientist talked exclusively within an empiricist repertoire. As with almost all our respondents, this happened repeatedly throughout the interview. Indeed, this speaker takes as his point of departure, in sentences 4 to 6, the relative absence of prior references to the contingent factor of 'personalities'. He identifies 'personalities' as something which has contributed to the field in some, as yet unspecified way, which he *could* talk about, but which he would prefer not to talk about. He seems to imply that unless the interviewers do come to appreciate the part played by personalities, they will not fully understand the nature of the field (5B6). The speaker is

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drawing attention here to phenomena which are important for participants, which exist for participants only in so far as they are constituted through use of the contingent repertoire and which can only be described and understood in terms of that repertoire.

Like the speaker in quotation 5A, this scientist hesitates at the outset. He has to be encouraged by the interviewer's sentence 8 before he begins to deal concretely with the impact of personalities. Then, despite having been invited to speak in general terms, he starts to talk about the supposed strong personal antagonisms of particular scientists. These specific statements lead to a series of increasingly strong and general assertions. Personal bitterness is said to have influenced scientists' knowledge-claims (5B9-10). This is taken to be inevitable; that is,

presumably, it is an endemic feature of science (5B 15). Moreover, personality clashes in other fields are said to have been much worse. Bioenergetics, it seems, is by no means a special case (5B16). Thus, in the course of a few sentences employing the contingent repertoire, Barton seems to have come close to undermining the basic assumptions of much of his previous discourse. However, his strongest contingent claim in sentence 16 is immediately followed by a reaffirmation of the empiricist position and by a reference to temporality (5B17). The sequence then ends with a return to the topic of contingent factors. We are told that his references to subjective factors are justified, but that their existence is in no way inconsistent with the objective progress of science (5B18).

At this point, the TWOD has been strongly implied, but not clearly expressed. The interviewer then replies by adopting the respondent's perspective and by asking for further clarification. He takes over the notion of a progressive move towards the truth from sentence 17, develops this in terms of the elimination over time of personal influences, but poses a question for Barton by treating the details of his empiricist assertions as insufficiently explicated (5B19). Unlike the speaker in 5A, this scientist is now obliged to do more than furnish a simple version of the TWOD. For this has effectively been accomplished already through the interaction of interviewer and respondent in sentences 17 to 19. Consequently, he responds in sentences 20 to 22 by describing succinctly how reliable experimental evidence is actually established. He then refers back to the case of the chemiosmotic theory and makes it clear that the effects of the personal antagonisms he had just described did not prevent the eventual adoption of the right theory in this case. Finally, in sentence 24, he produces a clear general formulation of the TWOD and, with some prompting from the interviewer, he extends this version to make it so all-embracing that it provokes outright laughter from all concerned (5B26).

In quotations 5A and 5B, we can see clearly that both scientists are faced

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with a similar interpretative problem. They have both made extensive use of an empiricist repertoire in describing what goes on in science. They both spontaneously, albeit rather hesitantly, begin talking about the importance of contingent factors in such a way that, despite their continual reservations, scientists' actions and judgements come to appear rather uncertain and arbitrary. They both then deal with possible contradictions between their two kinds of statements by offering very similar formulations, according to which empiricist and contingent elements become separated out over time. 'I think *ultimately* that science is so structured that none of these [personal] things are important and what is important is scientific facts themselves, what comes out at the end.' 'In the fullness of time a much clearer position will become apparent . . . and then, any personal rivalry will be seen for what it was, in relation to the facts, as they become more fully established.'

The TWOD from quotation SB is particularly interesting, because it suggests that personal rivalry, and presumably contingent factors generally, are actually identified as such by reference to the supposed scientific facts. Thus the speaker takes for granted that his recognition over time of certain scientific claims as factual and of others as non-factual enables him to discern how personal factors are inferred from what the speaker takes to be the degree of correctness of the claim. We have, of course, observed this phenomenon before in the construction of accounts of error. If this is generally the case, if scientists' accounts are normally constructed in this way, the

separation of contingent and empiricist factors, which scientists present as an observable feature in the social world of science, is, rather, a necessary consequence of their methods for constructing accounts of that social world. If each speaker identifies personal and social influences as always or almost always leading to false claims and to incorrect observations, and if he treats what he now takes to be correct claims as free of such influences, it will follow *necessarily* that currently known facts will appear to have been independent all along of personal and social influences. For contingent factors are by definition, or more correctly by interpretative procedure, those which are associated with false belief and error, and which therefore can have had no impact on what is at present known to be true. In contrast, those actions and judgements which are associated with 'the facts' will now appear, *because* of their link with 'the facts', to have been non-contingent, that is, to have been an unbiased recording of the realities of biochemical phenomena.

It is reasonable to suggest, then, that the temporal separation of empiricist from contingent factors in the TWOD is an interpretative accomplishment on the part of the speakers and not an aspect of scientists' experimental and theoretical actions themselves. This conclusion is more

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than an analytical suggestion derived from one turn of phrase in a single TWOD. For it also follows directly from our analysis of accounting for error in the previous chapter and from what we referred to there as the fundamental principle of social accounting in science. In other words, we are suggesting that the TWOD is another device which scientists use to construct and sustain interpretations of their social world that are consistent with empiricist formulations of their own scientific views.

It is clear that the TWODs examined so far have been constructed from an empiricist perspective. That the facts, in due course, speak for themselves and are in some way independent of personal and social factors seems to be taken for granted in each TWOD. It seems to be assumed that some facts at least can be distinguished from non-facts in an unequivocal way at certain points in time. This is implied in the claim that over time a clearer and clearer picture emerges, making possible the gradual identification and elimination of contingent influences. Moreover, it also seems to be assumed that contingent influences tend to distort scientists' conclusions and to lead to scientific error. Thus TWODs enable speakers to re-establish an empiricist basis for their talk because the organisation of TWODs takes for granted an empiricist position.

It is notable that the TWODs in our material tend to occur at the end of a speaker's conversational turn or to be immediately followed by a change of topic (seven instances at the ends of turn, one followed by a change of topic, and two others). Speakers do not normally proceed to elaborate them further. TWODs are a powerful reconciliation device because they re-state the self-evident in an appropriate fashion. TWODs enable the speaker to reaffirm the scientific legitimacy of his position where this has been put in question by his own speech. They do this by making the association between contingency and false belief a matter of interpretative fiat, by separating contingent and empiricist elements over time, and by reasserting the eventual dominance of the speaker's own empiricist formulations.

Temporality as an interpretative device

Let us examine another passage of interview transcript in order to see how far our conclusions so far are confirmed and in order to explore further the structure of the TWOD.

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Hawkins: 1 I think [science] could do with a great deal fewer theories, much less determinedly expounded theories. 2 If you look in the literature right now, you can easily see where much space is devoted to each person trying to defend their particular theory or their particular

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mechanism, rather than to the experiments to show that they've got [*unclear*]. 3 I think you'd find that immediately in the journals. 4 There's an enormous number of papers published that say nothing more than 'My theory is great and here's the reason.' 5 And what good do they do? Very, very little. 6 If the theory's right, don't worry. It'll have its day. 7 If it's wrong, then you're kidding yourself and everybody else in the process and making it difficult to do good science.

Interviewer: 8 Do you think that, in this field, your views are somewhat unusual? 9 Because there *has* been, appears to have been, a lot of controversy and discussion of theories?

Hawkins: 10 Oh, well I would say that they spend a very inordinate amount of their time on theories and much too little doing experiments. 11 One fairly good evidence of that, since you're doing this you should make a quick survey of the number of meetings held per year, by the people in this field and the list of people who attend them. 12 You would find that the same group of people talk to each other fifteen times a year at various meetings. 13 I *know* they're not saying anything intelligent fifteen times a year that they couldn't tell each other once a year much more effectively. 14 So what are they doing for the rest of the time? 15 Well, the answer is they're playing politics and they're talking theories. 16 One-upmanship and so forth. 17 They're not, it doesn't [*unclear*].

Interviewer: 18 This raises an interesting question. 19 If a field is like that, can you assume that the *right* theory, observationally based theory, is going to win out in the long run?

Hawkins: 20 In the long run, yes. It may not be very soon. 21 You see, facts in the long [run], there is one thing about science, there's no way to avoid the facts for ever. 22 Eventually, whatever theories exist, they will evolve to whatever is something that will fit. 23 So you see a situation in which they may swing completely. 24 You may have one year and you can say 90 per cent of the people are in chemical coupling. 25 That was not too long back. 26 Now you can say they are 90 per cent chemiosmotic. 27 Well that doesn't mean that one or the other was right, or anything of the sort. 28 But time will tell. 29 Because eventually data will be generated. 30 I think it merely slows down the process. 31 But I have great faith, in fact, that *eventually* we will know what's going on and that's all the question really is. [12-13]

This quotation from Hawkins' transcript follows an extended and forceful exposition of the empiricist position as a scientific ideal. The speaker condemns *all* the available theories in the area for being too far removed from the facts. In addition, theories are criticised for leading to improper experimental design. He suggests that the existing theories only *appear* to be supported by the evidence because experimenters have been unable or unwilling to separate their actual data from the speculative

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theoretical notions to which they are committed. He continues this theme in the opening sentences of the quoted passage, applying it here to science in general. He maintains that a great deal of the scientific literature is taken up by self-interested and speculative claims which are not properly grounded in experimental evidence (5C2-4). He suggests in sentences 5 and 7 that this work is not contributing to genuine scientific knowledge. Theories are presented as being proposed and accepted for scientifically improper reasons.

The general message of this passage, then, is that much of what passes for scientific knowledge is merely contingent and incorrect. However, this negative evaluation is to some extent countered by sentence 6: 'If the theory's right, don't worry. It'll have its day.' This is a very condensed formulation of the TWOD. It introduces the temporal perspective and it guarantees that the unhappy state of affairs he has been describing cannot continue indefinitely. By means of this remark (5C6), the speaker justifies his own insistence on refusing to engage in what he treats as premature theoretical work. Although many others in his field concentrate on unprofitable speculation, it is his approach of focusing on the data which is seen as eventually leading to the truth. Thus, in this initial sequence, the TWOD operates to resolve any apparent contradiction between the speaker's empiricist account of his own actions and his contingent account of the research network to which he belongs.

At this point, the interviewer picks up the implied contrast between the speaker's account of his own actions and those of his colleagues. In sentences eight and nine he re-states this contrast explicitly, suggesting that the respondent's approach to science seems exceptional in this area. Hawkins responds, in sentence 10, by repeating his previous criticism of these other scientists and then by going on to furnish further 'evidence' of their unscientific behaviour. He asserts that all of these people meet together fifteen times a year, that they cannot need to meet that frequently in connection with genuine scientific issues and that it necessarily follows that they must be engaging in activities which are improper by empiricist standards (5C13). He concludes his turn by identifying these supposed activities in contingent terms as 'playing politics, talking theories, one-upmanship and so forth'; and by contrasting them with what scientists should be doing. Although sentence 17 is not completely audible, it is clear from the rest of the passage that they should be engaged in doing proper experiments.

The interviewer's next response is to formulate explicitly the potential contradiction between the empiricist and the contingent elements in Hawkins' interpretations of scientific action. In doing this, he refers back to Hawkins' prior assertion that the right theory will undoubtedly have its

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day (5C6) and proposes that this seems to be inconsistent with his depiction of the actions and judgements of many people in the field. Surely, the interviewer suggests, in these circumstances one cannot be certain that the truth *will* out. The respondent counters, however, not by specifying in any further detail *how* he can be so sure that the right theory will win, but simply by restating the TWOD in stronger form (5C20-2). In particular, he emphasises the element of temporality.

The central point of this revised version of the TWOD seems to be that the time period involved may be very long indeed. Virtually every sentence places great stress on the need to give the correct theory enough time to emerge: 'in the long run', 'it may not be very soon', 'in the long run', 'no way to avoid the facts for ever', 'eventually theories will evolve that fit', 'time will tell', 'eventually data will be generated' and '*eventually* we will know what's going on'.

This emphasis on temporality is combined (5C23-7) with a strong reassertion of the contingent character of much scientific belief. Even though 90 per cent of people in the field may once have adopted the chemical theory and even though 90 per cent of people may now support chemiosmosis, this does not mean that either theory is right. Thus Hawkins stresses that even widely accepted theories may be wrong and, by implication, that their general adoption is due to the kind of personal and social factors that he has previously identified. This is one major reason why he has to extend the time period available for the correct theory to succeed. His rejection of all existing theories, in the face of an apparently firm scientific consensus, requires him, if he is to apply the TWOD to his own situation and thereby to justify his own research practice, to focus on the long period of time sometimes involved. In the *short* run, as he says immediately after this passage, there is no likelihood that a theory which he would accept will come to predominate.

This example of the TWOD provides further illustration of all the main points previously made. It grows out of the speaker's use of the two interpretative repertoires. It is employed to resolve potential contradictions. In this case, the interviewer's explicit formulation of a possible contradiction elicits a very strong example of the TWOD, which is closely similar in its organisation to those examined previously. This TWOD also resembles those above in the way in which an empiricist perspective is taken for granted and in the way in which the speaker identifies contingent factors by reference to what he takes to be the experimental facts. The respondent seems to treat the theoretical interpretations of others as self-interested speculation and their actions as contingent in various ways, simply because these actions and associated beliefs do not coincide in their scientific import with his own. Thus the speaker's assertion that other scientists are merely 'playing politics and so on' is directly derived from his

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opinion of their scientific views (5C13-16). It is his 'knowing' that their meetings are scientifically unprofitable which, from his empiricist perspective, means that they *must* be engaging in scientifically improper, and ultimately irrelevant, activities.

The most striking and novel feature, however, of this particular TWOD is the respondent's indefinite extension of the time element. It becomes clear from this example that speakers can deal plausibly with any situation where 'the facts' have not yet emerged, simply by deferring the time when contingent factors are to be eliminated. The eventual separation of contingent from empiricist elements is taken as an article of faith, as Hawkins himself says in the concluding sentence. The assumption that it will happen can be used to fashion scientists' accounts, without speakers being required to present the slightest evidence that such a separation has yet begun. Thus the TWOD is a highly flexible interpretative mechanism. Those speakers whose own scientific views have come to be accepted will be able to 'show' that, as the truth has emerged, so the influence of contingent factors has now been erased. This conclusion will follow necessarily from scientists' procedure of treating 'the facts' as by definition independent of such influences. However, those whose views have been less successful will not be forced to adopt a contingent

view. For they will always be able to defer the elimination of contingency into the future. In short, the TWOD can be constructed in a manner which allows any scientist who is claiming that his views are correct to reconcile the two interpretative repertoires in favour of the empiricist perspective and, thereby, to anchor his own scientific views in that perspective.

The TWOD and the contingent repertoire

We have so far examined three examples of the TWOD and we have observed a very similar interpretative pattern. This pattern is clearly repeated in all but one example from our collection. In this one, a pattern similar, but not identical, to the TWOD is used in the context of a strongly *contingent* position. Let us look at this exceptional case and consider its implications.

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Cookson: 1 I felt at that time that Spencer was wrong. 2 I was trying to say that if he is in fact wrong, you can't disprove him. 3 That's essentially what I was saying. 4 I wasn't really, it was a very personal kind of statement. 5 It was taking the position that I felt that there was no way that he could be right, then it was impossible to disprove him, more or less. 6 I don't think it has - well it turned out to be that I was wrong and [Spencer] was right. 7 I basically just feel that, I am so, I think that the

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chances of being right in interpretation are so tenuous in this business, that I think you have to really keep an open mind as much as possible and try not to become biased towards a particular model. 8 And that's essentially my feeling about this business really.

Interviewer: 9 But the reason for that is what, that none of the theories really generate very precise observational predictions, so that you can never ...?

Cookson: 10 Yes. The thing is that you can't, it's very hard to get your hands on these things that you are working on. 11 Membranes are extremely complicated and it's hard to know that you've ever got the variables all pinned down, so that when in fact you make an observation that that observation is really what you *think* it is. 12 I am trying to think of a good example. 13 All the alpha beta stuff [terms altered to protect the speaker's anonymity] is perfect. 14 By any criteria, up till a year ago, I don't think anybody reading that stuff would have had any argument that those things bound to the membrane but weren't transported.

Interviewer: 15 Because you'd gone through all the controls?

Cookson: 16 As much as we could. 17 Any thing that made, well I frequently used to say to the guys, 'Look you know', and especially when Stephenson first challenged this paper, I'd say to the fellows in the lab, 'Look, he can't be right, we've done everything we can think of.' 18 He did something we didn't think of, OK 19 That's I think very pertinent to what we are talking about. 20 You just don't, I mean what happens with science is that you make, even when you think somebody's right, OK you think you are right or you think somebody else is right, it's going to be 10 or 15 years. 21 I think the burden of proof becomes a time phenomenon. 22 It may be very clear right now that Spencer's right, but how do you know that five years from now somebody else isn't going to come up and say 'It looked good, but it's not really protons, it's a quark pump.' 23 That's one of my favourite gags, a quark pump. 24 How do you know it's not a quark pump? 25 It's got to stand up for a period of time. 26 It's got to stand up, especially in something like this, you have to do, you can't grab, you know you can't get it, you can't catch the variables that well. 27 I mean all you can do is make a lot of observations and if they are all consistent, eventually if nobody does something that absolutely shows that it can't be right, then it's accepted

as proof. [42-3]

28 It's a very complicated business, there are no set rules. 29 I mean rules change from day to day, that's the thing. 30 What bothered me with this [alpha beta] episode was the final and complete realisation that there is no such thing as absolute truth. 31 I mean, last summer, it really hit me like a ton of bricks that truth is simply what most people are willing to believe today. 32 And that's truth. 33 Tomorrow the population changes, people are not willing to believe the same stuff that they were willing to believe the day before yesterday, then truth changes. 34 And that is what this business is obviously all about, you know, clearly. [Cookson, 49]

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The first thing to consider here is whether this quotation does actually contain a TWOD. The TWODs discussed above:

- (a) stress the element of time;
- (b) treat 'proof' as something that necessarily emerges over time;
- (c) are used to reconcile the two interpretative repertoires.

The last of these three characteristics has been put forward as an empirical claim and the possibility of there being TWODs which are not so used must be left open. Thus TWODs must be identified solely by reference to features (a) and (b) above. The most likely candidate for being a TWOD in quotation SD is to be found in sentences 5D20-7. However, although these sentences certainly emphasise the temporal element, they do not assert that 'the truth will out'. They do not propose that correct belief will *necessarily* emerge over time. The establishment of correct belief is instead treated in sentence 27 as conditional: 'If they are all consistent, if nobody does something, *then* it is accepted as proof.' Consequently, this passage does not have the same structure as the previous TWODs, even though there is some resemblance. Nevertheless, despite the fact that this is not a fully-fledged TWOD, there is sufficient similarity for us to benefit from considering its interpretative organisation.

In this quotation, we have brought together two passages separated in the interview by several minutes of conversation. During the intervening period those involved continued to deal with the topic of assessing knowledge-claims and establishing proof. Then in the passage beginning with sentence 28, Cookson refers back to the alpha beta episode which had been a central topic in the previous passage. Thus his general deliberations on proof in the second passage can be seen as a gloss on the phrase 'accepted as proof' which ends the first passage.

Cookson's statements in the second passage are strongly contingent. Scientific truth is taken to be simply what most people happen to believe at any particular time (5D33). Scientific belief is presented as being strongly influenced by the people involved (5D3 1). The idea that there might be one final, correct set of beliefs is firmly rejected (5D28-34). In the first passage, in order to show that 'proof is a time phenomenon', Cookson suggested that Spencer's idea of a proton pump may one day be replaced by the idea of a quark pump. (The fact that this example is humorous does not affect the structure of the interpretation offered by Cookson.) But according to the second passage, it cannot be concluded that the quark pump has been proved to be better than the proton pump on the basis of any invariant rules of proof. For 'there are no set rules' and 'the rules change from day to day' (5D28-9). Thus from the strongly contingent perspective of this second passage, all he can mean by this example is that one truth has been replaced by another truth. The notion of 'proof as a time phenomenon'

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can only mean that at one point in time a certain theory can be proved to be correct, and at another point in time another theory can be proved to be correct. It is impossible to distinguish separate phases, in one of which a whole class of influences on scientific belief has been eliminated. The most that a speaker like Cookson in the second passage can consistently propose is a temporal sequence in which one contingent set of beliefs is replaced by another contingent set of beliefs. He cannot identify a stage of intellectual development which provides a final interpretative resting-place and in relation to which his own beliefs can be conclusively justified. Thus this quotation shows that the adoption of a strongly contingent conception of truth makes the TWOD unworkable.

We have identified the second passage as formulated within a contingent perspective. Turning to the earlier passage (5D20-7), there are several signs that an empiricist position is being used. The speaker constructs the example of the proton pump being, in some way, undermined by the quark pump (5D22). And he refers to the experimental difficulties of the field, in a way which suggests that the quark pump would have replaced the proton pump because it dealt more satisfactorily with the experimental findings (5D25-7). The suggestion seems to be that the quark pump would succeed because it is experimentally better. It may be necessary to wait ten or fifteen years (5D20), not simply for one true version to be contingently displaced by another, but for the experimental inadequacies of the first version to be demonstrated and for a more experimentally sound theory to emerge. To some extent, then, these statements seem to be grounded in some kind of empiricist perspective. Yet, at the same time, the respondent's final statement in the first passage is carefully conditional and instead of ending with a phrase like the previous speakers' 'eventually we will know what's going on' in the biochemical realm, he concludes with the more sociological concept of beliefs *coming to be accepted* as proven (5D27). Moreover, he never says *explicitly* that the quark pump was scientifically better than the proton pump. All we know for certain is that 'somebody else might come up' who rejects the proton in favour of the quark pump. The grounds for this rejection remain implicit.

Our suggestion, then, is that both empiricist and contingent elements are to be found in the first passage and, indeed, that this speaker, like those quoted above, tries to use a notion of temporal development to resolve the interpretative problems which are thereby engendered. However, as we have already shown, it is not easy to use the notion of temporality to provide strong justification for one's action and beliefs within a contingent framework. Only by disregarding the contingent features of the first passage, can one treat it as an effective TWOD. And if one reads the first

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passage in the contingent terms of the second passage, the potential TWOD ceases to function as such.

The question, therefore, arises of why contingent as well as empiricist elements are found in the first passage and why the powerful contingent statement of the second passage is devised. Clearly it cannot be due to a pronounced personal inclination towards the contingent position. For, in addition to Cookson's interpretative ambivalence in the first passage quoted here, he uses an empiricist repertoire in other parts of the transcript to stress that his theoretical views follow unproblematically from the experimental evidence. We suggest that the contingent repertoire

comes to predominate in these passages as the speaker engages in the unusual practice of acknowledging his own errors and making these errors scientifically legitimate.

In sentences 1 to 8, Cookson is answering a question about why he had written in a review article seven years earlier that Spencer's theory was impossible to disprove. One interpretative problem facing him in this section is that in the course of the interview he had already stressed that his present enthusiastic advocacy of Spencer's theory had been brought about 'strictly by the evidence'. His task in this passage, therefore, is to explain a criticism he had previously made of a theory which he now says is unambiguously warranted by experiment. He begins by saying that at that time he felt that Spencer was wrong and he goes on to try to specify what he had meant in the article. He clearly distances himself from his earlier views: 'I felt at that time', 'I was trying to say', 'I wasn't really', 'It was taking the position that'. He does say that 'it was a very personal kind of statement' (5D4). But this phrase works to separate the personal statement of the chemiosmotic unbeliever of seven years ago from the present speaker. It also suggests, however, that questions of proof and disproof can be dealt with in variable ways, depending on personal inclination. In the following sentence (*SD4*), he tries once more to state what it was he had been trying to express in the article. Then in sentence 6 he appears to abandon the attempt to recapture the logic of his previous position. He stops in mid-phrase and re-states his present opinion, that is, Spencer turned out to be right and the speaker to be wrong. This recognition of his error and of his mistaken attempts to undermine Spencer's theory leads him to formulate a rule of conduct: namely, the chances of being right are low and, therefore, one should not become too committed to one's present views. It follows from this rule that the recognition and abandonment of one's own erroneous views is a sign of scientific merit.

By the end of sentence 8, Cookson has made his own prior error seem allowable, if not commendable, by drawing attention to how hard it is to be right. He still seems to be organising his discourse in empiricist terms.

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He has in no way revised his previous claim that Spencer had been shown *to* be right strictly by the experimental evidence. Nevertheless, getting it right has been portrayed as an unpredictable business and attention has been drawn to the fact that one can never be quite sure when one has done so. At this point, the interviewer asks why it is so difficult to be sure that one is right and suggests that it may have something to do with the nature of the experimental evidence (5D9). The respondent takes up this suggestion enthusiastically, mentions some of the factors which make the evidence ambiguous and then searches for an example. The example he chooses, that of his own work on alpha beta, is another instance where he now states that his previous scientific interpretation was wrong in certain respects. He describes his initial negative response when Stephenson first challenged this work (5D17). The speaker explains that he now accepts that Stephenson has successfully questioned his findings by 'doing something we didn't think of' (5D18). Then he proceeds to develop the notion of proof as a time phenomenon. The subsequent discussion of proof, with its combination of empiricist and contingent elements, serves, like the previous account of interpretative uncertainty, to put the speaker's error in a reasonably favourable perspective. His argument shows that it is not just his own theories which are overthrown; even Spencer's theory may be shown to be wrong and abandoned in time. The most that anybody can do, he concludes, is to make a lot of observations, provide a consistent

interpretation and hope that you are not shown to be wrong (5D27).

In sentences 16 to 27, then, Cookson reflects upon his second error, develops the notion of experimental uncertainty, moves his exposition of the nature of scientific proof in a contingent direction, and provides moderate justification for his own mistakes by making them appear expectable. Both sentences 16 to 27 and 1 to 8 are organised, in part, so that the speaker's errors are made to appear normal and, thereby, legitimate. There then follows in the transcript an unquoted discussion of related topics which eventually gets round to general talk about the evaluation of experimental findings. Suddenly Cookson returns to the alpha beta episode and formulates clearly what he takes to be its epistemological implications (sentences 28 to 34). Truth is now viewed as that which most people are willing to accept at a particular point in time. In this passage, the respondent achieves a stronger, and less ambiguous, justification than before for his theoretical error. His views on alpha beta become as true for their time as Stephenson's or Spencer's for theirs.

With these epistemological assertions Cookson concludes his conversational turn (5D34). He has finally produced a comprehensive, contingent version of scientific belief which furnishes potent legitimation for his having advocated beliefs which he now accepts are wrong. Because this is

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such a forceful formulation, the kind of temporal concept which Cookson had used previously, and which is essential to the empiricist TWOD, is unnecessary to make it effective as a means of justification. The idea of movement towards a final or a more adequate stage of scientific proof is redundant when every stage has more or less equally uncertain scientific merit. That which is now widely regarded as wrong becomes as scientifically legitimate, for its advocates, as that which is now taken to be correct.

It appears from this case that the fully-fledged TWOD, and the associated empiricist perspective, is likely to be used in those typical situations where the speaker is reconstructing events in a way which directly displays the correctness of his current scientific views. The TWOD is less likely to be appropriate in cases where the speaker is engaged in making his errors understandable and scientifically acceptable. In the latter situation, it seems that a more effective reconstruction of the speaker's actions can be achieved by setting them within a strongly contingent portrayal of scientific action and belief.

Conclusions

In this chapter we have explored one implication of our previous analyses of scientific discourse in terms of the empiricist and contingent repertoires. Our discussion of these two repertoires implied that scientists will tend to have some difficulty in using them together in particular passages of conversation. We have looked closely at four passages in order to observe whether such difficulty is evident and whether any regular interpretative mechanism is employed as a means of combining the repertoires in a way which resolves potential contradictions. We have shown that the 'truth will out device' is used in this way in three of these passages. It is clear that the same pattern occurs in all but one of our collection of ten instances. Although our collection

of TWODs is small, its use by nine of our 34 respondents suggests that it is recurrent in scientists' discourse and that it has some interpretative usefulness.

We have shown that the TWOD occurs in situations where the two repertoires are used together in relation to the same sets of actions and where the potential incompatibility of these two perspectives is signalled by the speaker's tendency to hesitate, revise his claims and offer apparently contradictory statements. The TWOD is able to reconcile the potential contradiction between the empiricist and contingent perspectives because it assumes a clear distinction between empiricist and contingent influences on scientific belief and then separates them temporally. Experimental evidence is depicted as becoming increasingly clear and conclusive over

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time and as enabling scientists *to* recognise, discount, and eventually eliminate the influence of contingent factors. Thus the TWOD is a device for re-establishing an interpretative divorce between the two conflicting repertoires when they have been combined in one conversational passage. More generally, it is an interpretative resource which enables speakers to resolve the potential inconsistencies that periodically arise as they generate diverse accounts of their social world.

The main effect of the TWOD is to restore the primacy of the empiricist repertoire. As we have seen above, this dominant repertoire in scientific discourse enables speakers to treat their own views as requiring no justification beyond reference to 'experimental facts', which are treated as coincident with the real world. When this perspective is adopted in ordinary talk, a speaker's scientific assertions become indistinguishable from the empirical world under investigation.² The TWOD enables speakers to return to this relatively secure interpretative domain after having ventured into the more difficult realm of contingency, within which scientific belief and the speaker's views become uncertain and difficult to justify with any finality.

Why, then, do scientists ever depart from the empiricist repertoire in the course of informal interviews? One reason for this is that there are social phenomena in science which are informally given meaning by use of the contingent repertoire and which can only be described and, indeed, can only be said to exist in so far as the contingent repertoire is used. For instance, actions regularly occur in science which can be said to involve scientific disagreement, but which are typically described as personal antagonisms, intellectual rivalries, competitions for status, clashes between strong personalities, and so on. It is clear that in much informal talk among scientists such things are discussed, are taken to be an essential part of science and are depicted as influencing the course of scientific development. As we have seen in this chapter, scientists sometimes hesitate before employing the repertoire through which such phenomena are constituted. They tend to preface their remarks by phrases like 'I'm not sure *I* want to talk about. . . .' or 'If I am to be entirely honest, I must' Nevertheless, despite scientists' preference for the empiricist mode of discourse, it is inevitable that references to this aspect of science will be made, and its constitutive repertoire employed, as scientists draw on their past interpretative activities in order to make sense of their world for the interviewer. Indeed, although speakers sometimes hesitate before drawing attention to the realm of contingency, we have seen above that at the same time they tend to emphasise that its importance in science cannot be denied.

Consequently, it is to be expected that both repertoires will be used by scientists informally and that interpretative problems involving the two

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repertoires will arise which require resolution by means of the TWOD or by means of similar, as yet unidentified, devices.

The TWOD is a very effective reconciliation mechanism. Because the speaker's own scientific views identify the boundary between contingent and non-contingent actions and beliefs, the speaker experiences no difficulty in showing that, as beliefs which he takes to be correct come to be accepted, so contingent factors drop away. In addition, the duration of the process whereby correct belief is established is open to variation, depending on the particular circumstances specified by the speaker and on his ability or inability to show that his views are coming to prevail. The TWOD is so constructed that any scientist who claims that his views are correct, whether or not those views have yet been widely accepted, can reconcile the two repertoires in favour of the empiricist perspective and, thereby, gain for his own views the powerful justificatory support of that perspective.

The flexibility of the TWOD is, however, not indefinite. It is difficult to formulate a convincing TWOD in conjunction with a strongly contingent account of scientific knowledge. It is also difficult to use the TWOD to account for acknowledged errors. There is, therefore, a strong interpretative link between claiming correct belief, justifying that belief through the empiricist repertoire and using the TWOD to re-establish that repertoire. Conversely, acknowledging incorrect belief can be given greater legitimacy by use of the contingent repertoire which, in its strongest form, makes resort to a 'truth will out device' unnecessary.

These are our tentative conclusions in this chapter. Although they are based on analysis of a small number of cases, they are consistent with, and receive support from, the content of our previous chapters. Nevertheless, because we are claiming to have observed a recurrent phenomenon which is linked to the existence of interpretative perspectives adopted throughout science, the analysis should not stop here. Further close examination is required of discourse produced by other scientists in similar and in different interpretative contexts. The kind of fine-grained exploration attempted in this chapter exemplifies one direction in which our kind of analysis can be extended, that is, towards an increasingly detailed 'natural history' of scientists' discursive practices. But this is by no means the only possible line of analytical development. In the next chapter, we will explore a different avenue of investigation opened up by discourse analysis.