1986]. No doubt if I had seen it earlier this section would have taken a slightly different form. However, judging from the brief examination which I have been able to make of this work it does not alter the theory in any respects relevant to our argument (after all, from our point of view it is the broad outline and not the details of Paivio's theory which are important, and which I wish to defend). It is worth noting that whereas his earlier book [Paivio, 1971] was largely concerned with defending the theory from the formerly standard (but now outdated) view that all memory is encoded in our natural language, the new book is mainly concerned with defending it from critics who adhere to the 'propositional' [see chap.II.C below] theories which have since become very influential. I shall be giving my own reasons for rejecting 'propositional' theories, but Paivio's replies to these critics can surely only strengthen the case for 'dual coding'. It is also notable that Paivio shows little sympathy for the imagery theory of Kosslyn [1980], which argues strongly for the significance of imagery but within the context of an essentially 'propositionalist' framework [Paivio, 1976 pp.45,51]. In this my sympathies are again with Paivio.

## Notes to §.I.C.3.

1. Hacking, 1983 pp.22-24.

2./To speak of "theoretical entities" in this context seems to be the usual practice in philosophy of science. However, looking at the list we have just given it is clear that the explanatory constructs of science may just as well be substances or even abstract objects. What they all seem to have in common is that they are put forward as candidates for existence. Even confirmed instrumentalists must act as if the postulated entities, substances, etc. really exist whilst they are using the theory. "Theoretical existents" would perhaps be a better term, but there seems to be no pressing need to depart from the standard usage here, so I will refrain.

3. Hacking, 1983 p.23 - emphasis in original.

4. 1966 pp.10-11 (original French 1940).

5. 1967 §621f.

6. Sartre, 1966 pp.10-11 (original French 1940). Wittgenstein seems to be making the identical point, in a rather more gnomic form, in Zettel §s 621 & 627 [Wittgenstein, 1967].

7. 1981 p.209.

8. Taylor, 1981 pp.209-210.

9. Shepard, 1966 p.203.

10. He gained his doctorate from Yale in 1955 [Shepard, 1981].

11. See Shepard & Cooper, 1982 p.9.

12. I refer, of course, to the 'mental rotation' experiment of Shepard & Metzler [1971], and the extensive further work on the phenomenon carried out by him and his students [See Shepard & Cooper, 1982], and which is outlined below. It is worth noting that in the same year Meudell [1971] was able to provide some experimental support for Shepard's introspections about window counting. He found that the times taken by subjects to report how many window panes they had in their living rooms increased linearly with the number arrived at - just as we would expect if they were indeed counting panes in an image (as they said they were).

13. "Hypnopompic" images are those experienced whilst awakening from sleep. They are very similar to the "hypnagogic" images which many people experience whilst falling asleep, and, indeed, one may well wonder whether there is a valid distinction to be drawn here. However, both types do seem to show systematic phenomenological differences from the imagery experiences of full wakefulness, often being particularly vivid, bizarre and free from voluntary control [see e.g. McKellar, 1957 chap. 3; Richardson, 1969].

14. Shepard & Cooper, 1982 p.7.

15. Shepard, 1978a pp.182-3.

16. Shepard & Cooper, 1982 p.17. The memorandum itself appears as chapter two of this work.

17. Shepard & Metzler, 1971; Metzler & Shepard, 1974.

18. Shepard & Metzler, 1971 p.703.

19. 1976; Carpenter & Just, 1978.

20. 1974 (p.68 in the reprint in Shepard & Cooper [1982]).

21. At least, not in the straightforward way in which Shepard clearly intends the concepts to be taken. For discussion of Just & Carpenter's views see Shepard & Cooper [1982 pp.171-6].

22. Whatever that may be. I do not want to prejudge theories about the nature of imagery at this point (their consideration will be left until part II). The point is that, whether the mechanisms underlying the experiences we commonly call imagery be 'quasi-pictorial', 'pro-

positional', or whatever, it is hard to deny that Cooper's experiments deal with imagery in the everyday layman's sense, and with whatever it is which these theories are trying to explain. It is perhaps possible to doubt this for the Shepard & Metzler work.

23. The **locus classicus** for this rejection is Neisser [1967 chap.3].

24. E.g. Shepard, 1978b p.132, 1981 p.293; 1984a. In the light of the previous note it is notable that Neisser [e.g. 1976, 1978a,b] puts the point even more strongly than Shepard.

25. See e.g. Posner, Boies, Eichelman & Taylor, 1969.

26. The time advantage for same case matching in Posner's experiments disappears if the interval between them is more than about two seconds. This has been interpreted as showing the rapid 'fading' of the 'visual code'. However, I wonder if it might not just reflect a change in strategy. The two second gap presumably gives the subject ample time to name the first letter to himself. Matching names is obviously going to more reliably produce the 'right' answer, so once the name is available it may well be used in preference to a direct visual match.

27. Cooper & Shepard, 1973 p.83.

28. Cooper & Shepard, 1973.

29. This is not strictly correct because the letters shown in advance were in outline form and the test letters were solid. But one doubts if this would make a serious difference, and indeed, it does not seem to have done.

30. 1971; Metzler & Shepard, 1974.

31. Cooper & Shepard, 1973 pp. 121-5.

32. Cooper, 1975.

33. 1975.

34. 1976.

35. The standard reference on this is Orne [1962], but Intons-Peterson [1983] has recently demonstrated that imagery work is particularly vulnerable to this this sort of problem.

36. See especially Shepard 1975, 1978b, 1981.

37. This is experiment II of Cooper & Shepard [1973 p.140ff].

38. Cooper & Shepard, 1973 experiment I (described above).

39. 1976.

40. Cooper, 1975.

41. Cooper, 1975.

42. Typical rotation speeds for the 'three-dimensional' objects used in the Shepard & Metzler [1971; Metzler & Shepard, 1974] experiments were a great deal slower than those found with the two - dimensional objects used in Cooper's work. (However, dimensionality may not be the crucial factor in this - see Shepard & Cooper [1982 pp.178-9].)

43. For recent reviews see Corballis [1982, 1986]. These papers also point out that, albeit in a very different form and context, 'mental rotation' research antedates Shepard's entry into the field.

44. Shepard, 1981, 1984a,b.

45. Kosslyn, 1973; Kosslyn, Ball & Reiser, 1978; Kosslyn & Shwartz, 1978; Finke & Pinker, 1982.

46. 1975; Larsen & Bundersen, 1978.

47. See Shepard & Cooper, 1982 pt.II.

48. 1972.

49. E.g. Pylyshyn, 1979; Dennett, 1978a pp.167-9.

50. Yuille, 1983; Yuille & Steiger, 1982.

51. 1983.

## Notes to §I.C.4.

1. C.f. Shepard [1975; Shepard & Chipman, 1970] on the "second order isomorphism" between the image representation and its object. I think the point as I have expressed it here should be fairly uncontroversial. However, some iconophobic thinkers have expressed quite the opposite intuition in the cases of more numerous and less well defined features, such as the tiger's stripes. These contentions will be considered in §II.B.4.

2. E.g. Shepard, 1981, 1984a,b.

3. Kosslyn, 1980 p.vii.

4. See chap. II.B below.