Chapter C6

THE SYSTEM LOOKED AT AS A WHOLE, AND SOME INHERENT WEAKNESSES TO BE EXPECTED

SUMMARY OF CHAPTER

This chapter concerns itself, in a broader and less-specific way, with those "emergent" properties which are likely to arise in a large integrated system, or which are actually observable and need to be accounted for. In particular, likely non-adaptive by-products of sophisticated developments are suggested, on theoretical grounds, as a prelude to the systematic discussions of neurosis and psychosis in Chapters C7 and C8 respectively.

C6.1 When should it be feasible to mount a frontal reductionist attack on the perennial problems of psychology? — including such intangibles as Attention, "Mental Energy", Ego, and Morale

It will be important here to clarify what is meant by "reductionist" and "frontal attack", in this particular context. The *reduction* contemplated here entails a chain of causal *functional* explanations — stretching from behavioural phenomena down to the supposed functional elements from which the system appears to be constructed. Ideally these elements will be identifiable physiological or biochemical structures; but it will be held to be sufficient here if they can be narrowed down to sets of a manageable size, such as "linear molecules like RNA", or "signals involving coherent infra-red emission". The main point is that their functional role should be definable with sufficient precision for us to be able to make definite predictions about the operation or macro-characteristics of the system as a whole (Popper, 1934/1959, 1963/1969). [But note that the testing of such predictions need not just be by traditional experimental methods; we should also seek validation of the macro-model by means of "internal closure"].

Another requirement for a reductionist system — as conceptualized in this work at least — is that the basic elements should be self-organizing rather than having to be ultimately created by some transcendental "programmer"; (see Part A, above; and Traill, 1976e, Chapter VII). Hyland's analysis (1977a, 1977b) is also of interest in this context. He divides *hypothetical constructs* of psychology into three categories: Mentalistic, Mechanistic, and Physiological — and suggests that these cannot legitimately be mixed within any one explanation, though one may be used to interpret or explain another. It looks as though his *Mentalistic* category deals with entities like "ego" which, as they stand, (in Freudian theory), do not have enough precision to build up any extended theory in detail — though it seems reasonable to claim that a modest amount of closure can emerge from *ad hoc* psychoanalytic situations, when the conditions are sufficiently favourable. (It should be noted that this is no mean feat, even if we may hope to do better some day. Major advances in our knowledge will usually have to come in stages — and dearly bought at that!)

To the best of my knowledge, all computer-like models of mental functioning have always been *Mechanistic*[46] in Hyland's sense, and I take this to mean that they are never fully conceptualized as being self-organizing. In fact it is now easy to see that Chapter C5 was an attempt to convert Ashby's "Mechanistic" model into a *"Physiological"* one in Hyland's sense — which I take to mean "radically reductionist" (to the extent that one continues reducing, in

[46] My own use of the term "mechanistic" has been somewhat broader — including the physiological type of mechanism as well; (but then I have gone in for a further reduction below the usual concepts of physiology).

principle, until the elements or substrate seem to have become irreducibly simple — whatever we take this to mean).

When we base a model system on elements which are hazily defined (e.g. Mentalistic) or on elements lacking recognizable provision for self-organization (i.e. "Mechanistic" in the above sense), then in both cases our model will only be a qualitative approximation to the real natural system which it purports to represent. [We are here assuming that such natural systems do have these properties of ultimate discrete structure and self-organization, at least to a substantial degree]. Such approximations are very often the only way in which animals (including ourselves) can cope with the initial mysteries of the environment — so we should accept the necessity and importance of such "primary process" thinking in our patients and experimental subjects, and also in ourselves, whenever the occasion is *appropriate*. The existence of alternatives — Mentalistic *or* Mechanistic — is also potentially very useful; as it offers a means for a pragmatic switching from one to the other, as in Ashby's homeostat. However it will generally be best to at least have the option of using a more precise model, and we will take it that this must be one of the "Physiological" sort. The question then becomes one of whether we can translate all the important features of our approximation-models into the new reductionist framework, at least in principle. If we can, then we have the makings of a "frontal attack" on the problem in question. If not, then we may have to persevere with re-formulations of the approximation-models and perhaps also conduct research into any proposed new basic substrate — until such a cross-interpretation does become possible. (The Hegelian concepts of thesis, antithesis, and synthesis might profitably be discussed in the same terms also). 233

It is perhaps necessary here to refer again briefly to the supposed inadmissibility of trying to validate a theory by testing the internal consistency of its consequences rather than concentrating on its "observable" predictions; (Traill, 1976e; also Chapters A2 and C1, above). It is often said that J. B. Watson (1919, 1928, 1931; Watson and McDougall, 1928) was the father of this traditional behaviourist view; and his pronouncements certainly constitute a strong advocacy of this position. Thus (1928, page 7):- 234

> "Behaviorism's challenge to introspective psychology was: 'You say there is such a thing as consciousness, that consciousness goes on in you — then prove it [experimentally]. You say that you have sensations, perceptions, and images — then demonstrate them as other sciences demonstrate their facts'."

Or, on page 3 of the same work:-

> "Behaviorism thus leaves out speculations. You'll find in it no references to the intangibles — the unknown and the unknowable 'psychic entities'."

However a careful reading of his discussion suggests that his main complaint against Freudian and introspective psychology was that they seemed to him to be using a thinly-disguised form of Cartesian dualism, involving a non-scientific spiritual "soul", (ibid., pp 93-97): a "Mentalistic" concept in Hyland's sense, which *might* after all turn out to be compatible with a *scientific* "Physiological" formulation, if the ideas of the present work happen to be reasonably correct.

Anyhow, if this point could be cleared up, the remainder of his case in support of publicly observable experiments might arguably be re-interpreted as a support for whatever could be used with most precision — so as to minimize the intrusion of ill-structured concepts into the current corpus of scientific belief. In the 1914-1930 period there was a good case for identifying this criterion with a support for a sober experimental approach, but it is conceivable that the present-day preoccupations with obscure statistical interpretations of experiments *now show little advance in concept-precision* in any meaningful sense, while structural theories based on the fairly precise elements of physiology, biochemistry, ultra-micro anatomy, and physics, *can now claim to hold the initiative in the precision-game*. However it would seem to be unprofitable to

indulge in a controversy over the relative merits of these two approaches. Both are apparently necessary, and each will have its successes or otherwise, according to the current overall problem.

What then can either approach do to solve such perennial imponderables as: consciousness, attention, "mental energy", personal identity, morale, or the poorly structured concepts of Freudian theory such as ego and superego? To Watson (1928) such questions about supposedly-supernatural abstractions could be nothing but meaningless: "If the behaviorists are right … then there can be no such thing as consciousness or its substratum, the unconscious." There is some suggestion that at one time he may have taken a more moderate view, though he himself claimed to have tempered his views in the interests of expediency in the early days; anyhow McDougall (1923/1931)[47] cites him as saying:-

> "What has been called experience or consciousness may occur or exist for all I know or care. But I am not interested in it. I am concerned only to understand human behaviour. I know all behaviour is mechanistically determined by reflex processes; let me get on with the study of 'conditioned reflexes'."

Ashby (1960) also disclaims any insights or involvement on such issues. So should we be content to leave these concepts as vague impressions or permanent metaphysical intangibles? Of course, perhaps in the end some of them will defeat us — maybe even permanently. However, whenever a new way of looking at the mind/brain should happen to arise, then it would seem sensible to ask whether it will shed any light on the old imponderables. The present theory does 236
seem to offer a new perspective of this sort, so we may reasonably feel that any attempt to apply it to concepts like *morale* or *consciousness* will at least be instructive and thought-provoking, even if it is not correct in itself. But any actual success should have immediate application in explaining psycho-pathology.

C6.2 Consolidating the functional principles of the current model — constraints and hierarchies

Broadly speaking, the task of the brain is to obtain and maintain an *organized and readily-accessible* model of the *more important* features of the organism's environment. The whole purpose of any utilitarian model seems to be that it can be consulted rapidly, repeatedly, and with minimal effort or disruption during use; and this rather implies that appropriate parts of the model should be robust in the face of "interrogation" — and that the "referencing system" should be reasonably efficient, with an emphasis on building up "extensive" methods of set-formation rather than exclusive reliance on implicit sets using "intensive" methods alone. (Similarly, if a largish company is to be able to act promptly, its records should be filed and re-filed; and not just left in one large box even though each record might be clearly labelled. Moreover, these records should not easily fall to bits in the normal course of the retrieval of their information).

One might ask the innocent-looking question: "Why confine ourselves only to the modelling of the more important features of reality? — Why not aspire to ever-greater precision, and ultimately complete precision?" The latter extreme case of complete precision can be promptly dismissed due to the impossibility of rigourously modelling oneself, or of rigourously excluding oneself from any system of practical interest; (Landsberg and Evans, 1970). Other answers of more immediate relevance will however also entail practical problems:- how to *obtain* detailed 237
information about the environment without destroying it in the process; and how to actually *build and operate* any nearly-all-embracing model — given that we must only use material media for

[47] McDougall alleges that this is from Watson (1919), but I have been unable to trace it there; nor have I found it in the third edition. Moreover I have not found so tolerant a statement in Watson's other principal works on the subject (1928, 1931), nor in the debate between these two writers (Watson and McDougall, 1928). So perhaps it comes from one of Watson's earlier writings, of about 1912.

the purpose. These outline arguments, or the latter ones at least, look suspiciously like re-formulations of the "indeterminacy principle" of physics and its counterpart in biology, (Elsasser, 1958, 1961); but here the trade-off is between rigour of the *detail* portrayed, and *robustness* in the model — e.g. the real system itself is naturally correct in every detail, but maximally vulnerable or unyielding to interrogation, and so a poor "model" of itself in our present sense, unless it is naturally robust.

For the environment, robustness may be interpreted as being *constraint* in the number of conceivable configurations or "laws"; and as Ashby (1956) points out, we can usually take advantage of any such constraint. Elsasser too makes much the same point when he describes physics as the study of systems with many identical and expendable members, and indicates the relative simplicity of elucidating the properties of such systems. Anyhow, we do not have to look very far to find considerable amounts of constraint in the environment — notably among material solid objects, but also for plastic, breakable, and liquid configurations; and then also for the behaviour of our fellow human-beings, even if their constraints are more loose and capricious than those of the "physical" phenomena.

As long as the perceptual environment shows any tendency towards permanent distinctions or boundaries, then we will have the basic essentials for an adaptive responder; but actual environments are particularly likely to produce some quite sharp distinctions ready for exploitation — even if they are only boundaries between solids, liquids, or gases; (at "biological" temperatures, at least). Such toeholds on reality can offer a basis for the evolution of primitive creatures with only an initial $\mathbf{M^{-1}L}$ reflex capability, possibly restricted to "unsharp" discrimination of chemotactic gradients or concentrations. But note that the very existence of such evolved reflex-patterns constitutes a simple *model* of the properties of the environment, a model which would have evolved differently if the properties of the environment had been different. Moreover such a model would presumably be the prototype for subsequent modelling of pleasure/pain distinctions — a basic $\mathbf{M^{-1}L}$ attribute on which all subsequent model-building will eventually be predicated. 238

It seems reasonable to assume that, other things being equal, the most efficient type of model will be one which most faithfully reflects the same structural constraints as the outside reality which it purports to represent. After all, any departure from this will represent a departure from truth; and on the whole this will usually mean a loss in adaptability — though it may work well as long as the environment does not actually show its full repertoire of potential phenomena but continues to display an (ultimately spurious) appearance of surplus constraint. Anyhow, insofar as the model is likely to reflect outside structure, it will be instructive to look carefully at the constraints and regularities inherent in the observable environment (including the environment of ideas and culture, where humans are involved). Hopefully this will shed some light on the type of structure likely to develop in our mental models, and hence help to explain important aspects of our mental processing.

Rather than continuing to develop the theme of analysing the *manifest* properties of physical systems (started three paragraphs ago) and unfolding the hierarchical nature of these constraints, as already done above in Chapter A3, it would instead be more assimilable to the adult point of view to start at the other end of the process and work backwards *from* the abstractions of which adults are consciously aware. In fact abstract concepts seem to fall naturally into two broad categories which we will look at separately. There is the logical, mathematical, hard-science tradition; but there is also the rather more nebulous worldly-wise area of business, politics, the novel, and subtle interpersonal relationships — involving phenomena which are (as yet) too complex or lacking in discernible regularity for us to be able to cope *unless* we use gross approximations in our models, with all the dangers of mutual incompatibility and departures from truth which this entails. (One might also argue in favour of yet other categories of abstract concepts, such as mystical "inner experience"; however these will not be discussed here). 239

Western culture seems to endow formal mathematical systems, including logic, with some sort of mystical transcendental power — a privileged gateway to at least some of the ultimate undoubted truths (episteme) of nature. While there is some basis to such a claim, it cannot stand up in any absolute sense; and this work will treat all these mathematical systems as being, epistemologically speaking, no more than particularly successful types of mental model which are culturally transmittable with minimal difficulty because of the robustness of the basic schemata. This robustness and their general usefulness arises directly from the policy of selecting and refining such systems on the basis of how well they display internal closure among their basic operations. (In this sense then, there is nothing mystical about their properties — they have been inbuilt in much the same sort of way as survival-techniques are built into evolving living organisms). The practical value of such systems arises whenever they can be matched to physical phenomena — thus demonstrating the internal closure of our ideas about the latter, and so tending to validate them in this internal sense.

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However, thanks to the work of Inhelder, Piaget, and their colleagues, it has by now become apparent that there is also an important pragmatic (external) basis to these abstract concepts. In practice, natural physical phenomena are constrained to certain types of behaviour, and these constraints[48] are seized upon for the development of mental models. We have seen above that gross textural/chemotactic/etc. features may become reflected at the crude genetic $\mathbf{M^{-1}L}$ level; and the concepts involved in solid geometrical objects were explained as evolving from experience with reality, resulting in the $\mathbf{M^0L}$ level; (Part A, above; Traill, 1975b). By now the organism will be dealing with internal representations presumably, and this process may continue on from this less-obvious abstraction into the patently abstract. Thus during the Concrete Operations period, there will develop a mental model of the constraints inherent in the physical manipulation of the solid physical objects (such as rules of multiplication and set-closure), giving us our $\mathbf{M^1L}$ level. In so far as these rules for different individual operations (as represented in internal intensive coding) can become generalized (sorted into extensively defined sets), then we will have various separate types of algebra, including logic — and hence we will have reached the $\mathbf{M^2L}$ level. Similarly, any further generalization into an algebra of algebras will presumably give us an $\mathbf{M^3L}$ level.

Here we have been covering old ground. But the new point to be made here is to emphasize that our ability to build up such a hierarchy of abstractions is largely though not entirely governed by the real hierarchies of constraints which happen to be present in our external physical environment; and consequently that our adult mental model will presumably tend to reflect the same "logical" structure as the environment which it purports to represent. A corollary of this is that if we happened to have been brought up in a world with different-but-structured physical laws, then we would stand a good chance of adapting to them also — though this might well depend on the sizes of the logical leaps between one set of regularities and the next, more generalized, set of regularities. This thought leads us directly to the problems of the more nebulous "worldly-wise" type of learning task:-

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One of the most distinctive features about the *arts and humanities* is the important position they give to *egocentric and ethnocentric* considerations.

(By contrast, the hard sciences go out of their way to *decentre* their concepts. This has its admirable side, leading to such concepts as the heliocentric solar system, and relativity; but this does seem to encourage the risky idea that one's subjects or patients or acquaintances "should" constantly be objective and detached on all or most matters. More importantly in the present

[48] These notably include mathematical-group properties. I suspect that we might well be able to interpret these much further by a cybernetic analysis using a deeper reductionist interpretation; but that is a matter for discussion in the context of physics, and we will not go into it here.

context, it encourages us to forget or overlook the egocentric origins of our supposedly transcendental ideas on mathematics and the physical world; and this is sometimes suggested by the scant attention given to source-references in such disciplines. The danger in this forgetting of origins is that we will remain unaware of any corners that may have been cut in the past, to answer specific questions, but which cannot be legitimately cut for new questions which arise later on. I would suggest then that much[49] of our claim to objectivity in the hard sciences is, strictly speaking, spurious — though excusable for the "trivial cases" studied in the hard sciences; but if we are to progress significantly into the "soft sciences" in any formalized way, then we must inevitably go through the tedious task of uncovering the short-cuts and the *untidy* aspects of epistemology which these short-cuts have served to circumvent). 242

In discussing any egocentric activity, some view must be taken of the organism's self-concept; for as soon as it gets as far as conceptualizing objects as such, its own body will figure prominently among the objects considered. But even before that, at the Sensori-Motor stage, there will be developing sets of distinctions between "what can or cannot be influenced by my actions", and between what is subject to sensation and what is not; and here it is not necessary to conceptualize actual objects in any coherent sense. From this self-concept or ego, we may expect the differentiation of "those objects which are close to me, but are not fully me, and are rather less controllable" — giving the imago concepts of parents and other closely associated persons, who may ultimately come to embody societal values thus providing a basis for superego concepts.

[Many of the issues raised here were later discussed in greater depth (Traill, 2000, Part I), now available online as www.ondwelle.com/BK1_V28.PDF or in print as *"Physics and Philosophy of the Mind"*, Ondwelle Publications: Melbourne. — RRT, 2006]

C6.3 On modelling Attention, Ego, Consciousness, and Superego

Let us deal with these various concepts in turn, in chronological order this time. We may start by considering the nature of *attention*. Following Freud, this *can* be thought of as a room into which only a limited number of mental-preoccupations can fit at any one time (Section A1.4, above); but as a physiological model this is not really very credible, and we might do better to postulate a competitive energizing process such as has been demonstrated in the mutual inhibition in the retina (Teitelbaum, 1967; after Barlow, Fitzhugh, and Kuffler, 1957). This would involve a negative cross-feed of some sort — conceivably a primitive competition for scarce resources, though it is also possible that inhibition signal-targets could be specific, and perhaps even learned. (The ethological concept of displacement activity as a substitute for *both* of two mutually incompatible potential activities, seems to suggest specific inhibitions — though this could be attributed, somewhat improbably, to *local* scarcity of resources). Anyhow we shall tentatively assume that the phenomenon is *largely* one of emission of specific inhibiting signals which may be more, or less, generally effective — depending on the distribution of "labels" sensitive to such signals. (The potential usefulness of this postulated mechanism for explaining the Freudian concept of "repression" will perhaps be apparent at this stage). 243

Next we must look more closely at the likely methods for building up the *self-concept*. To this end, it seems helpful to consider the nature of motivation in general — leading up to the issue of what it is that provides the motivation for an individual to go to the trouble of forming a self-concept. The usual laboratory type of positive or negative reinforcement tends to be of the simple physiologically-obvious type: shock or food-reward, "stick or carrot"; and the effect of these unconditioned stimuli is initially to produce genetically-determined responses which are likely to protect or maintain the individual or his kin. The setting up of such genetic stereotypes, by

[49] In fact physicists seem to have partially escaped from this trap by recognizing the inevitable disturbing role of the active observer, and the principle of indeterminacy.

orthodox natural selection, may be regarded as a sort of trivial "motivation" of trial-and-error survival; and we may also identify it with the $\mathbf{M^{-1}L}$ level, not requiring any sort of brain, and just as much a characteristic of a plant as of an animal. By contrast, the simple "stick or carrot" learning will occur within the one continuing individual — though the present theory maintains that there will be a *captive* natural-selection process going on within some form of nervous system, and probably using fundamentally similar genetic-type mutation processes. Anyhow, we 244
shall identify this type of activity as being "Sensori-Motor" and as taking place at the $\mathbf{M^0L}$ level.

By now we have got past the mere issue of survival (a sort of "pleasure or pain" for the species), so we have reached the normal "literal" meaning of pain and "erotic" pleasure (in the Freudian sense of bodily sensation). It seems reasonable to suppose that it is those scheme-elements which are being attended to (and hence in communication with some signal pathway) that become associated with any feelings of pleasure or pain at about that time. This association, by "tagging" or by some other means of discrimination, would provide a ready explanation for approach or avoidance tendencies and hence for "motivation" in the formal sense. However, this in itself does not explain actual feelings (as opposed perhaps, to the outward "emotional" behaviour of a neonate or sensori-motor animal). It seems difficult to imagine feelings without consciousness; and for the want of any better guidance, it will be assumed here that consciousness must await some sort of self-concept, the very phenomenon which we are currently leading up to — as a somewhat *later* development.

Now we may recall from Chapter C5 that such elements were supposed to become "listed" in extensive sets of apparently related part-images of the outside world (perhaps because they gave similar parallax "responses" to a move of the head, or because of some other intensive property which they all happened to have in common). Furthermore, it was supposed that there was a propensity for the individual to selectively save those versions or ensembles of such lists which had "mathematical-group" properties or a tendency towards them — indicating a degree of *internal* closure in addition to the pragmatic pleasure/pain external closure encountered earlier. In this way, it was suggested, the individual re-constructs *by himself* a potentially realistic mental model for each important distinguishable object in his environment. At this stage, (if we may use 245
one of Piaget's examples), he probably cannot tell *slug A* from *slug B*, or understand the concept of *slugs in general*, (Baldwin, 1967, p 238); but this will apparently not invalidate our next two points, and the deficiency will, in any case, be made good in the following Concrete Operations period — see Table C5.4/1, and also Gambling and Traill (1977).

The first thing to notice in this is the postulated preference for internal closure. Another way of interpreting such a phenomenon would be to say that:- the *formation* of internal-closure gives "pleasure" to the individual and its *disruption* gives "pain". Clearly this is a new type of pleasure/pain, which might not be felt so consciously (by those having consciousness), but it might nevertheless be just as real. Presumably its origin would also be hereditary, though possibly in a trivial orthomaturational way, since we might reasonably expect *any* structurable dynamic medium to generate *some* stable configurations with group properties, under some conditions at least, (e.g. Goel *et al*., 1970; Goel and Leith, 1970; Leith and Goel, 1971). Indeed, as we saw at the end of the previous section, this is the ultimate justification for such a propensity:- there is an excellent chance that the outside environment will ultimately have similar properties, in one form or another. If inside and outside both tend to share the same basic property, then the self-organized modelling process appears feasible; otherwise it is difficult to see how life could exist with any substantial degree of complexity — or even, perhaps, how it could exist at all!

The second point, also introduced in the previous section, is that we can now start to explain the self-concept as a special augmented type of object-concept. From a sensory point of view, our vantage point of our own bodies is certainly unique, not only regarding vision and the various

tactile senses, but also in audition and olfaction. Perhaps even more important though, it is open for us to discover that hands, feet, and mouths are much more likely to move more-or-less in accordance with our wishes — while the behaviour, if any, of other objects in our environment will generally be much more capricious. True, the mother-figure in our environment might be over-responsive to our whim, possibly leading to a rather over-broad concept of where our self-boundary should be placed; but even then there will be a readily discernible difference in time-lag, reliability, and scope for misinterpretation — though of course the neurotic's perceptual process may "choose" to overlook such differences. 246

So, without needing to labour the point, it seems reasonable to suppose that initially one's self-concept is just another object-concept, derived in the usual way; but that its unique associations and properties ensure that it very rapidly comes to dominate the mental-object scene — especially in view of its inescapable omnipresence. (We may notice, in passing, that this is another example of ortho-maturation:- a development implicit or "expected" by the genetic code, but not actually coded into it). Thus then we appear to have the makings of a *personal identity* or *ego*, and we may provisionally take these terms as synonymous with *self-concept*, though we might wish later to endow the former terms with properties arising from further development.

At what stage then does the ego arise? Judging by the postulated evolution of other object concepts, we might say that during the sensori-motor (or oral) stage, it becomes built up as a non-integrated ensemble of ego-parts: "my hand", "my mouth", and so on. In the normal course of events we would expect such parts to become integrated as sets and groups, early in the following Concrete Operations[50] period — a development which may readily be associated with the wilful acts of autonomy over environmental influences attributed to the *anal* stage in development (according to the Freudian formulation). In view of the presumed pre-eminence of this ego schema and its antecedents, we might expect this particular set-and-group formation to be the first substantial sign of the emergence of group-formation in general. So while we might describe such a development as a Concrete Operations (or $\mathbf{M^1L}$) activity, we need not be surprised if it actually occurs in what is still a predominantly Sensori-Motor period. Such overlaps for different aspects of development are, after all, part of the Piagetian description. 247

So now we may turn to the thorny issue of *consciousness*. We can at least start by postulating two pre-conditions for consciousness:- attention, and self-concept. If we stop attending to something, then it slips from consciousness; and partial attention implies partial consciousness of the thing concerned. If we are unconscious, then we are not attending to anything. If we are dreaming, then we may be "unconscious" in behaviourist terms, but we are actually attending to internal schemata, and we ourselves *are* conscious in this sense.

But it might well be argued that a normal computer can and does "attend" very closely to its "senses" and to its motor activities; and it might even be said to switch its attention from one task to another when it is operating in a time-sharing mode (as is usual for large computers these days). Yet one would scarcely claim that such attention, on its own, would constitute consciousness; and the particular shortcoming which we will deal with here, is its lack of any flexible self-concept of the type we have been considering.

These two conditions may well be *necessary* for consciousness to occur, but are they likely to be sufficient? After all, the concept of consciousness is closely bound up with age-old concepts of *sentience* and *soul*[51]; and at first sight the proposed physiological/mechanistic organizations for 248

[50] in the wider sense which includes the "Pre-operations" sub-period.

[51] Lest there should be any doubt, I am not supporting any type of dualism here. Any "soul" will be supposed to have an ultimate physical embodiment — like that envisaged for any other mental phenomenon.

attention and self-concept are not immediately obvious as the likely bearers of sentience, nor of soul. It may indeed be the case that other pre-requisites will become obvious at a later date; but meanwhile it will at least set the stage if we look for potential makings of sentience and/or soul within such a mechanistic-physiological organization as the present one.

If we look more closely at sentience, it does seem to have a lot to do with pleasure/pain at a *symbolic* level — which, in the present context, may be interpreted as pleasure/pain relating to states of internal closure at the $\mathbf{M^1L}$ level. (In later development, the $\mathbf{M^2L}$ level might also become involved; but if consciousness can occur here before it arises, then clearly the $\mathbf{M^2L}$ phenomena cannot be essential ingredients). Perhaps all such symbolic pleasure/pain will involve the state of closure of the self-concept in some way; anyhow we may at least expect this to be true of the more powerful instances — in which sentience is most in evidence. Take, for instance, those "very human" traits of sentimental attachment to an object of some sort. It seems reasonable to assume that the internal schema associated with such an object is bound up in some way within the group-like structure which constitutes the person's ego. Consequently any loss of such an object (if it then results in a change in the internal schema) will be likely to upset the stability of the person's self-concept or ego; and, on the other hand, any refusal to accept the objective change by clinging to the old schema, will result in a mental drift away from reality. Of course Freud makes very much the same point in his "Mourning and Melancholia", and his term "cathexis" may be interpreted here as meaning "included within the group-like structure of the ego". 249

Thus there is a *prima facie* case for agreeing to the proposition that the necessary and sufficient conditions for sentience (and presumably soul and consciousness as well) are simply those suggested above:- Attention and Self-concept[52]. Provisionally then, we may accept this as a working hypothesis until some contrary argument or evidence leads us to re-consider the situation. We should bear in mind however, that any explanation of consciousness will probably appear at its least credible when one tries to apply it to one's own consciousness:-

> "*Cogito ergo sum*" — "I think [= 'I am conscious'?], therefore I am". "Perhaps *your* consciousness is explicable mechanistically, but surely mine is somehow special and transcendental — and probably eternal also! After all, I am quite unique and special in a remarkable way. Surely my life at least has a supernatural basis?"

(On the other hand though, these very thoughts help to suggest the important egocentric role of the self-concept as a hopefully stable point of reference in group structures at the $\mathbf{M^1L}$ level).

The remaining task for this section is to be rather more specific about the concept of *superego*, than in its previous mentions in Section C6.2 and in Traill (1975c). In the latter paper, superego was seen as "one-or-more schema (imago) embodying the perceived properties of another 'person'." To which the comment was added that this structure might provisionally be thought of as occurring at the $\mathbf{M^2L}$ level rather than the $\mathbf{M^1L}$ level of the ego; (though the terminology used was a little different). On second thoughts though, it seems more likely that superego constructs will be on the same level as the ego (i.e. $\mathbf{M^1L}$) — and not in the $\mathbf{M^2L}$ realm of Formal Operations and Secondary Process Thinking. (Of course it might later be appropriate to consider whether there might not be *another level* in between these two, especially if this would resolve some subsequent paradox. But for the moment, we will assume that this is not the case). The essence of the "debate" is this:- On the one hand we have several reasons for expecting the superego to make its appearance *after* the self-concept type of ego which we have been considering — which suggests the possibility of its being characteristic of a later stage, but by no means establishes this convincingly. Then there is the apparent ability of the superego to *control* the ego, and this seems to imply a higher echelon within the $\mathbf{M^nL}$ hierarchical 250

[52] provided it is based on pleasure/pain motivation toward internal closure, as described above.

organization; though against this, it will shortly be argued that this sort of control does not always operate in a downward direction within the $\mathbf{M^nL}$ hierarchy — and that the control must sometimes be upward or sideways![53]

On the other hand though, if one's self-concept is essentially an object-concept, and if the superego is also based on object-concepts ("perceived properties of another 'person' "), then it is difficult to see either of them as belonging initially to any level higher than $\mathbf{M^1L}$ (which entails power over objects); and indeed we might expect the basic "objectness" of self *and* parent-figure to lie in the $\mathbf{M^0L}$ level — in both cases. Moreover it seems unlikely that either structure has any strong affiliation with $\mathbf{M^2L}$ constructs, because in neither case are they directly and reliably amenable to the rational logic of the $\mathbf{M^2L}$ level of Formal Operations. Then again, if the superego differentiates from the ego in a gradual way without any discrete qualitative jumps, then it seems likely that it will still be found within the same functional medium as the ego. Anyhow this is the view which will be taken here, and maintained until a better contrary argument crops up.

But how is it that these parental imagos are supposed to modify the ego's activity? — What are the likely mechanisms? Well, at least it makes reasonable sense if we use the object-building conceptualization, and consider that the individual will usually be faced with apparent rival claims on his internal-closure tendencies. Of these, self-concept is undoubtedly the most important; but it is rivalled by other closely related configurations:- self-plus-other-people-closely-involved-with-me, mother, father, mother-father, animate things, and other such permutations. Different sets of haphazard experience or context will favour some such world-views for the moment, and discourage others — until the external situation changes yet again. But on the whole this will tend to yield a reasonably balanced view of reality for that individual, in the long run. Of course the important lesson to be learned here is that *society* (in one personified form or another) is a vital part of reality, of comparable importance to the *self*; and that flouting of society's norms is likely to be painful to either one's sense-receptors, or to one's ego-support through $\mathbf{M^0L}$ or $\mathbf{M^1L}$ retribution — "painfully" attacking one's internal closure at these levels. 251

In the longer term then, these superego/social group-like structures will presumably tend to shape their ego counterparts, and vice versa — each providing some internal constraints on the stability of the closure-patterns of the other. We may nevertheless accept the Freudian idea that the two start off as the same structure set, and that it is only in the light of further experience with the world that alternative closure-structured hypotheses evolve in favour of a differentiation of this sort. Such differentiation will presumably run counter to the preference for maximum closure — apparently expressed by the Eastern ideal of "Nirvana", a universal oneness which incorporates the self in a strifeless eternity — but such a world-view does not accord very well with the realities of an Earthly mortal world, so countervailing support for differentiation will build up as the infant becomes increasingly confronted with the evidence that "Mummy is not just part of me"! Paradoxically, some of this evidence may be seen in retrospect to be logically spurious (just as many scientific ideas or inventions had their initiative in concepts which were not in themselves correct); thus it has been suggested that the main incentive for the differentiation of "other" from "self" is the difficulty in accepting "bad" and "painful" into the concept of self — so some other scapegoat entity must be found, and this criterion of goodness-or-badness is therefore the original pseudo-definition for self-versus-other; (Fenichel, 1946). 252

[In passing, we may note that this trend toward self/other distinction can, in a sense, be induced to take a useful step back *into reverse* by the unfolding of genetic developments. The

[53] See also the later discussion and diagram of "Democratic pseudo-hierarchies" in Traill (1999, §8.3(5), p64) — now available online as www.ondwelle.com/BK0_MU6.PDF and in print as *"Mind and Micro-Mechanism"*, Ondwelle Publications: Melbourne. — RRT, 2006].

significant emergence of any new erogenous zone or mode will inevitably throw a new $\mathbf{M^{-1}L}$ (id) factor into the situation; and in particular, the advent of genital sexual arousal will predispose the individual toward a selective re-extension of ego as an amalgam with the concept of the loved one, into a more generalized group-like structure. Indeed such a psychological accompaniment to procreation would seem to be essential in humans if the resulting children are to encounter the ego-forming environment which the genetic code takes for granted — as an orthomaturational extra].

There are other useful ways of conceptualizing such schisms in mental structures. One notable approach is the theory of "Cognitive Dissonance" promoted by Leon Festinger and others (see the anthology edited by Fishbein, 1967); and criticized, on purist-experimentalist lines, by Chapanis and Chapanis (1964). The essential point here is that three propositions (A, B, and C) are each considered in relation to the other two. To put it briefly (and in the terminology of our present discussion), there must be mutual consistency, i.e. internal closure right round the triangular path — *or else* there will be a strong motivation to change one or other of the propositions; or to escape the "dissonance" in some other way. 253

The theory predicts, quite reasonably, that a "negative attitude" such as we might expect *C* to be in Figure C6.3/1, will induce a similar negative attitude in either *A* (differentiating self from mother, in this case) *or* in *B* (dissociating pain from both, and presumably projecting it onto some other conceptual object). Both these solutions imply a schism of one would-be group structure into two separate structures. Such differentiations are necessary if we are to develop an adaptive model of reality — *and* they depend on there being a detectable amount of differentiation in our perceivable environment; otherwise our picture of reality would remain as one undifferentiated mass — a trivial situation in which the chosen solution is to make C into a "positive attitude", thus embracing pain! (This solution is probably not feasible in this case, unless the genetic $\mathbf{M^{-1}L}$ nature of pain changes, or the "pain" is itself due to some other lack of closure, *or else* a higher $\mathbf{M^nL}$ level intervenes and so constitutes a case of masochism (Fenichel, 1946, pp 73-74)).

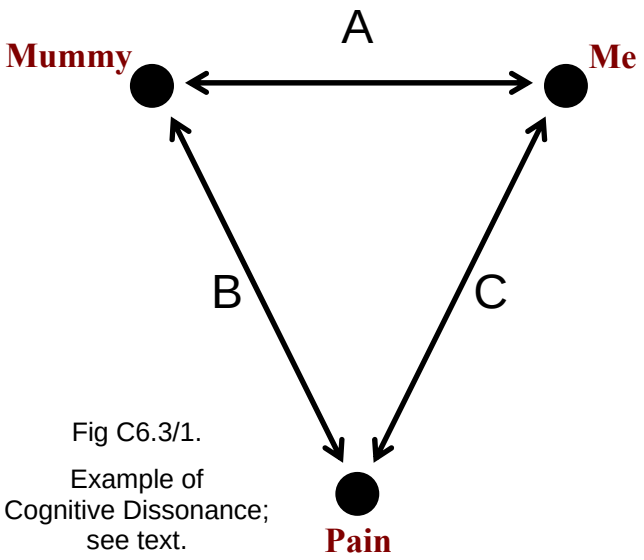


Fig C6.3/1.
Example of Cognitive Dissonance; see text.

One trouble with this simple model is that real situations will usually involve more than three elements, so that the web of affiliations between them will be much more complex, and indeed the simple triangle-based rules used above will not serve us any more until they have been extended. Such extension is best conceptualized by some sort of matrix-table of connections, and one such formulation is given by Abelson and Rosenberg (1958;— in Fishbein, 1967), a formulation which appears to work for the data which these authors provide — though we may doubt its general applicability in the form given by them:- a specific algorithm which amounts to a cluster-analysis technique and which gives non-believable results in some apparently applicable hypothetical examples. Of course, in a sense, the whole purpose of such biological attempts at meaningful differentiation *is* to perform cluster-analysis; but this is scarcely a matter for algorithms in the normal computer-oriented sense, and it should moreover be viewed as a potentially continuing process — open to feedback and new evidence, as well as being probably performed by some self-organizing process which will also be sensitive to feedback. By contrast, the "Repertory Grid" measurement techniques devised by George Kelly (1955) would appear to 254

do better justice to gauging what the important elements are (in the mind of the individual concerned), and how they should be clustered. To a considerable extent, these analyses can detect blockages in the formation of adaptive differentiations, and these may lead to solutions; but their proper use depends on feeding the relevant tentative findings back to the individual himself, (presumably at the $\mathbf{M^2L}$ level!)

The more biologically sensitive aspects of such modelling would seem to be quite compatible with the micro-element theory and its concepts of internal closure which we have been discussing. The major difference of emphasis is obviously in the fineness-of-resolution and the concomitant difference in measurability. In practice we will also expect the clinical/behavioural conceptualizations to recognize a degree of "fuzziness" in the subject's mental constructs 255
especially in his attitudes and associations, though also in his mental models of objects. (On the other hand, in the realm of the perhaps-unobservable, we can envisage a fairly precise discrete structure for elements at the molecular level, with the fuzziness arising as statistical consequences of populations of these discrete phenomena). Rather more significantly however, I am less certain that any actually-existing $\mathbf{M^nL}$ structure will necessarily come to be reflected in any cluster-analysis technique as currently administered, though I fancy that the Repertory Grid technique is flexible enough to do so if it is administered by someone who is sensitive to the possible importance of non-standard entities intruding into the "normal" domain of experimental study, *from* $\mathbf{M^{-1}L}$ *or* $\mathbf{M^2L}$ *levels*. Indeed perhaps the method has already picked up such phenomena. Moreover, some types of hierarchical or lattice structure may not necessarily lend themselves readily to expression and analysis via orthodox cluster-analysis matrices. If this is the case, then the main need is to *become aware* of the previously unsuspected structural complications of the subject's thought-affiliations.

But let us return to our specific case of concept-differentiation:- the nature of the superego, and its distinction from the ego. We have already identified the ego as being the individual's self-concept, or at least those aspects of it which are pertinent to consciousness or to the control of one's activities. Similarly superego is usually regarded as being a parent-figure personification of some aspect of society's demands on the individual — as seen by him; and subsidiary "parasite superegos" of hypnosis or war-neurosis serve much the same role, though in a more ephemeral way (Fenichel, 1946, p 125). But by what mechanical-or-physiological means could such structures exercise their influence over the ego — bearing in mind that in some cases this control seems 256
to become dictatorial in its strength?

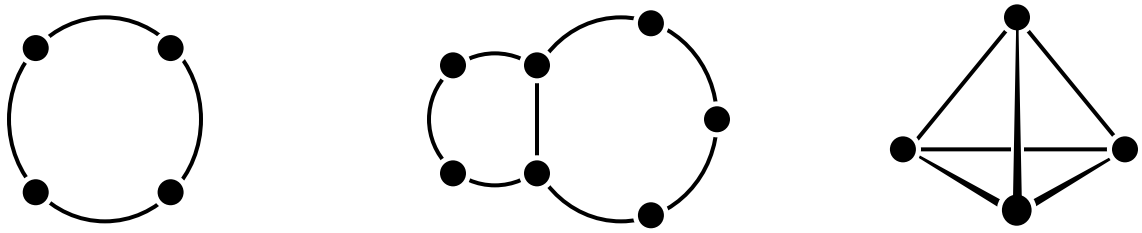
In natural conditions, surviving primate infants will always have considerable contact with one or more parent figures who will, to a greater or lesser degree, generate schemata with sufficient resemblance to their own characteristics for them to be able to "graft" these conceptualizations onto their own fragmentary self-image scheme-like structures — hopefully resulting eventually in a reasonably coherent whole which may now be identified as the self-image or ego. Even at the basic object-level ($\mathbf{M^0L}$) this is probably indispensable for any orthomaturational development of a self-concept; and the mechanism might fairly be explained as generating potentially-useful (though unstable) scheme-like structures as images of the examples presented — structures which are thus available for incorporation into the "jigsaw" process of building up a credible group-like stable structure to represent the self. It may reasonably be supposed that without a good supply of such part-formed pieces as "hints" available for introjection, the task of satisfactorily building up the "jigsaw" pattern of self would be virtually impossible. (Such a mirror-like function of Mother-Child interaction shows clearly in work such as that done in Edinburgh: Trevarthen (1974, 1975), and Maratos (1973, 1974)).

One consequence of this procedure is that the infant presumably "builds his house out of local materials"; that is, his self-structure will contain components whose composition is influenced by any local peculiarities in the environment which he has happened to have experienced. If we

confine our attention to the more object-centred experiences of the $\mathbf{M^0L}$ level, such variations are not likely to be very extensive — after all, geometrical and physical properties do not vary vastly from one place to another, even if there are some significant differences for such things as facial 257
configurations. However as soon as we advance into the complexities of social environments, there will clearly be very great local differences. Consequently the crucial $\mathbf{M^1L}$ aspect of the self-concepts might well be very considerably affected by the nature of the scheme-like fragments which become incorporated into the structure of the ego at this stage. This then is almost certainly a vital feature in personality formation (presumably in combination with *genetic* raw-materials and "tools"); and it is undoubtedly significant that this coincides with Freud's "Anal Stage" with the infant's exercise of his powers of choosing to give — or choosing to withhold.

But how does this explain the superego's apparent tendency to control the ego? Surely there must be more to it than a mere sharing of common scheme-like fragments? Well, it would seem likely that these fragments will often maintain viable connections with more than one schema-structure, and this will presumably mean that we must face the problem of trying to attain closure simultaneously in two separate-but-communicating sets. (Essentially this is the same problem as the case of Cognitive Dissonance problems in which there are more than the simple triangle of three entities; and in fact no full solution may be possible). If simultaneous closure of the two sets *is* possible despite their need to "cooperate", then well and good; but otherwise we must expect to see one set achieving closure at the expense of the other — or perhaps there will be deadlock, or oscillation between the two possibilities (suggestive of a manic-depressive condition perhaps?), or some other type of compartmentalization.

This discussion has been referring to the more macro ensembles such as schemata, and these are to be seen as being composed of coordinated *populations* of elements which we have taken to be linear molecules (such as RNA). At this stage it seems helpful to consider more closely just what might be happening at the molecular level — this being basic to any physiological-mechaniatic understanding of the underlying processes. Let us start by considering the stabilizing 258
influences on a simple "set" configuration (see Sections C2.3 and C2.4, above). Initially our extensive set is presumed to have been formed on the basis of some arbitrary intensive criterion. As such, it will only be "on probation" — with some sort of precarious metastability until such time as it might gain extra stability from elsewhere; otherwise it will simply be dissolved as a "Darwinian failure". One way of achieving this extra stability was seen as being the acquisition of group-like properties: simple closure around a "loop" in its own membership-references — or better still, by additional mutual corroboration with the loops of other sets; see Figure C6.3/2.



(a). Simple loop (b). Figure-of-eight (b). Polyhedron

Figure C6.3/2. Group-like corroboration around the topological loops inherent within the supposed intensive-reference patterns between members of a developing physical set. Looking from left to right, the configurations show increasing degrees of mutual support, presumably adding to the stability of the topology.

It is not clear precisely how this would be likely to work out. Indeed it would not be altogether surprising if the actual details were "messy and pluralistic" from the viewpoint of an observer who was looking for the sort of order he would find in a crystal lattice. It should, of course, be recalled that we are considering *communicational* networks, and that these are not necessarily the same as geometrical-physical considerations, despite anything that Figure C6.3/2 might suggest to the contrary. But must the different loops arise from different sets (which then form an amalgam), or could they arise *ab initio* within the same original set? And are the entities, 259
represented by dots in Figure C6.3/2, definite and distinguishable — or are they simply interchangeable exemplars, indistinguishable and diffusely distributed? There seems to be no compelling reason why these various possibilities could not all have some element of truth — in a "messy and pluralistic" way, and indeed the actual mix might well depend on the complexity of the structure to be depicted — simple structures evolving successfully by trial-and-error within the solitary set (and perhaps its exact replicas), while more complex structures would presumably require a more piecemeal approach (with or without the aid of higher $\mathbf{M^nL}$ levels).

(There are some interesting parallels here in the structure of various chemical substances *in bulk* — though it would be dangerous to read too much into such analogies. Ionic solutions, benzene derivatives with their conjugated double-bonds, and liquid crystals are cases in point).

Anyhow, the points which are important for our discussion arise here when we consider what is likely to follow if this sort of arrangement *applies to the* $\mathbf{M^1L}$ *structures* including ego and superego. For one thing, one's parent-figure basis for the superego will certainly be too well established and corroborated for it just to dissolve away if it does not happen to fit at all into a coherent whole with the self-concept. It is even less conceivable that one's self-concept could dissolve away under such circumstances — especially if we see it as the "gateway" to consciousness. Accordingly, if there is a serious incompatibility between the two, then one of the following courses would seem to be inevitable:- ▪ One might suppress the other (and this probably means "repress" in Freudian terms), either obstructing its external communication, or by using some sort of superior magnification of its own influence — probably by outnumbering the other in terms of elemental units, or by incorporating into its schema some elements which are 260
inherently more attention-promoting. There is some difficulty in seeing how this could work effectively *en masse* over a diffuse extended region, but it might well have some local importance.

▪ Another possible course is for one or both of the structures to accomodate its overall structure to the peculiarities of the other. Such structural changes are probably occurring arbitrarily in the elements all the time anyhow — as chance mutations. In these circumstances, there will be an encouragement for some mutations to proliferate so as to improve the overall closure (even at the expense of a more restricted type of closure), and this will *ipso facto* tend to reconcile the "demands" of ego and superego.

[▪ A third possibility might be "to do nothing" and to keep the self-concept apart from superego/social concepts. In so far as this is possible, it would probably amount to a dominance of the ego, denying the existence or relevance of social imagery. As such, it would appear to be a special case of the first possibility listed here; but it is perhaps worth noting that this seems very close to Laing's (1960) suggestion concerning the development of at least some types of schizophrenia. Briefly the scenario runs something like this: "I deny the impossible and stupid demands which society makes on my ego, so I will re-draw my concept of reality, narrowing it down to schemata which are closer to my inner *real* self. But now I find that my ego is becoming atrophied through lack of external closure. I shall blame the outside world again, and draw my concept of reality yet closer so as to protect the purity of my real self. …" — and so on, perhaps into catatonia].

Such concepts as *closure* and *differentiation* can probably only have a precise meaning when applied to small localized ensembles of discrete elements such as molecules; and even then we

would probably have to postulate that they exist in an artificially strict isolation. For such macro-oriented concepts as *ego* and *superego*, this limitation to structural definability will be even more applicable; and whether we like it or not, we will presumably just have to put up with it. Clearly such terms do make sense at the macro-level, and it seems likely from the above discussion that their discrete underpinnings at the micro-level can be plausibly postulated, if nothing else. Such limitations are by no means new. Any discipline concerned with large populations of discrete elements runs into the same problem: Physics and chemistry of fluid systems, and (arguably) the concept of socioeconomic classes, are cases in point. Of course we can find ways of handling such population concepts — appropriate to specific problems at least, even if we cannot arrive at an ideal generalized approach. (As examples of such ad hoc modelling we might cite Ashby's concentration on specially chosen configurations (1960), or the use of statistical mechanics for populations of particles or gas molecules in physics). There is no obvious reason why similar techniques should not be useful, in at least some contexts, for brain-systems if they can be adequately specified statistically and/or paradigmatically in this way; but in order to achieve sensible results in this approach, it will be more than usually necessary to be clear about what we are doing, and why we are doing it. (In such matters, other things being equal, it is probably more profitable to be specific — at the risk of being wrong — and then be on the look-out for evidence that might shed light on any errors implicit in the theoretical assumptions). 261

Anyhow, what can we now say about the ego and superego structures, and the nature of any dictatorial tendencies of one over the other? For one thing, we can start by casting doubt on the propriety of the "dictatorial"-power concept:- Joan of Arc may well have hallucinated voices which commanded her to crown the Dauphin, but it is also possible that these hallucinations and their content arose as *secondary* consequences of her pre-existing world-view on social matters — probably involving parental imagos within her superego, but not necessarily *originating* as a capricious command from such a source. In the context of the present theory, it is more informative to think of superego "commands" as particular *socially-oriented* sets which are somewhat *lacking in closure* and yet, for historical reasons, they are also important *constituents in the closure-pattern of the ego*. Or, to put it another way, the attempts at closure (for a specific aspect of self-concept) runs into a conflict between (i) the more obvious aspects of *self* and their self-consistency, and (ii) self as a *social* being within the context of what one sees as facts and also the closure-requirements within one's immediate society. 262

Emphasis on (i), the non-social *self*, would seem to be characteristic of the man who will expend great efforts to make exhaustive coherent sense of his own self or his ideas, (Leonardo da Vinci, perhaps?); while emphasis on (ii), the *social* being, looks rather more like Dixon's (1976) authoritarian military commanders whose self-image largely rests on the continued favourable opinion of "father figures", and who will tend to put themselves and their armies in suicidal situations in an unconscious attempt to maintain this favourable opinion. However I see no inevitable reason why we should expect people to be consistent on such matters. Such emphasis, one way or another, could well be situation-specific or (more precisely) specific to the particular aspect of the self-image which is involved. In practice though, if one is brought up in an environment in which one aspect of one's self-concept is learned as being predominantly a matter of social-approval, then there will probably be a similar learning-situation for other aspects of self as well. But this is not inevitable, and we might well be aware of the possibility for exceptions such as might arise from a home/school dichotomy — or situation-specific attitudes exhibited by the parents. (Inconsistent behaviour by parents *within* a specific situation constitutes a rather different phenomenon, and will be discussed in Chapter C8 as being a probable schizogenic factor). 263

Another influence likely to enhance the consistency of a person's view across different aspects of self-concept will presumably arise at the $\mathbf{M^2L}$ level. Here the person is likely to

realize, intellectually, that he is acting inconsistently; whereupon he may or may not feel strongly enough about it to try to remedy the situation. He might seek out situations which promote one attitude or the other, (this could be done unconsciously and perhaps entail Freudian repressions); or he might consciously seek enlightenment or other help. There is however no guarantee that such endeavours will succeed.

We may summarize the situation of the superego by suggesting ▪ that it consists of those aspects of ego-closure which depend for their stability on schemata relating to the parent-figures (as archetypal representatives of society); ▪ that "demands" are primarily felt-needs for closure; and ▪ that it is probably misleading to think of the superego as some separate self-contained structure which competes or cooperates with the ego, or with the id, in a rather mysterious and autonomous way.

C6.4 More about the likely hierarchical organization of concepts: parallel systems, inversions of control, and consciousness again

In Chapter C3 we considered the likelihood that the various levels on the postulated $\mathbf{M^nL}$ hierarchical scale might be using the same basic substrate. The tentative opinion resulting from this was that the levels $\mathbf{M^1L}$, $\mathbf{M^2L}$, and any higher than these, would all share the same substrate — quite likely within the neocortex; while the $\mathbf{M^0L}$ level would occupy a separate substrate, presumably in the older parts of the brain, though possibly elsewhere as well (see Section C5.4). The $\mathbf{M^{-1}L}$ level was not mentioned in Chapter C3, but it is fairly obvious that it would involve yet another separate substrate. It is, after all, defined in terms of *peripheral* nervous activity (early in Section C5.4). Whether or not such levels share the same substrate is likely to have a significant bearing on the properties of the physical-set elements (or "lists") in the levels concerned. List-structure, as depicted in Figure C5.2/3, entails actual-or-potential "calls" to other elements which are generally assumed to belong to a population which is *lower* in the $\mathbf{M^nL}$ hierarchy. But perhaps there is no compelling reason why this should always be the case — especially if the higher levels have no fundamental distinction between them to hamper such flexibility. 264

Bertrand Russell and his mathematically-minded contemporaries were much concerned to clarify the paradoxes which arose from an "inadmissible" use of sets, such as "the set of all sets including this set itself". But the biological world is no respecter of man-made restrictions, so there is no reason in principle why mental lists of the sort we have been looking at should not include themselves if any useful purpose could be served by doing so. Rather more to the point, they should be able to include references to *other* lists within their own $\mathbf{M^nL}$ level, perhaps reciprocally, and even to include references to lists *higher* on the $\mathbf{M^nL}$ scale![54] Same-level linkages might possibly be invoked as a means of effectively extending the practical length of lists; but here we will concentrate on some interesting implications arising from the latter suggestion that "membership"-references might extend upwards to higher $\mathbf{M^nL}$ levels.

Given the hierarchical $\mathbf{M^nL}$ structure, there is something of a dilemma as to where *ego* and *consciousness* could be fitted into it. In Traill (1975b), the ego was placed at the $\mathbf{M^1L}$ level (there referred to as "L_2"); while it was suggested that "Consciousness *may* be explicable in terms of a high*est* order schema" ... selected from those levels currently available to that individual. Subsequent accounts have left the ego at $\mathbf{M^1L}$, but some further thoughts have emerged concerning the placing of consciousness. In Traill (1976d, Section E1), the new suggestion emerges that consciousness may be: "some sort of communications-device-or-centre, *separate* from the pyramid-structure itself, and having a more-or-less stable and unchanging status throughout the development process." 265

[54] See original-page 250 above, and its new footnote[53]. — [RRT, 2006]

Section C3.2 of the present work, ends up by provisionally accepting what amounts to the latter concept: "as a sort of $\mathbf{M^{\infty}L}$ level — a sort of local approximation to an 'all-seeing' transcendental being." And yet in Section C6.3, ego (with attention) was seen as a precondition for consciousness — strongly suggesting that consciousness should be closely associated with $\mathbf{M^1L}$, the presumed level for the ego. How could these two implications be compatible? In topological terms, the solution turns out to be simple once one drops the assumption of strict hierarchical ordering:- One could have a *loop* structure for the communicational connections; and that is precisely the sort of innovation which would be made possible if sets could reference higher-order elements.

We may suppose that the "consciousness structure" (whatever it is in physical terms) is indeed closely associated with the ego (self-concept) and likewise at the $\mathbf{M^1L}$ level with it; and yet it will still be able to "call" or refer to schemata at the $\mathbf{M^2L}$ level, or possibly any levels beyond that, by means of this "inverted referencing". In this sense it could still effectively fulfil the role of a $\mathbf{M^{\infty}L}$, no matter how many levels of abstraction were added to the $\mathbf{M^nL}$ hierarchy; and yet it could still retain some connections with its presumed original place at $\mathbf{M^1L}$. Just what balance should be kept between these two types of affiliation is another matter, and it will be worthwhile for us to look briefly at what this is likely to entail:- 266

It is well known that introducing a communicational or control-path loop into a system is likely to cause problems of *in*stability — or *over*stability. One form of run-down system discussed by Ashby (1956) arises when the state-determined path of its transitions happens to bring it back to a state which is identical to one it has already passed through; so from then on, it will repeat itself *ad infinitum* unless outside agents intervene such as to give an adequate change-of-course to this dynamic process. Such a tendency to get stuck in a rut, pending a sufficient shake-up, constitutes a type of *stability*. If it occurs in a living organism, it will presumably manifest itself as some sort of paralysis — possibly damaging the organism's chances of survival, though there may be circumstances when it might aid survival instead; this will depend on ecological balances. Negative feedback, as understood by electricians and economists, will have a similar stabilizing effect (for good or ill); while positive feedback will magnify effects (for good or ill) — possibly leading to system breakdown, depending on the details and parameters of the system.

If consciousness does reside at the $\mathbf{M^1L}$ level, then it is difficult to see how we could control our abstract or concrete thoughts *without* control links (from $\mathbf{M^1L}$) to $\mathbf{M^2L}$ and $\mathbf{M^1L}$ respectively. Perhaps we could still acquire the relevant concepts fortuitously, as seems to be the case for sensori-motor development of $\mathbf{M^0L}$, but apparently we could neither direct our learning activities, nor consciously use the concepts once we had acquired them! Thus the anomalous "upwards" and "sideways" referencing would seem to have an important role in the mental life of primates. But apparently there is a price to be paid for this privilege, and this could turn out to be the risk of 267 having one's ego "de-stabilized" by interference from our own consciousnesses — either directly, or via the abstract thought of $\mathbf{M^2L}$; (and it might be argued that herein lies one danger in attempting to psychoanalyse one*self*). We shall not pursue the matter further in this chapter, but it is worth bearing in mind when considering the detailed nature of neuroses and psychoses, and the likely *useful* roles played by the Freudian defense-mechanisms.

Before leaving this section, it will be appropriate to elaborate slightly on the points made at the close of Section C5.4, concerning *parallel processing*. It was suggested there, that there might well be at least two different $\mathbf{M^0L}$ levels for mammals: one primitive and archetypal, while the other would be "purpose built" for the neocortex and (presumably) the basis for higher levels of the $\mathbf{M^nL}$ organization. Each would probably develop more-or-less independently, with little or no direct communication between them — in accordance with Ashby's comments (also cited in Section C5.4) on the undesirability of excessive interconnection. Similarly there was

mention of the better documented paralleling of visual and auditory receptive areas of the brain. Then again, it has long been realized that ablation experiments point to a considerable ability of the brain to use alternative (parallel) pathways or mechanisms. And of course, at the much smaller molecular level, it has been a crucial part of the current theory that there will be quite large parallel redundancies amongst synchronizable micro-elements.

For any system like this, we should beware of asking naive questions of the type: "Does the brain process its information by method X, or by method Y?" — inducing us to set up an experiment aimed at a decisive X-or-Y answer. In fact though, it is quite likely that the system as a whole will be quite able to operate *either* way if both methods are reasonably feasible; and even 268
if we can isolate small parts of the system, we might find that the configuration will fluctuate with time (as in chemical resonance). This makes for considerable experimental complication, though perhaps there might be ways for detecting the current state without unduly disrupting it by the very process of measurement itself. (For instance, the various frequencies and patterns found in Electro-Encephalogram (EEG) traces might turn out to be useful indicators of which specific subsystems or modes were currently being used by the brain).

The natural advantages of such a pluralistic system should be obvious. The greater the redundancy and (suitably organized) variety, the better prepared the system will be to face the surprises and buffetings of a capricious environment. Of course if the system finds itself in what seems to be a stable and reliable ecological niche, then there will be a case for *specializing* — dropping some of the cumbersome provisions for "the invasion which never comes" — and perhaps producing great efficiency within the context of the niche, outrivalling its slower all-purpose competitors; and yet the "day of wrath" may still come when the security of the comfortable niche will disappear. But then nature as a whole is also pluralistic. The specialized dinosaurs may go, but there are many other pluralistic cards in nature's hand, and the overall system of life will tend to continue in many other forms.

And yet there may be still more to be gained from *organizing* such variety to the best advantage. It will be recalled that each $\mathbf{M}^{i+1}\mathbf{L}$ level has been depicted as serving to form useful *sets* amongst the members of the $\mathbf{M}^{i}\mathbf{L}$ level below it, and this is indeed interpretable as a trial-and-error attempt to organize the existing variety to the best advantage, while still remaining pluralistic itself. Ashby is surely correct in pointing to the dangers of intercommunication within the brain (at least at the same $\mathbf{M}^{n}\mathbf{L}$ level), and the hazards of loops in general has just been looked 269
at; but insofar as the coordination can be managed "from above" *without disturbing the states of the elements*, then we can lay some claim to having the best of both worlds. Thus perhaps we can say that one interpretation of the importance of higher levels of intelligence is that it gives us the potential for specialization without *necessarily* abandoning our flexibility. It would be comforting if we could be confident that Homo Sapiens, as a race, is capable of realizing this potential through all eventualities!

C6.5 Distinguishing inputs and acquiring a conceptual hierarchy; success, failure, and the shadow of psychosis

At this stage we should return to the Ashby-type model developed in Chapter C4, and look critically at the practical details implicit in Figure C4.5/2. In particular, we should note that there are at least three different types of input (E_1, E_2, E_3) — each manifestly serving a different function which should not really be confused with the others — and yet we have so far said nothing definite about how such distinctions are to be made. To quote from Section C5.5 (paragraph 8), where the matter was mentioned in passing:-

> "... in any live situation it may well be a matter of some considerable subtlety to distinguish which input cues are to be considered as E_1, and which are E_3 ... And then the situation is further complicated by the need to consider evaluative feedback-input: E2 for the $\mathbf{M}^{0}\mathbf{L}$ case, to which

we may now add E4 for the $\mathbf{M^1L}$ case — thus introducing another feedback loop into the configuration of Figure C4.5/2."

[In this context, Ashby's "E_i" nomenclature is beginning to become less helpful because it obscures the supposed relationship with specific $\mathbf{M^nL}$ levels, and the distinction between "straight" information (E_1, E_3, E_5, ...) as against the evaluative feedbacks (E_2, E_4, E_6, ...). Although this issue will not arise again in the present work, after this present section, it might nevertheless help to clarify the situation if we consider an alternative notation which would correspond to the $\mathbf{M^nL}$ notation (in which each $\mathbf{M^iL}$ level was subdivided into a lower sub-level of elements "$\mathbf{m^il}$", and an upper sub-level involving sets and groups "$\mathbf{m^{i+½}l}$"). Thus we might now use a notation something like IP^i to represent the *I*n-*P*uts to the respective levels $\mathbf{M^iL}$; and differentiating this further into IP_r^i and IP_e^i — as variants to specify raw data or evaluation, respectively. Thus IP^0 would consist of IP_r^0 (=E_1), and IP_e^0 (=E_2) — with these relating respectively to $\mathbf{m^0l}$ and $\mathbf{m^{½}l}$ (which collectively constitute the sensori-motor level, $\mathbf{M^0L}$). And similarly for the other double-levels.] 270

As adults, we are inclined to take such distinctions between the different types of input for granted — until we hear stories of typists mistaking the typing-instructions for the text itself, or until our computer mixes up the different levels of its data when we fail to spell out every distinction according to the rules; or indeed until a psychotic patient appears incapable of reliably making distinctions of this sort. Moreover, children seem to be much amused by (comprehended) jokes which play at violating such distinctions — arguably because they thereby demonstrate to themselves, and to others, that they have mastered some vital part of this aspect of everyday reality; (internal closure again). Thus:-

First child: "Say something!"; *Second child*: "Something!".

But then it seems plausible that many adult joking-practices may serve a similar function in relation to levels within the social context. Here the purpose of "ribbing" a non-group-member may be seen as demonstrating that he does not have the necessary "in"-knowledge to distinguish fact from a *dead-pan delivery of fiction*; or at least the teller does establish his own position even if the "victim" *can* wend his way between the more concrete facts and the more abstract joke-component. In fact, such mutual negotiation of the distinctions is actually likely to be more satisfactory all round, and contribute to social cohesion (Fenichel, 1946) — unless there are other reasons for wishing to exclude the outsider, in which case there will presumably be dissonance at the turn of events, and some measure of resentment within the joke-teller. 271

But let us return to more clear-cut cases, and try to establish a measure of detail as to how we ever achieve the ability to make such distinctions within the mass of information which is presented to us. This should then shed some light on why the psychotic, and the computer, have difficulties in these matters.

First we may deal with the evaluative feedbacks: E_i (where *i* is even), or equivalently IP_e^k (where *k* is an integer). As far as the hereditary or "hardware" $\mathbf{M^{-1}L}$ level is concerned, there will presumably be no such feedback for the individual, though clearly there will be for the species via natural selection *between* individuals. So, for our present purpose, we may disregard any question of "E_0 or IP_e^{-1}" as potential modifiers of the $\mathbf{M^{-1}L}$ level. Looking next at the sensori-motor stage and the $\mathbf{M^0L}$ level, it is clearly closely related to physical pleasure/pain, of the traditional straightforward "reinforcement" type; and such feedback was seen as tending to stabilize existing constructs by "tags" of approval for those "under attention" when the reward occurred. Similarly, any negative reinforcement would tend to de-stabilize by means of negative tags, and presumably directed by attention in the same sort of way. (The "decision" as to what will be classified as pleasurable or painful has already been taken in the evolution of the species, and is incorporated in the $\mathbf{M^{-1}L}$-level structure).

And yet there was more to the sensori-motor period than just the physical aspects of the pleasure principle, though this is perhaps not apparent at first. If the individual concerned is 272
making any significant headway towards the construction of object concepts (in the sense of modelling the objects' group-like properties, and not simply acquiring rules-of-thumb for handling them), then it is difficult to see how this could possibly be done without using internal-closure criteria. (Of course it might be argued successfully that some animals, while starting into the sensori-motor period, never get to the stage of developing internal closure. Such possibilities should be borne in mind, and if they turn out to be valid then we might reasonably consider such modifications as re-defining the developmental periods in a more optimal way). Anyhow, the supposed internal reward derived from such internal closure does constitute a type of feedback, even if it is not strictly an "input" in the usual body-boundary sense; so it will not necessarily cause the same problems of disentanglement as those inherent in the various $E_{integer}$ inputs of Figure C4.5/2. Nevertheless it might be useful to formally label it as IP_i^0, with the understanding that it does originate internally — hence the subscript *i* for "internal", (not to be confused with "i" as a disposable integer in the earlier discussion).

So far there do not seem to have been any awkward decisions to be made about how to use the input. Hereditary structures and inbuilt random-generating features have presumably directed attention to this or that sensory phenomenon, so that a certain distribution of sensory (and motor) hereditary scheme-elements have been subject to a potential learning-process; but this has presumably affected the $\mathbf{M^0L}$ level alone, since the higher levels have not yet materialized, and we assume the $\mathbf{M^{-1}L}$ level to be uninfluenced by learning. Once the $\mathbf{M^0L}$ level has developed stable schemata for objects or other group-like structures, these will provide the elements for the $\mathbf{M^1L}$ development to begin — and here there will presumably be a new need for evaluative feedback as a means for choosing among this new crop of elements. How then is the evaluative 273
input correctly allocated between the two levels?

Considered in absolute terms, there probably is no such clear-cut allocation, and the same evaluative signals will initially descend equally on the attended-to elements of both $\mathbf{M^0L}$ *and* $\mathbf{M^1L}$, so that each is likely to share "praise or blame" along with the other — however unjust this may seem to be, and however retrogressive its effect. Moreover it seems likely that the $\mathbf{M^2L}$ level will receive the same indiscriminate treatment when it appears on the scene later on. (Indeed the same arbitrary distribution will occur to some extent *within* each level, because there is no guarantee that the phenomena attended to are actually related to the reward-or-punishment. However such situations are fairly rapidly corrected using versions of the "homeostat" principle discussed in Chapter C4 above, with behavioural consequences familiar to users of the Skinner-box experimental technique). Thorndike (1911) had been early in noticing an apparent asymmetry between positive and negative reinforcement: the "pain" case giving less predictable results — arguably because it is not always easy to predict the level (or the schemata within a level) which will switch-over in an "attempt" to avoid the noxious stimulus; and there are similar ambiguous implications for punishment in education! Experimental design, for the standard laboratory paradigm of the controlled experiment, appears to solve this problem: the Subject's attention is deliberately constrained into the desired channels, by such devices as saliency or training, so it is more-or-less known which level will be influenced most significantly. Of course this is fine as far as it goes, though it does rather seem to trivialize the Subject as an otherwise interesting system-to-be-investigated. It is this inherent limitation which has been so usefully transcended by some of the "less respectable" work, such as ethology.

But looking again at evaluative feedback, it would seem that we actually do eventually 274
manage to deal with many of our pleasure/pain sensations by responding at the correct $\mathbf{M^nL}$ level. True we may panic or act impulsively in response to stimuli which would be more appropriately handled by a "thoughtful" approach (using the higher $\mathbf{M^nL}$ levels); or we may make the opposite

mistake when it would have been better to act on impulse — "Wise men and grocers: they weigh everything!" (*"Zorba the Greek"*). However that may be, our various levels (if we accept their existence) do seem to develop along correct lines, in some of us at least; and this must presumably be due to the steering influence of evaluative feedback — directed, on average, to the appropriate levels. So let us consider what particular influences might tend to perform such steering correctly.

Probably *the* most important factor here will be selective attention of various sorts. To start with, it rather looks as though the significance of Freudian erogenous zones is precisely that their sequential pattern of ascendancy *does* direct the individual's attention to specialized types of phenomena which are likely to be the most important ones for that particular stage of development. After all, the Sensori-Motor ($\mathbf{M^0L}$) stage does involve *oral*/manual/visual/auditory experiences as a basis for object-concepts; whereas the crucial task for the $\mathbf{M^1L}$ development of the following period is the acquisition of an adequate self-concept, and here the "*anal*" activities of *autonomous* giving-or-withholding deserve close attention — along with the mysteries of "When does a part of me cease to be part of me?" Clearly it is likely that such vital-at-the-time matters will be promptly attended to if the individual is granted the bonus of erotic pleasure by so doing.

[Development in this way would constitute another example of orthomaturation. The "pre-programmed" unfolding of erogenous zones, in a strict sequential schedule, pre-supposes that the 275
appropriate environmentally-determined experiences will be available at these times. If these experiences do not occur, or if they bid for attention at the wrong time when erotic-attention is directed elsewhere, then it is probable that the "wrong" lessons will be learned. Moreover it seems likely that the secret of a successful *society* or *culture* lies it its particular knack of institutionalizing such "wrong" lessons such that they turn out individuals who are actually "right" for that society, as a stable ongoing system — even if the lessons were sub-optimal from the point of view of the individual, considered as a potential member of some other culture. (Margaret Mead, 1928/1954, 1935/1950).]

Another means for usefully directing attention would probably be provided by the tendency for the mind to *remain* concentrated on the same area of thought, for some time at least. The usefulness of this "mental set" depends on a tendency for phenomena in the environment to retain a similar logical connection for more-or-less extended periods of *time* (in addition to the tendency for them to have *structural* features in common with our postulated $\mathbf{M^nL}$ hierarchy); thus if one has just been actively involved with concepts of food, then one will tend to retain this outlook for any new phenomena — and, on the average, such a bias will turn out to be well-founded. But such selection is presumably occurring *within* a particular $\mathbf{M^nL}$ level; so would the same apply between the levels? In fact it seems that we do maintain such level-specific attention:- If I am concentrating on abstract matters, I will tend to continue to do so for a while; (though interestingly enough, I may also be able to maintain some degree of *separate* attention to some other task at another $\mathbf{M^nL}$ level — such as driving a car! Yet it seems that there will be times at which I must concentrate my "full" attention on one or the other; quite likely because the 276
particular problem has come to require the active involvement of other $\mathbf{M^nL}$ levels — as when I must think logically about the route I must take, or when the gearstick jams).

Once the ego has appeared, we must expect that it also will play a major part in directing attention; and in accordance with the arguments of Section C6.4, we may suppose that this could occur for any $\mathbf{M^nL}$ level — though it is by no means obvious that we actually do or can attend to $\mathbf{M^0L}$ or $\mathbf{M^{-1}L}$ levels, perhaps due to lack of loop-pathways which might provide needed negative feedback. Often such attention-biases will be "unconscious" but clearly they may alternatively be directed *consciously*. For the want of any better suggestion, we might reasonably suppose that the mechanism which does the actual directing of attention is itself the subject of attention at that moment. [How it is possible for the ego-ensemble to monitor and control what is apparently

another part of itself, is a matter which we will not discuss in detail here:- Perhaps it operates on two levels ($\mathbf{M^1L}$ and $\mathbf{M^0L}$), and it might thus operate as a miniature replica of the Ashby type of system which we discussed in Chapters C4 and C5]. Anyhow, as well as promoting attention, we may take it that there will also be "suppression" (conscious) and "repression" (unconscious) — as we shall see.

Ego-control is presumably one form of learned selection of attention, but there are likely to be other learned focussing methods which do not depend on the ego-schema to organize them. All that is needed, in principle, is pre-existing attention to a relevant set/list which contains a call or reference to the "focal" item, and perhaps some suitable stimulus to activate the set-schema — though the fact that it is already under attention would arguably suffice. Thus, instead of using the ego-complex with its relatively ubiquitous "$\mathbf{M^{\infty}L}$" control-connections, we would seem to be using a comparable-but-restricted schema from the $\mathbf{M^nL}$ level which is one step higher than the 277
focal item. One might also argue a similar case for "associations" within the same level, though it seems likely that such mechanisms would often turn out to require the participation of the tethered-sets to provide the extensive definition of linkages; (of course these would not be required if a satisfactory method for establishing direct, intensively-defined linkages could be adequately explained; or if there were a plausible case for hereditary or mutant connections on common chromosome-like micro-elements).

We have been considering possible mechanisms whereby evaluative feedback might be channelled in the direction of the most appropriate $\mathbf{M^nL}$ level — the one most likely to be praise-or-blame worthy. All the suggestions so far have involved *attention*, either *directed* onto the coding concerned, or persevering *inertially* in the absence of any stimulus to change further. But there is a further possibility which might also be classed as attention (though such categorisation is not crucial here), and this is the case of a structure which is more-than-usually *susceptible* to the effects of evaluative input stimuli — due to its own endogenous structural instability properties when these are also related causally to the evaluative feedback obtained.

To be more specific, consider the case of a set of elements in which there is some measure of internal closure, but which fail to form properly into an adequately self-consistent "group-like" structure. Thus, like many scientific theories, it will be stable enough to withstand the (postulated) normal processes of enzymic "garbage disposal", and yet it will not really have made the grade as a fully complete and stable structure according to the prevailing criteria. Its "loose ends" may therefore be thought of as being "extra reactive" — somewhat analogous to a sodium atom "looking for" a halogen atom so that their collective orbital pattern will be reasonably stable 278
and complete. Such persistent dissonance seems likely to attract attention, and also thereby to become involved in the initiation of behaviour and its consequent evaluative feedback; though the outcome from this is likely to fall short of the ideal:- If the feedback is negative, then the imperfect schema itself is likely to be *repressed* (tagged as "unsavoury" and therefore not to be admitted into attention if possible, or actively interfered with to prevent its future expression, but not usually annihilated because its residual stability is too great for that). If, on the contrary, the feedback is favourable, then those other schemata involved in bringing the shortcomings of the dubious structure into attention will be likely to suffer some degree of repression instead. In neither case will the problem really be solved; instead it will just have been swept under the carpet — though in real life it often turns out that this is the sort of thing which we must just make do with, at least in the short term. After all, what practical man will bother unduly about finding a perfect generalization, as long as he can cope satisfactorily in the real world by using *ad hoc* hypotheses in conjunction with a manageable set of identifiable *limitations and exceptions*? Such conceptualizations even enjoy a degree of scientific respectability — at least temporarily; Cartesian dualism is a case in point, and so is the wave-particle dualism of physics.

However we are beginning to encroach on the complementary topic of *non*-evaluative feedback, the structures evolved to make use of it, and how it is that there will actually be distinguishable $\mathbf{M^nL}$ levels — whether the evaluative feedbacks can be correctly attributed to them or not. Let us therefore turn now to consider the E_1, E_3, E_5, ... (or IP_r^0, IP_r^1, IP_r^2, ...) input paths, and how they might be differentiated. 279

Let us start by reminding ourselves concerning the type of construct which we expect to be developed in each of the respective levels; (see Table C5.4/I). Sensori-motor development entails the building up of *object* concepts using hereditary sense and action stereotypes as basic elements. Next (for $\mathbf{M^1L}$) we have Concrete Operations development involving interactions among objects, including other people, and one's own self — describable perhaps as the *piecemeal laws of physical nature* and the *"laws" of particular social interactions*. (Note the apparent beginnings of a dichotomy here, a point which we will come back to from time to time). Next there will be Formal Operations dealing with "abstractions", which seems to mean an internal involvement with *sets of piecemeal laws*. And so on perhaps, to yet higher levels.

There is nothing particularly profound in suggesting that such a hierarchical structure has evolved because, and only because, the real outside world can best be modelled in this way — and that the real world does, by-and-large, actually have that sort of structure. However it would perhaps be more significant to suggest that much of this mental structure is re-created anew in each individual — as a *result* of his interaction with the environment which has this structure. Clearly there will be some important hereditary guidelines such as pre-determined $\mathbf{M^{-1}L}$ elements (encapsulating many generations' experience in using elementary bases for object-modelling), and the pre-programmed sequence of emergence for the erogenous zones, discussed above. Moreover it seems likely that for the more primitive animals, and the more primitive parts of our own brains, the nature of $\mathbf{M^0L}$ structures will also be hereditarily determined. But there is also clearly much scope in primates for the development of individual differences, *despite* a similar-or-identical genetic legacy. In fact, the higher levels of the $\mathbf{M^nL}$ hierarchy probably depend for their structure almost entirely on experience gained through interaction with reality, and only minimally on hereditary encodings. 280 This independence from genetic influence will be particularly true if the various higher levels all share the same substrate, and have to arrange their own differentiation between levels. Nor will it make much difference to this independence if we suppose that different parts of the brain evolve their own separate hierarchical structures more-or-less independently — with each developing along similar lines, under similar influences.

It is interesting to consider the above-mentioned dichotomy (*physical-object-logic* versus *social*) in this light. Solid objects and the related "hard sciences" have a more discernible and regular manifest structure than we can find in the "social sciences", so it is no accident that examples to illustrate the postulated hierarchical structure have generally been "hard-science" oriented. Accordingly, it should surprise no-one if any $\mathbf{M^nL}$ representation of social phenomena were much more diffuse and lacking in the upper levels of abstraction. Indeed it would probably constitute a prime example of the use of sets-of-exceptions and special cases alluded to four paragraphs ago; and it would doubtless entail extensive compartmentalization and "logical inconsistencies" both within itself, and *vis a vis* the supposedly monolithic "hard science" structure (or structures!). Emotional guidance and tagging would presumably come into its own here, and so too would the emergence of the later erogenous zones: anal and phallic/genital.

This is not to say that social phenomena are inherently devoid of precise hierarchical structure. Indeed one of the main purposes of the present work is to demonstrate that it makes sense to envisage the existence of such structure, even though it may be beyond our powers to demonstrate it clearly. (If this basic structure is accepted as a premise, then this would mean that we could notionally replace a mentalistic view of social matters by a "physiological"/ mechanistic one; see Section C6.1, above). 281 But even given that basic hard structure does exist for social phenomena,

this structure is certainly not manifest nor easily construed. And rather more important:- Even if we did have very comprehensive structural models, this would not, it itself, guarantee that we could reap practical advantages from this knowledge; and probably we would then have to re-organize it into some *new* simplified model which hopefully would give us a better insight into how to control the environment to our best advantage. Indeed we would quite likely generate a series of such approximate models, to be produced under varying circumstances as if they were "exceptions" derived in an *ad hoc* way! Possibly this principle will be illustrated usefully in the following pages when attempts are made to explain neurotic or psychotic aberrations. Anyhow, this takes us conveniently into a consideration of the failure of the normal hierarchical organization:-

It is instructive to turn to the early pages of Chapman and Chapman's book (1973) and consider their overview of the symptoms of schizophrenia in the light of the above discussions. Let us look at some relevant fragments:- (page 4) "[the patient's] intonation and gestures seemed to indicate that he felt he was giving a meaningful reply" — which raises the question: "What are the principles by which this discourse is organized?". Then, his answer may be described as a "fragmentary description of several vaguely similar scenes, and he skips quickly from one to the other." In the context of our present theory, this looks rather like a case of a breakdown in the ability to use extensive definition (which would perhaps entail attending to a particular $\mathbf{M^2L}$ set, and using it to direct one's selection of lower level elements, thus "keeping to the point"). Such a failure might plausibly leave the patient to fall back on less-organized intensive definitions or other comparatively nebulous forms of "association". 282

Then, on page 5, it seems that the patient is "trying to talk about several themes" and that he "can handle only one idea at a time" — also potentially attributable to the failure of some expected set-organization to marshal its relevant components simultaneously, for whatever reason. As another example, it seems that "the question is too abstract for him" — suggesting a similar interpretation, and perhaps also specifically implicating the $\mathbf{M^2L}$ level due to the apparent deficit in Formal Operations. Similarly, where there are some of the features of a regression towards infancy, this may reasonably be attributed to a breakdown or partial malfunction of the higher $\mathbf{M^nL}$ levels, which would be absent in infancy anyhow; (the "inability to assume the point of view of his listener" would seem to be closely related to this issue because, as Piaget has demonstrated, such egocentric conceptualization and perception are characteristically present during the Concrete Operations period — at least in the wider sense of the term). However (page 7): "few, if any, schizophrenics consistently behave in a 'schizophrenic manner' ", so it would be rash to assume a total breakdown of any $\mathbf{M^nL}$ level. Finally, "intrusion of his feelings ..." might be put down to a weakness of $\mathbf{M^2L}$ "resolve".

Unfortunately there are other aspects of clinical schizophrenia which are less amenable to such explanations. These involve an apparent wilful negativism, which is difficult to explain in terms of $\mathbf{M^nL}$ deficiency because the patients give the impression of being all too competent in set-handling with the deliberate intention of being difficult! Thus (page 8, quoting from Kraepelin): "they deliberately turn away their attention …" and yet "in the end … a kind of irresistible attraction of the attention to casual external impressions" may draw them round — which suggests that $\mathbf{M^nL}$ deficiency may also exist alongside the negativism, and probably with some sort of causal interrelationship. Further instances (page 9) are cited from Bleuler, involving "evasion or *paralogia*" — such as the apparently deliberate adding of *one* to all numerical answers. Laing's (1960) account of the nature of schizophrenia as being a rejection of the apparently-hostile outside world, also sounds very similar — though seen from a different angle. This (perhaps justified) *paranoid* view of the world, is portrayed by Laing as leading to the seemingly rational choice of trying to escape from the world into one's own hermit-like ego, in order to protect that ego. But the tactic actually backfires (arguably due to the consequent lack of 283

external closure, and hence the non-maintenance of important schemata) thus leading to a psychotic state.

Seen in this light, paranoia seems to be an interesting special case; (see Section C7.7, below). Even if the essence of paranoia is structurally quite different[55] from "psychosis proper", it may nevertheless be seen as one of the likely *routes* into the structural deficiency which does produce the attention disorders of clinical schizophrenia. If it does facilitate the onset of psychosis in this way, then it is easier to see why the two types of symptom tend to co-exist:- the paranoia would tend to cause the psychosis-proper; and this in its turn could well reinforce the paranoid feelings — thus producing a vicious circle of causality).

We will return to questions of psychosis in Chapter C8, when a more systematic consider- 284
ation of the clinical and experimental evidence will be embarked upon.

C6.6 Dreaming, sleep, and sleep-modes

Our task in this section will be to draw together several disparate viewpoints concerning sleep, its nature, the purpose it might serve, and some thoughts on how it might be brought about. In particular, it would be helpful if we could reconcile Freudian dream-theory with the more recent distinction between different modes of sleep, and reconcile both with the current theory including the role proposed for sleep (in Section C2.3, above). By and large, evolution sees to it that there will usually be a *reason or functional significance* for any surviving structural or behavioural quirks of nature — even if no-one has yet found the relevant explanation; so it would not be surprising if all the details of sleep had their own particular significances. (Freud himself made very much the same sort of point[56], though expressed rather more weakly in terms of intuitive appeal, and referring to dreams alone rather than sleep as a whole).

The explanation which Freud[57] offers is that "A dream is the fulfilment of a wish"; 285
(1900/1953, page 91 and Chapter III). We may or may not agree that this has served well as a working hypothesis; but there are at least two aspects of this formulation which deserve ultimate clarification — before it is endorsed as well-supported by closure, or modified to that end, *or* abandoned altogether. The two points requiring clarification seem to be (i) the meaning of "wish", and (ii) explaining how unpleasant nightmare phenomena can be examples of "wish-fulfilment".

In much of his work, Freud was attempting the very difficult task of postulating a structure, as explicitly as possible, despite the lack of any helpful neurophysiological clues which might have helped him to bridge the knowledge-gap between the mental and the "hard sciences"; (Traill, 1976b). He was, in fact, quite well aware of the existing shortcomings of physiology and looked toward a time when the situation might be remedied; but he was nevertheless prepared to proceed despite these deficiencies. Thus, for instance, "There is no possibility of *explaining*

[55] This need not be the case. The basic structure could be similar to that for psychosis "proper" (which involves objects, logic, and attention as tangible signs) — but differ by being primarily involved with social objects and affiliation-networks.

[56] "It need not necessarily be possible to infer a function of dreaming ... from the theory. Nevertheless, since we have a habit of looking for teleological explanations, we shall be more ready to accept theories which are bound up with the attribution of function to dreaming". (Freud, 1900/1953, page 75). One might perhaps add that until such an explanation is found, our theory will be disturbingly lacking in internal closure. Incidentally, Freud's heretical playing-down of vain hunting after the observable, in favour of closure, seems to have been partly prompted by Scherner (1861) via Volkelt (1875); (Freud, 1900/1953, pages 84-87).

[57] After Griesinger (1845/1861) and Radestock (1879).

dreams as a psychical process, since to explain a thing means to trace it back to something already known, and there is at the present time no established psychological knowledge under which we could subsume ..." (etc.); (1900/1953, page 511). Accordingly it was scarcely feasible for him to enquire too deeply concerning the meaning of words like "wish" ((i) above); and although he did manage to explain the nightmare (ii) in terms of wish-fulfilment — as a sort of masochistic trade-off (1900/1953, page 557) — his account can nevertheless benefit from some structural tightening-up. Whether or not the current theory is correct, it can at least offer such a structural basis for attempting this sort of further development.

Let us try to interpret the idea of "wish-fulfilment" in terms of linear micro-elements and $\mathbf{M^nL}$ hierarchies. In fact there is no great difficulty in visualizing an ego-schema in which there 286
is a painful lack of closure reflecting some powerlessness to cope autonomously with a disobliging real world; nor should we be surprised if the individual should experiment mentally with ways of resolving this dissonance which threatens the very basis of his self-concept as an efficacious being. A primitive attempt at solution would be an all-out "Death-or-glory" confrontation with reality, with no pause for consideration. While such a ploy might occasionally work, it would generally turn out to be a poor gamble; so some sort of "experimentation" within the safety of one's own mental model system would usually be preferable as a start — leading perhaps to a subsequent judicious testing of any promising putative solutions. This scarcely needs to be said of problems which manifest themselves clearly at the logical $\mathbf{M^2L}$ level. Dreaming is not usually acknowledged as necessary for the solution of problems in "hard science" (though Kekulé's celebrated dream, leading to the notional discovery of the hexagonal benzene ring, is a notable exception; (Read, 1947, page 341)). Such problems are apparently so well structured that it is possible and preferable to use formal (even doctrinaire) techniques for making the best use of the available information — and to do so in an awake state. And yet even problems of this sort often have fringe aspects which are less amenable to formal treatment, so that it may well pay us to pause and "sleep on it".

Suppose we generalize the Freudian formulation somewhat, and suggest that the function of dreaming (as we know it) is to juggle the elements of our $\mathbf{M^1L}$ conceptual level in an "attempt" to find better solutions to the incompatibilities between the schemata of this level. This would entail actions and relations amongst objects, including "social objects". Now as "self" is the salient object in anyone's world-view, and as one's concepts of action and relationships apparently based on egocentric elements of action, it would seem to follow that all or most "thought experiments" 287
at this level would entail the self-concept in one way or another. Thus the new formulation given here would seem to subsume Freud's wish-fulfilment as a special case or even, it might be argued, be co-extensive with it.

Armed with this more structural explanation for dreaming, we are now in a position to attempt a more credible interpretation of "masochistic" nightmare-dreaming; but it will be helpful to start with the phenomenon of masochism itself. The Freudian conceptualization, as outlined by Fenichel (1946/1971, pp 73-74), depicts masochism as a package deal entailing a net gain in satisfaction, despite a very significant element of pain, which is seen as "a necessary evil ... unfortunate but unavoidable". Such sub-optimal solutions would seem to be just the sort of situation which we were considering for the more complex types of cognitive dissonance, in Section C6.3. The problem barely arose in the simple tripartite case considered in Figure C6.3/1, but for the more involved cases it became clear that cluster-analysis techniques, or similar imperfect-solution-finders, were the sort of mechanism which we must expect. Even so if, in principle, a much better solution could be found by formal means, the system must meanwhile be capable of carrying on and progressing in a less neat, but more robust, fashion. Masochism then, is presumably a particular more-or-less stable solution reached using such a technique — and the same can doubtless be said of all the other neuroses *as well as* many or all the indispensable

features of our $\mathbf{M^1L}$ levels. By contrast, dreaming seems to be the main *process* in which a "re-shuffle" of the existing $\mathbf{M^1L}$ "clusters" can take place.

In one sense, dreaming may be thought of as a temporary state of insurrection! — or perhaps as a stop to hold elections in the light of events which have occurred since the previous poll. 288
Anyhow the result is a "capacity and inclination for carrying out special psychical activities of which it is largely or totally incapable in waking life." (Freud, 1900/53, page 82). We may suppose that, during waking life, the $\mathbf{M^1L}$ status quo is controlled (or contrived) from exogenous centres; but during dreaming it seems that these controls are removed [58], and "local" configurations are left comparatively free to find their own equilibrium in their own way. Thus distressing ideas may all become switched to pleasant ones — "a palpable 'wish-fulfilment' …"; (Freud, 1900/53, page 556). Or alternatively, "An unconscious and repressed wish [from the "id" at $\mathbf{M^{-1}L}$ or $\mathbf{M^0L}$?], whose fulfilment the dreamer's ego could not fail to experience as something distressing, has seized the opportunity …" — offered by comparative freedom and a new local configuration arising from "the day's residues" — to present itself as a new potentially acceptable picture of reality. (*Ibid*., pages 557 and 573).

Of course there is no guarantee that the picture of reality offered will necessarily be correct, and there is even less chance that it will be found acceptable even if it is correct; however the effort will have been made, and such reviews of the current model would seem to be just as necessary here as in any business enterprise which would hope to survive in a changing world.

On awakening, the new configurations are rudely subjected to what almost amounts to an alien culture. In many cases they will simply not make any recognizable sense in consciousness, nor offer any new stability in any available broader context, so they will presumably just disintegrate without any permanent trace. In other cases they would become assimilated into the mould 289
of the existing schemata, so that "the dream loses its appearance of absurdity .." as seen in the light of $\mathbf{M^2L}$ rational thought; (*ibid*., page 490). Such a *secondary revision* looks very like the sort of transformation which happens to a story or picture when it is reproduced by persons from a different culture who are unfamiliar with the nuances of meaning implicit within the original setting; (Bartlett, 1932). Probably there is no mere coincidence in this similarity; in both cases there is presumably an attempt being made to recover closure internally — among elements which arise separately from different sources, and so show little initial promise of having collective group-like properties. Of course, once in a while, a new superior closure will be found — surpassing the preceding structure in "mathematical elegance". This is presumably where real progress will take place, ultimately justifying the whole roundabout procedure.

Until after World War II, there was probably not much point in distinguishing between sleep and dreaming in any theorizing on the function of dreams. However it is now common knowledge that there are at least *two modes* of sleep with markedly differing characteristics: *Slow wave* or "Orthodox" sleep, and "Paradoxical" or *REM* (*R*apid *E*ye *M*ovement) sleep. Moreover it has been established that dreaming, as we know it, is associated with the brief periods of REM sleep, and not with the Slow Wave variety which accounts for about 80% of sleep in adult humans. (Jouvet, 1967; Kleitman, 1963; Oswald, 1964, 1966, 1970).

Thus it would appear that the above discussion about the function of dreams has offered an explanation of REM sleep only. So what sense can we make of the residual Slow Wave sleep? While there is no decisive lead as to what the answer might be, it is worth remarking that dreams (as we know them) seem to deal mainly or exclusively with $\mathbf{M^1L}$ matters, while any re-shuffling 290
of ideas during waking-hours will mainly concern $\mathbf{M^2L}$ concepts; so what about the other levels?

[58] "Self-consciousness is suspended or at least retarded, ... "
(Spitta, 1882, p 199; quoted by Freud, 1900/53, page 90).

We may of course dismiss the $\mathbf{M^{-1}L}$ level as being immutable within the individual, and this leaves $\mathbf{M^0L}$ as a plausible area of concern for Slow Wave sleep — assuming it has any function at all. If that is the case, then it would seem that there is another sort of "dream" going on during slow-wave sleep, and that this deals in re-shuffles of Sensori-Motor sets and semi-groups. Unlike REM-sleep, this $\mathbf{M^0L}$ activity would presumably have no direct concern with the *activities* and status of the ego (though it will probably be concerned with its bare object-like basis), so we might expect that its relevance to Freudian theory would be somewhat circumscribed. In any case it is unlikely that much if any of this activity would ever be retained in consciousness in view of this remoteness from ego-interest, though I understand that there is some slight evidence in favour of simple realistic memories emanating from this non-REM sleep activity; (Pound, 1977; after Rechstaffen *et al*., 1963).

Taking this allocation of roles as a postulate, there are several predictions which we might reasonably make about the two modes of sleep and the proportion of time spent on each. One might, for instance, expect different types of stress to produce different patterns. However here we will only consider cross-species and cross-agegroup differences. Firstly we would expect that animals which exhibit no $\mathbf{M^1L}$ (Concrete Operations) capabilities would also have REM-free sleep — with corresponding compromise characteristics for intermediate cases. This does indeed seem to be the case (Jouvet, 1967):- The tortoise shows no REM-sleep while the hen shows very little, and the largely stereotyped behaviour repertoires of such non-mammals would appear to be almost entirely sub-$\mathbf{M^1L}$ in their nature, with learning limited to certain circumscribed $\mathbf{M^0L}$ constructions — of which the most spectacular is the phenomenon of "imprinting". Mammals, 291
on the other hand, are generally more concerned with learning anew the relationships between objects, involving $\mathbf{M^1L}$ Concrete Operations — and their proportion of REM-sleep is also correspondingly higher. Moreover sheep are arguably "less bright" than the other mammals considered here (rat, cat, and man), corresponding to their somewhat lower percentage of REM-sleep; and it is reported (Pound, 1977) that those lowliest mammals, the echidnas, exhibit an absence of REM-sleep similar to that of non-mammals.

Across age-groups, we might expect that the older an animal becomes (up to maturity) the more it will become pre-occupied with activities involving the higher $\mathbf{M^nL}$ levels. Accordingly we would predict that adult animals would show more REM-sleep than the neonates of the same species. In general, however, this is not the case at all; indeed quite the reverse seems to hold for mammals — though on the sparse evidence supplied here it could well be true within the non-mammal category. There seems little point at this stage in offering any detailed speculation as to why this should be so, though clearly this is a matter which deserves attention in the future. Suffice it here to suggest that there may well be extra complications in the more advanced mammals — complications which we have not yet formulated, or perhaps not even envisaged. Anyhow, this suggests that, even if we are on the right track, we still have a great deal to explain. In the circumstances, this should not really surprise us.

Before concluding this section on sleep, we should perhaps consider briefly what sort of mechanism or mechanisms might control which mode of sleeping-or-waking will be operative within the individual animal at any given time. It is all too easy to adopt what amounts to an authoritarian view of the system and claim that "the orders" come from such-and-such a centre; 292
but of course this merely shifts the problem (even if the assertion is correct) because then we should properly ask how this "centre" decides the mode it will support. It seems likely that the most fundamental form of regulation will consist of competing attempts (mutually inhibiting) by various subsystems to stop other ongoing activity while they clear up their own state of comparative disarray — comparable to stocktaking, or sorting and filing accumulated correspondence. One might perhaps think in terms of such subsystems becoming increasingly inefficient due to unadjusted configurations, until the worst-affected reaches some sort of

threshold and bids to shut itself off from the others, for the time being. (We might provisionally think of these subsystems as being: *consciousness*, $\mathbf{M^1L}$, and $\mathbf{M^0L}$ — corresponding to wakefulness, REM-sleep, and Slow-Wave sleep, respectively). Of course, in so far as overall coordination is required here, some sort of "semi-authoritarian centre" will be needed; but this should be seen as a consensus-device rather than as an all-powerful feudal lord. In time, we might expect habit schemata to play a part in ordering sleep modes — in conjunction with periodical influences both outside and internally; but the fundamental instigator would probably be the consensus balance.

In this connection, it is perhaps appropriate to mention the model proposed by Kilmer, McCulloch, and Blum (1969). This is a computer model in which it is sought to simulate the supposed activity of the Reticular Formation in selecting modes of behaviour — using a consensus approach. It will thus be useful to bear this model in mind in any attempt to elaborate this issue further; its formal cybernetic features stand a good chance of being correct, even if we are less sure concerning the details.

Finally, we would do well to consider how such mutual inhibitions might be physically put into effect. It is generally assumed that specific nerve-fibre contacts would be used — in effect constituting a bounded-extensive definition of the addressees. Leaving aside the question of how signals are to be directed into these channels in the first place, such an explanation would scarcely be adequate for ensembles in which the active elements are of molecular dimensions (rather than cellular). A tethered-extensive definition would also tend to be totally unwieldy, and probably impossible to set up. By elimination then, it looks as though such inhibitions may have to be addressed *intensively*, to specific sites on each element concerned in the process. 293

C6.7 Bio-energetics and Pharmacology: Freudian "Mental Energy"

If linear molecules really are vital, what signal-mechanisms could they offer?

It *seems* to be obvious that any discussion on matters relating to neuropharmacology should start with the chemical preparations themselves, or with the clinical effects which they produce. However now that we are armed with some sort of structural idea about what may be the details and purpose of molecular activity in the nervous system, there is some point in attempting an alternative approach:- Let us elaborate the likely details a little more explicitly, and then consider in what ways this system might be open to chemical interference or modification, and the likely clinical effects which might plausibly follow. It will then be comparatively less important to concern ourselves with detailed matters of chemistry; and this aspect could then be dealt with subsequently, in the light of particular theoretical requirements. Of course any such further elaboration is also likely to facilitate other external tests of validity, as well as such internal tests as the construction of properly self-organizing computer models.

For obvious reasons, traditional neuropharmacology has concentrated on the synapse. In view of the present theories, we should now also be examining possible mechanisms (and vulnerabilities) of:- {a} How elements might *specifically address* and call each other ("naming" or "intensively defining"); {b} How cue-signals might *traverse along* an element; and {c} How logic elements such as "*And*-Gates" might operate at this level. These questions, especially "{a}", will involve us in some rather specialized theoretical matters concerning ultra-micro energy transfer.[59] Of these, the more speculative and heretical suggestions, concerning unobservable structure, may well turn out to be superfluous or wrong. However it seems worthwhile to introduce them as being sufficiently plausible to merit tolerant consideration, 294

[59] Some of these issues have already been discussed in Chapter B2, above; though from a rather different viewpoint.

because if they should happen to be right, we would have great difficulty in trying to arrive at them systematically via orthodox approaches which emphasize impartial observation.

Now let us postpone "{a}", the problem of address-labels, and deal first with:-

{b} Internal signals within molecules — what form could they take?

Let us begin by taking a closer look at the linear microelement, as depicted in Figure C5.2/1, and the likely behaviour of the string of sites along it. It has been supposed that some sort of discrete signal will, in favourable circumstances, travel along this string of sites — thus potentially triggering the release of other *free* signals as chemically-induced molecular-photon emissions (probably in the infra-red range, and phase-related to those from other sources if they are to carry any effective message across any appreciable distance).

> [If the linear micro-element in question happened to have a consistent series of conjugated double bonds, or some other electrically conducting pathway, then we might well suspect that the postulated captive signal would consist of an *electron* traversing this path. However it seems rather unlikely that these conditions could be adequately met in any realistic system; and there might also be some difficulty in explaining how the electrons could be re-cycled after their transit.]

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Accordingly, if there is such a signalling process at all, it seems more likely that we should be considering a captive energy-quantum, and referring to it by an accepted term such as "phonon" (more properly used for relatively homogeneous systems such as crystals), or "exciton" (Burnett, North, and Sherwood, 1974).

Unfortunately, like much of psychology, this individual within-molecule aspect of chemistry is inadequately observable, so it is very difficult to ascertain *in any descriptive detail* just how the exciton is likely to interact with its string of molecular sites. As in psychology, much work has gone into formulating the *manifest behaviour* in formal mathematical-statistical terms; and the success of this ploy for *technological*[60] applications has tended to blind us to our fundamental ignorance about what might feasibly be going on in the unobservable domain. It is, after all, very tempting to hide behind our elegant mathematics and the behaviourist/operationalist premise that the "unobservable" does not exist. Anyhow, it seems extraordinarily difficult to find an expert in this field who is prepared to step beyond what is safely established statistically, and consider hypothetically the detailed nature and behaviour of excitons in such ultra-micro situations. But the present work has frequently encountered this need to postulate a substructure within one "black box" or another, so there seems to be no new reason why the same approach should not be used on the mysteries of fundamental physics and chemistry wherever this seems likely to produce conceptual progress. Meanwhile however, we may happily continue to use the accepted statistical-behavioural concepts whenever they seem adequate for our immediate needs.

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A modified analogy to macro waveguides?

Let us suppose then, that the linear molecule will have the same sort of general properties as a more macro wave-guide (such as a non-uniform lumpy guitar string), but with possible additional constraints due to quantum effects. (Quantum theory is part of the cybernetically-unsatisfactory mathematical mystery, as it stands; but we may often let it pass without elaboration as a generally-accepted and useful descriptive formulation). Non-uniformity in a wave-guide will make a considerable difference to its performance — as any dedicated Hi-Fi enthusiast will know. When the wave-guide is uniform, as shown in Figure C6.7/1, then any established disturbance will

[60] See the distinction drawn (e.g.) by Bannister (1968) between the needs of Science, and those of Technology: (page 230, column 2).

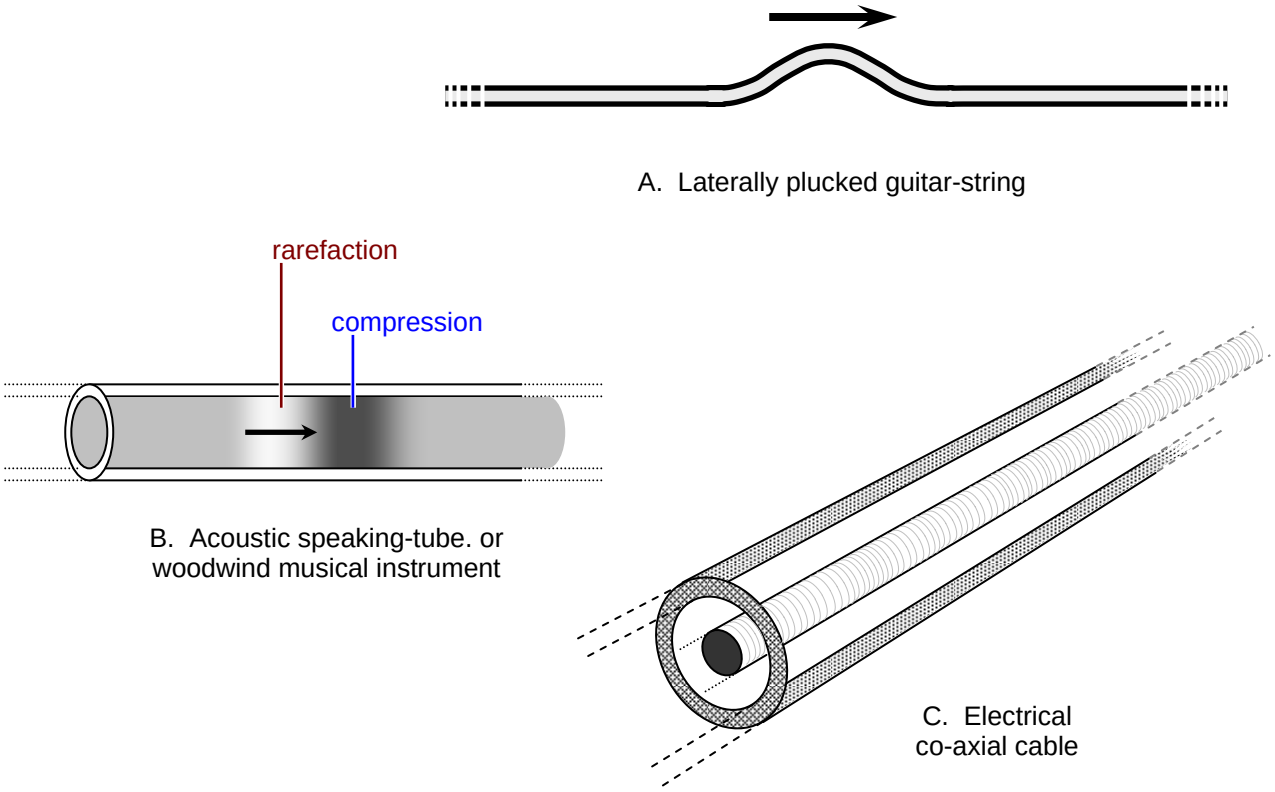


Fig C6·7/1. Examples of uniform wave-guides

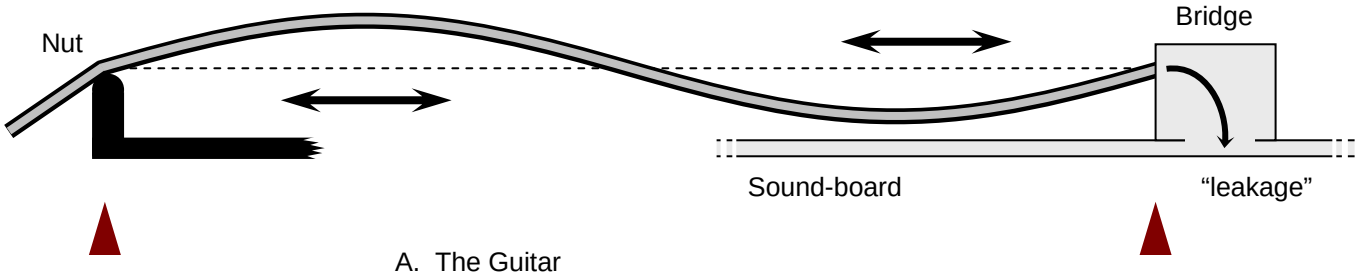
propagate at *constant* velocity[61] along the wave-guide — for ever if the wave-guide should happen to be undamped and endlessly long (or looped without violating effective uniformity).

Any discontinuity[62] in such a pathway will tend to cause a *reflection* of the signal back towards the source; and if this reverse-travelling disturbance meets with another discontinuity, then it will tend to bounce back again — resulting in a *standing wave* in between the two discontinuities: see Figure C6.7/2. Thus it is possible to semi-trap the energy of this disturbance between two sites along the linear wave-guide, as well as confining it to the wave-guide itself (a constraint which, in fact, depends on the same sort of discontinuity principle).

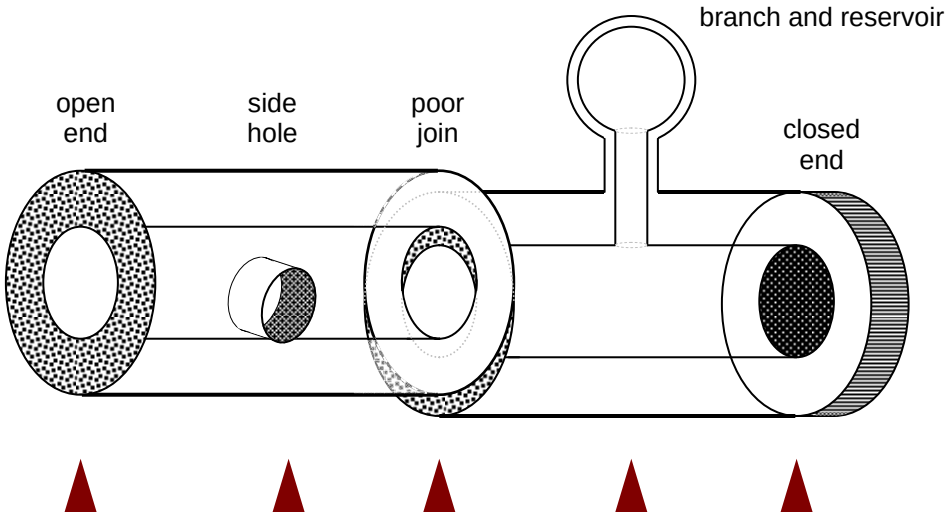
At any point along a wave-guide, and most obviously at any discontinuity, the propagated signal must so-to-speak "decide" whether it will continue on in its present direction, or reverse its direction, or take some other sideways path, or indeed to dissipate itself resistively as heat; or even to suspend itself in storage as if in a wound spring. Moreover different parts of the total signal energy may well be allocated simultaneously to any combination of these possibilities, which may leave us wondering which proportions of the energy will become distributed into each alternative. It is not the purpose of this present work to give a quantitative discourse on the finer points of acoustics; but there are some important *qualitative* details which do deserve clarification, and these relate to the actual micro-mechanisms of the alternatives we have just considered.

[61] If the medium is "dispersive", then each frequency has a separate constant velocity.

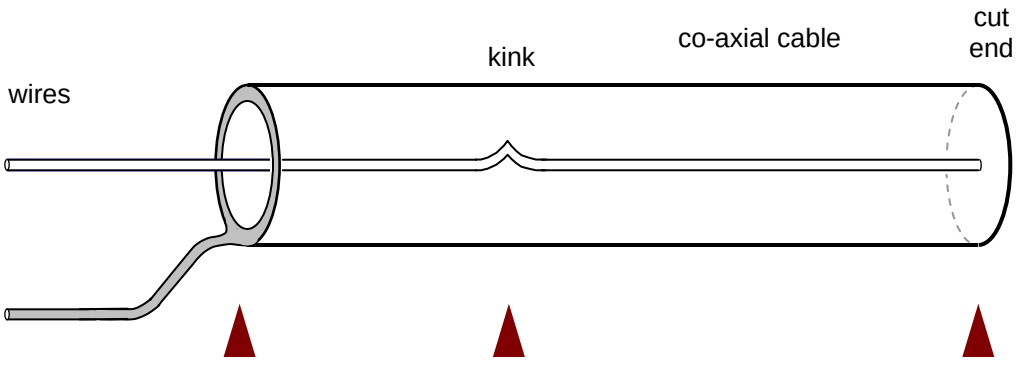
[62] Also see Karbowiak (1965, Chapter 3), Benade (1960), Kinsler and Frey (1962), and Nederveen (1969).



A. The Guitar



B. One type of speaking-tube (or woodwind) configuration



C. Unmatched electrical impedances

(297)

Fig C6·7/2. Examples of non-uniform wave-guides.
▲ = site of reflection or partial reflection, (changes of impedance).

For instance, let us look at the concept of *resistance*. Here we have "dissipation" of energy into "waste" heat; but what does this really mean? In fact it means a loss of our orderly real-or-conceptual control over the energy of the signal — that is, a loss of negentropy or information. It would seem that such a phenomenon might make sense only when viewed from a comparatively macro viewpoint — and that, by contrast, individual *quanta* of energy would not be able to be frittered away like this in a gradual run-down of energy. Resistance then, would appear to be a statistical "behavioural" manifestation of massed discrete quantum phenomena which are *individually precise* (and possibly even deterministic in a sense — though not experimentally determin*able*). 299

Similar considerations will apply to the conduction of excitons of energy along linear molecules. Here "energy dissipation" would only have meaning in the more macro context of parallel molecular waveguides which normally operate in a phase-related way. If the signal traversing the different pathways were delayed by arbitrarily differing amounts, then the phase relationship would be destroyed, and the collective more-macro signal would become misdirected into some irrelevant direction — and probably stripped of any message as well.[63]

{a} If molecular exciton-signals reach specific targets, what "labels" could they use?

Of the problems raised at the start of this section, the most crucial explanatory task before us is evidently Problem "{a}": accounting for the postulated specific addressing-code, directed at specific types of element or reception site.[64]

It is scarcely to be believed that a simple allocation of "broadcasting frequencies" would offer sufficient code-variety on its own; so we must look for something which is a bit more sophisticated, and this will presumably entail keylike *patterns* of signal components — probably distributed appreciably in space or time (though not inevitably so as we shall see). In Chapter B2, above[65], it was assumed that a *time*-distribution would be operating, but let us now re-argue the issues more comprehensively and distinguish three conceivable bases for patterns of signal-distribution suitable for an exciton-molecular system:- 300

(1) The spatially-extended keylike signal may be received as a ***space**-distributed complex* (which would then presumably have to be translated into internal exciton-mediated activity).

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[63] This could occur as a result of the failure of cross-feed coordination depicted in Figure C5.2/2, as it is unlikely that such dubiously-identical parallel elements could maintain proper synchrony without such help — unlike laser-crystals. [In fact it would seem that the criterion for a good optical or acoustical extended *signal-conducting medium*, is that it should display a statistically reliable delay between its absorption of an incident quantum of a given frequency, and its "decision" to eject another such quantum; that this delay value should apply at all such sites throughout the medium; and that these sites should be homogeneously spaced. Thus reliable phase relationships will be maintained. (Also see Stumpf, 1973, Chapter 1).]

[64] Two types of analogy may serve as imperfect illustrations: (i) *Telephone numbers* (and especially *cell*-phone numbers) show the power of using a precisely formulated label-code to home in on a specific target — though that will be a single unique target rather than the here-envisaged *diffuse population target* of unanimous schema-encodings, of which all-or-many would presumably respond to the same "phone number". Anyhow note that these use a serial ***time***-base, like spoken speech. (ii) Traditional *Lock-and-key* mechanisms use matching spatial codes to achieve their specificity — and note that immunological recognition uses the same trick using "lumpy" protein key-patterns. Such coding is obviously in ***3D space*** rather than time. — [RRT 2006]

[65] As noted earlier, this is now actually in a separate online document: www.ondwelle.com/MolecMemIR.pdf — See especially Fig [B]2.3/2 for two plausible mechanisms.

Receptors A and B, perhaps placed a significant distance apart, could each be activated simultaneously by their respective frequencies or other parallel stimuli. Consequently they would then each pass on an internal exciton toward an *and*-gate within their common molecular structure, such that if-and-when the two excitons reached the *and*-gate together, a further internal signal would be passed down the effector or "program" segment — and the reception process would have been completed. Unfortunately however, given the likely frequencies (with wavelengths > 1 μm), it is difficult to see how A and B could be a "significant distance apart" (compared to the 1 μm) and yet still be sufficiently in touch via intra-molecular communication-channels. Such a model could still be of some service though, if we drop the requirement for A and B to be so far apart, and instead use it as one possible device for solving case (3), below.

(2) The signal may be treated as a ***time-distributed complex of discrete quanta*** *forming an identifiable time pattern*[66]. Here we can envisage an initial stimulation of receptor A which sets up an internal exciton-signal. Further progress will then presumably depend on the more-or-less precisely-timed arrival of a correctly-tuned signal at receptor B, and another at C, and so on; (Traill, 1976b; and Chapter B2 above[65] (alias Traill, 1977)). There seems to be no obvious objection to a system such as this, and moreover it is easy to see how the appropriate time-pattern of signals could arise — through the optical dispersion of the various Fourier components of an initially integrated pulse or other disturbance *having a quite specific shape*. Such dispersion could be particularly pronounced in myelin wave-guides, (Chapter B4, above — *ibid.*). 301

(3) The specificity of the signal might lie in its ***"shape-as-such"*** *as a composite irregular pulse or wave-packet*[67] *on arrival at the receptor,* where this implies a signal time-span comparable to the period of component frequencies.

This pulse-shape modification rather presupposes *populations* of supposedly-unison photons, and hence a move toward the macro-effects of everyday life. (After all, the wave pattern within an individual photon cannot be "bent" in this way!). The FM or AM coding of radio signals would serve as a close analogy, but we have to be careful not to import such notions into isolated ultramicro quantum situations.

Optical dispersion — its constant modification of signal shape-and-timing

In view of the likely prevalence of dispersion, it is doubtful whether any emitted pulse or disturbance could maintain its shape[68] until it reached a site which was realistically remote. However it should be noted that there is no requirement that it should be the *same* shape as when it started; it is merely necessary that it should have *a* characteristic shape by the time it is received — and possibly different characteristic shapes for different receptors (where the same signal is likely to be used at different sites). […[69]]

[66] (*e.g.* a coordinated volley of well-separated quanta; *i.e.* with each pair having a time-span between them which is appreciably greater than the period of individual component frequencies, as illustrated by the *last sketch* in the New Figure C6.7/2a below). The original 1978 sentence (black text) here singled out this special "well-separated" case. However that was being overselective: Overlapping or even simultaneous quanta can also be included here — *as long as they are not truly interacting* before they reach their target. (That is the unlikely "(3)" case, which we will briefly consider next). [2006]

[67] odd shapes like the (omitted) *sum-curves* for first three sketches in New Figure C6.7/2a — see below.

[68] Here we take the *wider interpretation* of "shape" — including *time intervals between* logically-related photons ("case (2)") — as well as the more obvious but sometimes-questionable shaped-pulses of "case (3)"

[69] [Sentence deleted as irrelevant and confusing. — RRT, 2006]

Nature has a way of capitalizing on odd effects like this. One possibility here is that this constant *reproducible-and-predictable* "translation" of signals as they travel along their optical path will make it easier for *some* receptor, *somewhere* along the path, to establish meaningful communication — partly by Darwinian trial-and-error. We will return to this idea below in the subsection "Fixed-range signals" below (o.p.304), and in New Figure C6.7/2a.

Meaningful signal-combination from two sources simultaneously

But there is yet another twist to this question of remote shaped-patterns, and that is that they might arise in a barely-predictable way from the interaction of signals in the presence of a receptor competent to "capture" an ephemeral pattern — a pattern which would normally disintegrate without trace.

A simple way of detecting coinciding signals like this would be • just to receive each one individually, at closely situated receptors such as those suggested at the close of "(1)" above, and then let the separate resulting *intra-molecular* signals interact via some suitable *and*-gate arrangement. The question of external interaction of the signals themselves would therefore not even arise in this case, and indeed the arrangement turns out to be very similar to that of "case (2)" — differing mainly from the Fig.B2.3/2 versions in its apparent lack of internal "delay units", so that it would appear to be merely a special case of the latter. 302

If we are looking for a fundamentally different alternative mechanism, then we must apparently grasp the nettle of • selective interaction at the receptor itself, and contemplate such questions as: how it might *simultaneously* cope with two incident quanta; what (unobservable) structural changes might be involved internally; and just how strictly simultaneous, and geometrically-arranged the coincidence of the quanta would need to be. For instance it is conceivable that the polarization of the two quanta should be more-or-less perpendicular, the trajectories should perhaps be at about 70º, and maybe the peak amplitude of one of them should arrive at about 5 picoseconds before the peak of the other (± 2 p.sec.).[70]

Suggestion for deeper investigation of exciton interaction

No further attempt will be made here to explore the feasibility of these mainly-external types of interaction, but perhaps some remarks about how to approach the problem would be appropriate. Probably the main need is to analyse, in as much *structural* detail as possible, the intricacies of the *process* of ordinary single-quantum absorption into atomic and molecular orbitals. Even though no hard experimental evidence will be available for establishing the nature of the dynamic sub-structure, this should not be allowed to halt the programme while there is still plausible progress to be made using internal-closure principles for investigation — on the reasonable assumption that the real system must have group-like properties if it is to sustain itself cybernetically. (Of course such model-building should take full account of accepted formulae and formulations of physics, though without necessarily accepting their implicit assumptions on such matters as causality). Depending on the degree of success with such a programme, it might then be comparatively easy to extrapolate — more or less convincingly — to cases involving transient phenomena *and* multiple incident photons. One might even come to some (partially) testable hypotheses leading perhaps to a (partial) justification by traditional criteria. This amounts, of course, to advocating a reductionist programme in physics along the lines that the present work is attempting to apply to psychology. 303

[70] Fortunately, we can probably ignore the totally heretical idea that the two quanta might coalesce just before reception: the case of pure interaction!

Other applications for signal-combination?

Before leaving the inconclusive "case (3)" concerning the *shape* of signal pulses, let us look briefly at what implications would be likely to follow on from such mixing of signals from different sources. To start with, it would not be much use on its own for the type of specific name-calling envisaged in the theory of sets and groups developed in connection with the postulated $\mathbf{M^nL}$ hierarchy. It might however, conceivably play a useful auxiliary role by governing which elements out of the many would be available "on call", and which should instead remain dormant for the time being. Perhaps this might express particular moods or sleep modes, or ensure a balanced "randomized" access amongst the roughly equivalent alternative target elements (by making any individual element accessible only if the "spotlight" happens to be pointing in its direction) — though this would seem to be a particularly cumbersome way of achieving such a straightforward objective. Nor is there anything very convincing about the mood/mode suggestions unless we can envisage some reasonably accurate way of directing these auxiliary signals to specific target-areas: either using the call-sign principle (which simply takes us back to the use of "case (2)" above — time distribution), *or else* as an agent of locality-based "extensive definition" of elements.

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If simple extensive areas are all we are concerned with, then this device would seem to be rather superfluous since we could arguably just make do by having a limited range to our signals and concentrating our target elements within this range. However it may well be that complex and variable extensive-regions will be required — for hologram storage perhaps (Pribram, Nuwer, and Baron, 1974; Pribram, 1971) — so there may well be important uses for such phenomena. Nevertheless we must remain in some doubt as to whether they are even feasible; and anyhow the "case (2)" paradigm seems to be the most promising explanation of how "intensive definition" naming would operate, so we may provisionally accept *it* as the norm — while bearing in mind the possibility of these other additional mechanisms.

Fixed-range signals

There are also some implications arising from "case (2)" which are worth considering, and which might even be testable in an orthodox experimental way! If the original signal disturbance-shape is continually being modified by dispersion as it progresses away from its source — becoming ever more spread out in its spectrum of Fourier-components, then we might obviously expect that the ability of a receiving mechanism to recognize it will probably depend on its being at the correct range away from the source: neither too far away *nor* too close (see New Fig. C6.7/2a). This phenomenon could do much to ensure an adequate spread of signals, so that they will not generally be intercepted prematurely by nearby receptors — with which the emitter might well have an internal link anyhow. Or to put it another way, it suggests a rather special communicational topology which might profitably be investigated from a mathematical point of view; and at a more everyday level we might well contemplate the implications of the Knight's move in chess![71] (Also see Figure C8.1/7, below). (Of course, on a larger scale, nerve tracts also achieve a similar non-Euclidean topology).

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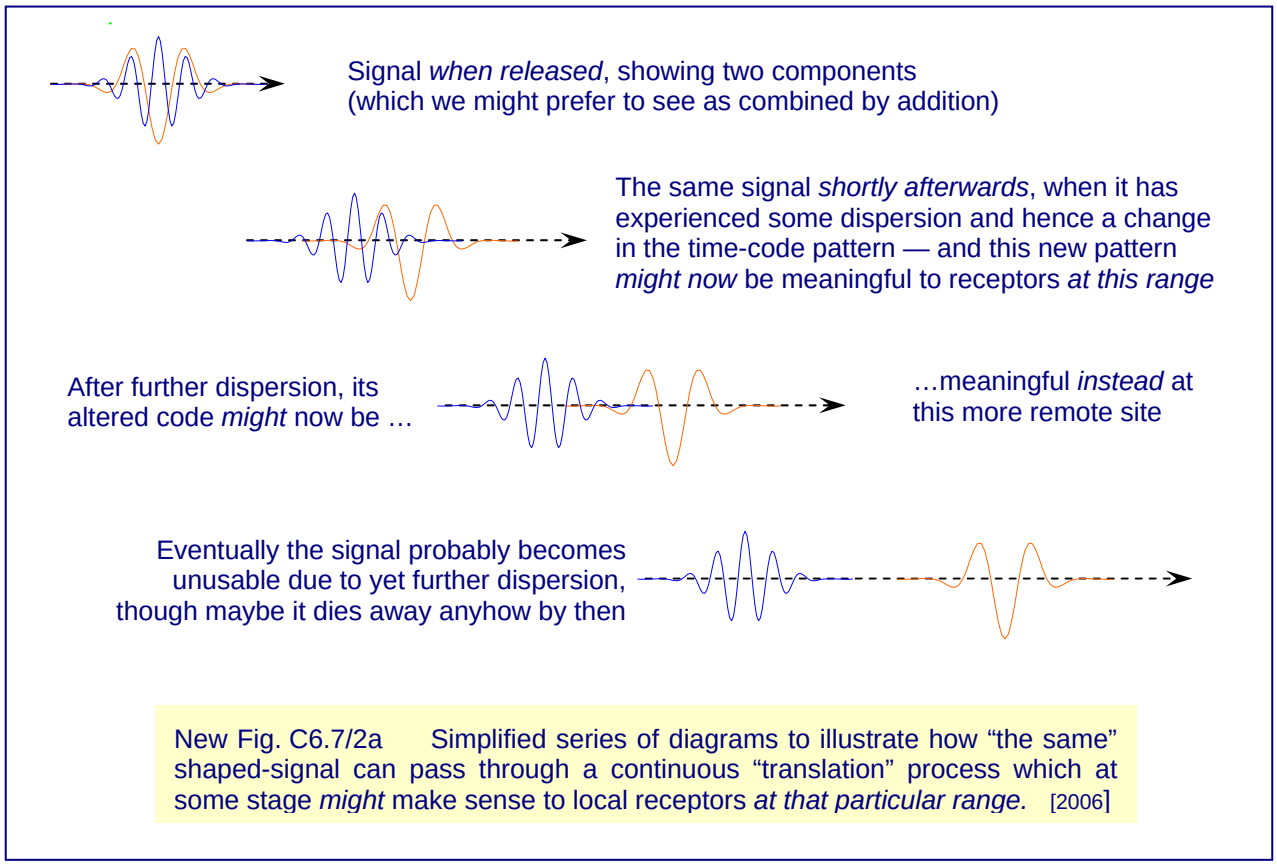
A further implication arising from this is that a change in range might mean that a given signal will now be interpreted differently: the meaning may thus be locality-dependent — like the word "pavement" considered separately on each side of the Atlantic. It would follow from this that effective "mutations" of elements could occur if-and-when there were a substantial movement in the location of receiving-elements, or of the emitting-elements — or indeed if there

[71] At one extreme the chessboard King can move only to adjacent squares, and at the opposite extreme the Queen can move right across the board if there are no obstacles. *Between these* we have the Knight which can move only to certain *intermediate-distance* squares, all at the *same restricted radius*.

were a significant change in the optical path between them, reversibly or irreversibly, spontaneous or "deliberate". There would thus be some scope here for pathogenic or therapeutic pharmacological intervention, though on the whole such effects seem more likely to operate on the acoustic paths which we have been supposing to operate along the molecular structures themselves. It is to these acoustic paths and their likely control mechanisms that we will now return.



New Fig. C6.7/2a Simplified series of diagrams to illustrate how "the same" shaped-signal can pass through a continuous "translation" process which at some stage *might* make sense to local receptors *at that particular range.* [2006]

added 2006

Molecules as waveguides and logic units

Figures C6.7/1 and C6.7/2 drew attention to the nature of wave-guides in general, and served to introduce the idea that linear molecules might also be viewed as wave-guides — though subject to manifest quantum constraints which would not be apparent in more macro systems, where individual quanta would be hidden amongst a statistical population of fellow quanta. From there we went on to examine a variety of technical difficulties related to systems of this sort. Having done that, we should now go back to the main theme of molecules-as-waveguides and consider how reflections and storage might be expected to influence the progress of excitons along the molecule; and also look at how such potentially logic-gating mechanisms might be influenced from outside the molecule. 306

Following on from the work of McCulloch and Pitts (1947; McCulloch, 1950) and elaborations by Hebb (1949), there was considerable discussion until the 1960's of the supposed role played by neurones as logic elements or "formal neurones"; (Blum, 1962). Clearly there is still much to support the idea that interaction effects such as summation do occur at neural cell-bodies and other sub-synaptic sites (Eccles, 1964; Katz, 1967) and *perhaps* there is no need to enquire any further in the case of "simple" behaviour, such as in invertebrates, though this is highly debatable (Miller, 1970). But such formulations do not, by themselves, explain how transmitted messages interact with chemical "transmitter-substances". Moreover the more recent ultra-micro

studies have shown that neurones are generally much too complex to be adequately modelled by simple binary logic elements — even as a rough approximation — nor by ternary logic elements (Traill, 1970); or even logic elements with any number of straightforward on/off inputs. On the other hand though, it will now be argued that mechanisms roughly approximating to such binary elements could well be found at the molecular level — in keeping with the 'linear micro-element' theory of mentation. It might therefore be possible to update some of the earlier "formal neuron" theory on these lines, though no attempt will be made to do so here. Moreover it is rather difficult to see how the "plastic properties" of neurones (Bureš and Burešová, 1970; Lippold, 1970; Spencer and April, 1970) and the consolidation of Short Term Memory into Long Term Memory (Griffith, 1970) could be properly explained without going into detail of this sort.

There are 16 mathematical operators for binary logic, (Blum, 1962). Each determines whether the "result" will be *on or off* ("true or false") — given its own particular pattern for the on/off-ness of two independent inputs A and B. Thus "*X = A or B*" will mean that X will be "on" for the three cases:- 307

(i) Both inputs *on*;

(ii) A = *on*, B = *off*;

(iii) A = *off*, B = *on*;

but that X will be "off" for the fourth case:-

(iv) with both inputs *off*.

Of the sixteen patterns, only ten are truly two dimensional in the sense that the result really depends on both A and B. Four of them will be entirely determined by the state either of A or of B, (one-dimensional); while the other two are entirely independent of both! (zero dimensional). These latter six cases are thus "degenerate" or trivial from the two-dimensional point of view, and so cause less difficulty in explanation. Other cases are of somewhat improbable utility at molecular level, and can anyhow be manufactured from multiple use of the others if all else fails. For example:-

(A *and not* B) *or* (B *and not* A)

It will therefore suffice here if we look mainly at the following four:
and, *or*, (A *and not* B), (B *and not* A) —
with some brief mentions of the trivial cases.

To set the stage, we shall take it that we are considering a linear molecule with side-chains, each potentially capable of *picking up* a photon from outside the molecule, or *emitting* such a photon, or storing quanta of energy as a local excitation state — presumably entailing some sort of structural change relating to itself, and this might or might not affect the energy-handling properties of the system. Let us define A to be an exciton travelling down the main chain from the molecule, in the "correct" direction; and B as the exciton arising from a newly captured photon (or from storage) — where the new photon approaches the main chain via a side-chain. 308
These may then interact directly, or affect each other indirectly by changing the configuration of the system.

Molecular *"and"*-gate

Consider now the properties of a non-uniform molecular waveguide in this context. What would be merely partially-reflecting obstacles in any macro-system, are here likely to be totally reflecting due to quantum considerations (probably entailing group-like configurations involving the molecule itself) — thus effectively trapping the first exciton-signal, be it A, or B. This trapped state could then be relieved by the arrival of the other exciton of the pair — raising the local system to a higher energy state which could thereby pass the threshold of the quantum-barrier and so generate a further exciton-signal moving down the next section of the molecule, and/or emitting a photon capable of influencing other such molecules. This mechanism would thus constitute an "*and*-gate"; see Figure C6.7/3.

309

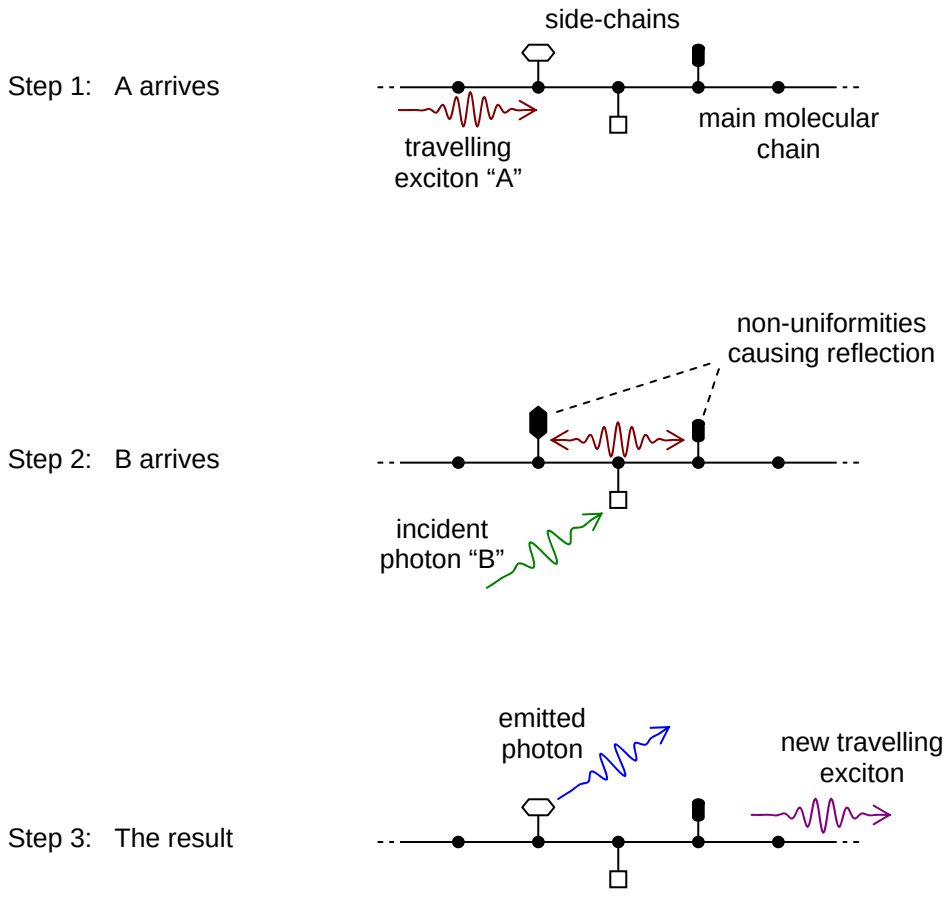
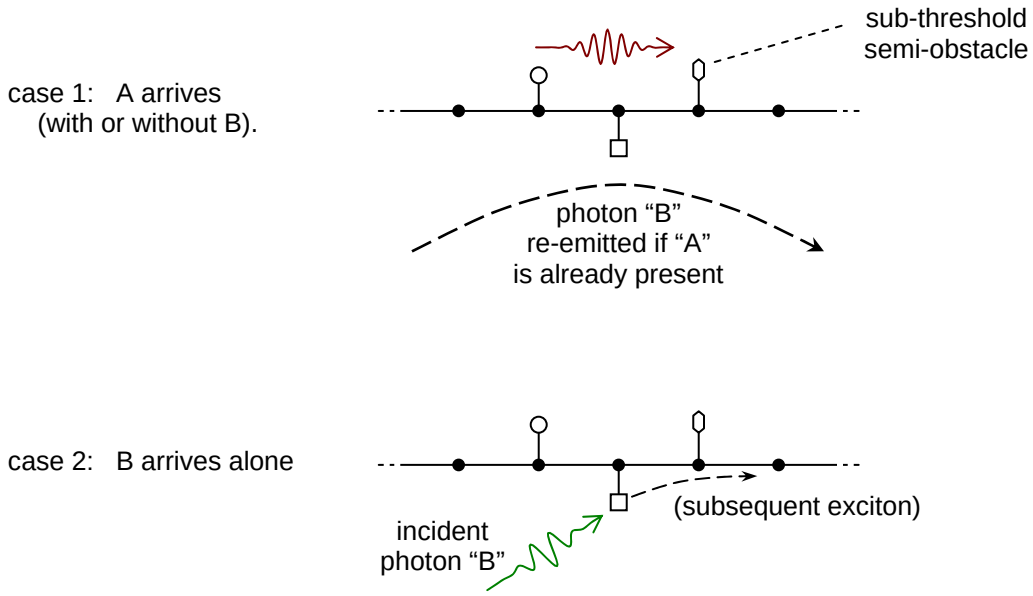


Fig C6.7/3. One possible molecular embodiment of an *and*-gate, with the following logical properties:- .....

	A	not-A
B	**act**	
not-B		

Molecular *"inclusive-or"*-gate

The construction of an *or*-gate would be somewhat simpler as we can now dispense with the reflection-trapping mechanism — accepting the "new travelling exciton" as a direct consequence of either the old one (A), or of a newly received photon-signal (B). In the improbable event of *both* arriving simultaneously, several different things could happen. The incident photon could be re-emitted, giving an inclusive-*or* as shown in Figure C6.7/4 — though this re-emission might be delayed, leaving a possibly changed configuration in the meantime. Perhaps there would be interference such that there would be *no* resultant travelling exciton — giving a case of "exclusive-*or*" from the molecule's point of view — though there would presumably be other alternative outputs such as photon emission or a *backward*-flowing exciton. Alternatively we might obtain a *qualitatively different* resultant exciton which is otherwise orthodox — a sort of super-positive response (from the molecule's viewpoint), of which arithmetical addition of energy-values would be a special case. 310



	A	not-A
B	act	
not-B	act	

Fig C6.7/4. One possible molecular embodiment of an inclusive-*or* gate, with the following logical properties:-

(309)

Two different Molecular *"not"*-gates

Systems involving the concept of "not" may be explained in terms of configurational changes which are caused by the "negating signal", and which have the effect of blocking or sidetracking the other signal. Thus Figure C6.7/5 represents the "*A and not B*" case, and the situation for "*B and not A*" can be depicted as in Figure C6.7/6. 311

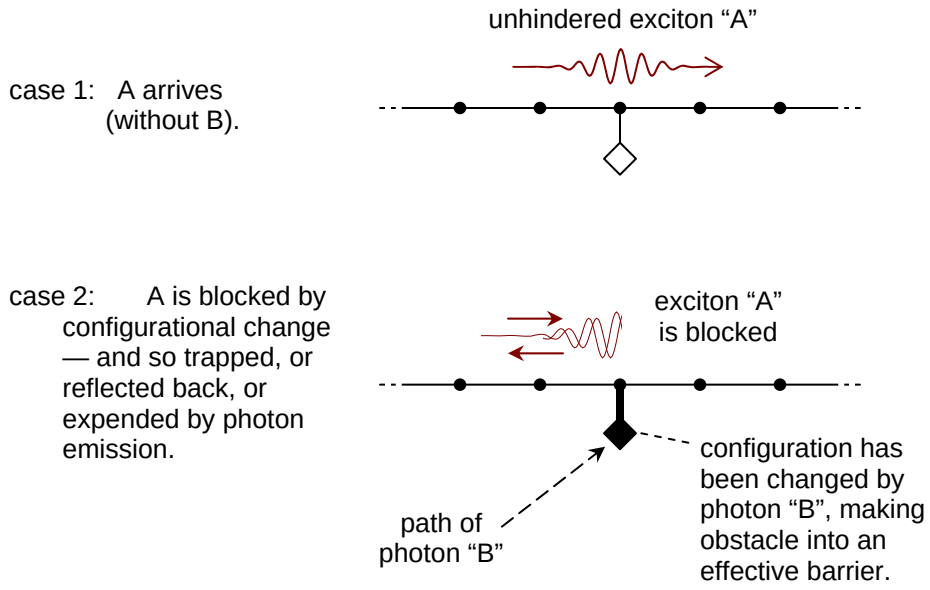


Fig C6.7/5. One possible molecular embodiment of *"A and not B"*, i.e. the logical condition depicted by:-

	A	not-A
B		
not-B	**act**	

(310)

The latter case, whether or not this arrangement actually occurs in nature, at least serves to highlight the possibility that the system might respond unexpectedly selectively when faced with quanta having differing energy-values. In the example shown, it was the lower-energy signal which was diverted by a "high-pass filter" (so that it ended up doing switch-throwing work, rather than continuing as a signal in its own right); but it is also conceivable that a "low-pass filter" in the same position could similarly divert a higher energy quantum into the role of switch-thrower for a lower energy signal. And this would be a rather more surprising phenomenon, though the idea that the uniformity-or-otherwise of the waveguide will depend on the signal-frequency, is a commonplace of electronics. Thus the degree of reflection at the discontinuities in the wave-guides of Figure C6.7/2, will depend very much on the frequency or transient-properties of the disturbance being propagated; so that, for certain conditions, some of the discontinuities will "pass unnoticed" as far as that particular signal is concerned. Whether such selective treatment occurs much, or at all, at the postulated molecular-pathway level, is rather a moot point; but there must presumably be some provision for signal-sorting *somewhere* in the system, be it in molecular activity, or nerve-fibre optical dispersion (Chapter B4, above), or both, or whatever. At cell-level, at least, there is evidence of a comparatively macro type of signal separation; 312

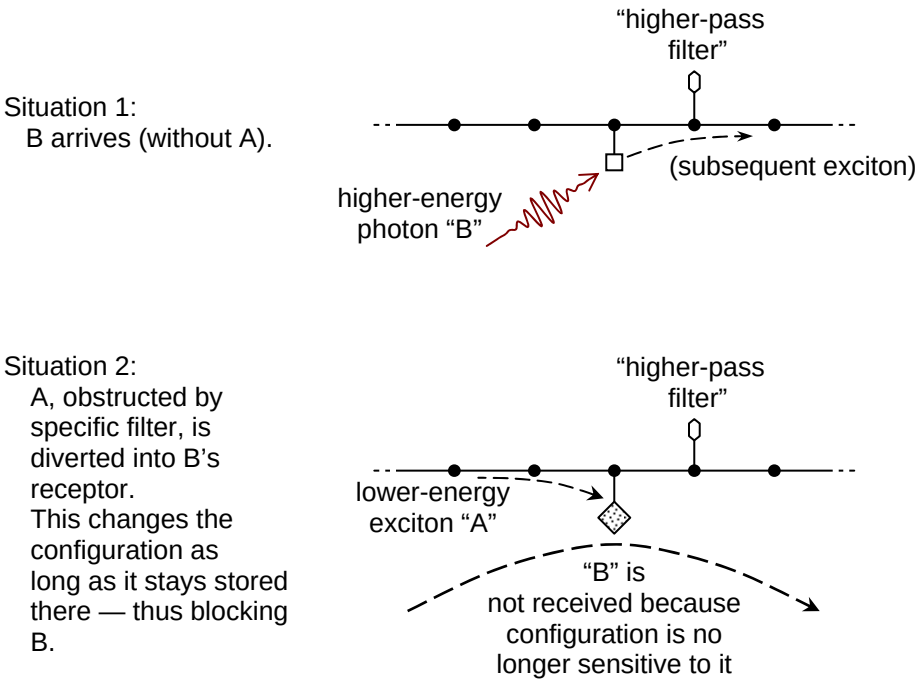


Fig C6.7/6. One possible molecular embodiment of *"B and not A"*, with the logical properties:- ……

	A	not-A
B		**act**
not-B		

(311)

(Hughes, 1965; Chung *et al*., 1970; Waxman, 1972; Grossman, Spira, and Parnas, 1973; Goldstein and Rall, 1974).

Trivial logic-cases

Of the trivial or "degenerate" logical functions, we might just note the following examples. (1) *A regardless of B* is obviously just normal transmission along a wave-guide, without obstruction or qualification. (2) *B regardless of A* is reception of a photon without any influence from any incumbent exciton — at the start of a "label" for instance. (3) "Contradiction" is a dead-stop with no (within-molecule) output — though presumably we may allow it to be a photon-emitter to dispose of its acquired energy — or perhaps it will do so by back-reflection or other such complicating action?

The implication here in "(3)", and in Figures C6.7/3 and C6.7/5, that there might be important outputs expressed as photons emitted *into the exterior*, or reflections sent *backwards* along the molecule, once more calls into question the value of categorizing such phenomena in terms of the sixteen binary operators — even though they have now apparently been rescued from their embarrassing inapplicability for normal neurons. If such a mathematically-oriented formulation is called for at all, then we would seemingly need a system which contemplated: two or more *different types of output*; *storage* and its likely configurational changes with varying stability; 313

and also the constraints imposed by the *conservation of energy*. Such a calculus might eventually be forthcoming, but meanwhile we would do well to keep to first principles or else cautiously use a hybrid pluralistic formulation.

Implications for Freud's vague theory on "Mental Energy", etc.

We are now in a position to offer some new comments about how pharmacological chemicals might operate. There has long been considerable evidence that many of them are site-specific; thus it does not take much imagination to see such additions as new components in the "wiring" of Figures C6.7/3 to C6.7/6 — either as configurational changes comparable to those supposed to arise from the storage of excitons, or as entirely new "electronic components" which create, modify, or abolish reflecting-discontinuities and any frequency-selectivity which they might have. Of course many such chemical agents occur naturally, as neurochemical transmitters or whatever; and it is well known that the effectiveness of some exotic agents lies in their ability to compete for site-occupation with the "normal" occupants of those sites. There is no obvious reason why these sites should not be the linear-molecule sites postulated here; though of course it is not suggested that there is any direct current evidence to support this notion.

The psychoanalytic theoretical literature is replete with concepts involving the blocking of mental "discharge", though it has never been entirely clear just what, in material terms, is being blocked or discharged. Thus Fenichel (1946, page 11) writes:- 314

> "The basic pattern which is useful for the understanding of mental phenomena is the reflex arc. Stimuli from the outside world ... initiate a state of tension that seeks for motor or secretory discharge, bringing about relaxation. However, between stimulus and discharge, *forces are at work opposing the discharge tendency*. The study of these inhibiting forces, their origin and their effect on the discharge tendency, is the immediate subject of psychology. Without these counterforces there would be no psyche, only reflexes [Ferenczi (1926)]." — Emphasis added.

In the absence of any precise idea as to what is meant by such terms as "forces at work", or "discharge tendency", or even "reflex arc", it is something of an effort to take seriously the notion that our mental propensities should be considered as channelled-energy or forces within our brains (except as a metaphorical analogy). Nor, given the accepted view of (*fuzzy*) logic at cell or synapse level-of-resolution, can we really very credibly explain how a *specific* blockage could be set up and *maintained*. However the above exposition in terms of quantized molecular phenomena does seem to offer the basis for just this sort of precision and specificity. In particular, the problem of how to cope with blocked "A" excitons and their energy, has arisen as an explicit issue in connection with Figure C6.7/5. Accordingly, it may now be within our grasp to define Freudian "mental energy" in reasonably precise physical terms — presumably involving quantum energy, or its entropy given the collective state of synchrony between molecules, or both.

By the same token, it should now be possible to be more explicit about "mental economics" and the closely related notion of mental exhaustion (Fenichel, 1946, pages 13-14). Qualitatively this has always been a plausible idea once the "energy" concept has been accepted, because energy or negentropy must ultimately be supplied from limited resources and be directed along routes with limited channel-capacity. The latter would now seem likely to be quantifiable in terms of molecular acoustics, and nerve-fibre wave-guide properties (Part B, above); while quantitative approaches to questions of energy-*source* have been suggested by Cope (1973) — involving the storage of infra-red quanta in mitochondria, after their generation via redox potentials. 315