Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

CHAPTER 4

Architecture and the Human Sciences

We saw in Chapter 3 that the architect, in the act of designing, may display rational or empirical attitudes to his task. Often he combines them but occasionally one meets an extreme. The extreme rationalist, for instance, will be concerned with the abstract, self-consistent geometry of his building and, by definition, he will have little interest in the ways in which it impinges on the senses of those who use it. Certain architectural theorists of the mid-eighteenth century, such as Laugier (1753), were rationalists in this sense—they sought to apply Cartesian, or equivalent, method into the design of architecture and this led Laugier in particular to believe that architecture consisted, essentially, of columns, beams and pedimented roofs. All the other elements of building—walls, windows, doors and so on—were 'licences' in his terms and therefore to be avoided. One can trace a direct tradition from Laugier and his contemporaries through early nineteenth-century neoclassical architects such as Schinkel, to our own day (Broadbent, forthcoming). The supreme exponent, of course, was Mies van der Rohe, who succeeded in building a Laugier-like architecture of columns and beams, eliminating even the pedimented roof. He avoided the problem of walls, windows and the other elements of building, by filling the spaces between his columns and beams with glass, thus giving the *appearance* of designing without recourse to licences in Laugier's terms.

The buildings he thus achieved, such as the Farnsworth House (1950) or Crown Hall at the Illinois Institute of Technology (1955) (see Figure 4.1) also confirm that other aspect of architectural rationalism—they contribute rather less to user-comfort in terms of environmental control, than the average greenhouse.

The extreme empiricist, on the other hand, will be concerned with sensory experience to the exclusion of a rational structure, in the philosophical sense. Again one can take a direct tradition from the empiricist philosophers themselves, through aestheticians such as Addison and Gilpin, Price and Payne-Knight (see Hipple 1957) to such Picturesque designers as Repton (1840), Nash (1960) and others. We tend to dismiss them as irresponsible, concerned with visual delight to the exclusion of user-comfort and convenience. We also tend to believe that their Picturesque effects were gained at the cost of considerably more expenditure by their clients than straightforward, honest building would have demanded. I have traced the progress of this view elsewhere (Broadbent, forthcoming) to the Puritan sense of morality and respon-

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

sibility which Ruskin and others introduced into architecture. Sometimes it is true, but on the whole I believe we have done these architects an injustice. The finest of them were concerned not just with visual effect but with pleasurable sensory experiences of a multi-modal kind.

Take one early, but supreme, example—the garden which Henry Hoare and others built at Stourhead (1743), on the edge of Salisbury Plain. In Banham's view (1962) Stourhead is the finest work of art which was ever created in England (Figure 4.2); one can agree with that, in terms of visual delight alone. However, as Hoare left it, Stourhead also stimulated the senses of smell (from varied planting), hearing (from the controlled play of water,

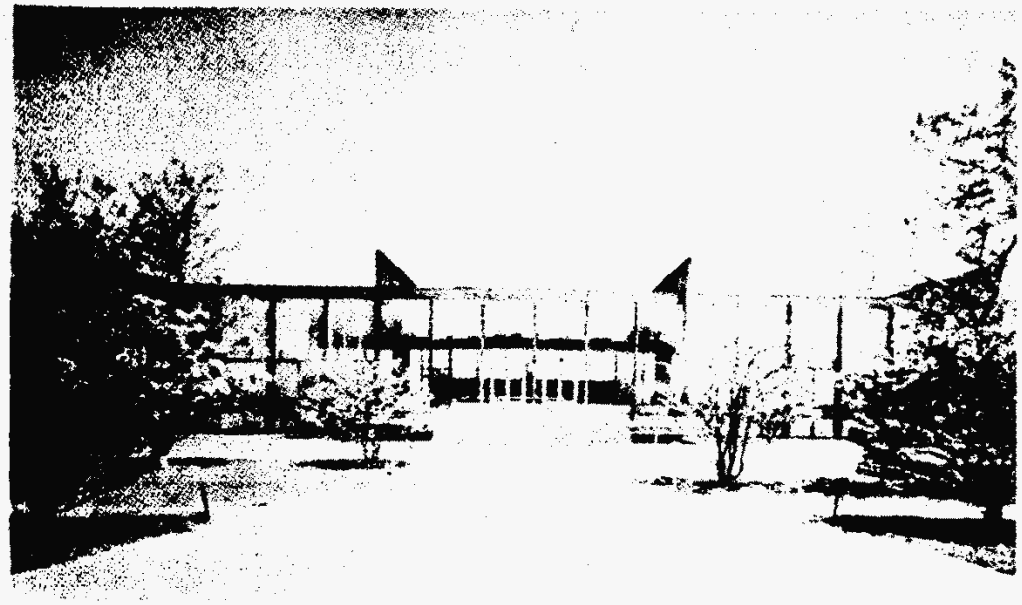

Figure 4.1—The ultimate conclusion of a rational tradition which originated with Laugier and others in the mid-eighteenth century. Mies van der Rohe's Crown Hall, the school of architecture at the Illinois Institute of Technology, Chicago (1955)

both externally and in the Grotto), heat and cold (Flitcroft's *Pantheon* contained one of the first central heating plants to be built since Roman times) and even the sense of equilibrium (the timber bridge over one arm of the lake was designed to 'give' slightly as one walked across it) (Woodbridge, 1965, 1970).

I have also suggested elsewhere that throughout the eighteenth and nineteenth centuries technical innovation in architecture was largely the work of empiricists and there are signs again now (1970) that an empiricist approach is emerging again. Most environmental scientists are empiricists by nature and few architects would dispute their contention that, among other things, one should design for visual, thermal and aural comfort. Some of us would go further than that, in the belief that the architect should design not just

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

for comfort but for delight. It seems inconsistent that he should design for, say, thermal and aural delight without at the same time designing for visual delight.

However, the founding fathers of twentieth century architecture seem to have been rationalists by nature. Mies was the most extreme of them, but Le Corbusier, Gropius and others certainly subscribed to rationalist ideals. They set up self-consistent systems on the basis of personal insights from time to time; they even tried to formulate self-evident truths or axioms. One thinks of Sullivan's 'form follows function', Wright's 'internal space is the reality of the building', or Le Corbusier's 'the plan is the generator'. At their best, these architects achieved a marvellous fusion between rationalism and

Figure 4.2—The paradigm of empiricist architecture, design for sensory delight. Henry Hoare's Stourhead in Wiltshire (1743)

empiricism (which is particularly true of Wright) but, as we have seen in the case of Mies, the closer they approached to pure rationalism, the less satisfactory their buildings prove to have been, from the point of view of user comfort.

It was bad enough when their rationalism determined the form of the building itself, but at worst it extended also to trying to determine the lives which people should live within it. As Le Corbusier put it:

> 'Demand a bathroom facing south, one of the largest rooms in the house or flat . . . One wall to be entirely glazed, opening if possible onto a balcony for sun baths; the most up-to-date fittings with a shower-bath and gymnastic appliances.
>
> . . . Never undress in your bedroom. It is not a clean thing to do and makes the room horribly untidy.'

In each case, and there are several others in this 'Manual of the dwelling' from *Vers une architecture*, Le Corbusier has clear ideas as to how people

should live, and tries to build them into the house so that people will be forced to live in these ways. His enthusiasm for fresh air and exercise was fostered by Dr. Paul Winter, a contributor to his journal (edited jointly with Ozenfant), *L'Esprit Nouveau*. Now, what if the user wanted a small, private, intimate bathroom; how could he live comfortably in a Le Corbusier house?

Again people *have* to live tidy lives if they are to match the conventions of his architecture: 'Demand bare walls in your bathroom, your living room and your dining room . . .', whilst the final clue as to how people's lives should be ordered by the architect is provided in the following phrase:

> 'Built-in fittings to take the place of much of the furniture, which is expensive to buy, takes up too much room and needs looking after.'

So for that matter does built-in furniture and it also fixes once and for all the arrangement of the room. Contrast this with that staple of the British furniture industry, the three-piece suite with sideboard, which allows for an extraordinary number of permutations in the arrangement of a living room. Each item is movable and any number of people, from one to five, can arrange themselves comfortably and in convenient groups, sitting side by side, face to face or at right angles to each other. It is difficult to envisage any arrangement of built-in furniture which would offer so many possibilities.

To be fair to him, Le Corbusier did design individual items of furniture such as chairs and he seems to have sensed that his personal predilections may not have been the only basis for design. He appears to have been asking for an empiricist approach, one might almost say behaviourist, to the building up of standards relating to human needs, for use in design. 'By needs,' he said, 'I mean utility, comfort and practical arrangement.' Not only that; he was also quite clear that needs could be established by observation and statistical analysis:

> 'A standard is necessary for order in human effort.
> A standard is established on sure bases, not capriciously but with the surety of something intentional and of a logic controlled by analysis and experiment.
> All men have the same organism, the same functions.
> All men have the same needs.
> The social contract which has evolved through the ages fixes standardized classes, functions and needs producing standardized products.'

If all men have the same organism, the same functions and the same needs, then clearly it should be possible to identify the basic standards for design which Le Corbusier seeks. Once those standards have been laid down, then design itself should become a matter of deducing for a particular building the actual form which the general standards determine. As he says:

> 'The establishment of a standard involves exhausting every practical and reasonable possibility, and extracting from them every recognized type conformable to its functions, with a maximum output and a minimum use of means, workmanship and material, words, forms, colours, sounds.'

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

Such standards exist, he believes, in painting and sculpture, 'the great standards of the heart', and they also exist in the motor-car industry, where simple function (to travel) and a complicated series of aims (comfort, resistance, appearance) have forced, he says, the 'absolute necessity' of standardization. So all motor-cars have the same essential arrangement.

Nor was Le Corbusier alone in this desire to establish standards. Gropius presents his case for standards in *The New Architecture and the Bauhaus* (1935):

'A standard may be defined as that simple practical exemplar of anything in general use which embodies a fusion of the best of its anterior forms—a fusion preceded by the elimination of the personal content of their designers and all otherwise ungeneric or non-essential features. Such an impersonal standard is called a "norm", a word derived from a carpenter's square.'

He is less precise than Le Corbusier who wanted to define his standards in mathematical terms and indeed Gropius only resorts to mathematics in those rather doubtful diagrams by which he proves to his own satisfaction that, given the same daylight angle (30°), ten-storey blocks allow one to pack more flats at a greater density, on to a given site, than do three-storey blocks and that they also afford a better daylight angle (17° 50′) than three-storey blocks.

Gropius's much maligned successor as Director of the Bauhaus, Hannes Meyer, also looked for fundamental standards on which architecture could be based:

'Thinking of building in functional and biological terms as giving shape to the living process leads logically to pure construction; these constructive forms have no native country, they are the expression of an international trend of architectural thought. Internationality is a virtue of the period. Pure construction is the basis and characteristic of the new world of forms.

1. sex life
2. sleeping habits
3. pets
4. gardening
5. personal hygiene
8. car maintenance
9. cooking
10. heating
11. insulation
12. service

These are the only requirements to be considered when building a house.' (Meyer, 1928)

Curious that no one in Meyer's house ever indulged in reading, writing, conversation, listening to the radio or most of the other activities which might be assumed under the general heading of 'living'. Yet even in this list Meyer expressed his priorities for a particular time and place. For many people in many parts of the world 'car maintenance' is impossible because there is no car to maintain. Others might find 'pets' or 'gardening' to be quite

irrelevant and, finally, Meyer looked for more fundamental standards even than these:

> 'All life is an urge towards harmony. Growing means striving after the harmonious enjoyment of oxygen + carbon + sugar + starch + protein. Work means our search for the harmonious form of existence.'

Once one reaches this level of generalization, there is little left of a philosophy to help the designer make decisions when he is faced with real design problems. Meyer's own successor as Director of the Bauhaus, Mies van der Rohe, had an even pithier comment to make of it: 'Life is oxygen + carbon + sugar + starch + protein . . . Try stirring that together,' said Mies, 'it stinks.'

Meyer's conception of standards extended beyond architecture to the whole of a culture or, rather, he sought to relate architectural standards to cultural standards:

> 'The standardization of our requirements is shown by: the bowler hat, bobbed hair, the tango, jazz, the Co-op product, the DIN standard size and Leibig's meat extract. The standardization of mental fare is illustrated by the crowds going to see Harold Lloyd, Douglas Fairbanks and Jackie Coogan. Grock and the three Fratellini weld the masses—irrespective of class and racial differences—into a community with a common fate. Trade union, co-operative, Ltd., Inc., cartel, trust and the League of Nations are the forms in which today's social conglomerations find expression, and the radio and rotary press are their media of communication. Co-operation rules the world. The community rules the individual.'

Meyer's list, as it happens, points out the difficulty of establishing standards in this way, for none of these products survives in precisely the form in which he knew it or with the ubiquity which he implies. The bowler hat, jazz of the 1920s and Harold Lloyd's films do survive as the cult objects of minority groups; the Co-op, Leibig's and DIN are still operative but their products and standards have changed out of all recognition. In other words, Meyer's examples represented standards only for one cultural group (western Europe and America) at a particular moment in time (the mid-1920s).

It seemed necessary, therefore, to look for more fundamental standards of the kind which, say, behavioural psychologists had begun to pursue. Meyer had actually invited psychologists (although largely of Gestalt persuasion), sociologists and other human scientists to the Bauhaus (1927–28)—an initiative which Gropius seems to claim as his own in *The New Architecture and the Bauhaus* (1935) and *The Scope of Total Architecture* (1956). Others too, such as Richard Neutra, see the human sciences as contributing to *Survival through design* (1954), and in the 1960s there has been an increasing amount of traffic in the other direction. It has become almost fashionable for psychologists and sociologists to take a specialist interest in environmental research and design.

The motives, largely, are political, starting with a generalized concern for the environment. Sometimes, however, the reasons are more specific, as

declared by Cohn-Bendit and others in their statement entitled *Why sociologists?*, which triggered the Parisian student revolt of May 1968. They suggested that Mayo, in his famous observations at the Hawthorn factory in 1927 (in Roethlisberger and Dickson, 1941),

> '. . . closed the epoch of . . . speculative systems concerning society as a whole and opened the glorious era of empiricism and of "scientific" data-collection. At the same time, in selling his services to the management of an enterprise, Mayo initiated the age of the large-scale collaboration of sociologists with all the powers of the bourgeois world . . .'

In other words, the sociologists' skills were being used to promote the interests of management, to find ways of increasing productivity and so on. Cohn-Bendit and his colleagues go on to say: 'industrial sociology seeks, above all, the adaptation of the worker to his work'. This from a phenomenological point of view is intolerable and it seems to many of those who hold such views that environmental design could offer them opportunities for exercising their skills in constructive ways, by trying genuinely to find out what people *want* rather than manipulating them to accept what is offered. As we shall see, there are difficulties in this but the intention is admirable enough and, for now, we ought to encourage it.

Yet problems arise immediately from causes which Cohn-Bendit and his colleagues touched on. Sociology, for instance, had been a rational matter, initially. Its founding fathers, such as Saint-Simon (1720–1825), Comte (1798–1857)—not to mention Marx (1818–83) and Engels (1820–95)—had brooded on the nature of society and set up models which (for them personally) explained its structure and functions and the mechanisms of social change. Saint-Simon for instance believed, like his contemporary Laplace, that a general theory of the sciences could be set up, against which (given the appropriate data) all future states of any given system could be predicted. Comte took his model from Newtonian mechanics, thinking in terms of social statics and social dynamics, whilst Spencer was much given to biological analogies.

A number of fundamentally different models have been developed in sociology. Buckley (1967) identifies five: the mechanical model, the organic model, the process model and the two equilibrium models of Parsons and Homans. Inkeles (1964) on the other hand, identifies six, which he describes as: evolutionary/developing; structural-functional; physical science/mathematical; organismic; equilibrium; and conflict models. We may collate their descriptions in the following manner.

1. *Physical science models.* Comte's aim initially had been to set up a *social physics* in which society could be seen as an astronomical system in which human beings were attracted by mutual attraction or differentiated by repulsion. One could thus apply the laws which were proving so successful in

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

physics and engineering to the study of man himself. Now clearly, the models against which physics was developed, concepts such as space, time, attraction, repulsion, inertia, force, power and so on, arise in the first place as a result of human experience; they were things which men 'felt in their bones'. It is not surprising, therefore, as Buckley says, that ' . . . we find conceptions of *moral or social space* in which social events occur; *position* in social space, and a *system of social coordinates* defining man's position in it . . ., *attraction* and *inertia* of individuals and groups, the latter regarded as a *system in an equilibrium* of *centrifugal* and *centripetal* forces'.

The question at issue is (given that these concepts originated in anthropomorphic analogies): can they really be applied, with any conviction, to the study of society as a whole? At best they are drawn at the wrong level and at worst they introduce a phoney precision into the discussion of social affairs which may well be misleading even where it is not downright harmful. As Inkeles puts it:

> 'The precision of expression which characterizes physical science, with its dimensions of space and time, its forces and vectors, greatly tempt those who weary of the ambiguity of so many sociological terms, the vagueness of the relations specified between variables, and the indefiniteness of the conclusions reached.'

It is a refuge, in fact, for habitual convergers; but it has other, rather more sinister implications. In Inkeles' words:

> 'The most obvious, and most often cited, explanation for the appeal of the physical science model is that the success of physicists and chemists has given their approach an aura of power and prestige so great that people are inevitably attracted to it.'

2. *Evolutionary models.* In these society is seen as progressing, by definite steps, towards a final stage of perfection. Comte thought in terms of three stages which he called conquest, defence and industry, whilst Spencer and Sumner used a kind of 'social Darwinism'—survival of the fittest—to justify their attempts to block social reform. Marx and Engels presented the best known of evolutionary models, based on five great modes of social being: firstly a primitive Eden which is usually forgotten in accounts of their work; secondly, Slavery in which the exploited are actually owned; thirdly, Feudalism in which the workers are still exploited but no longer owned; fourthly, Capitalism, a depersonalized exploitation in which the worker is subject to the routine of the factory so that production and marketing may be maximized; and finally, Socialism in which no one is exploited and the individual is encouraged to develop towards a state of self-realization. Each stage carried within itself the seeds of its own destruction and would be succeeded inevitably, by the next stage higher on the scale of evolution.

Durkheim assumed an evolutionary process in which successive stages are marked by the ever increasing division of labour, whilst Sorokin believed that

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

societies evolve from an ideational phase in which truth is based on faith, through a stage of sensate culture in which truth is revealed empirically, to an idealistic culture in which the two are synthesized and demonstrated by reason.

There have been other, later and even more sophisticated evolutionary models but, as Inkeles says, they have been largely abandoned now if only because after certain events of the twentieth century no one can seriously believe that society *has* evolved.

3. *Organismic models.* These depend on analogies with living organisms, with particular reference to structure and function. They are concerned in particular with the ways in which societies are maintained and carried forward, even though their individual members change with each new generation. If the evolutionary approach is concerned with social change the organismic approach tries to understand how society is working, as a system, at a particular moment in time. Spencer in particular was fond of drawing analogies of this kind; he was well aware that they could be drawn too far and should be limited to matters concerning the relationships of wholes and parts, but he persisted nevertheless in drawing them further than they could bear. It is easy to say that societies (or even cities) are born, grow, reach maturity and die, to draw analogies between traffic and circulation systems, between communications networks and the nervous systems, but Spencer's mistake, according to Deutsch, is that he failed on the whole to choose the appropriate level at which to draw his analogies. His analogies were drawn between societies and single organisms, whereas for many purposes it would have been better to draw them with whole species.

3A. *Equilibrium models.* Those of Homans and Talcott Parsons are special cases of the organismic model in that they draw on more sophisticated concepts, such as homeostasis, to explain the ways in which society defends itself, say, against juvenile delinquency in much the same way as the body takes action against infection. It is clear, as Inkeles says, that society sometimes fails in this; it cannot maintain itself in a state of near equilibrium; the pressures to change are too great and if a society does not yield to them it will die. Mills and others oppose these equilibrium models directly with a conflict model. They suggest that the true state of society is not one in which agreement is reached by consensus but one in which progress depends on an endless struggle between the privileged and the deprived, with the latter struggling constantly to secure advantages for themselves.

4. *Mathematical models.* Since World War II, with the increasing availability of computers, sociologists, like so many other people, have turned increasingly to the building of mathematical models. The work generally

starts, as Inkeles says, in one of two ways. A researcher observes that time and again his results seem to follow a given form; Bales, for instance, noticed in his study of small groups, almost invariably, that 45 per cent of all acts were directed towards one person; that acts were directed towards other individuals in decreasing numbers; and that about 6 per cent of all acts were directed to the man who received least attention. Bales found, moreover, that the observed pattern fitted fairly closely a harmonic curve. It became possible, using this curve, to predict the pattern of probable interactions for other groups of up to eight people.

Frequently, however, there is no ready-made model of this kind and the sociologist has to construct one; this clearly has its difficulties. Simon (1957) has shown that a great many social processes can be modelled in *stochastic* terms, that is to say in terms of sequences within which the probability of a given event depends to a large extent on preceding events. City size, income, word frequencies and other linguistic phenomena can all be modelled in terms of stochastic processes.

Nevertheless mathematical modelling carries a number of hidden dangers. Like the behaviourist, the mathematical modeller tends to think that his techniques are 'neutral' but the fact that one is using a model at all is a declaration that one has chosen to see the world in a particular way. Simon develops this idea:

> 'First . . . we do well to avoid *a priori* philosophical commitments to models of particular kinds—whether they be probabilistic or deterministic, continuous or discrete, analytic or set-theoretic . . .
>
> Second, we must not expect to find the models we need ready-made in a mathematics textbook. If we are lucky, we shall not have to invent new mathematics, but we are likely to have to assemble our model from a variety of new materials. For this reason, we should be wary of borrowing, in any wholesale fashion, analogical models from the natural sciences. Analogies there will undoubtedly fit . . . but it will be safer to notice them after we have developed our theories than to attempt to employ them as a basis of theory construction.'

However, models are one thing and techniques are another. The Nanterre group (Cohn-Bendit et al.) suggested rightly (although they got their dates wrong) that sociology had moved away from rational speculation to become an empirical science and empiricists, as we have seen, tend to think of their techniques as 'neutral'. Durkheim (1858–1917) tried to discover 'social facts' by collecting data on, say, *Suicide* (the subject of one of his most well-known books), analysing it statistically so as to plot the *rates* at which suicides took place, comparing these rates for different social groups and thus detecting any *social* implications of variations in the rates.

Max Weber (1864–1920) finally saw the difficulties of both the rational position (which seeks 'insights' without really demonstrating *how* its models actually fit the facts) and the empiricist position (which becomes so bound up

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

with demonstrating the existence of connexions that it hardly ever attempts to show *why*). Weber tried to resolve this by setting up theoretical models *which could be tested* but describing them at the same time in terms of an individual view—ascribed to a hypothetical observer in a specific historical context. He had no use for the ideal type or even for the statistically average, asking the highly pertinent question as to what relationship the average frog would have to all the particular frogs which a biologist observes.

Curiously enough, this view was also put forward by Hitchcock and Johnson in their highly perceptive book on recent (1932) trends in the architecture to which it gave a name: *The International Style.* International style housing, they say:

'. . . implies preparation not for a given family but for a typical family. This statistical monster, the typical family, has no personal existence and cannot defend itself against the sociological theories of the architects. The European functionalists in their annual conferences set up standards for ideal minimal dwellings. These standards often have little relation to the actual way of living of those who are to inhabit them . . . Too often in European *Siedlungen* the functionalists build for some proletarian superman of the future. Yet in most buildings the expressed desires of a given client are the most explicit and difficult functions . . . The idealism of the functionalists too often demands that they provide what ought to be needed, even at the expense of what is actually needed. Instead of facing the difficulties of the present, they rush on to face the uncertain future.'

Yet some things *can* be established statistically, standardized and used as the basis for design. We know that human tissue is damaged by exposure to excessive heat or cold. There is a very high probability indeed that any man would die if he were exposed overnight, unprotected, to a temperature of minus 50°C, or one of plus 200°C. We could move in from these limits and establish the ranges outside which 90%, 80% . . . 10% of men would die. We could even establish the ranges within which 10%, 20%, 30% of men would feel comfortable although, clearly, it will never be possible to establish a simple temperature at which everyone, dark-skinned or light, brought up at the Equator or in the Arctic Circle, would feel comfortable.

Clearly such studies are the province of physiology. It seems, therefore, that *some* of the human sciences *can* present the designer with useful information. Before we decide which these are, however, we ought to look at an extensive range to see what possibilities are available. A tentative list in alphabetical order might read as follows:

Anatomy: systematic description of the body, usually under the headings describing ten major systems—skeletal, muscular, integumentary (skin), circulatory, respiratory, alimentary, urinary, nervous, endocrine (glandular) and reproductive.

Anthropology (physical): comparison of different races in anatomical and anthropometric terms.

Anthropology (social): comparative study of complete human societies in different places, from the point of view of social structure, social function and social change.

Geoffrey Boradbent, *Design in Architecture: Architecture and the Human Science.* London: David Fulton Publishers, 1988

Anthropology (structural): attempts to apply the methods of structural linguistics to the study of kinship or other aspects of social anthropology (Malinowski, Radcliffe Brown, Levi-Strauss).

Anthropometrics: direct measurement of the human head and body against a check-list of those dimensions which have been found useful in certain kinds of research; e.g. stature, waist, girth, weight, etc. Statistical analysis of those dimensions.

Archaeology: study of what survives from the physical environment within which people lived in the past; examination of tools, weapons, pottery, buildings, tombs and so on, dated according to distribution (where they were found geographically), stratification (the depth at which they were found) and their relationship to other materials; association (the things they were found with) and typology (comparison with other artefacts about which details are already known).

Demography: observation and recording of births, deaths, disease, etc., and their statistical analysis as indicators of living conditions within a community.

Ecology (human): study of man as an organism in relation to his physical environment; effects of geographical location, climate, degree of shelter, food supply, interactions with other species, etc., on growth, size and development of other physical characteristics.

Ergonomics: method of establishing standards in which certain aspects of the physical environment (independent variables, such as illumination levels, noise levels, temperature, air movement, etc.) are subject to controlled variations. The effects of these variations on human performance are measured in terms of 'comfort', output, efficiency, etc., (the dependent variables) analysed statistically and used in the drawing of inferences about human performance in general or as a basis for design (Murrell, McCormic).

Ethnography: descriptive study of peoples and their distribution, physical characteristics and relationships with each other.

Ethnology: historical ethnography, concerned with customs, culture and so on.

Ethology: according to Mill, 'the science of the formation of character', but more recently used to describe studies in animal behaviour, especially those concerned with territoriality, aggression, etc., (Lorentz, Ardrey, Hall) and their relationships with human behaviour (Morris).

Linguistics: the descriptive, comparative or other study of *language* (the common tool of communication between members of a community) and speech (an individual's use of language). *Diachronic* linguistics deals with changes over time in a particular language whilst *synchronic* linguistics compares different languages at the same point in time. *Structural* linguistics (Saussure, etc.) is concerned with the ways in which words are related to each other in language, either by their positions in sentences (*syntagmatic* relations) or in terms of shared meanings, rhymes etc., (*paradigmatic* relations), on the assumption that such relationships are common to all languages because of certain fundamental structures in the brain. *Generative grammar* (Chomsky, etc.) assumes that such mental processes predispose one to learn language in such a way that the sentences one utters are grammatically correct.

Parapsychology: study of events for which direct empirical evidence is not available, such as thought-transference, telepathy, haunting, communication with the dead, and other forms of extra-sensory perception (Rhine).

Pathology: study of the changes which have occurred in the structure of the body as a result of disease; assessment of any treatment the patient may have received, as an aid to deciding further treatment; deduction as to cause of death.

Physiology: systematic, structural analysis of the ways in which different parts of the living organism are adapted to each other, and of their interactions and functions.

Psychiatry: treatment of mental disease by methods including psychoanalysis, but including also shock treatment, drugs and so on.

Psychoanalysis: belief that descriptions of the nervous system in physiological terms do not explain its unconscious workings; use of 'psychical apparatus' described by Freud to account for these unconscious workings. According to Freud, the predispositions, appetites, etc., which we inherit at birth together form the *id*. As we gain experience of the world, part of the id develops to form the *ego*, its intermediary with the external world. A special agency within the ego is formed in childhood through dependence on one's parents; this is the *super-ego*. One's purpose in life is to satisfy one's instincts, the driving forces behind the basic needs of one's id. In particular, one has to satisfy two basic instincts—*eros* which aims at binding things together, particularly in sexual love—and *thanatos*, the 'death wish', which aims at destruction (Freud, Jung, Adler).

Psychology: originally the study of *mind*, but many psychologists now would deny the existence of mind, preferring to think of psychology instead as the study of *behaviour*. Typical concerns of psychology are the study and correlation of abilities, especially those contributing to intelligence; the measuring of personality traits in terms of physiological and social factors, effects of heredity and/or environment on personality; function of the nervous system; individual development, motivation, feeling and emotion, value systems; physiology and psychology of perception, especially in terms of vision, learning, memory and other cognitive processes (Osgood, 1953; Woodworth and Schlosberg, 1954; Miller, 1964).

Social psychology: observation of people in groups and of their effects on each other in terms of output, efficiency, well-being, and in other respects.

Sociology: the study of society—as distinct from the individual—in terms of all that happens to human beings by virtue of their reactions to each other (Ginsburg, 1955). These reactions may be observed, described and classified under three major headings: social structure, social function and social change. Under structure, for instance, one might study the various units of social organization, family and kinship, various kinds of social or working groups, larger groups such as the neighbourhood, the city and so on. The study of social functions might include those factors which tend to hold groups together: political, legal, economic, administrative or institutional, not to mention co-operation, control and discipline. Social change might start with defiance and conflict, it will be concerned with differentiation, stratification and mobility within society (Inkeles, 1964; Broom and Selznick, 1955; Green, 1956).

Clearly these sciences differ greatly in scope, methods and aims. They differ greatly in degree of rigour and the extent to which they can help the designer with positive results. Many of them in any case are still embryo sciences, anxious above all to establish their respectability as true sciences. General surveys of their applications into environmental studies have been presented by Craik (1970) and Proshansky, Ittelson and Rivlin (1970). But difficulties arise because some of their practitioners seem far more anxious to demonstrate their grasp of a methodology than to produce results which are usable in design. They collect large quantities of data and submit it to minute analysis, without really stopping to think what their analyses are for.

These and other problems have been discussed, often at considerable length, by psychologists such as Wells (1965a and b), Rohlen (1967), Sommer (1967), Canter (1970), Stringer (1970) and Lee (1970 and 1971), by sociologists such as Broady (1966, 1968), Guttman (1966), by architects such as Manning (1967), Rapoport (1969), Broadbent (1970) and Marcus (1970). The RIBA Research Committee (1970), also Hillier (1970), have had much to say on the subject and it has formed the substance of conferences at Dalandhui (Canter, 1970), Kingston (Honikman, 1971) and of the Environmental Design Research Association (see Chapter 13).