ARCHITECTS, ENGINEERS AND BUILDERS

The Alfred Bossom Lecture by

OVE ARUP, CBE, FICE, FIStructE,

delivered to the Society on Wednesday 11th March 1970, with the Lord Holford, RA, FRIBA, MTPI, in the Chair

THE CHAIRMAN: The Alfred Bossom Lectures, which have been given annually since 1952, have always been something to look forward to. Both the subject and speaker tonight are no exception. Last year Maxwell Fry spoke on the subject of crematoria, and there was a fascinating discussion afterwards. Before that we had Fello Atkinson. The name of this year's lecturer, Ove Arup, is a household word among civil and structural engineers, architects and builders; and in fact it is about this particular household that he is speaking this evening. A rich and varied experience as an organizer and problem-solver and creative designer has given him the authority to speak on this vexed question of communications in the building industry. Ove Arup knows (and he demonstrates it in his work) that if you design sensibly you can achieve elegance as well. He has demonstrated this superbly in his little footbridge over the Wear at Durham. He has also demonstrated in his collaboration over the Sydney Opera House that even when there is a gap between design and construction this gap can be closed; and those of you who have been lucky enough to see the film of the roof of the opera house being constructed will know what an achievement it is – but in such a case the gap is closed with far more difficulty, complication and cost.

As one of the lesser architects who worked with Ove Arup and his partners I feel privileged to be taking the chair for him tonight. I only want to make one further comment before asking him to speak, and that is to say that two other Royal Gold Medallists in architecture, namely Buckminster Fuller and Pier Luigi Nervi, share with Ove Arup this conviction that design and execution are reciprocal and not separate parts of the building process. This lends even greater significance to what Mr. Arup has to say to us.

The following lecture was then delivered.

THE TITLE of my talk doesn't sound promising. 'What, again!' would be a natural reaction. It was suggested in order to make the title suitable for a Bossom lecture, it being implied that as long as the title was correct, what followed didn't matter. But somehow this way out doesn't appeal to me, so we are stuck with the title, and I had better consider what can usefully be said about this much-laboured theme.

The trouble is that the terms Architect, Engineer and Builder are beset with associations from a bygone age, when building was something very much more primitive than it is now; and they are inadequate to describe or discuss the contemporary scene. The Building and Construction Industry, to which they all belong, is in a state of flux. If I delve into this chaotic conglomeration, I will find myself overwhelmed by its complexity, and can certainly do very little justice to the theme in one lecture.

What then is useful? The word only has a meaning in relation to an aim, and the aim in this case would naturally be to suggest ways in which the building industry, which term I shall use this evening to include the construction industry, could do whatever it has to do more effectively than at present.

To do this one would have to define *what* the building industry should do, *how* this

could best be done, and *what* reforms this suggests – indeed a tough proposition.

If you look at the building industry in a global sort of way it embraces all the activities which shape our physical environment. But the environment is the product of our way of life, and it again influences our way of life. In the past the environment, the landscape in all its natural and urban forms just happened, it was never before deliberately created by man, except in small patches. The technological revolution is changing all that. Man's battle with nature has been won. Whether we like it or not, we are now burdened with the administration of the conquered territory. Nature reserves, landscape, townscape: they will all be wantonly destroyed, to the ultimate ruin of man, or they must be deliberately planned to serve his need. Much has been destroyed already and more will be destroyed, but the alarm has sounded. Pollution, population explosion, etc., is news. The battle is on, and it is a crucial battle for mankind. Those who long to return to the good old days must be told firmly that that road is now closed.

Logically, we would now have to define man's needs to enable us to discuss the means to provide them.

This, I am afraid, is beyond the wit of man. How we want to live is a matter of values, and values are under debate. Even if a vague ideal way of life could be agreed on – and it could only be vague – the way to achieve it would be equally debatable. Any hope of defining the task of the building industry on the basis of some such ultimate aim must, I am afraid, be abandoned, at least as far as this lecture is concerned.

The purpose of life is like that of a work of art, it emerges only during the making.

This doesn't mean that we can do nothing. I think we can give a push in the right direction, and if enough join in, it may even have some effect.

We could start from one of the entities or structures produced by the building industry, as for instance a bridge, a water reservoir, a harbour, or a factory, school, town hall or other building, and consider how such an entity is planned, designed and finally built. We know it can be done in many ways, some good, some bad, and some indifferent, measured by the result. If we can find out what is needed to produce a good result, the best possible result, an entity of quality we might say, then what applies to one entity might well apply to most, and might also give us a clue as to how the organization of the building industry could be improved to facilitate the production of such entities of quality. We have to realize, of course, that we don't necessarily get the best total environment, the best town, for instance, by ensuring that each of its constituent parts is a perfect example of its kind. These parts must also be integrated and priorities assessed, to produce the right environment. But it would certainly be an improvement if the parts taken separately were satisfactory. And as the need for proper integration of parts is a feature of all design – whatever sized entity we are dealing with – the experience we gain on a smaller scale may help us to tackle the larger.

To treat such an entity as an independent whole is of course a device to limit the area of attention, it is the only way by which the human mind can deal with the chaotic material presented to it. The danger is, that we forget to switch the mind back to the connections which we have so ruthlessly severed.

Everything in nature hangs together in various ways, and the same applies to the artificial world of human creation. The connection may be a matter of proximity in space, of generations supplanting one another or of different species that feed on one another.

In our building activity we are mainly interested in three such relationships:

1. The relation of part and whole,
2. That of means and ends, and
3. What I might call the spiritual relationship between inanimate objects, usually thought of as aesthetic, though I don't think this word covers it entirely.

This last is a very difficult relationship or quality to define, describe or manipulate – but is of the greatest importance. The words 'art' or 'artistic' are vague enough to cover it, perhaps. I will return to it later.

In the total building activity relating to an entity or a job, it is usual and indeed useful to distinguish between two stages, design and execution.

Design can be simply defined as 'constructive forethought'. *Designing* is a mental activity devoted to 'figuring out' and *deciding* how to make or build a thing or an entity, what it should be made of, what it should look like, how it should be made, etc.

A *design* is the sum of all these decisions recorded in the form of drawings, sketches, models, prototypes, instructions, specifica-

tions, etc., covering all the facts which must be known and the processes which must be gone through to realize the project.

Defined in this way, the design is obviously the key to what is built. The actual building or execution is equally important, or more important if you like, but it does not add anything to the concept of the thing, if it is carried out as visualized in the design.

What I will call '*the total design*' defines the entity completely.

I use the word 'total design' to distinguish it from what usually goes under the name of design, or is called a sketch, scheme, blueprint or plan – which are generally only partial designs, ranging from a mere recording of a tentative idea to what almost amounts to a total design which only needs to be supplemented by the detailing of certain parts or site arrangements carried out by manufacturers, contractors or specialists. Such definitions are always somewhat arbitrary or blurred at the edges, but the idea of total design implies that sufficient decisions have been made and recorded to enable others skilled in organizing such work to carry it out.

As mentioned, most things are parts of other larger things and consist in turn of many smaller things, and their designs are therefore also organized in a kind of *chain or hierarchy of part and whole*. The designs of part and whole are always interdependent, but in varying degrees. Some entities are fairly self-contained, and are thought of mainly as wholes – for instance a building or water-tower. Others have only meaning as parts – a concrete beam, for instance. But the designer or designers of one thing can't also design all the other wholes or parts in the chain, he must stop somewhere; the stopping is done by giving him a brief. The designer of a bridge need not bother about the larger context, the road-net, etc., if he is given a brief telling him where the bridge is to be built, what traffic it will carry etc. The design is then a *closed* design – upwards. Downwards he must know all *relevant* details – for instance he may have to know the quality of cement – but not necessarily how that quality is obtained in the factory. He must simply know everything which would or could affect his design, including of course the cost of different possible methods of construction.

The *hierarchy of ends and means* sometimes coincides with that of whole and part – for instance the foundation is part of a building and also a means of enabling it to be built on that spot; but generally the path diverges: a crane is a means of building a tower, but not part of it, a building is a part of a village but a means of educating children or manufacturing shoes. Obviously the ends and means relationship affects the design very much, and if this is closed upwards it too must be defined by the brief, which must specify exactly what the entity is going to be used for.

The chain of means and ends generally ends up in some spiritual sphere implying value judgements. We build a school for the education of children – for what? Value judgements, whether in the sphere of art, ethics, religion or politics tend to be controversial. Therefore the further we go along the line to search for the ultimate ends, the more difficult it is to reach agreement on what these ends are.

We are faced with the paradox that the pursuit of value of some kind or other is undoubtedly the mainspring of action, and yet if people really went about thinking about the ultimate purpose of all they did nothing would ever get done, there would only be a glorious fight about what ought to be done.

This kind of thing is not unknown in human affairs, but fortunately it is not what people normally do. In most cases they don't think at all – and that is perhaps going a bit far in the other direction. They are quite happy to pursue means without bothering about the end – let alone anything so remote as an ultimate end. In fact means have a habit of becoming ends in themselves. This saves thinking, and encourages action. But, seen in a wider context, it could be the wrong action.

The *artistic relationship* of things may also affect the design – the whole in relation to its surroundings and its parts – but is of course also often controversial.

A *part design* is either a part of a total design or a total design of a part, in relation to a given entity.

In theory the total design includes all its part designs, but in practice the obligation to define all its constituent parts is mostly discharged by making use of already designed and mass produced parts and partly processed materials readily available. We are moving strongly in that direction; it simplifies design, encourages mass-production of standard components, thereby lowering cost, and if coupled with such

practices as using standard computer programmes for statistical calculations it can speed up everything – but it also reduces the freedom of the designer and the possibility of matching the parts to the whole – so necessary for artistic excellence. A proper integration may therefore require a needed part like a window or partition to be specially designed by the design team in collaboration with the producers of the article. As manufacturers are often backward in applying rigorous functional or aesthetic criteria to their products, the result can be a great improvement in the design of this part, thus both lowering costs and raising standards. But it can only be done for large repetitive jobs.

Since the start of the Modern Movement architects have toyed with the idea of a standard, prefabricated kit of parts which could be assembled into different types of building: strangely enough, for it would kill what is generally understood by architecture, and anyhow it is, and has always been, nonsense. You can design a system of limited flexibility with a limited number of standard parts, but the parts can then only be used for that system.

We started this inquiry by considering a particular entity, its position in the chain of things, and its design, by which it is defined.

How then is a design of excellence or quality produced?

I described designing as a mental activity. It is set in motion by the challenge of a particular practical problem, that of satisfying a brief with means which are available, or can be made available.

To meet this challenge the designer's mind must be stocked with a great deal of knowledge about available materials, their behaviour under various conditions, their cost, their durability and the manner in which they can be used, about processes and construction techniques and a host of other things which are far too numerous to mention here. He must have the ability to supplement this knowledge and experience with new data relevant to the particular problem –for instance site conditions, local resources, etc. – and if his own resources are insufficient, he must get advice elsewhere. Lack of expert knowledge is not conducive to excellence. He must have a thorough look at the brief, absorb it in his mind, question it and criticize it and have it supplemented if necessary. Having marshalled sufficient data to start with, he sets to work on the problem. His imagination juggles with the data, hauls out for inspection various combinations and possibilities, discards them, tries again – intuition, invention, ingenuity spring into action, tentative solutions emerge, are developed, analysed, adopted as working hypotheses, new relevant data collected, partial decisions made, etc. It is difficult to describe this process in detail, and I think it is quite impossible to replace it with some computerized technique, as has been suggested. The result will depend on three things:

1. The completeness of the data on which the design is based.
2. The quality of the brain in which the design process takes place.
3. The effort, devotion and enthusiasm applied to the problem.

This is not exactly surprising. It means that the *best designs* are produced by good designers with plenty of knowledge and experience and plenty of imagination, ingenuity and inventive capacity, who take the trouble to gather all the relevant information and keep on worrying about the design until they are completely satisfied with the result. And perhaps we should throw in a bit of luck and an interesting problem to solve.

What the designer is trying to do is to produce a structure or building which

1. Functions well,
2. Looks well,
3. Lasts well,
4. Costs little,

but if we survey the whole field of possible structures, the emphasis placed on these four demands differs widely.

All structures must fulfil their particular function, for that is the reason for building them. But the functions vary, from those which are easily defined but difficult to fulfil (such as bridging a gorge), to others which would be easy enough to fulfil if only we could manage to define them (such as those of teaching hospitals, involving several authorities and a large number of doctors all with their different and often conflicting demands which are, moreover, likely to change before the building is finished).

All structures should also look right – they create our man-made environment which is of concern to us all. But the importance of this varies widely – between, for instance, a jetty and a cathedral.

All structures must also last well – that is, they must be stable and able to withstand wear and tear by natural forces or imposed

loads. This again may be a simple matter, or in the case of daring engineering structures, a very complicated one.

And finally, all structures should cost as little as possible, but again, the need for economy varies. Economy is a matter of devising a sensible way of building the structure. It therefore depends on engineering design and construction – not on costing, which is a means of guessing more or less accurately what the cost will be. Even the richest client doesn't want to spend more than necessary.

Corresponding to this difference in emphasis we are wont to divide structures into two categories, architectural and engineering structures.

Roughly speaking, engineering structures are those which have an easily defined and undisputed function but which present structural problems of some intricacy, whereas architectural structures are those where aesthetic and functional problems dominate.

And of course architectural structures are supposed to be designed by architects and engineering structures by engineers.

This division has done a great deal of harm, because it has diverted attention from the fact that *all structures* must be submitted to the threefold discipline of functional, aesthetic and structural or technological organization. But it has its roots deep in history. Architecture, building as a 'fine'art, can trace its origin back to antiquity. It concerned itself with the design of mansions and important public buildings according to varying principles or theories which had more to do with forms, spaces and proportions than with strains and stresses. Engineering structures – bridges, tunnels, harbours, etc. – were classed as utility structures. They were built on quite different principles and did not have anything to do with architecture. Ordinary houses were, and are still to some extent, the province of builders.

The traditional differences persist in the differences in background, training and outlook of the two professions. Fifty years ago they didn't even speak the same language. Each profession lacked understanding of the values the other profession stood for, which naturally led to a neglect of those values in their own designs. The natural tendency of a designer to care for the appearance of what he creates was actually thwarted rather than encouraged in the education of engineers, with predictable results. And the emphasis on the spiritual quality and the preoccupation with architectural theories in architectural schools sometimes made pupils forget about how their beautiful drawings were to be transformed into real buildings.

Even the firms which carried out the work – the split between designers and constructors having occurred centuries before – were divided into builders, working for architects, and engineering contractors, working for engineers.

The Modern Movement changed all that in theory. It was discovered that the work of bygone engineers was in fact architecture. It is now accepted that bridges and factories and all that are architecture. So is housing, in fact everything built is architecture. And the same spirit which is supposed to be moving architects is behind town-planning and landscaping as well as interior design and furnishing. Everything made by man for man's use now has to be designed. And in all these spheres dedicated engineers are trying to conjure forth that mystical spiritual quality which is the essence of art.

The difference between builders and civil engineering contractors is also disappearing. Buildings are just as much constructed as are bridges or radio-masts. If we add to this that technological advance has produced a host of new experts and specialists, and computerized techniques for dealing with all this bewildering detail, it is clear that in large complex jobs we cannot manage with one designer on each job, we need dozens.

This brings us to the very topical subject of teamwork.

I have earlier emphasized the need to integrate all design-decisions relating to a job. The growing specialization makes that very difficult, but it also makes it *more necessary than ever* if we are to produce the perfect job – or let us say a job which is as good as we can make it. I am quite convinced that lack of proper integration of design decisions is largely responsible for the mediocrity of much of what is built to-day. What we build should always be a whole, an entity, and the job of designing it is very much the job of giving it the wholeness of a work of art, and the inevitability of the perfect tool. If you split the design up amongst a number of specialist designers each acting more or less independently, plus various clients and authorities who do not even realize that they are making design

decisions which may affect the design adversely, you won't get a whole but a hotch-potch. You don't get quality that way, anyhow.

I come back to what I said before, that the quality of a design depends on three things:

1. The completeness of the relevant data;
2. The quality of the brain of the designer;
3. The effort, devotion and enthusiasm applied, except that now we are not dealing with one brain but with many.

(As I expressed it about thirty years ago: 'The problem arises how to create the organization, the "composite mind", so to speak, which can achieve a well-balanced synthesis from the wealth of available detail. This, I suppose, is one of the central problems of our time.')

'A composite mind which can achieve a well-balanced synthesis from the wealth of available detail' is of course an abstraction, an ideal which cannot be achieved. Even a single mind would rarely achieve a well-balanced synthesis – if such could be defined. The various ideas are emotionally charged. Even the most rational engineering solution is only one out of many possible solutions, and is preferred by its author on the basis of some intuitive feeling which he would find difficult to explain. Designing is not a science, it is an art – but an art confined by the nature of its medium and the aims to be achieved.

The idea of a composite mind is useful, nevertheless. To be effective, the participating minds must collectively span over an area of knowledge and experience which covers all the knowledge needed to produce the best possible design. Each should preferably be an expert in his own field – or at least have easy access to supplement his knowledge if required – and the fields should overlap so as to leave no gaps, and to facilitate communication. But equally, or even more important, they should share a common aim, that of creating 'total architecture'. This is not an aim which can be defined – anything which has to do with art is emotionally charged and therefore *personal*. But there must at least be agreement about one thing: that total architecture is not just a matter of creating a sculptural monument which enhances our visual environment, or a matter of fulfilling certain functional requirements or satisfying the need for 'firmness'. It is all these things together, and moreover they have to be achieved at a cost the client or the community can afford, and must therefore embrace the art of building in a practical, sensible way. As I said before, the relative importance of these claims varies, but they cannot be neglected on any job.

I would define architecture as: 'A way of building which delights the heart', because this emphasizes the two essentials, that it is a way of building, and must therefore be judged by the standards of competent building, and that it must touch the heart – it must give us a shock of delight.

But delight is not only aesthetic delight. There is delight in economy of means, in the recognition of inventive simplicity, of directness and clarity of structure, in the appropriateness of the spiritual quality expressed in the combination of forms and spaces. Architecture can transmit to us the human emotions which inspired it – perhaps unconsciously, perhaps even accidentally – it can appear as forceful, bombastic, exuberant or modest, restrained, controlled, it can be serene or exciting, cool or giving warm welcome – or it is just right – why, you cannot say. And this spiritual quality, which can neither be defined nor created according to a formula or recipe, but which can contribute so much to our happiness, this quality is the result of personal involvement, of enthusiasm. And of many other things as well, but enthusiasm must be the impelling force.

It is clear, then, that even agreement on the ideal of Total Architecture leaves plenty of room for disagreement on what kind of architecture and which claims should receive preference, for that they frequently clash is obvious. It is therefore also necessary that the members of the team are on the same wavelength, that they are excited by the same things. If two people come together who recognize that they share the same enthusiasm, then there is great joy, then a bond is created, then they can collaborate and fructify each other's minds.

Perhaps not necessarily, if they are on the same level. I am sorry, but I can hardly begin to make a statement without thinking that the opposite may be equally true. It is not my fault, really, for that's how things are. After all, two sculptors, or two architects, on the same job is really not so hot – or should I say too hot? They have to be very intimately attuned to make a success of it. But there are all sorts of fruitful relationships. If, for instance, one acknowledges the other's pre-eminence, and the relationship

is that of master and admiring disciple – and it need not go to that extreme. If there are several members who cover the same field of expertise, it is desirable that there is an acknowledged line of command, but it is equally desirable that it should hardly be noticeable. If each member of the team is encouraged to contribute his share to the total solution and is not just told to shut up and do as he is told, ideas will trigger off other ideas, and there *will* in creative moments come into being a kind of composite mind, superior to the sum of its components.

It is not so difficult for members of different professions to collaborate, because their pride is not affected by having to accept the expertise of another profession. But what is absolutely necessary is that they should respect each other, and each other's point of view. They should recognize that each has a valid contribution to make, that the goal is not yet reached if the solution of one part or one aspect is second rate. Great architecture can be created from a tortuous structure or at inordinate cost, but it would be greater still if structural clarity and ease of construction could be added to its virtues. And who knows that this might not be achieved by further effort? Complete perfection is unattainable, but if we are satisfied too early we are not even attaining what is possible.

To reach this state of understanding between members reared in different establishments where no thought is given to other than their own disciplines, takes time. *Ad hoc* teams, hurriedly thrown together for the duration of one job, are useless for the production of quality, unless the coordination of the work takes place at a higher level between principals who agree on the total aim. They have to get acquainted with each other's territory, to understand at least the principles followed and the aims pursued. They have to approve of these aims, and they must come to like each other, or at least accept with tolerance and humour each other's idiosyncrasies. They must to a large extent be prepared to sink their own personalities in that of the group, forgetting status, position, and personal or professional pride. In a choir a member will enjoy making his or her own contribution, but it is the performance of the ensemble which matters and which all members are proud of – even the one who moves the chairs about. This sharing of enthusiasm and pride in the work of the team is the best seed-bed for nurturing a work of quality.

Of course, enthusiasm is not enough. It must be tempered with realism, with the ability to apply critical analysis. It is an advantage of team work that where enthusiasm is leading one astray, as it easily can do, other members of the team may be able to supply the antidote. For my whole argument rests on the fact that if you want Art in building you cannot afford to neglect mundane, practical matters.

There must of course also be some organization and leadership, so that the whole thing doesn't degenerate into a talking shop.

The fundamental design decisions will nearly always be taken by a small nucleus of people representing the disciplines primarily involved. You have to start with an idea, a tentative proposal and then investigate the implications. The important thing is not to freeze any decision until its consequences for the detailing can be assessed. If new factors emerge – the client changing his mind, for instance – the whole position should be reviewed afresh.

To generalize about the organization of the team is, however, quite impossible and to attempt a survey of the many forms it can take would take too long. It depends on the nature and size of the job, the personalities involved and the whole social setting.

The ideal would be a relatively small closely knit team, working in the same place and having a continuity of work on a few jobs at a time, so that the members could really learn to appreciate each other's qualities, or if necessary shed those members who didn't fit. In such a team the question of leadership need hardly arise, each member taking the lead in his own subject. Even the professional demarcations may fall away – at least in the discussion of the main design decisions. But generally there will be a natural leader, an architect for architectural jobs, an engineer for structural jobs, or a manager type understanding what it is all about and almost representing the client inside the team.

But such a small team has its limitations. Jobs are getting bigger and bigger and more like machines to work in, full of installations of different sorts. Or large engineering jobs may call for scientific research, the invention of construction techniques, extensive computer services etc. Top level men in all these fields cannot give their full time to work on a small team – yet their advice may be crucial

to the problem in hand. So unless such a small team, or several such, can be embedded in a very large multi-disciplinary engineering firm with free access to all kinds of advice, it will have some difficulty in obtaining this special help.

Large, technically complicated jobs may therefore require a different organization – the design will have to be organized on different levels and be split up in parts to be designed by well coordinated teams. To paraphrase the well-known tag:

> Large parts have small parts,
> The art is to unite them,
> And small parts have smaller parts,
> And so *ad infinitum*.

But the important thing is the human element in whatever organization adopted, the determination to succeed, the agreement about aims, at least among the leaders of the design team, *and the powers that direct their work*.

This brings me to my last task, for which unfortunately hardly any time is left, to see how these conditions for producing excellence can be realized in the rough and tumble of the real world.

For it is not enough to have the will to produce a work of quality, and the insight and ability to know how to do so, you must also have the power to get it done.

Unfortunately the three are seldom combined.

The power to initiate action rests mainly with a small minority wielding political or financial power. Their main preoccupation is, however, with the maintenance and extension of this power. Improving the quality of our environment is not likely to come high on their list of priorities unless it can be made to serve their primary objective. And with the best will in the world, their power to act depends on their voters or shareholders, and *their* support can only be won by appealing to their pocket. And even where idealists among them are prepared to use their power to the utmost for a good cause, their ability to choose the right advisers and the best cause is questionable.

This is not surprising, for even those who are concerned with building, with planning and design, those who have both the insight and ability, and often the will, do not agree on their objectives. Apart from the fact that they differ in their likes and dislikes, each can only have a limited and varying knowledge of *all* the factors – local, national and worldwide – which have a bearing on, or would be affected by, a planning decision. As regards large-scale planning they must to a large extent be guided by intuition, by a kind of Utopian vision. Where their views carry weight is in relation to a limited objective which they have made a special study of, a design of a neighbourhood, for instance. It is heartbreaking for them and for others who share their values to see their hard-won success in reaching a good solution brushed aside by those in power for reasons which have nothing to do with and completely ignore their own objectives, as happens frequently. The advisers may of course not be wholly disinterested, and the powers may possibly be right, or may have no choice in the matter – but one feels that they so often are wrong because their priorities are wrong, at least seen from the point of view of long-term benefits.

But this, I am afraid, does not only apply to those in power – it applies to everybody. The will – or rather the wish – to see our environment improved is fairly widespread in so far as the matter is given any thought at all. But it is not very strong. At least there are a number of other things we want still more. First of all, we must make a living – we have to, otherwise we can't make anything. Just as the Government first of all must try to stay in power – otherwise it can't influence matters for good. Making a living is quite a job in itself, and while you're at it, you had better lay something aside for your old age, and look after your family. And whilst you yourself may be content with only a modest place in the sun, you see no reason why your wife and children should be worse off than your neighbour's. And so on.

And if it isn't money we are after, it is recognition, prestige, status – we want our fellow-beings to love us, if possible, but at least to respect us. And if we are more discerning, we may realize that the applause of the uninformed is worth less than the respect of those who share our values. And that the values themselves are more important even than the respect of others, that what matters is that we can respect ourselves. And we move into the sphere of other motives which generally would be classified as less selfish, but which perhaps are even more selfish, because they satisfy a part of ourselves which we would like to see win. We move into the sphere of ideas, and their motive power, of compassion for suffering humanity, of allegiance to a cause, of

identification with a larger unit, town, country – mankind. And we come to the pleasure of exercising our faculties, the satisfaction of the creative urge – which is bound up with the quest for quality. Self-fulfilment, if you like. As Maria Callas said in an interview recently: 'How can you exist if you do not do things, and how can you exist with self-respect if you do not do things as well as lies in you? And how can you achieve that if you do not work at it?'

That, as I have already pointed out, is the attitude of those creative people who could make a contribution if allowed to. But occasionally you see this attitude allied to a thirst for fame which can lead astray. That is the trouble with all these motives – they are hardly ever pure, they are mixed with all the other motives, and taken in all, it is the grosser, simpler motives which are strongest, We have to accept this fact and use it. To realize a 'higher' aim, we must attach it to a 'lower' one, and it must at least not go against the business of making money. That is why ambition, a striving for recognition and status, can be so useful for begetting the right kind of action. And that is why if we want quality, at least of a spiritual kind, we must master the economy of construction.

This digression into the tangled complex of motives is not irrelevant to our theme, for it is motives which beget action, and it is action guided by deliberate choice we are seeking. But you will agree that it is hopeless for me to attempt a review of this tangle. I would only say this, that in the discussion of world affairs, attention tends to be focused on measurable things, gross national product and the rest. The importance of 'imponderabilia', of the dreams of mankind, are neglected in the interest of 'realism'. Which is very unrealistic. For it is the power of these dreams which will decide our fate. And it is the unfortunately fragmented fraternity of people with imagination and a perhaps irrational concern for humanity which is our hope for a better world.

The divisions within the building industry do not help matters. All the many economic units, professional firms, builders' manufacturers, etc., of which it consists are in business to make money. Prestige, status, etc., comes next – but also mainly as an aid to profit. Collaboration therefore collides with competition. The same rat-race is repeated inside the firms themselves. The business of designing is split up among a number of autonomous units concerned with safeguarding their interests, and clients and government agencies knowing little about the business of building. The gap between design and execution is almost unbridgeable, preventing the designers from obtaining first-hand knowledge of the cost of various means of construction, an essential requisite for original, inventive design. The prevailing system of quantity surveying only makes matters worse. It erects a barrier between the architect and the builder, thus widening the gap between design and construction. It enables construction to start before the design is completed, a very bad habit leading to confusion, delay and extra expense. It encourages architects in their besetting sin, the delusion that they can create original masterpieces without soiling their hands with such mundane matters as how the pieces are put together. And it lulls the client into the delusion that his affairs are in safe practical hands, wont to deal with money and real estate and such solid realities. Whereas the fact is, that these over-elaborate bills of quantities are a clumsy method of defining the contractor's obligations, which can be better done by drawings and specifications; that costs should not be based on what other contractors have quoted on other occasions for various fictitious items taken out of their context, but on the operations, plant, materials and manpower needed to carry out the job in hand; and that it is too late to find out that the job costs too much after the design is finished, and then proceed to muck around with the design.

As it is the design which, apart from fluctuating factors, determines the cost of the job, costing, which of course is very necessary, must be an integral part of designing, and the quantity surveyor – and that incidentally is a bad name, for the taking out of quantities is in itself a very simple job if it is not unnecessarily complicated to impress the layman – must immerse himself in the prime cost of various site and factory operations, etc., to become a useful member of the design team.

That individual quantity surveyors can be very useful indeed in the present situation is another matter altogether. I have always maintained that character and intelligence are more important than letters after the name.

It is quite impossible for me to deal with all the other factors which inhibit integrated design – private property rights, the frag-

mentation of public authority, the restrictions too freely imposed in the form of bye-laws and regulations, etc. I will just say a few words about the dichotomies between design and building, and between professional and commercial.

Over a large area of the building industry design is undertaken by professional firms for a fee, and building by commercial firms for what they can get in the market. This difference in remuneration widens the gulf between them and inhibits collaboration, because a free and frank discussion about design and construction methods and costs is bedevilled by the reluctance of the builder to put the cards on the table for fear of the financial implications. In any case both methods of remuneration are highly unsatisfactory – but it is not easy to suggest any better. To award the contract to the lowest tenderer in open competition is a very risky undertaking for the client, as has been shown over and over again. It is the quality and efficiency of the firm that matters to him.

And *vis-à-vis* the professional designer, the architect or consulting engineer, the client is in some respects helpless, he must take him or his firm on trust, as you must your doctor, dentist or solicitor. The choice of consultant is obviously very important for the client, yet is often undertaken very lightly. This method of remuneration does not call for competition in design, which could be stimulating, but is at the same time fraught with danger. In fact, the less the consultant spends on the design, the more money he makes, and the worse the design will be, probably without the client being any the wiser. This is perhaps not quite so serious as may appear, because firms depend for their commissions on their reputation and standing in the profession, which is built up gradually through their performance. But the client, as an outsider, can easily be taken in by experienced client-charmers.

The professional Institutions exist to:

1. protect the public by ensuring that everybody entitled to practise has the necessary qualifications and obeys certain rules of conduct;
2. advance the disciplines and skills on which the profession is based and enhance the reputation and social status of the profession;
3. prevent competition by unscrupulous or undignified means likely to mislead the public, or by unqualified persons, and one could perhaps add:
4. thus fix a scale of fees and conditions of employment from a position of strength.

As you see, this is a mixture of public and private benefits – the only way a thing like that can be made to work at all – and it has on the whole worked well. It encourages professional pride – which is both good and bad. It is good because it embraces pride in your work, the essential quest for quality. But when the pride leads to pomposity and sectarianism it is bad. Specialization is necessary, the practice of 'apartheid' between professions is absurd and harmful.

I should like to see the various Institutions pulling together more to fulfil their rôle as *guardians of quality*. And it seems to me that the organization of construction or building ought to be a profession, and should gradually be merged with the activity of designing. Then nothing would hinder the free exchange of information. This would in my opinion be a better way than making design a commercial activity and merging it with building, as in the contractor's package deal. The latter gives the public no protection – and the quest for quality, for artistic wholeness, would suffer a serious setback, in competition with soulless efficiency. After all, the professional man has his standards of excellence, his pride in his work, for which he is usually prepared to make a great effort, even if it does not pay. I expect most professional firms lose on those jobs they are most proud of. A commercial firm's first duty on the other hand is to pay a dividend to its shareholders.

That the public as a whole does not understand that design is a creative activity which determines the quality of the job is shown by the attitude of clients and government departments, of lawyers and administrators. Of course there is a good deal of routine design, which is just a repetition of previous designs, according to given rules. But quality can only be produced by personal effort, and that takes time. That time is seldom available. The difference between a good and a bad design can be tremendous – but the client pays the same for both, and as cash is the only acknowledged yardstick for value, they are assumed to be equally acceptable. A great mistake. The cost of the fee is actually insignificant compared with the cost of the job and the effect of the design on the job. But unfortunately one cannot be sure of getting a better job by paying a higher

fee – as might be the case with sculptors or opera-singers. The effort must be given freely from an inner compulsion. But the extra cost involved for the designers may of course be inhibiting. In fact, fee scales are much too low to allow for the effort to produce a masterpiece; it's a luxury one indulges in for one's own pleasure. They are too high for the far too frequently mediocre design: they are too low for small jobs, too high for large. They are too low for service engineers to do their job as they should, which they as a consequence seldom do – they get the contractor to do the detailing. And they are too high for quantity surveyors. But as you can't measure quality or the real value of the service to the client, there is not much you can do about it. All this is of course my personal opinion, and I have said enough already to get my neck wrung.

I have dealt rather perfunctorily with the obstacles to a good design – I have no time to look at the other side of the coin. It would present a picture of great endeavour by many designers to improve the quality of design. The best architectural and engineering design is getting better all the time, and is setting an example which will have a greater effect than mere talk. And powerful corporations and firms who seek to increase their prestige by the way they build are realizing that vulgar display is less convincing than all-round excellence. In the end it will be the general level of understanding of what good building could do for us, which will decide what we get.

DISCUSSION

THE CHAIRMAN: Mr. Arup has painted a picture on a large canvas and with a broad brush, and I must say that I feel that the picture gains depth the more you consider it. He has not, as you heard, opted for the package deal – I think quite rightly. He has opted for a very closely integrated building profession geared to research and development and good communications and going about the job in the right way.

I would like to open the discussion with a question. Does he think that there is a case for any division of responsibility in the organization, in order to achieve the multiple mind which he has been describing? Does he think that you might have a corps of people – call them technicians or even quantity surveyors – who would be first class at business administration, at costing, at maintenance, even at the standardization of components, and who would rather not complicate their job by attempting to contribute to the wider objectives that he has just described? The point of my question is that there is such a quantity of shelter to be provided for a world whose population, as U Thant was saying only yesterday, is capable of doubling itself in twenty-five years; therefore one is bound to ask whether Mr. Arup thinks there can be some division of responsibility not vertically, as he has described it, but horizontally? Even if it is only to clear the way for the greater effectiveness of the vanguard which he has so brilliantly described?

THE LECTURER: Naturally a vast amount of building is, and has to be, more or less routine work, an adaptation of what has been done before. Designs of excellence are almost by definition rare, they can only be produced by caring greatly for the 'horizontal' integration between various disciplines and by ensuring that the quality is not lost – but on the contrary enhanced – by the detailing. In ordinary routine work there is neither the time, the money nor the ability to exercise such care, nor would it always be appreciated sufficiently by clients or public – to begin with, at least. But the importance of works of quality is that they set an example which tends to raise the general standard. The exception may in time become routine.

MR. J. R. LOWE, BSC(ENG), CENG, FICE, FISTRUCTE: Is it Mr. Arup's impression that in this country we tend to spend less money on our buildings than we should? One of the architects with whom my firm generally works claims that on the Continent they consistently spend from 50 to 100 per cent more on their buildings than we do. Whether they spend it correctly or not is not the point; there seems to be a general feeling that aesthetics are not fully appreciated by the public in this country, who are not prepared to pay for them to the extent that they are abroad.

THE LECTURER: It is difficult to say how much money we should spend on a building as compared with an aeroplane. But I do think it is often the case that you have to spend more money than the absolute minimum to get something good and good to look at. Whether the situation in this respect is worse here than on the Continent is hard to say. We need statistics, we cannot go just by impressions.

MISS BARBARA WORTH: When speaking of team work, Mr. Arup said that it might be better not to have two sculptors working on one building or one project. Can I ask whether he thought Coventry Cathedral was spoilt by using more than one sculptor?

THE LECTURER: That is quite a different case, because there were a number of creative artists each working on one particular job, with

the architect putting their work together. It is he who should look after the harmony of the whole conception and see that sculptures are relevant in that setting. He controls the total architecture. So at Coventry it was a matter of whether a particular architect had chosen the right sculptors to go together. But if two architects or two sculptors are working on the same job then you can expect trouble, because any architect worth his salt feels very strongly about his building designs – he cannot tolerate another architect at his level, unless it be a partner and they have grown up together and understand each other. Then they almost work like twin brothers. But you see this very rarely.

MR. JOHN T. CALVERT, CBE, MA (John Taylor & Sons): Mr. Arup rather decries the package deal, yet he calls for more integration as between the designer and the builder. It seems to me that if one has complete integration between the designer and the builder it inevitably leads to a package deal. Could Mr. Arup elaborate on what he has in mind?

THE LECTURER: There is nothing wrong with a package deal as such. But in practice it doesn't work so well, if the aim is to produce a work of art, the ideal solution for a particular set of circumstances. To achieve this, the leadership, who have the power to make decisions, must give it first priority, and they must understand what excellence is. They should in fact be, or failing that, give their support to, sensitive designers. This is much more likely to happen if the leaders are architects or professional people. When I first came to work in this country I was in a firm of 'package dealers', Christiani and Nielsen, specializing in reinforced concrete structures, and particularly in marine work, quays, jetties, etc. They were pioneers in this field, both as designers and constructors, and their designs were at that time very much more efficient than those of the average consultants, but they had to be skimped, owing to the competition, and art didn't come into it. Nevertheless in such a specialist field it may very well be the best system.

But in general, a 'package dealer' would have to pay out of his own pocket for any improvement in the design – as for instance avoiding overcrowding of a site – if in competition with other firms – and would the shareholder stand for that? But as I have said, the kind of organization adopted is less important than the people involved, and the need for carrying the clients with you exists in both cases.

MR. S. COHEN (Shell International Petroleum Co. Ltd.): To what extent has the professional man, the architect or engineer, influenced new and modern materials in the building industry, and vice versa?

THE LECTURER: In many cases new materials have been invented by engineers or architects because they realized the need for something different, and were able to provide it. But as a rule it is the producers, the manufacturers, who are most able to initiate new inventions – but they lack the knowledge of what is needed, they tend to cater for the needs of yesterday, to produce an 'ersatz' for old materials. There is therefore a crying need for the two sides to get together.

THE CHAIRMAN: I think that the message of Mr. Arup's lecture, when read, will be heard not only in the household which I referred to at the beginning, but also by clients, owners and government departments – by all those who commission buildings. Things are going a little bit off the rails through lack of confidence in what the professions can and cannot do. We are all only too familiar with people who confuse the building industry with the motor industry or the machine-tool industry. Obviously these industries have points in common. But we have far too many clients in this country who confuse what Mr. Arup was describing as economy of means in architecture and engineering with economy in research, or economy in end-results, which are quite a different matter.

The question was asked as to whether building is more expensive abroad. I think one of the answers is that if people really care about building they will see that enough money is provided for its social objectives to be met and also for the research needed to produce it, but they will be just as canny about getting value for money and economy of means on the way. We have had joint committees and consultative committees in the building industry for many years, we have had conferences, working parties, symposia. Tonight we have had one man's philosophy, and he has given it more wholeness as an argument than many of the committees have done. I am sure you would like me to thank Mr. Arup on behalf of the Society for giving so much thought to this lecture.

The vote of thanks was carried with acclamation and, another having been accorded to the Chairman upon the proposal of Mr. Neville Ward, a Member of Council of the Society, the meeting ended.