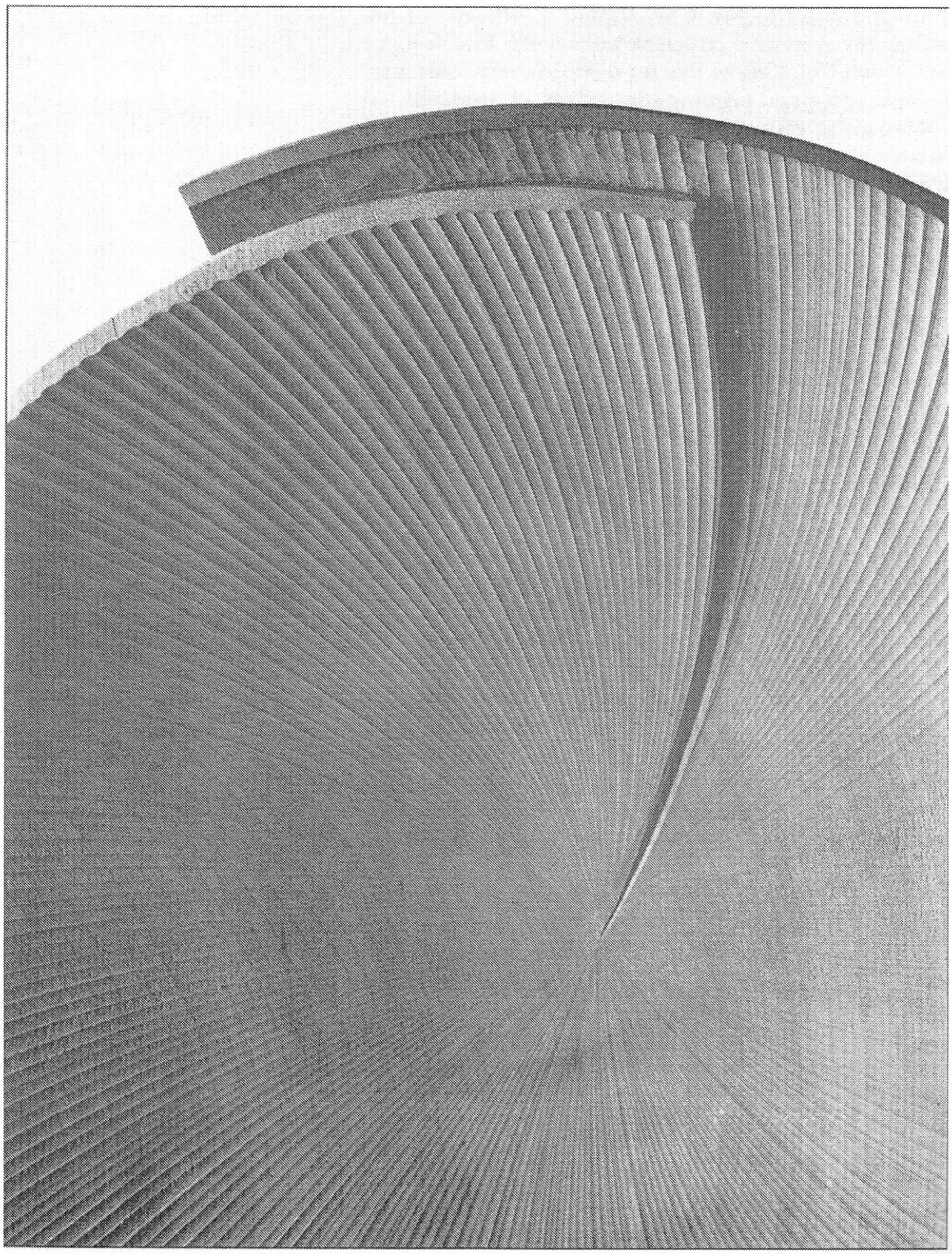
The Nature and Art of Workmanship

David Pye

The Herbert Press



Foreword: Apostle of workmanship

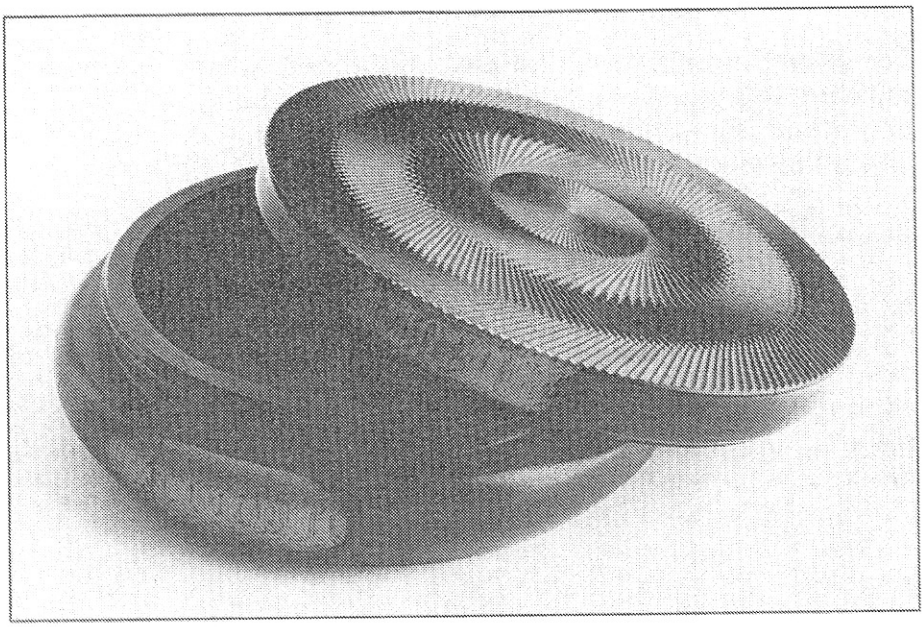
The phrase "workmanship of risk" means that at any moment, whether through inattention, or inexperience, or accident, the workman is liable to ruin the job. It is in opposition to the "workmanship of certainty," in which the quality of the result is predetermined and beyond the control of the operative. These are incisive concepts that cut through much of the confusion generated by such multivalent terms as craftsmanship, quantity-production, hand-made, and skill. And as David Pye points out, "...all the works of men which have been most admired since the beginning of our history have been made by the workmanship of risk, the last three or four generations only excepted."

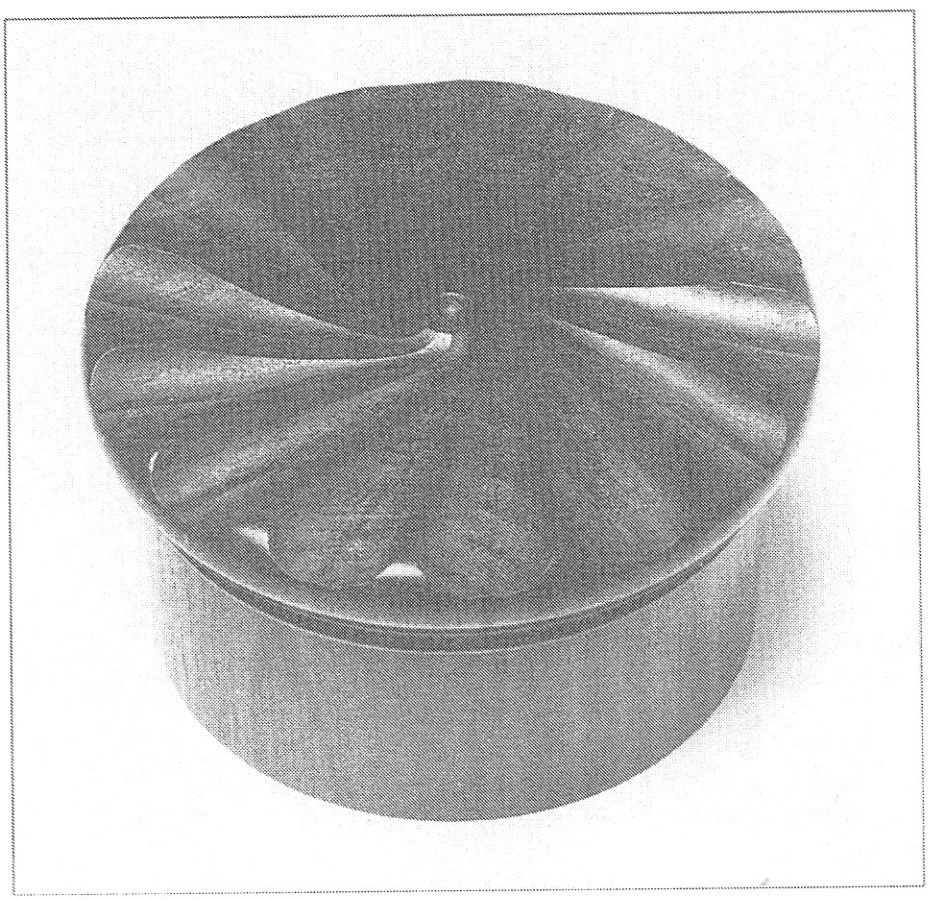
The examples of Pye's own work shown with this introduction describe his concerns and illustrate his arguments. They were all made by the workmanship of risk, but they each reside at different places along the spectrum from rough or free workmanship to highly regulated workmanship.

The bowl with two handles that appears on the front cover at first glance may appear so circular that it must have been turned on a lathe. But wait, it has four protruding handles, so it can't possibly be a lathe's product, and indeed, it is not. It was made almost entirely by carving, with partially jigged hand tools. Working freehand, with the deftness that's characteristic of the practiced workman, Pye bandsawed the disk, then whittled the shape of the bowl's exterior with a stock knife—a guillotine-like chopper affixed to the cutting block by a loose pivot, an arrangement offering great leverage under reasonably close control. He roughed out the inside with a heavy gouge-shaped adze, before mounting the blank on the fluting engine he designed and made solely for this purpose.

Pye's fluting engine, itself a marvelous example of design in the service of workmanship, permitted him to define and gradually to deepen the pattern of carved flutes that characterize his bowls. He spaced the flutes by eye and drove each cut by strength and dexterity. The surface that results is entirely good, in that every cut is clean and sharp, and regulated, in that the pattern seems totally uniform. However, as you approach the piece, pick it up and turn it in your hands, irregularities and variations reveal themselves. The object displays a

Wild service tree dish
(David Pye/Crafts Council)





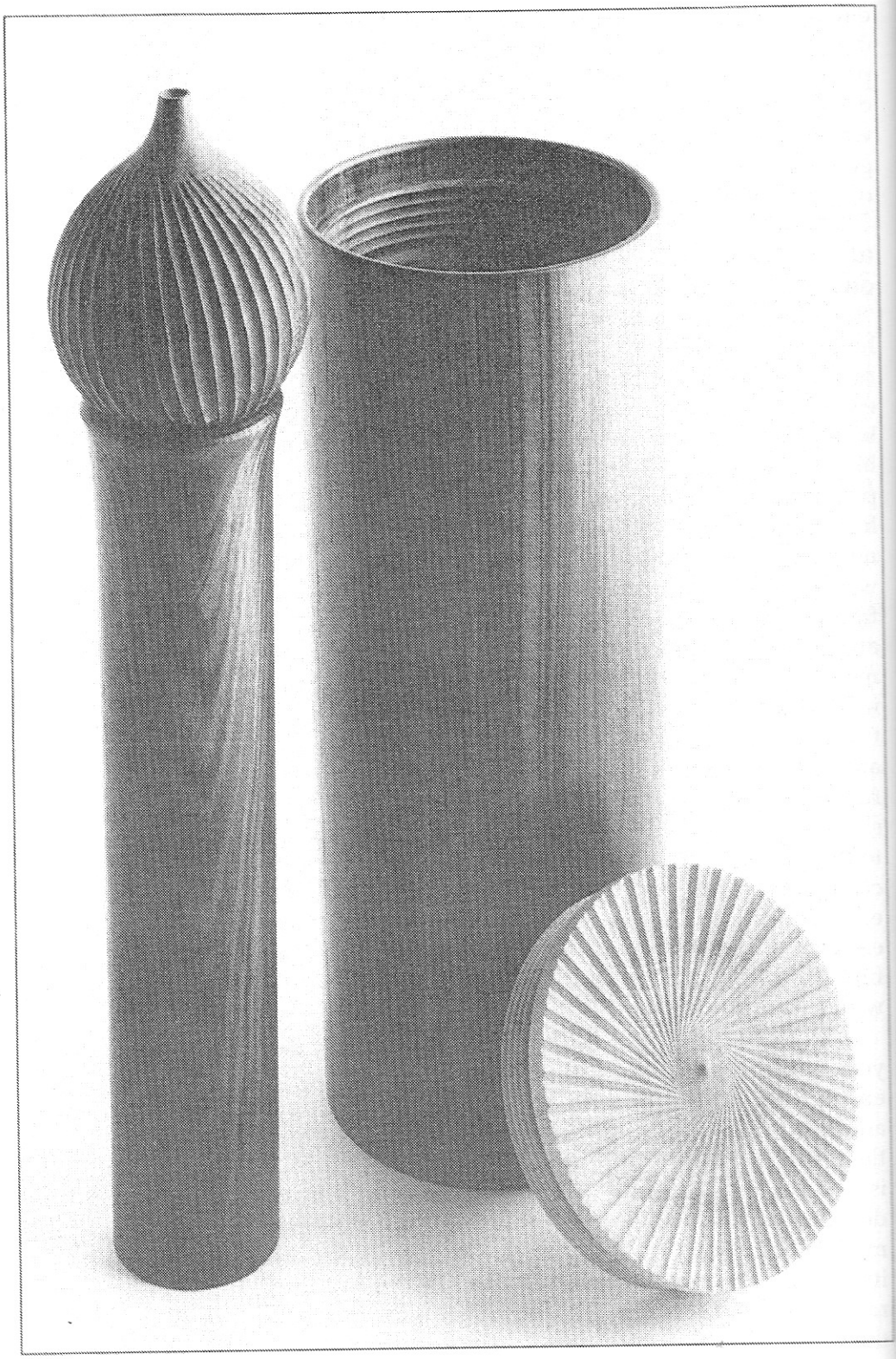
East African blackwood box
Screw lid
3.75 in/9.5 cm diameter
(David Pye/Crafts Council)

Kingwood box
Screw lid
2 in/5 cm diameter
(David Pye/Crafts Council)

delightful diversity, as new aspects and new levels of detail shimmer into view. Of course this is the didactic point of the exercise, for Pye believed passionately that diversity in the made environment is the tonic our weary souls require. And one of the main ways we can get it is by valuing and encouraging free workmanship of this very sort.

The little boxes, on the other hand, were lathe-turned, though with a foot-powered machine of Pye's own making, and emphatically not, as he once wrote, "because I have romantic ideas about doing it all 'by hand' (or by leg?) but because for small and very highly regulated work it is quicker." Small and highly regulated indeed! I have in my hand a little wooden box I bought from Pye in 1978, when I made a pilgrimage to his workshop in southeastern England. Like the examples photographed here, the box body is round and its lid fits nicely. It is turned of some tropical hardwood, now aged to a warm nut-brown. The top of the lid is where Pye illustrated his thesis on surface qualities. The figure of the wood crosses the little lid in semicircular arcs, a background pattern of color located within the material itself. A second pattern of shallow flutes spirals inward to a little point at the center of the lid. And a third pattern of grooves cuts the flutes at a shallow angle and at a constant depth, making relatively deep furrows through the ridges of the flutes, countered by shallow scratches across the valleys. Three overlaid patterns—in a disk two inches wide. All these marks Pye cut into the wood with exquisitely sharp gravers, guided by a small, lathe-mounted version of the large fluting engine. At the end he brushed the surface with flour-fine abrasive paper, and polished up the wood's color with a mere drop of oil.

As you examine one of Pye's boxes, and turn it in your hand, the light plays variously on the facets created by the carving. Aspects of first one pattern, then another, then another, come into view. The effect is subtle, complex and charming. But for all its diversity there is nothing equivocal about this little box. First it was designed, then the designer-who-is-also-the-workman made it, rigorously carrying out his intentions with clarity, experience and dexterity. Indeed, this is the thing rarely seen any more: highly regulated work, made by the workmanship of risk.



Kingwood needle case, Jamaica satinwood lid
4.5 in/11.5 cm

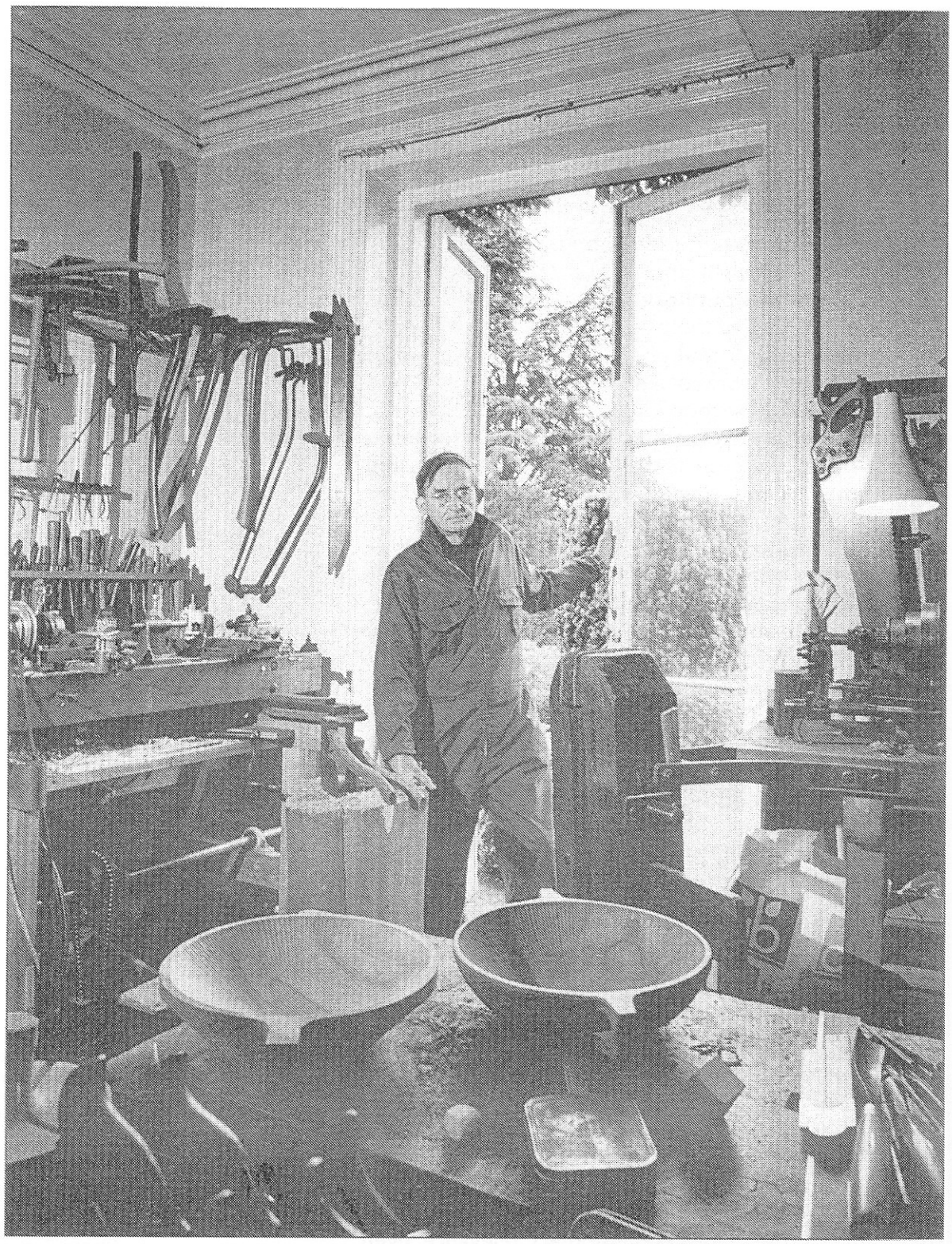
Kingwood box, wild service tree lid
5.5 in/14.5 cm
(David Pye/David Cripps/Crafts Council)

* * *

David Pye was trained to be an architect of wooden buildings, but after a few years in the field the Second World War propelled him into the Navy, kindling a lifelong interest in ships and naval architecture. He then taught for twenty-six years at the Royal College of Art in London, the last eleven as Professor of Furniture Design. During that period Pye designed furniture for industrial production (workmanship of certainty), and wrote this book plus its companion, *The Nature and Aesthetics of Design*. In an autobiographical note to a 1986 Craft Council publication, he wrote: "But all the while from the end of the war to the present day I have been consistently a maker as well as a teacher and designer. I have worked nearly always in wood and have done work of several kinds, but ever since the war, and particularly since I retired (in 1974), I have fairly steadily done...sculpture, carved bowls and dishes, and turned boxes." David Pye died at the start of 1993, at the age of 84.

Though first published in 1968, Pye's analysis of workmanship remains the only useful framework we have. The reason is that Pye, unlike most other intellectuals who write about art, design and craft, was himself a maker of things. He not only made things, he always made things, he thought from the perspective of the workman, and he took great pleasure in the activity of making. This put him directly in touch with the problems of designing and making, with the issues that confound every thoughtful workman. Unlike so many of us, however, Pye was also highly educated, and gifted with a sharp and lively intelligence. Thus he not only had his hands immersed in the issues, he was able to formulate a set of definitions and truths that have eluded other intellectuals.

The confusion, in fact, begins with William Morris and John Ruskin, the great theoreticians of the Arts and Crafts movement, still a powerful tradition in crafts on both sides of the Atlantic. The ideas of Ruskin and Morris are resurgent in our culture, in the nostalgic yearning for a simpler time, and in the popular veneration of crudely made and even dysfunctional craftworks. Whether they realize it or not, people still echo Ruskin's rhetoric, and Pye's summary of it (chapter 10) will be familiar to every modern reader. Thus Pye's trenchant critique retains contemporary relevance, even



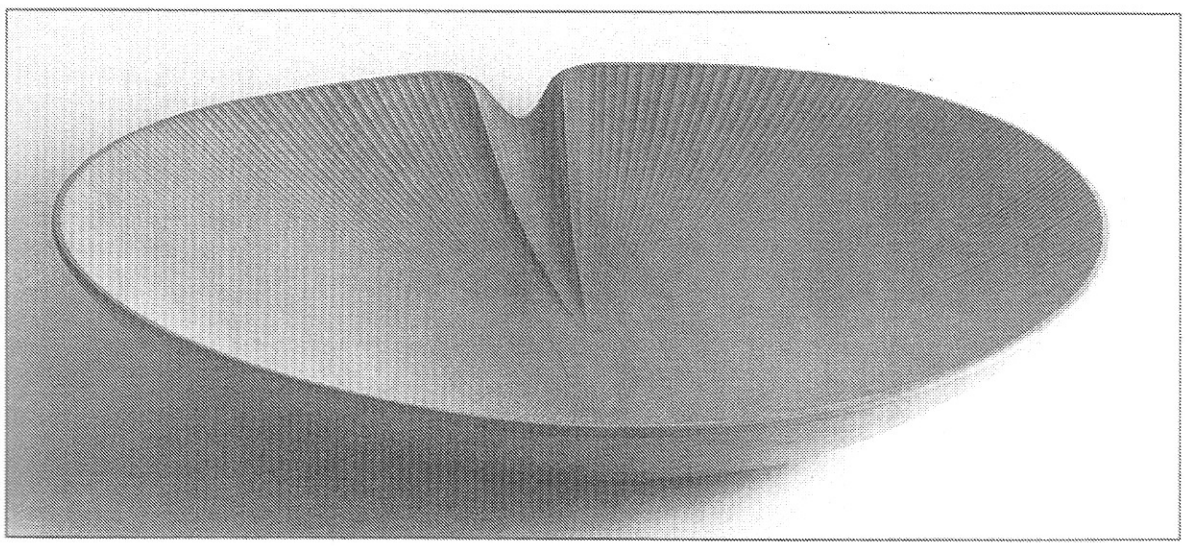
as we enter an era of automated production and cybernetic information.

When I met Pye in 1978, the current woodworking and crafts revival had well begun. I asked him whether he still believed, as he writes in chapter 11, that fine workmanship was in danger of extinction. He said he hoped not, at least, he was encouraged by the new and broad interest in craftsmanship and workmanship. Over the next 15 years, the crafts movement matured despite the buffeting of international recession, and now we can see that the workmanship of risk probably will survive, though not, as Pye (along with James Krenov) imagined, only in hands of part-time amateurs. When Pye first made the case, during the mid-1960s, his reading of the auguries was entirely accurate. But within fifteen years, in both England and America, professional craftsmen of the first order began to find ways to carry on, and to make work as good as has ever been made, and even to prosper as businessmen. Though pleased, Pye was at a loss to explain this new phenomenon. In retrospect, it's clear to me that one reason (among a great many) is the light shone on the problems of design and workmanship by Prof. Pye himself. He not only explained how to think about designing and making, but by his example he taught us how to recognize really good workmanship, and what it could mean to us.

—John Kelsey, Jan. 1, 1995

Opposite: Pye in his workshop (Philip Sayer/Crafts Council)

Wild service tree dish 15 in/38 cm diameter (David Pye/Crafts Council)



1. Design proposes. Workmanship disposes

In the last twenty years there has been an enormous intensification of interest in Design. The word is everywhere. But there has been no corresponding interest in workmanship. Indeed there has been a decrease of interest in it. Just as the achievements of modern invention have popularly been attributed to scientists instead of to the engineers who have so often been responsible for them, so the qualities and attractions which our environment gets from its workmanship are almost invariably attributed to design.

This has not happened because the distinction between workmanship and design is a mere matter of terminology or pedantry. The distinction both in the mind of the designer and of the workman is clear. Design is what, for practical purposes, can be conveyed in words and by drawing: workmanship is what, for practical purposes, can not. In practice the designer hopes the workmanship will be good, but the workman decides whether it shall be good or not. On the workman's decision depends a great part of the quality of our environment.

Gross defects of workmanship the designer can, of course, point out and have corrected, much as a conductor can at least insist on his orchestra playing the right notes in the right order. But no conductor can make a bad orchestra play well; or, rather, it would take him years to do it; and no designer can make bad workmen produce good workmanship. The analogy between workmanship and musical performance is in fact rather close. The quality of the concert does *not* depend wholly on the score, and the quality of our environment does *not* depend on its design. The score and the design are merely the first of the essentials, and they can be nullified by the performers or the workmen.

Our environment in its visible aspect owes far more to workmanship than we realize. There is in the man-made world a whole domain of quality which is not the result of design and owes little to the designer. On the contrary, indeed, the designer is deep in its debt, for every card in his hand was put there originally by the workman. No architect could specify ashlar until a mason had perfected it and shown him that it could be done. Designers have only been able to exist by exploiting what workmen have evolved or invented.

This domain of quality is usually talked of and

thought of in terms of material. We talk as though the material of itself conferred the quality. Only to name precious materials like marble, silver, ivory, ebony, is to evoke a picture of thrones and treasures. It does not evoke a picture of gray boulders on a dusty hill or logs of ebony as they really are—wet dirty lumps all shakes and splinters! Material in the raw is nothing much. Only worked material has quality, and pieces of worked material are made to show their quality by men, or put together so that together they show a quality which singly they had not. "Good material" is a myth. English walnut is not good material. Most of the tree is leaf-mold and firewood. It is only because of workmanlike felling and converting and drying and selection and machining and setting out and cutting and fitting and assembly and finishing—particularly finishing—that a very small proportion of the tree comes to be thought of as good material; not because a designer has specified English walnut. Many people seeing a hundred pounds worth of it in a London timber yard would mistake it for rubbish, and in fact a good half of it would be: would have to be.

So it is with all other materials. In speaking of good material we are paying an unconscious tribute to the enormous strength of the traditions of workmanship still shaping the world even now (and still largely unwritten). We talk as though good material were found instead of being made. It is good only because workmanship has made it so. Good workmanship will make something better out of pinchbeck than bad will out of gold. *Corruptio optimi pessima*! Some materials promise far more than others but only the workman can bring out what they promise.

In this domain of quality our environment is deteriorating. What threatens it most is not bad workmanship. Much workmanship outside of mass-production is appallingly bad and getting worse, to be sure, and things are seen in new buildings which make one's hair rise. But at least it is easy to see what the remedies are, there, if difficult to apply them. Moreover, it is not the main danger, because it is outside the field of mass-production, and the greater part of all manufacture now is mass-production; in which, although there is some bad workmanship, much is excellent. Much of it has never been surpassed and some never equaled. The deteriora-

tion comes not because of bad workmanship in mass-production but because the range of qualities which mass-production is capable of just now is so dismally restricted; because each is so uniform and because nearly all lack depth, subtlety, overtones, variegation, diversity, or whatever you choose to call that which distinguishes the workmanship of a Stradivarius violin, or something much rougher like a modern ring-net boat. The workmanship of a motor-car is something to marvel at, but a street full of parked cars is jejune and depressing; as if the same short tune of clear unmodulated notes were being endlessly repeated. A harbor full of fishing-boats is another matter.

Why do we accept this as inevitable? We made it so and we can unmake it. Unless workmanship comes to be understood and appreciated for the art it, is our environment will lose much of the quality it still retains.

2. The workmanship of risk and the workmanship of certainty

Workmanship of the better sort is called, in an honorific way, craftsmanship. Nobody, however, is prepared to say where craftsmanship ends and ordinary manufacture begins. It is impossible to find a generally satisfactory definition for it in face of all the strange shibboleths and prejudices about it which are acrimoniously maintained. It is a word to start an argument with.

There are people who say they would like to see the last of craftsmanship because, as they conceive of it, it is essentially backward-looking and opposed to the new technology which the world must now depend on. For these people craftsmanship is at best an affair of hobbies in garden sheds; just as for them art is an affair of things in galleries. There are many people who see craftsmanship as the source of a valuable ingredient of civilization. There are also people who tend to believe that craftsmanship has a deep spiritual value of a somewhat mystical kind.

If I must ascribe a meaning to the word craftsmanship, I shall say as a first approximation that it means simply workmanship using any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on the judgment, dexterity and care which the maker exercises as he works. The essential idea is that the quality of the result is continually at risk during the process of making; and so I shall call this kind of workmanship 'The workmanship of risk': an uncouth phrase, but at least descriptive.

It may be mentioned in passing that in workmanship the care counts for more than the judgment and dexterity; though care may well become habitual and unconscious.

With the workmanship of risk we may contrast the workmanship of certainty, always to be found in quantity production, and found in its pure state in full automation. In workmanship of this sort the quality of the result is exactly predetermined before a single salable thing is made. In less developed forms of it the result of each operation done during production is predetermined.

The workmanship of certainty has been in occasional use in undeveloped and embryonic forms since the Middle Ages and I should suppose from much earlier times, but all the works of men which have been most admired since the beginning of history have been made

by the workmanship of risk, the last three or four generations only excepted. The techniques to which the workmanship of certainty can be economically applied are not nearly so diverse as those used by the workmanship of risk. It is certain that when the workmanship of certainty remakes our whole environment, as it is bound now to do, it will also change the visible quality of it. In some of the following chapters I shall discuss what may be lost and gained.

The most typical and familiar example of the workmanship of risk is writing with a pen, and of the workmanship of certainty, modern printing. The first thing to be observed about printing, or any other representative example of the workmanship of certainty, is that it originally involves more of judgment, dexterity, and care than writing does, not less: for the type had to be carved out of metal by hand in the first instance before any could be cast; and the compositor of all people has to work carefully, and so on. But all this judgment, dexterity and care has been concentrated and stored up before the actual printing starts. Once it does start, the stored-up capital is drawn on and the newspapers come pouring out in an absolutely predetermined form with no possibility of variation between them, by virtue of the exacting work put in beforehand in making and preparing the plant which does the work: and making not only the plant but the tools, patterns, prototypes and jigs which enabled the plant to be built, and all of which had to be made by the workmanship of risk.

Typewriting represents an intermediate form of workmanship, that of limited risk. You can spoil the page in innumerable ways, but the N's will never look like U's, and, however ugly the typing, it will almost necessarily be legible. All workmen using the workmanship of risk are constantly devising ways to limit the risk by using such things as jigs and templates. If you want to draw a straight line with your pen, you do not go at it freehand, but use a ruler, that is to say, a jig. There is still a risk of blots and kinks, but less risk. You could even do your writing with a stencil, a more exacting jig, but it would be slow.

Speed in production is usually the purpose of the workmanship of certainty but it is not always. Machine tools, which, once set up, perform one operation, such for instance as cutting a slot, in an absolutely predeter-

mined form, are often used simply for the sake of accuracy, and not at all to save time or labor. Thus in the course of doing a job by the workmanship of risk a workman will be working freehand with a hand tool at one moment and will resort to a machine tool a few minutes later.

In fact the workmanship of risk in most trades is hardly ever seen, and has hardly ever been known, in a pure form, considering the ancient use of templates, jigs, machines and other shape-determining systems [1], which reduce risk. Yet in principle the distinction between the two different kinds of workmanship is clear and turns on the question: 'Is the result predetermined and unalterable once production begins?'

Bolts can be made by an automatic machine which when fed with blanks repeatedly performs a set sequence of operations and turns out hundreds of finished bolts without anyone even having to look at it. In full automation much the same can be said of more complex products, substituting the words 'automated factory' for 'automatic machine'. But the workmanship of certainty is still often applied in a less developed form where the product is made by a planned sequence of operations, each of which has to be started and stopped by the operative, but with the result of each one predetermined and outside his control. There are also hybrid forms of production where some of the operations have predetermined results and some are performed by the workmanship of risk. The craft-based industries, so called, work like this.

Yet it is not difficult to decide which category any given piece of work falls into. An operative, applying the workmanship of certainty, cannot spoil the job. A workman using the workmanship of risk assisted by no matter what machine-tools and jigs, can do so at almost any minute. That is the essential difference. The risk is real.

But there is much more in workmanship than not spoiling the job, just as there is more in music than playing the right notes.

There is something about the workmanship of risk, or its results; or something associated with it; which has been long and widely valued. What is it, and how can it be continued? That is one of the principal questions

[1] Shape-determining systems are discussed in my book *The Nature of Design*, in which the chapters on Techniques and on 'Useless Work' are relevant to the present subject.

which I hope this book may answer: and answer factually rather than with a series of emotive noises such as protagonists of craftsmanship have too often made instead of answering it.

It is obvious that the workmanship of risk is not always or necessarily valuable. In many contexts it is an utter waste of time. It can produce things of the worst imaginable quality. It is often expensive. From time to time it had doubtless been practiced effectively by people of the utmost depravity.

It is equally obvious that not all of it is in jeopardy: for the whole range of modern technics is based on it. Nothing can be made in quantity unless tools, jigs, and prototypes, both of the product and the plant to produce it, have been made first and made singly.

It is fairly certain that the workmanship of risk will seldom or never again be used for producing things in quantity as distinct from making the apparatus for doing so; the apparatus which predetermines the quality of the product. But it is just as certain that a few things will continue to be specially made simply because people will continue to demand individuality in their possessions and will not be content with standardization everywhere. The danger is not that the workmanship of risk will die out altogether but rather that, from want of theory, and thence lack of standards, its possibilities will be neglected and inferior forms of it will be taken for granted and accepted.

There was once a time when the workmanship of certainty, in the form colloquially called 'mass-production', generally made things of worse quality than the best that could be done by the workmanship of risk—colloquially called 'hand-made'. That is far from true now. The workmanship of a standard bolt or nut, or a glass or polyethylene bottle, a tobacco-tin or an electric-light bulb, is as good as it could possibly be. The workmanship of risk has no exclusive prerogative of quality. What it has exclusively is an immensely various range of qualities, without which at its command the art of design becomes arid and impoverished.

A fair measure of the aesthetic richness, delicacy and subtlety of the workmanship of risk, as against that of certainty, is given by comparing the contents of, say, the British Museum with those of a good department store. Nearly everything in the Museum has been made

by the workmanship of risk, most things in the store by the workmanship of certainty. Yet if the two were compared in respect of the ingenuity and variety of the devices represented in them the Museum would seem infantile. At the present moment we are more fond of the ingenuity than the qualities. But without losing the ingenuity we could, in places, still have the qualities if we really wanted them.

3. Is anything done by hand?

Things are usually made by a succession of different operations, and there are often alternative ways of carrying any one of them out. We can saw, for instance, with a hand-saw, an electrically driven band-saw, a frame-saw, and in other ways.

To distinguish between the different ways of carrying out an operation by classifying them as hand- or machine-work is, as we shall see, all but meaningless. But if we make an estimate of the degree of risk to the quality of the result which is involved in each we have a real and useful basis for comparison between them. Let us take two extreme examples: (A) A dentist drilling a tooth with an electrically driven drill. (B) A man drilling a piece of wood with a hand-driven wheelbrace, using a twist-drill and a jig. A is a machine-operation and B is a hand-operation: or, if you like, we will say that both are machine-operations. Operation A which the dentist does with a power-driven machine-tool involves 100 per cent risk (and there is no man that it lies in his mouth to deny it!) but operation B merely involves a five per cent risk or so, and only that because, if the hand-workman is fool enough, he may break the drill. Otherwise he has only to keep winding the handle and the result is a certainty. The source of power is completely irrelevant to the risk. The power tool may need far more care, judgment and dexterity in its use than the hand-driven one.

Let us consider some possible definitions of handicraft, or hand-work, or work done by hand. 'Done by hand' as distinct from work done by what? By tools? Some things actually can be made without tools it is true, but the definition is going to be rather exclusive for it will take in baskets and coiled pottery, and that is about all! Let us try something wider and say 'done by hand-tools as distinct from work done by machines'. Now we shall have to define 'machine' so as to exclude a hand-loom, a brace and bit, a wheelbrace, a potter's wheel and the other machines and tools which belong to what is generally accepted as hand-work. So that will not do either, unless we propose to flout the ordinary usage of mechanics: which on the subject of machinery seems a trifle risky.

Suppose that we try 'As distinct from power-driven machine tools'. Now we are faced with having to agree that the distinction between handicraft and not-handi-

craft has nothing to do with the result of handicraft—the thing made: for no one can possibly tell by looking at something turned, whether it was made on a power-driven, foot-driven, boy- or donkey-driven lathe. And then again, if we hold to this definition, do we say 'made *entirely* without the use of power-driven machine tools' or do we say 'made *partly* without... '? If we say 'entirely', then all the carpentry, joinery, and cabinet-making of the last hundred years is excluded, pretty nearly: indeed for longer than that. Louis Mumford remarks [2] (in a different context) that ... 'If power machinery be a criterion, the modern industrial revolution began in the twelfth century and was in full swing by the fifteenth.' The sawmill is a very ancient thing and so, of course, is the water-driven hammer.

But if we take the other course and say 'Partly without power-driven machine-tools' we include in handicraft most of the worst products of cheap quantity-production. Perhaps we can save the situation yet, by putting in a disclaimer and saying 'made *singly*, partly without power-driven machine-tools'. But now how do we know he hasn't made two of them and kept quiet about it? There is nothing about the product, the thing made, to tell us. And if we say 'in small numbers' why, exactly, do we include six and exclude seven or such-like? It sounds more like an expedient than a definition.

Suppose that we make a last attempt, shape a different course altogether, and say 'made by hand-guided tools, whether power-driven machine-tools or not'. By so doing we have written off every kind of drill, lathe, plane, and shooting board, all of which are shape-determining systems. So we shall now have to qualify the definition to include these tools which are only in part hand-guided; and then we shall have to try to exclude whatever machines we do not happen to fancy, from the same group.

Or shall we? Is it not time to give up and admit that we are trying to define in the language of technology a term which is not technical?

'Handicraft' and 'Hand-made' are historical or social terms, not technical ones. Their ordinary usage nowadays seems to refer to workmanship *of any kind* which could have been found before the Industrial Revolution.

Mumford, extending a conception of Patrick Geddes's, described [3] three phases in the development

[2] *Technics and Civilization*

[3] *Technics and Civilization*

of European economy and technics, each phase having a distinct pattern of economy and culture and a 'technical complex' of its own, which might be roughly indicated by referring to its principal materials and sources of power. The Eotechnic phase was reckoned to extend from about AD 1000 to 1760, and was a 'water-and-wood complex'. The Paleotechnic phase, of the Industrial Revolution, was a 'coal-and-iron complex', and the Neotechnic phase of our own day, which succeeded it, is an 'electricity-and-alloy complex' (Mumford was writing in 1930).

The essential ideas in his conception are, I think, first: that the Eotechnic phase contained, not so much the seeds, as the nine-month embryo of the Industrial Revolution; for all the prerequisite ideas, devices and techniques for it were already in being before it came about. Secondly: that the different phases 'interpenetrated and overlapped'. That is to say that, just as the technical features of the Paleotechnic phase, such as quantity-production and the workmanship of certainty, were in being quite early in the Eotechnic phase, so did techniques and devices characteristic of that phase persist through the Paleotechnic phase and even into our own day. I lately saw a wooden barrel (Eotechnic) with, beside it, a galvanized steel bucket (Paleotechnic) and a thermoplastic watering-can (Neotechnic). As for the workmanship of certainty having appeared during the Eotechnic phase, to quote but two examples: the monk Theophilus in the eleventh century gave a detailed description of punches and stamps for producing quantities of standardized ornaments in gold and silver [4], and in or about 1294 a smith called Thomas, from Leighton Buzzard, used stamping dies for forging standardized ornamental features for the grille of Eleanor of Castile's tomb in Westminster Abbey, which still exists [5]. It may be that in its earliest manifestations the workmanship of certainty was used for the quantity-production of ornaments more often than for utilitarian purposes.

Now the current idea of handicraft and the handmade has been deeply colored by the Arts and Crafts movement; and that became a movement of protest against the workmanship and aesthetics of the Industrial Revolution, which it contrasted with handicraft. As a result, I think, the idea has become accepted

[4] See H. Wilson, *Silverwork and Jewelry* (1903)

[5] See H. R. Schubert, *History of the British Iron and Steel Industry*

other determining system is there to guide it. Very few things can properly be said to have been made by hand, but, if there are any operations involving a tool which may legitimately be called hand-work, then perhaps these are they. Writing and sewing are examples.

4. Quality in workmanship

We have given some account of workmanship. Now let us consider some of the epithets which are commonly applied to it. There are, I think, four which we should examine: 'good' and 'bad', 'precise' and 'rough'. It is usual to equate 'good' with 'precise' and 'bad' with 'rough'. To do so is false. Rough workmanship may be excellent while precise may be bad.

The goodness or badness of workmanship is judged by two different criteria: soundness and comeliness. Soundness implies the ability to transmit and resist forces as the designer intended; there must be no hidden flaws or weak places. Comeliness implies the ability to give that aesthetic expression which the designer intended, or to add to it. Thus the quality of workmanship is judged in either case by reference to the designer's intention, just as the quality of an instrumentalist's playing is judged by reference to the composer's.

In some cases precision is necessary to soundness, but in many others it is not, and rough workmanship will do the job just as well. In some cases precision is necessary to the intended aesthetic expression but in others it is not and, on the contrary, rough workmanship is essential to it.

All workmanship, as we shall see, is approximation, to a greater or less degree. A designer may perfectly well expect and intend the roughest of approximation. Just as a composer by a notation like 'Con brio' may dictate how he wants to be played, so may a designer. If, on the other hand, the designer intends precision and gets it in the main, but finds it interrupted by passages of approximation he never intended, then the effect will be discernible, and this is bad workmanship. Good workmanship is that which carries out or improves upon the intended design. Bad workmanship is what fails to do so and thwarts the design.

All workmanship is approximation. There are in the world of manufacture, and not only in that of metaphysics, certain Ideas of which the things we make are necessarily imperfect copies. Nothing has ever been square because nothing has ever been straight, nor has anything been flat, nor spherical, cylindrical, cubical.

Socrates, in the *Phaedo*, maintains that the idea of absolute equality is suggested to us by the sight of things which appear to be approximately equal, because they remind us of something our souls knew before we

were born. A similar contention could of course be made about absolute flatness or straightness. I prefer another explanation for I do not think there can be much doubt how we have arrived at the idea of an absolutely flat surface when nothing flat exists. Whenever we make something 'flat' and find it is not flat enough, we always find that by taking more trouble we can make it still flatter: or we have always been able to do so hitherto: and so we find it easy to imagine we are approximating to a perfect flatness which it is just beyond our powers or patience to reach.

Unless we accept Plato's explanation and postulate a primordial inborn memory of ideal forms, our whole notion of geometrical perfection must have been built up by this sort of extrapolation.

Beyond this approximation to an unattainable geometrical ideal there is a second order of approximation to mere regularity. We do not always insist on exact duplication, or symmetry, or evenness of section, or fairness of a curve, or repetition of a unit.

This kind of approximation may be done deliberately, as it is for instance in the asymmetrical weaving of an essentially symmetrical pattern in some oriental rugs, for magical reasons; or it may be done as making a virtue of necessity where the desire or need for economy prompts us to rough workmanship. But, whatever reason we may give for it, in all such cases the workman admits to the work an element of the unaccountable and unstudied: of improvisation: either deliberately or because he has not the time or ability to prevent it.

Now a design is in effect a statement of the ideal form of the thing to be made, to which the workman will approximate in a greater or less degree. In a designer's drawing all joints fit perfectly! If the designer wants precise workmanship he is saying, as he shows the drawings and specification to the workman, 'This tells you how, ideally, it ought to be. Now show us how near you can get.' Or, on the other hand, he may be saying 'This is how it is supposed to be, but don't take it too literally. You know that a fairly rough job is usual in this sort of work, and that is what I should like to see.'

The trouble is that designs in so many trades are conceived in terms of combinations of simple geometrical forms. In architecture for instance it has hardly ever been otherwise. Now it happens that, as the Gestalt psy-

chologists have demonstrated, we have a very effective inborn ability and indeed compulsion to see the straightness in all the things which are fairly straight and the triangularity in all the things which are more or less triangular. [7] Consequently when we see a rough-hewn baulk of timber we assume at once, without having to learn the fact, that it was 'meant to be' a rectangular prism, which it manifestly is not. Conversely, when we see what, so far as the eye can tell, is a perfect rectangular prism, but there happens to be a great open joint in it, we know at once that the joint was not 'meant to be' there.

Let us provisionally give the name 'perfect' workmanship to that in which the achievement seems to correspond exactly with the idea: the spherical ball-bearing appears to be exactly spherical. Let us on the other hand give the name 'rough' to workmanship in which there is an evident disparity between idea and achievement. In rough work we see timbers 'roughly squared', components 'roughly lined up' and so on. In such cases we infer the idea from the achievement, the rectangular prism from the roughly squared timber.

The workman's achievement may differ from the idea for three quite separate reasons: it may do so because he intends that it shall, it may do so because he has not time to perfect the work, and finally it may do so because he has not enough knowledge, patience or dexterity to perfect it. The last of these reasons is the one with which every layman is familiar, and hence to the layman rough workmanship often suggests ineptitude. It is taken for granted that the man who did it must have been incapable of doing perfect work. To any workman or artist that idea seems laughable. Many of Rembrandt's drawings are rough, but not, one may safely say, because of ineptitude. But even where this is understood, the rough work, because less laborious, is, in the West, usually considered in some way inferior to the perfect. In the Far East this has not been so. In Japan the cult of a certain kind of rough workmanship has had a great following and become highly sophisticated.

In the workmanship of risk rough work is the necessary basis of perfect work, just as the sketch is of the picture. The first sketchy marks on the canvas may become the foundation of the picture and be buried, or they may be left standing. Similarly the first approxima-

[7] See R. Arnheim, *Art and Visual Perception*, chapter 2.

tions of the workman may afterwards disappear as the work proceeds, or they may be left standing. For the painter and the workman it is sometimes difficult to know when to stop on the road towards perfect work, and sooner may be better than later. In the workmanship of certainty, on the other hand, there is no rough work. The perfect result is achieved directly without preliminary approximation.

In the case of open joints which we know are 'not meant to be there' we are confronted by a kind of bad workmanship which is very common. The workman is essentially an interpreter, and any workman's prime and over-ruling intention is necessarily to give a good interpretation of the design. If he fails in this he will either distort or disrupt the design, or both. If he is using a constructing technique the result of failure is usually disruptive. Let us take, by way of a test-tube example, the circular joined wooden glass-frame or picture-frame in fig. 1. The frame is a ring: a continuous form. Continuity is evidently the essence of the designer's intention. If, then, by bad workmanship the ring is broken, as in fig. 2, the continuity is interrupted and the intention flouted. Anyone who is in the smallest degree sensitive to the aesthetic intentions of design must be aware of this.

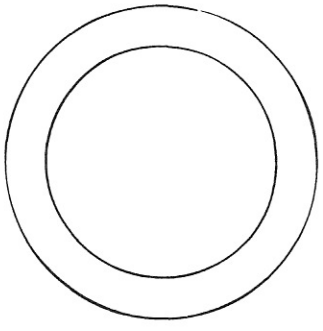


Figure 1

It is futile for a designer to aim at expressing continuity by means of a joined frame unless he is confident of getting expert workmanship. Otherwise he must seek the same effect by different means, either bending a single length of some suitable material into a ring, or cutting the ring out of a solid piece or else casting it. If a designer forces his intentions on workmen who, he knows, are not good enough at their job to carry them out, then he is quite as much to blame for the result as they are.

In all manufacture it is the rule rather than the exception to find that the degree of approximation in the workmanship of one piece of construction varies considerably in different parts of it and fairly often one finds rough work cheek-by-jowl with perfect work. The aesthetic success or failure of such a combination will depend on whether their being combined adds something to the design or detracts from it. If each acts as a foil to the other and sets it off, all is well, and we accept the combination without question as intentional; but, if

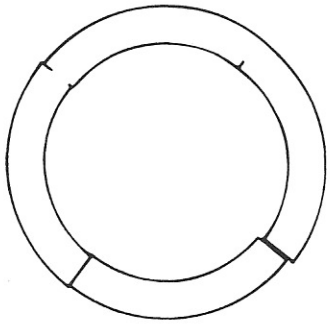


Figure 2

systems: such as jigs, forms, molds, gauges. The variety of these in even one trade can be very large. In the first place many tools are partly self-jigging. The adze is, for one. The whole secret of using it accurately is that the curved back of the descending adze strikes tangentially on the flat surface left by the previous stroke—which becomes a partial jig—and rides along it so that the new stroke more or less continues the plane of its predecessor (fig. 3). In the second place, there are different degrees of certainty in jigging. Thus, if you want to cut a piece of notepaper straight, parallel and three inches wide, you can go to work in six different ways. Either (1) mark the line on the paper, take a knife, hold your breath, and run the knife along the line: in which case you are relying on dexterity; or (2) you can cut a little outside the line and then trim back to it by paring off many little narrow slips of paper in succession: in which case you are relying on gradualness. Or (3) you can cut along the line with scissors, which, like the adze, are partly self-jigging because in their case the newly cut edge of the paper butts against the upper blade of the scissors and steadies the sheet while they continue the cut. In this case it is easy to make a good job of the cutting. Or (4) you can cut with a knife along a ruler; the ruler is an effective jig and high regulation is still more certain than with the scissors. Or (5) you can use a guillotine, in which case it is really quite difficult to avoid high regulation, for the operation is now completely jigged. Or (6) the guillotine could be fitted with a fence and an automatic feed of some sort, in which case you would have the workmanship of full certainty and you could produce thousands of identical strips of paper.

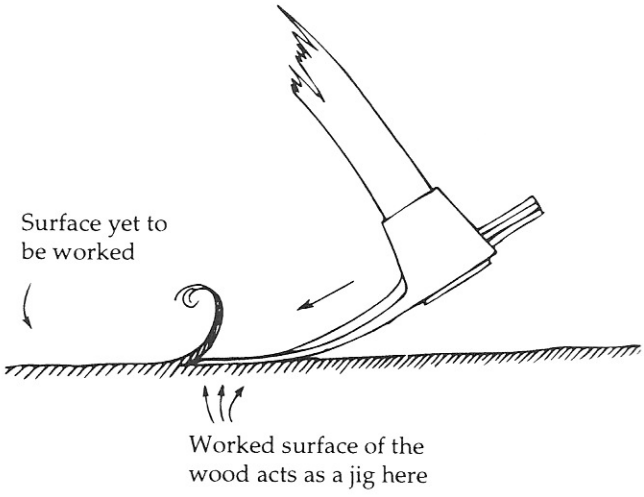


Figure 3

Now, of these methods of paper cutting, 1, 2, and possibly 3, will show moderately free workmanship. 4, 5, and 6 equally will show high regulation, and short of actual failure in workmanship it will be impossible to tell the results of them apart.

In free workmanship the flat surface is not quite flat but, when seen from close by, shows a faint pattern of tool marks: and the straight edge is not quite straight, but, seen close, shows slight divagations. The effect of such approximations is to contribute very much to the aesthetic quality in workmanship which I shall call *diversity*—and which will be discussed in chapter 6. The natural figure of materials such as wood, the play of

light in translucent materials, and the effects of wear, weathering and age, all contribute to diversity as well, but controlled freedom in workmanship has perhaps contributed more to the quality of our environment by way of diversification than any of them.

Free workmanship is now rare and becoming rarer. The workmanship of certainty is, simply of its nature, incapable of freedom. In old days free workmanship was the way of turning out cheap goods in quantity, but now even the smartest workman using it could not compete with the workmanship of certainty, and it survives successfully only in making a few things which the workmanship of certainty is incapable of, such as baskets and the products of the underwood industry, palings, spiles and hurdles, which are still in demand and have no acceptable substitute as yet. It is essentially deft, done with economy of effort. The liveliness and decision of it, and the fact that it is often associated with the countryside, have caused it to be thought that its practitioners must have taken pleasure in doing it: which may very much be doubted in some cases. The Welsh turner, James Davies of Abercych, told me that as a boy he had carved wooden spoons to be sold at fairs at, I think, twopence each. He said that at that price there was just time, when the spoon was finished, to look once at the inside, once at the outside, and then throw it over your shoulder on to the heap and start another! But having seen his work I do not doubt the spoons were a pleasure to look at.

Smiths are great exponents of free workmanship, for their trade above all needs deftness and decision. 'Strike while the iron is hot' is a very apt proverb.

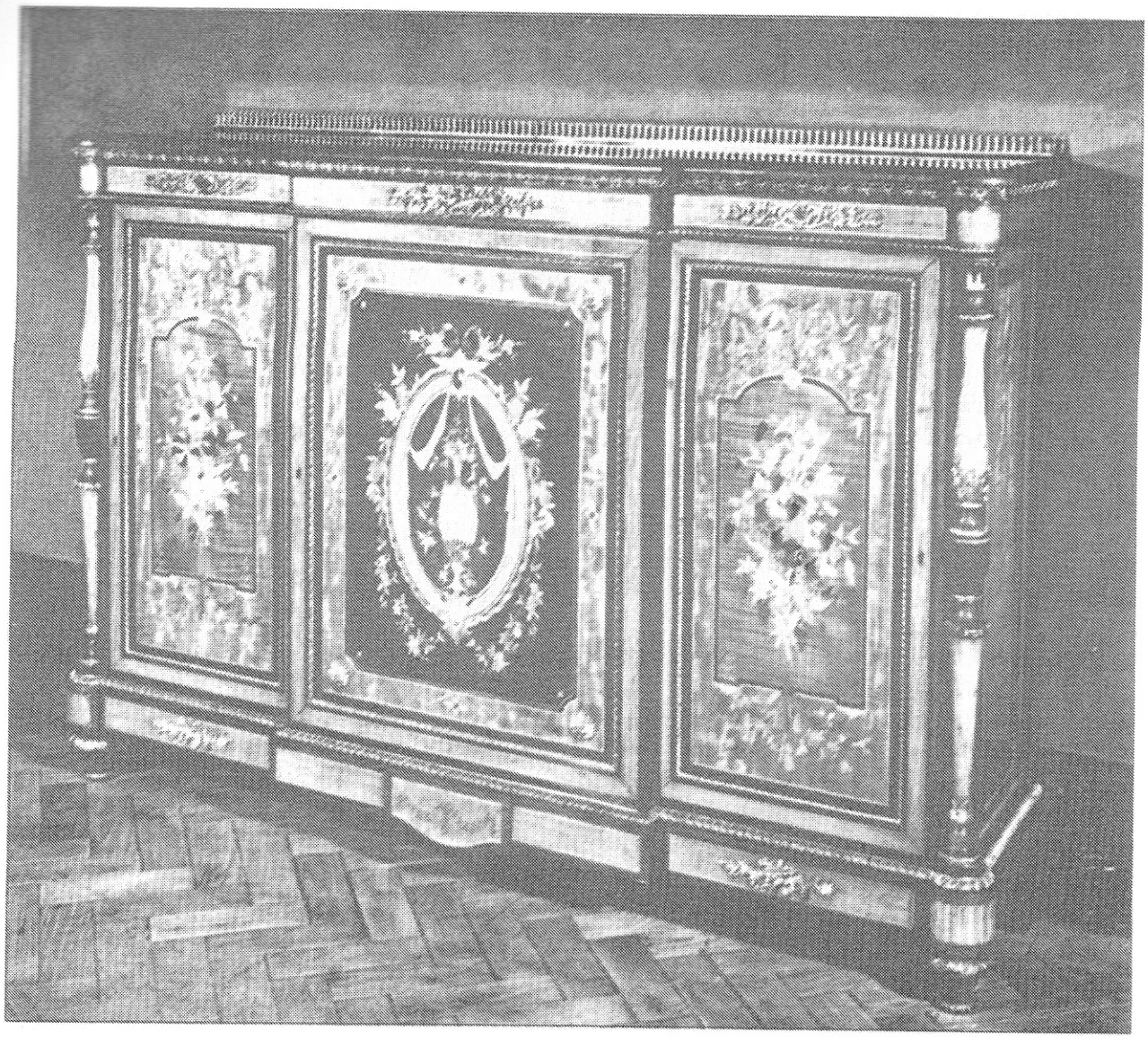
There is no substitute for the aesthetic quality of this workmanship and the world will be poorer without it, particularly the countryside. It is impossible not to regret that it is declining but quite impossible to expect that it will survive on any scale as a means of decent livelihood.

It will be as well now to define the other main terms used in this book and to make explicit the relationships among them. I have introduced new terms with great reluctance and have tried to select words whose ordinary meaning would be violated as little as possible. I have, however, had to limit the meaning of a few common words, much as in scientific terminology

'stress' and 'strain' have very precise meanings which though derived from their ordinary ones are more circumscribed.

Before considering the definitions the reader may find it convenient to refer to plates 1-10b, which begin on the next page, and to the commentary on them, which is largely concerned with demonstrating something of the difference between regulated and free workmanship, and with contrasting the workmanship of risk with that of certainty.

Text continues on page 49

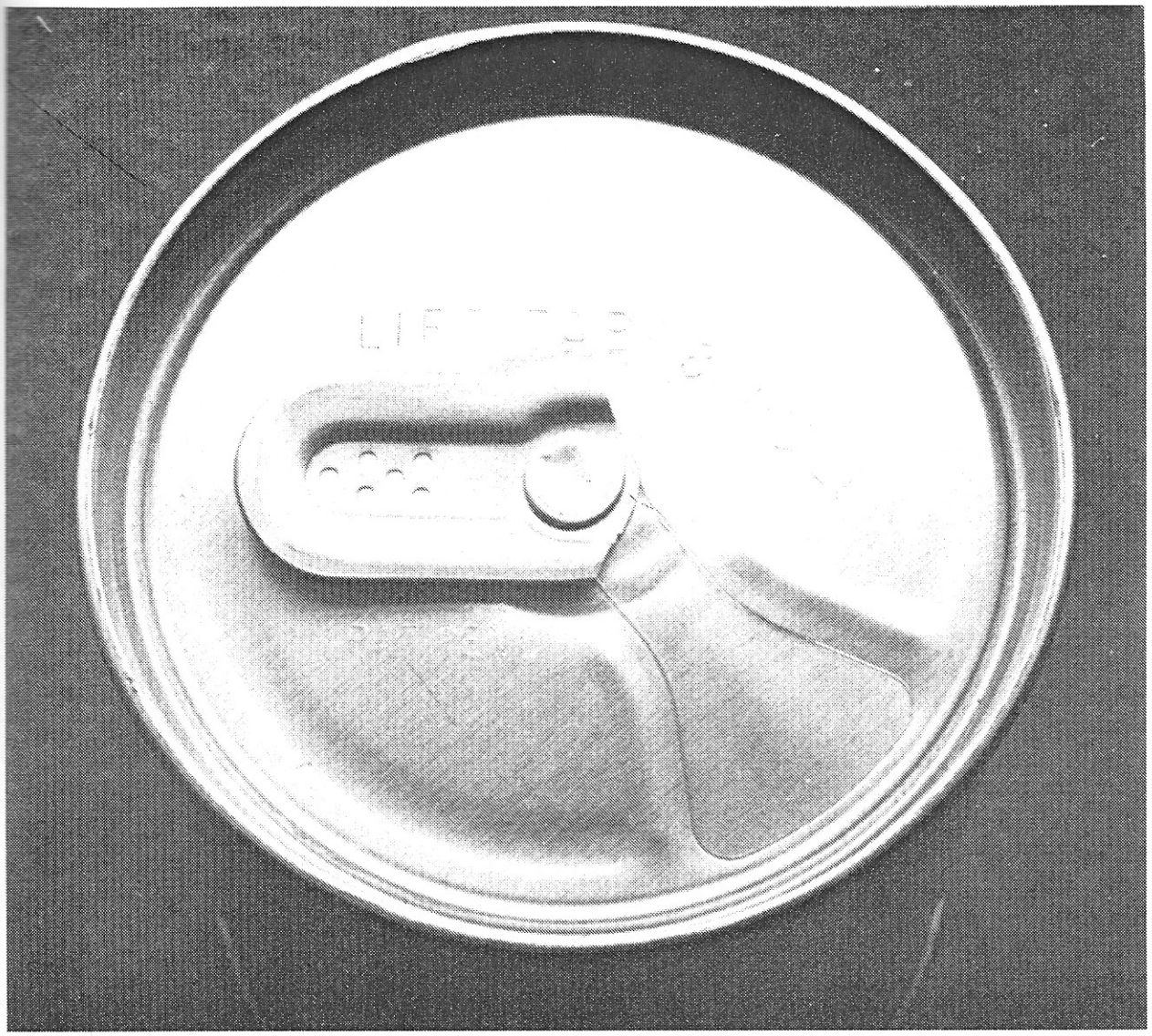


1 Drawing-room cabinet. Holland and Sons, 1868. *Crown copyright. Victoria and Albert Museum.*

Both these objects are of regulated workmanship. In neither is there any noticeable approximation. The can is entirely a product of the workmanship of certainty but it is less highly regulated than the cabinet, which is a product of the workmanship of risk. The central rivet of the can, for instance, is unevenly buckled, and there is unevenness in the impression of the lettering. These elements of free workmanship enhance the appearance by contrasting with the more completely regulated elements elsewhere.

The metal is not highly polished and for this reason the raw sheared edge on the right-hand end of the tab does not produce any marked sense of equivocality.

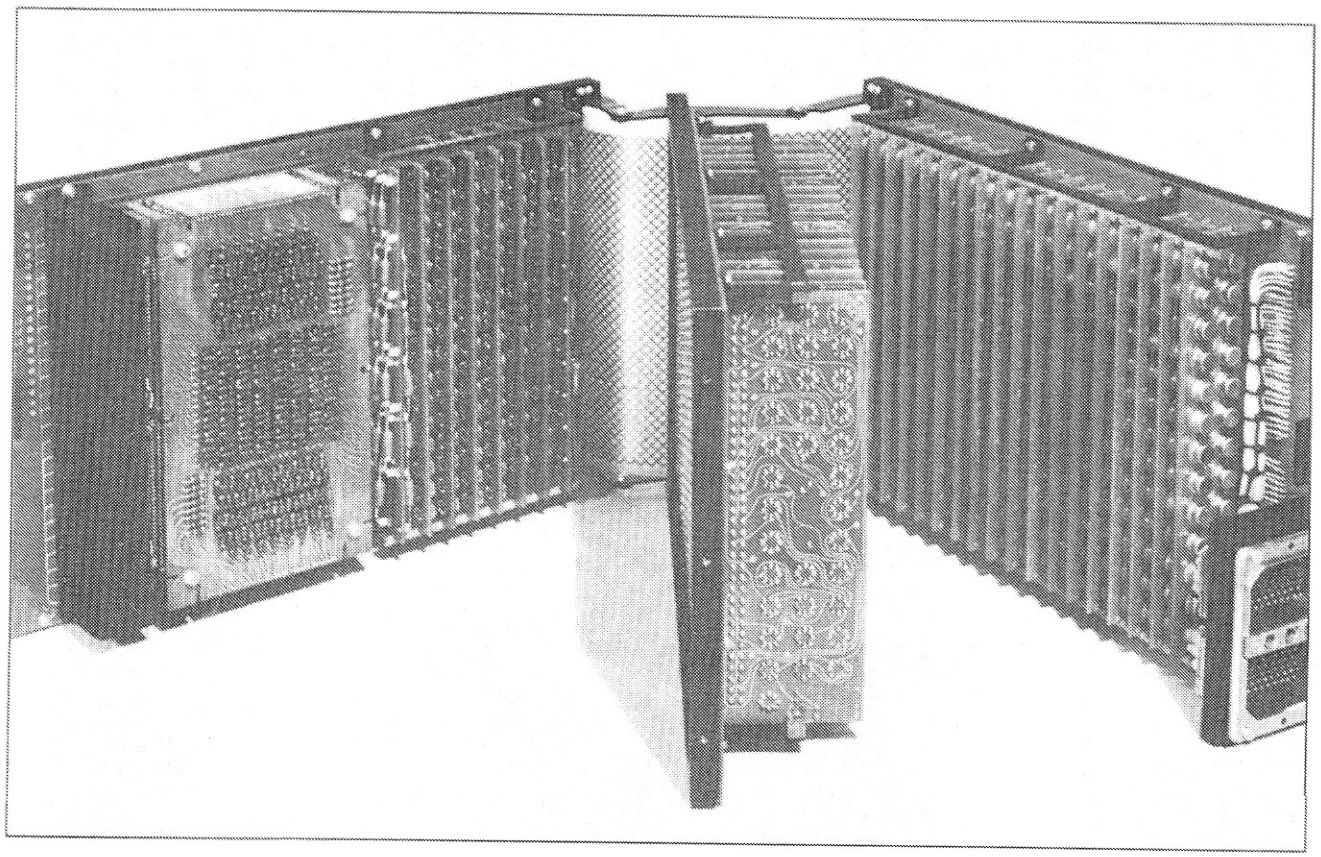
The can is an excellent piece of workmanship. Anyone accustomed to doing regulated



2 Top of beer can

work by the workmanship of risk must feel something of a pang at throwing such a thing away, for to make it by the workmanship of risk would be an intensely difficult and very long job.

The cabinet was made at a time when the art of workmanship in cabinetmaking, and no doubt other trades, stood at its zenith. The quality of it in the best Victorian furniture will never be surpassed. The eighteenth and twentieth centuries rarely equaled and seldom approached it. This was the kind of workmanship Ruskin and Morris were inveighing against (chapters 10 and 11). This is one of the sorts of quality that the crafts must continue. There is real danger that it will otherwise die out entirely.



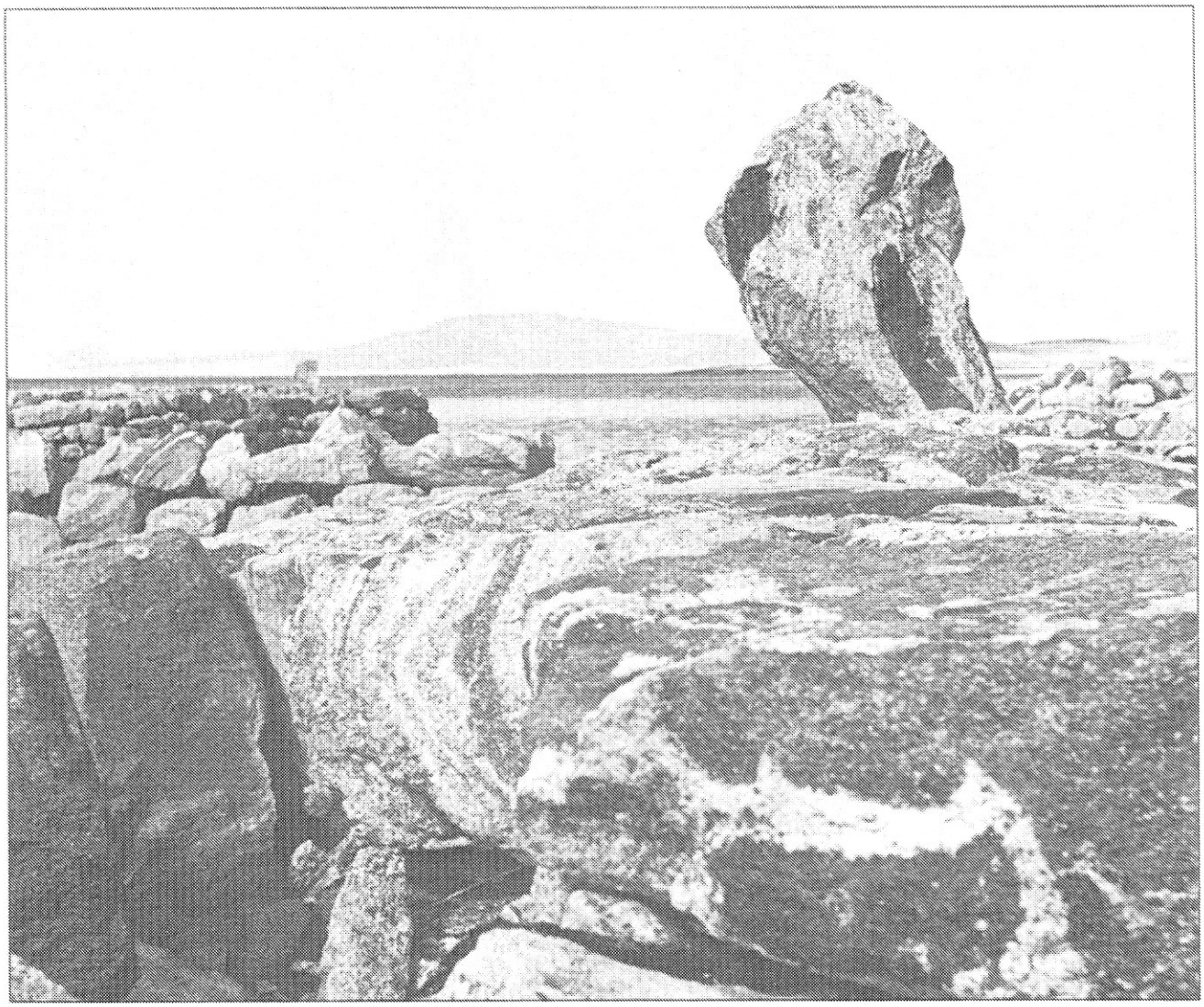
3 'Argus 400' computer. *By courtesy of Ferranti Lt.d*

The carving is of free workmanship entirely, but the computer also exhibits some of it, in the wiring at the near ends of the center and left-hand units, and also nearer the middle of the right-hand unit. The rest of what can be seen is of highly regulated workmanship, and the six hundred micro-miniature circuits (not visible here) are about as extreme examples of it as could be found. The two contrasted kinds of workmanship do not strike us as incongruous, probably because the same vein of neatness, order and compactness is evident in both.

The carving has characteristics which are typical of many other examples. Often the movements of the tool can be traced individually. The background, which 'is meant to be' flat, is not. The tool has overrun when the carver trimmed up the profile of the second leaf from the bottom on the left-hand side and has left a mark on the background which he could easily have removed but did not wish to. It has all been left as it is because higher regulation would, unless at the hands of an extraordinary artist, make the rendering less lively.

It is a common observation that a finished picture lacks the freshness of the sketch on which it was based. Free workmanship is essentially of the nature of a sketch.

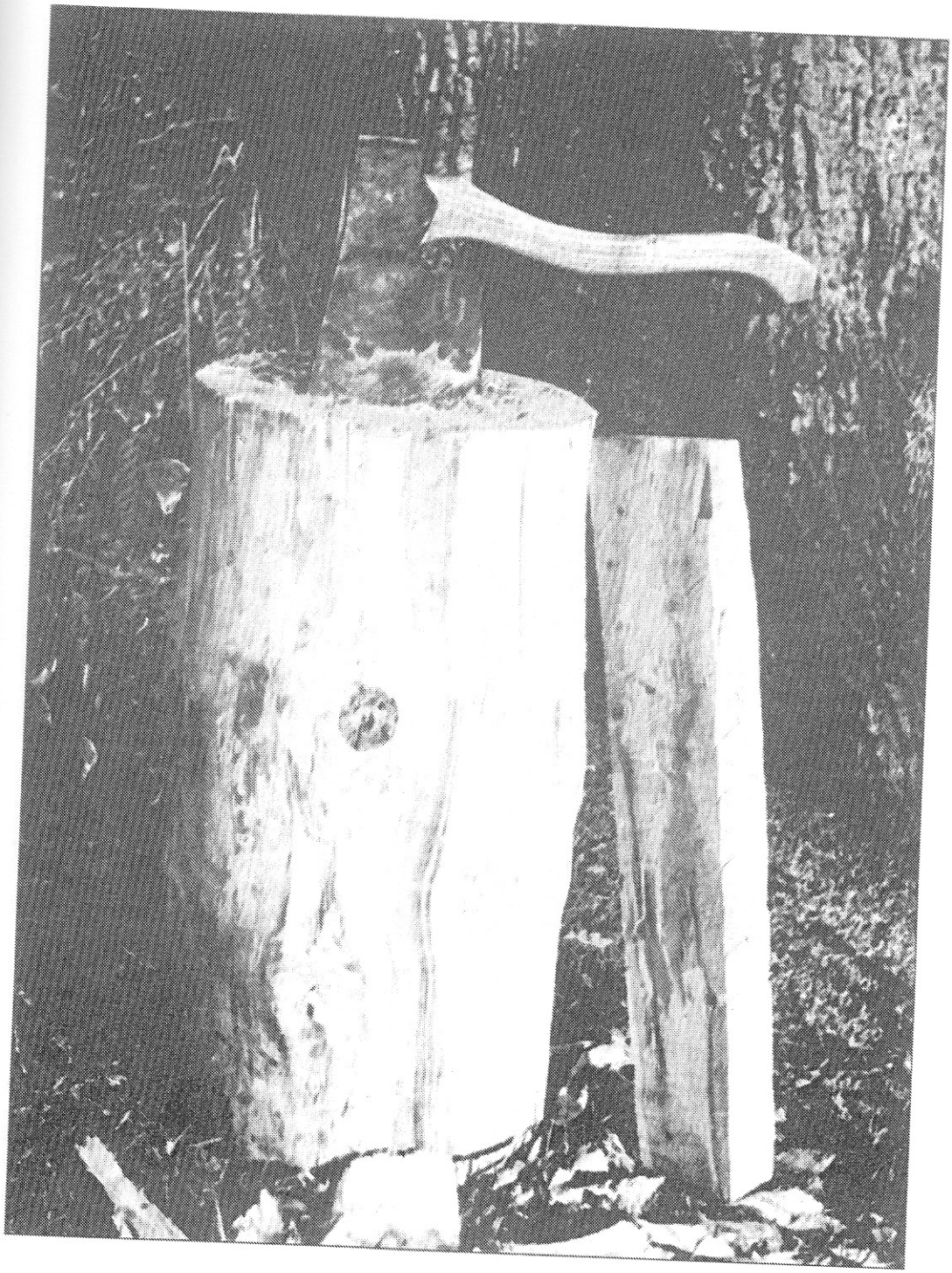
4 Carving of olive branch



5 Quay, with bollards. Barra.

In the bollards, the chopping-block and the billet we see rough workmanship. The quay on which the large bollard stands has been partly overthrown by the sea but it must have been rough enough before. It has grandeur and must have had it always. Little or none of that quality is here attributable to design; it comes from the workmanship and its setting. No working drawing for such a quay could have suggested any of it.

A broad-ax and its products are not often seen now but were very common when rough workmanship was the only means of cheap manufacture. The chopping block is simply a barked and trimmed log. There is a special attraction in the contrast between the quality of the chopped facets and the natural surface of the wood, and this has been felt, I think, all over the world if one may judge from ethnographic collections. They are great repositories of free and rough workmanship in some of its most attractive forms.



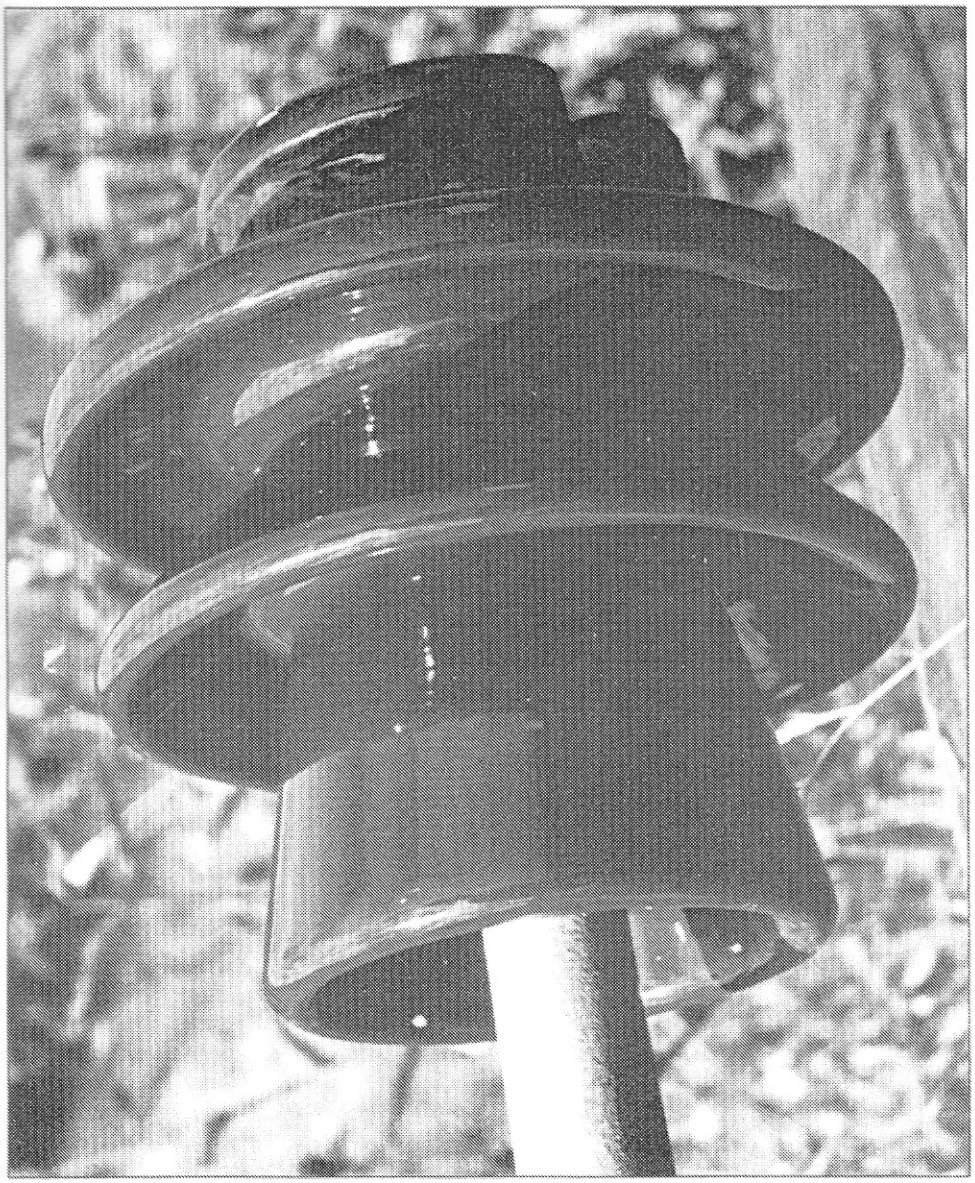
6 Rough-hewn billet, with chopping-block and side-ax

7 Lid of an earthenware crock.

The workmanship of risk does not necessarily produce free work such as we see in the crock lid, nor does the workmanship of certainty invariably produce high regulation, though it usually does and has done so in the case of this insulator.

Their similarity in material, color and glaze makes a comparison between the two objects particularly interesting, because aesthetically they are quite different in quality, and each in its own way is good. The insulator is diversified less boldly than the crock. On the small scale its only diversification comes from the slightly uneven flow of the glaze which causes a small ripple in the clean line of every reflection. The shape in itself contributes little, but it casts freely curving shadows and shows complicated reflections. These adventitious formal elements extend the diversity on to a larger scale also, corresponding to a considerably longer range.

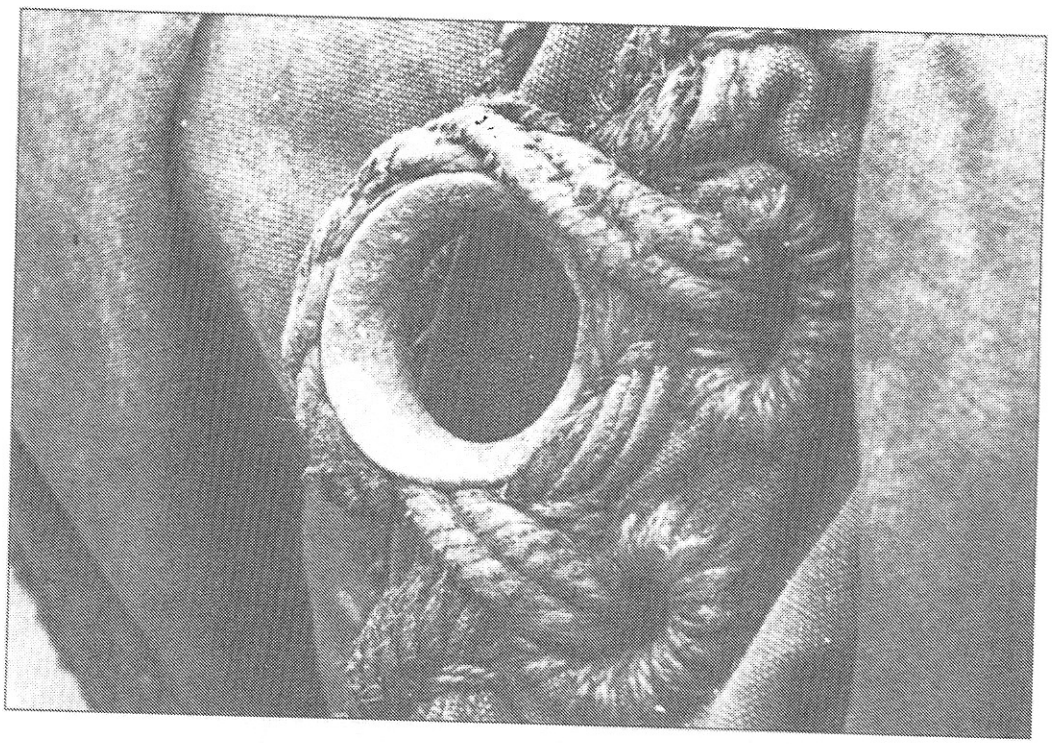
In the crock lid the larger-scale diversity is, by the free workmanship, built in and not adventitious at all. The striations, the flecked



8 Ceramic insulator for an electric power line

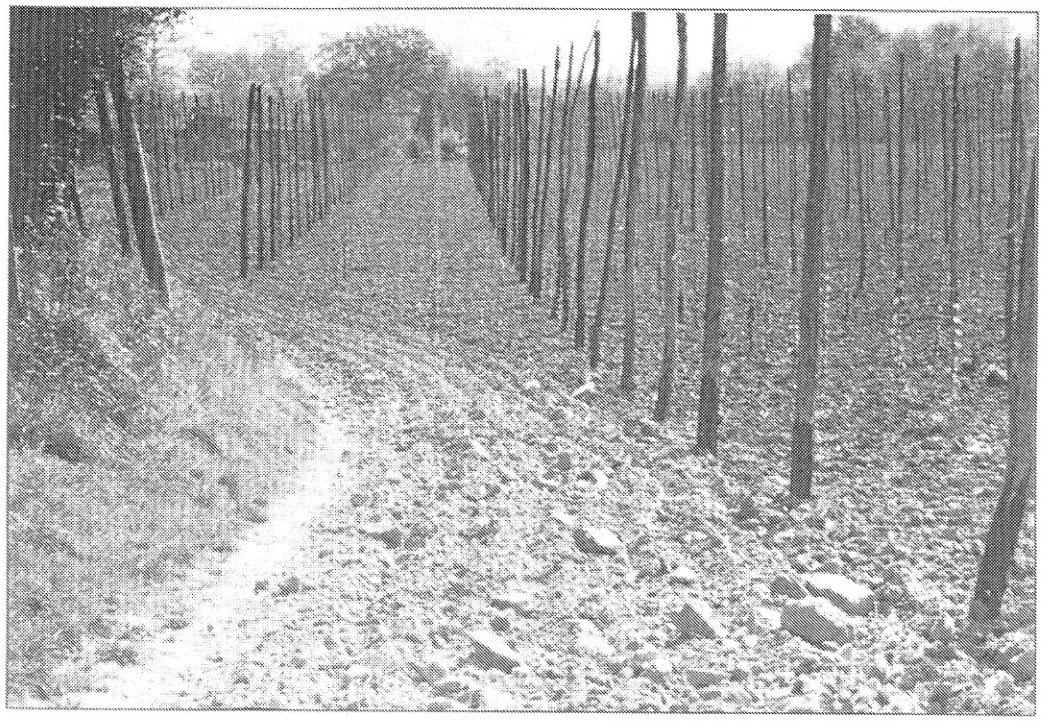
surface, the potter's hand-print and the asymmetry of the handle each build it up a stage farther and leave us with a vivid impression of life and decision.

The crock lid will serve to emphasize that in very few techniques is the workmanship of risk found in a pure state. The potter's wheel is an exact shape-determining system: a mechanical affair. However badly a pot is thrown it will pass through a stage of being very nearly circular in plan. But throwing pots on a wheel is the workmanship of risk none the less for that, as anybody can convincingly demonstrate.



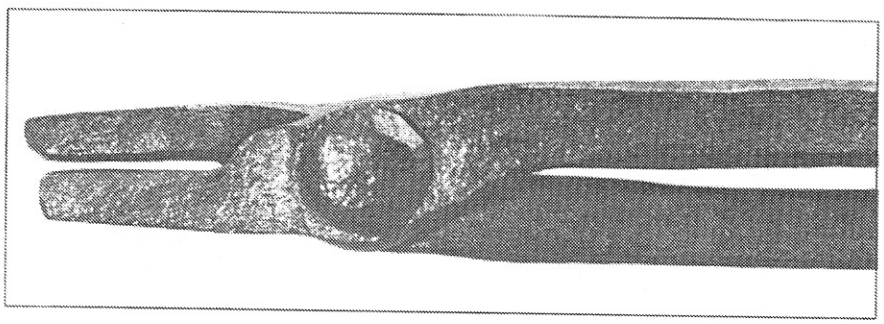
9a Cringle of a sail

Trades using similar techniques but making different things often work to different standards of regulation. It is interesting to compare the sail-maker's work shown here with the sewing of a suit of clothes. The two holes to the right of the cringle are not essentially different from button-holes. They are neat and workmanlike according to the accepted standards of heavy sailmaking, and are, moreover, a good deal neater than they need be for the sake of strength and durability. But they are not what one expects to get from a West End tailor. The standard of workmanship in weaving and tailoring is reflected in the price of it. This sail had to be cheaper and therefore rougher; but rougher does not imply worse. Sailmaking has a beauty of its own.

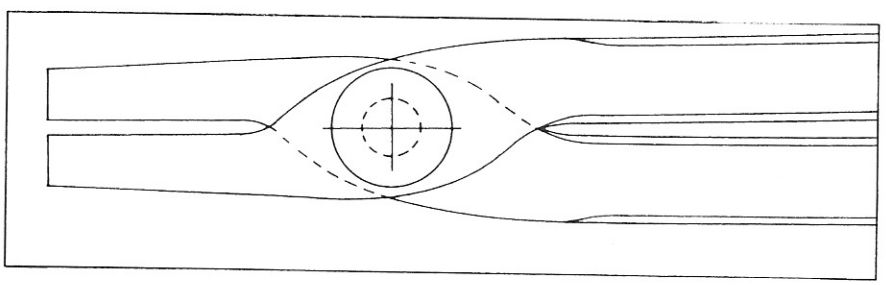


9b Hop-garden early in the season

A hop-garden is one of the many admirable pieces of workmanship which agriculture and forestry produce and which contribute much of its quality to the countryside we know. It is predominantly free workmanship but there has always been traditionally an insistence on regulation as well, in plowing a field, for example, or in aligning these hop-poles.



10a A pair of small blacksmith's tongs. Enlarged



10b A putative working drawing for the tongs

The tongs were forged in the usual way, by eye, without any drawing and indeed without taking any measurements. Except for shaping the rivet the only tools used were an anvil, hammer, punch, and hot-chisel: almost a case of the workmanship of risk in a pure form, though an anvil and hammer constitute a shape-determining system to some extent. The workmanship is pretty rough, while the drawing shows the ideal form to which it approximates.

It is the ideal form, and not necessarily the design, which the drawing shows. No smith in his right mind would have a design like that drawing in his mind's eye while forging a pair of tongs. If required, of course, he could make something very close to it, but any designer who required him to would be wasting money.

(Text continued from page 37)

Definitions and terminology are crucially important. A large part of the fruitfulness of scientific thought has come from one simple fact. It is that hitherto every scientific term has had an exact definition, verbal or mathematical, universally accepted. As a result communication in scientific terms between scientists has till recently been almost completely effective. Yet, on questions of art, communication is seldom so much as half effective. There is an immense amount of noise and little else. Definitions are the only possible basis for communication and we must have them. If they cannot yet be made final we must have provisional ones.

> ... Tzu-lu said, If the prince of Wei were waiting for you to come and administer his country for him, what would be your first measure? The Master [i.e. Confucius] said, It would certainly be to correct language. Tzu-lu said, Can I have heard you aright? Surely what you say has nothing to do with the matter. Why should language be corrected? The Master said, Yu! How boorish you are! A gentleman, when things he does not understand are mentioned, should maintain an attitude of reserve. If language is incorrect, then what is said does not concord with what was meant; and if what is said does not concord with what was meant, what is to be done cannot be effected...[8]

In the present context the important point when defining *design* is to distinguish between it and workmanship, and for this present purpose we may define design as whatever can be conveyed to the workman by drawings and by specification in words or numbers. For a fuller definition of design the reader is referred to *The Nature of Design*. In that book design is differentiated from invention and the essential nature of the activity of designing is examined.

The *designer,* as the term is used in the present context, means a person or group of people who decide the contents of the drawings and specification: that is to say, decide what information they are to convey. (The designer may of course also be the maker.)

The *intended design* of any particular thing is what the designer has seen in his mind's eye: the ideally perfect and therefore unattainable embodiment of his intention. The design which can be communicated—the design on paper, in other words—obviously falls far short of expressing the designer's full intention, just as in music the score is a necessarily imperfect indication

[8] *Analects of Confucius*, Book xiii, 3 (translated by Arthur Waley, 1938).

of what the composer has imaginatively heard. The designer gives to the workman the design on paper, and the workman has to interpret it. If he is good he may well produce something very near the designer's intention. If the workman is himself the designer he almost certainly will (but that does not imply that the designs a workman intends are necessarily good ones).

Now it is by reference to the intended design that we judge the quality of workmanship, and we have to infer the intention from what the workman has done. Moreover, the intended design will have been conceived in terms of the kind of workmanship, that is to say, the degree of regulation, which is economically suited to the product. Thus it is not possible to judge the quality of workmanship unless we have prior knowledge of that, and unless also we are in a position to judge what the designer might reasonably have been expected to intend. In times when there are established traditions in all branches of design and workmanship any moderately cultivated man will fulfill these requirements and will be a good judge of workmanship; but when, as now, traditions of design and workmanship are in flux, rapidly changing in many fields, more discrimination is needed.

The intended design of a thing and the *ideal form* of it may be, but are not necessarily, two quite different things. The ideal form is the most highly regulated form, and more highly regulated still than that. It is conceivable but not attainable: the perfect cylinder, the perfect rectangular prism, the perfect sphere. But the intended design so far from being concerned with these perfections may perfectly well be concerned with rough-hewn billets or cleft oak rails (plate 6). On the other hand the modern engineer's intended design, and the architect's, very often are conceived in terms of ideal forms: flat planes, straight edges, perfect cylinders, arcs of circles. This can happen because these are the forms which can be communicated with least trouble. Fully to describe the form of the billet in plate 6 would take any draftsman a matter of weeks.

Since the quality of workmanship is judged by reference to the intended design, it follows, as everybody knows, that what is good workmanship in one context is bad in another. The workmanship is good in plate 1 and also in plate 4, but if parts of the cabinet were finished like the carving it would be a sorry affair indeed.

It is possible in the same piece of work to put high regulation and quite free workmanship side by side, but unless the two are evidently dissociated (plate 25) very nice judgment is needed. Usually the highly regulated parts make the free parts look careless.

Technique is the knowledge of how to make devices and other things out of raw materials. Technique is the knowledge which informs the activity of workmanship. It is what can be written about the methods of workmanship.

Technology is the scientific study and extension of technique. In ordinary usage the word is slapped about anyhow and used to cover not only this, but invention, design and workmanship as well.

Workmanship is the application of technique to making, by the exercise of care, judgment, and dexterity. As opposed to design, workmanship is what for practical purposes the designer cannot give effective instructions about by drawings or words, although he can envisage it perfectly well. The designer is apt to imagine he has more control over workmanship than he has. Standards of workmanship become established in each kind of manufacture. The designer gets used to them, expects them, asks for them, and comes finally to believe he is getting them because he asks for them. Then he comes up against a firm who do not know their work and finds he is helpless. All he can do is to say 'do it again'. When the work is bad the second time, his resources are at an end. You cannot compel or command good workmanship by the terms of a contract.

Suppose that the designer can feel entirely confident that any of twenty or thirty firms working to the same drawings will turn out a nearly identical job, that is no evidence at all that the same drawings have actually enforced the same quality in each case. It simply means the firms are using about the same technique and are working to the same standard, being competitors; no matter who sends the drawings or what is in them.

Good workmanship is that which carries out or improves on the design, whether the design was made by the workman or another.

Bad workmanship fails to do so and thwarts the designer's intention in respect either of soundness or of comeliness: or else it makes things look equivocal in the sense that the material used appears to have, simultane-

ously, properties such as hardness and softness, or characteristics such as roughness and smoothness, which are incompatible with each other. A kind of equivocality is also produced by putting together formal elements, features, which are incongruous, such as a polished surface with a raw or jagged edge (chapter 9).

Skill is a word not used in this book. It does not assist useful thought because it means something different in each different kind of work. To a smith, dexterity is important but rarely in the extreme; but his judgment of certain matters, particularly heat, has to be brought to a pitch and decisiveness rarely needed or matched in woodworking trades, in which, however, more dexterity is often needed. Moreover, much of what is ordinarily called skill is simply knowledge, part of 'what can be conveyed by words or drawings'.

There is an old saying that when you have learnt one trade you have learnt them all. There is truth in it. Beside the special forms of dexterity and judgment which belong to any one trade, something general is learnt which makes it easier to learn others, though still not easy. This may be merely the habit of taking care but it seems to be more.

At all events 'skill' is ordinarily used to refer to an uncertainly distributed group of disparate things. Like 'function' you can make it mean what you please. It is a thought-preventer.

In the *workmanship of certainty* the result of every operation during production has been predetermined and is outside the control of the operative once production starts.

In the *workmanship of risk* the result of every operation during production is determined by the workman as he works and its outcome depends wholly or largely on his care, judgment and dexterity.

There are nowadays two quite distinct purposes to which the workmanship of risk can be applied. One is *preparatory*, the other *productive*. Preparatory workmanship makes not the products of manufacture but the plant, tools, jigs, and other apparatus which make the workmanship of certainty possible. The workmanship of risk should, I suggest, be termed 'productive' when it is used actually to turn out a product for sale.

The workmanship of certainty is almost invariably regulated and the workmanship of risk often is also. *Regulated workmanship* means workmanship where the

achievement appears to correspond exactly with the idea; things meant to repeat appear to repeat exactly, things meant to be square look exactly square, and so on. If, on the other hand, they do not appear to repeat exactly or to be exactly square, then there is an evident disparity between idea and achievement, there is approximation, and we call the workmanship *free*, or, in cases where the disparity is very large, *rough*.

In the workmanship of risk, in all trades, the course of historical development has usually been to increase the workman's power to regulate, and the standard of regulation aimed at has tended to get higher. There are indeed many instances where the workmanship of risk achieves higher regulation than that of certainty: for instance in the production of an accurately flat surface on a machined casting, or in optical work.

The workman is the term I propose for a man, woman or group of people who interpret and execute a design by the workmanship of risk using judgment, care and dexterity. I propose to use it as a generic term, like 'the executive' or 'the judiciary'. The workman is thus the agency which provides the tools, jigs, prototypes and other material basis for mass-production. In most trades the workman will at one moment be working freehand while at the next he will be applying the workmanship of certainty, making use of jigs and machine tools; and the preparation and combination of a series even of completely jigged operations or machining operations always involves judgment and care if not invariably dexterity.

By an oddity of usage 'workmanlike' is a laudatory word and 'workmanship' is at least neutral, while the word 'workman' tends to be used as though it meant the same thing as 'laborer'. I have a respect for many laborers, but I do not intend that meaning. One can no longer use the word 'craftsman'. It is getting flyblown. Too many cranks and too many people trying to grab higher wages have called themselves by it. To call a man a good workman should imply the highest respect, just as it once did to call a man a good seaman, no matter whether he was a shipmaster or an A.B.

It was the workman of other days who made, by the workmanship of risk, the tools, jigs and prototypes which enabled the machine-tools of our day to be built and with which in turn the workman of our day is now making the material basis for automation. The tools, jigs

and machines on which the workmanship of certainty will always depend are simply the stored embodiment of the care, judgment and dexterity exercised by the workman at an earlier time. And if machine-tools are now able to breed other machine-tools it is only because the workman is their matchmaker, their midwife, their nurse, doctor, educator and much more.

In the Science Museum in London can be seen the first of all lead-screws, which Maudslay chased for the first screw-cutting lathe, and one of the first planers, whose bed Roberts chiseled and filed flat. How many generations of screws and plane surfaces can those two machines have bred?

'The workman' covers Stradivarius and it covers the monk who drew the Chi-Rho page in the *Book of Kells:* for the workman may or may not also be a designer.

In the workmanship of risk, decisions are very often made by the workman which could have been made by the designer, and the workman may himself be the designer. Consequently the term 'workmanship' is often used far more loosely than the definition I have proposed will allow. By that definition nothing is workmanship which a designer could alter by speaking or writing a word or two; and workmanship is the exercise of care plus judgment plus dexterity. These can be taught, but never simply by words. Example and practice are essential as well. It is no part of a designer's job to teach them, even though he may be able to.

By numerical control certain designs can be translated (not interpreted) and 'told' directly to a machine tool so that a prototype or tool can be made without any care, judgment or dexterity being exercised at this stage. Ultimately automation may dispense with the operative altogether; but hardly with the workman, who will presumably remain indispensable to it somewhere, even if numerical control advances to the point that a set of machines, given a suitable program, can design and make another without the workman intervening at all.

'The workman' is to stand for a group of people just as much as for one. A group of people executing a design are closely analogous to an orchestra and decidedly not to a team. A team has either a driver with a whip, or another team opposing it. In an orchestra each player (workman)—is interpreting—(working to)—the same score—(design)—and is called on to play the instrument—(apply the technique)—in which he is expert,

at the stage in the performance where it is needed.

The workman is essentially an interpreter. It is usual to suppose that sometimes, in Ruskin's words '... the thoughts of one man can be carried out by the labor of others' because the design is 'determinable by line and rule'. If the designer, so-called, has no interest in the appearance of the job, his thoughts will be so crude that this may even be true, in fairly simple cases. But, where, on the contrary, the designer is a responsible man, it can never be true. It is no more possible for an Act of Parliament to determine the law than it is for a 'design'—meaning an affair of drawings and instructions—to determine the appearance of a thing. There are judges to determine what the Act means after Parliament has done its best to make its intentions clear. It is for the workman to determine what the designer means after he had done his best. So it is for the conductor or pianist to determine what Bach means after he has done his best, by means of a score. The judge, the pianist, and the workman are interpreters. Interpreters are always necessary because instructions are always incomplete: one of the prime facts of human behavior.

No drawing, however fully and minutely dimensioned, can ever be more than a sketch as regards the appearance of the thing drawn. The eye and mind discriminate things which can never be specified or dimensioned: the qualities and colors of surfaces, the minute variations of profiles, and still other nuances of shape too tenuous and subtle to describe in practice.

John Dreyfus's book, *Italic Quartet,* is a remarkable account of an undertaking defeated by a very good workman's inability effectively to interpret a kind of design to which he had not been brought up. It shows that Edward Johnston, the great calligrapher, clearly understood—and his patron did not—that, workmanship being interpretation, the quality of a type in his time ultimately depended not on the designer but on the punch-cutter; for all the meticulous instructions that a designer might give him, and that Johnston in this case did give him, and which are illustrated in the book.

Although workmanship is interpretation, I do not suggest that anything a workman gives us can be as moving as what the performer of music does. No design lives in the same world as music, and the performance of music allows more subtle and deep expression than any workmanship can possibly attain to.

5. The designer's power to communicate his intentions

The definitions of design and workmanship proposed in the last chapter raise the question: how far is it possible for words, figures and drawings to prescribe the qualities of a work of art; so that if the designer's directions are faithfully obeyed the qualities automatically arrive? Is it really necessary that anything should be left to the workman's discretion?

On what properties of matter do the visual arts depend? From which objective, defined and measurable properties of things do we derive subjectively those indefinable qualities which are the stuff of visual art? Clearly there are very many physical properties, such as thermal conductivity, which do not concern us at all. Only size, shape, reflectance, color, and translucency are important here. Each one of these is measurable, shape as much as the rest; for any shape can be defined by coordinates of points on its surface as in a graph, and if the intervals between the coordinates are made very small the definition can, in principle, be made virtually complete. But coordinates, of course, will not always be necessary. The simple geometrical shapes characteristic of architecture and of mechanisms and other constructed things are so easy to define that even the familiar crude dimensioned diagrams which designers call drawings are sufficient.

Thus, in principle, it is possible for a designer to prescribe quantitatively all the properties by means of which any given object is judged to have the qualities of a work of art; and to give an absolutely complete description of it. In principle nothing whatever is beyond the reach of design. In principle it is possible to define all the properties of the crock-lid in plate 7 so completely that a manufacturer who had never seen it or even a photograph of it could produce fifty thousand perfectly indistinguishable replicas of it in plastic. And in principle, no doubt, the chemistry of claret from *this* vineyard in *that* year can be analyzed so completely that the wine can be perfectly reproduced in any desired quantity. In practice things are different.

There is nothing abstruse about practicability. These things are impracticable in design simply because no one would pay for the immense amount of exacting work which would be involved, first on the designer's part in making complete definitions, and then on the workman's in trying to comply with directions so volu-

minous as to slow his normal pace almost to a standstill. The cost of designing for quantity-production is high in any case, and so there is a strong incentive to design only in terms of shapes which are easy to communicate: either those of standardized components, or those geometrical shapes which are easily and automatically formed by the standard and readily available machine-tools on which so much of the workmanship of certainty depends.

This impoverishment is the price we pay at present for cheap quantity-production in which only this very simplified level of communication and execution is practicable, and in which as a rule the slight free modifications of shape and surface quality which mark the workmanship of risk are quite unattainable and indeed unthinkable, except in cases where the material is flexible or translucent (for the latter, see plate 30).

At this point the reader may find it convenient to refer to plates 22b-31b, which begin on page 101, and the commentary on them, which mainly deals with the difference between good and bad workmanship and the question of the designer's intention.

the rough work looks like an intrusion, mere evidence of carelessness, then the job is spoilt. Very often the apportioning of perfect and rough work is decided by the workman. If, as he interprets the design, he imports a combination which the designer did not ask for, he will have to do it with discrimination and understanding.

Before we can go much farther it will be necessary to improve on the terms 'perfect' and 'rough' which were provisionally adopted; for, as we know, 'perfect' workmanship only appears to be so and is approximate, while much workmanship in which some approximation can be detected by the naked eye is certainly not what one would ordinarily call rough.

Let us then say that, where the naked eye can detect no disparity between achievement and idea, the workmanship is 'regulated' or, in cases of extreme precision, 'highly regulated'. Where slight disparities can be detected let us say that it is 'moderately free'. Where there are evident (and usually intentional) disparities, as often seen in woodcarving and calligraphy, where precise repetition is on the whole avoided, let us say the work is 'free'. And, where we should ordinarily call the work rough, let us call it rough; remembering always that rough does not necessarily imply bad.

The term 'regulated' is apt, whether applied to the workmanship of risk or to that of certainty. On the other hand, the workmanship of certainty is all but incapable of free or rough work at present; but it must be remembered that, where construction is involved in the making of something, then although the components may be made by the workmanship of certainty, they will still nearly always have been assembled by the workmanship of risk. Regulated work is then possible, but, in quantity-production, bad is more probable, as in the case of the glass frame just cited.

Regulation is achieved in the workmanship of risk in three different ways, separate or combined. The first is dexterity: which means sheer adroitness in handling. The old-style shipwright with his adze can get a nearly true flat surface or a fair curve without any apparent guide, simply by coordination of hand and eye. Secondly, gradualness: the shipwright with his adze does not finish off the surface by removing handfuls of wood at each stroke, but in short light strokes taking off the wood in thin shavings. Lastly, shape-determining