BRITISH HISTORICAL ROOF-TYPES AND THEIR MEMBERS : A CLASSIFICATION

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THE classification concerns extant roofs of vernacular buildings built earlier than *c.* 1840. The types determined are illustrated by simple diagrams, based on actual examples. An incidental objective is to codify current usage of terms, and so provide a commonly understood language for the purpose of technical description or discussion. A glossary is appended, which serves also as an index to the type-diagrams. Wherever possible, established terms are employed, but neither the classification nor the glossary has etymological pretensions, and to give alternative terms for any particular arrangement or roof-member would lead to ambiguities it is expressly desired to avoid.

Thus a selection has been made in instances where there are different terms in current use for the same member or arrangement (e.g. MANSARD, gambrel, or curb roof), and in cases where it has become common practice to use a particular term indiscriminately for roof members performing their function in significantly different ways, older terms have been recovered and each made descriptive of a given function (e.g. PRINCIPAL-RAFTER and TRUSS-BLADE). Where terms for different features have become interchangeable, their presumed former precision has been re-established (e.g. KING-POST, CROWN-POST). Some terms in common use today have been avoided, as being liable to misinterpretation (e.g. "Principal", when signifying a ROOF-TRUSS). Occasionally, in the interests of systematization, terms have been given a strictness of meaning they may not previously have possessed (e.g. KING-POST, -STRUT, -STUD, -PENDANT, -BLOCK; QUEEN-POST, -STRUT, -STUD).

In the classification, account has been taken of certain important differences of carpentry practice between broad regions of England and Wales (fig. 1). On the one hand is the HIGHLAND ZONE, somewhat less extensive than that defined by Sir Cyril Fox,[2] here comprising almost the whole of Wales and a large part of northern England; in

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[2] Sir Cyril Fox. *Personality of Britain.* Map B.

general, the land is above the 500 ft. contour. On the other hand is the LOWLAND ZONE, very much more limited than that adopted by Sir Cyril, extending up the eastern side of England as far as the Humber, in which the land is mostly below the 250 ft. contour. Between the two is an INTERMEDIATE ZONE, of relatively diversified terrain; and with this is included the West Country, although geographically it has quite strong Highland characteristics.

The classification concerns only roofs, but the two carpentry systems referred to, here known respectively as the "BOX-FRAME" and the "CRUCK", are methods of constructing entire buildings, walls and roof (fig. 13). Each system has a remote origin, and gives rise to a whole family of roof types. Even the earliest and simplest surviving examples are already fairly mature.

It is now reasonably well established that the Cruck form of timber structure is almost if not completely absent from the Lowland Zone,[3] and that roof-types deriving from the Box-frame system of timber structure as originally evolved are rarely to be found in the Highland Zone (the Box-frame became ubiquitous as regards the body of the structure, but the traits of roof construction proper to the system remain distinctive). Yet the Cruck family of roof-types is not limited to the Highland Zone, nor the Box-frame family to the Lowland Zone. The two intermingle, are combined, or produce hybrids in the Intermediate Zone. Of the two, the Cruck family of types appears to be the more dominant in the Intermediate areas north of the Cotswolds (CB in fig. 1) and the Box-frame family to the south (BC in fig. 1).[4]

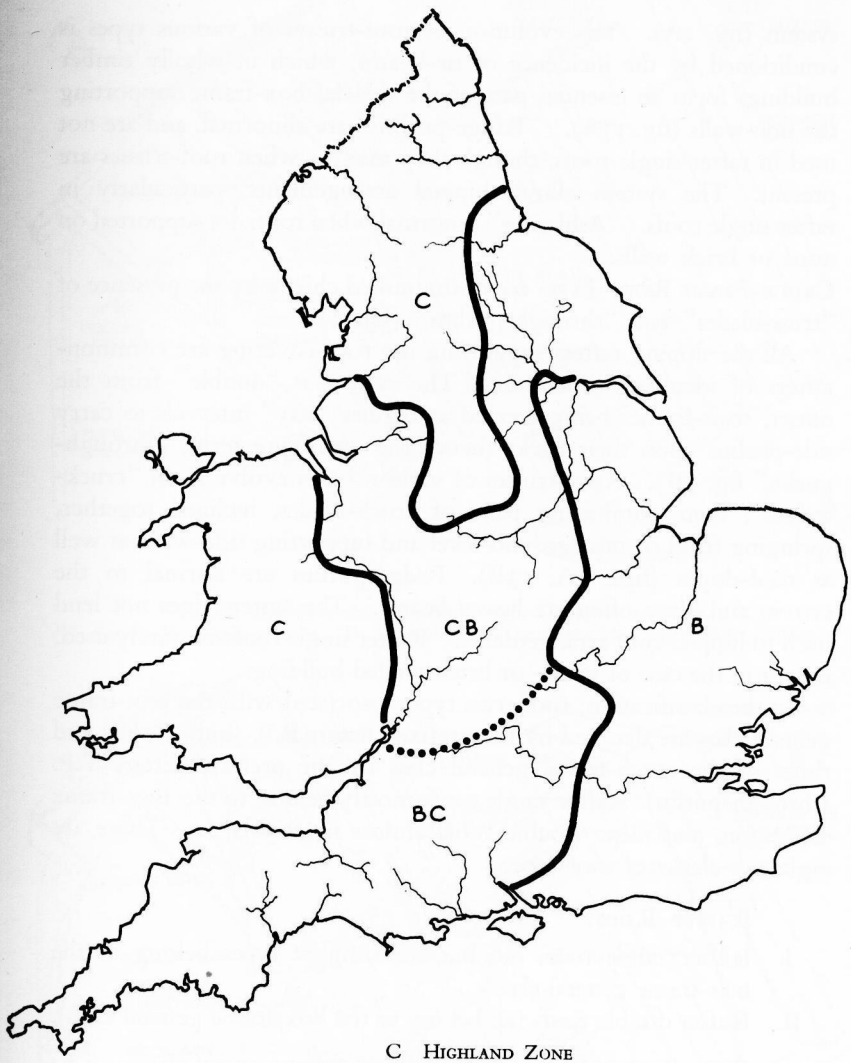
The following are the distinguishing traits of roofs associated with or deriving from the two systems:—

BOX-FRAME ROOF TYPES are evidenced chiefly by the presence of "principal-rafters", and "butt-purlins" and/or "collar-purlins" (fig. 2).

All the sloping rafters, whether "common" or "principal", reach the underside of the roof covering. "Side-purlins", if any, consequently have either to be received on the sides of the principal-rafters, made deep enough for the purpose (hence the qualifying term, "butt-purlin": fig. 2B), or held in position by "arch-braces", "collars", "angle-struts" or props from "tie-beams". Principal-rafters sometimes may diminish to common-rafter status part way up the roof-slope in order to provide a seating for side-purlins. Collar-purlins, supported on vertical "crown-posts", are characteristic, not found in the other

[3] J. T. Smith. *Medieval Roofs: A Classification.* Archaeological Journal, 1958, pp. 111–149; particularly Fig. 16.

[4] There may prove to be more than two main carpentry systems, and, no doubt, important sub-types eventually will be recognised.



C HIGHLAND ZONE
Cruck-frame homeland.

B LOWLAND ZONE
Box-frame homeland.

CB INTERMEDIATE ZONE
Admixed: Cruck-frame structure dominant.

BC INTERMEDIATE ZONE
Admixed: Box-frame structure dominant.

FIG. 1. Zones of differing Carpentry practice in vernacular construction in England and Wales

system (fig. 2A). The evolution of roof-trusses of various types is conditioned by the incidence of tie-beams, which in wholly timber buildings form an essential part of the skeletal box-frame supporting the side-walls (fig. 13A). "Ridge-purlins" are abnormal, and are not used in rafter single roofs, though they may be when roof-trusses are present. The system allows hipped arrangements, particularly in rafter single roofs. "Ashlaring" is normal when roofs are supported on stone or brick walls.

CRUCK-FRAME ROOF TYPES are distinguished chiefly by the presence of "truss-blades" and "through-purlins" (fig. 3).

All the sloping rafters supporting the roof-covering are common-rafters of identical dimensions. The system is "double" from the outset, truss-frames being erected at regular "bay" intervals to carry side-purlins upon their backs (hence the qualifying term, "through-purlin" fig. 3B). Roof-trusses of various types evolve from "cruck-trusses", these comprising pairs of cruck-blades, inclined together, springing from or near ground-level and supporting side-walls as well as roof-slopes (figs. 3A, 13B). Ridge-purlins are normal to the system and quite often are heavy beams. The system does not lend itself to hipped-roof arrangements. Rafter single roofs are rarely used, except in the case of stone- or brick-walled buildings.

In the classification, roof-truss types associated with the box-frame general class are denoted by the prefixed letters B.P. (butt-purlin) and those of the cruck-frame general class by the prefixed letters T.P. (through-purlin). Rafter single roofs mostly belong to the Box-frame succession, and rafter double roofs almost invariably so. There are eight sub-classes of roof-type.

RAFTER ROOFS

I. Rafter single roofs (all but the simplest types belong to the box-frame general class).
II. Rafter double roofs (all belong to the box-frame general class).

BUTT-PURLIN (B.P.) TRUSSES (box-frame general class).

III. Open trusses.
IV. Hammer-beam trusses.
V. Tie-beam trusses.

THROUGH-PURLIN (T.P.) TRUSSES (cruck-frame general class).

VI. Open trusses.
VII. Hammer-beam trusses.
VIII. Tie-beam trusses.

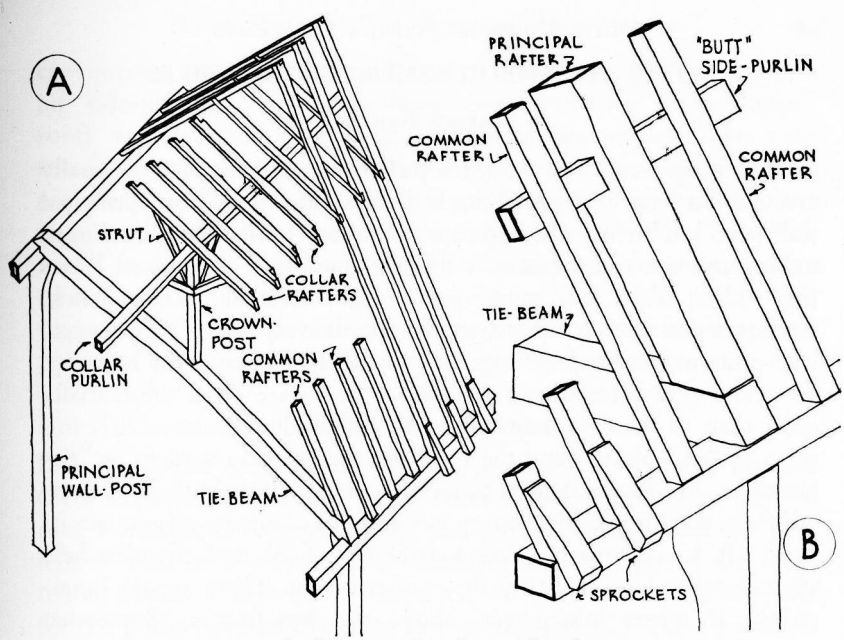


FIG. 2. Roofs of the 'Box-frame' type of timber structure.
A: Crown-Post Rafter Roof. B: Typical Roof-Truss details, showing 'Butt-Purlins'.

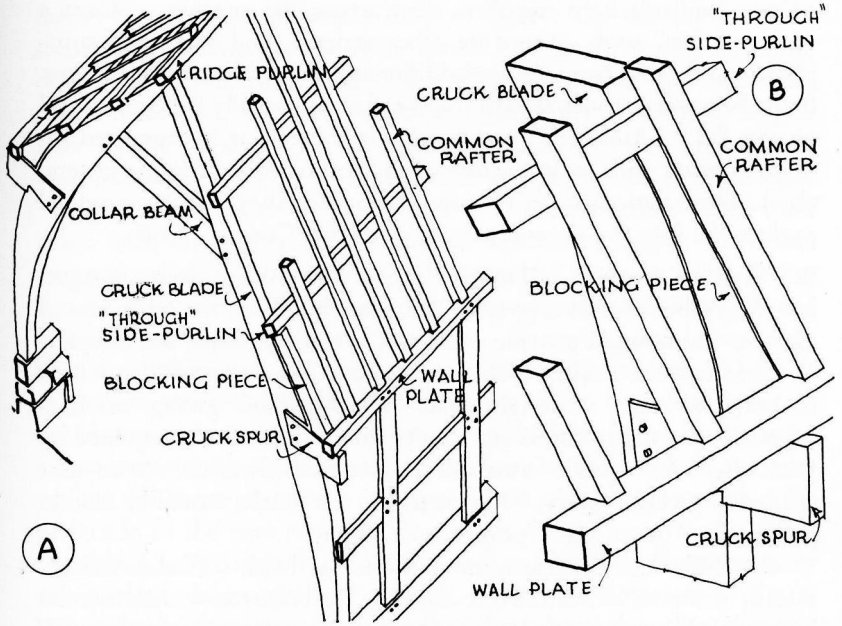


FIG. 3. Roofs of the 'Cruck-Frame' type of structure.
A. 'Open' Cruck Truss. B: Typical Roof Truss details, showing 'Through-purlins'.

NOTES ON THE CLASSIFICATION TABLES

Rafter Roofs

I. *Rafter single roofs.* In the developed box-frame system, as originally evolved, the length of a building is divided into "bays" by "principal wall-posts", of which the tops are connected horizontally by longitudinal and transverse beams, outlining a series of juxtaposed boxes (fig. 13A). If the roof covering is of light material, such as thatch, the bays might be 16 ft. square, on plan; if relatively heavy, the principal wall-posts would be closer together on the long sides of the building, the width (span) remaining the same. Spans are often substantially more than 16 ft; sometimes less. The longitudinal horizontal beams serve as "wall-plates", and the transverse horizontal members as "tie-beams". Above this skeletal frame is a pitched (double-sloping) roof, which in the simplest case comprises pairs of common-rafters, spaced from 1 ft. to 2 ft. apart, meeting at the top of the roof, the pairs held apart and in place solely by the roof-covering. There are no longitudinal members whatsoever, above the box-frames. Somewhat more elaborate are roofs in which the pairs of common rafters are each secured about midway up their slopes by a horizontal "collar-rafter", or two similarly light members slant across one another to form a "scissor rafter" roof. There are other varieties, and degrees of complication resulting from the use additionally of angle-struts and braces. In the better-class roofs, the common-rafters are usually heavy, and laid on the flat. "Ashlaring" is normal when the roof is supported on stone or brick walls (as in the case of all roofs of the box-frame general class). These various types of rafter roof, since they lack longitudinal purlins, fall into the general category of rafter "single" roofs.

II. *Rafter double roofs.* "Double" roofs, with purlins, were stronger, but the purlins needed support. In timber buildings the tie-beams of the box-frame could provide a seating for vertical props, and a typical arrangement was that in which a "crown-post" rose centrally from each tie-beam to carry a longitudinal "collar-purlin" giving nominal support to the collar-rafters and thus to the pairs of rafters conjoined by them (fig. 2A). Angle-struts splayed outwards from the crown-post assisted in giving rigidity. Alternatively, side-purlins could be held in position by "queen-post" props (fig. 5, IIg,h).

But difficulties became acute in stone- or brick-walled buildings, which, of course, lacked the box-frame. Tie-beams nevertheless could be provided, but now as part of the roof-structure, tying opposite walls or wall-plates together and at the same time affording a seating to

crown-posts carrying collar-purlins or to other kinds of prop supporting side-purlins. Yet the tie-beams were intrusive where "open" roofs were desired over large, individual apartments. The only means of supporting purlins then was by trapping or clasping them in position by arch-braces or angle-struts, or by placing side-purlins in the acute angles above the collars of the rafter-pairs of a rafter "double" roof. In the arch-braced and angle-braced types, as in instances where tie-beams were employed, the means of support of the purlins was concentrated at bay intervals, the rafter-pairs being made larger at those points and thus becoming embryonic "principal rafters".

Butt-Purlin Trusses

III. *Butt-purlin open trusses.* Trusses inevitably developed, but still there remained a confusion of function between the trusses and the roof envelope as represented by the common-rafters and the protective weather-covering. The chief sloping members of the roof-trusses almost always do double duty, on the one hand as supports for the purlins and on the other as common-rafters. These members are therefore aptly termed "principal rafters", being rafters of stouter dimensions than the generality of common-rafters. The principal rafters have to be sufficiently deep to receive the side-purlins, held somewhat precariously on their flanks by tenons, partial housings, dowels, or similar method (fig. 2B). Sometimes the principal-rafters revert to common-rafter status in the upper part of their length, after having given support to side-purlins, or they are formed into loops, locally, in order to allow the side-purlins to pass through.

Open roofs allow the alliance of the lower portion of the roof space with the general volume of the apartment below: tie-beams constitute a visual obstruction. The principal types resemble Rafter Roof varieties, except that complete trusses occur at bay intervals and are made stout enough to carry purlins. Sweeping arch-braces often tie the members together and assist in distributing the load and thrust of the roof across the top of solid supporting walls. In some important domestic and barn roofs, often of unusually large span, heavy arch-braces may do the work of supporting some or the whole of the side-purlins, but even so, strong principal rafters, their backs reaching the underside of the roof-covering, form part of each truss (fig. 9, IIIh). In other cases the truss-frame is truncated, at a height sufficient to carry side-purlins, above which is a Single or Double Rafter roof (fig. 9, IIIi). Again, there may be two frames, one above the other, dividing the bays. This class of roof-truss frequently embodies "base-crucks",

i.e. pairs of crucks of which the upper parts seem to be cut off at collar-beam line (fig. 9, IIIj-m). The term is recent and suggests that base-crucks belong to the other chief carpentry system, but at least in some instances they are in fact "cranked" principal wall-posts (i.e. bent at an angle), having nothing to do with the cruck tradition (fig. 9, IIIk, right). In other cases they represent hybrids, mixtures of the principles of the two systems, though the facts that often the main side-purlins are of the "butt" variety, trapped between the twin halves of a collar-beam (fig. 9, IIIk, l), and that the upper, supported, frame is either a rafter roof, single or double (fig. 9, IIIk), or of the principal-rafter kind (fig. 9, IIIl), maybe with subsidiary purlins, seems clearly to place most base-cruck trusses in the box-frame carpentry class.

IV. *Butt-purlin hammer-beam trusses.* In effect, these are tie-beam trusses with the central part of the tie-beam omitted. There are through-purlin versions (see Section VII), but in origin and development they belong to the box-frame carpentry class. The sloping principal-rafters are strengthened by triangles of timber members, framed on to the undersides, whilst at the bottom also being braced against the supporting stone, brick or timber walls. There are versions without collars, but usually there is one, sometimes two, and there may be either one or two stages of hammer-beams. When a hammer-post is lacking, in either the one- or the two-stage version, its place being filled by an arch-brace alone, the term "false" is applied. One type (fig. 10, IVe) approaches very closely to the true "queen-post" truss in design, falling short only in the facts that the central part of the tie-beam is omitted, as in the class as a whole, and the side-purlins abut the truss instead of being carried upon it as in true version.

V. *Butt-purlin tie-beam trusses.* Most are quite straightforward pairs of principal-rafters seated on a tie-beam. The variations lie mostly in the nature and arrangement of the infilling members. A central vertical member standing on the tie-beam may be either a "king-post", passing between the principal-rafters at the top, or a "king-strut", stopping against the undersides of the principal-rafters at the top. One type of tie-beam truss resembles the true "queen-post" (fig. 11, Vg), but the subsidiary members do no more than brace the principal rafters: they do not constitute, with the tie-beam, an independent frame.

Through-Purlin Trusses.

VI. *Through-purlin open trusses.* In the developed cruck-frame system, the length of a building is divided into bays by cruck-trusses.

These comprise pairs of straight or curved cruck-blades arched together and secured by ancillary members, rising from the ground or near the ground. Their function is to support side-purlins and a ridge-purlin upon their backs as well as to hold timber side-walls erect (fig. 13B). Thus the constructional system is double from the outset, and the roof is intimately associated with the wall. The longitudinal beams—ridge-purlin, side-purlins and wall-plates—are "through" members (fig. 3) which run uninterruptedly from end to end of the building, insofar as the lengths of available timber allow: joints can be "scarfed" together. They carry pairs of common-rafters and the roof-covering, which together form an outer envelope which is quite distinct from the supporting cruck-trusses. The cruck-trusses evolve into roof-trusses, supported on principal wall-posts, or, more often, on solid stone or brick walls; but the clearness of distinction between the truss and the roof-envelope is invariably preserved. The purlins are through purlins ; they separate the common rafters from the main sloping members of the roof-trusses, and as these sloping members are in no sense rafters themselves, they cannot legitimately be called principal rafters and are better described as blades.

"Open" cruck-trusses are those from which a tie-beam is omitted, its place often taken by a pair of "cruck-spurs" (fig. 3), projecting beyond the outer edges of the blades to support or to anchor wall-plates (fig. 14, VIa). Collar-beams link the truss-blades at a higher-level. Open cruck-trusses very often are arch-braced, under the collar-beam. Cruck-trusses may be raised high upon stone or brick walls, or start from an upper floor. In one variety of cruck-truss, the blades are each made up of two members, forming an obtuse angle with one another (fig. 14, VIi). The longer member forms the upper part of the blade and the shorter, a curved member, forms the lower, the two joined by a scarfed and pegged joint. This type too may be raised, or occur on an upper floor.

Particularly in barns, where the span is often large, impure types may be found. A small edition of a cruck-truss may stand upon a truncated, arch-braced, lower frame, major side-purlins being accommodated at the line of junction of the two frames, and lesser purlins on the backs of each (fig. 15, VIg). Another type is much more nearly a hybrid of the two carpentry systems: a base-cruck carries a pair of purlins on the truncating collar-beam and maybe another pair or other pairs on its outer flanks; above the main collar-beam is a pair of short principal rafters (*not* truss-blades), themselves diminishing to common-rafter status above a topmost pair of purlins and a secondary

collar-beam (fig. 15, VIh, left). The type could almost equally well be classified with the butt-purlin group. Among roof-trusses, as distinct from cruck-trusses in this sub-class, arch-braced collar-trusses form a particuarly important group, the arch-braces often being "deep", i.e. starting from well below the wall-top line (fig. 16, VIo).

VII. *Through-purlin hammer-beam trusses.* This is not a particularly extensive class, and may well echo the equivalents in the butt-purlin group, which, except in having the purlins supported on the truss-blades, they closely resemble (fig. 17).

VIII. *Through-purlin tie-beam trusses.* A series of cruck-truss types (fig. 19) has its counterparts in the open-truss tie-beam sub-class (VI). Striding horizontally across pairs of crucks, a tie-beam extends beyond the line of the crucks to support wall-plates which in turn stiffen timber side-walls, when such are present. There are "raised" and "upper" versions, and a type which, apparently, came to be used for a two-floored scheme, the tie-beam occurring at the first floor level, while cruck-spurs stiffen the upper side-walls (fig. 19, VIIId).

Tie-beam roof-trusses (figs. 20, 21), as distinct from cruck-trusses, form a very important group, with a whole variety of differentiated infillings within the triangle formed by truss-blades and tie-beams. If there is a central vertical member, more often than not it is a king-post rather than a king-strut, particularly in low-pitched roofs, and may extend above the junction of the truss-blades to carry a ridge-purlin. To this sub-class belongs the true Queen-post roof truss (fig. 21, VIIIk), in which the frame, completely independent of the common rafters, carries side-purlins *above* the queen posts. It is, however, a comparatively modern type, and its antecedents may well prove to belong to the box-frame carpentry system.

The Diagram Tables.

The type-diagrams within the general classes I-VIII are lettered alphabetically. Most of the diagrams illustrate common types: a few represent comparatively rare but particularly significant examples. Certain varieties of timber roof are so very common that they have been more searchingly subdivided than others, producing a larger number of types. The existence of unique, aberrant or crude examples has been ignored.

In the Rafter Roof diagrams, common rafters are shown in single line: elsewhere they are shown in single or dotted line or omitted altogether; whichever has seemed best for clarity. Some of the

diagrams show alternative arrangements permissible within the type, on either side of the centre line of the diagram.

All the types accompanied by diagrams represent known arrangements. Underneath each type-heading there are numbered notes, naming features which legitimately may accompany the type. Certain of the permissible differences or variations within each type arise from the circumstance that roofs may be carried either on timber supports or upon broad-topped walls. The notes often are expanded into categories listing alternative details which may occur in some particular part of the roof or truss, or in the structural infilling to a truss frame. In some cases, not all of these alternatives are definitely known to exist in connection with the type under definition, but the circumstances are such as to make it possible that each will eventually be discovered. In this minor sense the classification is anticipatory. Though ordinarily it may not be necessary to proceed beyond the type-headings, the notes should allow quite full descriptions to be given on occasion.