

## 5.06 *The Stud Frame*

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### *a. traditional and stud framing*

The evolution of the Australian stud frame has been the matter of considerable debate, and it is one of those rare questions for which it really is profitable to go back to definitions before pursuing the argument.

'Stud', meaning a vertical post, has been a building term since at least the ninth century. In traditional British construction, as in the box frame, the *studs* or *quarters* are relatively lightweight vertical members placed within the panels of the much heavier structural frame. Their function is only to carry the lining and cladding. A *stud frame*, by contrast, is one in which the heavy framing is omitted and the studs themselves become the structure. Compared with a traditional frame, the stud frame will have predominantly vertical members, much lighter in weight, and fairly uniform in size and spacing. In structural terms the implication tends to be that individual members do not perform specific functions, such as taking compression or bending, but rather that the whole wall acts like a diaphragm, or like the side of a birdcage. Openings may be cut through it at any point with no structural problem, providing that they are properly trimmed.

The stud frame will still require diagonal bracing, but the nature of this bracing is itself a useful indicator. In an English box frame the diagonals are major members - components of a complete frame which approaches the character of a truss. Loudon, for example, illustrates a partition in which the 'common quarters' [studs] measure 4 x 2 inches [100 x 50 mm] while the diagonal braces are larger, 4 x 3 inches [100 x 75 mm]. Moreover the brace is illustrated as cutting through the common studs, though not through the 'principal quarters' or large studs (however it may even be halved into these - one cannot tell).<sup>1</sup> Thus in general studs are placed only *within* the frame, and therefore they stop above and below the diagonals. This remained British practice, at

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<sup>1</sup> J C Loudon, *An Encyclopædia of Cottage, Farm, and Villa Architecture and Furniture* (London 1846 [1833]), p 39 §83.

least in interior partitions, until well into the twentieth century.<sup>2</sup> In Australia trussed partitions continued to appear in textbooks until about 1950,<sup>3</sup> though they were probably not longer being built, and such techniques has been entirely abandoned in external walls. United States practice prior to the nineteenth century as also much the same as British, as been shown by P E Buchanan in relation to the houses of Tidewater Virginia.<sup>4</sup>

In a stud frame, by contrast, the studs are the essential element, and are continuous for the full height, while the brace is a much smaller member which is let into the faces of the studs. In fact, if the frame is braced in both directions, a pair of diagonal steel straps can be used without any checking out of the studs at all. In North America the frame may be sheathed in diagonal boarding, plywood or hardboard, and this alone will be enough to brace it. In England itself a form of stud frame seems to have been used by the mid-twentieth century, as it was said that the normal method of construction for small timber buildings was to use four by two inch [100 x 50 mm] vertical studs with occasional diagonal braces. This, however, was not regarded as suitable for dwellings.<sup>5</sup>

The situation is confused because the modern Australian stud frame differs from traditional English framing, not just in the role of the stud but in other ways as well, and though these differences are less fundamental in terms of the definition, they are not necessarily less important. These are to do with the nature of the jointing and fixing, which is simpler and cruder. In traditional framing the members are hand worked for their positions, and the joints range from the simple mortice and tenon to much more complicated forms. In the Australian frame the studs were originally all mortised and tenoned to the top and bottom plates, but in modern practice the plate is at best only checked out to receive the end of the stud. There are no complicated joints elsewhere, though the plates may be halved together at the corners, and other members may be rebated for various reasons. The other difference is that more elaborate traditional fixings, like dowels and trenails, or expensive wrought nails, are replaced with cheap machine-made wire nails, often driven in on the skew to secure a butt joint.

### *b. the balloon frame*

The problem is that these characteristics, the lightweight, uniformly sized, uniformly spaced members, and well as the simpler joints, are all shared with what the Americans call the 'balloon frame', and this inevitably gives rise to the question of whether the Australian stud frame was derived from America. This can only be considered when one appreciates the fundamental difference between the two. In

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<sup>2</sup> R V Boughton, *The New Carpenter and Joiner* (3 vols, London, no date (?c 1935-40)), I, pp 188-9; W R Jaggard & F E Drury, *Architectural Building Construction* (3 vols, Cambridge 1945-6-7), I, p 170.

<sup>3</sup> F C Bloomfield, *The Australian Carpenter and Joiner* (3 vols, London, no date (?c 1935-40)), I, pp 188-9; W R Jaggard & F E Drury, *Architectural Building Construction* (3 vols, Melbourne, no date [?c1950]), II, pp 660-1

<sup>4</sup> P E Buchanan, 'The Eighteenth-Century Frame Houses of Tidewater Virginia', in C E Peterson [ed], *Building Early America* (Radnor [Pennsylvania] 1976), pp 64-5.

<sup>5</sup> S G B Stubbs [ed], *The Building Encyclopedia* (4 vols, London, no date [c 1955]), IV, p 1409.

traditional British, and even American carpentry, the joists are at the same level as the sill or sleeper, often of the same depth, and they are tenoned into its flank.<sup>6</sup> The studs or vertical members rise from this same sill. In no form of modern construction does the sill function in this way. In the balloon frame both the studs and the joists are *on top of* the bottom plate (which takes the place of the earlier sleeper). In the platform frame the floor is built first, like a platform, and the walls are built on top of that. If the building is two storeyed - which is rare for timber construction in Australia - the first floor level will become another platform, and the upper walls will be built upon that.

In the United States the platform frame is also used in some areas, such as California (though C D Elliott sees this as being a chronological rather than a geographical distinction, with the western or platform frame superseding the balloon frame in the twentieth century<sup>7</sup>). More commonly the walls are built first, and the floors are inserted between them, which means that the ground floor joists *run into the wall between the studs, and above the plate, rather than below it*. This may seem a trivial difference, but there are further implications at the first floor level. The studs do not stop, but run so far as practicable for the full height of the building. A stringer beam or bearer - commonly known in America as a *ribbon* - is fixed onto and partly let into the inner face to carry the upper floor. It is this continuity of the studs forming the outer envelope that characterises the balloon frame. It is a more radical departure from the traditional English box frame, but it is one that first took place in England itself in the seventeenth century (though at that time the traditional joints and fixings of course still prevailed).

This change in English practice was largely due to the prohibition in London of jettied-out upper floors in 1656<sup>8</sup> (though most writers wrongly attribute this to Cromwell's Act ten years later), after which, according to Trudy West, not only the main posts but also the studs ran full height to the eaves.<sup>9</sup> She implies that 'balloon frame' is a contemporary description of this characteristic,<sup>10</sup> which is difficult to substantiate, for the term is certainly not in general use until much later. She illustrates a 1½ storey sixteenth century house in Worcestershire where the studs do just this, though it is true that they are large and widely spaced by stud standards.<sup>11</sup> There is some indication that the change to full height studs was also due to the replacement in the market of English oak with longer lengths of sawn Baltic timber. The Baltic connection is especially relevant because the balloon frame - in the sense of one in which the studs are continuous through two or more floors - is standard practice in Scandinavia as well as North America.<sup>12</sup> However, West sees the change from oak framing to softwood as occurring much later, in the Regency period. At this time the studs begin to be placed much closer together, in order to conveniently

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<sup>6</sup> Buchanan, 'Tidewater Virginia', p 60.

<sup>7</sup> C D Elliott, *Technics and Architecture* (Cambridge [Massachusetts] 1992), p 18.

<sup>8</sup> *An Act for the Preventing of the Multiplicity of Buildings in and about the Suburbs of London, &c*, 17 September 1656 (London 1657), p 14.

<sup>9</sup> Trudy West, *The Timber-Frame House in England* (Newton Abbot [Devon] 1971), p 58.

<sup>10</sup> West, *Timber-Frame House*, p 79.

<sup>11</sup> West, *Timber-Frame House*, p 89.

<sup>12</sup> Stubbs, *Building Encyclopedia*, I, p 195.

carry the external boarding and the internal lathing, and there is no infilling between them. Also joints become simpler, and are halved, lapped and nailed.<sup>13</sup>

We have reached a point where it is possible to say that a stud frame - one of lightweight uniformly sized and spaced members with simple jointing - may or may not be a balloon frame. A balloon frame, in which members run through more than one storey, may or may not be a stud frame. In the United States the two aspects come together for the first time, and they remain so closely linked that some authorities go so far as to interchange the definitions, and identify a balloon frame as one made of machine sawn scantling of standardised dimensions, with butt joints using machine-made nails - all regardless of whether or not the studs run through more than one floor.<sup>14</sup> This is as repugnant to standard usage as it is to common sense, but it occurs as early as 1885,<sup>15</sup> and has become common in recent years.

Woodward stated that 'The balloon frame belongs to no one person, nobody claims it as an invention, and yet, in the art of construction it is one of the most sensible improvements that has ever been made.'<sup>16</sup> Subsequently, however, J M Van Osdel claimed that George W Snow introduced the frame in Chicago in 1833, and this claim was later promulgated by Siegfried Giedion.<sup>17</sup> Later still, Walker Field has attempted to attribute the structure to A D Taylor in preference to Snow.<sup>18</sup> These attributions to Snow and Taylor are both vague, and have been challenged. Other claims include that of Nathaniel Carpenter Ransom, who said that he built the first balloon frame in Wisconsin in 1852, but he wrote thirty years later and what he meant by the balloon frame is not certain.<sup>19</sup> William Bell published his *Carpentry Made Easy* in 1858, for the first time unequivocally illustrating the balloon frame, and is claimed to have built them for the preceding fifteen years. The safest position, as I will further argue below, is that of Woodward. Even the role of the balloon frame in the construction of Chicago is challenged by Gordon Jelley, who believes that it became common in that city only after the fire of 1871.<sup>20</sup>

Etymology, which is sometimes a help in these matters, only adds to the confusion. Cavanagh has convincingly shown that the *term* 'balloon frame' has earlier origins, possibly in one or more French expressions. One reference from Missouri of 1804 is to a *maison en Boullin*, which Cavanagh translates as 'a balloon house', though it seems to refer to a form of construction entirely different from the later balloon frame. Cavanagh cites a number of possibly relevant terms in Mississippi French (though few of them would comfortably follow 'en'), and cites the Quebec term *piece-*

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<sup>13</sup> West, *Timber-Frame House*, p 91.

<sup>14</sup> Professor Paul Sprague, letter of 22 July 1994.

<sup>15</sup> Jonathan Periam [ed R W E MacIvor], *The Pictorial Home and Farm Manual* (Sydney 1885), p 439.

<sup>16</sup> Periam, *Pictorial Home and Farm Manual*, p 438.

<sup>17</sup> Siegfried Giedion, *Space, Time and Architecture* (Cambridge [Massachusetts] 1963), p 351. The ultimate source of this is apparently J M Van Osdel, 'Recollections of John M. Van Osdel', *Inland Architect*, 1883, cited in F A Randall, *History of the Development of Building Construction in Chicago* (Urbana [Illinois] 1949), p 23.

<sup>18</sup> Walker Field, 'A Re-examination into the Invention of the Balloon Frame', *Journal of the Society of Architectural Historians*, II, 4 (October 1942), pp 3-29

<sup>19</sup> <http://freepages.genealogy.rootsweb.com/~mransom/NathanielBiography.html>.

<sup>20</sup> G A Jelley, 'The Balloon Frame' (MA, California State University, Dominguez Hills [California]), p xi.

*sur-piece en bouldins*, meaning saddle-notched log construction.<sup>21</sup> This seems much more relevant, but the implication that the Mississippi houses were of logs is probably unacceptable, for Cavanagh does not pursue it. In fact the problem is not quite so great, for *boulin* in technical French translates as 'putlock, putlog, ledger, spar',<sup>22</sup> which would allow a *maison en boullin* to be of sawn timber. But this is still a long way from showing that anything so described in Mississippi in any way resembled the canonical balloon frame of later dates.

Cavanagh also cites the first known use in English of the term 'balloon', which is a letter by Caroline Clark in 1835:

The buildings now are mostly small, and look as though they have been put up as quickly as possible, many of them are what they call here Balloon houses, that is built of boards entirely - not a stick of timber in them except the sills.<sup>23</sup>

It is not only apparent, as Cavanagh points out, that the term is already a familiar one. It is also clear - as Cavanagh does not stress - that it means something quite unlike the balloon frame of modern parlance, and more like a packing case made up out of boards.

To put the case briefly, it is not clear that the terms 'balloon' or 'balloon frame' originally had any meaning approximating that which they have since acquired. It is not clear that St Marks Church, Chicago, was a balloon framed building in that more modern sense. It is not clear that G W Snow or A D Taylor invented the balloon frame or anything else. The joints were probably not much simplified at this early stage, and indeed C D Elliott identifies the 1880s as the period when mortices gave way to nails,<sup>24</sup> though that is certainly an exaggeration, as in 1877 the Englishman R S Burn illustrated what he saw as typical American framing, with butt joints and skew nailing.<sup>25</sup> It is clear that lighter framing techniques were evolving in Chicago in the early 1830s, and possibly elsewhere in the Mid-West as well. In due course there was to crystallise out of these tendencies the form which was later called the balloon frame, but the first unequivocal evidence of this is in Bell's book of 1858. In searching out the earliest surviving example for the Smithsonian Museum, Paul Sprague found one which may even precede Bell's book, for he dates it to 'about 1855'.<sup>26</sup>

All this is very consistent with Australasian experience, in which during a slightly earlier period tendencies towards more lightweight and uniform framing, simpler joints, and the increased use of nails, were to crystallise out as the local stud frame, in so many respects comparable with the balloon frame of the United States.

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<sup>21</sup> Ted Cavanagh, 'Balloon Houses: the original aspects of wood-frame construction re-examined', *Journal of Architectural Education*, LI, 1 (September 1997), p 12.

<sup>22</sup> Alexander Tolhausen [revised Louis Tolhausen], *Dictionnaire Technologique dans les Langues Française, Anglaise et Allemande* (Leipzig 1877), p 128. Pierre Chabat, *Dictionnaire des Termes Employés dans la Construction* (Paris 1875), p 165, confines the meaning to putlock.

<sup>23</sup> Caroline Clark to her sister [collection of the Chicago Historical Society], quoted in Cavanagh, 'Balloon Houses', pp 5-6.

<sup>24</sup> Elliott, *Technics and Architecture*, p 18.

<sup>25</sup> R S Burn, *Building Construction* (London 1877), pp 90, 91.

<sup>26</sup> Paul Sprague, personal communication, 27 November 1998..

*c. competing American types*

There are in fact a number of distinct timber building traditions in the United States. The New England practice is very reminiscent of the British tradition, and it barely survived into the twentieth century. It was published by W A Radford in 1911 under the name 'New England Braced Frame Construction', but said even then to be a type 'rarely seen in modern work'. In this frame the hierarchy of size is very pronounced, with corner posts 8 x 4 inches [200 x 100 mm], angle braces 6 x 4 [150 x 100] and studs 4 by 2 [100 x 150]. It appears that the studs are completely interrupted above and below the bracing (always an indicator of archaism), rather than being checked through. At the ground floor the joists are checked out over the plate - or rather the sill, for it is six inches [150 mm] deep, with a ten inch [250 mm] joist fully checked over it. At the upper floor level the joists are likewise checked out over the girt, by about 50 mm.<sup>27</sup> Another such braced frame illustrated in 1913 has knee braces of a very much larger dimension than the studs, connected to the corner posts with shouldered mortice joints, and very reminiscent of traditional British practice.<sup>28</sup>

The authoritative American text of 1929, Dudley Holtman's *Wood Construction*, distinguishes a modified version of this, as well as two other distinct framing types, which we will consider in a somewhat different sequence. The modified form is described simply as 'braced frame construction', seemingly a more modern version of the New England braced frame, and is said to be the type 'brought from Europe and adopted by early New England and Colonial builders'. It does in fact still resemble the traditional box frame in that the studs are not continuous between floors, though the corner posts run straight through. At both levels the joists run in on top of the plate.<sup>29</sup>

Holtman's second type is of course the 'balloon frame', in which 'the supporting studs extend from the foundation to the eaves, a ribbon or ledger board being let into the studs to form the support for the joists.'<sup>30</sup> The definition is important because of the confusion caused by those modern writers who define the balloon frame on other bases. They are, however, in a minority. All practical handbooks, such as *Canadian Wood-Frame House Construction*, are unequivocal:<sup>31</sup>

Balloon framing differs from platform framing in that the studs used for exterior walls are continuous, passing through the floors and ending at the top plate which supports the roof framing.

As illustrated, Holtman's is a very unusual form of balloon frame, in that the lower floor is a platform, and the wall is built up from it. There is light bracing let into the outer face of the studs, and one level of 'fire stop' or zigzag timber nogging running

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<sup>27</sup> W A Radford, *Radford's Portfolio of Details of Building Construction* (Chicago 1911), p 54.

<sup>28</sup> C E White, *Successful Houses and How to Build Them* (1913), as reproduced in Paul Sprague, 'Chicago Balloon Frame' in H W Jandl [ed], *The Technology of Historic American Buildings* (Washington 1983), p 37.

<sup>29</sup> D F Holtman, *Wood Construction* (New York 1929), pp 231-2, 235.

<sup>30</sup> Holtman, *Wood Construction*, p 233.

<sup>31</sup> *Canadian Wood-Frame House Construction* (no place [Canada] 1968), p 36.

between the studs, doubtless to divide the space within the wall and hence discourage the passage of fire through it.<sup>32</sup>

Holtman's third type, the 'Western frame', took the platform principle even further, but it was said to be in only limited use, and was not recommended. The ground floor platform was constructed and boarded over, then a plate was laid over the boarding and the frame built off it. The studs were stopped by a top plate at first floor level, and then a thin joist-like piece or 'header' was laid over this to seal off the joist ends. The floor boarding was laid at this level, and a plate put on top of it, off which a new wall was constructed for the upper storey.<sup>33</sup> This is the system most closely related to Australian practice, and in America probably dates back to at least 1860, when George Woodward described as 'dangerous advice', 'Mr Todd's plan of sawing off the tops of the studding at the top of the floor of each story'.<sup>34</sup> It is also exactly the construction which was being recommended in Canada by the British Columbia Timber Commissioners in the mid-twentieth century,<sup>35</sup>

In the United States one generally finds the balloon frame contrasted with the 'combination frame', and as this is also found in Australia, it requires some explanation. It is much the same as Holtman's 'braced frame'. In a two storey structure the joists at ground floor level are above the plate, as in a balloon frame, and there are heavy corner posts running the full height, but all the ordinary 2 by 4 inch studs are interrupted by a horizontal girt at first floor level, as in a platform frame. The posts and girt measure 4 by 6 inches [100 x 150 mm], and there are heavy 3 by 4 inch [75 x 100 mm] or 4 by 4 inch [100 x 100 mm] angle braces which cut the studs.<sup>36</sup> A rare photo of a building under construction in Australia in 1898 seems to show a frame of essentially this type, with the studs stopping but the corner posts continuous between floors.<sup>37</sup>

A factor in America which encouraged this change towards discontinuous studs was the large volume of pre-cut and prefabricated timber housing, which tended to militate against longer members. A ready-made farmhouse plan published by the Canadian-Pacific Railway in 1911 shows a platform frame, though in no detail.<sup>38</sup> The T Eaton Company of Winnipeg, Canada, was a mail order kit house supplier, and the construction illustrated in their catalogue of 1919 is a true platform frame in which the joists are fully boarded in shiplap before the wall plate is even laid on top. The

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<sup>32</sup> Holtman, *Wood Construction*, p 233.

<sup>33</sup> Holtman, *Wood Construction*, pp 232, 237.

<sup>34</sup> George Woodward, *Country Gentleman*, 16 (1 November 1860), p 290, quoted in Sprague, 'Chicago Balloon frame', pp 51-2 n 3.

<sup>35</sup> C T Penn, 'Timber Houses: Design & Construction', in Stubbs, *Building Encyclopedia*, IV, p 1411.

<sup>36</sup> P G Knobloch, *Good Practice in Construction Part II* (New York 1925), plate 1, 'Balloon Framing', pl 2, 'Braced Framing'; C M Gay, 'Wood Framing' in F E Kidder & Harry Parker, *Kidder-Parker Architects' and Builders' Handbook* (18th ed, New York 1931), pp 722-3, fig 1 'balloon frame', and fig 2, 'combination frame'. Knobloch's balloon frame has no continuous braces, but seemingly relies upon the up-and-down firestop nogging, and the diagonal board sheeting. Gay, however, has 1 x 6 inch [25 x 150 mm] braces let into the outer face of the studs.

<sup>37</sup> Construction of a two storey timber building of the combination frame type at Bega, New South Wales, in 1898. At the ground floor the joists rest on top of the base plate. Mitchell Library videodisc 02286

<sup>38</sup> G E Mills, *Buying Wood & Building Farms* (Ottawa 1991), p 110.

shiplap is not the final floor surface, but is subsequently covered with tarred paper and another layer of floor boards, which of course does not extend under the wall plates. Unfortunately only the construction of a single storey building is illustrated, so one cannot tell whether a full plate would be inserted at first floor level.<sup>39</sup>

A catalogue of Aladdin Readi-Cut houses, of 1920, proudly points out that the studs are about thirty feet [9 m] high, and illustrates them with the 'joist hangar' [ribbon] in place. However, this is in a construction partly or wholly of steel, and it seems as if the term 'Readi-Cut' is used to refer to prefabricated or pre-cut structures generally. Another illustration in the same brochure shows an entirely timber structure, in which the studs are broken at the upper floor, a plate carries the joists, and another plate is on top of them, off which rise the upper studs.<sup>40</sup> There is also a vermin plate at ground floor level, in the manner of the true platform frame. The corner of the building is not shown, but as the specification does not describe any special post size for the purpose, it must be presumed that it is formed up from common studs. By 1925, if not before, Pacific Ready-Cut Houses of Los Angeles were using the platform system.<sup>41</sup> A Montgomery Ward catalogue of 1927, shows the studs interrupted by double horizontal plates at first floor level. This may even be a full platform frame, for the ground floor is platform framed, and it is not even clear from the illustration that the corner posts are continuous.<sup>42</sup> In 1928 Sears Roebuck & Co turned to the platform frame, or what they called 'air-sealed-wall construction', in their 'Honor-Bilt Home'.<sup>43</sup>

The vermin plate was to be seen as a critical feature of the Australian stud frame, and it is worth noting here that there were a number of ways of solving the problem in America, by using boxed sills of various forms, in which at least one member on edge is combined with the plate in such a way as to bar the space to vermin. Radford's *Framing* of 1919 illustrates at least three versions, but it is unclear how widely they were used in the United States, and they certainly had no impact in Australia.<sup>44</sup>

The distinction between balloon and platform framing, commonly forgotten today, was well understood earlier in this century both in Britain and in Australia. A British text, Boughton's *New Carpenter and Joiner*, probably of about 1940, contains clear comparative diagrams of the 'platform frame system' and the 'balloon frame system'.<sup>45</sup> Timber-frame construction 'in its true meaning' is seen as an innovation in Britain, and it is explained that it has been largely perfected in 'America' [ie the United States], Canada, and many Continental countries. Platform framing is said to be more popular than balloon framing in Britain.<sup>46</sup>

In Australia Clifford Lloyd's *Australian Carpenter*, of 1948, illustrates platform frames, but only single storey buildings are shown. One can infer, however, that

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<sup>39</sup> T Eaton Company, *Plan Book of Ideal Homes* (Winnipeg 1913), reproduced in Mills, *Buying Wood & Building Farms*, p 64.

<sup>40</sup> *Aladdin Homes Catalog No 32* (no place [Michigan] no date [1919]), pp 6, 13

<sup>41</sup> Rosemary Thornton, *The Houses that Sears Built* (Alton [Illinois] 2004 [2002]), p 18.

<sup>42</sup> Alan Gowans, *The Comfortable House* (Cambridge, Massachusetts, 1989 [1986]), pp 6, 53.

<sup>43</sup> Thornton, *Houses that Sears Built*, p 28.

<sup>44</sup> W A Radford, *Framing* (Chicago 1909), pp 18-21.

<sup>45</sup> R V Boughton, *The New Carpenter and Joiner* [3 vols, London, no date(?c 1935-40)], I, p 197.

<sup>46</sup> Boughton, *New Carpenter and Joiner*, pp 195-6; II, p 161 ff, 170.

Lloyd would have broken the studs in a two storey structure, for he does this even across the chord of a gable end.<sup>47</sup> In his *Building Construction*, of 1953, Lloyd shows platform frame construction throughout, but he illustrates a two storey brick veneer structure which has a platform at the base, studs continuous through the two levels, and a 'ribbon bearer' to carry the upper joists.<sup>48</sup> He explains that when timber cannot be obtained in sufficient length, separate frames may be made for each storey, the upper one resting on the joists. The disadvantage is that sectional shrinkage of the joists at both levels will cause a significant subsidence overall.

In his *Help for Home Builders* of 1957, Lloyd distinguishes the two basic systems, platform and balloon, referring to the balloon frame as being the older type, but more difficult to set out and erect.<sup>49</sup> All this is said, however, in connection with his diagrams of brick veneer construction, which in this case derive from Canada, so it may indicate merely that platform framing was superseding balloon framing in that country. The noteworthy characteristic of the earlier of these Canadian-influenced diagrams is that in a number of them there is a continuous line of nogging at skirting top level. This would itself serve as a vermin plate, and therefore eliminate one of the main advantages of the platform frame system - that is, it would effectively vermin-proof even a conventional balloon frame.

#### *d. definitions*

<b>type</b>	<b>joists /plate</b>	<b>studs</b>	<b>posts</b>	<b>1st floor</b>	<b>bracing</b>
US Western Frame [Holtman]	under	interrupted	interrupted	2 plates & header	?
English Box Frame	over	interrupted	continuous	girt	short interrupted
US Braced Frame [Knobloch]	over	interrupted	continuous	girt	short continuous
US Braced Frame [Holtman]	over	interrupted	continuous	two plates	halved
US Combination Frame [Gay]	over	interrupted	continuous	two plates	halved
US Balloon Frame [Knobloch]	over	continuous	continuous	ribbon	herringbone firestop
US Balloon Frame [Gay]	over	continuous	continuous	ribbon	let in
US Balloon Frame [Holtman]	under	continuous	continuous	ribbon	let in & firestop

<sup>47</sup> C Lloyd, *The Australian Carpenter* (Melbourne 1949 [1948]), sheets 31, 113 and especially 45.

<sup>48</sup> C Lloyd, *Building Construction for Craftsmen and Builders* (Melbourne 1953), sheet 12.

<sup>49</sup> C Lloyd, *Help for Home Builders* (Melbourne 1957), pp 106-7.

Australian stud frame	under	not applicable	not applicable	not applicable	let in
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We have now categorised the overseas types of frame so far as this is possible. The stud frame in Australia will be distinguished from traditional English box framing, and in part from the 'combination frame' by the facts that:

- the members, especially the verticals, are lighter in weight,
- they are largely uniform in size and spacing, and
- the diagonals are lightweight and are let into the studs rather than interrupting them.

The modern Australian stud frame and the modern American balloon frame will both share those characteristics (except that the Americans commonly have no braces as such, and rely on diagonal boards or other sheathing for the purpose). Both tend also to be distinguished from traditional English box framing in that:

- the joints are simple butts, checks and halves
- the fixings are nails, skewed if necessary.

But these characteristics are in no way fundamental to the definitions of the stud or the balloon frame.

Further, the modern Australian stud frame, unlike the bulk of earlier timber framing in Australia, is of the platform rather than the American balloon type. It is therefore distinguished by:

- wall plates resting above the floor joists, and
- complete discontinuity between wall frames at each floor level.

Nineteenth century timber framing in Australia hardly ever conforms to the first criterion, and as it is almost always single storeyed, the second does not apply.

#### *e. the stud frame in Europe*

The problem in examining the evolution of the modern timber framing types is that they seem to have developed more or less in parallel, and that they did so during a period when timber-framed external walls were not in normal use for buildings of

substance in Britain. The various characteristics which have been mentioned appeared separately at different times and places, and it was a long time before they became dominant or universal.

The first question is whether there was anything approaching the stud frame in Britain itself prior to the Australian and American developments. Peter Bell claims to have found 'a tradition of light timber stud framing' in England in the eighteenth and nineteenth centuries 'sufficient to account for' the Queensland (and by inference the Australian) stud frame.<sup>50</sup> He refers to cladding and lining in horizontal boards as a common element, but as very few English examples fit this description, and as many of Bell's Queensland ones omit the cladding, this does not assist his thesis. Apart from this, the common elements are said to be the use of sawn softwood studs of about 100 x 50 mm dimensions, spaced at about 500 mm centres, and mortised into the top and bottom plates. This description, however, is so generalised that it would apply to most traditional English box framed buildings, in which the studwork is only an infill within the structural frame. That is in fact the case with the framing described in Joseph Moxon's *Mechanick Exercises* of 1677,<sup>51</sup> the earliest source cited by Bell. He failed to understand the point because he relied upon quotations from the book rather than seeing the illustrations in the original.

Next, according to Bell, there was a general scaling down of members until cottages and other light buildings were made without posts, and with the stud wall carrying all the load, a technique known as 'late framing'. He purports to derive this category from Eric Mercer's *English Vernacular Houses*,<sup>52</sup> but Mercer in fact makes no attempt to define a distinct system called 'late framing'. He uses the phrase only to head a chapter about 'the ordinary framing of the late 17th and 18th centuries' which uses smaller scantling, but in which 'the forms are derived from earlier forms of framing'. Nothing illustrated by Mercer suggests even remotely the appearance of stud framing in the modern Australian sense.

Bell's only evidence of any substance is the publication by Nathaniel Kent in 1776 of plans of 'two Studd Work Cottages of the Smallest Size'.<sup>53</sup> To understand Kent it is easiest to refer first to another of his illustrations, that for 'two Studd Work Cottages of the Largest Size, with Hipped Ends'.<sup>54</sup> This structure is a perfectly traditional frame with the posts larger than the studs, and running full height; with a horizontal plate running between them at first floor level; and with diagonal members apparently as heavy as the posts themselves. The studs fit into the openings of this frame and are a maximum of one storey in height. This is entirely consistent with the practices illustrated earlier by Moxon. Kent's smaller cottages are treated somewhat differently, for two reasons. Firstly the end walls are of triple thickness brick, so that there is no call for corner posts. Secondly there is not a full upper storey, but only an attic, and as the lower wall incorporates a brick plinth of about 300 to 400 mm above floor level, the total height of the timber frame is little over one storey. Kent

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<sup>50</sup> Peter Bell, *Timber and Iron* (St Lucia [Queensland] 1984), p 48.

<sup>51</sup> Joseph Moxon, *Mechanick Exercises* ([nominal] 3rd ed, London 1973, reprinted New York 1970).

<sup>52</sup> Eric Mercer, *English Vernacular Houses* (London 1975), pp 125-6.

<sup>53</sup> Nathaniel Kent, *Hints to Gentlemen of Landed Property* (2nd ed, London 1776), facing p 263.

<sup>54</sup> Kent, *Hints to Gentlemen*, facing po 269.

therefore omits the plate at first floor level and runs the studs up the full height, stating 'As the Studds, in these Cottages, are run quite up to the Wall Plate, it is to be observed, that a Girder, sufficient to support the flooring Joists, must be laid ... and the Joists, must be fastened to the Studds.' This is largely consistent with the earlier balloon frame practice described and illustrated by Trudy West, as discussed above, and we can conclude nothing beyond the fact that there is a general trend towards lighter and more uniform members. It is also relevant to the use of the 'ribbon' in the American balloon frame.

If these designs could indeed be shown to relate to the stud frame as presently understood, they would still not necessarily be evidence for an English origin, as asserted by Bell, for Kent claimed his book to be based upon 'a three years residence, and observation in the Austrian Netherlands', as well as an extensive practice since that time in supervising large estates in different parts of England.<sup>55</sup> There is in fact a strong tradition of studded buildings in Belgium, rather resembling those illustrated by Kent, and examples can now be seen at the Bokrijk Museum.<sup>56</sup> There is also something of the sort in Normandy, where the appearance was so much appreciated that the diagonal braces were set on the inside, so as not to mar the exterior effect of the closely set verticals.<sup>57</sup>

There is an even more relevant tradition of 'close studding' in England, particularly in the south-east, a prominent example of which is 'Synyards' at Otham, Kent. The definition varies, but in the median type defined by J T Smith the studs rise a storey in height, extending from plate to plate without any horizontal members, and they are set closely enough to create a strong vertical effect. They do not extend through more than one floor as in the later balloon frame.<sup>58</sup> Cave identifies this close studding as a technique which was common as early as the fifteenth century, and quotes an Italian visitor to London in 1497 as speaking of mansions in which 'six-inch beams are inserted in the walls the same distance apart as their breadth.'<sup>59</sup> A group of London houses dating from before the Great Fire showed studs on the side flank not quite so closely spaced. There was horizontal division through the studs at the ground and second floor levels, but in the first floor they were uninterrupted except by bracing.<sup>60</sup> Outside London, according to Cave, the spacing of the studs varied widely - from seven to eighteen inches [180-450 mm] even within eastern Suffolk. The greatest

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<sup>55</sup> Kent, *Hints to Gentlemen*, p iii.

<sup>56</sup> A stable from Oost-Cappel in northern France, attributed to the late eighteenth century, is a conventional single-storey half timbered building but that it lacks any horizontal divisions or braces, and has simply a series of verticals spaced widely - perhaps a metre or more - running from the bottom to the top plate. A farmhouse from Abeele in western Flanders has narrower panels, and more closely resembles Mercer's English examples. A third building, not identified in the information available to me, has similar narrow panels but is distinctive in that it uses brick, apparently for some or all of the gable end walls, and for a plinth wall along part of one of the long sides. Illustrations and notes kindly supplied by Dr Marc Laenen, then the director of the Bokrijk Museum, 1990.

<sup>57</sup> Yves Lescroart, *Manor Houses of Normandy* (Paris 1997 [1995]), passim, and p 60 for the point about the brace.

<sup>58</sup> J T Smith, 'Timber-Framed Building in England: its Development and Regional Differences', *Archaeological Journal*, CXXII (1965), p 138, fig 5; pp 143-5; pl XVII.

<sup>59</sup> L F Cave, *The Smaller English House: its History and Development* (London 1981), p 57, quoting ----- [translated C V Moffati], *Itinerarum Britanniae* (1953 [?]),

<sup>60</sup> Houses on the north side of Long Lane, Smithfield, drawn by J T Smith in 1810, reproduced in Cave, *Smaller English House*, pp 144/5.

concentration of examples was in the south-eastern counties, spreading into East Anglia south of Norfolk, but they were also scattered over wide areas of the Midlands, the Welsh Marches and the northern counties.<sup>61</sup>

Whether this was in any sense a living tradition after the time of Nathaniel Kent is questionable. In 1804 Edmund Bartell speaks of 'stud-work with lath and plaster' as suitable for the construction of an ornamental cottage,<sup>62</sup> but we cannot be sure that he does not mean this to be within a conventional frame. When the American balloon frame is reported in England it seems to be seen as a striking novelty.

### *f. Robert Scott Burn*

The first reference to a frame in which all the vertical members are the same size, and also the first British reference to bracing which is merely let into the face of the studs, is found in Robert Scott Burn's *Colonist's and Emigrant's Handbook* of 1854.<sup>63</sup> Burn describes a 'frame house', which must almost certainly be based upon American experience. The bottom plates are squared logs and the top plates are also very large. The 'posts' or studs are uniformly 4 inches [100 mm] square and spaced at about 530 mm. The bracing is only 2 inches by 1 [25 x 50 mm], and though it is let into the studs, it is rather misleadingly referred to as 'struts', suggesting that Burn is caught in a traditional British mind set. Although the members are heavy, this is a balloon or stud frame. Even the rationale is that of the balloon frame, for Burn explains that such a house is 'only available to the emigrant settler who is located near a saw-mill, or who can erect one by which he may be provided with what in America is called "lumber" - that is, planks, &c. of various dimensions.'<sup>64</sup>

It is clear enough that the British themselves saw the American balloon frame as an innovation, and it is therefore somewhat futile to try to trace its previous existence in England. Burn says in 1877:<sup>65</sup>

We believe it will be useful to the student, and interesting in a general way, if we describe here a method of constructing timber houses, introduced and now largely practised in America ... The new style of putting timber together claims to be not only more quickly put in hand than the old method, but enables much lighter materials to be used ...

The system is named the 'Balloon Frame System,' ...

The principle followed out in the system is the employment of the timber in such a way that all the strains, or as many of them as possible, shall be made to act in the direction of the length of the fibres in the wood ...

Another feature is dispensing almost entirely with cutting the timber so as to obtain notches, scarfs, tenons, etc. ... and the securing of the various parts together being made dependent entirely upon the nails ... [driven diagonally] ...

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<sup>61</sup> Cave, *Smaller English House*, pp 57/59.

<sup>62</sup> Edmund Bartell, *Hints for Picturesque Improvements in Ornamented Cottages, &c* (London 1804), p 78.

<sup>63</sup> R S Burn, *The Colonist's and Emigrant's Handbook of the Mechanical Arts* (Edinburgh 1853), pp 47-8.

<sup>64</sup> Burn, *Colonist's and Emigrant's Handbook*, p 46.

<sup>65</sup> Burn, *Building Construction*, pp 88 ff.

Burn certainly illustrates the ground floor joists coming over the wall plate, as well as the use of simplified jointing and skew nailing. However, these simplified joints should not be regarded as a diagnostic, for the original Chicago balloon frames were largely mortised and tenoned. In about 1846 Solon Robinson began to argue for his own distinctive type of frame, which had very few mortice and tenon joints,<sup>66</sup> and by about 1860 the traditional joints were being challenged by George Woodward as doing little more than weaken the timber.<sup>67</sup> Burn's idea of the main characteristic of the balloon frame, that the strains act in the direction of the wood fibres, seems an odd one, but it almost certainly derives from Woodward's somewhat enigmatic statement that 'The floor joists being toed and clawed with suitable nails and spikes, all lateral or sideways thrust is in the direction of the fibre.'<sup>68</sup>

### *g. transitional examples in Canada & New Zealand*

There is a meaningful change from traditional British practice only when the studs themselves become the structure and the larger members are omitted. Thus a timber frame is only doubtfully a stud frame if there are posts at the corners of a much greater size than the studs, though anything up to and including a square of the larger stud dimension is quite normal. It certainly is not a stud frame if there are large intermediate posts as well. Most telling of all is where the diagonal braces are large, and are of the same width as the main members, for this is a clear indication that the structure is conceived as a complete heavy frame, with studs only used to fill the interstices and provide a fixing for the lining and cladding. In a fully traditional frame, as has been stated, the studs are completely interrupted above and below the brace, whereas in a modern stud frame the brace is a light piece let into the face of continuous studs.

Stud frame characteristics begin to emerge in parts of what is now Canada by the eighteenth century. The Germain Dugas house at New Brunswick, Nova Scotia, built after 1770, appears, from a photograph, to have vertical studs spaced at about 400-450 mm centres. They are fairly uniform in character, but in three main sizes - large corner studs, smaller studs flanking openings, and still smaller intermediate ones. Although the braces cut the intermediate studs (and finish with butting joints) they are short. There are no members shouldered to meet the diagonals, no curved members, and the scale and uniformity of the scantling is such as to suggest stud framing.<sup>69</sup> In Newfoundland there are also houses specifically referred to as 'studded' or 'full-studded', but these terms describe studs packed together touching each other in palisade fashion, a primitive form which in Europe had been superseded by framed types.<sup>70</sup>

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<sup>66</sup> Sprague, 'Chicago Balloon Frame', p 40.

<sup>67</sup> George Woodward, *Country Gentleman*, 16 (27 September 1860), p 210, quoted in Sprague, 'Chicago Balloon Frame', p 54 [n 25].

<sup>68</sup> Woodward, *Country Gentleman*, 14 (15 December 1859), p 210, quoted in Sprague, 'Chicago Balloon Frame', p 51 [n 3].

<sup>69</sup> A photo showing the building partly demolished appears in Harold Kalman, *A History of Canadian Architecture* (2 vols, Toronto 1994), I, p 86.

<sup>70</sup> Kalman, *History of Canadian Architecture*, I, p 97.

In the early missionary-built houses in New Zealand, according to William Toomath, the frames followed 'medieval methods'. He does not document this assertion, but if he is right in referring to three inch [75 mm] studs spaced up to 900 mm apart, and set between heavy square main or corner posts, then the description is not unreasonable. It seems, however, that it is no more than a surmise, based upon his acceptance of the thesis that a lighter frame was invented only in the 1830s in the United States.<sup>71</sup>

We have rather more explicit information about the Waitangi Treaty House, the Sydney-made building already referred to above. Here the studs are pit sawn and variable in size from 80 to 110 mm in the larger dimension and 55 to 80 mm in the smaller, doubtless a nominal three by four inches, with somewhat variable spacing, averaging about 515 mm. From inspection it appears that at least some of the corners are formed with double or triple studs. But only a small portion of the frame is visible, and it would seem from the survey drawings that the corner posts are larger than the ordinary studs, and perhaps square in section.<sup>72</sup> The frame is of the balloon type, in that the floor joists are above the bottom plate, while the diagonal braces occupy an intermediate position in the evolution of the stud frame. On the one hand, they are not major members with the studs stopping above and below, and on the other hand they are not lighter members let into the stud faces. They are of dimensions comparable to the studs themselves, and are halved into them.

There is in fact no precise point when the main framing is omitted, and the whole structure is built of small studs. There are buildings where the timber members are fairly uniform in size and spacing, but are of dimensions more like those of the traditional frame, and this can best be seen as a natural result of attempts to simplify carpentry to meet local conditions. At Waimate, Maori workmen were trained by the missionaries George Clarke and James Hamlin, the former the son of a Norfolk builder. The houses they built in 1832 are said to have had four inch [100 mm] square studs spaced four feet [1.2 m] apart, with mortice and tenon connections to the top and bottom plates.<sup>73</sup> This is exactly as Burn was to describe in 1854. Is this a simplified box frame with no studs, or is it a grossly oversized stud frame?

These tendencies are reflected in a drawing for the framing of a two-roomed migration house, produced by a New Plymouth Government officer in the 1850. It is unfortunately incomplete and inaccurate, but it shows what seems to be a lightweight frame of uniformly sized vertical members, spaced variably about 800-900 mm apart, with two lines of horizontal noggings, at sill height and mid-window height, and diagonal bracing members. The bracing appears sometimes to override the studs and noggings, and sometimes the reverse, which would be consistent with the use of halved joints. The floor joists rest on top of the wall plate, which is itself relatively small - perhaps about three inches [75 mm] deep.<sup>74</sup>

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<sup>71</sup> William Toomath, *Built in New Zealand* (Auckland 1996), p 18.

<sup>72</sup> Salmond Architects, 'Treaty House, Waitangi: Commentary on Original Framed Construction' (mimeograph report, Auckland no date [?c 1990]), passim.

<sup>73</sup> John Stacpoole, 'Waimate', in Frances Porter [ed], *Historic Buildings of New Zealand: North Island* (Auckland 1979), p 39.

<sup>74</sup> Martin Hill, *Restoring with Style* (Wellington 1985), p 79.

At about the same time as this double cottages were built for the married members of the Panmure Regiment, stationed at Auckland from 1848, and their construction, though not entirely uniform, shows many stud frame characteristics. Only one remains reasonably intact on its original site, two have been moved to Howick Historical Village, and some details are known of others. The joists rest on top of the base plate, in balloon frame manner.<sup>75</sup> The studs are all about 100 x 75 mm, though the spacing varies from 400 mm to 600 mm, most commonly 450 mm, and there is no noggling.<sup>76</sup> Large posts are not used at the corners, which are treated in various ways, usually by multiplying standard sized studs. In the Howick Arms / James White Store there are three studs at the corner disposed in much the manner used in twentieth century construction to ensure that there is provision for fixing the lining on both internal surfaces.<sup>77</sup> A survey by Christopher Murphy suggests that in some cases the angle bracing is continuous and interrupts the studs in the traditional way, as at the Beswick / Rowland house, but in others the studs are continuous and the bracing interrupted, as at the McDaniel / Briody and Beeching / Turner houses.<sup>78</sup> However, these conclusions cannot be relied upon, as Murphy does not seem to have considered whether the bracing might be halved into the studs, which would give the appearance of continuous studs from one side, and continuous bracing from the other.

A later building, the Ararimu School, now also at Howick Historical Village, has 5 by 3 inch [130 x 80 mm] studs with much narrower bracing [about 120 x 25 mm] let into the outer face, largely consistent with modern stud frame construction. In this instance there is only a single stud at each corner.<sup>79</sup> Surprisingly, however, the full depth bracing piece (albeit intermittent or halved), is also found in New Zealand into the twentieth century, and indeed even in a modernist design of 1943.<sup>80</sup>

In these New Zealand structures the stud frame is almost fully developed by 1850, and this evolution takes place without any apparent influence from Chicago. The buildings at Waitangi and Waimate are contemporary with, or actually precede the alleged invention of the American balloon frame in Chicago in 1832-3,<sup>81</sup> and there is no reason to suppose that they are in any way unique. Even the claim for the balloon frame in Chicago has been challenged by Bell, who asserts that the evidence is purely circumstantial, that the term 'balloon' was used in the United States in the 1850s simply to designate an unusually light frame, and that even these light frames spread only slowly and irregularly in that country. These comments are themselves open to challenge, but this is not material, given that the Australasian evolution appears to be entirely independent of whatever was happening in America.

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<sup>75</sup> C P Murphy, 'The Fencible Cottage: Soldier Housing', (MArch, University of Auckland 1995), p 86.

<sup>76</sup> Murphy, 'The Fencible Cottage', p 119.

<sup>77</sup> Observed by the writer, 1996.

<sup>78</sup> Murphy, 'The Fencible Cottage', pp 122, 86.

<sup>79</sup> Observed by the writer, 1996.

<sup>80</sup> *Building Progress* [Auckland], VIII, 3 (March 1943), p 9.

<sup>81</sup> Siegfried Giedion, *Space, Time and Architecture* (4th ed, Cambridge, Massachusetts, 1963 [1941]), pp 345-353; A W Field, 'A Re-examination into the Invention of the Balloon Frame', *Journal of the Society of Architectural Historians*, II, 4 [1942], pp 3-29; P E Sprague, 'The Origins of Balloon Framing', *ibid*, XL, 4 (December 1981), pp 311-319; Sprague, 'Chicago Balloon Frame' in Jandl, *Technology of Historic American Buildings*, op cit, pp 36-8.

### *h. Australia*

It is indeed possible that the timber framing used in California derived from Australia. Timber framed construction was almost unknown in California prior to the gold discoveries, for the Spanish had clung to the adobe and neglected the magnificent local timber. The first steam sawmill opened only in 1843 and the first water mill in 1846. It was immediately after this, and immediately before the gold discoveries, that the Australian William Bushton arrived with his family and some prefabricated houses. Of these his own house gained some fame in the twentieth century as being the oldest in the area.<sup>82</sup> In the situation as it stood the impact of one experienced carpenter might have been considerable, and the fact that successive loads of Australian timber continued to reach California may be relevant as well.<sup>83</sup> Investigations by Peter Barrett, however, have established that the Bushtons' were far from the first timber houses to arrive, and in fact the demand had already been sated, so they are unlikely to have played a critical role.<sup>84</sup>

The first Australian frame of which we have reasonably detailed information is another prefabricated building made in Sydney, this time the cottage built by the Royal Engineers in 1837 for Captain William Lonsdale, commandant at Port Phillip.<sup>85</sup> It was constructed entirely of what were called 'studs', even though those at the corners and angles measured 4 inches [100 mm] square, as opposed to 4 x 2<sup>1</sup>/<sub>2</sub> [100 x 63 mm] for the others. This is very comparable with the Waitangi Treaty House except that the ordinary studs are slightly lighter, but a more significant difference is that the braces measured only 4 x 1<sup>1</sup>/<sub>2</sub> inches [100 x 34 mm], and therefore must have been let into the studs rather than interrupting them. It is also very close to the American balloon frame of the variety still being described in 1902, with four inch square corner studs, and intermediate studs 2 x 4, or just slightly larger than Lonsdale's, but without bracing.<sup>86</sup> The simple fact is, however, that Lonsdale's cottage was using this framing four years after something like it appeared in Chicago, though there is nothing whatever to suggest that the one derived from the other. The two traditions must have derived from common sources, from similar practical considerations, or both.

The next stage in the Australian evolution is displayed in the dining room added by the builder George Beaver to Superintendent La Trobe's cottage in Melbourne in 1839. Only a small part of the frame has been made accessible to me by removing one board from the face, but from this the following features are clear:

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<sup>82</sup> *Argus*, 1 March 1923, p 9, and various unsourced newspaper cuttings kindly supplied by Mrs Shirley Jones.

<sup>83</sup> W F Morrison, *The Aldine History of Queensland* (2 vols, Sydney 1888), II, unpaginated appendix, sv Nehemia Bartley.

<sup>84</sup> P A Barrett, 'Building through the Golden Gate: Architectural Influences from Trans-Pacific Trade and Migration between Australia and California 1849-1914' (Master of Planning & Design, University of Melbourne 2001), pp 18-22.

<sup>85</sup> Miles Lewis, 'Lonsdale's Cottage' [draft typescript report to the National Trust of Australia (Victoria)] (Melbourne 1981), passim; Miles Lewis, 'Report of Inspections, &c' [typescript report to the National Trust of Australia (Victoria), Melbourne 1985), passim.

<sup>86</sup> William Bell, *Carpentry Made Easy* (Philadelphia 1902 [1857]), p 47.

- The base plates measure 133/140 x 65/68 mm, and are halved together at the corner.
- The studs measure 88/94 mm x 62/70 mm.
- There is a single stud at the corner, slightly larger than the others, but not significantly so. It is 94 x 70, the others 88 x 62, 89 x 68 and 88 x 63.
- Studs are spaced 307, 380, 455 mm.
- Probing at the junction of studs and plate reveals no clear evidence of tenons.
- Feeling the underside of the plate reveals no evidence at all of mortices.
- The studs are fixed to the plate with one or two diagonal nails from the side. I have not been able to extract examples.
- There is evidence to suggest that the frame was at first completely unlined inside, and no form of bracing could be seen (this may have existed elsewhere in the structure, or the room may have simply relied upon the support of the Manning house to which it was attached).

This is the earliest structure of the stud/balloon type yet identified even in American terms, as Paul Sprague has acknowledged,<sup>87</sup> but it is not a striking advance upon Lonsdale's cottage, and there are other examples, not much later in date, which suggest that this sort of framing was already widespread in the Australasian colonies.

Christopher How has described the construction of the Steam Packet Inn at Portland, Victoria, of 1841-2,<sup>88</sup> which is not merely a stud frame in the Australian sense but a balloon frame in the American sense, for the first time suggesting the possibility of some direct or indirect connection between Australia and the United States. It is constructed of pit-sawn timber imported from Tasmania, averaging 95 x 68 mm in size, or a nominal 4 x 2<sup>1</sup>/<sub>2</sub> inches, with some lighter timbers for top plates and jack rafters. The studs run the full height from top to bottom plate, with a 95 x 65 mm ledger halved in flush to the inside face. A 19 x 90 mm brace is let into the inside face of the studs, but stops short of the ledger and does not triangulate the full panel. The studs are tenoned to the plates, and the ground floor joists rest on top of the plate as in all earlier examples.<sup>89</sup> How is not explicit about the corner posts or studs, which could be an indication of whether the building should be seen in the context of earlier buildings like Lonsdale's cottage. Now before considering other Victorian examples it is necessary to make a point about the three so far discussed. Lonsdale's cottage

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<sup>87</sup> Paul Sprague, personal communication, 27 November 1998.

<sup>88</sup> The precise date is a matter of some contention, but Cash proposes that construction of the inn or some associated building began soon after April 1841, when the bulk of the materials arrived from Tasmania. It must have been substantially complete when the licence was granted on 19 April 1842, and probably fully complete when it opened for business on 1 July 1842. Ref Damien Cash, 'Former Steam Packet Inn, Portland: Historical Notes' (no place, 2000), pp 3-4.

<sup>89</sup> Christopher How, 'Translated Tradition in the Portland Bay Settlement. Traditional Timber Framing Techniques in a Cultural Development - Some Features Revealed in the Steam Packet Inn, Portland, Victoria, Australia', in Malcolm Dunkeld et al [eds], *Proceedings of the Second International Congress on Construction History* (3 vols, Cambridge 2006), II, especially pp 1602-3.

was manufactured in Sydney, and although the other two were both built in the Port Phillip District (now Victoria) they were unconnected, and in fact the Steam Packet Inn is effectively a Tasmanian building. It seems clear that these lighter framing techniques were already widespread in at least some British colonies, and that if they can ever be attributed to a single invention it will prove to be one of a much earlier date, and will have little to do with Chicago in 1833.

In the main section of the Mills cottage, Port Fairy, of about 1845, a smaller brace measuring 70 x 18 mm is let into studs measuring 93 x 70 mm, spaced at 520 mm centres. This is likely to have been influenced by Tasmanian practice.<sup>90</sup> Bracing let into the studs also appears in two buildings at 'Warrock' near Casterton, Victoria, also believed to be built in the 1840s, but the idea is again unlikely to derive from any local context. The owner and builder, George Robertson, was a trained cabinetmaker, and apparently a competent carpenter, before he emigrated from Scotland. One of these buildings is a grain store thought to have been built in 1844, and has 93 x 74 mm studs, with 75 x 23 mm bracing of local redgum let flush into the outer face. The other building is a dairy/storeroom believed to date from 1845, where the studs are 70 x 50 mm and the bracing 70 x 20 mm, similarly let in.<sup>91</sup>

Peter Bell has investigated a cottage at Burra, South Australia, which he believes to date from 1849, where the external walls are of studs measuring 110 x 35 mm, with diagonal bracing of 70 x 40 mm let into either the inner or the outer face. The corner posts are not square, as is commonly the case, but are 110 x 75 mm. This is too small to take lathing in both directions, so the laths were placed in one direction and onto their face was planted a batten to support the lathing at right angles.<sup>92</sup>

In 1852 the Melbourne architect F M White prepared a design for a model national school, for the National Schools Board, and the nature of the construction has been partly reconstructed by Lawrence Burchell from the specifications and drawings.<sup>93</sup> It seems that the corner posts were again somewhat larger than the ordinary studs, which measured 3 inches by 4 [75 x 100 mm]. The diagonal bracing was of the same section as the studs, and Burchell shows them as being halved together, though this seems improbable. Apparently the jointing of studs and plate is not indicated, though Burchell proposes a mortice and tenon. The joists are 6 inches by 3 [150 x 75 mm], laid on the flat, and they lie on top of the wall plate in the manner of balloon framing. It is shortly after this that William Howitt describes the general run of jerry building in areas outside the control of the *Melbourne Building Act*, in terms which I have quoted above. Howitt's references to 'spars and joists about two inches by three' [50 x 75 mm], or 2 x 2½ [50 x 63 mm], and the basket-like character of the construction, indicate that the stud frame was in use on a large scale in ordinary building. In a surviving example of 1854-5, 'Wood Cot Park', Gippsland, discussed below, the joists likewise rest on the wall plate.

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<sup>90</sup> Miles Lewis, *The Construction of Mills Cottage* (Melbourne 1986), p 10.

<sup>91</sup> A R J Billman, 'The Timber Vernacular' (BArch, Deakin University 1992), pp 94-5, diagrams 51-4; pp 99-101, diagrams 60-64.

<sup>92</sup> Peter Bell, 'An Early Timber Cottage at Burra' [typescript], p 10; also, but without the relevant illustration, 'Continuity in Australian Timber Domestic Building', *Australian Journal of Historical Archaeology*, VIII (1990), p 6.

<sup>93</sup> Lawrence Burchell, *Victorian Schools* (Melbourne 1980) pp 46, 48.

Another Victorian description, of 1855, again has the structure placed upon stumps, and the joists resting on top of the wall plate. It states that:<sup>94</sup>

These framed houses are put together with quartering, or small pieces of timber about three inches by four [76 x 102 mm]. The lower plates are spiked down upon small posts sunk a foot or two into the earth, and rising about twelve or eighteen inches above it. The studs or upright timbers forming the walls of the house are then morticed into these plates below, and into a series of plates above. They are placed at a distance of two feet [600 mm] apart, and further secured by a few diagonal ties, proper openings being left for doors and windows. The flooring joists, which should be two inches by six [51 x 153 mm], with their ends resting on the lower plates, at the same distance apart as the studs; and the rafters, which support the roof, are the same size as the joists, and placed at intervals of the same distance.

At the Tide Surveyor's house at Moreton Bay [Brisbane], of 1858, the studs were of pine, measuring 4 by 3 inches [100 x 75 mm], and there is no specific reference to larger corner studs.<sup>95</sup> They were spaced at 18 inch [450 mm] centres, which is closer even than at Waitangi, and is the modern dimension. The studs were tenoned into the plates, and 'batten braces' were halved into the studs. In some examples the spacing is as low as sixteen inches [400 mm], and it would be interesting to know whether this is related to the period of importation of sawn pine plastering laths from the United States in the early 1850s. In America these laths came in a standard length of four feet [1.2 m], and thus constrained the spacing of the studs to sixteen inches<sup>96</sup> (or, presumably, two feet).

At the former Commercial Inn, Yarram, Victoria of 1854 or earlier, the south wall has bracing let in, but the north wall - which so far as we know is coeval - has the studs, 83 x 64 mm, entirely interrupted by the somewhat lighter bracing, 78 x 50 mm. Let-in bracing is found at nearby 'Wood Cot Park', a mysterious house of about 1854-5, which looks prefabricated but contains some Australian timbers. The studs are 250 x 103/115 mm, and the braces 72 x 21 mm.<sup>97</sup> The original Anglican church at Clunes, Victoria, was built in 1860 and moved in 1870 to its present site, where it serves as hall to the later church. It may well have been prefabricated, and is clad in vertical board and batten, which looks remarkably American, as has been mentioned above. The braces are lightweight and are let into the studs, which one presumes to be the original form, but there seem to be many wire nails of later dates, and it is hard to determine how much alteration has taken place.<sup>98</sup> By about 1890 the use of lightweight bracing simply let into the face of the studs had become the norm in

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<sup>94</sup> 'Rusticus' [W S Chauncy], *How to Settle in Victoria* (Melbourne 1855), pp 21-2.

<sup>95</sup> Don Watson, *The Queensland House* [typescript report] (Brisbane 1981), pp 5.3- 5.4.

<sup>96</sup> O B Maginnis, *How to Frame a House* (2nd ed, New York 1896), p 8, quoted in Sprague, 'Chicago Balloon Frame', p 51 [n 3].

<sup>97</sup> Inspected March 2005.

<sup>98</sup> The oldest nails from the cladding seem to be of two sorts, cut brads with the head to one side only, and a form of wire-cut nail with a very deep head tapering inwards slightly, like the frustrum of a cone.

Victoria, and is found in quite unpretentious buildings such as the gardener's cottage at 'Rio Vista', Mildura, of about 1891.<sup>99</sup>

Standards of construction which were acceptable in remote Queensland, or during the shortages and pressures of the gold rush, did not necessarily survive into quieter times. One must remember that even in Victoria many of the builders and architects active in the later nineteenth century had emigrated from Britain after the gold rushes, or arrived during them but did not begin practice until later, so that there was a strong tendency for conservative British practice to reassert itself. The house 'Barwon Bank' at Geelong, of about 1853-5, has studs and bracing of the same size, about 4 inches [102 mm] square, with the studs interrupted at the brace. At 'Cooma Cottage', Yass, New South Wales, the walling of the additions likewise has bracing which completely cuts the studs.<sup>100</sup> In a pair of houses built in 1854 it was required:

Frame the several partitions shewn heads sills quarters and puncheons deal 3 x 3 the quarters to be tenoned to both heads and sills and when the sills run in the same direction as the joists they are to have a sufficient number of [?budging] peices [*sic*]<sup>101</sup>

In Queensland the newer lightweight construction was specifically criticised by F J Coote in 1862:

The usual method of building a timber house is by an arrangement of the smallest possible scantling, not very scientifically braced ... An equal or less quantity of timber properly disposed would produce a far better effect and be more useful in securing an equable temperature within the building. In arrangements of this kind some of the half-timbered houses of Essex and Norfolk supply admirable examples ... in these houses the greatest care was bestowed on providing principal bearing posts and heads and cills of large scantling, so as to admit of the interstices being filled with light material with the least possible detriment to the general fabric.<sup>102</sup>

This argument for half-timbering was of course without any substance, for there was no difficulty in filling a lightweight frame in exactly the same way, which was indeed the nature of much of the brick nogging that will be discussed below. Coote was really doing no more than defending traditional British practice in defiance of the logic imposed by new local conditions.

The older part of 'Leschenault' homestead in Western Australia, believed to date from some time before 1874, notwithstanding the use in it of wire nails, is described by Robin Campbell as having 4 by 2 inch [100 x 50 mm] studs and 4 inch square studs at the corners, the latter tenoned to the plates. The bottom plate is 4 by 2 [100 x 50 mm]

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<sup>99</sup> Andrew C Ward & Associates, *"Rio Vista" Conservation Analysis* (no place, 1988), p 151, which illustrates the interior of the old chaff store, a part of the gardener's cottage.

<sup>100</sup> Information from Clive Lucas, 18 September 1990.

<sup>101</sup> Russell, Watts & Pritchard, 'Specification for ... dwelling Houses... at Elwood ... Joseph Docker', 13 December 1854, Docker Papers, Manuscripts Collection, State Library of Victoria, p 8.

<sup>102</sup> F J Coote, in the *Transactions* of the Philosophical Society of Queensland, I (1859-82) [John Oxley Library 500/9, quoted in a letter from Ian Evans, 4 June 1991.

and the top 4 by 3 inches [100 x 75 mm], and there is diagonal bracing. It is not clear whether all the studs are tenoned into the plates, or whether the diagonal bracing is let into the studs, halved into them, or cuts them.<sup>103</sup> 'Bishop's Lodge' at Hay, New South Wales, was designed by the English immigrant John Sulman, and built as late as 1888 still with the diagonals cutting the studs completely. A skin drying shed at Dysart House, Kempton, Tasmania, appears to be an interesting transitional example, in that the braces are of almost the same cross-sectional area, but are fully let into the studs - which is only possible because the wider dimension is in the wall plane, so that the necessary rebate is only about half the stud depth.<sup>104</sup>

At the Mills cottage, previously referred to, the rear wing is thought to date from the early 1840s. It has a flagged floor, so the location of the base plate is not at issue. But it also has a loft, and the wall studs are continuous through the ground floor and the short side wall of the loft. The loft floor is carried on a girt or ribbon let into the face of the studs, in the manner of the American balloon frame.<sup>105</sup> The 1890s wing of 'Barooga' homestead, New South Wales, has a ground sill upon which rest very heavy joists, and from which also rise the studs.<sup>106</sup>

Industrial buildings, especially mills, are amongst the few multi-storey timber buildings in Australia, and therefore are the examples where one might hope to find the American style balloon frame in its fullest form. And one does. The Rupanyup Flour Mill in the Victorian Wimmera was built in 1906 as a balloon frame with the studs running the full three storey height, spliced where necessary, and it may well be typical of other mills of the period. But it is less likely to be typical of timber construction generally, for two reasons. The first is that the use of long studs was essentially dependent upon rail transport, to which all these mills had (more or less by definition) excellent access. The second is that mill building was probably a fairly closed area of specialisation. The mills themselves were in chains under joint management, and the contractors were specialists, amongst whom there may well have been American or other immigrant carpenters. It is less obvious why in 1949 the Associated Fibrous Plaster Manufacturers of Australia were promoting two storey house construction using American-style framing using continuous studs and a ribbon.<sup>107</sup> The probable reason is that their diagrams were American derived, through plaster industry connections.

### *i. platform framing*

The platform frame may have been a very late arrival. A standard school drawing of the Victorian Education Department in the 1870s still has the joists coming over the plate,<sup>108</sup> as does the drawing for a school at Cocoroc, of 1898-9,<sup>109</sup> though portable

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<sup>103</sup> Robin Campbell, 'Leschenault House - Conservation: Preliminary Report' (typescript report, Fremantle 1985), p 4.

<sup>104</sup> Frank Bolt, *Forgotten Tasmania* (Kingston [Tasmania] 1992), p 64.

<sup>105</sup> \*\*\* Insert Lewis Conservation Analysis ref.

<sup>106</sup> Inspected January 2000.

<sup>107</sup> F W Ware & W L Richardson [eds], *Ramsay's Architectural and Engineering Catalogue* (2nd ed, Melbourne 1949), § 6.1.

<sup>108</sup> Burchell, *Victorian Schools*, p 112.

<sup>109</sup> Burchell, *Victorian Schools*, p 116.

panelised schools were - almost inevitably - of the platform type.<sup>110</sup> The form persists in 1911 in a student constructional drawing exhibited by the New South Wales Institute of Architects.<sup>111</sup> However we must infer that the platform frame had achieved some degree of acceptance towards the turn of the century. Robert Haddon published a diagram in 1908 of what he said was one of the most common forms of timber construction, and it shows lightweight bracing let into the inner face of the studs, square corner studs or posts, and the base plate resting on the joists in the platform frame manner.<sup>112</sup> This is the first explicit evidence of a conventional stud frame of the platform type in Australia, though it seems to have been implied even by James Nangle in his *Australian Building Practice* of 1900. Another platform frame is illustrated by Haddon in about 1910.<sup>113</sup> While it is impossible to date and specify each change in practice, it seems that the situation may be similar to that in Canada, where light framing techniques are reported to have appeared after 1910.

One advantage of the platform system is that vermin beneath the floor cannot enter the wall space because of the plate at this location which Haddon calls, and which is still called, a 'vermin plate'. Haddon calls the bearer below the joists at this point the 'bottom plate'. Square corner posts were to remain common for many years, but although they seem logical, because they conform to the width of the two intersecting walls, they present grave difficulties in fixing the inner lining. This is why it became more common in the twentieth century to use at each corner three of the normal sized studs so disposed as to provide space for fixing the lining in each wall plane. In the platform frame as illustrated by Haddon the wall frame rests directly on the joists, though he does not illustrate this, it became the practice to place the joists in pairs below any wall plates running in the same direction, so as to support their full width. Later, however, there was to emerge a cheaper version in which the whole floor was boarded, and the plates laid on top of the boarding. This meant that the double joists could be eliminated, as could a great deal of cutting of floorboards along the line of internal partitions, and it also gave the convenience of a solid platform to work upon during building operations. It was regarded, however, as a cheap and nasty expedient.<sup>114</sup>

### *j. skew nailing*

Despite its appearance at La Trobe's Cottage and elsewhere, skew nailing seems to have gone out of fashion during the later part of the century, no doubt because it was seen as a form of jerry-building. But it reappears in the 1890s in those buildings of the Western Australian Public Works Department, such as the Police Quarters at Cue, which were described as 'portable', though 'pre-cut' would have been a more accurate

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<sup>110</sup> Burchell, *Victorian Schools*, p 124.

<sup>111</sup> *Building*, p17 February 1911, p 56.

<sup>112</sup> R J Haddon, *Australian Architecture* (Melbourne, no date [1908]), p 327.

<sup>113</sup> Robert Haddon, 'Australian Planning and Construction', in G A T Middleton [ed], *Modern Buildings* (6 vols, London, no date [c 1910]), V, p 192.

<sup>114</sup> George Topham, *Be Your Own Builder* (Sydney 1952), p 103.

description.<sup>115</sup> In Victoria the milking shed at 'Dorfstedt', Poowong, built by Danes in 1898, has skew nailed stud walls.<sup>116</sup> Robert Haddon in 1908 indicated skew nailing as an alternative to the mortice and tenon, and the practice was established even before that.

By contrast, Nangle refers in 1900 to 'framed or stud walls', which are said to be those 'constructed with uprights of light scantling spaced at equal distances apart, and mortised into plates at bottom and top'. The studs are to be spaced at 18 inch [450 mm] centres and to be sized 4 x 2 inches [102 x 51 mm] if of pine, or 4 x 2<sup>1</sup>/<sub>2</sub> [102 x 63 mm] if of hardwood, except that those at the corners are square. The bracing is 3 by 1 inch [76 x 25 mm] let in flush.<sup>117</sup> This description remains virtually unchanged in subsequent editions, and even in 1944 there is no reference to skew nailing in Nangle,<sup>118</sup> though it must by now have been the more common practice. Bloomfield, undated but possibly about 1950, indicated housing and skew nailing as standard, with no reference to mortice and tenoning as an alternative.<sup>119</sup>

Despite the advent of skew nailing, the mortice and tenon joint also continued in use in some areas, especially in Queensland. A specification of the State Advances Corporation for Workers' Housing, in use in 1939, has three inch [75 mm] square studs in the single face walls, and in the angles of the double walls, all tenoned to the top and bottom plates and spiked.<sup>120</sup> Indeed, according to Bell the mortice and tenon continued even as late as the 1950s in North Queensland.<sup>121</sup>

### *k. origins*

Thus the evolution of the stud frame in Australia is very sporadic, and the development seems even to reverse at times. Although there is no one point of origin, the fundamental aspects arise as a result of local conditions - the simplification of the carpentry suits pioneering conditions and unskilled workmen, and then is made more practicable as cheap nails become available. The lighter framing members are called for by building materials shortages during the gold rushes, and they become more practicable as mechanical sawmilling becomes normal. But our builders and architects were to all intents and purposes British builders and architects, and tended to revert to conservative British practice when in doubt, or when dealing with a more substantial or important building. The first persuasive evidence of American

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<sup>115</sup> Information from Ingrid van Bremen of Fremantle, 1990, referring specifically to the police quarters at Cue of 1896, though she believes that skew nailing was used also in the standardised portable school and post office, drawings of which are held in the Battye Library.

<sup>116</sup> Miles Lewis, *West and South Gippsland: Best Old or Renovated Farm Building* ([Melbourne] 1985), p 3.

<sup>117</sup> James Nangle, *Australian Building Practice, Part 1* (Sydney 1900), pp 131-2.

<sup>118</sup> James Nangle, *Australian Building Practice* ([2nd ed], Sydney 1911), p 196; (3rd ed, Sydney 1925), p 197; (4th ed, Melbourne 1944), p 211.

<sup>119</sup> F C Bloomfield, *The Australian Carpenter and Joiner* (3 vols, Melbourne no date [c1950]), I, pp 268-9.

<sup>120</sup> Standard specification, 'State Advances Corporation / (Workers Dwellings) / (Workers Houses)', copy filled out in 1939, in the possession of Ian Evans, Brisbane.

<sup>121</sup> Bell, *Timber and Iron*, pp 42, 49.

influence is the photograph, referred to above, of what seems to be an American 'combination frame' being built at Bega, New South Wales, in 1898.<sup>122</sup>

There is no evidence to suggest a specifically American origin for the Australian stud frame, despite its similarity to the lightweight form of balloon frame developed in the United States. I had come to this view many years ago (on the basis of far less evidence than is here presented) and it is important to place this on record because my position has been somewhat churlishly misrepresented by Peter Bell. In 1972 I said:<sup>123</sup>

The balloon frame, which is very much the same thing [as the Australian stud frame], made its tentative appearance in the United States in 1833, and many have surmised that the Australian stud frame developed from this source, and particularly as a result of American migration to Australia during the gold rushes. There is, however, no evidence to support this, and in fact such evidence as there is tends to support the existence of stud framing before the gold rushes, and possibly before 1833.

Bell, in his *Timber and Iron*, entered into a detailed if confusing discussion<sup>124</sup> which included reference to my own thesis and came to essentially the same conclusion, but he later made the claim that 'Before the publication of *Timber and Iron* and an earlier article derived from it, conventional wisdom amongst Australian architectural historians had it that the Australian stud frame was derived from the American 'balloon frame' imported from California during the 1850s gold rushes.' He ignored the facts that I had twelve years earlier made the same point; that he had used and acknowledged the thesis in which I had made the point; and that I actually had to argue him around to the view.<sup>125</sup>

The only aspect of this that should be of importance to future readers is that our conclusions - at least in relation to the lack of any American influence - are in fact the same. As Bell says:<sup>126</sup>

If it is simply the light stud frame renamed, the balloon frame is a cousin, not an ancestor, of the Australian stud frame. If it is a frame of studs unbroken from foundation to roof, its origins lie in Britain, not the United States ... If it is merely a polite term for skew-nailing, then a massive confidence trick has been played by American architectural historians, for a shoddy device for hasty,

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<sup>122</sup> Morton's photo studios, corner Camp and Canning Streets, Bega, worked on by Frank Zinger and his father. Mitchell Library videodisc 02286.

<sup>123</sup> Miles Lewis, 'Tradition and Innovation in Victorian Building 1801-1865' (3 vols, PhD, University of Melbourne 1972), I, p 161.

<sup>124</sup> Bell, *Timber and Iron*, pp 41-59.

<sup>125</sup> His stance had been almost precisely the opposite in his interim report of 1979, about which I wrote to him on 6 August (in what was actually a friendly letter):

I am positively enraged that you virtually ignore my suggestions about exposed framing and make vague attempts to draw a Californian connection. Surely you should accept

(a) that a mortised and tenoned joint is a normal British form;

(b) that standardised light scantling is a normal result of nineteenth century power sawmilling and cheaper nails, and was as much a characteristic of the Victorian goldfields as of California.

<sup>126</sup> Bell, *Timber and Iron*, p 59.

cheap construction has successfully been passed off as a major technical innovation.