

3.04 Origins of *Pisé de Terre*

- a. Carthage to Rome
- b. France
- c. François Cointeraux
- d. Britain
- e. dissemination
- f. the twentieth century

a. Carthage to Rome

Pisé de terre is made by ramming loam mud into *in situ* formwork very similar to that used for mass concrete. It is found in many Mediterranean and Near Eastern countries, and is a traditional form in Zhejiang Province of China.¹ More likely to be of direct relevance to Australia is the south of China where there is to be found a tradition which may be either Chinese or Iberian in origin, or a merging of the two. The older houses of Macau, as well as the city wall, are of *pisé*, and by 1842 the method was regularly used in Hong Kong, where:²

... for large buildings such as barracks, where space and solidity are the principal considerations, a material made of common soil or disintegrated rock, sifted and mixed with lime, then pounded between strong boards into solid walls, seems as good as anything else, and costs about half what brick or stone would do.

Pisé was known to the Phoenicians and remarkably enough, its unbroken line of descent from this source can be traced down to its ultimate appearance in Australia. In his *Natural History* Pliny refers to walls in Africa and Spain

... that are called framed walls (formaceos), because they are made by packing in a frame enclosed between two boards, one on each side, and so are stuffed in rather than built, and do they not last for ages, undamaged by rain, wind and fire, and stronger than quarry-stone?

He mentions watchtowers and earthen turrets of this sort that were built by Hannibal in 221-229 BC when he was preparing for war on Rome, and which in the first century after Christ could still be seen.³ There seems to be no clear evidence of *pisé*

¹ R G Knapp, *China's Vernacular Architecture* (Honolulu 1989), pp 31, 88-9.

² *Hong Kong Gazette*, 1842, quoted in Malcolm Purvis & John Warner, *Tall Storeys* (Hong Kong 1985), p 19.

³ Pliny the Elder [Caius Plinius Secundus], *Natural History*, book xxxv, ch xlvi: the translation quoted is N Rackham's in the William Heinemann edition, IX (London, 1952), pp 384-5. Robert Stuart, *Dictionary of Architecture*, (3 vols, London, nd [1832]), sv Wall, states that the Romans learnt the method from the Carthaginians, and the same proposition is made (as if it were a new hypothesis) by Richard Delbrueck, *Hellenistische Bauten in Latium, &c* (Strassburg 1907), pp 384-5. A *pisé* building more than a thousand years old was reported to be still standing at Ceuta in Africa; *Ecclesiologist*, IX (new series VI) (1848), p 219. The method was still in use in Africa during the nineteenth century and was said to be common in the kingdom

in Spain or France before the time of Hannibal,⁴ and the reasonable inference seems to be that the inhabitants learnt it from the invaders.

Pliny does not himself say that the Romans built in this way, but Palladius (whose own estates were in Italy and Sardinia), says in *De Re Rustica* that all gardens should be enclosed, and that some people use mud enclosed 'in formis' to imitate brick walls, or mud stone where the materials are available.⁵ Varro also mentions fences of earth and gravel formed in a mould, which were to be seen not only in Spain, but in the area around Tarentum in South Italy.⁶ Such a description might refer to cob placed between shuttering, but pisé is a better documented technique in relation to Rome, and is intrinsically more probable. In England a Roman building at Verulamium [St Albans] has been found to have wall bases of flint in lime mortar, finished on top with transverse grooves for putlocks, and here again the best interpretation is that this was for pisé construction.⁷

However we read this evidence, pisé is certainly closely related to Roman concrete construction, and it seems to have persisted in its original form in post-Roman Italy, Spain and southern France. It seems that watch towers made of stones, mortar and rubble rammed into a frame survived into the nineteenth century, and that this type of construction had been continued by the Goths under the name of *formatium*. Isidorus refers to *formarium*, or *formarium opus*, and the word *forma* [or mould] in Spanish still means a mud wall.⁸ But pisé in particular is called *tàpia*, from what is said to have been the north African word for a mud wall, *tabut*, and the Arabic *tabiya* for an earth wall.⁹

of Barra, *Builder*, VIII, 411 (21 December 1850), p 610, quoting *Seven Years' Service on the Slave Coast*.

⁴ J F Arellano, 'Earthen Industrial Buildings in the Canal of Castilla: Eighteenth and Nineteenth Centuries', in Malcolm Dunkeld et al [eds], *Proceedings of the Second International Congress on Construction History* (3 vols, Cambridge 2006), I, p 243. mentions only Pliny, Varro and Isidore amongst early sources. Hubert Guillaud & Alejandro Alva, 'Historical Earthen Architecture and Construction in the Mediterranean Region. What future for such an exceptional cultural legacy?', in Santiago Huerta [ed], *Proceedings of the First International Congress on Construction History* (3 vols, Madrid 2003), II, date the first known pisé in Gaul to the 3rd-2nd centuries BC.

⁵ Wyatt Papworth [ed], *The Dictionary of Architecture* (London 1853-92), sv Formaceum or Formarium Opus.

⁶ Marcus Terentius Varro, *De Re Rustica*, book i, ch xiv, 4: 'ex terra et lapillis compositis in formis, ut in Hispania e(t) agro Tarentino.' See M E Blake, *Ancient Roman Construction in Italy from the Prehistoric Period to Augustus* (Washington 1947), p 325. Lloyd Storr-Best, *Varro on Farming* (London 1912), p 45, reads it as 'ex terra et lapidibus', refers to this type of wall as being of concrete - which seems somewhat unjustified - and identifies the form of construction as the same as the traditional English flint wall. This is perhaps a more reasonable interpretation, and it may be safer to assume that Varro refers not to rammed earth, but to earth and stones placed in formwork like concrete.

⁷ L F Cave, *The Smaller English House: its History and Development* (London 1981), p 20, interprets this as being for cob, and assumes that it was made from clay, but in fact most cob (contrary to Cave) was built without formwork even at later dates.

⁸ Papworth, *Dictionary of Architecture*, svv Formaceum, Pisé; William Smith, *A Dictionary of Greek and Roman Antiquities* (2nd ed, London 1848 [1842]), p 47.

⁹ J F Arellano, 'A Review of Historic Use of Earth in Construction in the Iberian Peninsula', *CHS Newsletter*, 74 (August 2006), p 16.

b. France

The modern use of pisé is mainly attributable to its rediscovery in France. Jean-Baptiste Rondelet, who worked on the restoration of a pisé building in 1764, did not publish the fact until his *Traité de l'Art de Bâtir* appeared in 1812,¹⁰ but it is worth noting that a recently published house near Valence¹¹ is almost identical with Rondelet's illustration,¹² which in its own turn certainly reached Australia. The formal rediscovery of pisé came in 1772 when Georges-Claude Goiffon published a treatise *L'Art du Maçon Piseur*, both as an article in Rozier's *Journal de Physique*¹³ and as a separate volume,¹⁴ in which he described the method and extolled its virtues. He pointed out that it was still in use in Lyonnais for houses of two and three storeys, the better ones being roughcast with lime mortar, and also in neighbouring provinces including Dauphiné, where the earth was so plastic that it set as if it had been polished, so that roughcast was not normally required. He was able to cite an example of pisé, over seven metres high, which was still in good condition although it was 150 years old.

Goiffon recommended that the panels of boarding which formed either side of the form work be 760 mm high and no less than 1.7 metres or more than 4 metres long, a good typical length being 2.4 metres. These panels rested on edge on putlocks passing through the wall at 81 centimetre centres, and they were kept from falling outwards by upright members fitted into mortices provided at either end of each putlock, and tied across in pairs at the top by loops of twisted rope. Small struts between the panels at the top prevented them from falling inwards. The foundation was built up in masonry, and before any earth was placed in the mould a bed of lime mortar was laid over the masonry base. The earth was placed in thin layers, and beaten by a workman standing in the mould and using a *pison*, an implement consisting of a wooden head connected to a handle about 1.2 metres long, with which he beat the earth between his feet and just ahead of him. Unless the mould finished at the end of a section of wall, in which case it was closed with a vertical panel, each successive layer of earth placed in it was stepped back slightly from the end, so as to form between them a rising joint which was sloping rather than vertical. All rising joints, as well as beds, were differentiated with a layer of mortar, so that the overall effect was like some sort of massive Cyclopean masonry. Woods, an Englishman travelling in France in 1816, described pisé he had seen in the area south of Lyons as¹⁵

... formed into blocks in a sort of mould on the work itself, and separated by pretty thick beds of mortar. In some districts the blocks are pretty regular

¹⁰ Jean-Baptiste Rondelet, *Traité Théorique et Pratique de l'Art de Bâtir* (6 vols Paris), I, p 229.

¹¹ Jean Dethier [compiler], 'On Architecture in Raw Earth' (exhibition mounted by the Centre Georges Pompidou, Paris, 1981), no 29. The illustration is not included in the book published after the exhibition.

¹² Rondelet, *l'Art de Bâtir* p pl VI.

¹³ G C Goiffon, 'L'Art du Maçon Piseur', in *Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts*, I (March 1772), pp 682-697.

¹⁴ Goiffon, *L'Art du Maçon Piseur* (Paris, 1772).

¹⁵ Joseph Woods, *Letters of an Architect in France, Italy and Greece* (2 vols, London 1828), I, p 136.

parallelopipeda [*sic*], about 6 ft long and 3 ft thick; in others they are very irregularly shaped.

Though Goiffon's account was a great deal more detailed than the description above would suggest, the Abbé Rozier considered it neither clear enough nor systematic enough to repeat in his *Cours Complet d'Agriculture*. He had recently discovered that pisé was as much use in Catalan Spain as in Lyonnais and Dauphiné, while at Barcelona in particular the normal practice was to build outside walls of stone and inside ones of pisé. Its use in France extended over a large area, from the county of Avignon as far north as Tournus in Burgundy. All this information Rozier put forward in an introductory footnote to the article on pisé in his *Cours Complet*, which had been written for him by one Boulard, building inspector of the town of Lyons.¹⁶

While Goiffon had been somewhat uncertain of how to select a good pisé earth, Boulard asserted that any soil could be used except for a clayey one, which would crack, or a sandy one, which would not bind. The best was a 'strong' earth such as could be moulded by the hand, but without sticking to the fingers; it should not contain organic matter such as roots or dung, which would impede the consolidation of the pisé and would subsequently rot out and leave voids, but so long as it was a good soil it would be improved by the presence of small gravel. He recommended a standard formwork panel or *banche* of 2.7 by 0.8 metres, and he described an alternative method in which the rising joints were vertical rather than sloping; this was more quickly carried out, but it was not so strong and the joints could not be made tight, so it was recommended only for farm walls. To reinforce the corners he recommended, much as Goiffon had done, the formation of quoins of mortar, 8 centimetres thick, and between 45 and 60 centimetres square, which should alternate with 8 centimetre layers of pise.

Boulard put forward various refinements applicable to house construction, such as to internally reinforce each *banchée* - the block of pisé produced by one set of formwork - with planks of fir, one of which was laid longitudinally at mid-height, and four transversely, a pair at quarter height and another pair at three-quarter height. While Goiffon had recommended that all but the largest doors and windows be cut out after the pisé work was complete, Boulard favoured leaving the openings and building in stone dressings and lintel as soon as head height was reached. Boulard's other major contribution was to place at the level of each story a set of planks, running centrally along each wall and halved and nailed together at the junctions to tie the whole building together. Differences such as this give the impression of being inspired suggestions rather than the result of a closer observation of existing practice, and Boulard's main concern must have been to differentiate his account from Goiffon's sufficiently to avoid a charge of plagiarism. Sentences, and indeed whole paragraphs of Goiffon are used, in different places and a different order, sometimes to the detriment of the overall sense. There are further variations in Rondelet's account,¹⁷ but as it was published only in 1812, it need not be further considered here.

¹⁶ F P Rozier, *Cours Complet d'Agriculture* (10 vols, Paris, 1793-1800), VII (1787), sv Pisai ou Pisé.

¹⁷ Rondelet, *l'Art de Bâtir*, I, pp 230-9 & pl V.

c. François Cointeraux

The definitive account of pisé construction was neither Goiffon's nor Boulard's, but that of a third writer of intermediate date, François Cointeraux, a prolific writer on matters of rural building.¹⁸ Cointeraux's attention was drawn to the subject when he demolished some pisé houses at Lyons which appeared from their title deeds to be 165 years old, and after publishing a description which was partly derivative from Goiffon, he went on to publish separately his own, improved method of pisé construction.¹⁹ It was the former of these works which introduced pisé to the English-speaking world, and the main features of which must now be summarised. Cointeraux's works were also published in German,²⁰ whilst in Italy, though they were not directly translated, they inspired the content of a work published in Florence in 1793 and generally believed to be by Giuseppe del Rosso, *Dell' Economica Costruzione delle Case di Terra*.²¹ Thomas Jefferson is known to have owned at least one of the books,²² but thought the method unsuitable for local use.

Cointeraux's description of suitable earths was the source of Boulard's, but he also listed a number of characteristics which would help to identify a satisfactory earth, such as the presence of the burrows of field mice, and various tests which could be done if necessary. The soil had to be dug up with a pick, the clods broken up, and any stones larger than a walnut raked out; it must be neither too wet nor too dry, and if necessary water was added. All this was much in accord with Goiffon, but not so his recommendation that unsuitable soils should be mixed to produce something usable - a clayey soil with a chalky or sandy one, and a rich earth with a poor one. Goiffon had recommended, where only a limited amount of good soil was available, that it be used in the lower courses where strength was required rather than diluted by mixing: Boulard had adopted an intermediate position.

The foundation wall was built up in 450 mm brick or masonry to a height of 600 mm above ground level, to protect the pise from rising damp and from the splashing of water dripping from the eaves. The putlocks were placed on it at 920 mm centres (as opposed to Goiffon's 760 mm and Boulard's 890 mm) and the masonry built up a further 160 mm between them, so that when the sides of the formwork rested on the putlocks they overlapped the top of the masonry by 80 mm. These sides consisted of two panels of tongued and grooved deal boards, 25 to 30 mm thick, assembled to a width of 890 mm and held together by six or eight ledges running transversely across the outer face. The putlocks or joists measured 1.1 metres by 80 mm by 90 mm, and

¹⁸ A bibliography produced at Grenoble, kindly provided by Peter Myers, credits Cointeraux with sixty-nine publications, though many are small, and/or are re-issues of the same text under different titles.

¹⁹ Cointeraux's writings on pisé are found in the four *cahiers* of his *École d'Architecture Rurale* of 1790-1, and in two further publications of 1806. The present account is derived from Henry Holland's translation, in the Board of Agriculture, *Communications*, I, part iv (1797), pp 387-401, of the first *cahier*: *École d'architecture Rurale, ou Leçons par lesquelles on apprendra soi-même à bâtir solidement les maisons de plusieurs étages avec la terre seul ... (1er cahier) - Constructions économiques pour les campagnes ou bâtiments incombustibles* (Paris 1790 [?]).

²⁰ Jean Dethier, *Down to Earth* (New York 1983 [Paris 1981]), p 190, cites François Cointeraux, *Schule der Landbaukunst* (Hildberghausen [Germany] 1793).

²¹ Hugh Pagan Limited, *Architecture Catalogue No. 20* (London 1994), p 16.

²² Elton Engineering Books, *Catalogue Number 14* (London 1999), p 18.

had 270 mm mortices at either end to accommodate the tenoned ends of the vertical posts. These were about 1.5 metres high, so as to extend well beyond the top of the side panels, which were placed in between with their lower edges resting on the putlocks.

Wherever the wall came to an end or a corner, or an aperture was to be formed in it, the mould was closed by a transverse piece made of deal, not quite rectangular but tapering 15 mm on one side, so that the outer face of the wall would have a batter, and each course would be 15 mm narrower at the top than the bottom. The batter was also provided for, as it in fact was in Goiffon's and Boulard's descriptions, by adjusting the small wedges which held the outer one of the upright members in the mortice of the putlock. At the top of the mould there was once more a small strut or 'wall-gauge' jammed crosswise between the two sides to determine the correct width, and above it a loop of cord connecting the tops of each pair of upright members, a stick being twisted in it until it pulled the two sides tightly together.

The workmen stood inside the mould and placed the earth in 80 to 100 mm layers, beating it down with the blunt-headed rammer which is now referred to as a *pisoir* rather than a *pison*. When the mould was filled up it was dismantled and moved along the wall so as to overlap the completed section of the work by 25 mm: here was a major difference in Cointeraux's description, for the work had been carried up almost vertically, rather than on the slope, at the end of the mould where no closing panel was used. No mortar joint was made, and the next length of *pisé* was said to unite perfectly with the preceding one, with no visible junction. Nor does Cointeraux mention any horizontal beds of mortar on the foundation wall and between courses, but only the small layers placed in the quoins at 150 mm intervals to imitate dressed stone quoins. In the top of each course were cut 150 mm deep by 90 mm wide grooves to take the formwork for the next, but they were not located immediately over those below, but mid-way between, so as not to weaken the wall; the vertical joints between the formed sections were likewise staggered.

For each successive course the closing panel or head piece of the mould had to be planed down, so that where the first course had tapered from 460 to 445 mm, the second tapered from 445 to 430 mm, and so on in subsequent courses, the top of a two-storey, six course wall being 380 mm thick. Cointeraux's provisions for reinforcing the work with timber were less elaborate than Boulard's but he did recommend that a rough-sawn board, 200 to 250 mm wide and 1.5 to 1.8 metres long, be laid between courses at corner and wall junctions; also that at mid-course height, especially if the earth was poor, off-cuts of plank 250 to 280 mm long (so as to leave a few centimetres of earth covering them) be laid transversely at about 600 mm centres to spread the load. Like his predecessors he described ways of building in timber plates to support flooring and roofing timbers. The holes left for the putlocks were not stopped up immediately, as they helped the wall to dry out; this drying took about six months, and then the surface of the wall was scabbled, loose dust removed with a stiff brush, and roughcast or stucco laid over it, the workmen stopping the holes with stones or old plaster as they went. One *pisé* building by

Cointeraux himself is known to survive, though in decrepit condition: the former Hôtel Maccabbes, in the St-Just district of Lyon, now a motor repair shop.²³

d. Britain

In England the well-known neoclassical architect Henry Holland had already begun promoting pisé, and had used it at Woburn Abbey for the construction of the 'hovels' for the labourers in 1787-8. These were stuccoed and decorated with fresco painting,²⁴ a traditional French mode of finishing pisé which was mentioned by Boulard, but not by Goiffon, and which therefore suggests Boulard as Holland's source of inspiration. Indeed Holland's clerk of works, Robert Salmon, was to become architect to the Duke of Bedford and lived in a small pisé house which he had himself built in Woburn Park.²⁵ In 1797 Holland reported the success of this experiment in an article on cottage building in the first volume of the *Communications* of the Board of Agriculture. As an appendix was attached Holland's translation of Cointeraux's work, and in the same volume there appeared a letter from Jaucour, a French clergyman and a refugee from the Revolution, describing the particular method of pisé building with which he had been familiar at Montbrison, in one variation of which the individual courses were as shallow as 150 mm.²⁶ In 1815 Cointeraux visited England and built a demonstration house, upon which an account of his method was published by the Royal Society of Agriculture.²⁷

Pisé became increasingly known in progressive agricultural circles. In 1804 Edmund Bartell, misled by the name, initiated the fallacy that this construction originated in Pisa, by referring to it as 'The method of building cottages at Pisa, in Italy'.²⁸ In 1805 J M Gandy published his *Designs for Cottages*, in which a number of designs were said to be suited to pisé construction,²⁹ and his *Rural Architect*, with more farm buildings in pisé.³⁰ Pisé was described in William Barber's *Farm Buildings* of about

²³ Information from Peter Myers, 2006.

²⁴ Dorothy Stroud, *Henry Holland* (London 1950), p 35.

²⁵ Humphry Repton [ed Anne Gore & George Carter], *Humphry Repton's Memoirs* (Norwich 2005), p 70.

²⁶ Board of Agriculture, *Communications*, I (1797), Holland's translation, 'Pisé, or the Art of Building strong and Durable Walls, to the Height of Several Stories, with nothing but Earth, or the most common Materials' in the Appendix, pp 387-401, relates to his article 'On Cottages' in Part ii, p 79 ff. Jaucour's letter to the Under Secretary of the Board of Agriculture, London, dated 14 June 1797, also appears in part ii, pp 403-4.

²⁷ Elton, *Catalogue 14*, p 18. It is here stated that Cointeraux is referred to in writings such as those of Plaw, Papworth and William Barber. These do discuss pisé, but I am not aware that Cointeraux is mentioned by name in any other English work except Papworth's *Dictionary of Architecture*, referred to above.

²⁸ Bartell certainly had no information from Italy. He referred to the *Communications* of the Board of Agriculture, to the introduction of the material by the late Duke of Bedford [at Woburn Abbey] and to its use in Ireland: Edmund Bartell, *Hints for Picturesque Improvements in Ornamented Cottages, &c* (London 1804), pp 119-121.

²⁹ J M Gandy, *Designs for Cottages, Cottage Farms and other Rural Buildings; including Entrance Gates and Lodges* (London 1805), p x.

³⁰ J M Gandy, *The Rural Architect, consisting of various Designs for Country Buildings* (London [check 1805]), cited in Gavin Stamp, "'At Once Classic and Picturesque ...': Alexander Thomson's Holmwood", *Journal of the Society of Architectural Historians*, LVII, 1 (March 1998), p 51. These were of a rather severe, monumental and abstract character, which is probably attributable to the constraints imposed by the technique, though these designs have

1805,³¹ William Atkinson's, *Views of Picturesque Cottages* of 1805,³² in Pocock's *Architectural Designs*, of 1807,³³ and in the *Farmer's Dictionary*.³⁴ It was described in Lugar's *Country Gentleman's Architect* of 1807 as being very proper for cottages and capable of bearing 'a stucco, or colour' if open to the sun and air, though not suited to a confined, low or damp situation,³⁵ and J B Papworth in his *Rural Residences* of 1818 recommended it for use wherever several labourers' cottages were to be built at once.³⁶

Joseph Wood, writing in 1816, describes the pisé he saw in France, south of Lyon. He suggests that the method is probably unsuited to a climate so wet as England's, and gives no indication that he is aware of the experiments which had already been made.³⁷ It does not appear that pisé had become common in Britain, but rather that it was a system favoured by the agricultural improvers and writers of the day. In 1819 Abraham Rees published his influential *Cyclopaedia or Universal Dictionary of Arts Science and Literature*, with a detailed description and illustrations derived from Cointeraux by way of Holland, and making some reference to Jaucour ['Jancour'],³⁸ and in the same year Peter Nicholson published his *Architectural Dictionary* with a version of the same description, and the same illustrations, redrawn.³⁹ The method was then described in William Wilds's *Cottages and Houses for the Humbler Classes* of 1835 mainly based upon Holland and Jaucour, by way of Nicholson's *Architectural Dictionary*, and favouring forming the quoins and the door and window jambs in brick or stone.⁴⁰ James Flitcroft, the source of our information on Rose Hill Villa, was influenced by Wilds's account and, having seen building work using the 'trough' (shuttering) near Winchester, he admitted that 'the walls were very much better than

has been interpreted by Summerson as 'sharp prophecies of functionalism and cubism': John Summerson, 'The Vision of J M Gandy', in *Heavenly Mansions* (London 1949), p 123, quoted by Stamp, p 51.

³¹ William Barber, *Farm Buildings: containing Designs for Cottages, Farm-Houses, Lodges, Farm-Yards, &c. &c ... Also a Description of the Mode of Building in Pisé, as adopted in several Parts of France for many Ages; which would be attended with great Advantage if practised in this Country, particularly in cottages and Farm-Yards* (J Harding, c 1805).

³² William Atkinson, *Views of Picturesque Cottages with Plans, &c* (London 1805), pp 14-15.

³³ W F Pocock, *Architectural Designs for Rustic Cottages, Picturesque Dwellings, Villas, &c* (London 1807), p 6.

³⁴ Vol II of the *Farmer's Dictionary* is said to have plans and elevations of pisé cottages: Abraham Rees, *The Cyclopaedia, or Universal Dictionary of Arts, Sciences and Literature* (45 vols, London 1819) sv Pisé.

³⁵ Robert Lugar, *The Country Gentlemen's Architect* (London 1807), p 2.

³⁶ J B Papworth, *Rural Residences* (London 1818), p 15. Papworth's description is based on Holland, though he gives the height of the foundation wall as only eighteen inches (0.46 metres), and mentions that 'a greatly improved operation of pise walling has since been published': here he undoubtedly refers to Cointeraux's improved version of 1806.

³⁷ Joseph Woods, letter of 11 July 1816, in *Letters of an Architect in France, Italy and Greece* (2 vols, London 1828), I, p 136.

³⁸ Rees, *Cyclopaedia*, sv Pisé. The plate is dated 1817.

³⁹ Peter Nicholson, *An Architectural Dictionary, containing a correct nomenclature and derivation of the terms employed by architects, builders, and workmen &c* (2 vols, London 1819), II, pp 526-534 & pl I. The plate is dated 1818. Remarkably the 1852 edition, which purported only to expand upon the original, reduced all this to a token paragraph: Peter Nicholson [ed Edward Lomax & Thomas Gunyon], *Encyclopedia of Architecture, being a new and improved edition of Nicholson's Dictionary, &c* (London 1852 [1819]), II, p 298.

⁴⁰ Wilds, *Cottages and Houses*, chapters 1 & 11, passim..

those done without it, and had a much better face to receive the coating'.⁴¹ The circle is nicely closed by the article on pisé in Tomlinson's *Cyclopaedia of Useful Arts*, a work widely read in Australia.⁴² Tomlinson's account clearly derives ultimately from Cointeraux, but is illustrated with Rondelet's view of a pisé house, printed in reverse.

The French tradition did not enjoy a total monopoly in England, for there was some reference back to northern Africa, the original source of the construction. Rev J C Wright, rector of Walkern in Hertfordshire, had apparently seen pisé work in Africa, and at his rectory he built a pisé school, garden walls and outhouses. Under his guidance the Rev Langlands, at nearby Aston, built before 1835 a combined schoolhouse and dwelling measuring 15 metres by 8 metres, and published a detailed description of the method in the *Ecclesiologist* in 1848.⁴³ These buildings must have inspired the writer in the *British Magazine* in 1836 who proposed pisé as a cheap method of building churches, one of which, 'executed in a good substantial and workman-like manner', had cost £460.⁴⁴ There was thus a minor revival in England of actual building in pisé, as opposed to writing about it. In 1849 the *Builder* reported pisé work at Enrys and Penrose in Cornwall, where it was supposed that an 'artificial pisé' gravel' had been used because no suitable material occurred locally.⁴⁵

There were also attempts to improve the system. At the Great Exhibition of 1851 C B Allen exhibited a 'model of a labourer's cottage, with improvements in construction to lessen expense.' The external walls were of pisé, with quoins and dressings of brick, and the internal partitions were of hollow brick.⁴⁶ In his book *Cottage Building* of 1853 Allen once again made reference to Wilds, but described his simplified construction in which the shuttering was simply two planks held together with bolts, the lower ones being withdrawn when the planks were raised, and re-inserted so as to rest across the top of the finished section. He further prescribed that the base wall should be about 150 mm wider than the pisé work itself, and should be finished in a damp-proof course of Roman cement, stone or tile.⁴⁷

e. dissemination

Although Thomas Jefferson had dismissed pisé as unsuitable for North America, François Cointeraux wrote in 1792 to President George Washington, offering to teach the method to settlers. He received no recorded response,⁴⁸ but in 1806 Samuel

⁴¹ *Builder*, I, 22 (8 July 1843), p 266. Of subsequent accounts, Wyatt Papworth's *Dictionary of Architecture*, sv, follows J B Papworth's brief version, but also makes reference to Burns, *Mechanical Arts* (2nd ed, Edinburgh 1860), pp 124-130.

⁴² Charles Tomlinson [ed], *Cyclopaedia of Useful Arts and Manufactures* (published in parts, London, nd [c 1852]), sv Pisé.

⁴³ *Ecclesiologist*, IX (new series VI) (1848), pp 216-219; Wilds, op cit, p xxiii.

⁴⁴ *British Magazine*, July 1836, cited in B L F Clarke, *Church Builders of the Nineteenth Century* (London 1938), p 27.

⁴⁵ *Builder*, VII, 326 (5 May 1849), p 211.

⁴⁶ London, Great Exhibition of the Works of Industry of all Nations, 1851, *Official Descriptive and Illustrated Catalogue* (3 vols, London 1851), II, p 768.

⁴⁷ C B Allen, *Rudimentary Treatise on Cottage Building* (London 1854 [1853]), pp 31-2.

⁴⁸ Gardiner Hallock, 'Pisé Construction in Early Nineteenth-Century Virginia', in Jan Jennings & Pamela Simpson [eds], *Perspectives in Vernacular Architecture, XI* (Lexington [Virginia] 2004), p 40.

Johnson (an American of that name), published his *Rural Economy*,⁴⁹ with a description of pisé derived from Holland's translation of Cointeraux. Justice Bushrod Washington, nephew of the president, inherited Mount Vernon in 1802, and between 1810 and 1815 constructed seven pisé buildings under the guidance of Johnson's book. But what he built might be regarded as cob rather than pisé, for by his own account he used clay as the raw material, and added water to it during compaction, totally contrary to good pisé practice. The predictable cracking occurred, so he tried a more sandy mix. Washington was followed by his associate, General John Hartwell Cocke, who likewise took Johnson's book as a text when building slave quarters at 'Bremo Recess' in 1815, followed by others at 'Bremo', 'Pea Hill', then followed by his son at 'Four Mile Tree Plantation'. Cocke also used clay, and still worse, added straw to the mixture.⁵⁰ Another American edition of Holland's translation was published in 1821 by the American Farmer, Baltimore.⁵¹

C B Allen's description was transcribed almost verbatim by John Bullock in *The American Cottage Builder*, except that the reference to the use of gravel in pisé causes Bullock to make a somewhat misleading cross-reference to his chapter on octagonal houses.⁵² This comes about because Orson Fowler, the promoter of the Octagon Cottage, described it as the 'gravel wall' mode of building, though in fact it was a form of concrete, as is discussed below, rather than of pisé. While pisé was a part of the existing Spanish tradition in California and New Mexico, there is not much indication that the nineteenth century revival caused it to spread into the north or east of the United States.

It was only three or four years after Abraham Rees's publication, and at least partly under his influence, that pisé made its first appearance in Australia, as will be discussed below. Immediately after this, and possibly also inspired by Rees's publication, pisé was used for many of the houses in Salem, South Africa (though the practice seemingly ceased as a result of flooding which occurred in 1823):⁵³

the walls, which were to be about two feet thick, and solid, were constructed of pounded clay, slightly sprinkled with water; the prepared clay was shovelled to a depth of a few inches into a moveable wooden frame about six feet long and one foot deep, where it was then beaten, or rammed down, by paviors, an instrument which was used to ram down paving stones, a fairly heavy block, having a flat lower surface and a heavy broomstick-like handle attached to the upper side. When the wooden frame was filled and the clay had remained a short time therein it acquired consistency, being bound together by constant sprinkling of water during the beating and ramming part of the process; the form was then removed further on the wall, to repeat the operation. The result was that the walls were built in great blocks of earth.

⁴⁹ S W Johnson, *Rural Economy; Containing a Treatise on Pisé Building as recommended by the Board of Agriculture in Great Britain* (New York 1806); cited in Dethier, *Down to Earth*, p 190.

⁵⁰ Hallock, 'Pisé in Virginia', pp 45-51.

⁵¹ Dethier, *Down to Earth*, p 190.

⁵² John Bullock, *The American Cottage Builder* (New York 1854), pp 16-17.

⁵³ Ronald Lewcock, *Early Nineteenth Century Architecture in South Africa* (Cape Town 1963), p 219, quoting W B Lanham & E R Willmore, *The 1820 Settlers of Sevenfountains and Salem* (Grahamstown 1959), p 4.

In the twentieth century a Rhodesian mining company built the railway station at Simondium of pisé, to the design of Herbert Baker. Although pisé was said to be the material of many of the older farm buildings in the Drakenstein Valley, the choice of the material for the station was apparently not the result of this tradition but of the contemporary writings of the Englishman J St L Strachey [*infra*].⁵⁴ At Empandeni, at about the same time, there was built a whole complex of pisé buildings including a schoolroom, seven dormitories, twelve single-room dwellings, six small fowl houses and one very large one. At the Globe and Phoenix mine pisé structures were built using antbed, as referred to above, and circular huts were made using two rings of corrugated iron spaced 230 mm apart.⁵⁵

Rondelet was to be directly influential in New Zealand, where there survives a pisé building of 1841-2, built as the printery of the Roman Catholic Mission at Kororareka. It is known as Pompallier house and is now preserved by the New Zealand Historic Places Trust. Here many of the priests and brothers of the Society of Mary came from the Lyonnais, the home of pisé. Amongst these was a lay preacher, Louis Perret, who spent eight months at Kororareka before he became disgruntled and left, and while there he acted as supervising architect for the printery. The base walls are 0.6 metres thick, for the first floor is timber framed, with infill panels of pisé only 200 mm thick.⁵⁶ Perret's textbook seems to have been Rondelet's *Traité*, for the French priest, Father Garin, subsequently complained that 'the principles of Rondelet ... are not based upon the soil of the antipodes, a soil which one thinks to be quite good is found to be quite bad.'⁵⁷

Pompallier House arose from exceptional circumstances, and seems to be the only unequivocal example of nineteenth century pisé surviving in New Zealand, though Archbishop Redwood wrote of his father's 'Stafford Place', Nelson, of 1843, as being of 'peasy',⁵⁸ and J E Fitzgerald's house near Christchurch was (but probably incorrectly) referred to in 1850 as being of pisé.⁵⁹ In 1901 the cement manufacturer Nathaniel Wilson built a substantial house, 'Riverina', of what is described as 'rammed fired clay'. The clay was reportedly dug in a nearby paddock, burned in a fire of purri logs, then mixed with lime, and rammed between formwork. The fired clay may have had a pozzolanic effect, and the product - notwithstanding the ramming - might be better described as concrete. In fact steel mesh was incorporated, and the outside was rendered in cement.⁶⁰ There seems to have been some further use of pisé construction in New Zealand, but how or where is unknown, for the evidence is only the fact that in 1919 Clough Williams-Ellis quoted a New Zealand specification for a pisé house. The fact that a Ruberoid damp course and galvanised iron air vents were specified

⁵⁴ Clough William-Ellis, *Cottage Building in Cob, Pisé, Chalk & Clay* (London 1919), pp 86-7.

⁵⁵ William-Ellis, *Cottage Building in Cob, &c*, pp 78-80.

⁵⁶ *Pompallier House*, pamphlet published by the New Zealand Historic Places Trust, undated; R M Ross, 'Old Kororareka: New Russell', in Frances Porter [ed], *Historic Buildings of New Zealand: North Island* (Auckland 1979), pp 32-3.

⁵⁷ John Stacpoole, *Colonial Architecture in New Zealand* (Wellington 1976), p 22.

⁵⁸ R M Ross, *A Guide to Pompallier House* (1970), quoted in M L D Allen, 'A Renaissance of Earth Building in New Zealand' (MArch, University of Auckland, 1991), p 41.

⁵⁹ Charlotte Godley *Letters from New Zealand by Charlotte Godley 1850-1853* (Christchurch 1951), p 154.

⁶⁰ Penelope Carroll, 'Legacy set in Concrete', *New Zealand Heritage*, Spring 2002, no page.

shows that it was a contemporary building, but there is nothing distinctive about the pisé work itself except that the raw material was a pipeclay loam, specified because it was found near the site.⁶¹

In India pisé seems to have been used fairly extensively during the nineteenth century by the Royal Engineers, and Williams-Ellis quotes a description from Colonel Maclagan's *Manual on Earthwork*, which is apparently of Indian application. In 1867-8 the material was used for the gaol at Ettah, and reports on the construction by H Sprenger, assistant engineer, and E Beattie, executive engineer on the Grand Trunk Road, are also quoted by Williams-Ellis.⁶²

f. the twentieth century

In Europe these traditional methods remained current, or were revived, especially in the time of shortage after World War I. Dr O von Ritgen published his *Volswohnungegen und Lehmabau*, in which he discussed traditional pisé as well as various improvements, such as the use of an iron stamper to ram the earth.⁶³ There was also a hybrid method known as *quaderwände* used in Germany, in which pisé blocks were formed in separate moulds and then laid on the wall while still wet.⁶⁴

Between the wars pisé and other earth building techniques received a surprising amount of attention in Britain. Basically, they were promoted by idealists like J St Loe Strachey and Clough Williams-Ellis, and dismissed by the practical building industry. Strachey, the owner of the *Spectator*, was a conservative but a political activist, and developed an interest in housing for agricultural labourers. He at first believed that concrete would be the solution, but in 1913 the *Spectator* published a letter from a reader in Uganda drawing attention to pisé, and enclosed a cutting from the South African *Farmer's Weekly* in which Harold L Edward described his own exercise in pisé construction in South Africa, and referred to the wide use of pisé in New South Wales. Strachey was then lent a copy of the New South Wales Government's *Farmer's Handbook* of 1911, in which the method was described, and in 1915 he built an apple shed on the family property, 'Newlands Corner'.

Newlands Corner was in wartime use as a hospital, and Strachey next built a dining room in a variant technique using compressed chalk, hence known as *pisé de craie*. This was designed by his son-in-law, the architect Clough Williams-Ellis. Strachey now promoted the material more generally, and was encouraged by General Sir Robert Scott-Moncrieff, who issued instructions for pisé walling to engineer companies on the western front, based upon the Australian system.⁶⁵ In 1919, following his return from war service, Williams-Ellis published his book, *Cottage Building in Cob, Pisé, Chalk & Clay*, which was to prove enormously influential in Britain and elsewhere. As Williams-Ellis admitted, neither he nor Strachey had much

⁶¹ Clough Williams-Ellis, *Cottage Building in Cob, Pisé, Chalk & Clay* (London 1919), pp 86-7.

⁶² Williams-Ellis, *Cottage Building in Cob, &c*, pp 73-8.

⁶³ O v Ritgen, *Volkswohnungen und Lehmabau* (Berlin 1920), pp 26-30, 64-66

⁶⁴ Clough Williams-Ellis, *Building in Cob, Pisé and Stabilised Earth*, p 82.

⁶⁵ Mark Swenarton, 'Rammed Earth Revival: Technological Innovation and Government Policy in Britain, 1905-1925', *Construction History*, XIX (2005) pp 109-113.

knowledge of the long prehistory of pisé when their interest began, but by the time the book was published the broader context was becoming understood.⁶⁶

After the war the Board of Agriculture set about providing smallholdings and houses for returned servicemen, and Lawrence Weaver, the former architectural editor of *Country Life*, became the commercial secretary, with responsibility for implementing the programs. A flagship development was initiated at Amesbury, Wiltshire, to build cottages in a variety of materials. A prototype pisé cottage built at Strachey's Newlands Corner in 1919 was followed by six pisé houses at Amesbury in 1919-20, and twenty-six of other materials. Upon this basis the Ministry of Agriculture set about promoting pisé more generally. By 1921, however, it had become generally accepted that pisé was not in fact competitive with other materials such as brick, and it receded from prominence.⁶⁷

A proposal to establish a Building Research Board had been blocked in about 1918 by Lord Curzon,⁶⁸ head of the Department of Scientific and Industrial Research. But the idea was successfully revived and the Board produced its own report on earth building techniques, *Building in Cob and Pisé-de-Terre*, which concluded that such materials were not practicable for any sizeable urban housing scheme. However experimental wall sections erected by the Board had been surprisingly successful, as had buildings elsewhere. There was even a patent taken out by Cornish and Gaymer for a new panelised system of pisé construction.⁶⁹ Although direct links have not been established, it seems almost certain that the Anglophile Australia of the period would have been influenced by this burgeoning interest in Britain, thus completing the circle of development which began with the New South Welsh influence upon Strachey.

⁶⁶ William-Ellis, *Cottage Building in Cob, &c*, pp 15 ff.

⁶⁷ Swenarton, 'Rammed Earth Revival', pp 112-120.

⁶⁸ Swenarton, 'Rammed Earth Revival', p 113.

⁶⁹ H B Newbold, *Modern Building* (4 vols, London, no date [?c 1935]), II, pp 87-96