ENGLISH HERITAGE

BODMIN MOOR

An archaeological survey

VOLUME 2: THE INDUSTRIAL AND POST-MEDIEVAL LANDSCAPES

Peter Herring, Adam Sharpe, John R Smith and Colum Giles

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CORNWALL COUNTY COUNCIL

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Abbreviations

B&WR	Bodmin and Wadebridge Railway
CAU	Cornwall Archaeological Unit (now the Historic Environment Service, Cornwall County Council)
CCC HES	Cornwall County Council Historic Environment Service
CCRA	Cornwall Committee for Rescue Archaeology
CRO	Cornwall Record Office
HER	Historic Environment Record
MPP	Monuments Protection Programme
NMR	National Monuments Record
PRO	Public Record Office (now the National Archives)
RCHME	Royal Commission on the Historical Monuments of England (now English Heritage)
RIC	Royal Institution of Cornwall (housed in the Royal Cornwall Museum, Truro)
SMR	Sites and Monuments Record

Preface

The first volume reporting on the Bodmin Moor archaeological surveys undertaken in the 1980s, published in 1994, covered the prehistoric and medieval landscapes, leaving the industrial and post-medieval landscapes to this companion. Fruitful partnerships between the Cornwall Archaeological Unit (now the Historic Environment Service of Cornwall County Council), the Royal Commission on the Historical Monuments of England (now absorbed into English Heritage), and English Heritage itself, begun so successfully with volume 1 have been continued. Many other more local partners have also contributed to this volume: landowners and farmers, local communities, and local archaeologists and historians. The range of surveys and sources either purposefully established to feed into this report or those other independent surveys that were made use of, is set out in Chapter 2, but the detailed and accurate mapping based on vertical aerial photographs continued to be the framework for most recording.

It is generally accepted that archaeologists, land managers and local communities cannot effectively guide change within the historic environment and actively manage its archaeological, historical and semi-natural components without adequate information to inform decision making. The intensive surveys reported on in these two volumes, together with the historic landscape characterisations of first Bodmin Moor (Countryside Commission 1994), then the whole of Cornwall (Cornwall County Council 1996), and latterly the Lynher Valley (Herring and Tapper 2002) provide an historic environment record and interpretation for the Moor as detailed and sensitive as any in Britain. This applies to the industrial and post-medieval remains as much as it does to the medieval and prehistoric.

As might have been predicted, there have been changes in context, practice and attitude since 1994 regarding issues of access to the Moor and the celebration and management of its archaeological remains. Threats from major road and reservoir developments have receded (though there will probably eventually be alterations to the A30 west of Temple), but the Bodmin Moor Bill failed, and the Moor was not made an Environmentally Sensitive Area. Significant Countryside and now Environmental Stewardship Schemes have been agreed for most commons and many private farms, bringing financial support for traditional and sustainable farming regimes. These schemes are intended to benefit all aspects of the environment (natural, historic, aesthetic and amenity) and also the local farming communities who do so much quiet stewardship of the nationally important Moor.

A significant issue not predicted in 1994 was the effect on the historic environment of significant reductions in grazing levels, especially on Bodmin Moor's commons. East Moor in 1994 was still open rough grassland on which the important prehistoric and medieval settlements and field systems, prehistoric ceremonial and ritual sites, and medieval streamworks were clearly visible. A decade of greatly reduced grazing has allowed large parts of East Moor to scrub over, obscuring many remains, reducing the freedom to roam and explore widely, and, it is believed, increasing the threat of damage to important archaeological layers from root and rhizome systems on the one hand and erosion caused by grazing animals tracking through passages in dense scrub on the other. Changes in grazing levels on the Moor's other commons, as part of the more recently agreed Stewardship Schemes, can be expected to have similar consequences. In response to such concerns, two sets of maps have been prepared identifying areas of high historic and high natural environment importance on Bodmin Moor. The intention is that the Stewardship agreements will be carefully monitored and adjusted so as to ensure that archaeological and biodiversity interests are both managed to the mutual benefit of both.

Land managers on the Moor are also now working with the provisions of the Countryside and Rights of Way Act 2000; there has been a significant increase in provision of access, information and amenities for visitors to the Moor. The remarkably well-preserved archaeological remains of prehistoric, medieval, post-medieval and industrial activities continue to be a key focus of many visits. They challenge people's sense of being in timeless wilderness when exploring the Moor, instead confirming that many have passed their way before, that many have lived and worked among the tors, on the downs and around the twisting valleys, and that many have built monuments to help confirm and celebrate their relationship with the special place that is Bodmin Moor.

Today's moorland community is responding to new challenges and opportunities, and in doing so is forming its own stratum on the multi-layered historic landscape that is Bodmin Moor.

This volume has been stalled in production for a number of years; text, illustrations and maps were largely prepared between 1993 and 1996. It seems incredible today that the Bodmin Moor Project, of which this volume represents the final part, was started in 1979 almost 30 years ago. Fortunately there has been little additional work on post-medieval and industrial aspects of the Moor since 1996, and the most significant relevant publications have been Stanier 1999 and Gerrard 2000, both being substantial publications based in part on doctoral theses (on granite quarrying and medieval tinning respectively). Apologies are offered to readers and authors for the delay, and regret is shown to the family of Jack Parkyn of Wimalford (*Frontispiece*), to whom this volume is dedicated. Jack gave generously of his knowledge of moorland ways, and would have delighted in picking over the contents of this report, but sadly he passed away in 2003.

Acknowledgements

The surveys, the results of which are reported on here, were funded by various agencies: English Heritage, the former Royal Commission on the Historical Monuments of England (RCHME), The Countryside Commission, Caradon District Council, and Co-operative Retail Services (in association with the Manpower Services Commission). English Heritage and RCHME (now incorporated within English Heritage) financed report preparation and publication. Grateful thanks are offered to all of these bodies by the Historic Environment Service of Cornwall County Council, formerly the Cornwall Archaeological Unit (CAU).

Numerous people helped in the various survey and research projects, and in the several stages of report preparation. Within CAU, apart from the three principal authors, the following were involved: Nicholas Johnson, Peter Rose, Dr Sandy Gerrard, Nigel Thomas, Jacqueline Nowakowski, Jenny McLynn and Joanne Norman. Hand- and computer-drawn illustrations within the bound volume were produced by Rosemary Robertson, with the exception of Figs 127, 129–30, and 133–6 (by Allan Adams), Fig 20 (by Adam Sharpe), and Figs 61 and 70 (by the late Clive Carter). Other figures from early editions of the Ordnance Survey and from CAU archives were prepared for publication by Peter Herring and Cathy Parkes. The four folded maps were prepared by Jill Colclough from material provided by CAU: the 1:25 000 general map by Peter Herring; the 1:10 000 map of the Minions area by Adam Sharpe, West Moor by Peter Herring; and the Temple area by Peter Herring and John R Smith.

Norman Quinnell and Martin Fletcher undertook the Bodmin Moor Survey fieldwork for the RCHME which included recording the Moor's turf steads (peat platforms). Dr Sandy Gerrard single-handedly surveyed most tinworks in St Neot parish for post-graduate research and also, for CAU, sketch-plotted on to 1:2500 aerial-photographic maps the West Moor streamworks. Adam Sharpe of CAU directed the Minions Survey, the Community Programme project whose members were Justin Andrews, Tula Breen-Turner, John Broadwater, Richard Cock, Lisa Cogley, Richard Couch, Tony Croft, Noel d'Artese, Pat d'Artese, the late Don Dodds, Lizzie Fuller, Mike Gibbs, Andrew Grimes, Francis Halloran, Cliff Hambly, Peter James, Kate Lynch, Jo March, Jenny Martin, Darren Mitchell, Gavin Moffatt, Keith Morse, Angie Rooke, Anna Viola and Gilly Williams. John R Smith (CAU) sketch-surveyed Bodmin Moor's china-clay works and with Adam Sharpe planned the Burnt Heath and Glynn Valley clayworks. Peter Herring (CAU) sketch-surveyed the Moor's remaining industrial sites and landscapes with the exception of Kilmar's quarries and Northwood's clayworks, which were sketch-surveyed by Nigel Thomas. Peter Herring and Nigel Thomas also entered the data into the Cornwall Sites and Monuments Record. Tony Blackman and the Young Archaeologists Club (Cornwall Branch) have helped with information on stone splitting, and David Methven helped interpret remains at De Lank Quarry.

Information on non-industrial remains was obtained from Colum Giles, Allan Adams and Paul Barnwell (the RCHME's farmsteads survey), Jacqueline Nowakowski and Peter Herring (turf, farmsteads, fields and farming), Tony Blackman (turf, Second World War, farming), Pamela Bousfield and Jill Thomas (Second World War), and Graham Lawrence (farming, Second World War and waterworks). Numerous moorland people helped Tony Blackman in his research on turf; they are all cited within Chapter 7. In addition Marion Bunney, Charlie and Bob Tapp, Richard Herring, Morley Rowe, Robin Hanbury-Tennison, Wolter Noorlander, and Oonagh, Rosemary, Bernard and Richard Parkyn all provided valuable oral information on various subjects.

Comment, information and advice were given by the following: Peter Stanier (granite quarrying), Robin Stanes (farming), the late Professor Harold Fox (stone splitting, turf cutting, farming), Michael Messenger (LCR), Kenneth Brown (engine houses), and Dr Roger Burt (mining statistics).

Grateful thanks are offered to all the landowners, land agents, tenants, commoners and Commoners Associations of the Moor who kindly gave permission for the various surveys to be undertaken, and often freely gave time to talk about the history of their land.

Practical help was also given to the Minions survey by Linkinhorne Parish Church Committee, Upton Cross Village Hall Committee, Len Tracey (St Cleer and District Commoners Association), Beryl and Howard Martin, Martin Eddy, George Bishop, and Mr and Mrs Hanlon. David Brown, Mike Welbourne, Jan Richards and Steve Foster of Caradon District Council have supported the Minions Heritage Area in various ways. Mike and Pauline Matthews of Higher Tober and Mr and Mrs Talbot-Smith of Higher Harrowbridge helped Peter Herring during the general survey.

Documentary and cartographic archives have been consulted at the Cornwall Records Office (CRO), the Courtney Library of the Royal Institution of Cornwall (RIC), and the Local Studies Library at Redruth. Other libraries used were the Penzance Library, Morrab Gardens, and the Liskeard and Bodmin branches of the County Library. The late Roger Penhallurick of the Royal Cornwall Museum and Angela Broome of the RIC, Christine North, formerly of the CRO, and Terry Knight, formerly of the Local Studies Library, provided much information and advice.

Within the former RCHME (now English Heritage), Bruce Eagles and Martin Fletcher moved the project along positively while Robin Taylor provided help with publication matters. Bruce also closely read a draft of this volume. Ann Carter also of the former RCHME prepared the 1:2500 maps from aerial photographs which form the basis of much of this survey. Within English Heritage Brian Kerr and Fachtna MacAvoy managed report preparation, and Margaret Wood and Andrew McLaren provided advice and support for the authors and illustrators respectively.

The French translation of the Summary was by Annie Pritchard, and the German translation by Ingrid Price-Gschlössl for First Edition Translations Ltd.

Summary

Bodmin Moor's well-preserved prehistoric, medieval and early post-medieval landscapes, carefully mapped and recorded by The Royal Commission on the Historical Monuments of England (RCHME) and the Cornwall Archaeological Unit (CAU), were presented in the previously published Volume 1 of the Bodmin Moor archaeological survey (Johnson and Rose 1994). The present volume complements the first and provides a comprehensive basic record of this archaeologically rich granite upland area by reporting on its important industrial and later post-medieval features and landscapes. A 1:25 000 map of the industrial and post-medieval landscape (Map 1) completes the set begun with those of the prehistoric and medieval landscapes included with Volume 1.

Recording of industrial and post-medieval remains on Bodmin Moor was undertaken over a number of years from the early 1980s by various bodies and individuals. Some survey work was done especially for this volume, for example the measured plans of selected china-clay works and mine sites, and sketch surveys of West Moor's tin streamworks and the remaining china-clay works. Others were done in the knowledge that this volume was in preparation. These included the survey of the particularly heavily industrialised Minions area in advance of heritage management works. Sketch survey and systematic assessment of all known industrial remains on the remainder of the Moor was undertaken by CAU as part of English Heritage's ongoing Monuments Protection Programme. All of these surveys benefited from the photogrammetric mapping by RCHME (described in detail in Volume 1) of principal features such as cuttings, dumps, leats, turf steads and trackways, but all also made use of fieldwork and systematic cartographic and documentary sources.

This volume also draws on the results of other projects. Most notable of these is the doctoral thesis of Sandy Gerrard (Gerrard 1986) on medieval streamworking and early tin mining in St Neot parish that established methods of recording and analysing complex earthworks, and proposed valuable interpretative models which have informed all subsequent work, including that reported on in Chapter 4 of this volume. Peter Stanier's doctoral thesis on granite quarrying, Tony Blackman's oral history work on turf cutting and saving, and post-graduate survey by Peter Herring and Jacqueline Nowakowski of post-medieval fields and farmsteads have helped shape Chapters 5, 7 and 9 respectively. The RCHME Farmsteads Survey of east Cornwall covered part of Bodmin Moor and its results have also been fed into Chapter 9.

Most systematically recorded and discussed here are the remains of the three main extractive industries: streamworking and mining, granite quarrying, and china-clay working. For each industry, descriptions of the various forms of the typical earthworks and structural components of extraction and dressing complexes are accompanied by expositions of the processes that produced them. These are set against background histories that include discussions of the constraints on the use of certain technologies imposed by operating in a part of Cornwall that was relatively remote from communications networks. Remains of each of these industries are generally better preserved on Bodmin Moor than elsewhere in Cornwall. This is largely due to the marginality of many of the sites and their early abandonment without subsequent damaging reworkings.

Minerals that developed during the granite's intrusion into the pre-existing sedimentary rocks included tin, copper, arsenic and wolfram. Copper mining was important in the 19th century and wolfram streamworking and mining in the 20th, but tin has been the principal mineral exploited on Bodmin Moor from at least medieval times. Tin has been mined from lodes and also worked, via streamworks and shoadworks, from shoad, the ores which geological and geomorphological processes had removed from the lodes and redeposited, usually in valleys. The many mining, streamworking, dressing and smelting techniques which have been applied through time to the several minerals have left rich and varied industrial remains.

Because granite quarries and china-clay workings survive less well elsewhere in the South-West, it is by examining the particularly well-preserved and clearly understandable remains on Bodmin Moor that extraction and dressing processes and transportation methods are best reconstructed.

The cutting and saving of turf (peat), for use as a fuel, both by industry (often as turf charcoal) and in the moorland home, is described and discussed in detail, as is the extension of enclosed land through new farms and smallholdings, the latter mostly established before the early 19th century by the families of industrial labourers. Significant changes within moorland farmsteads which reflect the adoption, in the 19th century, of new agricultural technologies and changes in agricultural specialisations are examined in detail.

The development of semi-industrialised communities with services and amenities, and other uses of the Moor – water supply, woodland management, military activities and recreation – have not yet been subjected to such close study and are thus given an introductory treatment.

A final chapter considers possible directions for future study of the whole historic landscape and its components: prehistoric and medieval as well as industrial and post-medieval.

Résumé

On a présenté, dans un premier volume des études archéologiques de Bodmin Moor, publié précédemment (Johnson et Rose 1994) ses paysages préhistoriques, médiévaux et du début de la période post-médiévale, bien préservés, ils ont été soigneusement cartographiés et répertoriés par ce qui était alors la Commission Royale pour les Monuments Historiques d'Angleterre (RCHME) et l'Unité d'Archéologie des Cornouailles. Le présent volume vient compléter le premier et fournit un répertoriage fondamental complet de cette région de hautes terres d'une grande richesse archéologique en insistant sur ses importants paysages et vestiges, industriels et post-médiévaux tardifs. Une carte du paysage industriel et post-médiéval au 25 000 ème (carte 1) complète la série commencée avec celles des paysages préhistoriques et médiévaux inclus dans le volume 1.

Le répertoriage des vestiges industriels et post-médiévaux de la lande de Bodmin Moorfut entrepris, sur un certain nombre d'années, à partir du début des années 1980, par divers organismes ainsi que par des particuliers. Certains travaux de prospection furent commandités spécialement pour ce volume, comme par exemple les plans à échelle de certaines usines de kaolin sélectionnées et des sites miniers, et les croquis des mines d'étain de West Moor et des ateliers de lavage qui restent. D'autres, furent entrepris en pleine connaissance que ce volume était en préparation. Ils comprennent la prospection de la région, particulièrement fortement industrialisée, des Minions avant des travaux de gestion du patrimoine. Des plans sommaires et une évaluation systématique de tous les vestiges industriels connus sur le reste de la lande furent entrepris par l'Unité d'Archéologie de Cornouailles dans le cadre du programme continu de protection des monuments d'English Heritage. Toutes ces prospections ont bénéficié d'une cartographie photogrammétrique par RCHME (décrite en détail dans le volume 1) des principaux indices tels que les tranchées, les dépôts, les biefs, les plateformes à tourbe et les voies d'accès, mais toutes ont également fait usage d'un arpentage sur le terrain et d'études systématiques des sources cartographiques et documentaires.

Ce volume puise également dans les résultats d'autres projets. Le plus notable étant la thèse de doctorat de Sandy Gerrard (Gerrard 1986) sur les ateliers de débourbage médiévaux et le début de l'extraction de l'étain dans la paroisse de St Neots qui a établi des méthodes de répertoriage, et d'analyse, des traces au sol complexes et a proposé des modèles d'interprétation d'une grande valeur, qui ont influencé tous les travaux qui ont suivi, y compris ceux quifont l'objet de rapports au chapitre 4 de ce volume. La thèse de doctorat de Peter Stanier sur l'extraction du granit, les travaux d'histoire orale sur le découpage et la conservation du gazon de Tony Blackman et une étude de 3ème cycle, de Peter Herring et Jacqueline Nowakowski, sur les champs et les fermes post-médiévaux, nous ont aidés à donner forme aux chapitres 5, 7 et 9 respectivement. L'étude des fermes effectuée par RCHME dans l'est des Cornouailles couvrait une partie de Bodmin Moor et ses résultats ont également été intégrés dans le chapitre 9.

Ici, on répertorie et examine plus systématiquement les vestiges des trois principales industries d'extraction: le débourbage et les mines, les carrières de granit et le travail du kaolin. Pour chaque industrie, les descriptions des diverses formes des traces au sol et des composants des structures et des complexes d'extraction et de traitement s'accompagnent de la présentation des procédés qui les ont produits. Ceux-ci se détachent sur un fond d'histoires qui comprend des discussions des contraintes sur l'utilisation de certaines technologies imposées par le fait qu'elles opéraient dans une région des Cornouailles qui était relativement éloignée des réseaux de communication. Les vestiges de chacune de ces industries sont en général mieux préservés sur la lande de Bodmin Moor qu'ailleurs en Cornouailles. Ceci est en grande partie dû au fait que nombre de ces sites étaient marginaux et qu'ils ont été abandonnés précocement, ce qui leur a évité de subir les dégâts causés par des reconstructions ultérieures.

Parmi les minéraux qui se développent pendant l'intrusion du granit dans des roches sédimentaires pré-existantes, on trouve l'étain, le cuivre, l'arsenic et le wolfram. L'extraction du cuivre était importante au 19ème siècle et le débourbage et l'extraction minière du wolfram au 20ème, mais l'étain était le principal minerai exploité à Bodmin depuis au moins l'époque médiévale, voire plus tôt. L'étain était extrait de filons et aussi travaillé, au moyen d'ateliers de lavage et de puits à partir d'étain d'alluvions, le minerai que des procédés géologiques et géomorphologiques avaient arraché des filons et redéposé, généralement dans les vallées. Les nombreuses techniques d'extraction, de traitement et de fonte qui ont été appliquées au cours des temps aux divers minéraux ont laissé des vestiges industriels d'une grande richesse et variété.

Parce que les carrières de granit et les usines de kaolin ont moins bien survécu dans d'autres régions du sud-ouest, c'est par l'examen des vestiges particulièrement bien préservés et faciles à comprendre de Bodmin Moor qu'on arrive le mieux à reconstruire les procédés d'extraction et de traitement et les méthodes de transport.

On décrit et examine en détail le découpage et la conservation de mottes de gazon (tourbe), à usage de carburant, aussi bien dans l'industrie (souvent sous la forme de charbon de tourbe) que dans les foyers de la lande, ainsi que l'extension des terres clôturées à cause de nouvelles fermes et petites propriétés, ces dernières essentiellement établies avant le début du 19ème siècle par des familles d'ouvriers d'usine. On examine également en détail des changements significatifs parmi les fermes de la lande qui reflètent l'adoption, au 19ème siècle, de nouvelles techniques agricoles et des changements dans les spécialisations agricoles.

Le développement de communautés semi-industrialisées avec des services et des commodités, et les autres utilisations de la lande - approvisionnement en eau, gestion forestière, activités militaires et loisirs - n'ont pas encore été soumis à une étude aussi rapprochée et se voient donc recevoir un traitement d'introduction.

Un ultime chapitre envisage des directions possibles pour de prochaines recherches sur l'ensemble du paysage historique et de ses composants: préhistorique et médiéval aussi bien qu'industriel et post-médiéval.

Zusammenfassung

Die gut erhaltenen vorgeschichtlichen, mittelalterlichen und frühen nachmittelalterlichen Landschaften von Bodmin Moor, die von The Royal Commission on the Historical Monuments of England (RCHME) und der Cornwall Archaeological Unit (CAU) sorgfältig kartografisch erfasst und dokumentiert wurden, sind bereits in Band 1 der archäologischen Vermessung von Bodmin Moor (Johnson and Rose 1994) vorgestellt worden. Der vorliegende Band ergänzt nun den ersten und liefert eine umfassende Basisdokumentation dieses archäologisch so ergiebigen Granithochlands und erläutert seine bedeutenden industriellen und späteren nachmittelalterlichen Besonderheiten und Landschaften. Eine Karte (1:25.000) der industriellen und nachmittelalterlichen Landschaft (Karte1) vervollständigt die Reihe, die mit den vorgeschichtlichen und mittelalterlichen Landschaften in Band 1 den Anfang genommen hat.

Zahlreiche Organisationen und Personen haben seit Anfang der 1980er Jahre über mehrere Jahre die industriellen und nachmittelalterlichen Überreste auf Bodmin Moor dokumentiert. Eigens für diesen Band wurden bestimmte Vermessungen durchgeführt, wie z. B. die Karten von ausgewählten Kaolin- und Bergwerksanlagen und Grundrisse der Zinnwäschereien und den restlichen Kaolinwerke im West Moor. Weitere Vermessungen erfolgten in Vorbereitung zu diesem Band wie die des besonders stark industrialisierten Gebiets von Minions vor Beginn der Arbeiten zum Erhalt des Kulturerbes. Als Teil des laufenden Denkmalschutzprogramms von English Heritage wurden von CAU Umrisskarten und eine systematische Bewertung aller bekannten industriellen Überreste im übrigen Heidemoor durchgeführt. Sämtliche Vermessungen profitierten von der von RCHME durchgeführten (und in Band 1 eingehend beschriebenen) fotogrammetrischen Kartenerstellung der wichtigsten Merkmale wie Einschnitte, Abfallsammelplätze, Gräben, Rasenstellen und Pfade, wobei sie sich ebenso auf Feldarbeit und systematische kartografische Quellen und Dokumentationen stützen.

Dieser Band stützt sich aber auch auf die Ergebnisse anderer Projekte. Insbesondere auf die Doktorarbeit von Sandy Gerrard (Gerrard 1986) zum Thema der mittelalterlichen Zinnwäschereien und des frühen Zinnabbaus in der Pfarrei St. Neot, in der Methoden zur Aufzeichnung und Analyse komplexer Erdarbeiten erstellt und wertvolle Zuordnungsmodelle vorgeschlagen werden, die für alle nachfolgenden Arbeiten, einschließlich all jener, über die in Kapitel 4 dieses Bandes berichtet wird, Informationen liefern. Peter Staniers Doktorarbeit über den Abbau von Granit, Tony Blackmans auf mündlicher Überlieferung aufgebaute Arbeit zum Stechen und Aufbewahren von Torf und die akademische Studie von Peter Herring und Jacqueline Nowakowski über die nachmittelalterlichen Felder und Gehöfte haben jeweils ihren Beitrag zu den Kapiteln 5, 7 und 9 geleistet. Die RCHME Farmsteads Survery, die Vermessung der Hofstätten im Osten von Cornwall deckte auch einen Teil Bodmin Moor ab. Diese Ergebnisse fließen in Kapitel 9 ein.

Ganz besonders systematisch aufgezeichnet und besprochen werden in diesem Band die Überreste der drei wichtigsten Rohstoffindustrien: Zinnwäscherei und Bergbau, Granitabbau und Kaolinverarbeitung. Für jeden Industriezweig sind die Beschreibungen der verschiedenen Formen der typischen Erdarbeiten und der strukturellen Komponenten von Gewinnung und Wäsche von Ausführungen zu den Verfahren, die sie hervorgebracht haben, begleitet. Sie werden vor ihrem geschichtlichen Hintergrund erläutert, wie z.B. Diskussionen über den beschränkten Einsatz bestimmter Techniken, der darauf zurückzuführen ist, dass das jeweilige Gebiet von Cornwall relativ weit vom Kommunikationsnetz entfernt war. Die Überreste dieser Industrien sind im Bodmin Moor zumeist besser erhalten als anderswo in Cornwall. Grund dafür ist zumeist die abgelegene Lage vieler dieser Anlagen und das frühe Auflassen derselben ohne eine nachfolgende schädigende Überarbeitung.

Zu den Mineralien, die während der Intrusion des Granits in das bestehende Sedimentgestein entstanden sind, zählen Zinn, Kupfer, Arsen und Wolfram. Im 19. Jh. war der Kupferabbau von Bedeutung und im 20. Jh. der Abbau und die Wäsche von Wolfram, aber Zinn war das wichtigste Mineral, das ab dem Mittelalter, wenn nicht schon früher, im Bodmin Moor gewonnen wurde. Zinn wurde aus Adern abgebaut und über Zinnwäschereien und Graupenwerke auch aus Graupen gewonnen. In geologischen und geomorphologischen Prozessen wurden diese Erze aus den Adern freigesetzt und dann zumeist in Tälern abgelagert. Die zahlreichen Abbau-, Wasch-, Klär- und Verhüttungsmethoden, die im Lauf der Zeit für die verschiedenen Mineralien angewendet wurden, haben uns zahlreiche und vielseitige industrielle Überreste hinterlassen.

Im Gegensatz zu Granitsteinbrüchen und Kaolingewinnung in anderen Teilen des englischen Süd-Westens, die weniger gut überdauert haben, lassen sich die Abbau- und Auswaschverfahren sowie die Transportmethoden durch eine Prüfung der besonders gut erhaltenen und leicht zu interpretierenden Überreste im Bodmin Moor am besten rekonstruieren.

Das Stechen und Aufbewahren von Torf zur Verwendung als Brennstoff, sowohl für den industriellen (oft als Torfkohle) als auch den Hausgebrauch, wird in allen Einzelheiten beschrieben und diskutiert, ebenso die Ausweitung von befriedetem Land durch neue Gehöfte und Kleinlandbesitze, wobei letztere zumeist vor dem 19. Jh. von den Familien der Industriearbeiter geschaffen wurden. Wesentliche Änderungen an den Gehöften im Heidemoor

aufgrund der Übernahme neuer Agrarmethoden sowie von Änderungen in der landwirtschaftlichen Spezialisierung im 19. Jh. werden eingehend untersucht.

Das Entstehen halbindustrialisierter Bevölkerungsgruppen mit Versorgungsdiensten und Einrichtungen und sonstige Verwendungen des Moorwassers, sowie Forstverwaltung, militärische Aktivitäten und Freizeitgestaltung wurden bisher noch keiner eingehenden Untersuchung unterzogen und werden daher in Form einer Einführung dargestellt.

Das letzte Kapitel behandelt mögliche Richtungen für das zukünftige Studium der gesamten historischen Landschaft und ihrer Komponenten – sowohl prähistorischer und mittelalterlicher als auch industrieller und nachmittelalterlicher Natur.

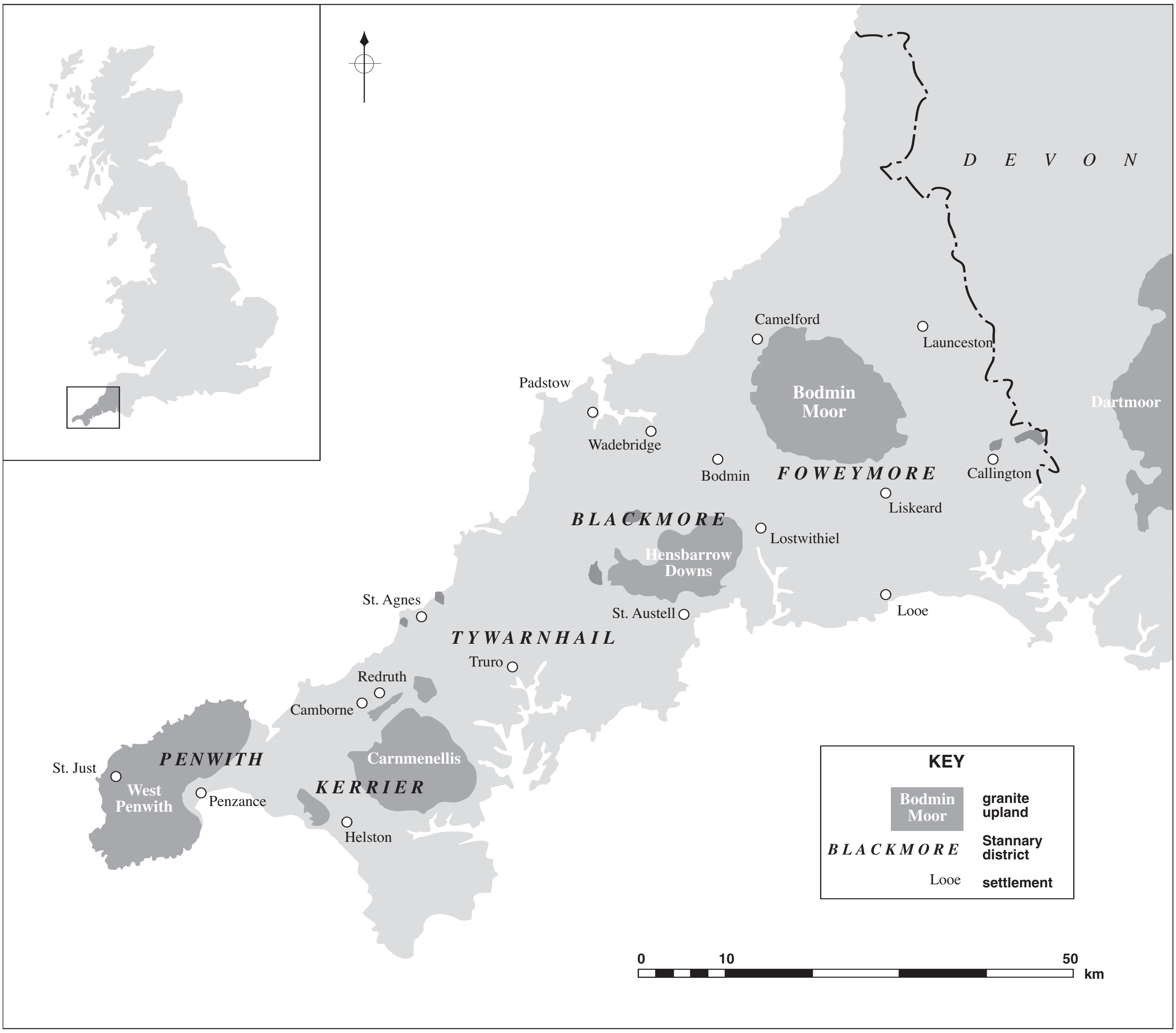


Fig 1 Cornwall; granite uplands and Stannaries. (© Rosemary Robertson)

1 Background

by Peter Herring

1 Introduction

Travellers rushing along the recently improved A30 road between Launceston and Bodmin may be forgiven for barely noticing that they are passing through an upland area, let alone one of Britain's best-preserved (and now most fully recorded) archaeological landscapes. The road's cuttings and embankments slice through or run across surprisingly few stretches of open moor and most of the land visible from the road is either enclosed and settled or forested. Passengers may notice that most of the field boundaries within the enclosures are perfectly straight and thus modern. If they wonder why most of the shrubs growing on the stone and earth walls of these 19th-century intakes are thorn, gorse and heather they will not be surprised to learn that 200 years ago the Bodmin to Launceston turnpike, the predecessor of the A30, ran through almost uninterrupted moorland from Temple to Hendra (*see* Johnson and Rose 1994, map ii).

If travellers then, in the late 18th or early 19th century, having rested at the lonely Jamaica Inn, had struck off down the Fowey valley and across to the already famous rockpile, the Cheesewring, they would have entered an area still dominated by the turf ricks and grazing livestock of Rillaton manor's tenants. One or two small tin mines and streamworks and the chinking chisels of granite moorstone splitters would have disturbed any romantic reveries and have hinted at the changes soon to occur in this south-eastern corner of the Moor. During Victoria's long reign these were so dramatic and far-reaching that by the turn of the 20th century a visitor to the Cheesewring, itself by then firmly on every tourist's map, would have been overwhelmed by the abundant evidence for the starkly industrial character of much of the area.

Mineral railways and tramways criss-crossed the downs, bringing an ever present 'busyness' to the scene; engine houses, dressing floors, buildings, shafts and dumps of recently abandoned copper and tin mines were visible close by on almost all sides; and the sounds of drilling, blasting and stone-shaping emanated from the still-operating granite quarries below the Cheesewring, across the Withey Brook at Goldiggings, on Bearah, Kilmar and Notter Tors to the north and east, and on Caradon Hill to the south. An industrial village had sprung up in once open moorland at Cheesewring Railway (now called Minions), and numerous terraces, cottages and smallholdings, the homes of the mine and quarry workers and their families were scattered across the landscape. The extensive heathland of old was now fragmented, but still used for fuel and pasture.

The Caradon/Cheesewring area may have been the most intensively industrialised place on the Moor but, as this volume sets out to demonstrate, the modern explorer will find the remains of industry across the whole of the block of upland. The evidence dates from the medieval period (tin streaming, turf cutting and granite splitting) to the present day (china-clay working and granite quarrying). These remains, generally well-preserved and (given permissions) readily accessible, can be extensive (the leats and streamworks of West Moor), dramatic (the Glynn Valley china-clay works, or the De Lank quarries), or poignant (Phoenix United tin mine). Care must be taken, however, not to allow the quantity and variety of industrial remains to create an impression of continuous and all-pervading industrial activity in this moorland landscape. In fact it has been spasmodic; industry rarely played more than a marginal role in the lives of Bodmin Moor's always relatively small population of permanent occupants, the farmers and herdsmen. This reflects the relative remoteness of this Cornish upland and the limited range of resources it appeared to offer.

That is not to say that the moorland industries were unimportant – during the medieval period the working of alluvial and eluvial tin deposits made a very considerable contribution to the economy of the county, whilst the half century from the 1830s to the 1880s witnessed a positive ferment of industrial activity around Minions and to a lesser extent across much of the rest of the Moor. Like the medieval tinners who preceded them, most of the 19th-century copper and tin miners, quarrymen and railway builders had no intention of remaining on the Moor when better opportunities offered themselves elsewhere, and as mines, pits and quarries closed the land was left once more to the farmers.

2 Topography, climate and soils

by Adam Sharpe

*[*See *Johnson and Rose 1994 and Brewster 1975 for fuller accounts, and Chapter 3 of this volume for details of geology and mineralogy.]*

Bodmin Moor is Cornwall's largest granite upland (*see* Fig 1). At just under 200sq km in extent, it takes the form of an asymmetric dissected dome rising from the surrounding Devonian and Carboniferous sedimentary rocks to a maximum height at Brown Willy (SX 15857995) of 419m (1,375ft) above OD. Denuded of its original sedimentary cover by millions of years of weathering it was spared the effects of glaciation but subjected to periglacial conditions. As a result the Moor is characterised by a mix of gently rounded hills and, towards its edges, by concave-sided ridges topped with rugged tors (Fig 8).

The moorland drainage pattern echoes the principal underlying lines of weakness in the granite. Although the major rivers and streams have their sources near the centre of the Moor, the topography dictates that the mouths of almost all lie on the south coast. The River Fowey divides the upland into two unequal parts and defines much of the moorland edge to the south whilst its tributaries, the Loveny and Bedalder Rivers and the smaller Cardinham Water, drain most of the south-western part of the Moor. The north-east and east are drained by the Penpont Water, the Withey Brook and tributaries of the Rivers Inny and Lynher, which also rise on the Moor; all flow into the River Tamar. The Seaton and East Looe Rivers rise in the far south-east of the Moor. Only the rivers and streams of the north-western corner send water to the north coast; these are tributaries of the River Camel and most notable are the De Lank and the Alan. Dozmary Pool (SX 194745) is the only substantial natural expanse of standing water on the Moor, though modern reservoirs have been impounded at Siblyback (SX 234708), Crowdy (SX 145835) and Colliford (SX 175720).

Like the rest of Cornwall, the Moor has a mild, damp maritime climate. Snow is rare, but rainfall is high compared with the immediately surrounding lowlands. Areas over 250m (820ft) above OD have in excess of 1,500mm (59in) precipitation each year as opposed to less than 1,000mm (39in) just off-Moor, and low cloud and hill fog are common during the autumn and winter.

The moorland soils tend to be shallow and relatively acid whilst gleying is marked on the higher or more exposed areas, whose poorly drained soils developed extensive but (compared with Dartmoor) shallow blanket peats. Undisturbed valley bogs are rare, though some have developed where natural drainage was disturbed by medieval and later tin streaming.

3 Archaeological and historical background

As has been demonstrated in volume 1 of this survey (Johnson and Rose 1994, chapter 4), Bodmin Moor possesses extensive and well-preserved prehistoric landscapes, mainly of Later Neolithic and Earlier Bronze Age date. Round-house settlements with their enclosures, fields and pasture boundaries can be seen in association with ritual and ceremonial monuments such as cairns, stone circles, standing stones and stone rows. Agricultural regimes seem, from field evidence, to have varied from mixed to purely pastoral. At present it appears that the Moor was largely abandoned towards the end of the second millennium BC and then used for around 2,000 years as extensive summer pastures by lowland farmers, some practising transhumance, until gradual resettlement from about AD 1000.

The medieval settlers, many of whose farms and fields are also remarkably well preserved, occupied small hamlets of longhouses and practised mixed farming, their communal arable land organised into strips. Cooperative systems began to break down in the later medieval period and single farms with enclosed field systems replaced hamlets. Rough grazing, whether on the commons or on privately owned ground, dominated the Moor throughout this period and people probably still brought livestock on to the Moor from the surrounding lowlands. Turf (peat) and furze (gorse) formed the principal domestic fuels.

Some tin streaming may have been practised in the later prehistoric, Romano-British and early medieval periods, but clear evidence for industry first emerges for the later medieval period with tinning, turf charcoal manufacture and stone splitting, all significant activities, bringing noise, people and wealth to the Moor and stimulating further agricultural expansion (*see* Austin *et al* 1989). Many of the industrial workers would probably have been poor, landless migrants, others local farmers making productive use of their quiet seasons (*see* Fox 1996 for contemporary Dartmoor).

As the more easily worked eluvial and alluvial tin deposits were exhausted, from at least the 16th century, tinners and copper miners turned their attention to the lodes themselves. More capital-intensive ventures with attached employees were established throughout the Cornish and Devon orefields, leading to clearer definition of industrial and non-industrial workers, and setting in place the organisational and capital-raising structures for the 18th- and 19th-century flowerings of the copper, tin, china-clay and granite quarrying industries, all of which impacted relatively late on Bodmin Moor. The 1830s Caradon copper bonanza stimulated the establishment of an infrastructure (the extension of the Liskeard–Looe Railway to and beyond Caradon) which enabled quarrying and tin mining to follow rapidly in its wake. The Bodmin–Wadebridge Railway, initially an agricultural (sea-sand) railway, allowed granite dimension-stone quarries and china-clay works to be opened from the 1840s and 1860s respectively in the western third of the Moor.

Although copper mining, and tin mining and streamworking largely died out in the late 19th century, with only small-scale and very sporadic metal mining and streamworking (for tin and wolfram) taking place during the 20th century, granite quarrying has continued to the present, albeit at a reduced level, and china-clay working continued until 2001 when the Stannon pit closed. De Lank is now the most significant dimension stone quarry in the South-West whilst Stannon china-clay pit, like Lee Moor on Dartmoor, was a significant outlier of the main St Austell china-clay production area.

Agriculture on the Moor continued with a pastorally biased mixed farming regime into the 1950s and 1960s. In the 1990s, and now in the first decade of the 21st century it is almost entirely pastoral, the inbye fields turned over purely to improved pasture. This continuity from the later medieval period in the main regime masks both rapid changes in practice through the period from 1800 (most of which have left traces in the Moor's farmsteads, surviving implements and tools, and field systems) and also a great extension of the area of enclosed land during the 19th century; industrial workers' smallholdings in the first half of that century and more substantial farms in the second.

The increasingly sophisticated society which was industrial Britain not only provided the market and capital which stimulated and supported the Moor's mines, quarries and pits, but also effected other changes to its population and landscape. The accelerated fragmentation of communities, the decay of communalism, and the concomitant rise of individualism throughout Britain during the period considered in this volume (1800–2000) have affected both society and the state in fundamental ways, and even a marginal, sparsely populated area like Bodmin Moor, remote from urban centres, has not entirely escaped their impact. Nonconformity not only left us its chapels but also revitalised the established church and, perhaps most importantly, instilled strongly held ideologies regarding personal salvation via hard work into those who laboured in the Moor's workplaces and farms. Demands on the state and local authorities to provide universal elementary education (the schools built during the late 19th century), clean water (the waterworks and reservoirs), and public services (post, electricity, police, etc) have all left their marks on the Moor. The power of the state or local authorities democratically to impose public interest on private interests is also clearly visible in the early Forestry Commission conifer plantations, the Second World War airfield at Davidstow, the three large reservoirs, and the successive improvements to the A30 mentioned at the beginning of this chapter.

4 The nature and scope of this volume

The first volume of the Bodmin Moor archaeological survey, dealing with the prehistoric and medieval landscapes up to *c* 1800 (Johnson and Rose 1994), was produced with this companion in mind – on the Moor's industrial remains and its post-1800 landscape; hence the omission from that first volume of descriptions and discussions of medieval and early post-medieval tin streamworking and turf cutting, and the more recent extractive industries: metal mining and granite, china-clay and rab quarrying. They all appear here (Chapters 4–7), alongside treatments of other aspects of the 19th- and 20th-century history which have left material remains or have altered the form or nature of Bodmin Moor's landscape. Industrial settlements (cottages, terraces, smallholdings) and associated services and amenities (chapels, schools, public houses, etc), together with transport and communications systems (road and rail) developed alongside industry (Chapters 10 and 11). Farmers either reused and altered medieval fields, pastures and farmsteads or, especially in the 19th century, established new intakes and altered the extent and intensity of use of rough pastures, both commons and privately owned. Their farming regimes, also inherited from the earlier period, remained little changed until the later 20th century, but their practices became increasingly mechanised during the period covered by this volume (Chapter 9). Water supply, forestry, military activities (particularly in the Second World War) and recreation have all also had an impact and left more or less obvious remains (Chapter 8).

Variety among the volume's substantial chapters (4–11) in terms of their organisation, degree of detail and typical illustrations reflects three principal variables.

1. The scale, detail and completeness of archaeological recording of the remains (*see* Chapter 2).
2. The form of complementary historical research (cartographic, documentary and oral: *see* Chapter 2).
3. The character of the remains themselves; whether substantial and easily visible (such as mine buildings, quarry faces or china-clay leats) or more ephemeral and less easily visible (most turbaries, or the effects of grazing); and whether the remains are typically in discrete complexes (such as mines, clayworks and quarries) or are extensive landscape features (eg farms or turbaries).

Nevertheless, common to all chapters is the principal and unifying aim of this volume: to combine with the descriptions of the remains (both general and particular) a series of expositions and explanations of the processes or practices, often changing through time, which created them.

The volume follows its companion, therefore, in not being a detailed inventory of all sites on Bodmin Moor, although all significant china-clay works are described (Chapter 6), as are selected quarries (Chapter 5), while documented mining sites have been tabulated (Appendix). Where appropriate, notably to explain strategic changes in these processes or practices, more general historical overviews (mainly economic and social) have been briefly introduced and a separate chapter (3) discusses the geological, semi-natural, technological and social resources of the Moor. The volume's value ought, then, to be significantly increased as it should contribute to an understanding of the remains of industries, land uses and ancillary features elsewhere in Cornwall, south-west England and further afield.

5 Organisation of the surveys

As will be seen from the review of survey methods and sources (Chapter 2), the various projects and studies whose results are gathered into this report were not all elements of one overarching survey like that reported on in volume 1. While the preparation of this volume was planned from the mid-1980s, and under way from 1993, the surveys and studies on the other hand were largely undertaken for particular reasons such as academic research, rescue recording, site identification, conservation, presentation and statutory protection (*see* Chapter 2).

6 Study area

Archaeological survey for this volume (*see* Chapter 2 and Fig 3 for survey details) was essentially confined to the granite (*see* Fig 8). It was also restricted to the extent (193sq km) of the photogrammetric plotting (at 1:2500) by RCHME for the Bodmin Moor Survey, using vertical aerial photographs taken in 1977 by Cambridge University Air Photography Unit (*see* Ann Carter, in Johnson and Rose 1994, 8–10 and fig 2). The plots covered the areas that were still moorland in 1977. Where appropriate, to place remains on the Moor in their immediate contexts, cartographic and documentary research carried the study a little way beyond the granite (for example, railways, mining, moorland services and amenities; *see* Figs 2, 39 and 137 and 143).

Fig 2 *Principal settlements, main roads (simplified), and railways (maximum extent). The granite boundary (stippled band) and some topographical features are also indicated. (© Rosemary Robertson)*

2 Survey methods and sources

by Peter Herring

1 Introduction

Systematic recording of industrial and post-medieval non-industrial remains was not an integral part of the original Bodmin Moor survey, as described in chapters 2 and 3 of the first volume (Johnson and Rose 1994, 5–23). Certain features, however, were plotted by Ann Carter during the RCHME photogrammetric planning, including leats, streamworking cuttings (and some spoil heaps), some tinners' pits, quarries, china-clay works, peat platforms, trackways, and perimeter boundaries of post-medieval field systems, and others (notably peat platforms, or turf steads) were recorded by the RCHME during fieldwork. The publication of the present volume had, however, always been envisaged and opportunities were taken throughout the 1980s to record the industrial remains on the Moor. Not all the projects outlined below were under the direct control of CCRA/CAU, the RCHME or English Heritage, but each was carried out to a high and consistent standard. There is considerable variation in the scale (1:500 to 1:2500) and detail of the record produced, but we can feel satisfied that at least 90 per cent of industrial sites with surviving remains on Bodmin Moor have been identified and recorded to at least accurate and closely annotated sketch-survey level, and significant numbers of sites now have measured plans and elevations (*see* Fig 3).

Non-industrial post-medieval remains have been less systematically recorded and, with the exception of the RCHME's work on turf steads (peat platforms) and the more recent RCHME farmsteads survey, projects have fallen outside the control of CCRA/CAU, the RCHME and English Heritage. Nevertheless, significant good quality historical, cartographic and oral history data have been collected from various sources and, although archaeological recording of extant remains has been patchier, sufficient material has been accumulated to enable coherent narratives of most aspects of post-medieval moorland history to be composed.

As the record utilised in the production of this volume has such diverse origins, this chapter on methodology comprises a listing of projects and principal secondary sources.

2 Recording industrial remains on Bodmin Moor

Excavation of West Colliford openwork and mill (1979–80)

A large and well-preserved late medieval openwork and its tin stamping mill, together with associated leats and dressing floors, were fully excavated by joint directors David Austin (St David's University College, Lampeter) and Tom Greeves (then of Devon Committee for Rescue Archaeology) in advance of flooding for Colliford Lake Reservoir. The Level 3 report prepared as an MA thesis by assistant director Sandy Gerrard (1983) formed the basis of its full publication (Austin, Gerrard and Greeves 1989).

Survey of selected streamworks and other tin working sites in St Neot parish (1981–3)

Sandy Gerrard (then of St David's University College, Lampeter) undertook large-scale and carefully annotated plane-table surveys of most alluvial and eluvial streamworks (and associated reservoirs, leats, dressing floors, etc) within the catchment of the Colliford Lake Reservoir (*see* Fig 3 for locations). He also excavated another possible stamping mill and a storage building at East Colliford, and a tinners' shelter at Redhill Marsh – all sites to be flooded by the reservoir (Level 3 reports deposited in the Colliford Archive, Royal Cornwall Museum). In addition Gerrard surveyed a number of other tin streaming and early mining complexes elsewhere in St Neot parish (Fig 3). This material was used in Gerrard's doctoral thesis (1986) and formed the basis for original work on the classification, analysis and interpretation of streamworking remains (Gerrard 1987; Austin, Gerrard and Greeves 1989). Gerrard's large-scale plans have been assimilated into the 1:2500 industrial archive (*see* below). Copies of Gerrard's plans and survey notes, an appendix of Gerrard 1986, are held by CCC HES.

Rescue survey of Cheesewring Quarry (1984)

The interior of this important dimension-stone quarry was recorded by measured plane-table survey (1:500) by Nicholas Johnson and Peter Rose of CCRA in advance of removal of dumps of waste rock. Maps and records are held by CCC HES (*see* Fig 5).

Surveys for volume 2 (1986–7)

Surveys of selected areas were funded by the RCHME to provide interpretative material for this volume. There were three components to this project.

Sketch survey of streamworks and other tinworking sites on West Moor, Altarnun

Sandy Gerrard (CAU) sketch-plotted details of the very well-preserved and inter-connected complexes of leats and streamworks in this 15sq km area of open moor on to base maps compiled from Ann Carter's 1:2500 photogrammetric mapping. Field notes were transferred to context cards and drawn-up maps were provided with interpretative overlays (including

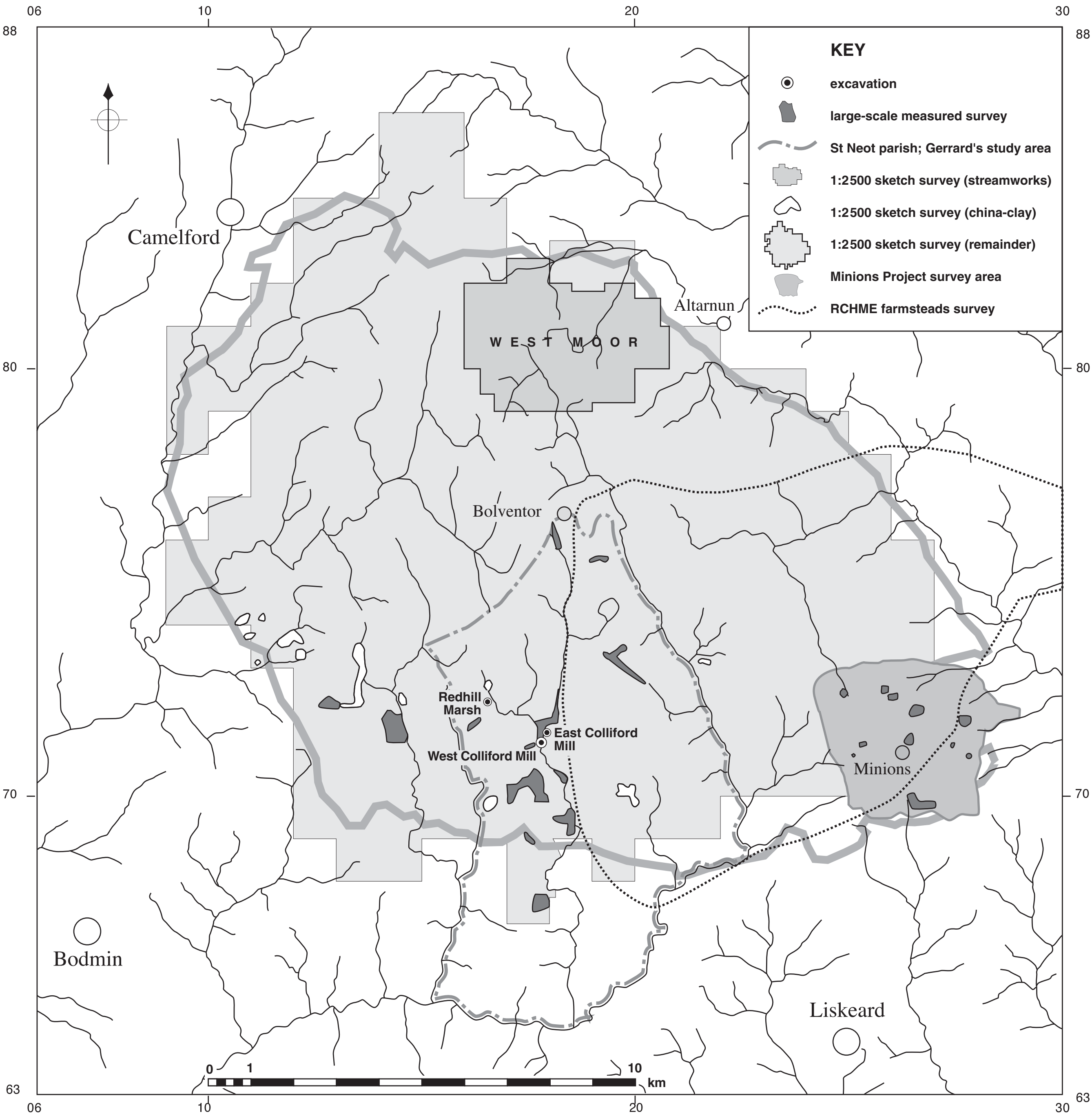


Fig 3 *Bodmin Moor; extents of archaeological surveys of industrial and post-medieval remains. (© Rosemary Robertson)*

relative chronologies) using Gerrard's classification of streamworks (all held by CCC HES).

Sketch survey of china-clay working sites

John R Smith (CAU) used 1st and 2nd edition (1882–3 and 1906–7) OS 1:2500 maps to produce sketch plans of all known china-clay works (with the exception of active works at Stannon and Park and works being decommissioned at Hawkstor). Detail was added and significant losses noted before interpretative, stylised plans were produced identifying main activity areas. (Records are held by CCC HES.)

Measured survey of selected sites

Following Smith's sketch plots two important china-clay extraction and dressing complexes in Cardinham, Burnt Heath and the Glynn Valley works, were selected for large-scale measured survey. Plans at 1:1000 (Glynn Valley) and 1:250 (Burnt Heath) were produced, by plane table using a microptic alidade, by John R Smith and Adam Sharpe (both of CAU). They also planned the tin dressing floor on Hardhead Downs at 1:100 (Fig 6): the extraction and dressing floors at Hobb's Hill Mine were planned by Sandy and Helen Gerrard at 1:500 (Fig 4). Field drawings, archive plans and interpretative overlays are held by CCC HES.

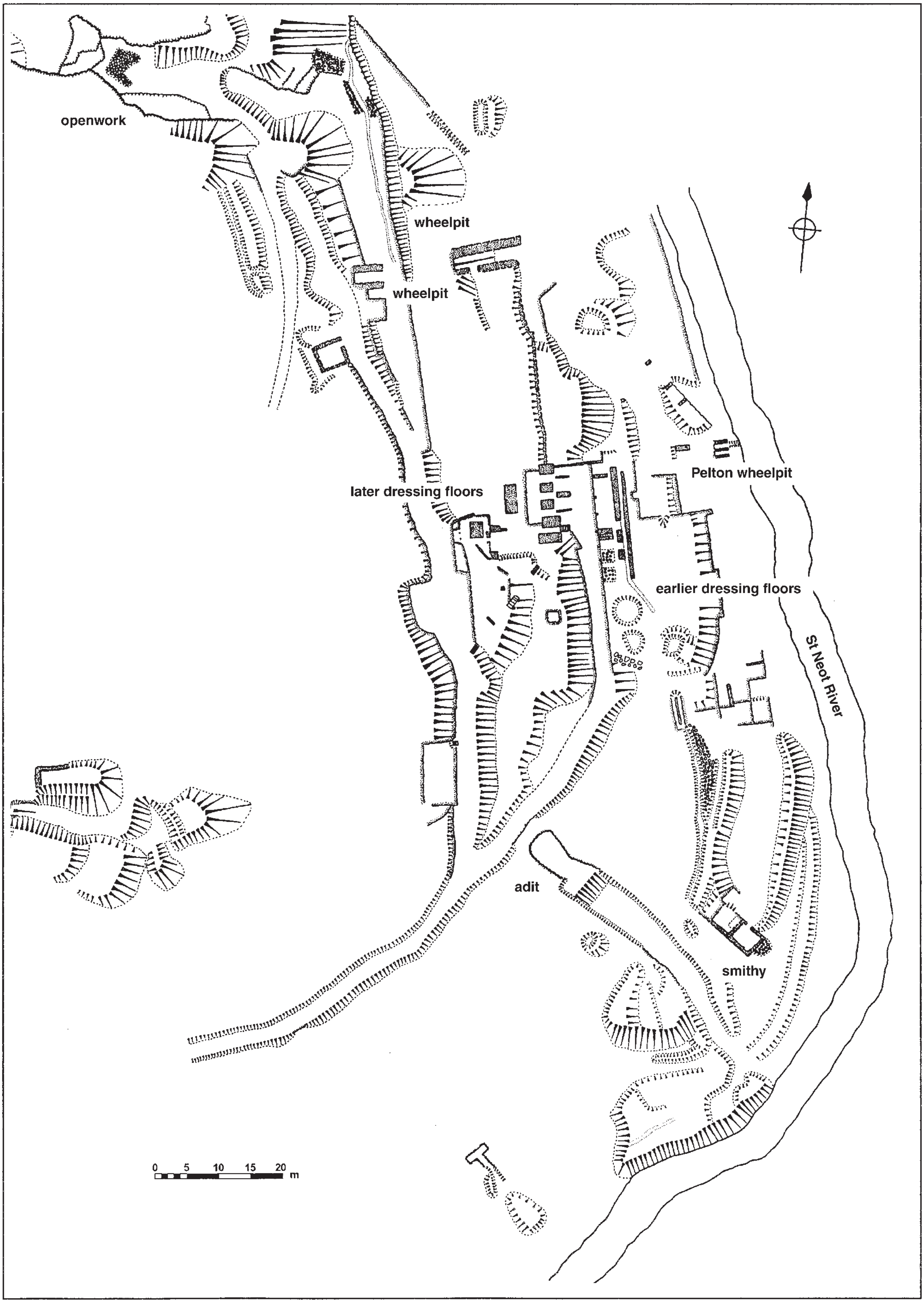


Fig 4 *Detail from a plan of Hobb's Hill Mine dressing floors (SX 18686928) made at 1:500 by Sandy and Helen Gerrard using a plane table.*

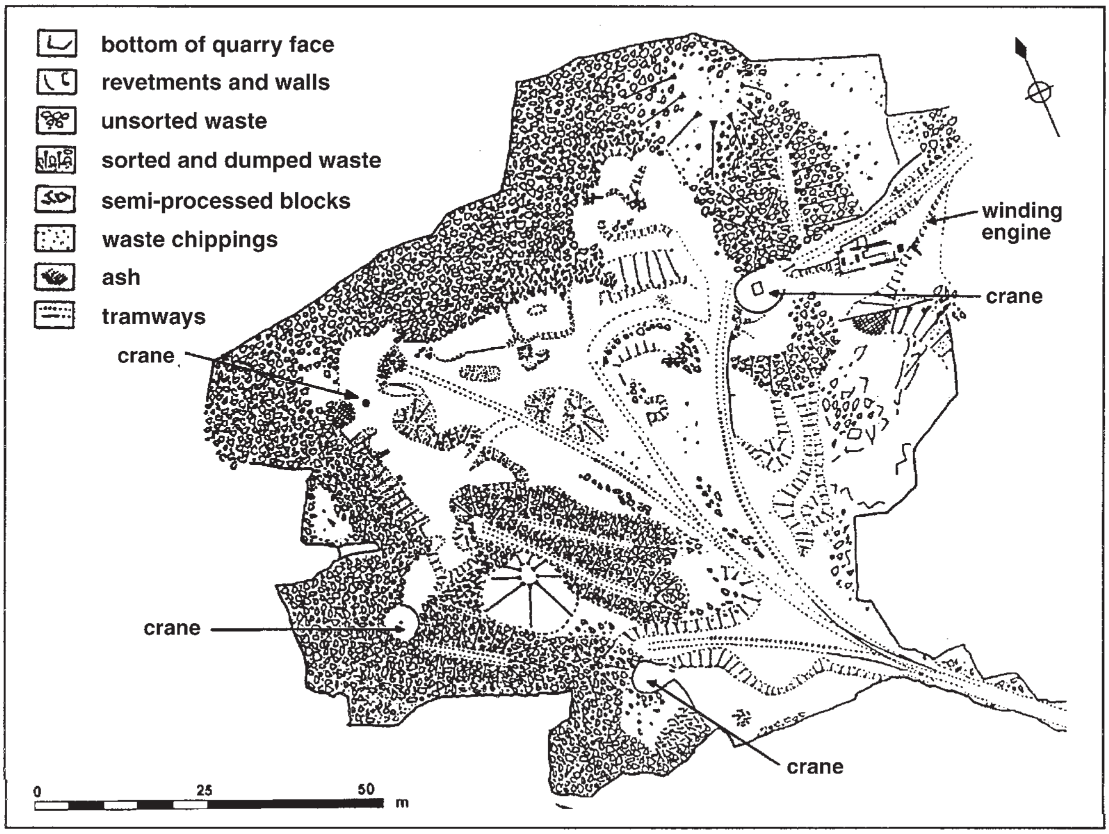


Fig 5 The interior of the Cheesewring dimension-stone quarry as recorded by measured plane-table survey (1:500) by Nicholas Johnson and Peter Rose of CCRA in advance of removal of dumps of waste rock. (CCC HES, GRH 124/7)

Minions Area Survey 1987–8

A year-long Community Programme established in 1987 and directed by Adam Sharpe for CAU undertook documentary research and a field survey of the mines, streamworks, quarries, railways and settlements within a two-mile radius of Minions village, in order to provide Caradon District Council with both general and specific management strategies for the proposed Minions Heritage Project. An outline survey of the principal industrial features of the area was achieved through air-photo transcription and rapid sketch survey by Sharpe, the MSC teams producing detailed surveys of selected sites and features at scales from 1:1000 to 1:50. The results of the project were summarised in a CAU publication (Sharpe 1989a) and the archive is held by CCC HES.

Sketch survey of other industrial remains (1988–9)

To collect information for the preparation of a document supporting proposals for reviewing and extending statutory protection of archaeological remains as part of English Heritage's Monuments Protection Programme (MPP), Peter Herring and Nigel Thomas (CAU) sketch surveyed at 1:2500 all known industrial remains within the Bodmin Moor study area not recorded in earlier projects. This entailed assessing and recording 170sq km, the most extensive of the various surveys. Detail was added in the field to base-maps compiled from 1st, 2nd and 3rd edition OS 1:2500 maps, parish Tithe Maps (*c* 1840), the RCHME photogrammetric plots and additional sketching from aerial photographs (particularly in streamworks and in those enclosed areas not mapped by Ann Carter). Detailed field notes were also made.

Plans were drawn up onto gridded film and the field notes formed the basis of explanatory overlays. The MPP document (Rose and Herring 1990) summarised this information and also pulled together the material from the previous projects. It also included outline histories of Bodmin Moor's main industries and described the principal processes and components of the various types of industrial site found on the Moor.

The details of each site recorded in this and all of the other projects were entered into the Cornwall and Isles of Scilly Historic Environment Record, held by CCC HES.

3 Recording post-medieval non-industrial remains on Bodmin Moor

Research and survey of post-medieval settlements and field systems (1980–4)

Postgraduate research into the landscape history of Bodmin Moor by Peter Herring (University of Sheffield) included the study of post-medieval settlements, field systems and farming practices in the

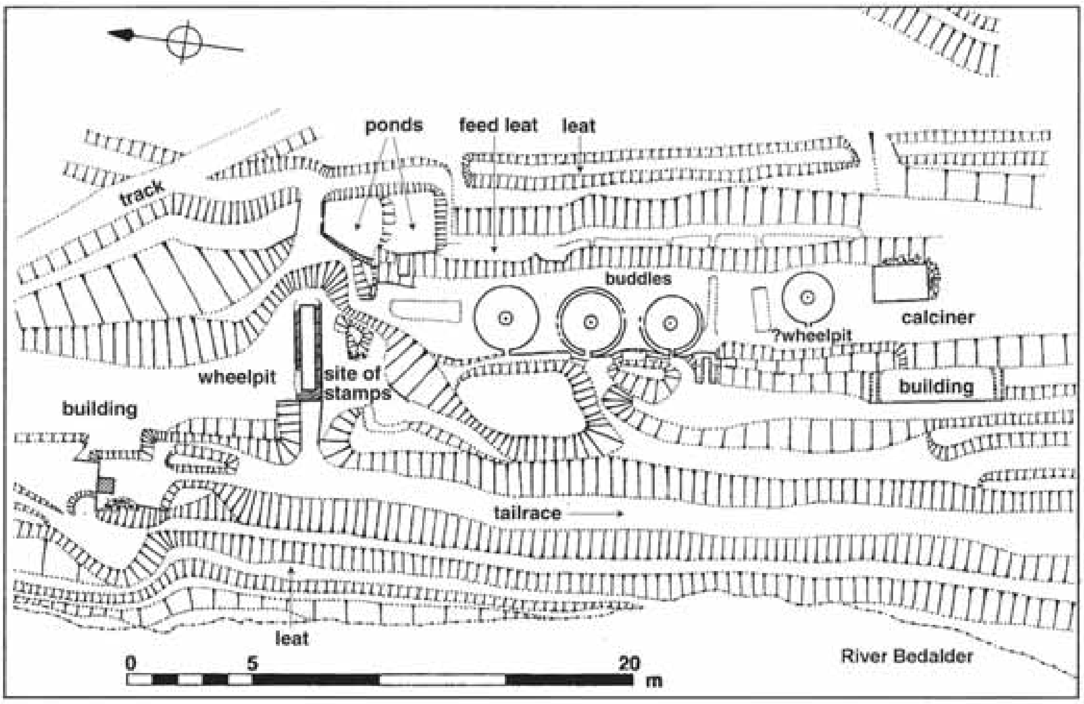


*Fig 6 Measured plan of Hardhead Downs dressing floor (SX 14697150) made at 1:100 by Adam Sharpe and John R Smith (*see *also Figs 65 and 66). (CCC HES, GRE 122)*

parishes of St Breward, Blisland, Altarnun and Advent, through, in the first instance, cartographic and documentary sources (Tithe Maps, early editions of OS maps, leases, census returns, etc). Selected sites were then subjected to various levels of fieldwork from measured survey (1:1000 and 1:500) at Brown Willy, through sketch survey (the fields and farms on Butterstor), to field visits (most settlements in the granite areas of the parishes mentioned, plus visits to various other settlements elsewhere on the Moor). Extensive research into secondary sources and limited oral history work were also undertaken. Some results were included in Herring 1986; much remains unpublished.

Post-medieval farmstead surveys (1981–4)

Jacqueline Nowakowski (University of Sheffield) prepared large scale (1:500) sketch surveys of 15 post-medieval farmsteads in the central and north-western parts of the Moor to gather material for analysing the function of buildings and enclosures and identifying activity areas within farming settlements, for an undergraduate dissertation (Nowakowski 1982). Later, whilst attached to the Department of Archaeology at Cambridge University, Nowakowski studied post-medieval farmsteads throughout Bodmin Moor, preparing 1:2500 sketches (based on OS plans) of most, together with selected 1:100 and 1:50 plans and elevations supplemented by cartographic research (utilising mainly Tithe Maps and early OS plans). Considerable oral history work was also carried out, particularly amongst farmers in the Fowey valley. The main product was a paper on successional use of buildings, enclosures and other farmstead features (Nowakowski 1987; and *see* Figs 120 and 121, Chapter 9).

Recording of peat platforms (1983–5)

Norman Quinnell and Martin Fletcher of the RCHME described and measured key dimensions of all peat platforms (now called turf steads from local usage; *see* Chapter 7), either mapped photogrammetrically by Ann Carter or encountered on the ground during confirmatory 1:2500 field checks (*see* Johnson and Rose 1994, 11–15). Dimensions were recorded on Field Information Overlays (ibid 1994, 14); copies are held by the NMR and CCC HES.

Farmsteads survey (1994)

Colum Giles, Allan Adams and Paul Barnwell of the RCHME recorded 42 farm complexes in the southern and eastern parts of Bodmin Moor and in the area immediately to the east, in the Lynher valley, as part of a national survey of farmsteads. The moorland provided a southern upland area to contrast with upland regions elsewhere, and the Lynher valley gave the potential to make intraregional comparison between upland and lowland farming systems. The survey area appeared to be representative of a much wider region and the buildings of the selected parishes (Altarnun, St Cleer, St Neot, North Hill and Linkinhorne) survived relatively well, giving the opportunity to study farm buildings while they were still in agricultural use or at least before the tide of demolition and conversion had advanced too far.

The farmsteads were recorded to RCHME levels 2 and 3 (RCHME 1996). Architectural evidence was combined with evidence drawn from primary documentary sources to produce a written history and description of each site, and this written archive was supplemented by photographic coverage, block plans, and in some cases measured survey drawings. The full results of the RCHME's farmsteads survey are available for public consultation at the National Monuments Record Centre, Kemble Drive, Swindon, SN2 2GZ (Tel: 01793 414600) and a summary of the survey findings has been published (Barnwell and Giles 1997).

Research into turf cutting on Bodmin Moor (1995)

Extensive oral history work was undertaken amongst farming families in the upper Fowey valley by Tony Blackman (Cornwall Archaeological Society), in association with Peter Herring (CAU), into the practice of cutting and drying turf, the mode of transporting and stacking it, and its use on the domestic hearth in the mid- to late 20th century. The results of this work, summarised in this volume, will be published in a series of descriptive articles by Blackman and Herring. An archive of photographs, transcripts of conversations, etc is held by CCC HES.

4 Other related studies

With one or two notable exceptions (Shambrook 1977; 1982: Stanier 1985a; 1987), there have been surprisingly few detailed studies of the industrial and post-medieval remains on Bodmin Moor beyond those discussed above. Specific sites and complexes on the Moor are treated within works dealing with aspects of the whole of Cornwall or the South-West and in more general or popular publications covering all or part of Bodmin Moor. The most important works are introduced in the following summary.

Detailed studies

Dozmary Pool Ice Works (H R Hodge 1973): oral history and sketch of site.

Liskeard and Caradon Railway and mines (Messenger 1978): documentary and cartographic history.

Caradon mining district (Shambrook 1982): documentary, cartographic and statistical history supplemented with brief site descriptions and photographic record.

Caradon mining district (Stanier 1987): documentary and cartographic history with some fieldwork.

Granite working in the Cheesewring district (Stanier 1985c): documentary, cartographic and statistical history supplemented with brief site descriptions and some site surveys.

Bodmin Moor sites and complexes treated in more general works

Industrial archaeology

Todd and Laws (1972) include a small number of sites on Bodmin Moor in their introductory survey of Cornwall's industrial archaeology.

Mining

Bodmin Moor mines are covered in several statistical and geological surveys, including Webb and Geach 1863, Spargo 1864, Collins 1912, Dines and Phemister 1956 (and 1988 revision) and Burt *et al* 1987. More discursive histories also incorporate the more important moorland mines, particularly those in the Caradon district (D B Barton 1961; 1964; 1965; 1967; Jenkin 1966).

Quarries

Peter Stanier undertook doctoral research (mainly documentary, cartographic and statistical) on the granite industry of south-west England (1800–1980) and has published several valuable papers summarising his results and interpretations (Stanier 1985b; 1986a; 1986b; 1992).

China-clay working

Rita Barton produced a detailed history of this important industry (1966) and John Smith has pioneered research into the material remains of its processes (Herring and Smith 1991; Smith 1992).

Bridges

Charles Henderson (1928 with H Coates) noted a small number of moorland and moor-edge bridges.

Railways

The Liskeard and Caradon Railway is included in several books and articles, including D B Barton 1964, Tolson *et al* 1974, Fairclough and Shepherd 1975 and Stengelhofen 1988.

Local studies which include industrial and post-medieval history and remains

A number of later 19th- and early 20th-century travel books touch on aspects of mining, quarrying, china-clay working, turf cutting and agriculture on the Moor. Among the more useful are Collins 1851, *Murray's* 1856 and 1859, Breton 1912, Folliot-Stokes 1912, Malim 1936 and Leigh 1937. More objective and systematic local histories include Maclean 1873 and 1876, Munn 1972, Brewster 1975, Axford 1975 and Bousfield (ed) 1988.

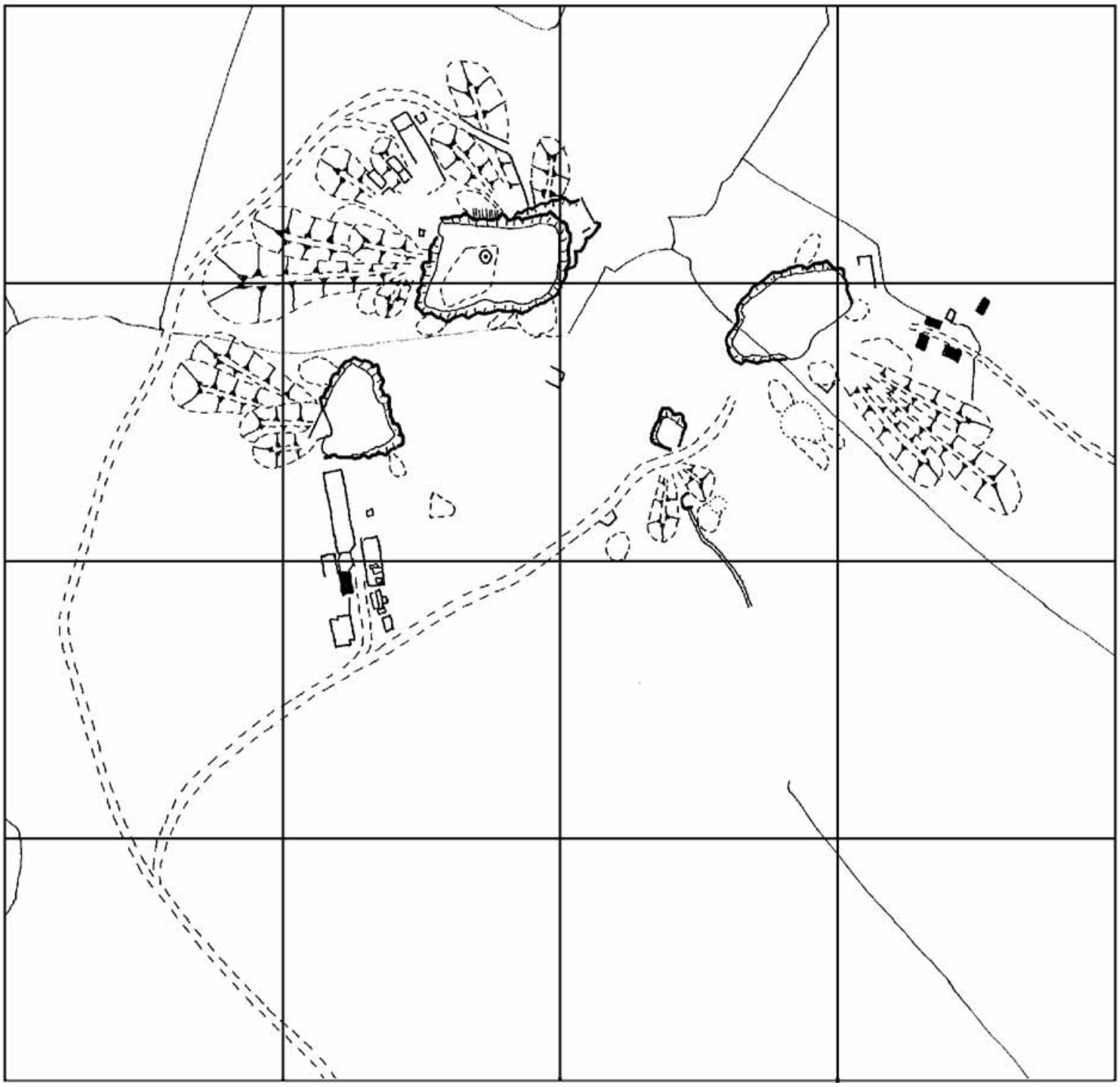


Fig 7 Carbilly Tor (SX 126755): sketch survey of quarries made at 1:2500 from a tight network of fixed points derived from three editions of the OS 1:2500 maps, the RCHME air-photo plot, supplemented by a slightly looser network based on the 1840 Blisland Tithe Map and further sketching from aerial photos. Detailed field notes were also made of all features and record photographs were taken. Grid is 100m and north is at the top. (CCC HES, Bodmin Moor Industrial Survey, SX 1275)

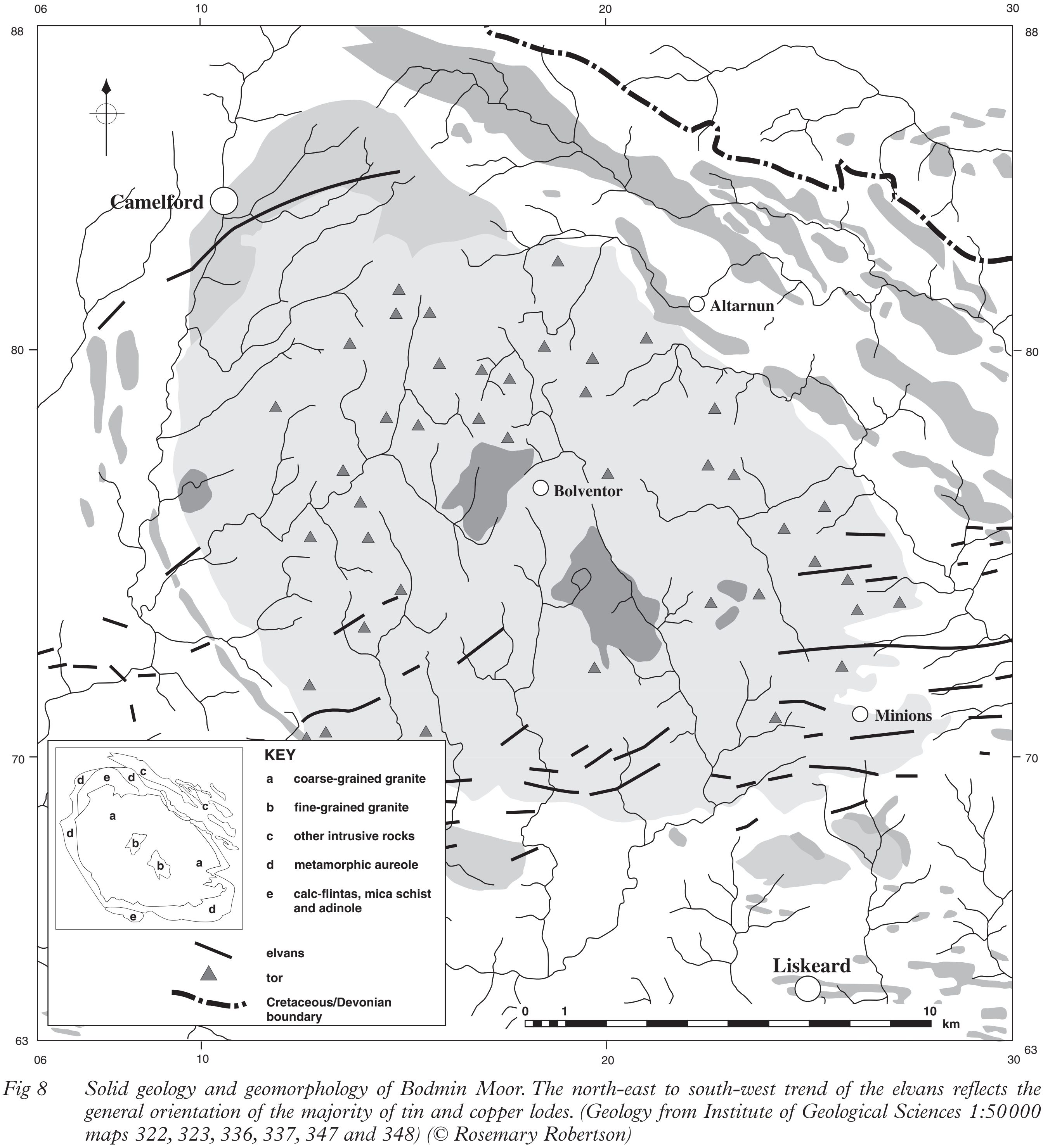


Fig 8 Solid geology and geomorphology of Bodmin Moor. The north-east to south-west trend of the elvans reflects the general orientation of the majority of tin and copper lodes. (Geology from Institute of Geological Sciences 1:50000 maps 322, 323, 336, 337, 347 and 348) (© Rosemary Robertson)

3 Resources

by Adam Sharpe

1 Geological and geomorphological background

(This sub-section is based largely on R M Barton 1964 and Bristow 1996.)

Between 300 and 275 million years ago, a discordant batholith of acid magma was intruded under highly folded Devonian and Carboniferous sedimentary rocks, its upper surface following the newly formed ENE–WSW geoclines (major folds) of the contorted rock cover, forming a series of cupolas or bosses which are now exposed from Dartmoor to Scilly. The Bodmin Moor granite is amongst the oldest, its emplacement dating to between 287 and 288 million years ago.

Beneath 5km of rock cover this material slowly cooled to form a holocrystalline granite, whilst the sedimentary rocks it abutted became baked and metamorphosed.

Further, more minor intrusive activity subsequently occurred along major lines of local weakness. This new material, cooling more rapidly, developed a finer crystal structure and is known locally as elvan. As the granite mass cooled and mineral rich fluids migrated through it, it shrank slightly and cleavage joints opened up within it in three planes – vertical joints trending ENE–WSW known as tough way or cross joints, NNW–SSE cleaving way or longitudinal joints, and floor or quartering joints which developed parallel to the original roof of the dome.

Hot, volatile gases and mineralised fluids and steam emitted from the magma during the cooling process made their way through shrinkage cracks and fissures which had developed as a result of continuing earth movements. The initial boron-rich fluids modified feldspars to form tourmaline; in a subsequent episode of pneumatolytic change fluorine modified feldspars to quartz and mica, and finally magmatic water and carbon dioxide attacked some feldspars, starting the process of converting them to kaolin.

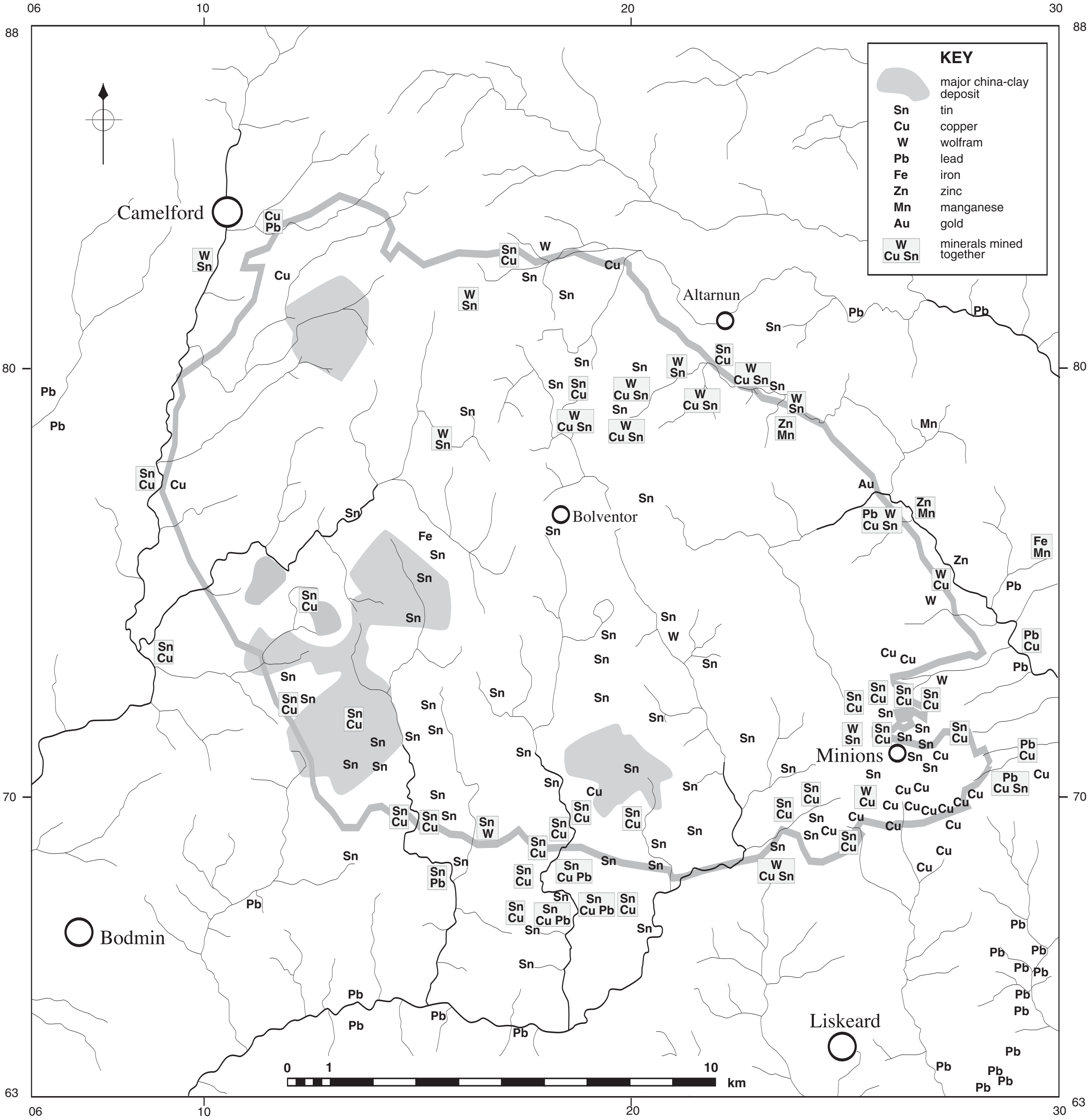
During the Permian and Triassic periods, between 280 and 200 million years ago, the granite gradually became unroofed. The geomorphological processes which occurred during this period (the late Mesozoic Era) are still unclear, but it appears that the granite and the remnants of its overlying sedimentary cover formed a series of impressive uplands, part of the Variscan mountain chain, at the margins of a continental land mass. During the subsequent Tertiary period (roughly between 65 million and 12 million years ago) during which the continental Alps were uplifted, the area which was to become Cornwall was submerged to form a continental shelf studded with low islands. Its subsequent re-emergence incorporated a series of stillstand phases which may be responsible for the extensive near level platforms which dominate the Moor's present topography (though some authorities, for instance Bristow 1996, have suggested that these represent a planation surface).

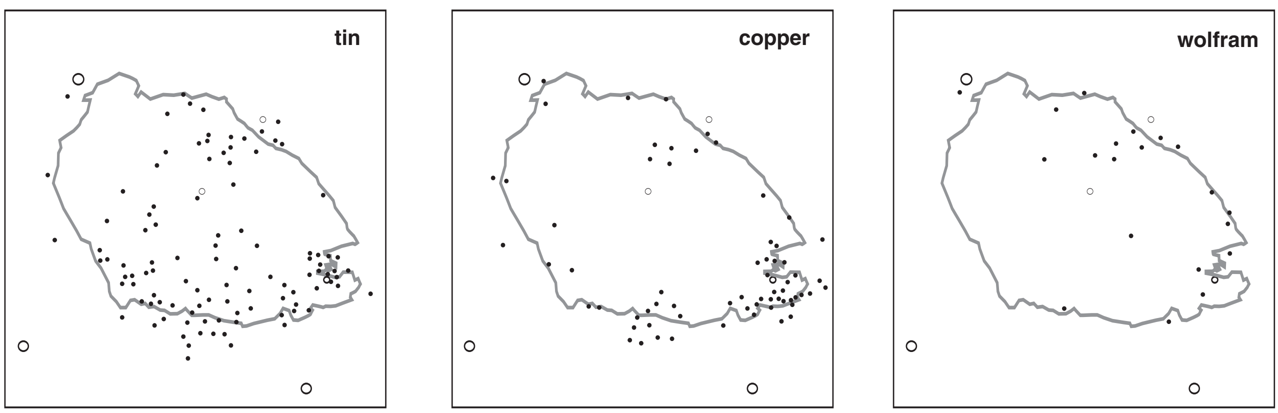
Exposure to water laden with carbonic and organic acids penetrating from the surface during the subsequent Jurassic period modified the upper parts of some lode structures, copper ores being oxidised or partially dissolved and redeposited through leaching in zones around the water table. Sub-aerial weathering along both vertical and horizontal joints within the granite dissolved out feldspars, opening up the joints and producing growan (quartz sand) and clitter (detached granite blocks) as erosion lowered the ground surface. The more resistant granite was less affected by this process and remained as tors crowning low hills.

Cornwall lay on the southern fringe of the furthest advances of the ice sheets during the Devensian glaciation, but was exposed to extreme climatic conditions including permafrost whilst exposed rock was subject to extreme thermal stressing. Hydrological weathering during periglacial periods resulted in widespread surface erosion, and the movement and re-emplacement of eroded material through gelifluction or transport by meltwater smoothed the Moor's contours. Cassiterite mixed with rock fragments detached from mineral lodes during the colder phases was transported in scree and mud flows, in some cases reaching streams and rivers swollen with meltwater, where it was tumbled and sorted by density from the parent rock with which it was mixed. Although much of this ore must have been flushed out to sea, substantial amounts settled where the water velocity slowed, to be gradually blanketed in silts, gravels and organic sediments.

2 The availability of resources and their effect on industrial development on Bodmin Moor

Moorstone and detrital tin were abundant and widely distributed, and were the basis of significant moorland industries from the medieval period until the early 19th century. The Moor was not so readily able to meet the needs of later industry, however. Most of the lode structures from which the alluvial tin initially derived had been removed by weathering, and those that had survived (mostly on the moorland's southern edge) were poor in Cornish terms. The copper deposits, although rich, were almost wholly confined to the south-eastern corner of the Moor and were not recognised until the 19th century (Fig 9). Although granite was available almost everywhere on the Moor, accessible high quality material was scarce, and in contrast to the Hensbarrow Moors to the west,


KEY
major china-clay deposit
Sn tin
Cu copper
W wolfram
Pb lead
Fe iron
Zn zinc
Mn manganese
Au gold
W Cu Sn minerals mined together
Camelford
Altarnun
Bolventor
Minions
Bodmin
Liskeard
0 1 10 km


tin
copper
wolfram

workable deposits of china clay were small, few in number and generally of poor quality. In addition, poor road and rail access made the transport of fuel, machinery, materials and products difficult. The Moor was also very thinly populated and by the 19th century had neither a local skilled workforce nor a developed industrial and commercial infrastructure in any of its surrounding towns.

Three distinct and isolated phases of industrial activity on the Moor can be identified. The first, from about the 12th to the 15th centuries, was based wholly on tin streaming; the second, from 1840 to 1880 began with copper mining, but later embraced deep mining for tin, the development of large-scale granite quarries, china-clay works and the two mineral railways; the third, from 1945 to the present day, is based almost entirely on china-clay working.

3 Granite and elvan

Granite was readily available in the form of exposed or shallowly buried semi-rounded boulders (moorstones), runs of clitter surrounding tors across all areas of the Moor not blanketed in eluvium or alluvium and the tors themselves. Not all granite was useable for construction purposes, however, since the resistance of *in situ* granite to weathering varies considerably. Some has weathered to considerable depth and has become a crumbly or clayey mass without any strength or coherence, particularly where subjected to large amounts of ground water movement, and often in proximity to mineral veins where the feldspars had been modified by volatile agents. Elsewhere, as in the tors at surface, and generally at depth, the granite has been less altered and retains a high degree of coherence and strength.

Whilst boulders, clitter and tor material were suitable for vernacular construction where their large crystal structure and partial weakening by weathering were of little account, the rarer fine-grained, unaltered granites were required for cut work – dimension stone. The distribution of developed granite quarries on the Moor however reflects not simply granite of the desired quality but those deposits which were readily accessible, all being sited near the periphery of the upland area. Almost all the major quarries are within two main groups. The first includes De Lank and Pendrift near St Breward, Carbilly and Bedwithiel a short distance to the east, and Corner Quoit and St Bellarmin's Tor near Millpool a little to the south; the second is clustered around Minions on Caradon Hill, Stowe's Hill (Cheesewring) and at Goldiggings, with outliers to the north on Bearah Tor and Kilmar Tor. Quarries producing hardcore were more widely dispersed, but most owe their siting to available road access. Decomposed granite for road surfacing or repairs was obtained from small rab pits adjacent to byways, whilst quarries supplying stone for small-scale building works were also fairly widely dispersed (Fig 72).

4 China clay

Kaolin or china clay, $(Al_4Si_4)10(OH)$, occurs to some degree in most of the granites of the south-west, and is associated with localised chemical alteration of the rock. In places, however, more extensive alteration of the granite took place. Large scale 'slads' of china clay of sufficient purity to warrant extraction are relatively rare and are located to the west of Roughtor at Stannon, near the centre of the Moor around Temple and in the south near St Neot at Parson's Park, whilst minor deposits were tried along the western fringes of the Moor near Blisland (Fig 83). Moorland clays were generally unsuitable for brickmaking, and most bricks were imported.

5 Other stones

Granite was available in a range of forms from sand and gravel, clay and rab, to moorstone and harder quarry stone and could meet almost all construction needs. Where slate was used for roofing it was often imported from Delabole or the quarries near Tintagel and Boscastle, though small quarries producing lower-quality slate fringed the Moor to the south near St Neot but turf, straw or rushes were sometimes used to roof domestic and agricultural structures (corrugated iron being common from the late 19th century).

6 Minerals

As on Dartmoor, there are few *in situ* mineral deposits within the Bodmin Moor granite, probably the result of millions of years of erosion having removed most of the lode structure emplaced during and after the development of the granite boss. Copper is found only in a relatively narrow contact zone in the killas fringing the granite, richest in the area surrounding Caradon Hill, though occurring to some degree around the whole periphery of the Moor, whilst the surviving tin lodes mostly occupied a 2.5km band along the edge of the granite. Occurrences along the Fowey valley may indicate a geological structure subdividing the granite boss. Wolfram, found in small pockets, was almost always associated with tin, most notably in the north and east of the Moor. Other than copper, tin and wolfram, the only other metal ores found in economic quantities were iron, in the form of pyrites associated with the

Fig 9 *(Opposite) The mineral resources of Bodmin Moor, derived from documented mine outputs. The heart of the Moor was poorly mineralised, much of the tin output recorded from this area almost certainly deriving from streamwork sources. Whilst the richest copper deposits were found around the southern periphery of the Moor near Minions and St Neot, a small but significant cluster of lodes to the south-west of Altarnun was also profitably worked. The narrowness of the metamorphic aureole to the east and south of the Moor is marked by the mines working lead, zinc, iron and manganese on the fringes of the granite contact, whilst to the west and north the boundaries of this zone were less distinct and such mines were found at a greater distance from the granite. (© Rosemary Robertson)* copper ores and haematite in an isolated occurrence at Shallow Water Common (SX 154762), a small amount of zinc blende and some manganese (Fig 9).

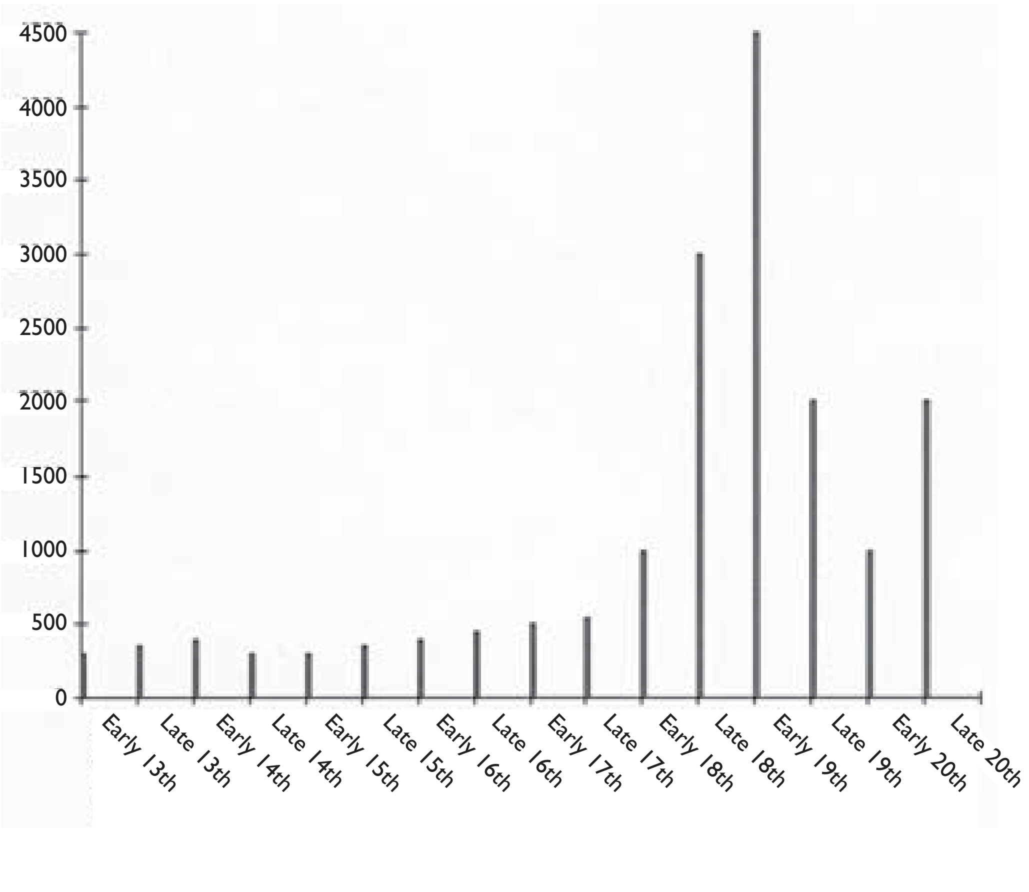
The granite-killas contact is steep to the east of the Moor, and the related metamorphic aureole is narrow, lead being mined only 2km from the contact; to the south it is rather wider, and low-temperature minerals were found correspondingly further from the granite. To the north-west, the contact is also shallow and the metamorphic aureole extends to the coast, small-scale mines working lead and antimony being found from St Teath to Padstow.

Tin is found only as Cassiterite, SnO_2, a mineral exceptionally resistant to weathering and therefore found as shoad in a range of sizes from grits and coarse sands up to lumps (corns) weighing as much as a kilo. In the lode, it ranges in colour from near-white through reddish and greyish browns to black, sometimes visibly crystalline, but often so finely disseminated within the host rock that it is not visible to the naked eye. Its high specific gravity (7.0) and hardness (6.5) are particularly distinctive.

Copper, in contrast, is a highly reactive metal and was found as a wide range of ores, reflecting the effects of leaching and redeposition by ground water. The upper zones of such lodes (gossans) are generally leached of all copper, being made up of indissoluble limonite (hydrated iron oxide). Below, in the zone of oxidised enrichment were native copper, Cu, the red oxide cuprite, Cu_2O, the green and blue carbonates malachite, $CuCO_3.Cu(OH)_2$, and azurite $2CuCO_3Cu(OH)_2$, whilst beneath these in the zone of sulphide enrichment were the most economically important minerals: chalcocite, Cu_2S_4, and bornite, Cu_5FeS_4. Below again, where the lode was unaltered, was the copper-iron sulphide chalcopyrite, $CuFeS_2$. Wolfram, (FeMn)WO4, was the principal ore of tungsten, and was found in association with tin in some areas of the Moor. Arsenic was found as mundic or arsenical pyrites, FeAsS, whilst iron occurred as pyrites, $4(FeS_2)$, and as haematite, $2(Fe_2O_3)$.

Total production figures for these minerals are difficult to estimate. The major copper mines of the Caradon area produced about 600,000 tons of ore during their 50-year lifespan; the output figures for the remaining moorland copper mines were small. The figures for tin are more difficult to summarise, given that early production figures are virtually non-existent. The graph (Table 1) shows Collins' (1912) estimates for total Cornish tin production from the early 13th century when output is estimated to have been about 30 tons *per annum*, to the beginning of the 20th century when production was in rapid decline from a peak of about 10,000 tons *per annum* during the 1870s. Bodmin Moor is estimated to have been responsible for about 3 per cent of total Cornish production, though this area would have been the source of a high proportion of the output in the medieval period, before the development of deep mining in the western stannaries.

Table 1 Estimates of total tin production in Cornwall between the early 13th and the early 20th centuries (Collins 1912)



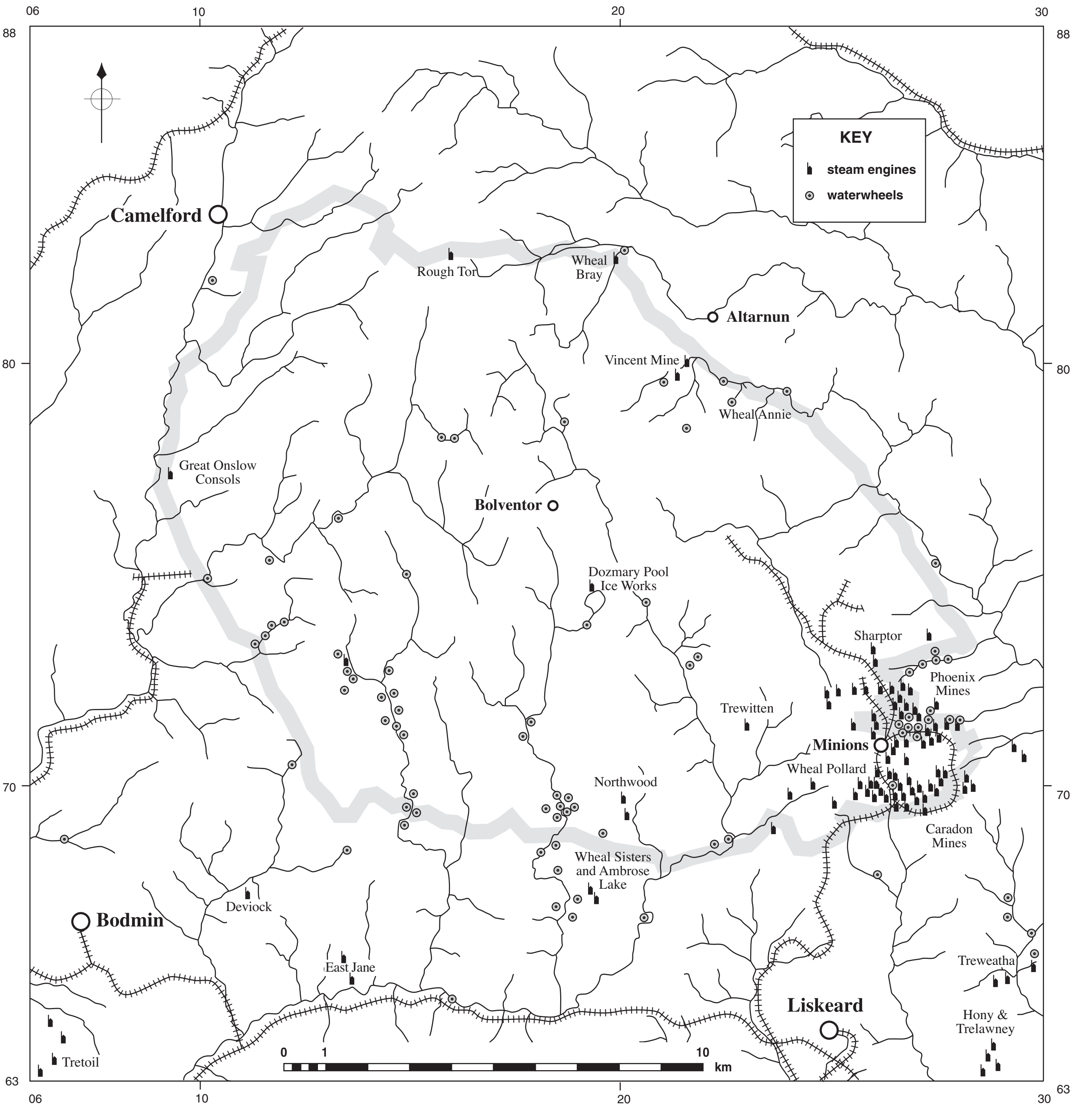


Fig 10 Documented non-agricultural power sources on Bodmin Moor during the 19th century (mainly mines, but includes clayworks and ice works). Poor transportation links, essential for the carriage of coal, confined the use of steam engines almost exclusively to the south-eastern corner of the Moor served by the Liskeard and Caradon Railway. Elsewhere on the Moor, water power continued to serve as it had done for centuries before, significantly limiting the potential for the development of deep mining. (© Rosemary Robertson)

7 Organic raw materials

Although the moorland valleys appear to have been quite heavily forested in prehistory, palaeoenvironmental data suggest that by the medieval period the moorland vegetation cover resembled that of today (Walker 1989). The thin, acid soils which had developed on these exposed, wet uplands were almost exclusively used as rough grazing, and, beyond the fields, most were covered in tough wiry grasses, giving way to bracken or heather in the most exposed areas and to willow scrub bordering streams and the less exposed marshes where mosses, cotton grass and reeds would predominate. In the deeper valleys on the fringes of the Moor fingers and pockets of oak-dominated woodland are still to be found, as in areas around farmsteads where trees (typically beech and sycamore) have been deliberately planted.

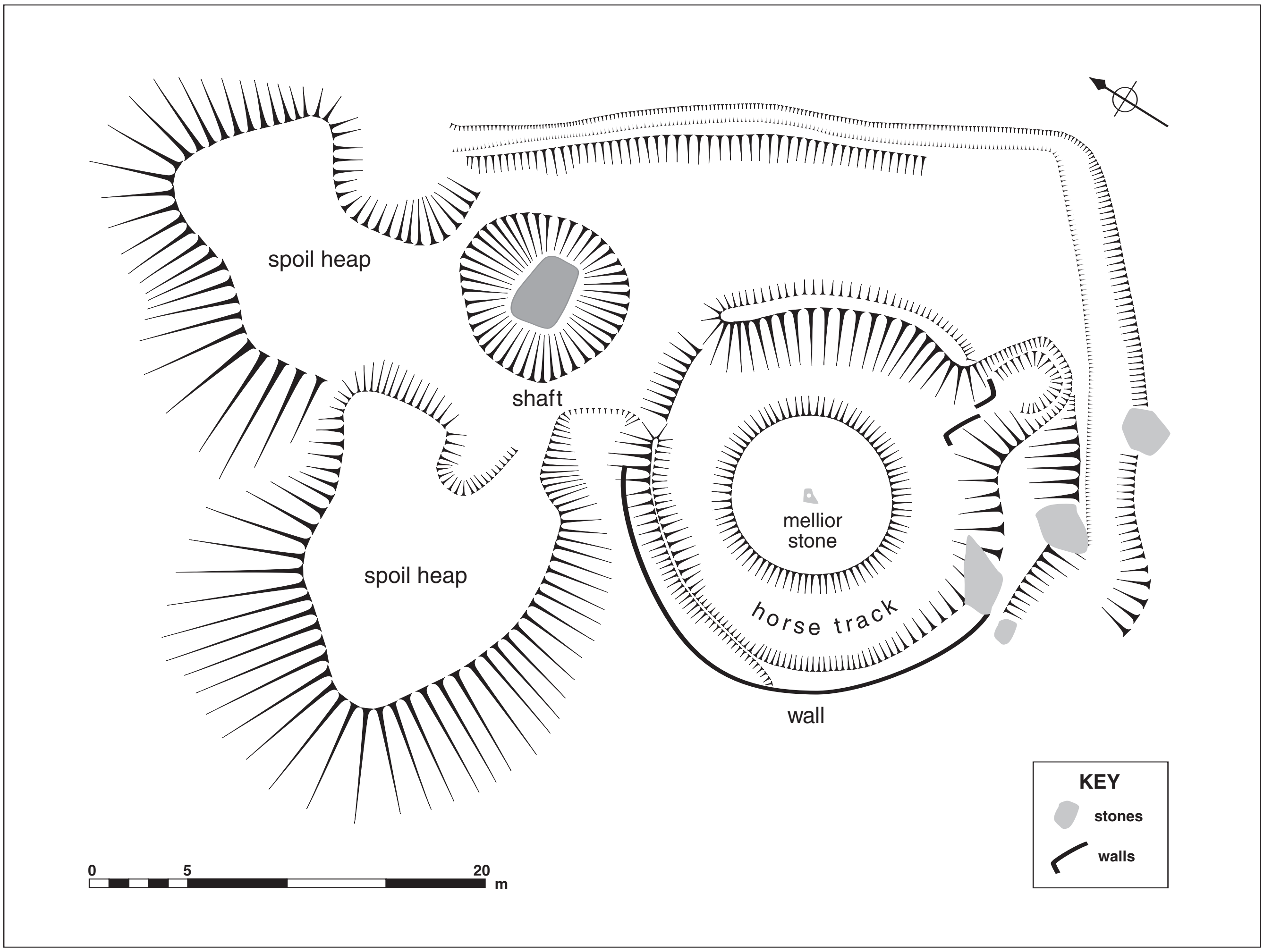


Fig 11 A well-preserved horse whim platform, with its associated shaft and dumps on Webb's Lode, South Caradon Mine (SX 26747021). The small recess on the right hand side of the whim platform was probably a fodder store. Operations on this shaft seem to have come to nothing, with the result that the evidence for the motive power used during shaft sinking has survived at this site. (CCC HES, GRH 33/M2/1)

Since late prehistory, timber is likely to have been a scarce and carefully managed resource, the quantities available unsuitable as a basis for large-scale use as fuel or construction material. As in other damp western uplands, however, peat had developed and 'turf' came to be used as the basic fuel, both for domestic purposes, where it was commonly supplemented with gorse (locally furze), and for early industry, where the rights of tinners to cut turf as a smelting fuel were confirmed by charter in 1201 (Lewis 1908). Turf charcoal continued to be used for this purpose (together with imported coppice charcoal) for at least the following four centuries (*see* Chapter 7), though turbary rights on Dartmoor were being granted to Cornish tinners by the mid-15th century, suggesting that supplies of peat suitable for industrial purposes were by then already in short supply. Turf continued to be used as a domestic fuel in a few areas of the Moor until very recently.

With the single (and unusual) exception of the ice-packing steam engine installed at Dozmary Pool Ice Works (SX 193747, Fig 107), coal, not peat, fuelled the hearths of later industry. Although the nearest suitable deposits were in South Wales, a considerable trade had grown up between Wales and Cornwall by the 1830s to support the Cornish mining industry. Until the construction of the Liskeard and Looe Canal (and subsequently the Liskeard and Caradon Railway), the expense of transporting supplies of coal to the Moor had restricted industrial exploitation, resulting in the continued widespread use of water power (Fig 10). With the development during the second half of the century of transport networks capable of carrying bulk materials this brake on development was to a degree lessened.

8 Agricultural resources

by Peter Herring

Poor drainage, thin acid soils, exposure to wind and rain and susceptibility to fog or low cloud make Bodmin Moor a marginal land for agriculture, and farms here have always been noticeably poorer than those on the moorland fringes or in the Cornish lowlands. Mixed farming on the Moor has, since the

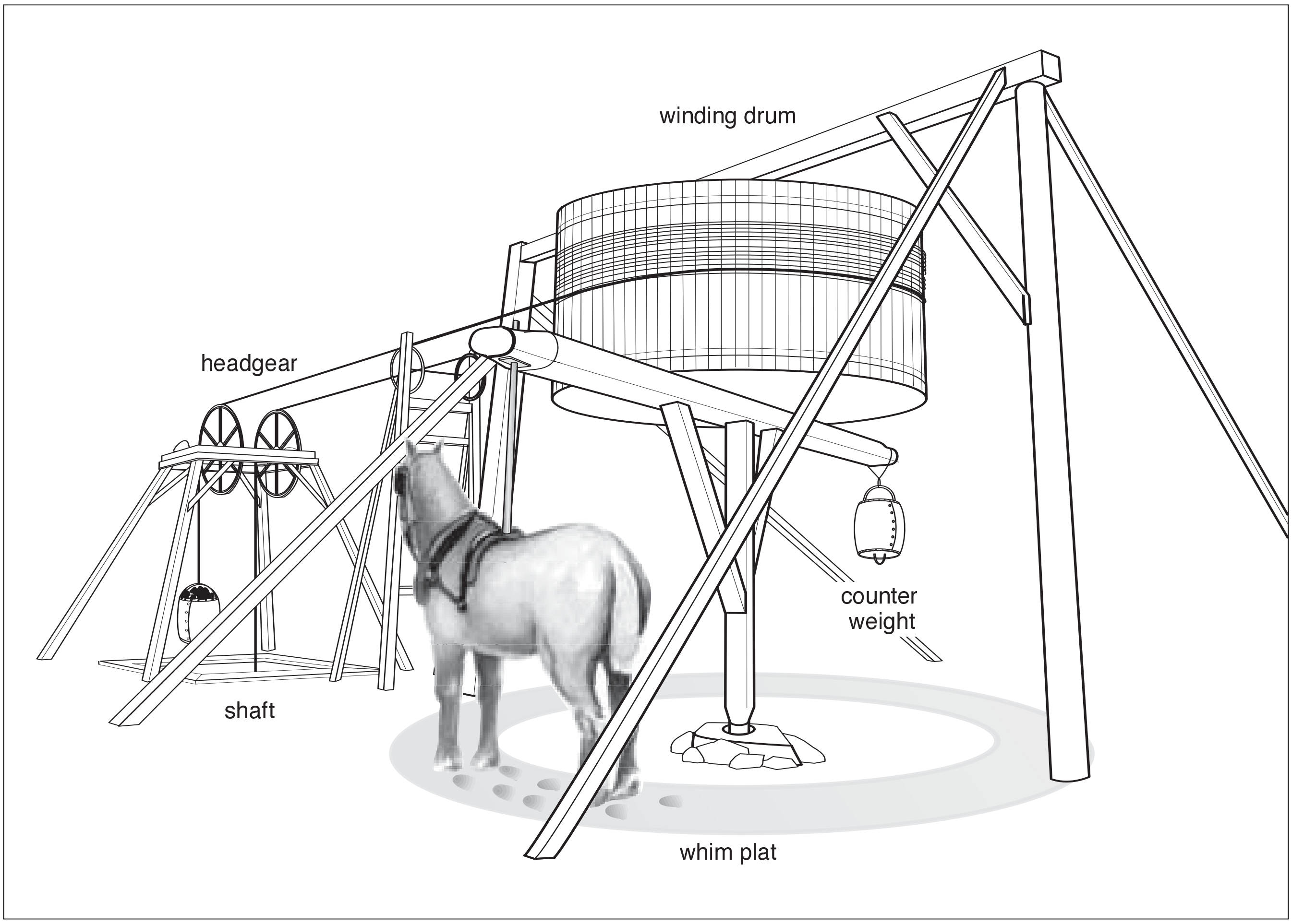


*Fig 12 Reconstruction drawing (by Rosemary Robertson (©) with guidance from Adam Sharpe) of horse whim on Webb's Lode (*see *Fig 11) showing the general arrangement used at such sites. All of the timber components could be readily dismantled and moved from site to site. The yoke to which the horse was attached was pivoted so that the direction of hauling could be reversed without unharnessing.*

medieval period, been adapted to these conditions with emphasis on the pastoral in terms of relative acreages in various land uses (arable, meadow, rough pasture). Oats, rye and dredge, tolerant of poor soils and able to ripen in this climate, were always grown rather than wheat and barley.

The availability of extensive rough grazing was important in determining the form taken by agriculture on Bodmin Moor, livestock being moved onto it during the summer to allow fodder crops (grain, roots and hay/silage) to be grown in inbye fields. The extent and pattern of the commons, the field systems and most of the lanes and routes to and through them were inherited from the medieval period except, of course, in those areas where there was extensive 19th-century intake. These intakes, encouraged by local lords keen to improve returns from their land and driven by the need to accommodate industrial labourers, inevitably reduced the area available for rough grazing, resulting in higher stocking levels and gradually increasing pressure on the commons. A shift during the interwar agricultural depression from purely summer grazing to overwintering on the commons has significantly altered the character of many areas, with gorse and heather much reduced and replaced by close-cropped grass, whilst hardy Scottish breeds of cattle and sheep have now largely replaced local Cornish ones (*see also* volume 1, 3–4).

9 Power

Muscle power

The relative isolation of sites on Bodmin Moor and the lack of good external transport links constrained the adoption of mechanised power technologies during the late 18th century, when they were being adopted elsewhere in Cornwall, and held back the development of industrial activity on the Moor until well into the 19th century. Although water power was used wherever possible, human and animal muscle continued to provide the basic power sources for many operations on the Moor, whether clearing and cultivating fields, winning and working granite and china clay, or finding, recovering, and dressing tin and copper ores. The physical traces left by such technologies are often ephemeral, and in many cases the use of animal or human muscle has to be inferred in the absence of other evidence, though the circular platforms marking the sites of the horse whims which provided the means of winding ore and waste to surface on many mines are a distinctive and relatively common site type on the Moor (Fig 11).

Water power

Until the mid-19th century, water was the only other source of power used on the Moor. The climate ensured that some precipitation occurred all year round and surface water in the form of rivers, streams and, in places, lakes and bogs was more or less ubiquitous. Few sites requiring running water would have been very far from a suitable source and leats tapping rivers or streams were commonly constructed for domestic and industrial purposes. Although many of these were relatively short – less than a few hundred metres – the artificial watercourses serving some eluvial streamworks and later mines could be very extensive (Fig 13), requiring careful engineering (though as in the case of the Tresellyn Mine leat, this was not always achieved!). Good examples include the Phoenix Leat (Map 3) brought to the mine from Twelve Men's Moor over a distance of 3km, the multiple leats serving Glynn Valley clay pit (SX 143718, Map 4), or the very extensive networks which fed the West Moor tinworks (Map 2). Most moorland leats seem to have been narrow and shallow; excavation evidence from Colliford suggests that most were unlined, though they developed clay or silt bases over time (Austin *et al* 1989).

Some sites, however, were so elevated or so remote from suitable water supplies that such approaches were not practicable and tinners were forced to construct 'run-off' leats contouring along hillslopes to intercept surface water and to convey it to holding reservoirs – an approach which must have been somewhat unreliable, and would have restricted operations to the wetter winter months. Well-preserved examples of such leats and their associated reservoirs can be seen in the moorland to the north-west of Minions and in the system of parallel leats on the west side of Buttern Hill (SX 175808; Fig 13 and Map 2).

Whilst the primary function of the water carried in these leats during the medieval period was to provide the washing water used in eluvial streaming operations, it also drove small waterwheels powering the stamps and crazing mills which reduced the ore, played an important part in the tin dressing process, and powered the bellows of the smelting houses. With the development of lode mining, the importance of water in ore dressing increased, whilst waterwheels were increasingly adopted to power pumps and winding devices.

During the mid-19th century, although efficient high pressure pumping engines were commonplace throughout Cornwall, Marke Valley (SX 280717) and Phoenix United mines (SX 266724), like Temple clayworks (SX 136718), retained large pumping waterwheels operating flat rods, whilst Treveddoe Mine (SX 152696) appears to have used only water-wheels for power throughout most of its working life. Increased ore and waste production necessitated the installation of smaller rotative beam engines at many mines, but the waterwheel remained the prime mover for most dressing machinery, as at Hardhead (SX 148715; Fig 6), Wheal Annie (SX 237794) and Hobb's Hill (SX 185693; Fig 4), whilst the five small wheels recorded at Wheal Jenkin (SX 264713; Fig 68) were typical of those used to recirculate tin pulp and water on most dressing floors. Water was also much used in the operation of china-clay works, both for washing and as a source of power (Map 4).

Whilst most moorland waterwheels (generally breast-shot or overshot) were modest in size, ranging from 2–4m in diameter, the Gawns Wheel (SX 113732) at 15m in diameter and the Phoenix Old Sump Wheel (SX 268727) at 18m were amongst the largest in Cornwall.

Steam power

Only one steam engine was installed on Bodmin Moor during the 18th century and the first two decades of the 19th century (at Stowe's Mine, SX 260721), a period which spans the entire period of operation of atmospheric steam engines and the development of the high pressure engine. This may well have been due to lack of interest in Bodmin Moor as a potential copper mining area and to its remoteness and poor communications networks.

Within a few years of the first discoveries under Caradon Hill that situation had changed completely, with beam engines being the prime movers on almost all of the copper (and subsequently, tin) mines in this newly developed mining field. Documentary information is patchy for all but the largest mines, but the 118 installations mapped or recorded at 48 sites on and immediately bordering the Moor is probably nearly complete (Fig 10). The majority (99, or 84 per cent) were on mines close to Caradon Hill, the remainder being scattered thinly around the southern and eastern edge of the Moor.

Although the functions of some installations cannot be deduced on available evidence, 53 (45 per cent of the total whose functions are identifiable) worked pumps alone (in some cases by flat rods to a number of shafts), 26 (22 per cent) were rotative winding engines, ten (8.5 per cent) worked stamps or copper crushers, two (1.7 per cent) worked man-engines (the same engine at two locations at South Caradon: SX 265698 and SX 274699), 15 (12.7 per cent) combined more than one function, generally winding and stamping, though occasionally also working pumps; the remainder were small, two driving steam capstans, one driving a pulveriser, one an air compressor and one a mine sawmill. The functions of engines sited on mines on the fringes of the Moor have not been analysed.

As elsewhere in Cornwall, pumping engines (like that shown in Fig 18) predominated and tended to have cylinder diameters between 30 and 60in (the two largest were the 70in at South Caradon (at SX 269698 but later moved to Wheal Jenkin, SX 265712) and the 80in at Prince of Wales' Shaft (SX 267720; Fig 16). In some cases, as at West Rosedown (SX 274722), the engines also supplied power to pumps in outlying shafts via flat rods (Fig 18). The second most abundant

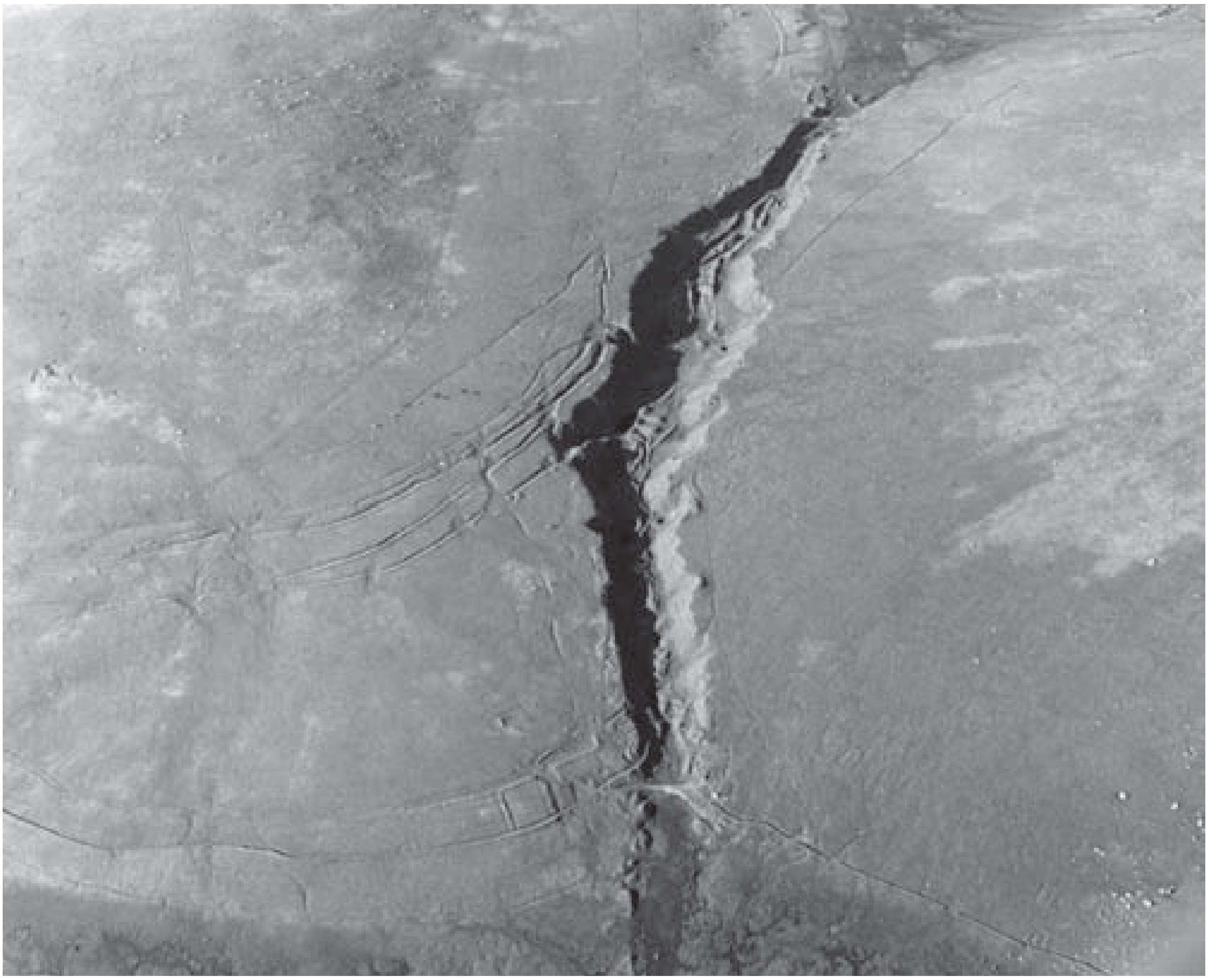


Fig 13 Looking north-east to a section of the complex of run-off leats created on Buttern Hill, West Moor (SX 177807) to collect sufficient water for the operation of streamworks in the area. Although the number of leats in this area of the Moor is unusual, reflecting the absence of major water courses, the need to secure adequate and reliable sources of water underpinned almost all mining operations on the Moor until the early 20th century. (CCC HES, AP F33/155)

group of engines were smaller winding engines, each probably winding from two or three shafts. Given that the larger mines on the Moor commonly had several steam whims, the total for this type of application is small, suggesting that horse whims and waterwheels continued to be used for ore haulage on many of the smaller Bodmin Moor mines well into the 19th century. Small (20- to 26-in cylinder) multifunction rotative engines seem to have been relatively common, and were often the only engine recorded for a mine, working pumps, hauling ore and driving dressing plant. Where a second engine was purchased this often also seems to have combined several functions. Steam-powered copper crushers were too expensive to install on any but the larger mines (smaller mines used water power or manual labour), and on tin mines water generally powered dressing floors and stamps. Small twin-cylinder horizontal steam engines were used by the larger quarries to power pumps and cranes during the late 19th and early 20th centuries, but do not figure in this list (Fig 14).

Only three engine installations pre-date the opening of South Caradon in 1836, whilst many engines were scrapped or sold at the closure of the smaller copper mines which failed in the 1860s. With the notable exception of the retrial of Phoenix Mine (SX 267720) between 1907 and 1914 and the undated (though possibly very late 19th century) reworking at New Phoenix (SX 253712), beam engines thus had a very short currency of use on Bodmin Moor, their uptake almost certainly having been hampered by the poor transport networks connecting the Moor to coal ports.

Internal combustion engines and electricity

By the early 20th century all the moorland beam engines had been scrapped and new ventures reverted to water power (particularly in the form of small water turbines), or made use of internal combustion engines (petrol, diesel, gas oil, producer gas) or electricity, often generated on site. From the 1940s, the availability of tractors and powerful contractors'

Fig 14 *Small horizontal steam engines provided basic power sources for many of the smaller mines and quarries of the Moor during the later 19th century and well into the 20th century. Such plant required no elaborate buildings and was readily transportable. This example at Caradon Hill Quarry (SX 26957049) powered the mast cranes used to transport materials around the site. (Adam Sharpe)*

Fig 15 *Launders fed water to Row corn mill's overshot wheel (SX 09517665)* c *1910. (Postcard held by Peter Herring)*

excavation plant allowed rapid and dramatic landscape modification where used (as at Davidstow airfield), whilst the gradual extension of the electrical supply grid brought cheap and flexible power to all but the most remote sites. A number of farms and cottages still rely on diesel generators, though it is not long since the last domestic waterwheels were finally abandoned.

10 Technological and social resources

From a background of almost wholly seasonal use, permanent settlement of the Moor seems to have developed between the late 11th and the early 14th centuries, almost certainly reflecting agricultural colonisation and improvement. During the following four centuries both colonisation and desertion seem to have taken place, together with a shift from settlement predominantly in hamlets to that in single farms (Rose 1994), almost all settlements being primarily, if not wholly, agricultural in function. It is unclear, therefore, who made up the workforce for the many and often large streamworks which are evident on the Moor. Whilst some of the smaller works might have been operated by landowners, tenants or their adult offspring on a part-time basis, particularly in the winter when there was more space in the agricultural calendar, some accounts (notably Beare 1586) suggest that many streamworks labourers were employed on a full-time waged basis.

'I take *the tinner* to be him that geveth wages by the yeer to another to work his right in a tinwork for him as a dole … or els worketh his right himselfe … *the worker* is he that taketh upon him to sue the tinners right ffor wages by the yeere, or els for lesse tyme *the spaliar* is he that cometh jornies now and then to the tinwork for his hire and for the day saveth the worker from spale [a fine] …' (Beare 1586, 7).

It may be, therefore, that the majority of an industrial workforce totalling no more than a few hundred persons consisted of specialist labourers originating from settlements off the Moor whilst agricultural labourers undertook occasional work for their landlords as spaliers when required. Tinning, as Hatcher (1973, 83) noted was, 'held by many to be an occupation into which one was driven by necessity rather than choice' whilst Beare suggested that wages of about £3 per annum were common at the end of the 16th century, far below those of ordinary unskilled labourers and barely enough to sustain life (Beare 1586, 59). The early shallow mines were ill-ventilated, unpleasant and dangerous places of work, as indicated by Carew: 'In most places their toil is so extreme as they cannot endure it for above four hours a day … unsavoury damps do here and there distemper their heads … the loose earth is propped by frames of timberwork as they go, and yet now and then falling down, either presseth the poor workmen to death, or stoppeth them from returning' (Carew 1602).

Most of these early 16th-century to late 18th-century mines were small-scale and the whole of the industrial population of the Moor during this period need not have been large. Whilst this would have required a core workforce possessing particular specialised skills, it would have continued to provide opportunities for a modest number of unskilled local labourers. By the 18th century, however, mining seems to have declined almost completely over much of the Moor, and probably provided occupation to little more than 100 individuals. Even into the early 19th century the population of a typical moorland parish totalled less than 1,000 souls. Most lived on the more fertile fringes of the Moor and the majority of adult males would have been engaged in agricultural work.

'The moors in the parish of St Cleer, barren and desolate in the extreme, on which nothing useful to the purposes of man was found, but huge masses of granite, or scanty sheep pasture, and which were as silent as they were desolate, have assumed a cheerfulness and activity, the result of noisy and busy labour' (*Mining Journal*, 8 May 1844).

The initial discovery of rich deposits of copper under Caradon Hill in the early 1830s occurred, therefore, in an area which lacked a locally based, suitably experienced workforce to support development. Word of the new opportunities in the area soon spread and skilled men (and soon after, their families and friends), many from the declining mining districts around Breage in West Cornwall and later St Austell, mid-Cornwall, flocked to the area. During the following two decades, a period during which the combined outputs of the principal mines of the area rose from nothing to over £170,000 worth of ore *per annum*, the populations of the south-eastern parishes rose at a dramatic rate, that of St Cleer by 66 per cent in the first decade of operation of the Caradon Mines, that of St Ive by over 150 per cent in the following decade as the busy mining settlement of Pensilva became established (Deacon 1986–7).

'Busy! I tell you one thing, there wadn'a spare bed I don't think, in Upton Cross or Henwood or Minions that didn' have a lodger, in fact I can remember my grandmother she had two beds in one room and they was never cold – when the night men got out morning the day men come home and go in' (pers comm Mrs M, Minions Survey Archive, 1988; probably referring to the late 19th or early 20th centuries).

The settlements which grew up near the mines and quarries were little more than serviced dormitories for the labour force; the commercial and administrative infrastructure developed in the old stannary town of Liskeard to the south of the Moor.

Deacon's analysis of the census statistics suggest that the majority of the incomers were young, skilled underground miners, but given that the area had no history of operating mechanised deep mines, engineers, mine captains, pursers, storesmen, assayers, engine drivers and timbermen would also have been encouraged to bring their expertise to the area. The demand for the large and relatively unskilled labour force on which copper dressing was based also provided considerable opportunities for local men, women and children. Miners soon represented a significant proportion of the male adult population of some parishes, in St Cleer, for example, rising from just under 30 per cent in 1841 to over 60 per cent in

Fig 16 Beam engines, though integral to the expansion of Cornish mining during the 19th century, were little used on Bodmin Moor except in the Minions area. The 80-inch cylinder pumping engine installed at the Prince of Wales' Shaft, Phoenix United (SX 26637198), seen here from the west, was the last of its kind to be erected in east Cornwall. (Adam Sharpe)

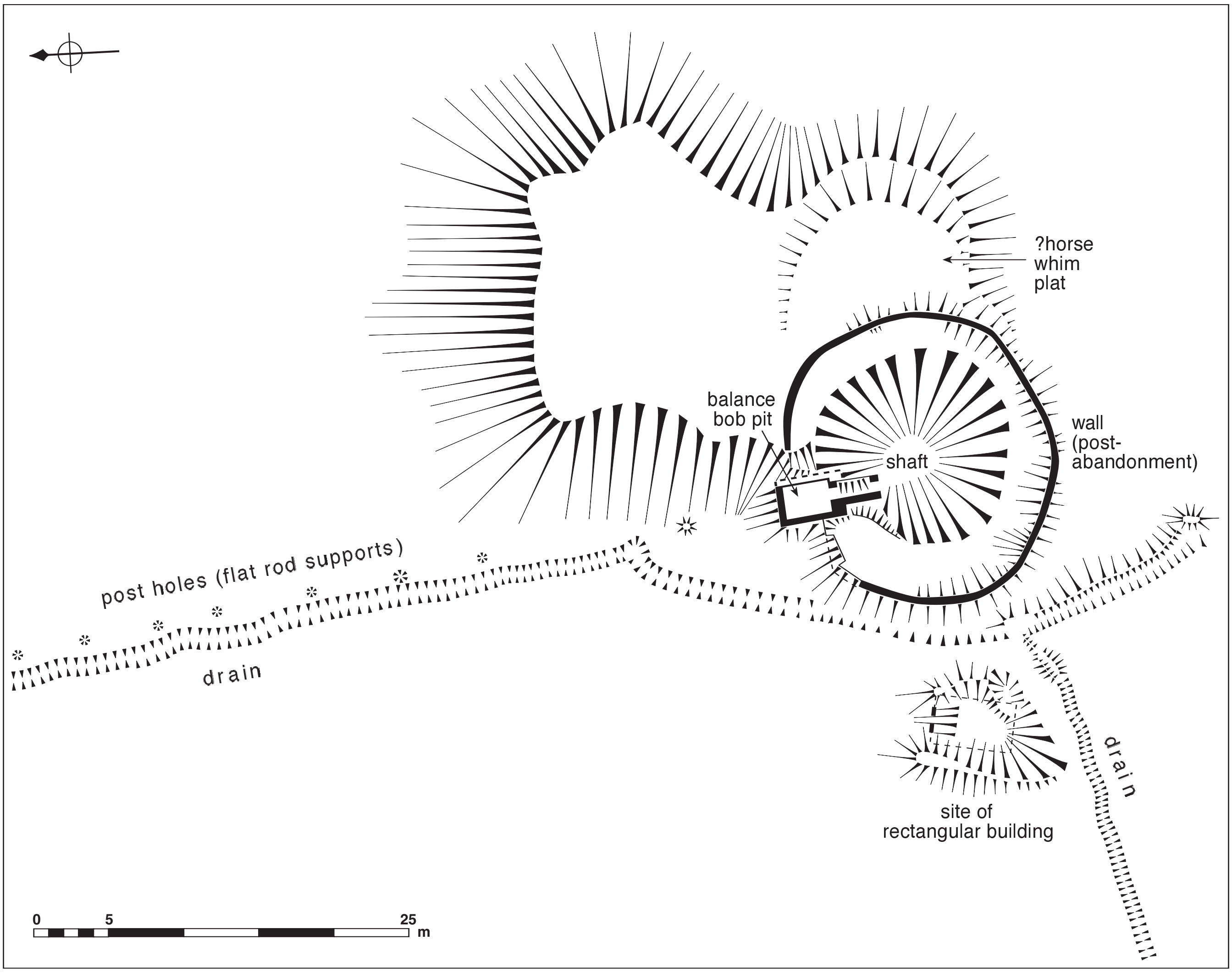


Fig 17 The use of centralised power sources to operate remotely sited machinery was typical of 19th-century mining practice. In the days before electricity, wires, chains, ropes, axles and iron or wooden rods were used in this fashion. This shaft at West Rosedown Mine (SX 27397113) is typical of many whose pumps were operated by reciprocating rods driven by waterwheels or beam engines sited some distance away. The line of pits marking the sites of the rod supports can be seen to the north, whilst the masonry pit on the edge of the shaft held the counterbalanced rocking beam which converted horizontal into vertical motion. (CCC HES, GRH 33/M2/9)

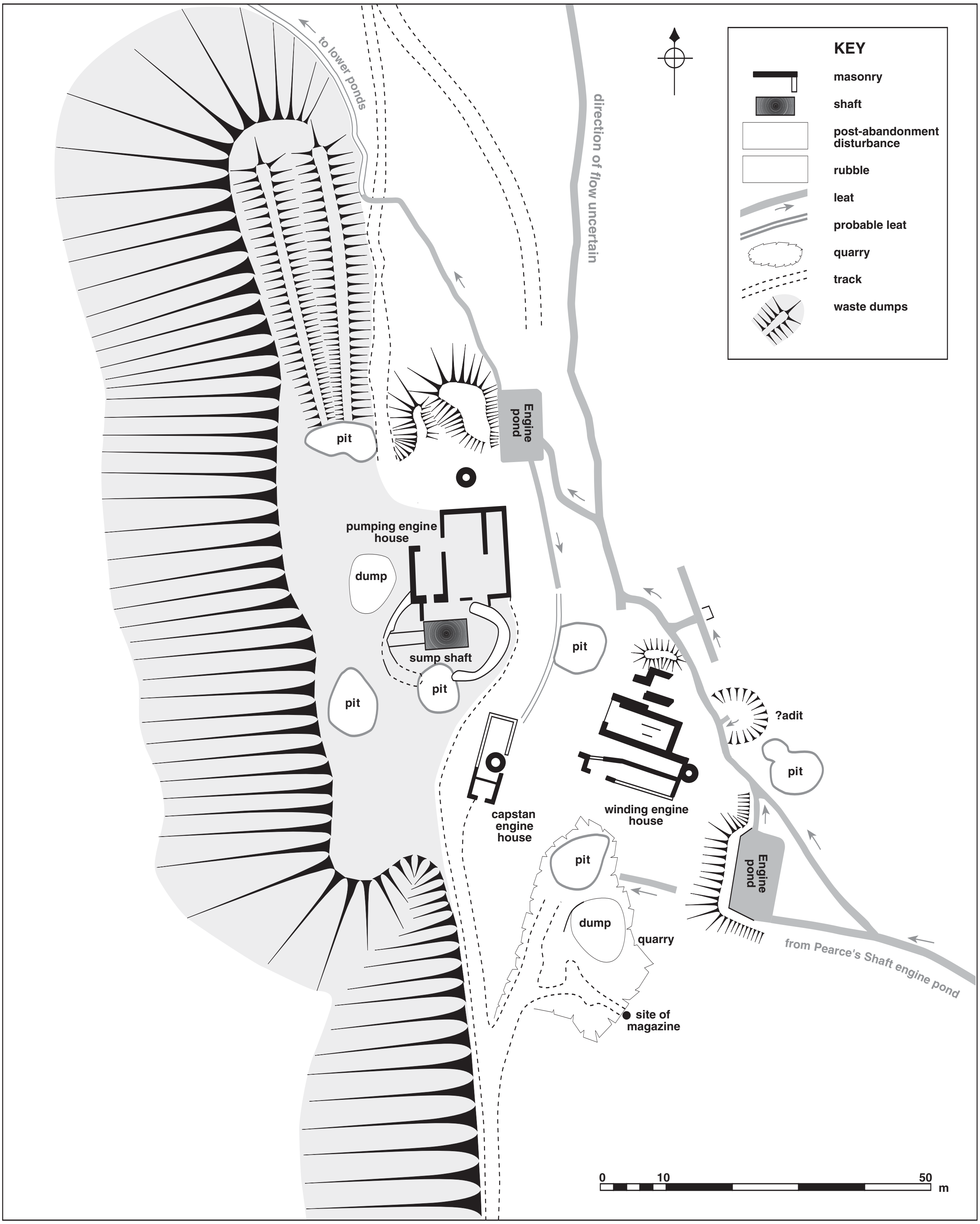


Fig 18 *The arrangement of engine houses at Sump Shaft, South Caradon Mine (SX 26517005), is typical of 19th-century Cornish practice. The pumping engine house (with its large boiler house, chimney and engine pond) is set next to the shaft, a balance bob at the edge of the shaft counterbalancing the weight of the pump rods. Upslope (south-east) and at an obtuse angle to the pumping engine house stood the winding engine with its smaller boiler house, whilst on the levelled working area to the south of the shaft was a small steam capstan used for shaft maintenance. Water on this site was carefully conserved, as can be seen from the network of leats interconnecting the engine ponds. A small quarry had been opened to provide stone for the construction of the buildings. (CCC HES, GRH 33/M2/8)*

1871 (presumably from a base in 1835 of virtually zero), whilst the proportion of females employed on mines rose only slightly less dramatically. The rapid success of the mines was also reflected in an unprecedented rise in the birth rate in the area, in 1859 this being 51 per 1,000 in the Liskeard registration area (Deacon 1986–7).

11 Moorland people

by Peter Herring

Those less transitory inhabitants of the Moor, descendants or successors of the medieval farmers or of those who established, at considerable personal expense, the 19th-century intakes, were, and remain, without being at all sentimental, tough, adaptable and resilient; winds and rains lashed them as much as their fields and roofs, hardening them. A general lack of capital compared with their wealthier Moor-edge or lowland cousins encouraged a resourcefulness made manifest archaeologically in the often tortuous sequence of successional use of structures and objects. A disused dwelling house becomes a stable, then a cow house, a sheep shelter, a fowl house, a store and finally a source of roofing slate, quoin stones, timber, etc. A dung spreader once broken or replaced becomes a makeshift trailer before being partly dismembered, its wheels, axle and drive shaft finding new uses before the main body is given a final job as a permanently closed gate.

Looking across to Dartmoor, Dr Harold Fox has closely documented enterprise driven by need in the variety of part-time or seasonal occupations to which medieval and post-medieval people have turned their hands (Fox 1994a; 1994b). Stone splitting and working (into millstones for grain or cider, press bases for cider or cheese troughs), tinning, cutting turf and making charcoal from it, and herding animals brought onto the moors from other people's farms: Bodmin Moor farmers or their sons and daughters would have supplemented household incomes through such activities down to the 19th century at least.

Fig 19 The Joice family of Dozmarypool Farm (SX 19377469), in 1926. (Print supplied by Wolter Noorlander)

4 Mining

by Adam Sharpe

1 The historical background

Although there is no direct evidence for the exploitation of tin in Cornwall during late prehistory, finds dating from this period recovered during later mining activity suggest that some tin was won by the streamworking of alluvial deposits from the Late Bronze Age to the early medieval period (Penhallurick 1986). In 1198, the tinners were placed under the supervision of a warden appointed by the Crown and Stannary Law, introduced in AD 1201, probably codified the practices of a well-developed industry. By the 12th century, Cornish tin streams, particularly those on Bodmin Moor and Hensbarrow, were producing a substantial proportion of the tin used in the western world (Gerrard 1986).

By the 13th century, the eastern Cornish stannaries had begun to decline in favour of those in the west, possibly as a result of the incipient exhaustion of their deposits of stream tin and Gerrard (*ibid*) has suggested that by the late 15th century the Bodmin Moor tinners, like their counterparts in west Cornwall, had been forced to develop tin lodes *in situ*. Lacking powerful pumps, little more than the outcrops of these lodes could be worked and most of these early mines were small-scale.

The move to deep mining required the development of new techniques for excavation, haulage, ventilation, and ore dressing. Although adits or waterwheel-driven pumps allowed exploitation to greater depths, the concomitant investment in equipment, infrastructure and development work placed substantial financial burdens on undertakings, necessitating considerable backing capital. In contrast to those in the western stannaries, the Bodmin Moor lodes seem to have been considered poor and remotely sited, and following the exhaustion of the outcrop deposits there was little investment in their reworking until the early 19th century. Most of the ore won during the intervening period derived from the reworking of old tin streams.

Given their remote locations, the Bodmin Moor mines were not, initially, able to benefit from the development of the steam-driven pumps which had revolutionised the industry in west Cornwall, and it was not until the discovery of rich copper deposits near Minions in 1836 that true deep mining was to develop. The following 20 years saw a dramatic resurgence of interest in the Caradon Hill area, the resulting investment in infrastructure making possible a short-lived but important mining boom whose effects rippled across the Moor as a whole. The collapse of copper prices during the 1860s curtailed the operations of all except the largest mines, but the discovery of rich tin deposits at Phoenix United Mine renewed interest in many abandoned moorland workings. Ore prices continued to decline during the following decades, however, and by the mid-1890s almost all mining on Bodmin Moor had ceased, as in the rest of Cornwall.

Periods of international tension during the 20th century were accompanied by renewed interest in strategic minerals. Although substantial ventures were tried at the Prince of Wales' Shaft (SX 267720) and South Phoenix (SX 262716), it soon became apparent that most of the viable ore reserves had been exhausted. Deep mining was abandoned and subsequent operations (lasting until the 1950s) concentrated almost entirely on the recovery of wolfram from abandoned streamworks in the north of the Moor.

2 The organisation of the mining industry

> '… When the new found work enticeth with probability of profit, the discoverer doth commonly associate himself with one or more partners, because the charge amounteth mostly very high for any one man's purse, except lined beyond ordinary, to reach unto; and if the work doth fail, many shoulders will more easily support the burden …' (Carew 1602, reprint of 1969, 91).

The stannaries

The Cornish mining industry appears to have been remarkably resistant to change throughout its long history. In 1201, the first Stannary Charter had been issued, codifying apparently long-standing privileges of 'Digging tin and turfs for smelting it at any and all times, freely and peaceably and without hindrance from any man, everywhere in moors and in the fees of bishops, abbots, and counts … and of buying faggots to smelt the tin without waste of forest, and of diverting streams for their works, and in the stannaries, just as by ancient useage they have been wont to do.' (Lewis 1908).

It also effectively exempted tinners from general laws and taxes, in return placing under Stannary Law all those involved in the industry, from owners of tin works or blowing houses, tin merchants, makers of mining tools, etc to the spaliers and pioneers who mined and dressed the tin itself. The law dealt with all rights and interests relating to the finding and working of ore and the right to use water for those processes; the rights of mineral owners to a proportion of the tin won; the regulation of all dealings between miners and smelters; assay and coinage (taxation) and the adjudication of disputes, whether between tinners or between tinners and outsiders. It covered subjects as diverse as the regulation of mine bounds, bribery of officials and the maintenance of the purity of smelted ore, but unlike other medieval guilds, it did not establish an apprentice system, provide mutual protection through the limitation of competition, or encourage cooperative agreements, a bias which influenced the development of the industry until the late 19th century. Stannary districts, Foweymore, Blackmore, Tywarnhail and Penwith/Kirrier, each with Vice-Wardens and Stannary Courts, were established in the principal population centres (Fig 1 and *see* Lewis 1908).

Although the ores of precious metals remained Crown perquisites (and could only be worked as Mines Royal), other minerals were, by the medieval period, the property of landowners, who were entitled to a proportion of the value of any ore mined. It was not, however, always necessary to obtain permission before commencing mining – a reflection both of ancient custom, and the particular importance of tin in the national economy because of its role in the manufacture of pewter, brass and bronze, and its importance as an export commodity. In wastrel, as in several and other enclosed land, where mining had formerly taken place and dues had been paid, it was necessary only to bound the land formally and register it with the nearest Stannary Court. In enclosed land which had not previously been worked, however, the permission of the landowner was required. By 1632, the right to search for tin had been extended across the whole of the land surface of Cornwall excepting ground covered by houses, gardens and orchards. Once established, bound marks had to be kept in repair on an annual basis, and a certain amount of work undertaken to prevent a sett from becoming forfeit. Bounding brought rights: to free access to running water (including rights of diversion); to purchase suitable brushwood and faggots for smelting (a virtual right of seizure); of turbary; of access to the highway; of exemption from ordinary taxation, impressment, forced labour and from any summons except that of the Stannary Warden (Lewis 1908).

Probably the most stringent laws were those relating to washing (ore-dressing), blowing (smelting) and coinage (assay for taxation) to ensure that all due taxes were paid to the Crown. Dressed tin had to be smelted by registered blowers before the appropriate coinage days (the Midsummer or Michaelmas taxations), stamped with the registered mark of the smelter and entered into an account. It had then to be moved during daylight hours as quickly as possible by prescribed routes to coinage towns, where it would be assayed, stamped and taxed according to its quality. Inevitably a considerable amount of tin went nowhere near the coinage towns (Lewis 1908).

Early copper working

The earliest attempts to mine Cornwall's copper ores were undertaken by the Mines Royal in the 1580s, but were not a success, and little exploitation seems have taken place until the passing of the Mines Royal Acts of 1689 and 1693. From small beginnings, the industry grew rapidly, remaining outside the jurisdiction of the Stannaries throughout, although mine operation was very similar. Ore prices (and hence the viability of the industry) were regulated through the system of 'ticketing' – the auction arrangements at which dressed ores were sold – where prices were fixed by a small and powerful purchasing cartel of smelters and owners. With two notable exceptions (Copperhouse and Carn Entral in the west of Cornwall), almost all smelting was undertaken near Swansea in South Wales.

Mine organisation

The earliest tinworks were probably operated as partnerships by small groups of men, but early records also suggest other forms of organisation were beginning to emerge: the Cost Agreement, in which one or more partners paid a money contribution or provided substitutes in lieu of their physical presence (cost and spale), and Tribute in which an owner might set the work to 'farm', in other words lease the mine for a share of profits. By the 16th century, tinworks worked by partners were becoming rare, and capitalised groups of shareholders whose mines were run on tribute or by waged labourers were becoming common. Even streamworks were relatively expensive to operate given that the tin could be sold only at the biannual coinages, whilst the development of underground mining and its higher associated costs must have made it difficult for all but the most wealthy adventurers to avoid borrowing against future profits. The basis on which virtually all Cornish mines were operated until the end of the 19th century was known as the cost book system. Suitable shareholding partners were sought – preferably bankers, merchants and smelters. A company was formed, a purser elected to direct affairs, and an initial call for funds made. When profits were made they were paid out as dividends; where funds were required to meet debts or underwrite development, calls were made to the shareholders. If one or more refused to respond and their share could not be bought up by the other partners, the mine was wound up together with its lease and machinery. If proceeds did not meet debts any remaining shareholders had unlimited liability for payment.

If investing in a mine was a speculative business for adventurers, there was at least a chance of profit, given luck or intelligent investment. Miners, however, tended to be poor, men without any prospect of riches. In the early days they might be paid wages, or a mixture of wages and profit on ore mined. By the 19th century, a tripartite system of payment had developed according to the nature of the work undertaken. Tribute, which had begun as the subcontracting of the operation of the whole of a tinworks to an individual or group for a percentage of profits, developed into a system whereby small associations of about eight labourers bid against one another for the right to work productive areas of mines. Each pitch covered a set distance along a lode and would be for a proportion of the value of the ore raised, the rate set being dependent on its richness and ease of working. Such bargains were re-let every six months. The adventurers were responsible for the infrastructure of the mine, the men for tools, light, powder and the haulage of waste. Tutwork payment applied to development work in dead ground, subcontracting teams of tinners providing their own tools and materials, bidding for agreed rates of working per fathom. Surface workers, clerical and managerial staff, and specialised artisans were paid wages, a system which only gradually became the norm for all employees. For underground workers some vestiges of both tribute and tutwork survived until recently in the form of bonus payments based on ore production or progress rates.

These working methods had a number of important influences on the development of the industry. The biannual smelting and the consequent reliance on loans increasingly placed control in the hands of financiers, particularly tin dealers and merchant buyers – in 1601, for instance, this was a small group of London Haberdashers (Carew 1602), but by the 18th century the Cornish smelters had gained effective control of the industry. The cost book system, geared towards profit rather than long-term investment, relied on the will of all of the shareholders to contribute towards investment in development, and many mines closed through lack of stamina rather than lack of potential. Within the mine, the central place of the tribute system favoured the piecemeal development of its richest areas and, in setting miner against miner, did nothing to encourage unionism or the improvement of working conditions.

3 Prospecting

> 'Where we suspect any mine to be, we diligently search that Hill and Countrey, its seituation, the earth, or grewt, its colour, and nature, and what sort of stones it yields; … that we may the better know the grewt, and stones, when we meet with them at a distance in the neighbouring valley; for mineral stones may be found 2, 3, 4, 5 miles distant from the Hills or Loads, they belong unto' (Anon 1670, 2096).

The development of mines or streamworks depended on the finding of workable ore bodies. Although medieval tinners recognised the existence of mineral lodes, they were more interested in the more readily recoverable shoad: material dislocated from its parent veins and hydrologically dispersed, as they thought, by Noah's Flood (Genesis 1.v.9–10),

> '… in this Concussion of waters the surface of the Earth, together with the uppermost of those Mineral veins, were then loosed, and torn off, and by the descending of the waters into the valleys, both the earth, or Grewt, and those mineral stones, or fragments so torn off from their Loads … were … by the force of the waters carried beneath their proper places, and from some hills even to the bottoms of the neighbouring valleys; And from thence by Land-floods, many miles down the rivers … .' (Anon 1670, 2097).

Many methods were used to find this shoad: 'metalline stones in the sides, or bottoms' of river banks (*ibid* 2097), recognisable by their 'ponderousness' and 'porosity' (*ibid* 2097). Primitive assays could be made by crushing them and separating samples into their constituent parts in water on shovels (vanning). Angularity would indicate proximity to the parent lode. Where convenient natural erosion had not taken place, the ground was broken up and leats used to wash away material in order to expose any shoad present. Cliffs or outcrops and stones in ploughsoil, road surfaces or walls were also worth examination, whilst minerals in the soil were known to stunt certain plants. Other useful natural phenomena included, '… waters which may be thought to issue from such loads … Mineral steams, Barrenness of soyl, and the pitching of Nocturnal Lights on the supposed orifices of Mines … .' (Anon 1670), and while prospectors also used dowsing to find their lodes, or even discovered their locations through dreams (Pryce 1778), many must have very sensibly simply tried the ground adjoining already successful streamworks or mines (Concanen 1831).

Such prospecting did no more than locate potentially workable ground. Before developing a streamworks, the quality, depth and lateral extent of the shoad would have to be tested through strategically placed excavations. Once work had begun, trial pits dug ahead of the line of work would determine whether or not efforts should continue.

For *in situ* lodes, pits were used to find their outcrops and test their richness: a prospecting method – 'trayning' – used by Cornish miners throughout recorded history, mentioned both by Norden in 1584 and by Carew in 1602, but described in detail by the anonymous writer of 1670:

> '… we sink down about the foot or bottom of the Hill an Essay-hatch (… about six foot long and four foot broad) as deep as the Shelf. And it is observable, they are always to be as deep as the Shelf for this reason, that otherways you might come short of the Shoad … . If we find any Shoad in this first Essay-hatch, our certainty is either encreased if any Shoad were found before, or begun … [it] is held an infallible rule, that the nigher the Shoad lies to the Shelf, the nigher the Load is at hand, & vice versa.'

> 'Albeit we find no Shoad in this first Hatch … we are not (as yet) altogether discouraged, but ascend commonly about 12 fathom, and sink a 2d Hatch, as the former: and in case none appear in this, we go then as many fathom on each hand as the same height, and sink there as before, and so ascend proportionately with 3 or more Hatches … as it were in brest, till we come to the top of the Hill, and if we find none in any of these Hatches, then farewell to that Hill.'

> 'But if we find any Shoad in any of these Hatches, we keep our ascending Hatches in a direct line; and as we draw nearer the Load, the deeper the Shoad is … from the surface, but the nigher the Shelf; as suppose it be 7 foot deep, and but half from the Shelf, then we presently conclude, the Load to be within a fathom or 2 of us, and so we lessen our first proportion accordingly … .'

> 'Sometimes it falls out, that we may over-shoot a Load, that is, get the upper side of it, and so we loose it; for which we have another (counted also infallible) Rule, viz. that finding Shoad lying near

Fig 20 Well into this century, the location and sampling of unworked mineral deposits relied on the hand excavation of small pits; as a result, most moorland areas of Cornwall's mining districts are liberally peppered with them. Recent experiments (Nowakowski 1997) suggest that two or three pits could be excavated in a day by a single individual. This was no mere labourer's work, however, for the future of a mine or streamwork could depend on the skill and experience of these primitive geologists. (Adam Sharpe)

the Shelf in this Hatch, and finding none in the next ascending, we have overshot our Load' (Anon 1670, 2109).

Recent experimental fieldwork on the Hensbarrow moors (Grove and Sharpe 1994) showed that the shape of these pits reflects their excavation by a single individual using a long-handled shovel digging down to the bedrock or intact subsoil (the Shelf or fast country) below any head. Pit widths tended to be more or less constant (roughly 1m), ie that necessary to provide elbow room during shovelling, whilst lengths were to a degree proportional to final depths. Only the minimum of material was excavated, and a tinner working alone could probably excavate two or three pits in a day (Fig 20).

Tinners had '…liberti… to dig mine serche make shafts pitche bownds & for tyn to worke in places for their most advantages (excepting only and reserving all sanctuary grownd churchyeards mils bakehowses and gardens …)' (Beare 1586, 12), providing that adequate compensation was paid to the lord of the soil for any damage. In several the tin lord could appropriate the lode for his own working, rent it out to another tinner, or leave it unworked. In wastrel, any man could 'make trial of his fortune', providing that he acknowledged the rights of the lord through a payment of toll tin (Carew 1602, reprint of 1969, 95–6). They appear to have been under no obligation to backfill their excavations – at least in unenclosed land – and over much of Bodmin Moor, evidence for this preliminary phase of activity is well preserved. Where lodes were located, pits often became obliterated by extractive activity (Fig 21), but where lodes or shoad were not found, or proved unworkable, the sequence of operations remains clear (Fig 22).

Pits are commonly found in arrangements of closely set chains of two to four near outcrop workings, suggesting that these were used to project the strike of lode outcrops in advance of development. Very long chains of 20 or more, as at Silver Valley (SX 252712) and East Caradon (SX 275704) near Minions, seem to date to episodes of re-exploration during the early decades of the 20th century. At Roughtor Mine, SX 162828, over 70 can be seen in one single line. Elongated costeaning trenches were used relatively recently to achieve the same ends on Goonzion Downs (SX 176677). Prospecting tunnels at the interface between overburden and bedrock found in West Cornwall in areas of deep geliflucation (Sharpe 1994) may also have been used on Bodmin Moor, but have not been identified. Because of the effects of weathering, shoad recovery was not applicable to copper ores, but pits were probably dug to expose the leached, iron-rich outcrops (gossans) of the lodes.

Whilst some pits seem to have been associated with the re-prospection of alluvial deposits and a few are

Fig 21 (Opposite) Examples of prospecting evidence. On Cardinham Moor (SX 13407175) (top) a tightly defined linear cluster of small pits to the west of the streamwork reflects a mixture of shoad sampling and extraction. The prospecting trench is probably a relatively recent feature. At Letter Moor (SX 17527020) (centre left) the picture is less complex, with pits being sunk to test the quality of the shoad upslope to the west and south-west of the eluvial streamwork. On Warleggan Downs (SX 15716971) (centre right), short north-south aligned strings of pits were used to locate the outcrop exploited by the openwork to the south-west and the lode back shafts to the north-east. Several east–west trending lodes were probably originally identified during the working of the massive streamwork dividing Rillaton Common from Craddock Moor to the north of Minions (SX 25647171) (bottom). The plan shows prospecting pits associated with the streamwork (on its east side) and with outcrop workings (to its west), as well as an area of shoad extraction on the western bank of the streamwork. The use of chains of pits aligned counter to the line of the lode outcrop is particularly clear immediately to the west of this area. (CCC HES, Bodmin Moor Industrial Survey, SX 1371, 1770, 1569, 2571)


KEY
area of streamwork
leat
dam
outcrop working
prospecting/shoad pits
turf stead
CARDINHAM MOOR
prospecting trench
artillery gun emplacement
artillery gun emplacement
LETTER MOOR
PENKESTLE MOOR
WARLEGGAN DOWNS
shafts
dressing floor and buddles
tank
RILLATON COMMON
CRADDOCK MOOR
ponds
0
100
400
m

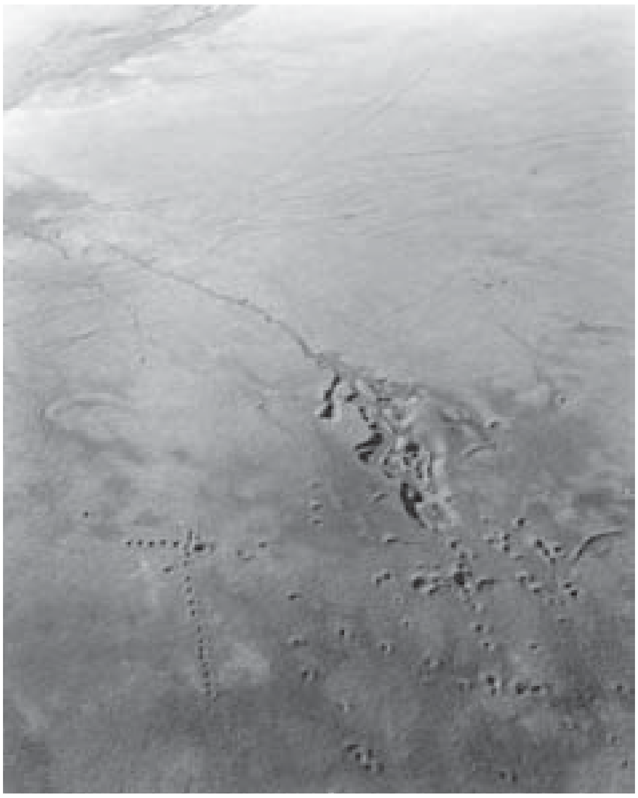


Fig 22 *Despite the very small scale of this streamwork (on West Moor; SX 19427972, looking north-west), it had at least three washing reservoirs and was the focus of very determined prospecting activity. The very regularly aligned pits to the lower left of centre are likely to be 19th- or even 20th-century in date and appear to be overlain by a shell crater. (CCC HES, F33/84)*

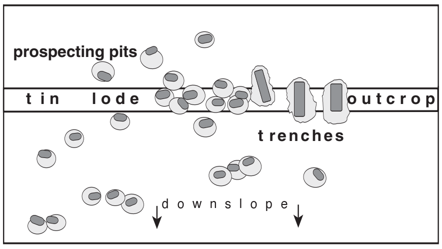
associated with china-clay working, analysis of 69 groups of pits on Bodmin Moor reveals the largest associations to be with outcrop mining (25 groups = 36 per cent) and eluvial streamworks (21 = 30 per cent). Smaller numbers were associated with shoad workings (seven = 10 per cent). Only five groups (7 per cent) were associable with openworks, a rare site type on Bodmin Moor, but one at which excavation and waste dumps may obliterate prospecting evidence. Herring also noted the proximity of eleven groups of pits (16 per cent) to developed mines, possibly indicating now obscured outcrop workings (*see* Fig 24: also Rose and Herring 1990).

By the 18th century, most mineral outcrops had been tried, and their positions were marked by earthworks whose upcast could be sampled and reworked: '… there are those that, leaving the trades of new searching, do take in hand such old stream and loade works as by the former adventurers have been given over, and oftentimes they find good store of tin, both in the rubble cast up before, as also in veins which the first workmen followed not' (Carew 1602, reprint of 1969, 90–1).

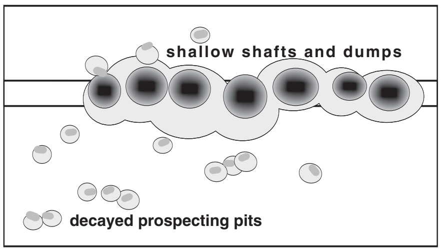
Geological reports and maps began to appear in the early 1800s. As more mines were worked and an understanding of mineral geology developed, the courses of known lodes were extrapolated to suggest favourable new locations but since this took no account of faulting, many apparently promising sites proved of little worth. By the late 19th century surface prospection had been replaced by underground sampling and chemical assays, whilst specialised handbooks (eg Foster 1894, Dana 1922 or Truscott 1923) and the new schools of mining disseminated technical information. The old prospecting techniques continued in use on Bodmin Moor however, eluvial and alluvial deposits being examined through pitting and core-drilling as recently as the 1970s (*see* Fig 23: also Geevor archive).

Fig 23 *The physical sampling of mineral deposits remains the basis of prospecting to this day. Although most samples are now recovered through diamond drilling, manually operated core drills like this Bangka drill were used extensively on Bodmin Moor during the re-examination of its alluvial deposits by Geevor Mine a few decades ago. (Photograph held at Geevor Museum)*

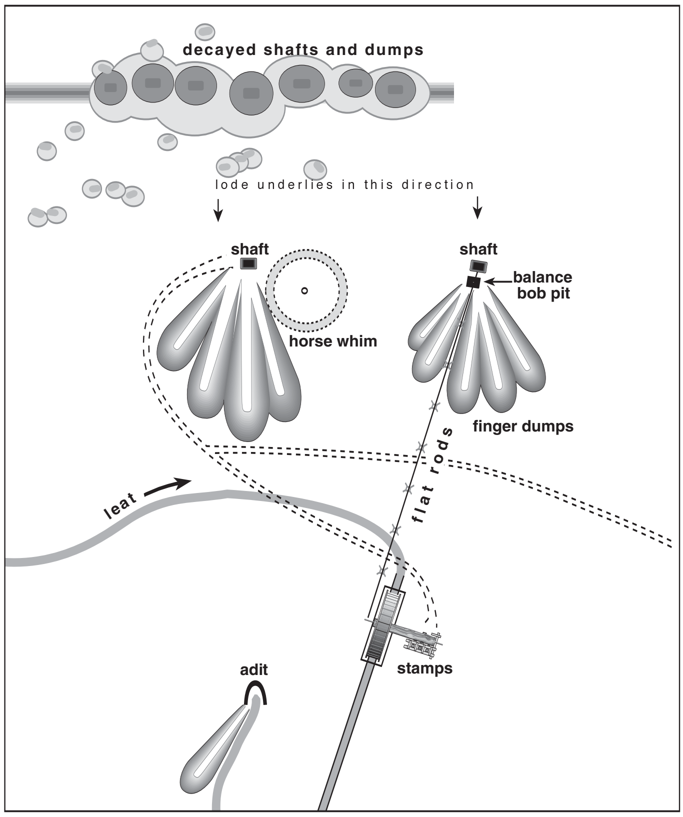
Fig 24 *(Opposite) This simplified sequence shows the development of a section of mining landscape from initial prospecting and the location of the lode outcrop (top, left), the establishment of outcrop workings (middle, left), the re-exploitation of the lode using small shafts and adits (top, right), and the redevelopment of the site using steam-powered mechanised plant in the 19th century (bottom). (© Rosemary Robertson)*



c **1660**

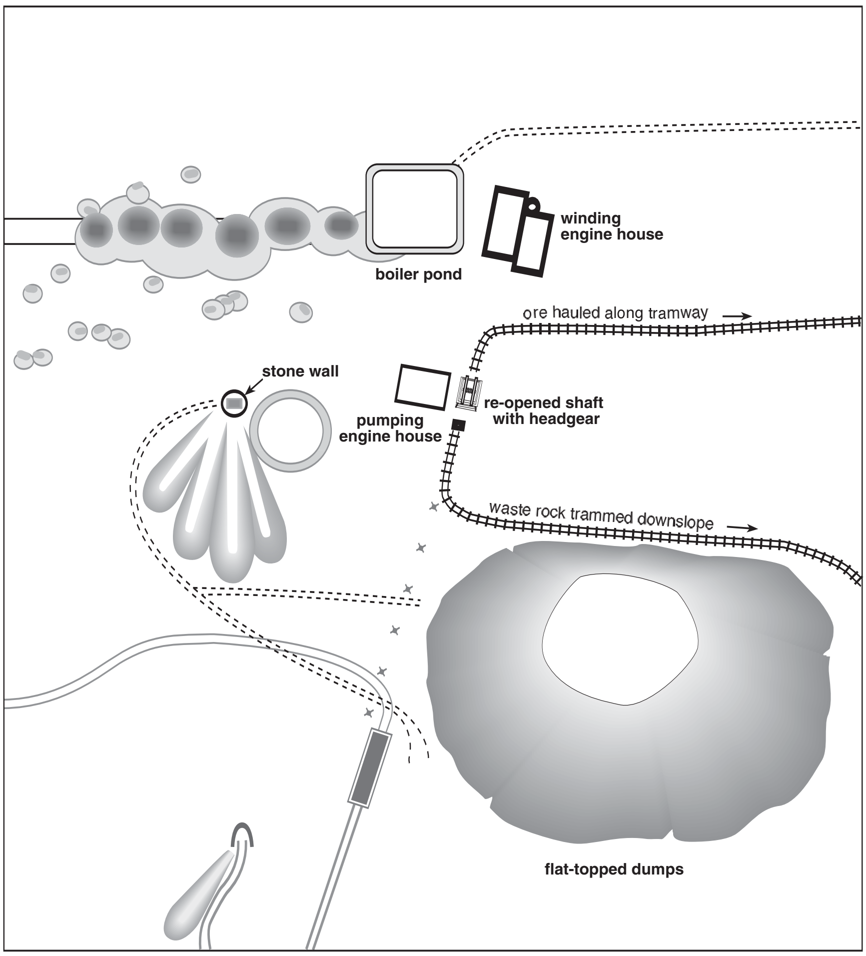


c **1670**



c **1750**

c **1850**



4 Streamworks

'I have heard reported that before the generall fflood called Noyes flood there was no tyn in the moores low grownds & vallyes but the tyn lay hid in the rocks hills and great mines so that the strength of the flood breaking forth from the high grownd caried with violence the most gloriest fattest and principall of all the tyn laboring so far that they never payd untill the time that they came unto the low vallyes which are the very same workes that we call streame workes hatchworks and moorworkes' (Beare 1586, 97).

Shoad

Tinstone or shoad was found concentrated in two contexts. First, it occurred in valley bottom (alluvial) deposits of varying thickness, often beneath deep overburden and could contain between 0.75lb/yd^3 (0.28kg/m^3) to perhaps 5lb/yd^3 (1.9kg/m^3) of cassiterite. Richer deposits tended to be found within hollows in river beds or areas of decreased flow, where concentration had taken place. Tumbling by the rivers tended to clean quartz and other minerals from the cassiterite, resulting in a material of high purity which needed little dressing before smelting. Secondly, shoad also occurred in eluvial deposits in dry valleys and hollows on hillslopes, where it had been deposited by gelifluction during periods of interglacial or post-glacial warming (Fig 25). 'Tin is also found disseminated on the sides of hills in single stones, which we call Shodes, … sometimes a furlong or more distant from their lodes, and sometimes these loose stones are found together in great numbers, making one continued course from one to ten feet deep, which we call a Stream; and when there is a good quantity of tin in it, the tinners call it, in the Cornish tongue, Beuheyl, or a living Stream; that is a course of stones impregnated with tin.' (Pryce 1778). Whilst this had been topographically concentrated, it had been subjected to much less weathering than that in alluvial deposits, and hence required crushing and dressing prior to smelting.

The mechanics of streaming

Where found in sufficient quantities, both forms of shoad, alluvial and eluvial, could be excavated by streaming at relatively low cost and without the need for complex equipment. Since valley shoad was usually buried beneath metres of peat and unmineralised gravel, mere panning was useless. Once an area of overburden had been broken up manually, a stream of water would be turned over it, washing finer or less dense waste material clear of the working area and into a drainage gully. Any remaining rocks were piled into dumps after which, if necessary, the process was repeated. Once the shoad deposit was reached, water was used to separate the dense cassiterite (specific gravity about 6.5 to 7.0) from its lighter gravel matrix (specific gravity about 3.5) (Fig 26). This process was described in detail by Hitchins and Drew in 1824:

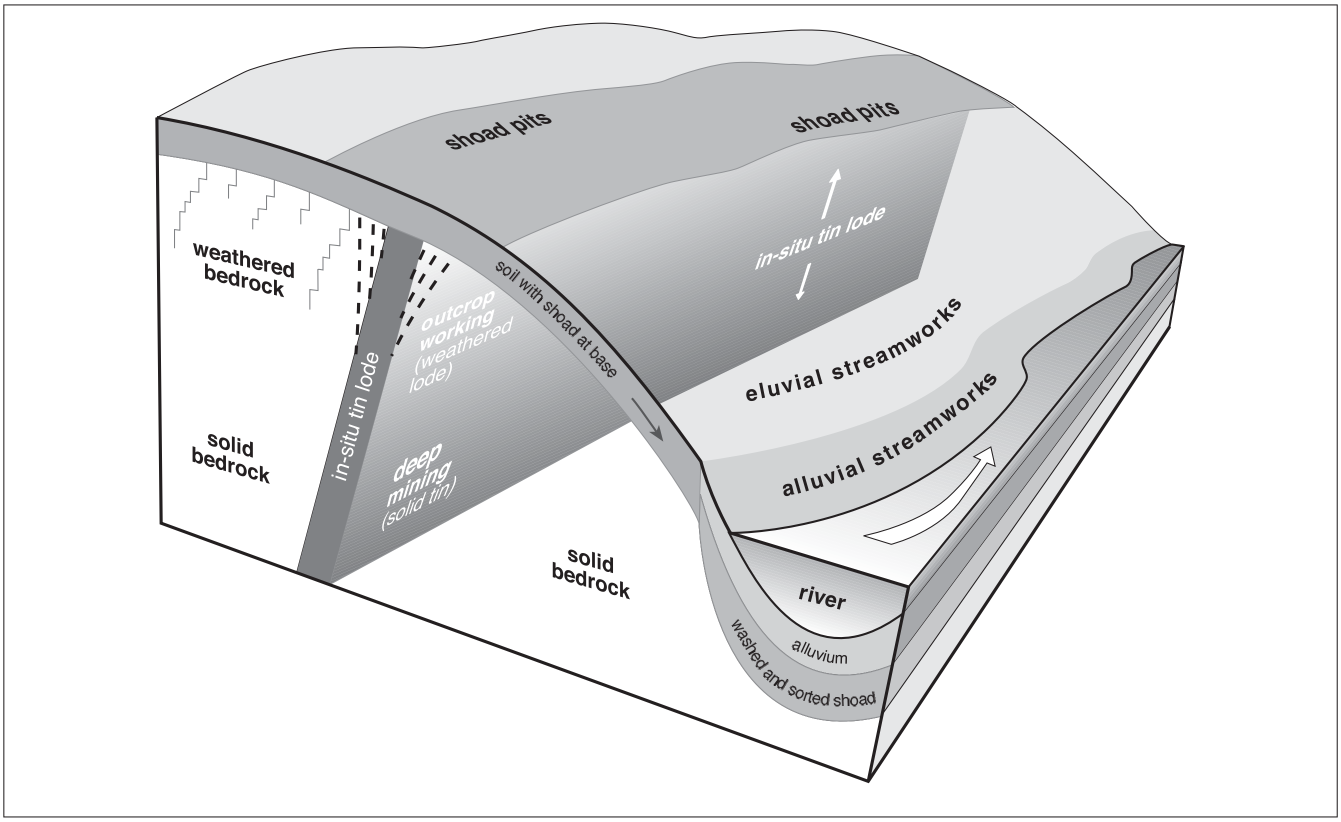


Fig 25 Shoad and lode. The cross-section shows how the location of ore relative to the parent lode determined differing forms of exploitation. (© Rosemary Robertson)

'… a stream of water is conducted on the surface to that spot where he intends to begin his operations. A level is also brought home to the spot from below, as deep as the ground will permit, and the workings require, to carry off the sand and water. The ground is then opened up at the extremity nearest … the discharge of the water; from which place the streamers … proceed towards the hill. On the ground which is laid open, water running over an almost perpendicular descent, washes off the lighter parts of such ground as had been previously broken by picks, carrying them through the under level, which is called the tye, and leaving behind the sandy ore, and such stones as are too heavy to be thus removed. In this stream the men, provided with boots for this purpose, continue to stand, keeping the sand and gravel at the bottom in motion. From it they select the larger rubbish, throwing it to one side, picking from their shovels such shode as appears. The precipice over which the water runs is called the breast; the rubbish thrown away is called stent; the sand, including tin, is called gard; the walls on either side of the tye are called stiling; and the more worthless parts which are driven away by the stream are called tailings. In this manner they continue to dig or break their ground until the whole is exhausted, which is sometimes the work of many years' (Hitchins and Drew 1824, 603–4).

Flow rates through the tye (the area between the open face and the downslope dump) were crucial. Too fast and much of the tinstone would be carried away; too slow and its base would choke with material, all of which would have to be rewashed. Optimal flow rates depended on the volume and head of the washing water (which might vary seasonally), the firmness of the ground, the size and density range of the shoad and the slope of the ground being excavated. From field evidence, Gerrard (1986) has demonstrated that trench angles were adjusted relative to prevailing slopes

Fig 26 Tin streaming was a laborious and mucky business, yet one which required great expertise if it was to be successful. The tinners, working in small gangs, would be responsible for prospecting, constructing leats, drains and washing reservoirs, clearing overburden, and, up to their knees in muddy water, making relatively precise judgements about the water-flow rates which governed shoad recovery. The activities of these artisans, who for a few centuries made the South-West the largest producer of tin in the western world, also silted important medieval ports, turned many once fertile valley bottoms into marshy wildernesses, and utterly transformed the appearance of most upland valleys. This photograph shows early 20th-century streaming for wolfram at Kenton Marsh. (Reproduced courtesy of the British Geological Survey. IPR/101-16CX. T C Hall, 17.8.1907 A00504)

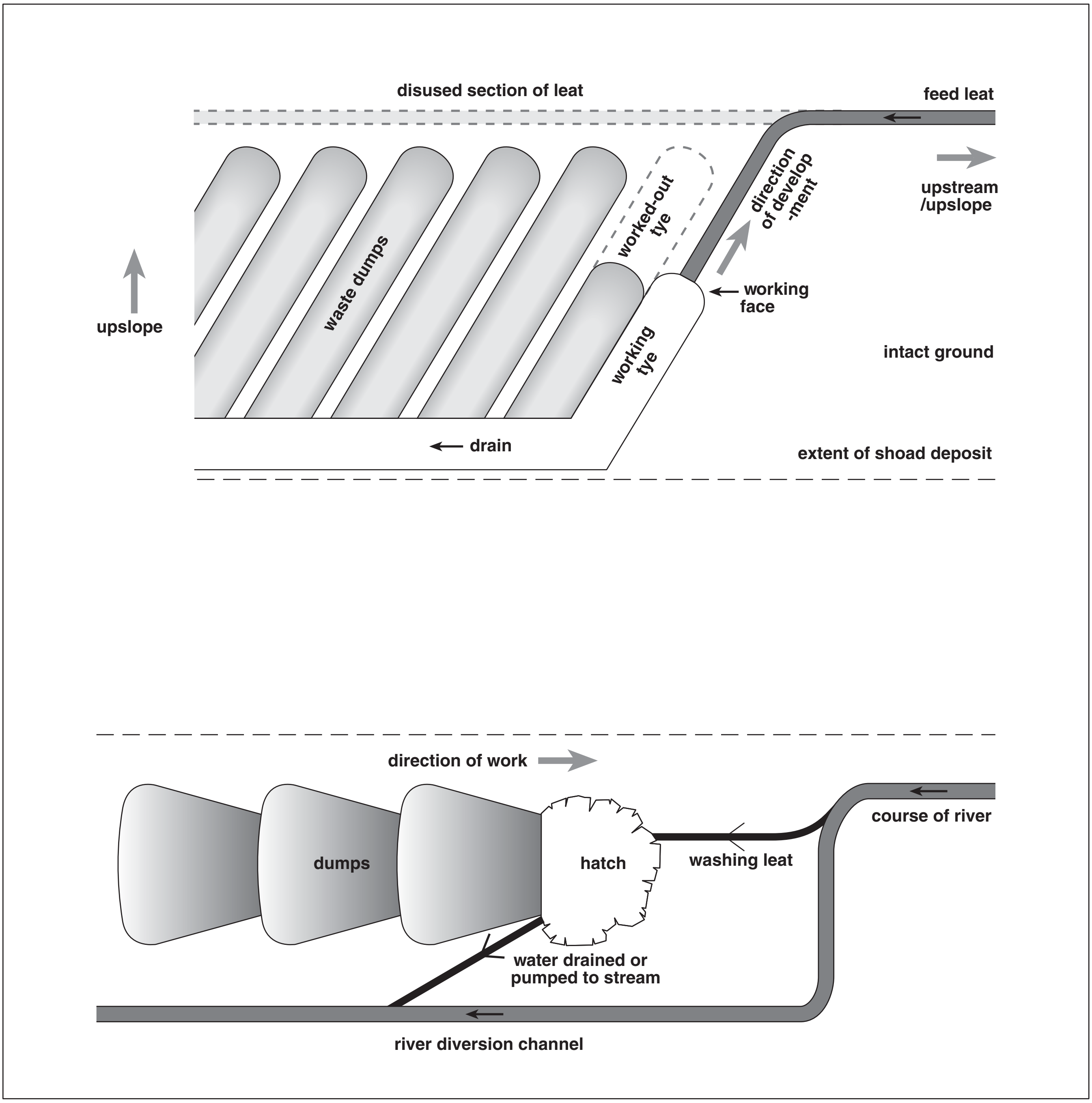


Fig 27 The development of a streamwork was based on the progressive and controlled exploitation of the underlying shoad deposits. Although the forms taken by the waste dumps vary, only two basic approaches were used. In the first (top) the ground was exploited by means of a series of narrow and more or less parallel trenches within which the washing water flow could be optimised to recover the maximum amount of shoad. In the second (bottom), the shoad was quarried from a working face and processed in a separate operation.

to achieve optimal flow conditions: where slopes were shallow, excavations were cross-contour, encouraging rapid washing; where steep, they were angled to the valley sides, slowing flow rates (Fig 27). Examples of streamworks demonstrating the variety of dump forms created in this fashion are illustrated in Figs 28 and 29 (alluvial) and 30 to 32 and 34 (eluvial); the types represented are described further under 'streamwork morphologies' below.

Recovery of shoad by simple gravel washing could only have been partial, even in the best-managed streamwork, since separation of tinstone would be limited to a relatively narrow size range. Recognising that fine shoad was being lost during operations, tinners subsequently constructed shallow inclined launders (also called tyes) across which the outwash streams were passed to increase recovery rates. '… his men are digging up the stream tin, and washing it at the same time, by casting every shovel of it, as it rises, into a Tye, which is an inclined plane of boards for the water to run off, about four feet wide, four feet high, and nine feet long, in which, with shovels, they turn it

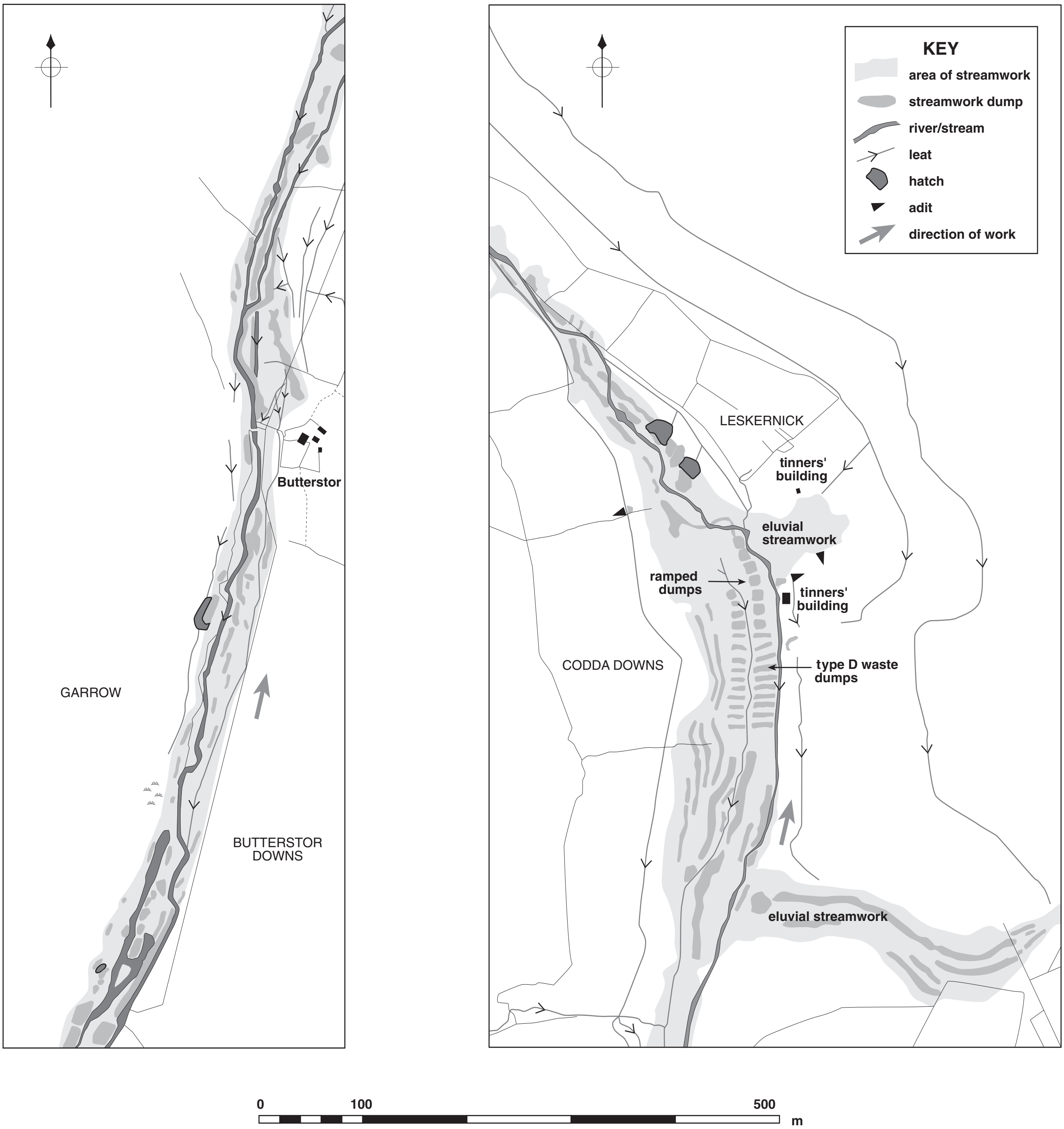


Fig 28 Two examples of parallel-banked alluvial streamworks. Between Garrow and Butterstor (left, SX 14897846) the present stream course incorporates a number of right-angled changes of direction marking the points where it cuts through the upcast banks which divide former extraction areas. To both north and south, flooded sections of former stream diversion channels are still evident. Between Codda Downs and Leskernick (right, SX 18207951) the parallel nature of the waste dumps is particularly evident. Near the centre of the plan, the Type 3 banks and the small area of ramped dumps immediately to their north reflect one or more episodes of reworking. The stream here still follows its diversion channel along the extreme eastern side of the valley bottom. (CCC HES, Bodmin Moor Industrial Survey, SX 1478 and 1879)

over and over again under a cascade of water that washes through it, and separates the waste from the tin, till it becomes one half tin.' (Pryce 1778, 133).

Gerrard concluded from evaluation excavations at Lydford Wood, Devon in 1995 that temporary buddles of this sort would be set up in a drainage channel in a streamwork, to which material would be barrowed for dressing (Sandy Gerrard, pers comm). Even using such equipment, however, losses of fine material were probably considerable. Many streamworks were operated during the winter months, the tinners working knee-deep in mud and gravel and it is not surprising, therefore, that later reworking of waste material proved worthwhile.

The excavation of a tye was extended from the outwash drain towards the valley side(s) as far as a

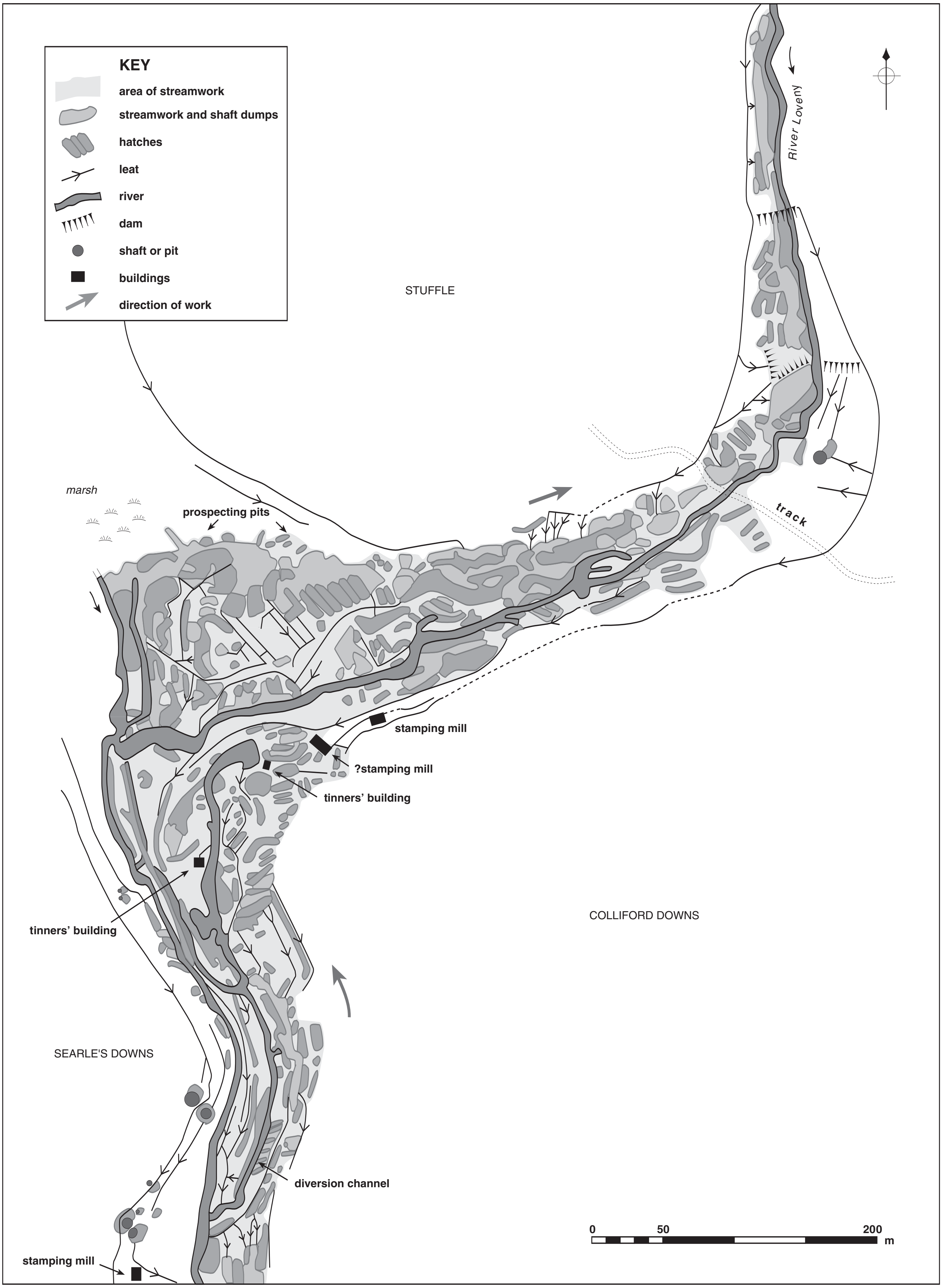

KEY
area of streamwork
streamwork and shaft dumps
hatches
leat
river
dam
shaft or pit
buildings
direction of work
STUFFLE
River Loveny
marsh
prospecting pits
track
stamping mill
?stamping mill
tinners' building
tinners' building
COLLIFORD DOWNS
SEARLE'S DOWNS
diversion channel
stamping mill
0
50
200
m

Fig 29 (Opposite) The exceptionally complex valley floor archaeology at Colliford (SX 17657185, now inundated by Colliford Lake reservoir) reflected both the varied nature of these large-scale alluvial deposits and the effects of many phases of reworking of the valley shoad. Virtually every form of waste dump patterning is represented, threaded through by river diversion channels and leats. The tinners' buildings and stamping mill (centre) are almost certainly not all contemporary. (Drawing © Rosemary Robertson; after Gerrard 1986, figs 5.4 and 5.5)

deposit appeared viable. Once this limit had been reached, a new tye was commenced immediately upslope and parallel to the first and the procedure repeated, waste being dumped into the preceding work area. As streamworks developed, worked-out areas became progressively backfilled with parallel dumps of waste; the only open area was that being currently worked. Lighter tailings washed into the 'level' ran as far as the water could carry them, in some cases burying downstream waste dumps almost completely, and where topography allowed, travelling considerable distances to be deposited as enormous fans of silt, as at Witheybrook Marsh (SX 250730) where large areas of the original valley have been filled to depths over 4m. Where discharged into fast-flowing watercourses, tailings might stay in suspension for miles, and such was the volume of material carried off the Moor in its rivers that ports like Lostwithiel were seriously affected:

'… divers tynners in working of their streame workes with floods hath conveid and caried the gravell and robble from the said workes to the great rivers and so from thence with the streame driven them to the Havens of … ffoy to the great hindrance of the havens. So far forth that is for the river of ffowey yt hath bin reportid before this tyme that the great boates have past up under Lostwithiall bridge as far up as directly under the castle of Restormell … wheras now by reason that the tynners do streame the tayles of their workes directly into the great river … waters bringeth with them the rubble garde and sandes so much quirting up the rivers that small boats and barges cannot now come but litle more than halfe the way that it hath used in tymes past …' (Beare 1586, 72).

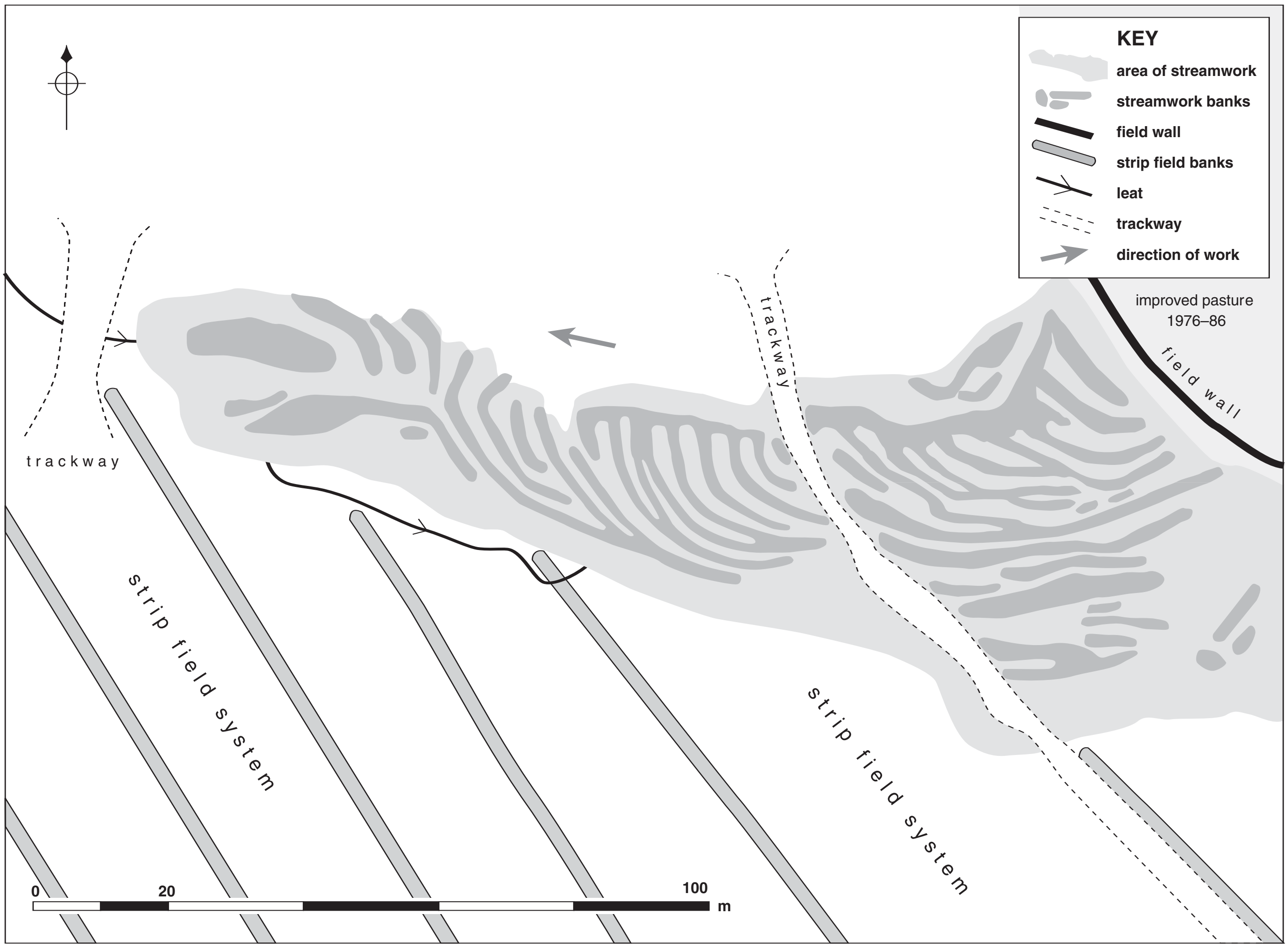


Fig 30 The curving forms of Gerrard's Type C eluvial dumps are shown to good effect at Brown Gelly (SX 20087304). The leats supplying washing water ran along the northern bank, whilst the main drainage channel was to the south. The streamwork has truncated a number of medieval strip field banks in the moorland to the south. (After Gerrard 1986, fig 5.17)

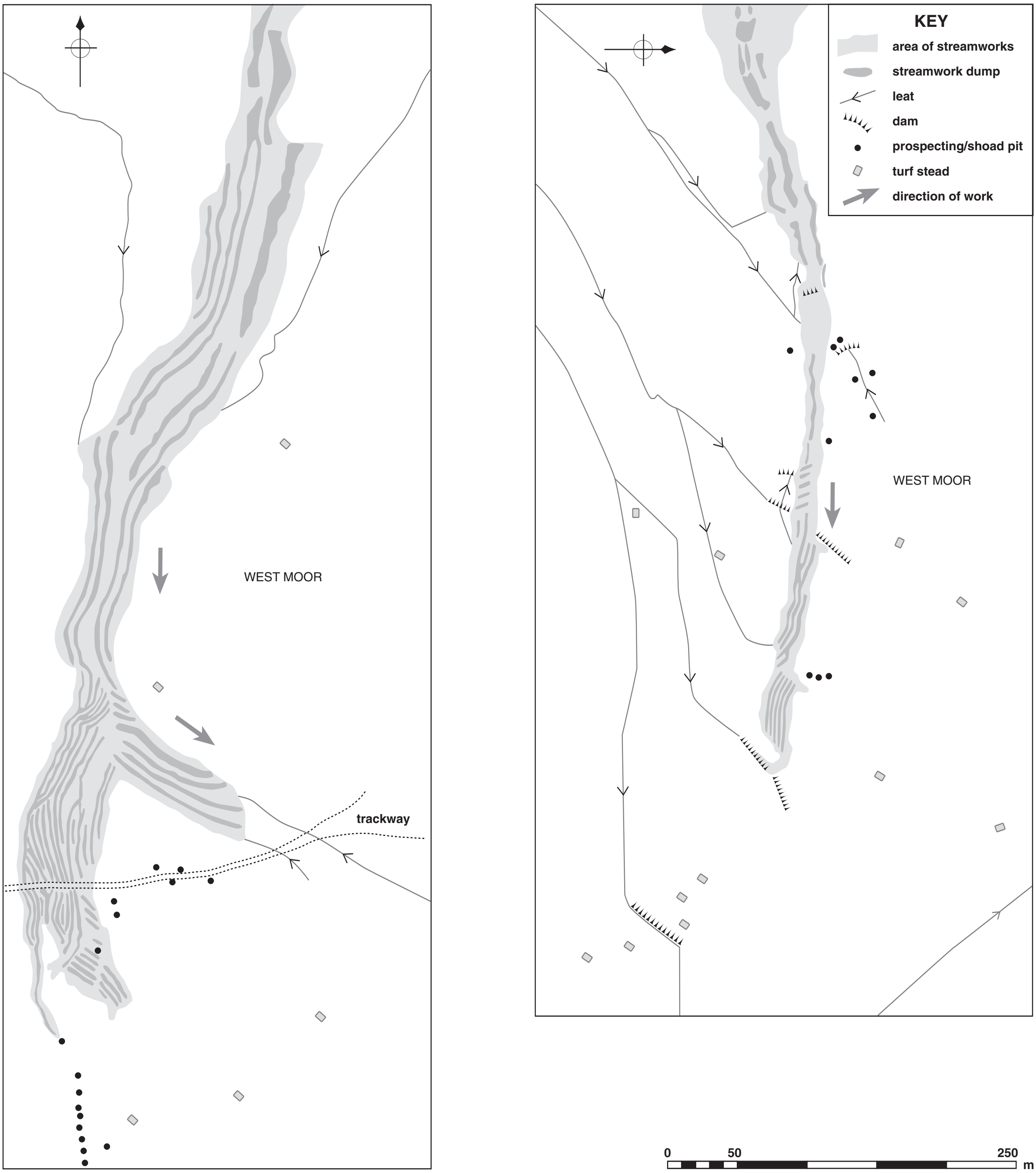


Fig 31 Two examples of parallel-banked eluvial streamworks on West Moor. Whilst the broad banks of the northern section of the streamwork to the left (SX 19057915) are reminiscent of alluvial practices, the closely set waste dumps to the south almost certainly reflect the shortage of water in this area and the resultant need to work narrow tyes. The prospecting pits to the south of the streamwork would probably have established that shoad values in this area were too low to be economically workable. The many leats and reservoirs associated with the second example on West Moor (right, SX 19508068) indicate some of the difficulties in supplying sufficient washing water to eluvial streamworks in elevated areas. The probable development of this streamwork is shown in Fig 35. (CCC HES, Bodmin Moor Industrial Survey, SX 1979 and 1980)

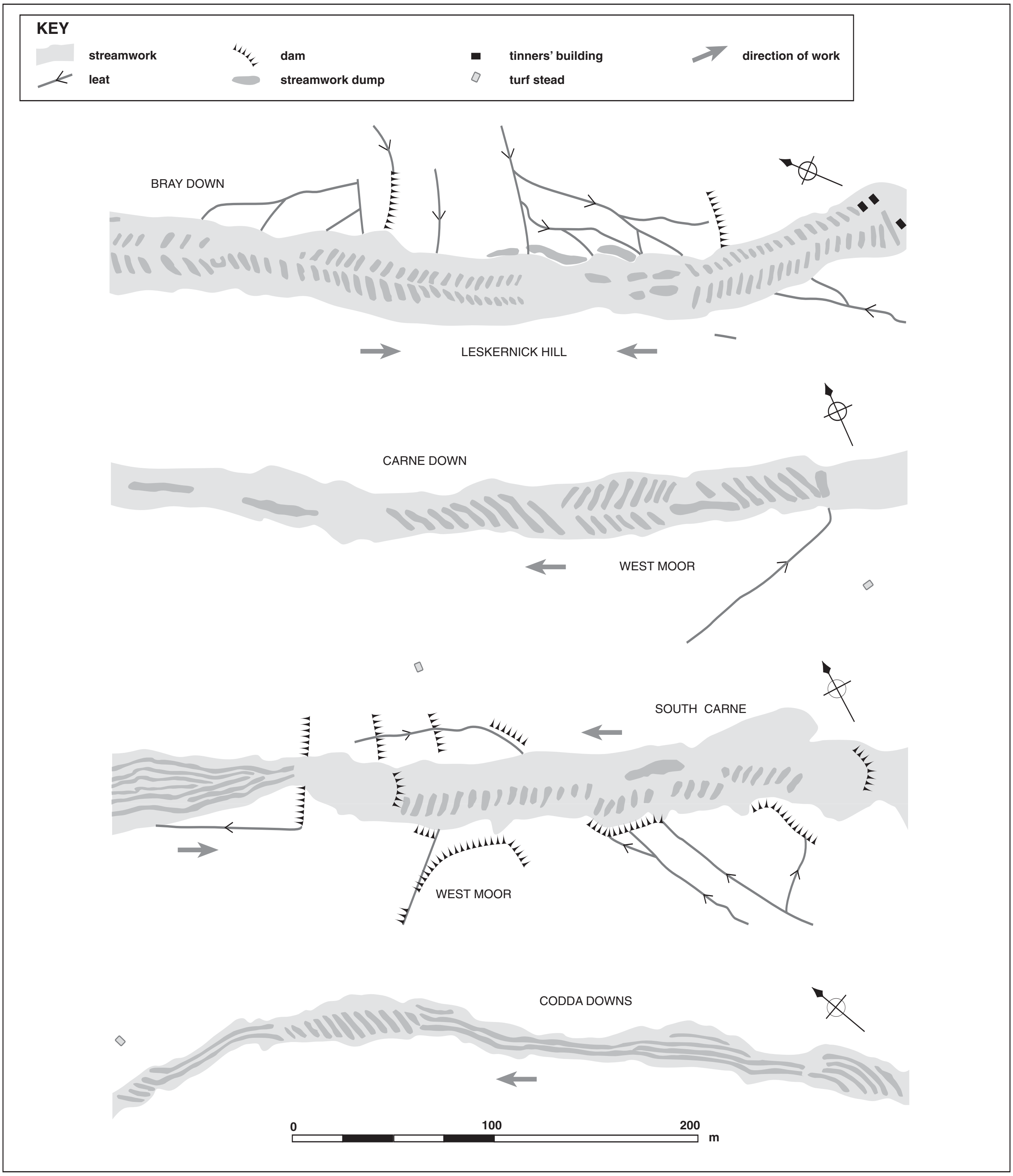


Fig 32 *Four examples of Gerrard's Type D eluvial streamworks. The interfluve between Bray Down and Leskernick Hill (SX 18588051, top) is marked both by the change in direction of the dumps and also the abundance of leats in an area totally devoid of running water. Between Carne Down and West Moor (SX 19588138, second top), areas of single and paired Type D banks, together with waste dumps parallel with the streamwork cutting (left) reflect adaptations to changing topography. Another streamwork crossing an interfluve, this time between South Carne and West Moor (SX 20228113, second bottom), is again marked by an abundance of dams and leats. The difference between the dump patterns to east and west may reflect alternative extraction strategies used by different groups of tinners working the two areas. A short section of Type D waste dumps amongst Type B banks in a narrow streamwork on Codda Downs (SX 17517900, bottom) may represent an area of reworking or simply a subtle adaptation to the prevailing topography. (CCC HES, Bodmin Moor Industrial Survey, SX 1880, 1981, 2081, 1779)*

Hatchworks and ramped-dump workings

Where alluvial deposits lay under considerable depths of silts and gravels, the excavation of narrow tyes was not always practicable. Survey evidence suggests that in these cases shoad was recovered from small hatches (quarries) excavated into the alluvium. Being below river level, they would generally have to be pumped dry, and waste material had to be barrowed from working faces. The limited distribution of such sites probably reflects the additional costs implicit in their operation, which may have been viable only in areas of rich shoad. Some may be no more than prospects.

Many late 19th-century reworkings of alluvial deposits adopted a similar approach, though developing the upstream face of the hatch as a continuous excavation (Fig 33). Waste was barrowed away to form tips with characteristically shallow upslope faces and steeper downslope faces – the ramped-dump works described by Collins in the mid-1870s.

> 'With tin-gravels in particular, the tin-ground or pay-gravel, is often buried beneath many feet of sand, gravel, peat, or other substance containing nothing of value; and this must be removed before the pay-gravel can be dealt with. The most advantageous mode of working is to clear the over-burden away completely from a good sized space, remove the ore ground for subsequent treatment, or treat it on the spot, and then to fill up the space with the over-burden from the next section. In this manner no part of the over-burden has to be removed to a great distance, nor yet to be lifted to any considerable height.' (Collins 1875, 33).

Well-preserved examples of this form of working can be seen at Brown Willy SX 158782 (Fig 33) and Merrifield SX 145720. The site at Minzies Downs (SX 183757) was surveyed by Gerrard (who uses the term 'cuesta', the characteristic shape of a type of desert sand dune, to refer to this form of dump, eg Gerrard 1987) but the streamworks have largely been obliterated by the construction of the Colliford Reservoir.

Water management

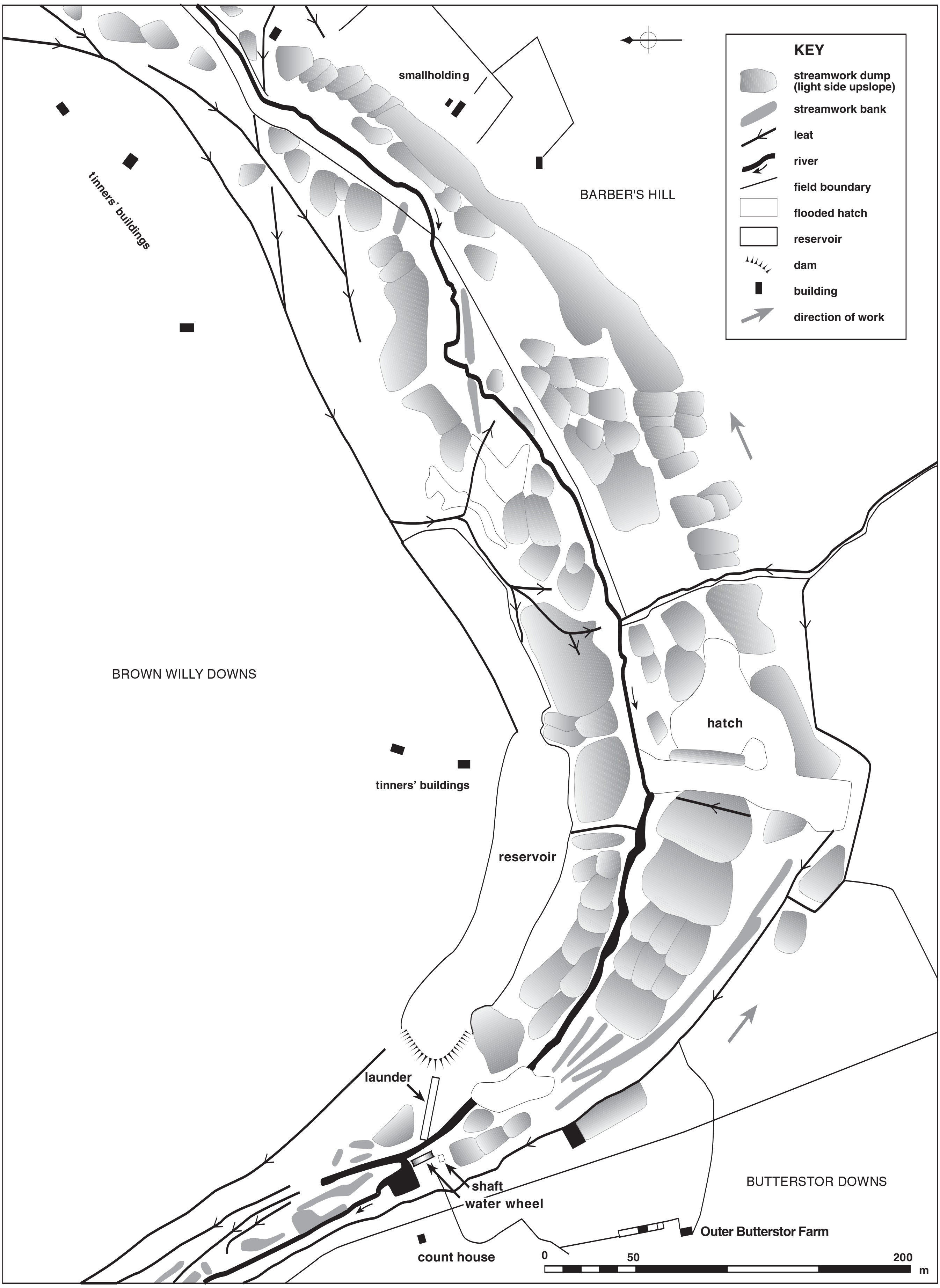
Although the methods used to work alluvial streamworks (Beare's 'stream workes hatchworks and moorworkes') and eluvial streamworks (probably the sites occasionally referred to as 'dryworks') were very similar, they differed radically in the matter of water management. Within primary alluvial deposits, the major problem lay in keeping the streamworks dry, the diversion of rivers and streams often involving major excavations: '… the tinners go to work, casting up trenches before them, in depth five or six foot more or less … and three or four foot in breadth, gathering up such shoad as this turning of the earth doth offer to their sight. If any river thwart them, and that they resolve to search his bed, he is trained by a new channel from his former course.' (Carew 1602, reprint of 1969, 89). Good examples of extensive diversion channels can be seen at Garrow (SX 147777), Butterstor (SX 150788) and Leaze (SX 139771). Where valley bases were virtually flat or shoad at considerable depth, natural drainage of the tye would be impossible and washing water had to be pumped back into the river, as was the case in late workings at Wheal Rosa (SX 157784; Fig 33), Trezelland (SX 186787), Merrifield (SX 144725) and Gillhouse (SX 185737). The working of such sites might have been restricted to the drier summer months: '… the streamer carries off what he calls the Overburden, viz. the loose earth, rubble, or stone, which covers the Stream, so far and so large, as he can manage with conveniency to his employment. If in the process of his working he is hindered, he teems (or lades) it out, with a scoop, or discharges it by a hand pump: but if those simple methods are insufficient, he erects a rag and chain pump so called; or if a rivulet of water is to be rented cheaply at grass, he erects a water wheel with ballance bobs, and thereby cheaply keeps his workings clear from superfluous water, by discharging it into his level' (Pryce 1778, 133).

In contrast, eluvial workings suffered from a deficiency of washing water, and often extensive leats had to be cut to bring this from streams and rivers (eg *see* Fig 35). Where no suitable stream was available, reservoirs filled by the run-off water picked up by networks of contouring leats on nearby hillsides during wet weather were constructed – an approach which necessarily resulted in intermittent working, probably only during the wetter winter months (Fig 13). Around Minions where there seems to have been no suitable major watercourse, collection reservoirs flank most of the streamworks, with good examples to both east and west of the Withey Brook (SX 2471) and Trewalla valleys (SX 2571; Map 3). Where original drainage patterns had been severely disrupted by previous streaming activity – as in parts of West Moor (SX 1780) and Craddock Moor (SX 2571) – the reworking of the more elevated valley-edge alluvial deposits also necessitated the construction of reservoirs and leats to provide washing water (Maps 1 and 3).

The sizes and dates of streamworks

The scale of tinworks varied considerably, reflecting the extents and depths of the deposits they exploited. Some were little more than a couple of metres in depth, ten metres in width and a few tens of metres in length and evidently witnessed little development (Fig 36). Others, however, were colossal undertakings of quite staggering depths (Fig 37) stretching over kilometres, the results of many decades of operations.

Fig 33 (Opposite) A particularly well-preserved section of hatches, ramped dumps and associated structures relating to a late period of working at Wheal Rosa, Brown Willy (SX 158782). Physical relationships between the dumps show that operations progressed from south to north. The scale of such late 19th- and early 20th-century alluvial workings is evident from the extent of the now-flooded hatches just to right of centre. (CCC HES, Bodmin Moor Industrial Survey, SX 1578) (© Rosemary Robertson)


KEY
streamwork dump (light side upslope)
streamwork bank
leat
river
field boundary
flooded hatch
reservoir
dam
building
direction of work
smallholding
BARBER'S HILL
tinners' buildings
BROWN WILLY DOWNS
tinners' buildings
hatch
reservoir
launder
shaft
water wheel
count house
BUTTERSTOR DOWNS
Outer Butterstor Farm
0
50
200
m

'The Old Tin Dyke near the Hurlers is well worth an inspection. Speaking from memory, I should think that it must average 20ft in depth, 100 in width, and three fourths of a mile in length, terminating in the great swamp of Witheybrook Marsh … .' (Pedlar 1864).

The earliest-mentioned streamworks date from the 14th century, and are documented in abundance from the late 15th century following requirements for the formal registration of bounds (Gerrard 1986, 46–7). There can be little doubt, however, that streaming had been carried on for centuries beforehand, possibly, as suggested by Penhallurick (1986), from late prehistory. It has been suggested by Gerrard amongst others that tin streaming on Bodmin Moor was being undertaken before AD 1000 and was at its height during the 12th–14th centuries, but by the 16th century had greatly declined. Some streamworks were retried – in many cases after abandonment for many centuries, both for tin, and at some sites in the north of the Moor during the last years of the 19th century, for wolfram. Moorland streamworks were re-prospected during the 20th century, Roughtor Marsh (SX 1581) and Witheybrook Marsh (SX 2572) in the first decades of the century, Penpont (SX 1882), Lower Crook Marsh (SX 1782?), Buttern Hill (SX 1881), Withey Brook and Tregirls (SX 2180) in the 1940s. A re-evaluation of the alluvial deposits of the northern Moor was undertaken as recently as the late 1970s but only Trewint was restarted, producing wolfram and tin as a by-product of gravel working.

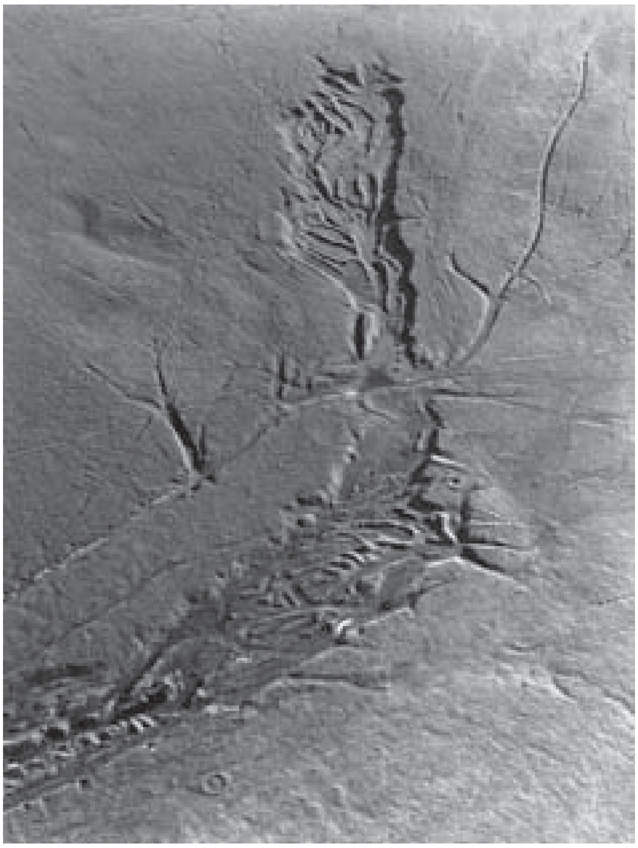


Fig 34 A relatively small-scale eluvial streamwork on West Moor (SX 20078041, viewed from the north-east) which incorporates Type D and Type C dump patterning. Few traces of leat systems are visible though a number of turf steads can be seen in the surrounding moorland. The hollow set within the small rectangular feature just to right of centre is probably a small prospecting shaft. (CCC HES, F41/163)

The reasons for streamwork abandonment cannot always be identified through field survey – in some cases tinners may have reached the limits of their setts, or operations may have become uneconomic. Many alluvial deposits show evidence for partial reworking, and sites such as Colliford (SX 1771) seem to have had complex development histories (Fig 29). Eluvial streamworks, however, seem more often to be single phase and to have been abandoned through the exhaustion of workable deposits.

Dating streamworks is problematic; archive evidence can rarely tie specific sites to dated operations. Although no archaeological dating of Cornish streamwork earthworks has been attempted some relative phasing of sites is possible. Very early, late Iron Age or Romano-British workings were hinted at by radiocarbon dating the peat that formed in a streamworks cutting at Stuffle (SX 182 718) (Walker 1989, 179–83). The early decline of the Foweymore Stannary might also suggest that many streamworks are of early date, but given the persistence of streaming technologies, morphology cannot be relied upon alone. Within St Neot parish, where there are many apparently early and small-scale works, mid-19th-century Census returns list tin streamers, tin sales are listed from Stuffle (SX 183 722), Tin Hatches (SX 183 756) and Menniridden (SX 168 728) (Brooke Archive; CRO, X745), whilst contemporary accounts of operations (eg Michell 1833, 15) force us to conclude that many streamworks that appear to be earlier may be less than two centuries old.

Survey has shown that most of the watercourses and the majority of the dry valleys on Bodmin Moor have been worked for shoad. Time has softened what must originally have been raw and ugly scars across the landscape and all have now revegetated, but many former alluvial streamworks have become dangerous and virtually impassable marshes. The extent of known and probable streamworking on Bodmin Moor is summarised on Fig 39.

Streamwork morphologies

Boundaries between adjacent tinworks are frequently difficult to detect, but analysis suggests that 67 alluvial and 80 eluvial streamworks can be identified and classified using the morphological system developed by Gerrard (Gerrard 1987).

Of these, 26 display only one type of dump patterning whilst 33 sites display combinations of dump types (14 of which are combinations of types 1, 2 and 3) probably indicating variations in working method in response to local conditions, or areas of reworking.

Unlike alluvial streamworks, of which nearly half exhibit features which suggest late reworking, the majority of the eluvial works appear to be single-phase, and are more likely to be medieval or early post-medieval in date.

Table 2 Alluvial streamworks

Gerrard Identifier	*Type*	*Description*	*Number*
1	Hatchworks	Isolated quarries in the alluvium	28
2	Ramped dump	Extended quarries, multiple wedge-shaped dumps downstream	25
3	Parallel dump	Banks parallel to or angled to stream edge	52
4	Retained dump	As 3, but with stiling (revetment) to banks	2
	Unidentifiable	Poor preservation or other factors	8

Table 3 Eluvial streamworks with single waste dump form

Gerrard Identifier	*Type*	*Description*	*Number*
A	Few dumps	Amorphous dumps	14
B	Parallel	Elongated dumps parallel to streamwork sides	16
C	Curving	Curving parallel dumps – combinations of types B and D	0
D	Angled	Parallel banks angled to streamwork sides	4
	Unidentifiable	Disturbed/other factors	14

Table 4 Eluvial streamworks – waste dump patterning on 53 complex sites

Gerrard Identifier	*Type*	*Number*
A	Dumps of amorphous shape	23
B	Elongated dumps parallel to streamworks sides	54
C	Curving parallel dumps – combinations of types B and D	13
D	Parallel dumps angled to streamwork sides	38

Tinners' buildings

Survey has also revealed 46 small buildings associated with streamworks, most either within or very close to workings, occasionally in groups of two or three. Most are rectangular or sub-rectangular in plan: one, at Leskernick (SX 179799; Fig 38) is triangular; a few are irregularly shaped. They are rarely more than 4m in length internally, the majority having floor areas between $3m^2$ and $10m^2$, a single entrance and no evidence for internal subdivision. Thirteen have fireplaces. It is probable that these buildings (Fig 40) served as shelters. 'At dinner tyme … they syt downe together beside their tynwork in a little lodge made up with turves covered with straw …' (Beare, cited in Gerrard 1986) '… many litle howses buylte for the Stannerie men to shrowd them in neere the worckes.' (Norden, cited in Whetter 1974, 72). Smaller examples (Fig 41) like that at Trewalla (Sharpe 1989a, 182–4) seem to have been deliberately hidden, suggesting that they served to conceal valuable tools and ore from thieves: '… his unstamped tin … was concealed in a recess in the wall of the store-house, a cave dug out of the bank of the hill … and the entrance to it was disguised by wall-stones laid in courses fitting the opening.' (Baring Gould 1897, 15). A small number represent adaptations of earlier buildings; at Brown Gelly part of a disused longhouse was made use of for this purpose.

Gerrard's excavations of tinners' structures at Colliford (SX 178716) and Redhill (SX 16827220) produced neither datable material nor evidence to confirm their functions (Gerrard 1986, Appendices II and III), but Herring (Rose and Herring 1990, 378) points out that the distribution of this site type is biased towards alluvial streamworks (67 per cent), particularly those in the more remote central and northern areas of the Moor which appear to have been reworked, suggesting that these buildings may have temporarily accommodated tinners working away from home. The fireplaces occasionally incorporated into the gable walls of these shelters (Fig 38) suggest a post-1600 date (*ibid*).

The distribution of the structures (Fig 39) plotted through fieldwork probably represents only a small proportion of the original population. Although those with stone walls are likely to remain recognisable, many examples were probably wholly built of turf sods (like that excavated by Gerrard at Redhill Marsh) and will have left few obvious field remains.

5 Shoad works

Running water was essential to the recovery of shoad by streaming, both to remove waste during excavation and to separate and concentrate ore before smelting. Some shoad deposits, however, were in situations where the use of leats was topographically impossible. In these special circumstances, tinners recovered what they could by digging swarms or shambles of small pits – shoad works.

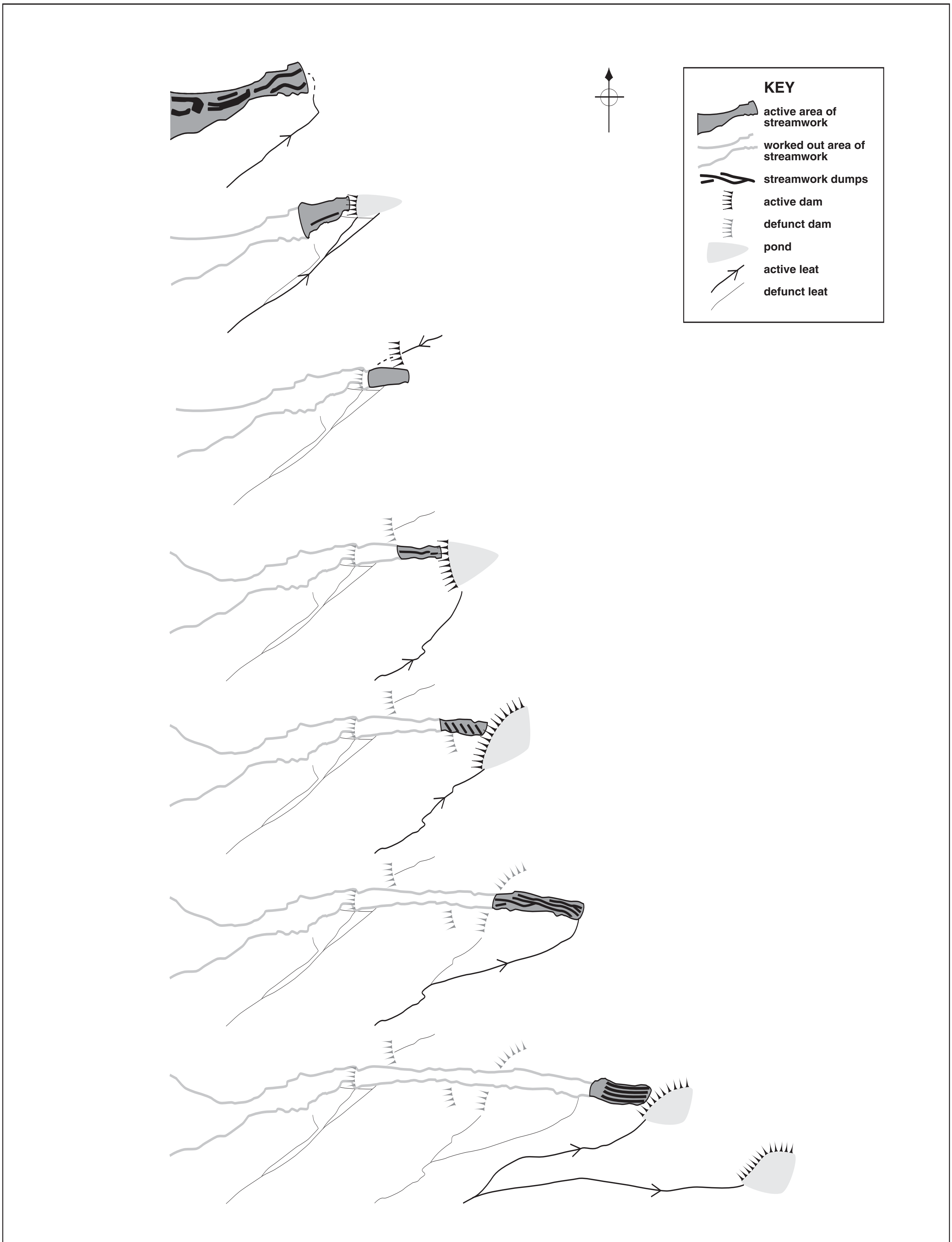

KEY
active area of streamwork
worked out area of streamwork
streamwork dumps
active dam
defunct dam
pond
active leat
defunct leat
0
100
500
m

Fig 36 Type D eluvial streamworks on West Moor (SX 19158088), viewed from the north. These small areas of this dump form may represent a quite late reworking of areas of the shoad deposits since they appear to overlie the very silted remains of earlier Type B workings, discernible in places along both valleys. (CCC HES, F33/79)

Fig 35 (Opposite) The hypothetical development of one of the eluvial streamworks on West Moor, marked by the succession of water supply arrangements; in each case the progressive extension of the streamwork made existing dams and leats redundant. Only in the final phase of operations did the tinners realise that former short-term strategies had resulted in much wasted effort in the repeated construction of leats and dams. Sadly, it appears that their newly found foresight did not pay off, and work was finally abandoned 150m to the west of the new reservoir. (Based on CCC HES, Bodmin Moor Industrial Survey, SX 1980) (© Rosemary Robertson)

Fig 37 Some idea of the scale of the larger streamworks on Bodmin Moor can be obtained from the depth of the cutting and the sheep (left of centre) seen in this view of a part of the very extensive excavations between Buttern Hill and Leskernick (SX 17988081). Industrial activity on this scale must have resulted in the movement of many tens of thousands of tonnes of silt, resulting in the creation of large areas of marsh downstream, some of which were subsequently reworked for the residual tin they contained. (Jacqueline Nowakowski)

Understandably, given the labour-intensive nature of this method and its consequent inefficiency and cost, only a small number (22) of these sites were created on Bodmin Moor. Some lie at the upper margins of eluvial streamworks – near Trewalla streamwork (SX 255710) or on Cardinham Moor (SX 133716) – where they appear to have worked deposits distant from parent lodes, possibly as extensions of streamworks. A second group are closer to intact lodes, in some cases overlying them, as at Hardhead (SX 150715), Goonzion Downs (SX 1767) (Fig 42) and Berry Downs (SX 195687). On shallow slopes weathered lode material would be subjected to only slight dispersion from parent deposits, and must have formed diffuse spreads of relatively angular material in the soil overlying and surrounding the lodes.

After prospecting to define its quality and extent, shoad was recovered by digging small pits – in some cases many hundreds of near-contiguous excavations. Although these sites appear chaotic at first glance, detailed survey can reveal distinct patterning, suggesting a structured approach to exploitation. Where intact lodes were located, as at Goonzion (*see* Fig 42), their outcrops were also developed. Even where pits were most densely packed, only a maximum of 50 per cent of the deposit could have been recovered, the remainder being covered with pit upcast. It may be that the benefits of recovering the remainder would have been outweighed by the costs of undertaking the work. There is no evidence on Bodmin Moor for the shallow strip mining of such deposits, though this has been found elsewhere in Cornwall (Sharpe 1994).

Shoad recovery was evidently based on its visual identification within the upcast (probably from a definable horizon within the soil). Only larger pieces of ore could have been extracted in this fashion and it is not surprising that there is evidence at Goonzion for the re-prospecting of deposits. Ore treatment would have taken place at sites adjacent to watercourses.

6 Outcrop working

Given the considerable depths to which many of the Bodmin Moor streamworks were excavated, often to the underlying bedrock, unworked mineral lodes would have been exposed from time to time. Even where this was not the case, abundant relatively unweathered shoad material in the eluvium would have alerted streamers to the presence of nearby lodes and most of the major tin lodes to the north of Minions would have been discoverable in this way. Lode material was probably left unworked whilst there were substantial unexploited reserves of alluvial and eluvial shoad; indeed, legislation prohibited miners bounding mine works within streamworks (Lewis 1908, 162, quoting from BM Add. MS. 6713, fol.128). The depletion of the richest shoad reserves, possibly during a short but intensive period of activity spanning perhaps three centuries, forced tinners to turn their attentions to the intact lodes, records of tin output suggesting that this occurred rather later on Bodmin Moor than in the western stannaries, lode replacing shoad as the primary source of ore as late as the early 16th century on Foweymore (Sandy Gerrard, pers comm).

This change had considerable implications for the tinners. Techniques and equipment perfected over many centuries for hydraulic excavation were entirely unsuitable for gaining access to and exploiting lodes in the parent rock, which required new technologies for rock-breaking, haulage, ventilation and crucially, for pumping. The first mines were small-scale and limited to the upper parts of the lodes (the backs), often within relatively soft, weathered rock, or from outcrops where some natural drainage was possible. Two distinct types of field remains resulted: openworks and lode back workings.

Openworks

'… they wrought a Vein from the bryle to the depth of eight or ten fathoms, all open to grass, very much like the fosse of an intrenchment … . This … they call a Coffin, which they laid open several fathoms in length east and west, and raised the Tin-stuff on Shammels, plots or stages, six feet high from each other, till it came to grass.' (Pryce 1778, 141).

The forms of openworks depended on the topography within which their lodes outcropped. On hillslopes, overburden was stripped away and flat-bottomed quarries excavated, waste and ore being barrowed (later trammed) to dumps and dressing floors. If these developed in depth, or had been cut from level ground, excavation proceeded in a series of steps each about 2m in depth, which allowed material to be shovelled to surface in stages (shammelling). As openworks deepened, however, windlasses became necessary and the excavations would have required some form of artificial drainage – whether by adit or primitive pumps. Rock breaking was undertaken manually using picks and wedges, sometimes preceded by fire-setting, though leats surveyed by Gerrard at the 'openwork' at Colliford (SX 175711: *see* Fig 43) may have played a role in exploitation, possibly during initial overburden stripping (as a form of hushing), the recovery of shoad preceding lode development, or, as Gerrard suggests (1986, 245), for quenching after fire-setting. Ore-bearing rock was subsequently sorted, crushed and dressed.

Despite often impressive surface appearances, most openworks on Bodmin Moor were relatively shallow and development in depth tended to be during later phases of operation as at Treveddoe (SX 152697; Figs 44 and 45), where although early shafts and levels were intersected by the deepening openwork, the majority were developed on the lodes beneath and

Fig 38 A stone-built triangular tinners' shelter (incorporating a triangular chimney) on the fringes of an alluvial streamworks to the west of Leskernick Hill (SX 179799). (Adam Sharpe)

beyond it during its later phases of operation (Peter Herring, pers comm). At Goonzion (SX 177677) and at Colliford cross-cut prospecting levels were cut from the bases of the excavations into the surrounding country, though no development seems to have resulted (Gerrard 1986).

Openworks had an important place in the development of true mining, though they were relatively rare and by the 18th century were regarded as old-fashioned, Pryce describing such a coffin or beam as: 'Old workings which were all worked open to grass, without any Shafts, by virtue of digging and casting up the Tin-stuff from one stage of boards to another. Workings all open like an intrenchment.' (Pryce 1778, 318). Their first documented use on Bodmin Moor was at South Trekeive, St Cleer (?SX 228700) before 1357 (Gerrard 1986). Most of the examples on the Moor seem to have been worked during the 16th and 17th centuries, though a stanniferous elvan on Hobb's Hill (SX 185694; Fig 43) was worked in this way during the 19th century (Martin Mount, pers comm), and Treveddoe (SX 153696) continued to be exploited into the first decades of the 20th century (Fig 45).

In Cornwall, openworks appear only rarely in the documentation, and within specific areas of the mining districts. On Bodmin Moor, only four openworks were described as 'bemes', others, like Lamelgate (SX 218705), being termed 'mines' or 'tinworks'. Treveddoe remains impressive today, but 'Clennacombe Beme' (SX 265722) mapped by Symons at Phoenix Mine in 1867 has been infilled; the site at West Colliford interpreted by Gerrard as an openwork now lies beneath a reservoir; the 'Beame Worke' documented in 1691 in Altarnun parish and those at 'South Trekeff' (South Trekeive) and 'Kerla Mine' (Crylla, SX 2370) can no longer be located. Of the 14 'possible' openworks in Gerrard's lists (1986), half were probably sub-setts within and immediately adjoining Treveddoe. Fieldwork revealed 27 openworks on 20 sites, 2 of them, West Colliford (Fig 43) and Hobb's Hill, St Neot, being surveyed in detail

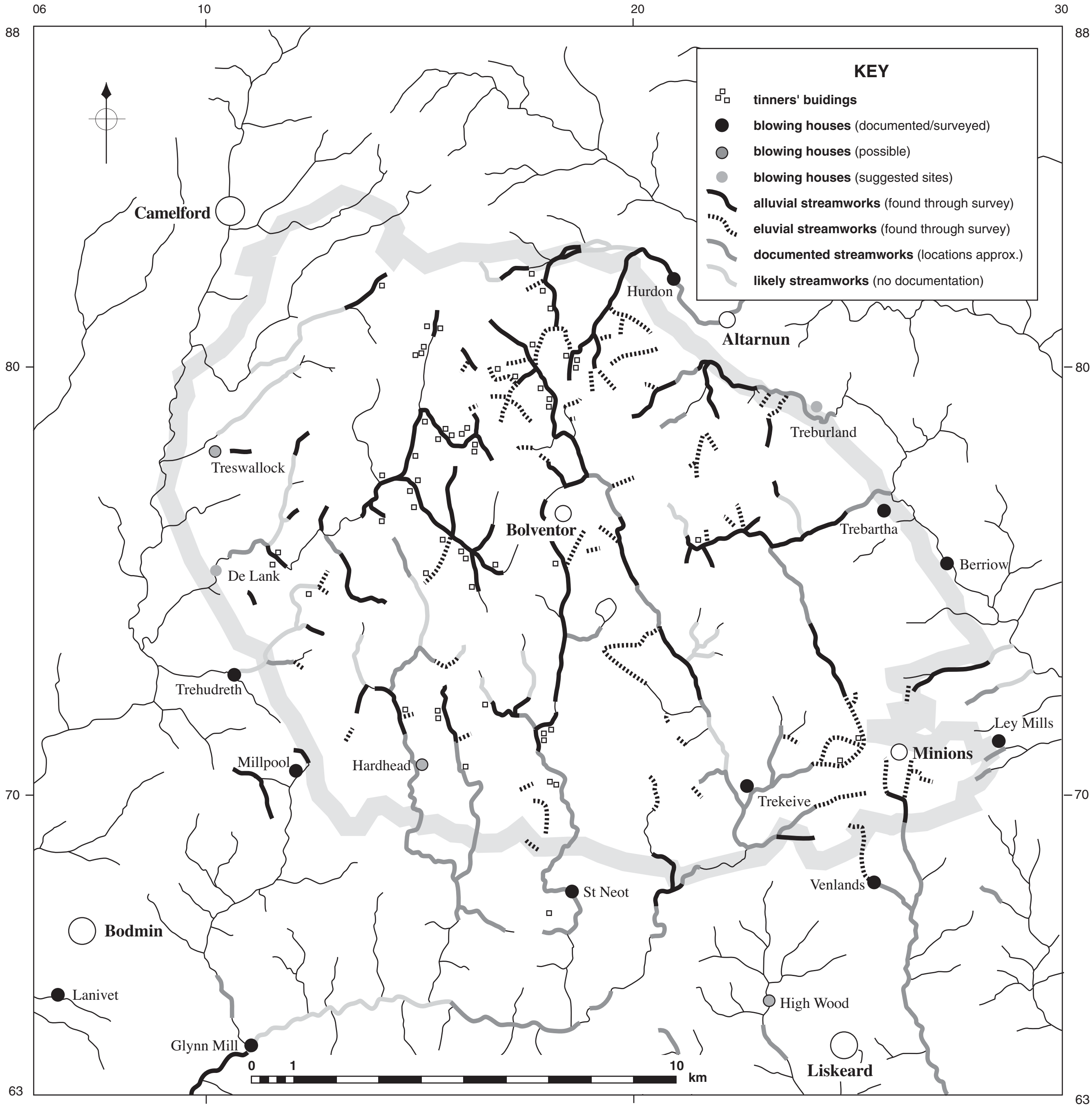
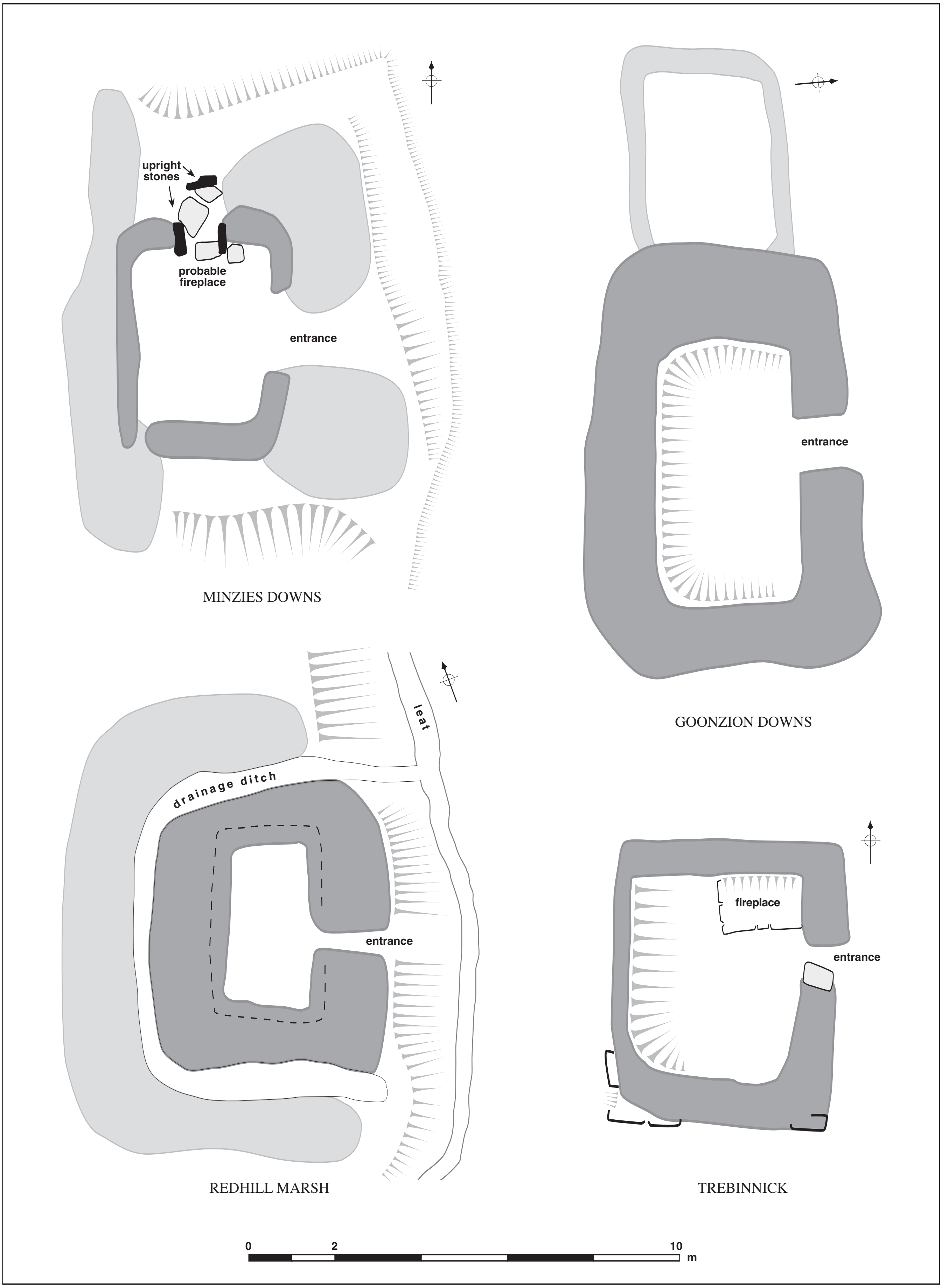


Fig 39 *The distribution of streamworks and associated sites on and surrounding Bodmin Moor. All of the major watercourses flowing off Bodmin Moor contain some streamworking. Evidence for this activity is best preserved towards the heart of the Moor, though documentation indicates that it occurred in areas where little or nothing can now be detected. The distribution of tinners' buildings shows a distinct bias to the more remote, northern areas of the upland, suggesting that they were used as temporary accommodation by tinners. In contrast, all known blowing houses are located around the periphery of the Moor where power and fuel sources were readily available. (© Rosemary Robertson)*

Fig 40 *(Opposite) Four larger tinners' structures. The fireplaces sometimes incorporated into their construction suggest that they were intended as shelters for the tin-streaming workforce, perhaps as overnight accommodation in the more remote areas of the Moor. Their construction varies, though stone components are common. Although dark, damp and cramped, they would have provided welcome shelter from the elements. Their size suggests that they would have probably accommodated relatively small groups of men, teams of between four and six at most. Minzies Downs (SX 18137604), Goonzion (SX 17906758), Redhill Marsh (SX 16827220) and Trebinnick (SX 18367049). (After Gerrard 1986, fig 5.37)*


upright
stones
probable
fireplace
entrance
MINZIES DOWNS
entrance
GOONZION DOWNS
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drainage ditch
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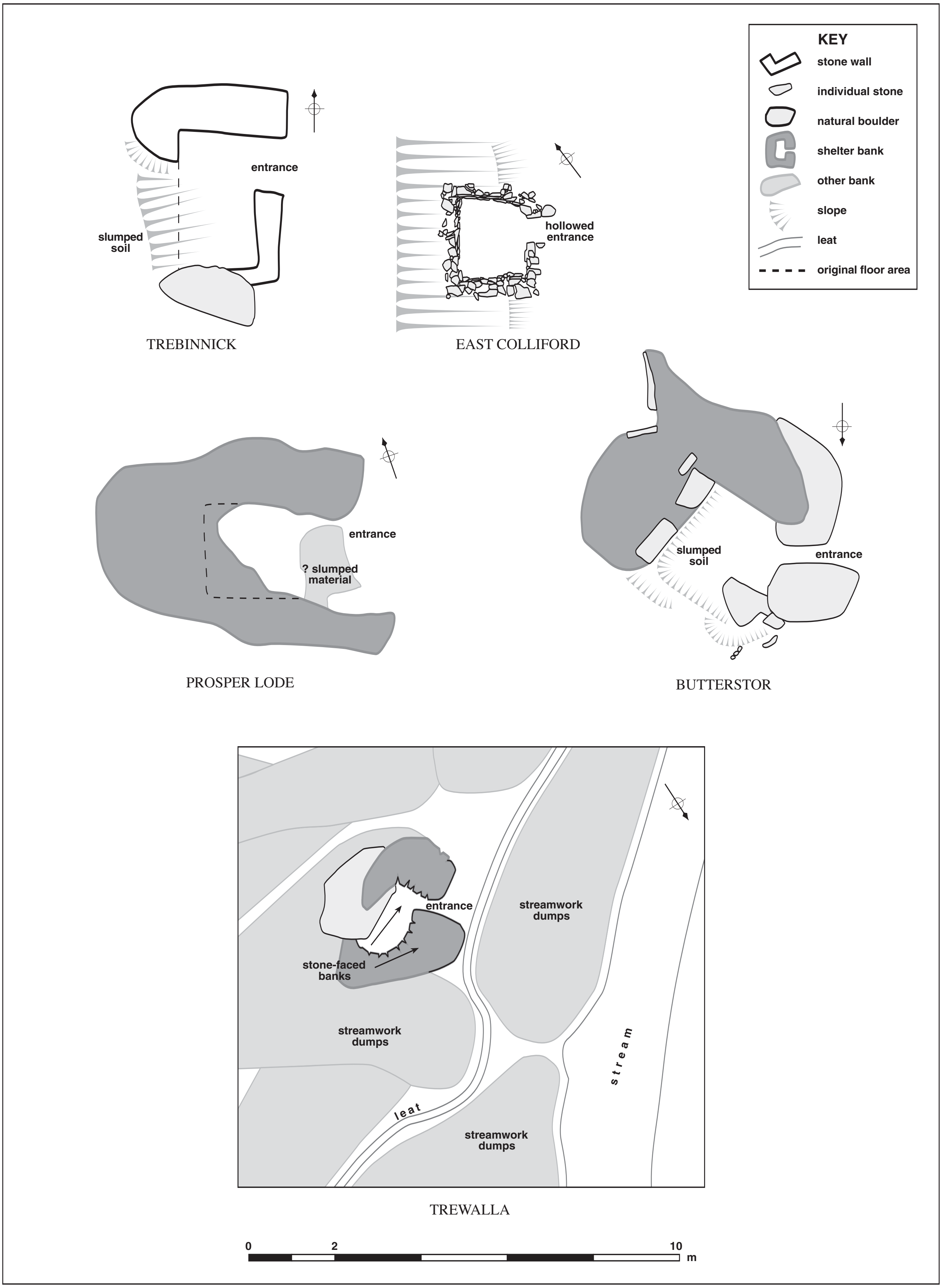
KEY
stone wall
individual stone
natural boulder
shelter bank
other bank
slope
leat
original floor area
entrance
slumped soil
TREBINNICK
hollowed entrance
EAST COLLIFORD
entrance
? slumped material
PROSPER LODE
slumped soil
entrance
BUTTERSTOR
entrance
stone-faced banks
streamwork dumps
streamwork dumps
streamwork dumps
leat
stream
TREWALLA
0
2
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m

Fig 41 (Opposite) Five small tinners' structures, all probably used as concealed tool stores or ore caches. Trebinnick (SX 18447051), Butterstor (SX 14897810) and Trewalla (SX 25307098) all incorporate natural boulders, against which streamwork waste and soil were mounded. The excavated example at East Colliford (SX 17837167) (Gerrard 1986) appears to have been carefully constructed of coursed masonry, whilst that adjacent to the Prosper Lode near Minions (SX 25637142) was probably turf-built, and is now a very low earthwork. All were probably originally roofed with turves or reeds. (After Gerrard 1986, fig 5.37; CCC HES, Bodmin Moor Industrial Survey, SX 1478, Sharpe 1993, figs 75 and 102)

by Gerrard (Fig 4), the remainder being recorded through Herring's rapid survey. Of these, only seven were of beam type, that is having four vertical or near-vertical sides, the remainder being sited on hillsides and having at least one open end. In scale, they varied from 5m to 50m in width, in length from a few tens of metres to nearly 200m, and from 1.8m to 35m in depth (though their true depths were often masked by backfill).

Lode back workings

'When we have found our Load, the last Essay hatch loses or rather exchanges its name for that of a Tin-shaft, or Tin-Hatch, which we sink down about a fathom, and then leave a little long square place, termed a Shamble, and so continue sinking from cast to cast … till we find either the Load to grow small, or to degenerate into some sort of weed … Then we begin to drive either East or West, as the goodness of the Load, or conveniency of the Hill invite; which we term a Drift, 3 foot over and 7 foot high; so as a man may stand upright, and work …' (Anon 1670, 2102).

Unlike openworks, clusters of shallow shafts accessing lode outcrops are relatively common on Bodmin Moor, as elsewhere in Cornwall. The approach required only basic resources, though without pumps and hardened tools, excavation was limited to shallow depths.

Depths of overburden would have varied considerably, from under a metre where slopes were steep and rock hard, to perhaps 5m in areas of deep geliflucted cover or where chemical weathering had softened the country rock. Where extensive shoad accompanied the lodes, generally where they outcropped on shallow slopes, narrow quarries

Fig 42 Goonzion Downs, St Neot in 1977 (SX 176677, north to top). Several important closely set parallel tin lodes outcrop here, and have been worked by a variety of methods over the centuries. Two lines of lode back pits and shafts with their associated prospecting pits can be seen to the north of the road, others are visible crossing the ground to the south. Just above the centre of the view, the lodes were worked by small openworks (one showing as a prominent area of backfill). Just to its right is a 19th-century shaft. Most striking of all are the many thousands of shoad collection pits which occupy all of the southern half of this site whose presence reflects the impossibility of working this ground by streaming. These pits are partly overlain by prospecting features, including a trench cut only a few decades ago (after this photograph was taken) by Geevor Mine who were interested in the possibilities of re-milling the waste dumps. (University of Cambridge, RC8/BU/93)

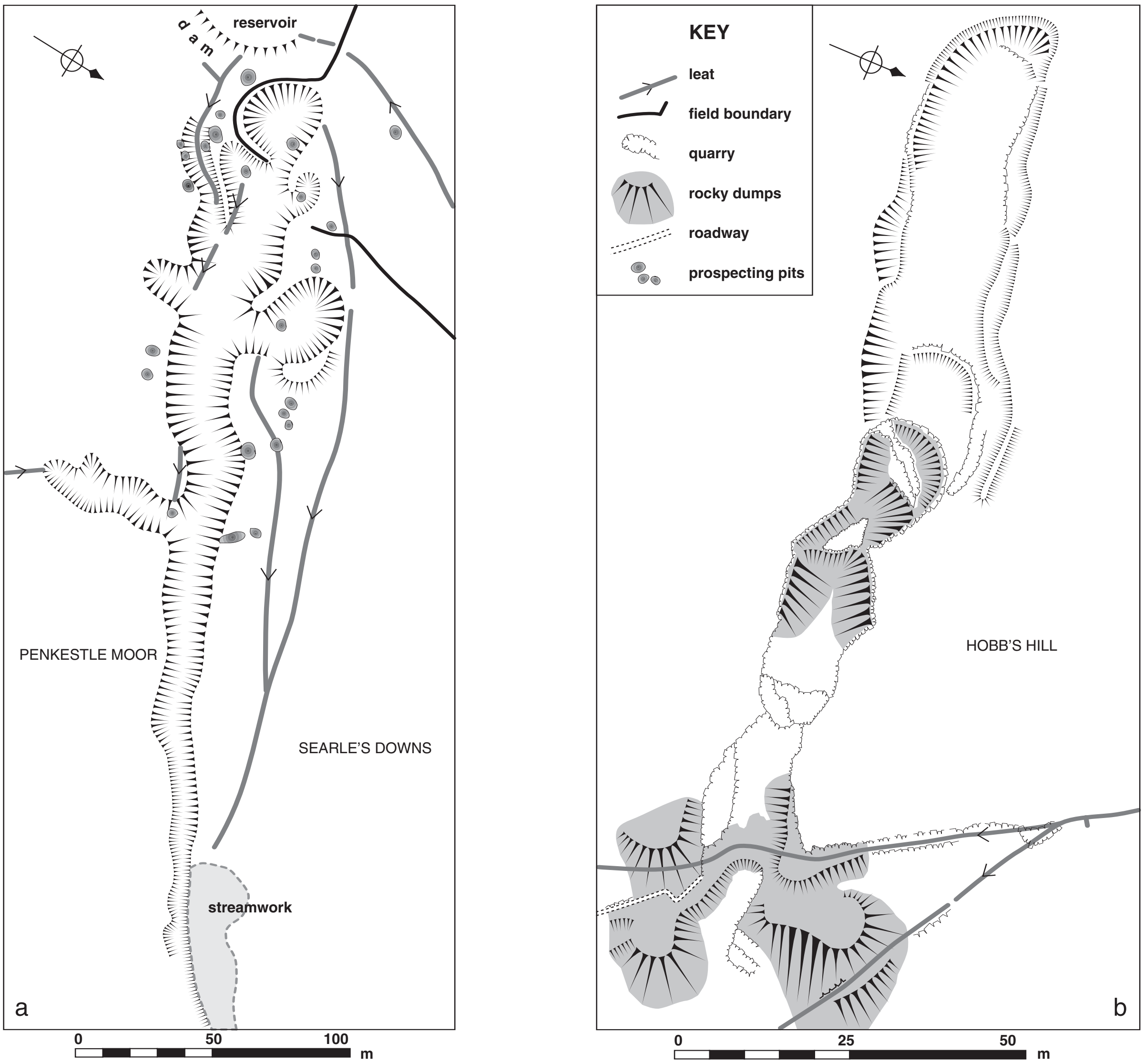


Fig 43 Two moorland openworks. Both are rather atypical. The Colliford openworks (SX 175711) may have been worked by a hybrid of streamworking and mining technologies, whilst Hobbs Hill (SX 185694) represents the 19th-century application of quarrying techniques to a large but low grade tin deposit. (After Gerrard 1986, figs 5.24 and 5.25)

aligned along the lodes were cut down to bedrock to recover shoad and clear overburden, spoil being dumped into linear heaps along their edges. Small shafts developed from these quarry bases gave access to stopes on the lodes, as can be seen at Goonzion or near Minions. More often, however, shafts were cut from the moorland surface (Figs 46 and 47). Through weathering and, in some cases, deliberate backfilling, most now appear as relatively shallow hollows with steeply sloping sides accompanied by overgrown spoil dumps, and any traces of surface infrastructure such as windlasses have long disappeared. Shafts are closely spaced, often being little more than 10m apart, '… a shallow shaft was sunk onto the lode and the cassiterite mined by the use of galleries [stopes on the lode] in precisely the same manner as that of the later deep shafts …' (Gerrard 1986, 89). Contemporary accounts appear to support this interpretation: 'If the lode lie slopewise, the tinners dig a convenient depth and then pass forward underground so far as the air will yield them breathing, which, as it beginneth to fail, they sink a shaft down thither from the top to admit a renewing vent … .' (Carew 1602, reprint of 1969, 93). Recent excavation evidence (Sharpe 1994) indicates that these closely spaced shafts connected to shallow stopes, combining the functions of access, hauling and ventilation. Survey evidence for overlapping waste dumps and of some deliberate backfilling suggests that lodes were often progressively exploited along their outcrops for many hundreds of metres, worked stopes being used for waste disposal – an approach which made it almost impossible to return to previously exploited ground.

Bodmin Moor tin lodes were generally narrow, contemporary accounts suggesting 300mm to 600mm as the average; below this size a lode would have to be exceptionally rich to warrant working (Fig 48). Some dead ground would probably have to be removed to produce stopes wide enough for the small team of men who broke the rock and sent it to surface: 'The proportion of Men is, 2 Shovelmen, 3 Beele-men, which are as many as one Drift can contain, without

Fig 44 Some idea of the large scale of Treveddoe openwork (SX 153696, from south-west) can be got from this view. Sheer rock walls rise up to c *35m from the openwork's floor to right and left. (Peter Herring)*

being an hinderance to each other. The Beele-men rip the Deads Ore; the Shovel-men carry it off, and land it by casting it up with shovels from one shamble to another, unless it be where we have a Winder with two Keebles [great buckets made like a barrel with iron hoops placed just over the Wind Hatch, as it was then termed] which as one comes up, the other goes down' (Anon 1670, 2104).

The narrow stopes produced by such shallow mining almost certainly twisted to follow the lodes which they only patchily exploited. The maximum depths achievable were limited by available pumping equipment, usually buckets or rag and chain pumps. Most would have been no more than 10 or 20m deep, though where particularly rich ore was found and deeper drainage could be achieved, nearly double this was possible. 'The back of the lode has been worked by the old men to a depth of 14 fathoms, who, if we may judge by the extent of their excavations must have found large deposits of tin.' (Webb and Geach 1863, 75).

Lode back shafts are often accompanied by evidence for prospecting, but only very rarely by dressing floors, suggesting that ore was transported to locations where water power was available (Fig 49).

Elongated strings of such workings are found throughout Cornwall and (with openworks) are generally accepted as the earliest morphologically distinct evidence for lode mining. The currency of this form of working is difficult to determine, given that it is not distinguishable in the documentary sources. Of the 186 early documentary references to 16th- and 17th-century mining activity in the Foweymore Stannary noted by Gerrard (1986, Gazetteer) the majority are described only as 'tinworks', a classification which was applied without distinction to both mines and streamworks. In all likelihood, most pre-18th-century 'mines' were of lode back form. Gerrard argues (1987) that most of the Foweymore tin derived from streamworks, lode mining starting in the western stannaries perhaps a century before Foweymore. It follows that early 16th-century 'tinworks' whose locations suggest mining rather than streamworking are likely to be amongst the earliest on the Moor. Two clusters have been identified. The first, in the southern part of St Neot parish, is centred on Goonzion Downs (SX 1767), extending along the western side of the Loveny valley as far north as Hobb's Hill. The second cluster, to the north of Caradon Hill (SX 2571), is flanked by streamworks (Figs 49 and 50, and Map 3). Between them, these two areas contained the richest and most accessible tin lodes on the Moor, and were the sites of the most successful deep mines in later centuries.

Outcrop mining represents the earliest stage in the development of true mining. It is likely that as improved pumping and hauling equipment were developed, new ventures would have developed as shaft

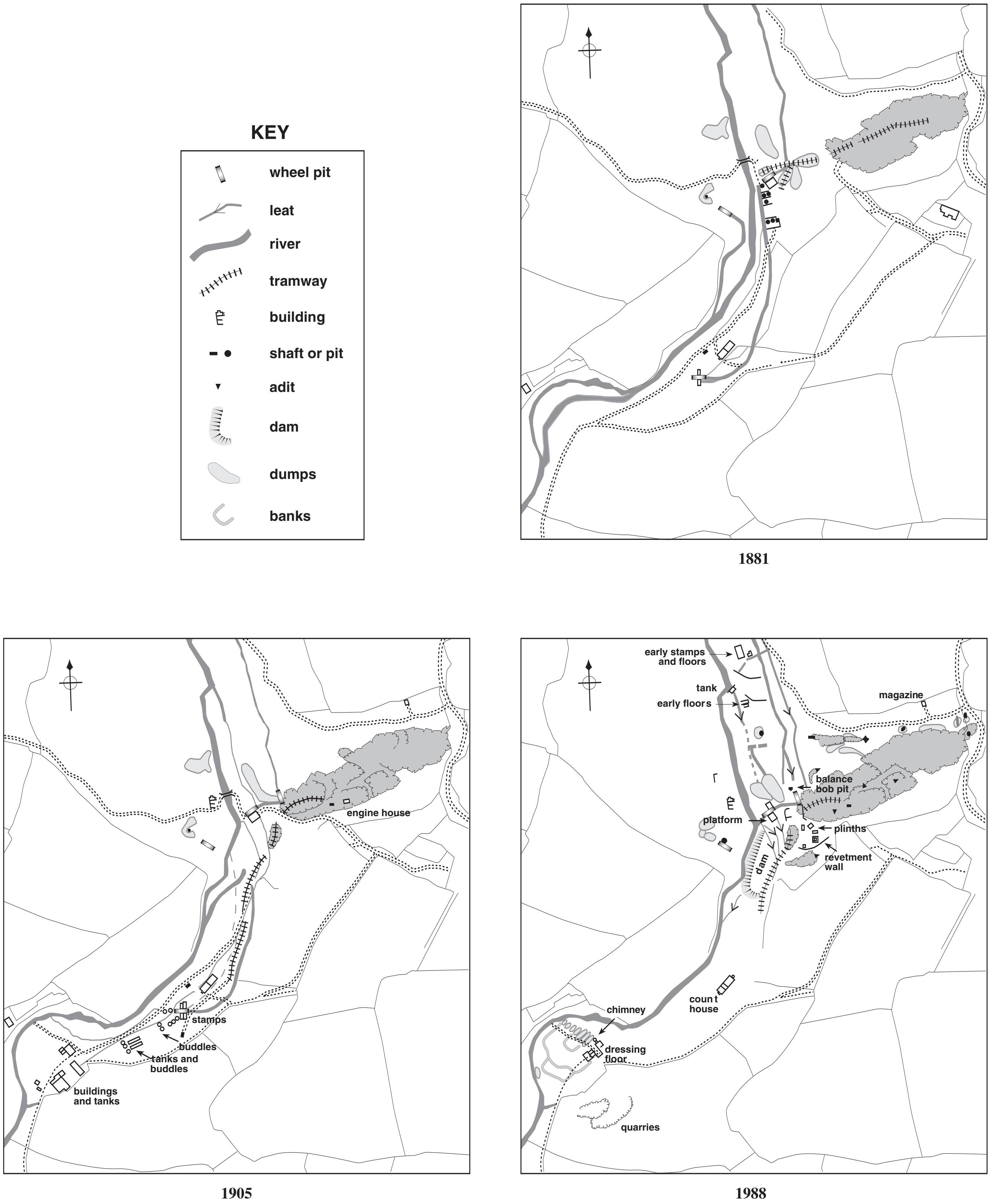


Fig 45 Treveddoe (SX 153696) is one of the earliest documented openworks on Bodmin Moor, but also its longest lived, operating well into the 20th century. The original openwork was probably small-scale; its associated dressing floors lay next to the river. Expansion during the 19th century was on a large scale, however, and resulted in the construction of tramways leading to new dressing floors some way downstream, the diversion of a section of the river, and to true mining beneath the base of the openwork. (© Rosemary Robertson)

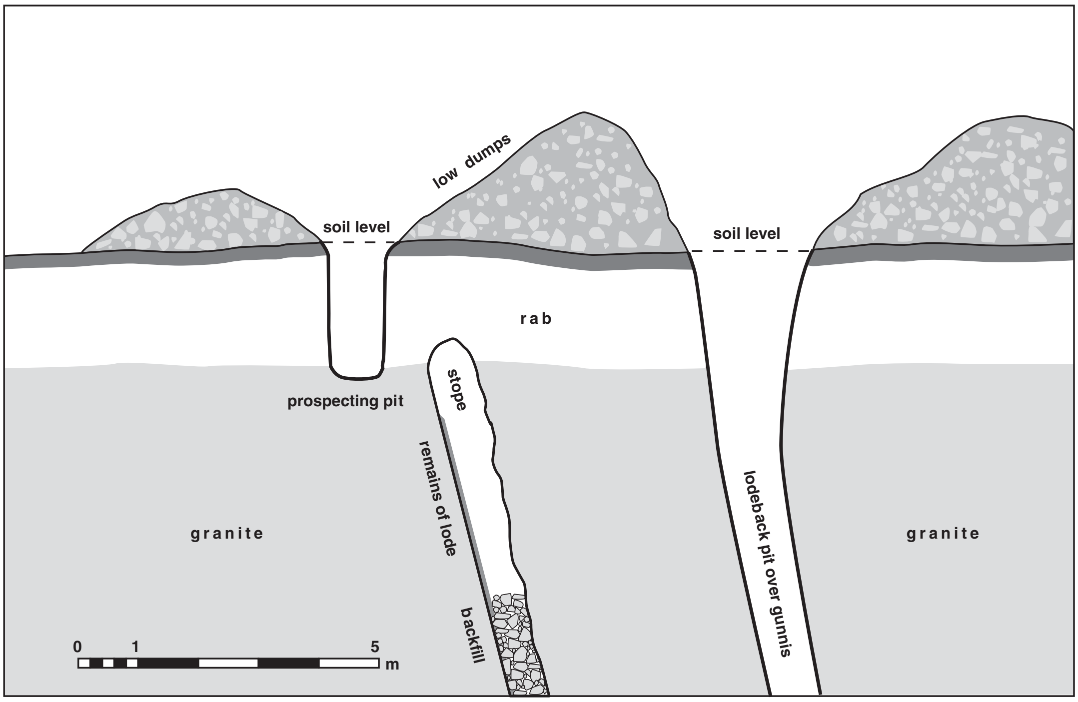


Fig 46 A schematic section through shallow mining features. The location of the interface between subsoil (rab) and intact bedrock was the principal determinant governing the depth of prospecting features associated with outcrop mining, and the depth from surface at which stoping (extraction) was commenced, intact lodes not being found above this point. Requirements for access and ventilation resulted in stopes being connected to surface at regular intervals. At surface, outcrop working takes the form of lines of discrete pits and associated waste dumps. Below ground, extraction generally produces near-continuous linear excavations. (© Rosemary Robertson)

and adit mines, whilst some existing outcrop workings like Stowes near Minions were reworked to very considerable depths. Such developments incurred considerable costs and although not all lodes could be economically developed in depth, many could be exploited, however inefficiently, as outcrop workings. Although this approach was probably regarded as extremely old-fashioned by the early 18th century, it is possible that it continued to be practised on a small scale for perhaps a century more.

7 Early shaft and adit mines

> 'For conveying away the water they pray in aid of sundry devices, as adits, pumps, and wheels driven by a stream and interchangeably filling and emptying two buckets, with many such like, all which notwithstanding, the springs begin to encroach upon these inventions as in sundry places they are driven to keep men, and somewhere horses also, at work both day and night without ceasing, and in some all this will not serve the turn.' (Carew 1602, reprint of 1969, 93).

The shallow mining of lode outcrops was clearly labour-intensive. Repeatedly sinking new shafts to exploit ground must have been very time-consuming, and without good drainage gave access to only a small proportion of the lode. Working a few fathoms below the surface, up to their knees in water which they had no means of clearing, in ground which must have been weathered and prone to roof falls, miners knew that without better drainage they could only scratch the surface of the wealth beneath them. The transition from outcrop working to true mining probably occurred gradually. The use of hand-worked rag and chain pumps or buckets allowed mines to be worked a little way below the water table, but it was the development of adit drainage and the use of waterwheel-driven pumps which marked the development of true mining.

Adits were, however, expensive investments. They required deep valleys if they were to be driven at useful depths without excessive excavation costs, and it is likely that the first of the Bodmin Moor mines to be developed in this fashion were those where lodes outcropped near watercourses. Much of the field evidence for early shaft and adit working on Bodmin Moor comes from mines flanking the St Neot, Warleggan and Fowey rivers, but early adit mines probably also developed from the east of Bray Down, to the north of Caradon Hill and to the east of Stowe's Hill, where pre-existing lode back workings were deepened to form a series of shafts. 'The old men carried their operations as deep as the water would allow them, and it would be difficult to match such a range of coffins [on the Stowe's Lode] as they have left, in any part of the country' (Worth 1880).

The portals of many of these adit systems have now become obscured through collapse, but it is often possible to trace the lines of ventilation and haulage shafts, some associated with horse whims, along the lode outcrops. Fig 51 shows an extensive example of such mining to the north of Minions. Although the plan

Fig 47 The re-excavation of outcrop workings at Silver Valley, Minions, as part of a wolfram prospect just before the last war. Were it not for the suit worn by the gentleman on the left and the strand of barbed wire in the foreground, this 1936 scene could have been witnessed four centuries earlier when the lodes were first being worked. (HG Ordish collection; copyright reserved)

Fig 48 Most early underground mining features are small in size and irregular in shape. This adit (at Geevor Mine in West Cornwall) is typical of pre-20th-century practice, and is similar in appearance to many on Bodmin Moor. (Adam Sharpe)

is early 19th-century in date, most of the shafts probably date to the previous century. Smaller examples of shaft and adit mines can be seen at Bray Down (SX 186619), Halvana (SX 215786) and Hobb's Hill (SX 184695).

Although blasting explosives and drilled chargeholes were introduced into Cornish mines during the late 17th century, their impact on the small and primitive mines of the Moor was probably limited. Shaft sinking, the driving of levels and ore extraction by stoping probably continued to be largely based on fire-setting and the use of hammers and gads (chisels), wedges, picks and shovels (Jenkin 1927). Workings would have been narrow, only the absolute minimum of rock being removed, and only the highest grades of ore recovered. Much of the waste produced would have been stacked in worked-out stopes, rather than hauled to surface for disposal.

Although deeper adits might drain well over 50m depth of ground, many were relatively shallow: 'Trelawney's Lode was worked by the old men by an adit driven up in a series of steps or rises just as the course of tin ran, and eventually unwatered the lode to the 20 (fathom) down to which depth they have removed the tin stuff' (Webb and Geach 1863, 62).

Some existing outcrop workings must have been deepened in this way, but ore deposits capable of providing a return on the levels of capital demanded by deeper mining seem to have been relatively uncommon on Bodmin Moor, and documentary and field evidence suggests that development stagnated on all but a small number of sites where deep drainage was possible. At many mines work ceased almost completely.

If adits allowed greater depths to be accessed, they also brought new problems. Whilst primitive windlasses (eg that shown on Fig 47) would have served for winding depths of a few fathoms or so, mines deeper than this required far more effective means of bringing material to surface. In some cases adits served to bring out waste and ore but although they connected underground workings with locations suitable for dressing floors, most were small in section, part-full of water and passed through areas of stoping. An alternative option was to install hauling equipment such as horse whims or waterwheel-powered winding gear at selected shaftheads, allowing material to be 'raised to grass'. In practice, these were often not well placed in relation to dressing floors and much ore continued to be barrowed out through adits. Topography placed absolute limits on the depths of ground which could be drained by adits alone. Except on a small number of favoured sites, the expansion of mining made possible by adits and waterwheel-driven pumps must have been short-lived, and commonly the evidence for the stage of development intermediate between outcrop working and deep mining has been obscured.

8 Later deep mining

There is little documentary or field evidence for mining on Bodmin Moor during the 18th century apart from a few small and relatively unimportant ventures. The isolation of the district and its lack of infrastructure made it expensive to install and service the plant and other resources necessary to establish and promote deep mines, discouraging investment, and only one Newcomen engine was briefly installed on the Moor (at Stowes, SX 260721 in 1730), on a site 20sq km along unsurfaced lanes from the nearest port. Much of the development of steam power on Cornish mines during this period was based on the exploitation of copper ores – something not known to exist on Bodmin Moor at the time – and by the early years of the 19th century the few mines working on the Moor remained small, shallow and technologically backward.

Developments during the mid-19th century

The discovery of large reserves of copper under Caradon Hill in 1836 provided the spur for change. Development began on an unprecedented scale, and although many of the resulting mines were little more than short-lived speculations, those around Caradon Hill and Phoenix United were central to a revival of mining in East Cornwall which lasted for nearly half a century.

> 'All about us monstrous wheels were turning slowly; machinery was clanking and groaning in the hoarsest discords; invisible waters were pouring

onward with a rushing sound; high above our heads, on skeleton platform, iron chairs clattered fast and fiercely over iron pulleys, and huge steam pumps puffed and gasped, and slowly raised and depressed their heavy black beams of wood. Far beneath the embankment on which we stood, men, women, and children were breaking and washing ore in a perfect marsh of copper-coloured mud and copper-coloured water' (Fig 57, and *see* Collins 1851).

Although equivalent deposits of ore were not to be found elsewhere on Bodmin Moor, the discoveries around Minions sparked renewed interest in sites which had been little worked for decades. Most moorland mines show evidence for re-prospection or reworking around 1840, but lacking the advantage conferred on the Caradon area by the building of the Liskeard and Caradon Railway, other areas proved expensive to develop and only Onslow Consols, Roughtor Consols and Wheal Bray were at all significant as copper producers.

Rich tin deposits found at Phoenix United in the 1860s (Figs 52 and 53) provoked a second wave of interest in Bodmin Moor and some ancient moorland workings were re-started or overhauled, notably Tregeagle (SX 175685), Hammett (SX 186696), Halvana (SX 215786), Vincent Mine (SX 208793; Fig 54) and Hobb's Hill (SX 186694), but most trials proved what had been long suspected: there were few unworked bodies of ore of any size on the Moor, and those that had been viable in the past were more or less exhausted.

Technological requirements

By the mid-19th century, economic conditions were such that only larger mines could hope to succeed. Copper ores were sold after only rudimentary dressing and at low concentrations, but steam drainage and hauling plant were essential in order to achieve the high outputs necessary for success, whilst the transport charges associated with the movement of such large quantities of ore kept profits per ton low. Likewise, tin mines had to be extensive and heavily mechanised if they were to be able to exploit reserves of lower-grade ore.

The development of deep mining depended almost entirely on that of steam power – at first for pumping, but eventually to wind ore and waste and to power crushing and dressing plant. The first Newcomen engines introduced in the early 18th century were so fuel-hungry that they were barely usable in Cornwall, even by the few rich mines with ready access to coal supplies. Watt's improvements transformed the inefficient atmospheric design, and by the turn of the century many mines were erecting engines to access hitherto unavailable reserves. Immensely more powerful than any other available power source, these engines were also expensive to purchase, install and run. In their main period of use from the late 18th century to the late 19th century nearly 3,000 engines were installed in Cornwall. Following the late 19th-century collapse of mining, internal combustion engines or electrical power became the preferred power sources, together with water turbines, where practicable.

Deep mines could not function without extensive ore reserves, efficient equipment and access to cheap bulk transport systems, factors favouring only a few of the Cornish mining fields in the early years of the 19th century. The new mines tended to be larger than their predecessors, and one new site with centralised dressing floors might replace half a dozen earlier undertakings, each with its own pumping, winding and dressing plant. Pumping shafts were equipped with large beam engines or were served by systems of flat rods; powerful winding engines could haul from up to half a dozen shafts; man-riding skips (or at South Caradon, man-engines) superseded ladderways. With the benefit of steam power for pumping and winding, mines could reach to depths in excess of 500m (roughly 250 fathoms) from surface and extend over considerable areas. Where a sett was long or wet, pumping and winding engines might be strung out along the lode outcrop for over a kilometre (for instance at South Caradon, SX 2669), where there were six pumping engines and four winding engines), but smaller mines tended to install comparatively small pumping engines; winding engines not only hauled from several shafts but also powered crushing equipment, functions that many smaller mines continued to power using water.

Although pack animals and carts had served to link production shafts and dressing floors on earlier mines, requiring little more than rough tracks, the need to transport heavy machine parts, timber, masonry and coal and to carry large quantities of ore to dressing floors led to the construction of networks of surfaced roads, and, in a few cases, horse-hauled tramways (eg that at Vincent Mine, Fig 54) – extensive systems incorporating inclined planes being laid at Phoenix United and South Caradon (Figs 52, 53 and 57). Short tramways were commonly used when developing waste dumps. Only one aerial ropeway is known to have been installed, during the late working of Wheal Tregeagle (SX 177684).

In another change from earlier practice, where most mines had been run on a part-time basis with little investment in infrastructure, accommodation and workplaces were provided for large and increasingly technical workforces. As well as mine offices (count houses), there might be workshops for smiths, engineers, timbermen, mine agents and samplers (assay houses), stores for parts, coal and timber, and drys (change houses) for both underground and surface workers – at Phoenix United a total of 801 employees in the later decades of the 19th century (*see* Figs 52 and 53, also 55).

Underground, the use of explosives for rock-breaking had become the norm and small, remotely sited powder magazines can still be seen at a dozen moorland mines. Chargeholes continued to be drilled manually; only the last working of South Caradon Mine, the abortive reworking at Prince of Wales' Shaft, Phoenix United and a handful of other small late undertakings made any use of mechanical rock drills. Although shafts still tended to follow the underlies of lodes, making the installation of efficient mechanical hoisting equipment difficult, access ways and workspaces underground tended to be more organised,

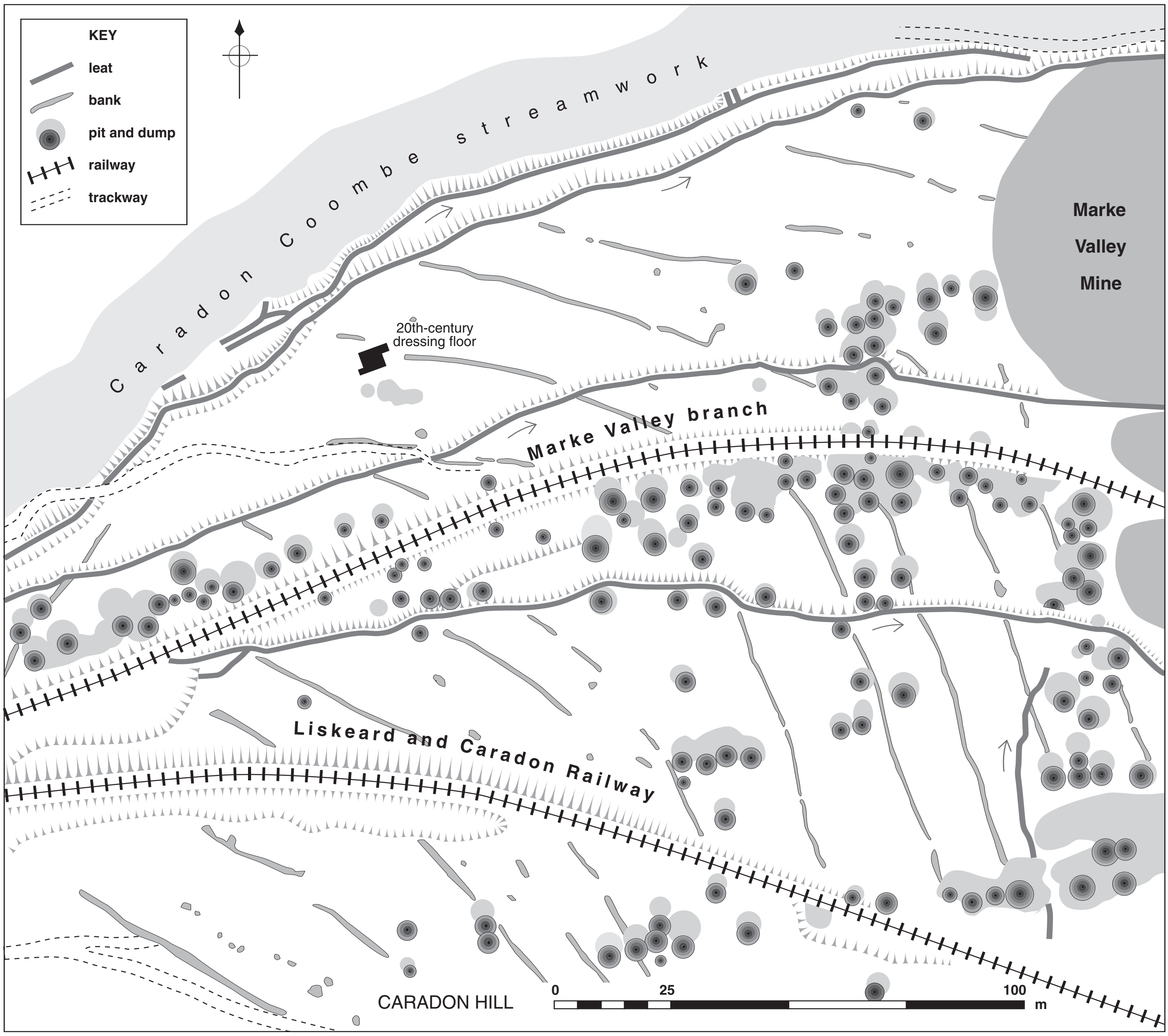


Fig 49 A section of the complex, multi-phase mining landscape on the north-east side of Caradon Hill (SX 275716). Caradon Coombe is known to have been streamed for tin. On the hillslopes above, east–west trending pits and hollows and associated prospecting pits mark the sites of early outcrop workings for tin. The landscape is crossed by leats carrying water to the waterwheels, engine ponds and dressing floors of the mid-19th-century Marke Valley Mine. All of these features are superimposed onto a medieval strip field system, and in turn have been overlain by an unfinished branch of the Liskeard and Caradon Railway to the mine. To the upper left of centre are the remains of a small 20th-century dressing plant intended to rework the slimes and sand deposited in the valley bottom by the long-defunct Wheal Jenkin upstream. (CCC HES, GRH 33/M1/5)

Fig 50 The mining landscape on Rillaton Common to the north of Minions (SX 261715, viewed from the south in 1988). The broad gash of a medieval streamwork cuts across the upper left hand side of the photograph; another has been covered by the gardens of the settlement, though its reservoir can still be seen at lower left. On the common itself the positions of five major lodes are clearly visible where they were worked by outcrop mining techniques. Shelstone's or Trelawney's runs a little south of the main bend in the upper track (formerly part of the LCR). South Phoenix Mine (lower right) was developed on two of these, Greenhill and Grace Dieu lodes, Wheal Prosper (on the edge of the gardens) on a third, the Prosper lode. Phoenix United Mine lay just off to the upper right, exploiting Stowes lode, the northernmost and richest, visible in the distance. (CCC HES, F16/78)

and on a much larger scale than the mines of the previous century, particularly the stopes (extractive areas) on the larger copper mines, some of which were massive in extent. Hauling levels were cut to accommodate small hand-propelled wagons, whilst overhand stoping (mining upwards into the lode) gradually replaced underhand stoping (where work proceeded downwards).

The 2,000–4,000 tons of dressed ore produced annually by each of the principal copper mines of the Minions area during their heyday represented less than 10 per cent of mined rock. Waste handling became a significant factor, and despite some disposal underground in worked-out areas, most was hauled to surface and massive dumps of rocky waste trammed out onto valley-side tips still dominate these sites. Ore production figures for even the largest tin mines were small by comparison, Phoenix United averaging about 400 tons per annum, but with recovery rates averaging little more than 1 to 2 per cent by weight, they also produced very considerable spoil dumps and tailings discharges. At smaller, less mechanised mines, a higher proportion of the ore brought to surface may have been stamped, since spoil dumps, other than those containing the unmineralised rock resulting from shaft sinking, seem to be rare, and it is probable that the majority of the waste was reduced to fine particle size and flushed into watercourses.

Developments during the later 19th century and the 20th century

Though the Caradon copper boom was extremely profitable, it was short-lived, and following a steep decline in prices through the 1860s only the larger copper mines remained at work, those which survived having raised their ouputs to maintain profitability. From 1855 to 1865 the copper price dropped by 23 per cent, by 1885 by 81 per cent of the 1855 figure (Burt *et al*, 1987), levels at which none could continue at work. In the mid-1880s, the closure of South Caradon and the loss of its

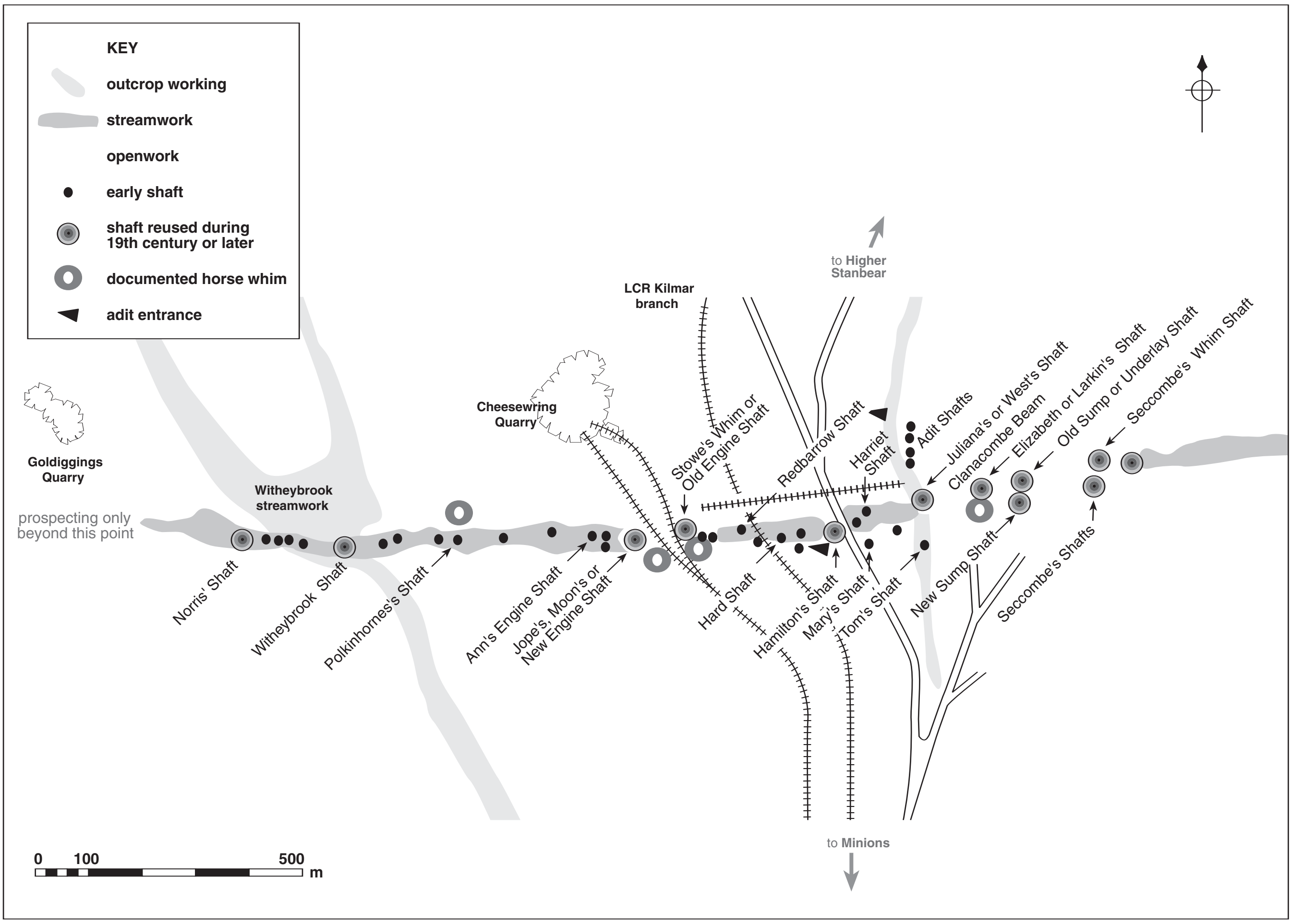


Fig 51 The closely set shafts and horse whims along the outcrop of the Stowe's Lode to the south of the Cheesewring on Rillaton Common (SX 25027220 to 26337218) date from the earliest phases of deep mining in this area, probably during the late 18th century. The shafts were cut through extensive outcrop mining features (including to the east a now-backfilled openwork, Clanacombe Beam). Sections of the lode were subsequently reworked using the first steam engine on Bodmin Moor at Stowes' Mine during the early years of the 19th century and to great effect by Phoenix United Mine during the second half of the century. (After Stanier 1987, fig 3)

pumping capacity doomed the neighbouring, interconnected mines. In a period of less than 50 years, the seven richest mines of the area had produced no less than 650,000 tons of copper ore, South Caradon alone being responsible for nearly a third of this. Only Phoenix United had substantial tin deposits, but by the 1890s the tin price had also fallen steeply and the mine closed in 1898.

Brief rises in metal prices during the early 20th century brought some attempts to rework these mines. The abortive reopening of the Prince of Wales' Shaft at Phoenix United from 1907–14 is probably the best known (Figs 16 and 56). Attempts to rework mines like South Phoenix (Fig 59) also came to nothing although one or two mines like Treveddoe continued to be worked on a small scale. The search for wolfram marked the last attempt to exploit Bodmin Moor's mineral deposits. The Buttern Hill alluvials were reworked at Wheal Rosa (SX 181820) during the late 19th century, whilst Silver Valley (SX 253715), Buttern Hill, Wheal Annie (SX 237793), Cannaframe (SX 205786), Craddock Moor (SX 256200), Hawk's Wood (SX 268755), Gazeland (SX 166698) and Halvana (SX 215786) were briefly retried in the first decades of the following century – only Hawk's Wood producing any appreciable output. During and following the last war, Silver Valley and Buttern Hill were reopened on a small scale, whilst Hawk's Wood was prospected.

Survival of evidence for later mining

The survival of evidence for 19th-century and later mining on the Moor is patchy, though best around Minions, reflecting the former importance of this area, but even in this area subsequent activities have resulted in the disappearance of many important features from the landscape. Disappointingly little remains of the largest mines: almost the whole of Phoenix United (SX 266723) (Figs 52 and 53) was razed to the ground on its closure, few buildings survive at East Caradon (SX 278702), West Caradon (SX 262699) or Marke Valley, whilst at South Caradon (Figs 57 and 58), although some of the engine houses still stand, most mine structures have been reduced to their foundations. Survival is best at

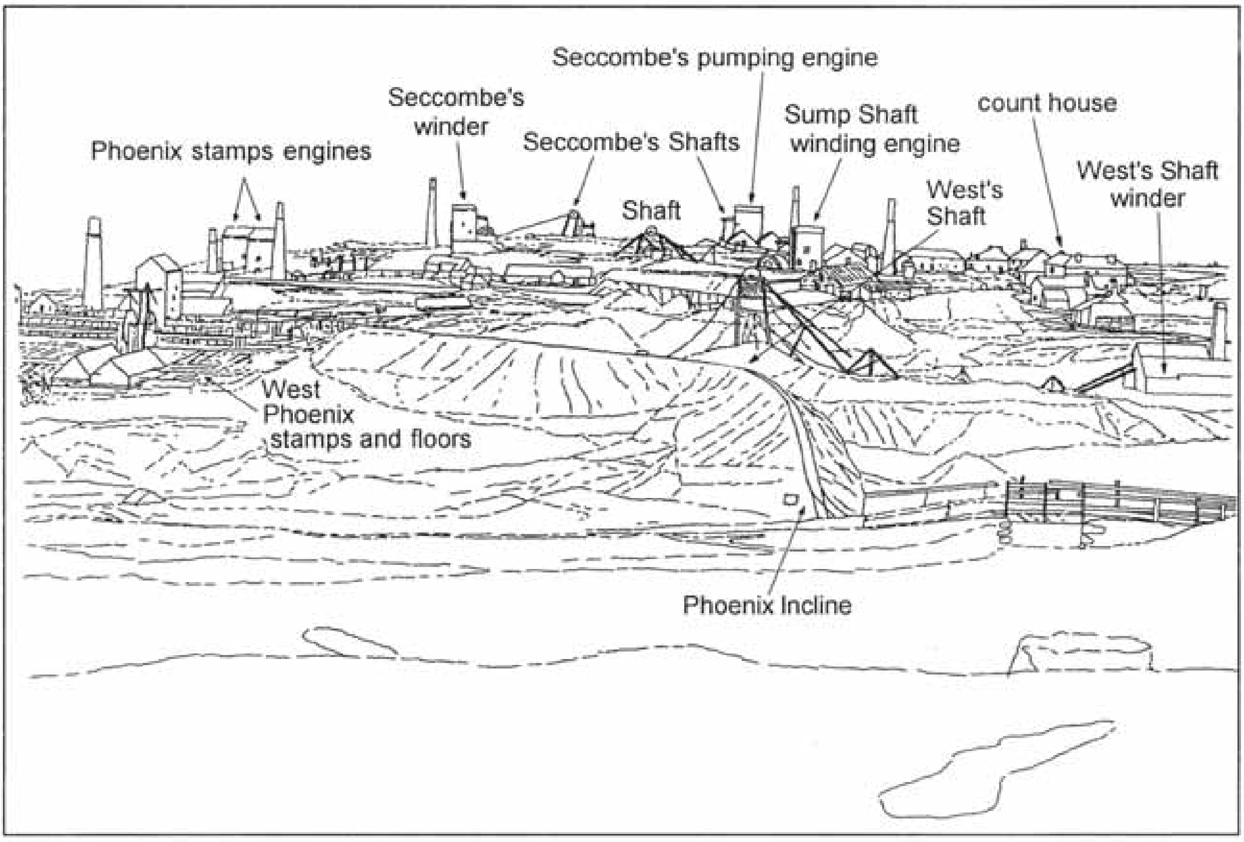


*Fig 52 A view looking east across Phoenix United Mine (SX 266721) at the height of its development, taken from a late 19th-century photograph. As well as production shafts and the their pumping and winding engines, this complex included the mechanised dressing floors of the Phoenix and West Phoenix sections of the mine and (right) the principal service buildings of the mine, clustered around the count house or mine office (*see also *Fig 53). (After Messenger 1978, 47)*

three later tin mines, Wheal Jenkin (SX 265713), South Phoenix (SX 262715; Fig 69) and Prince of Wales (Phoenix) (SX 267720; Figs 16 and 56). In all three cases, the mine layouts remain largely interpretable. Elsewhere on the Moor, Treveddoe, although overgrown, retains a good range of structures, as does Wheal Bray (SX 198823), whilst well-preserved 19th-century dressing floors mark the last workings of the openwork at Hobb's Hill (Fig 4) and the alluvial deposits at Bowithick (SX 181824). Almost all the smaller moorland mines had failed well before the end of the century and nearly a century and a half of abandonment has reduced many of their sites to overgrown earthworks.

Of approximately 100 engine houses built around Minions, some evidence remains for 42, although only 14 of these are still immediately recognisable for what they were. Some, as at Phoenix United, had been demolished by the end of the 19th century, a few, as at West Phoenix (SX 252721), were used for demolition practice during the last war and one – South Phoenix (SX 262714) – was converted into a dwelling (now an interpretation centre). The remainder were robbed for stone in a piecemeal fashion or have simply fallen down.

Engine houses were strongly built to counter the stresses set up by the machinery they contained and have resisted demolition and weathering better than other mine structures, which, apart from wheelpits, balance bob pits and sections of revetment walling tended to be more slightly built. The count houses at West Caradon (SX 278702) and Phoenix United (SX 276721) (Fig 52) are typical of the imposing structures erected by larger mines; those at South Phoenix (SX 262714), Northwood (SX 201696) and Goodaver (SX 205745), now converted to dwellings, were clearly more humble structures, like that at Wheal Tregeagle (SX 17496863), now an animal house (Fig 55). Smaller mines probably simply rented rooms in handy cottages. Some mine smithies and stores on the periphery of the Moor have been adapted as farm buildings (as at Marke Valley Mine, SX 280717) or converted to domestic use (like the dry at South Phoenix). The extensive ranges of store and accommodation buildings described by Worth at Phoenix United have gone without trace, though the foundations of an early 19th-century miners' barracks still survive at Burning House nearby (SX 263 723). Many mine waste dumps have been quarried as sources of cheap hardcore or were reprocessed for residual minerals. Those that survive tend to be small or isolated, almost by definition relating to earlier or unsuccessful operations.

It would be wrong, however, to give the impression that the field evidence for the later history of mining on the Moor is of poor quality. Although many sites of this period apparently consist of little more than ruinous buildings, isolated wheelpits, sections of walling or hard-surfacing, overgrown waste dumps, leats and other

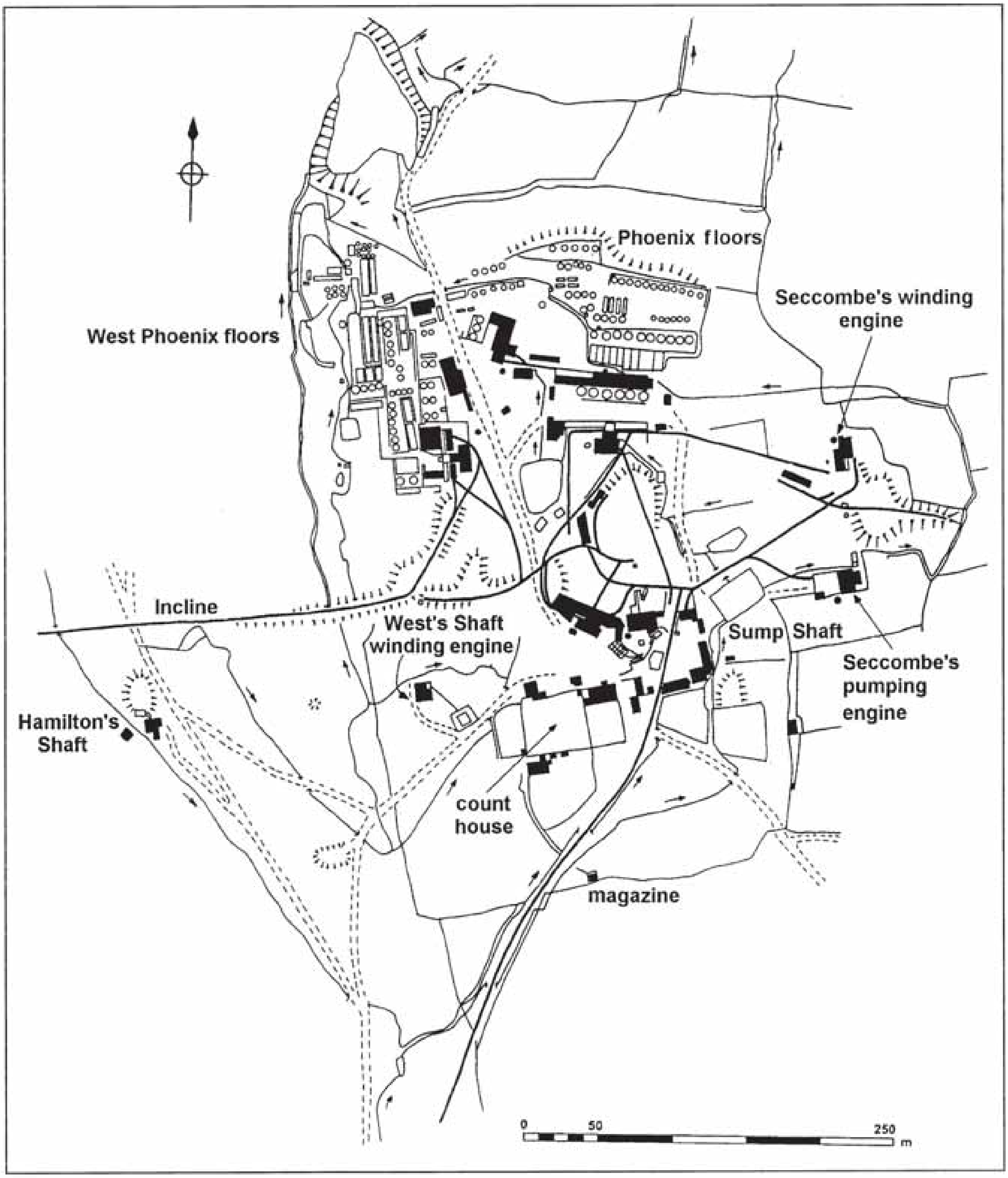


Fig 53 The large number of beam engines and the scale of the mechanised dressing floors associated with the largest of the Bodmin Moor tin mines – Phoenix United – are evident from this illustration based on the 1883 OS 1:2500 map. (From Sharpe 1993)

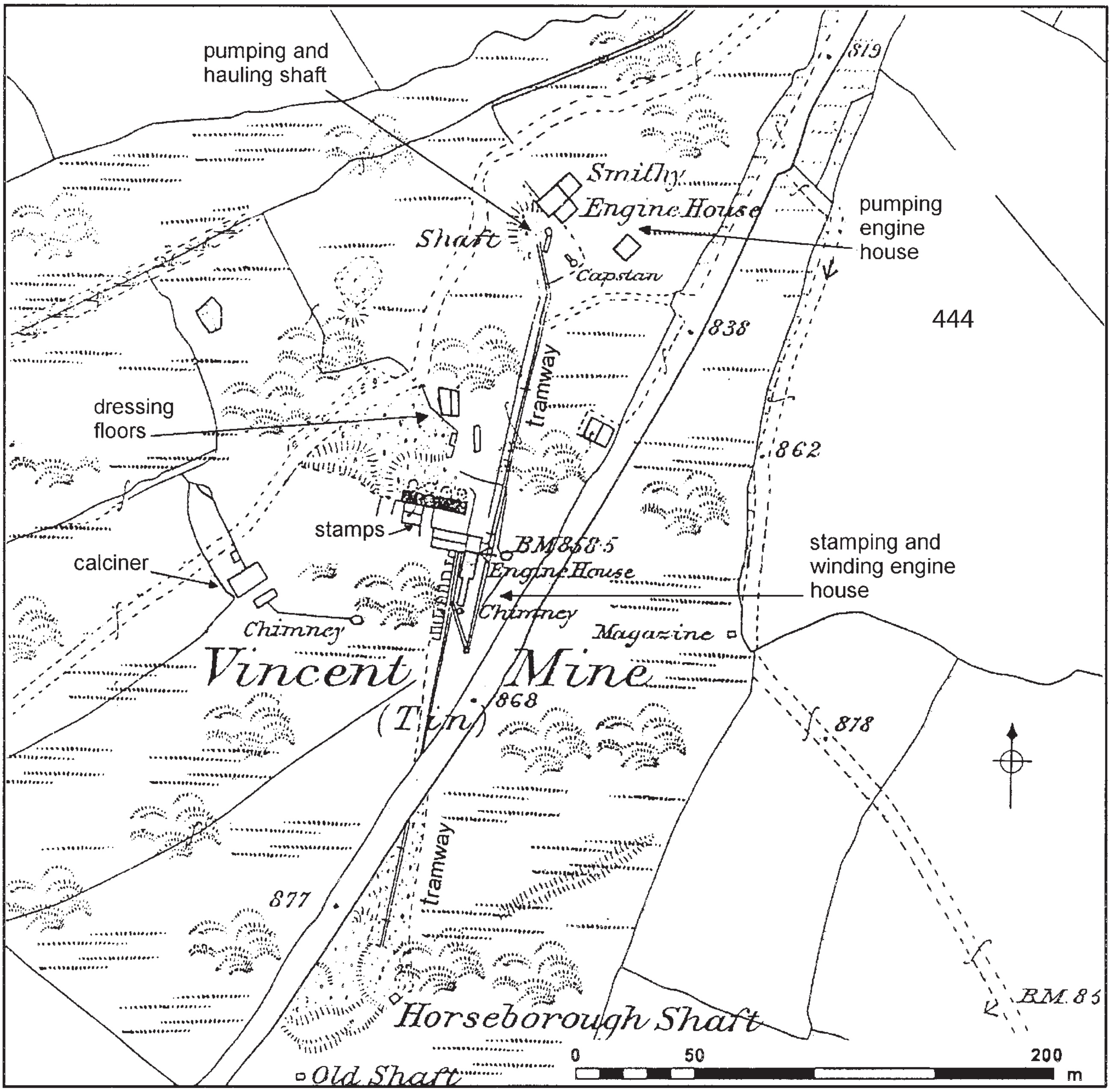


Fig 54 *In comparison to Phoenix United (Figs 52 and 53) or South Caradon Mine (Fig 57), Vincent Mine, near Altarnun (SX 209794), was typical of many of the smaller mechanised mines on the Moor, its two small steam engines pumping, winding, stamping and powering the dressing plant. (From OS 1:2500 map, 1 edn, 1883; sans serif labels added)*

earthworks, experience has shown that detailed field survey is often capable of reconstructing such sites, even where written documentation is sketchy or wholly absent.

9 Ore dressing

Mineral lodes are complex physical and chemical combinations of metallic and non-metallic compounds, most unwanted by miners. Except in the case of well-weathered alluvial tin, dressing was necessary to separate their constituents and concentrate ores sufficiently to render them smeltable. The specific methods used varied between minerals, but were based on five basic principles.

Primary selection and sorting

Primary selection and sorting took place both underground, where poor or difficult ores were left unmined, and in the dressing plant, where visible waste was rejected before further processing.

Size reduction

Size reduction was necessary because most ores occur in intimate physical combination with waste. Ore-bearing material was thus reduced sufficiently to ensure physical separation of most of the ore from the waste, a process initially achieved manually using hammers but over time mechanised using stamps, crushers or grinders to increase throughput. Control over the size of output from this stage was important and was eventually maintained by automatic controls incorporated into the crushing devices. Since separation in subsequent processes worked most efficiently with a feed of consistent grain size, undersize products were separately treated whilst oversized material was re-crushed. The dressing of all but the smallest particles of copper ores was based on crushing followed by manual selection. For tin, the small size to which the ore had to be crushed to achieve the effective separation of ore from waste made this approach impossible.

Differences in density

Differences in density between ore and waste were exploited. Where all material had been reduced to a roughly similar size, fragments of ore were far heavier than those of waste. The feed was mixed with water to form a semi-liquid pulp and passed over devices where careful adjustment of flow rates resulted in heavy ores being deposited and lighter waste being carried away. In practice this could rarely be achieved in a single operation and three products were separated, high purity ore, mixed material and waste, the mixed material being re-treated, often following further size reduction. Fine ore particles suspended in the washing stream were either discarded, or subjected to further processes. The simple tyes and buddles developed by tin streamers were refined to allow the treatment of large quantities of contaminated fine-grained lode material, and a range of devices, many mechanised, were devised to treat different grades and sizes of material: pits, strips and tanks, buddles, vanners and shaking tables, round and rag frames. Jigs, kieves and sieves exploited the tendency of dense ores to settle to the bottom of a mixture of similarly sized material when agitated in water.

Exploitation of other physical or chemical characteristics

For some ores, these processes were sufficient to produce a smeltable concentrate – black tin. Some contaminants might remain, however: those, like wolfram, whose specific gravity was so similar to tin that they could not be separated by density, and those which were chemically bonded to the ore, in particular sulphides of iron and arsenic. The presence of these minerals made the ore difficult to smelt, and black tin contaminated in this fashion is understood to have commanded a far lower price.

Processes involving heat, the exploitation of surface characteristics, susceptibility to magnetism or chemical treatment were developed to achieve final cleaning of

Fig 55 Although some of the larger mines on the Moor possessed impressive offices, the former count house and workshops at Wheal Tregeagle (SX 17496863), like many of the smaller moorland mines, were probably never more than workaday structures, and in this case have been reused as agricultural buildings. (CCC HES, GCS 5818)

the tin. Although wolfram continued to be difficult to remove until the late 19th century, sulphide contamination could be dealt with from an early period '… when we perceive much Mundick in our Tin … we are necessitated to burn away this Weed in (the) kiln … .' (Anon 1670, 2112). Ores were roasted in an oxidising atmosphere to the decrepitation point of the sulphides, when sulphur, arsenic, cadmium, lead and other low-temperature minerals were driven off as vapour. Most iron compounds were rendered semi-soluble and could be removed by washing the roasted residue. During the later part of the 19th century when arsenic became a valuable by-product, it was recovered by condensation in elongated flues attached to the furnaces. In the 20th century, techniques based on the differences between the surface characteristics of minerals replaced calcining, whilst susceptibility to magnetism removed iron and wolfram.

In practice, dressing floors were set up and fine-tuned when in use to provide the most efficient recovery of economically valuable minerals, given available technology, resources, and ore quality. Much depended on the skill of the plant manager, who monitored the dressing process throughout. Complete recovery was neither technologically possible nor economically viable and some ore was always lost. Historically, technological improvements have reduced these losses, particularly in relation to the fine grain material formerly run to waste, and has allowed the treatment of low-grade or contaminated ores.

Copper dressing

Copper ore dressing leaves few archaeological traces. The ores were massive though low-grade. Being brittle they could not be stamped without reduction to such a

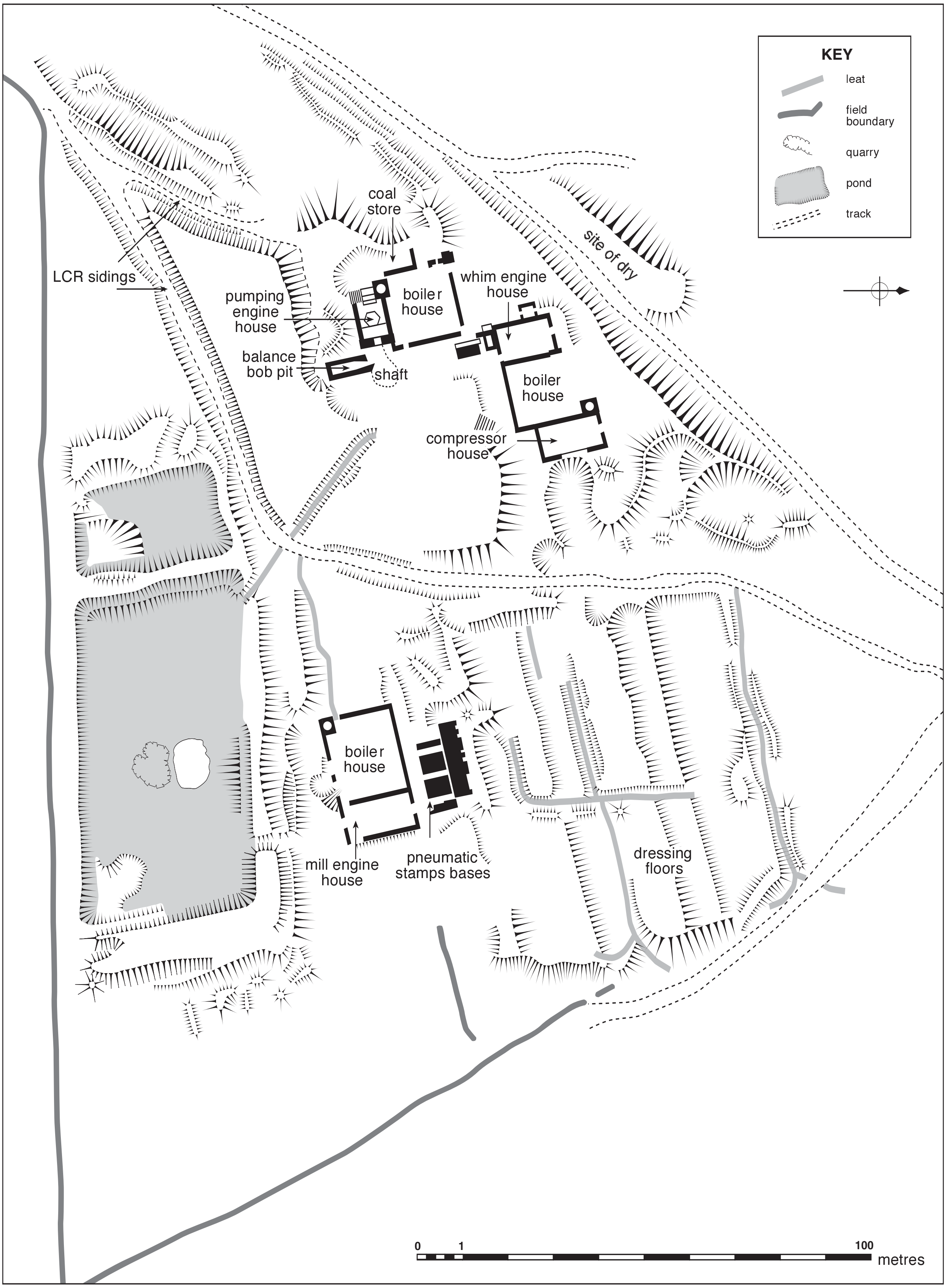


Fig 56 The site surrounding the Prince of Wales' Shaft (SX 26637198) just to the south of the old Phoenix United Mines probably represents the only planned mine complex established during the long history of industrial activity in this area. The pumping engine, winding engine, compressor house and carpenters' shop were clustered around the shaft, with the miners' dry just to the west. To the east, downslope from the engine pond and mill ponds, lay the mill power house, crushing plant and the terraced floors created for the vanners and other dressing plant. Sadly, this venture was destined not to succeed and survey evidence suggests that the mill buildings may never have been completed. (CCC HES, GRH 33/M1/6)

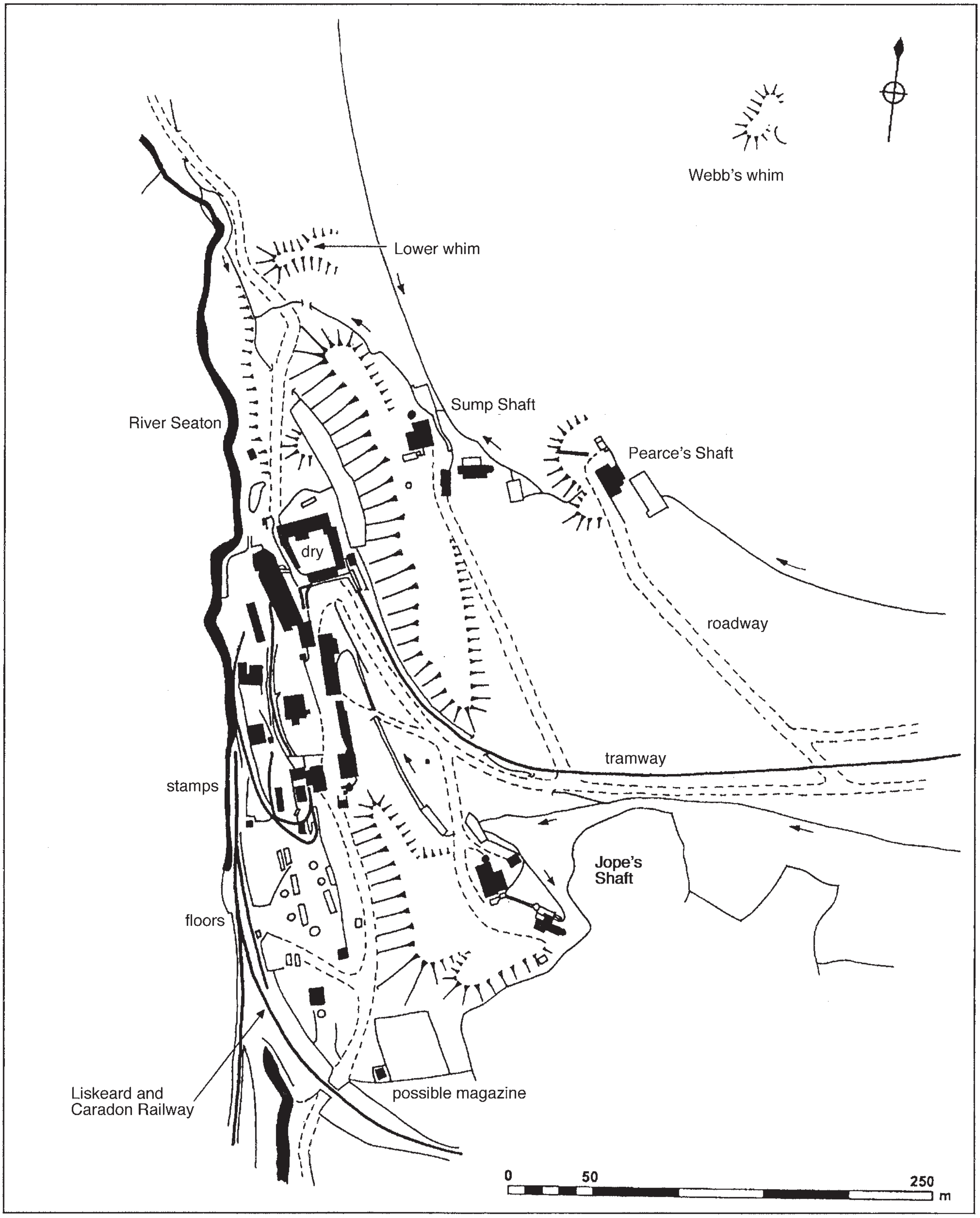


Fig 57 *South Caradon (SX 264699) was the largest and most successful of the copper mines of Bodmin Moor and the key to the development of the Caradon Mining Field and the construction of the Liskeard and Caradon Railway. In contrast to Phoenix United (Figs 52 and 53), dressing operations relied on a vast workforce of manual labourers, many of them women and children. (From Sharpe 1993; based on the 1883 OS 1:2500 map)*

Fig 58 A section of the cobbled floors which are now the only indication of the formerly very extensive copper dressing floors of South Caradon Mine (SX 26436998). Although the massive sheds which once covered large parts of this area have gone, the positions of post pits, doorways, roadways and drains can still be readily discerned. Such slight features are typical of the surviving dressing floor evidence at most former copper mines in Cornwall. (Adam Sharpe)

Fig 59 This postcard view of Wheal Prosper (SX 26077130) shows one of the last working mines on Bodmin Moor during its short period of activity in the early 20th century. (Postcard held by Adam Sharpe)

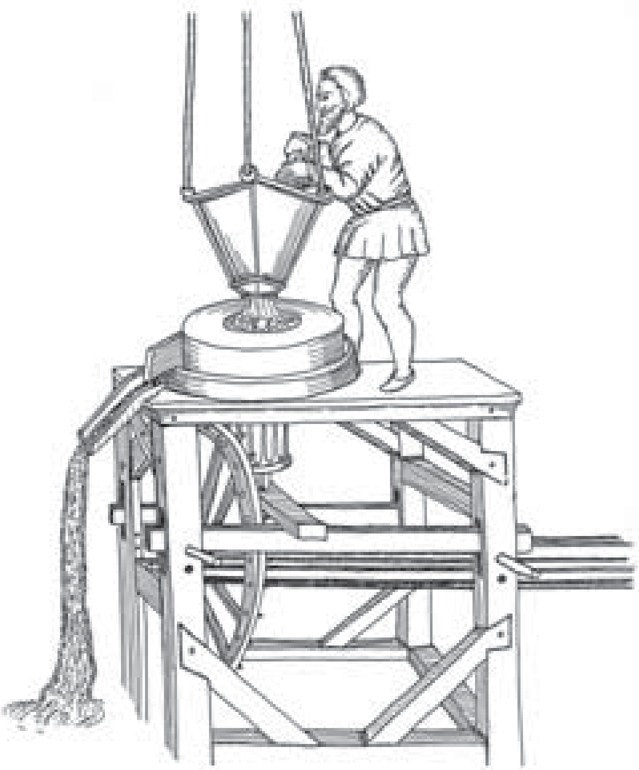
fine particle size that separation became difficult, and thus were broken manually or by using crushing rolls. Being visually distinctive, most were recovered by hand picking during a series of stages of size reduction (spalling, cobbing and bucking) undertaken by a large workforce consisting principally of women, sorting being into three categories: prills (pure ore), drage (mixed ore) and halvans (low-grade ore which had to be stamped). Small grain ore was recovered by jigging, whilst buddles and other density separation methods were used for the finest material. The resulting low grade ore (generally below 10 per cent) was sent direct for smelting. Sulphide contamination was not significant since it promoted an endothermic reaction during preliminary roasting, reducing fuel costs. Given the large labour costs involved in ore dressing, and the cost of transporting high bulk but low value dressed ore to the smelters, there were few successful small copper mines.

The South Caradon dressing floors in the Seaton Valley (SX 264699) were the largest on Bodmin Moor constructed almost exclusively for copper ores. Their extensive layout was mapped by the Ordnance Survey in the late 1870s (Fig 57). A tramway from the production shafts brought ore to a large open-fronted building where manual breaking and sorting took place. To the south beyond a series of large open yards were the combined stamps and crusher plant, again linked to the dressing shed by a tramway, whilst to the south again was a cluster of tanks and buddles where the finest material was separated. The whole site measured 300m in length; averaging 55m in width, it covered an area of 16,500sqm and was the workplace of over 100 mine staff.

Hardly any trace of the dressing floors remains, the buildings having been almost completely demolished and all the equipment removed. Some idea of their scale can still be gained from the vast expanse of cobbling which extends across the valley floor in the northern part of the site (Fig 58); sockets for timber uprights and the channels which carried washing water survive, whilst nearby is the pit for the 20ft (6.75m) wheel which drove the stone breaker. Comparable arrangements of sheds and yards were mapped by the Ordnance Survey in 1878 at Glasgow Caradon Consols (SX 282703), West and East Caradon (SX 262700 and SX 277703) and at Marke Valley (SX 277717). At Phoenix United, the copper dressing floors had already been replaced by those for tin, but would have been of similar character. By this period almost all the other moorland copper mines had been abandoned for less than a decade, yet there was virtually nothing left to map of the sheds and yards which had been the workplaces of many hundreds of men, women and children.

Tin dressing

In contrast, the density-separation methods underlying all but the most primitive forms of tin dressing made for relatively small workforces tending semi-automated plant from an early date. The very earliest tin streamers probably hand-selected virtually pure cassiterite for



smelting. Ore grains smaller than coarse gravel would have been unrecoverable and proportional losses must have been very high. Even as late as the early 18th century, the richest ore was still hand picked for sale to the smelters without any further dressing. Most ore, however, was physically contaminated by other materials. Primitive hand mortars found elsewhere in Cornwall and documented on Bodmin Moor near Trebartha, SX 255776 (Latham 1971, 137) must have been used for ore crushing preliminary to hand picking, but it was not until the application of density-based separation in water, a technique with a long pedigree in gold mining, that any but the simplest ores could be treated.

The development of true mining around the late 14th century required tin dressers to develop far more

Fig 60 *(Left) Until the advent of wet stamping, crazing mills were often used to assist in ore reduction. Their technology differed little from contemporary grist mills, and in some cases only the presence of excessive scoring on what would otherwise seem to be small millstones indicates their industrial use. Hand-operated rotary querns were probably used for small-scale processing well into the medieval period. (After Agricola)*

Fig 61 *For many centuries, manually operated buddles and settling pits were the mainstay of the density separation equipment available to tinners. This technology has a long pedigree – variants almost certainly being used during late prehistory for gold separation, and adapted as the 'tyes' documented in streamworks for the collection of fine tin from the waste stream. The process was small-scale and labour intensive until its mechanisation during the 19th century, though even then the underlying process remained essentially unchanged. (© Clive Carter)*

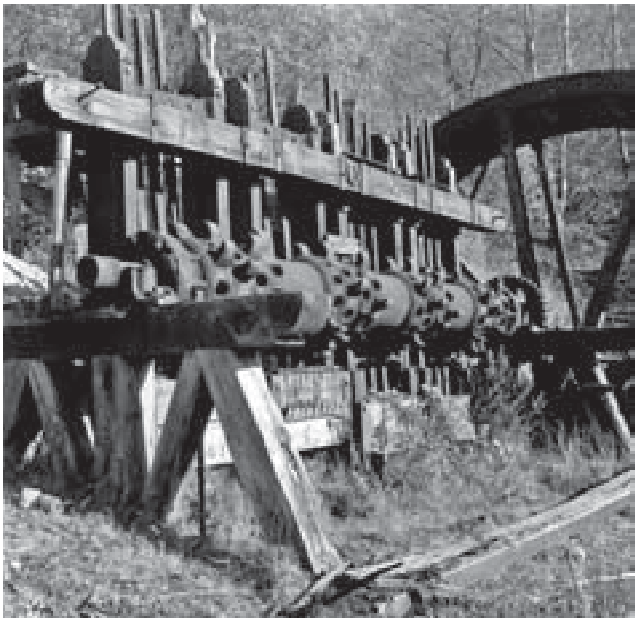


Fig 62 These 16 heads of tin stamps at Treveddoe, photographed in 1957, were typical of 19th-century versions of the equipment which had been used to undertake primary ore reduction on the mines of the Moor since the 16th century. Almost all were water-powered, only a limited number of large, late mines being able to afford steam engines to drive their crushing plant. Notice the horseshoe nailed to the top rail for good luck. (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Charles Woolf [57/125/52] © RIC 2008)

efficient means of separating ore from rock. Size reduction was probably the first process to be mechanised, hand mortars giving way to grinding in rotary querns (Fig 60), a technique which survived in the form of crazing at sites like the '… tin mill called the crazing mill, formerly a corn mill …' at 'Oddicrofte' (Addicroft, SX 300728, in Linkinhorne parish) in 1610. If mechanised crushing produced an efficient physical separation of ore and waste, it also

Fig 63 This granite mortar stone with its four wear hollows found at Millpool, Cardinham (SX 12297070), is typical of the surviving evidence for most stamping mills. (Adam Sharpe)

reduced the material to a size – coarse sand or smaller – which required far more sophistication during the washing or dressing process if losses were not to be unacceptably high. The crushed product was fed into a stream of water passing across a gently sloping board which incorporated a surface of selected turves to trap the heavier minerals (Fig 61). Further concentration was achieved using a second wash (Carew 1602). Although this method ensured the recovery of some of the smaller ore, losses were probably still high.

The earliest stamps machinery, probably introduced during the early 14th century, operated on batches of dry material on open mortar blocks, and was slow and inefficient, requiring fine judgement as to the extent of crushing (Gerrard 1987). The crushed ore was then passed to buddles and racks for differential settling. Wet stamps, in which water was mixed with the ore feed, were a significant 16th-century development (*ibid*). A grating incorporated into the front of the coffer box retained the material being stamped until it was small enough to pass on to the next process. Stamps continued to be used for size reduction well into the 20th century for all but the delicate copper ores and could be free-standing or incorporated into masonry-built stamping mills, under whose roofs other stages in the dressing process might also take place (Figs 62, 63 and 64).

The first detailed account of tin dressing dates from 1778 (Pryce), and describes methods used to treat lode-derived cassiterite. As in modern dressing, each process produced concentrate and reject fractions, together with mixed material for re-treatment. Gerrard suggests that medieval tin dressers sorted the ore into crop tin (the purest) and tails for separate dressing, and the practice of separating richer ore persisted into the 18th century, when it was hand picked from the ore pile. The remainder was hand reduced with sledge hammers (spalling) and fed to the stamps, after which the pulp was run into elongated pits where it settled according to density along their lengths, the heavier material being deposited nearer the inlet points. The material was then de-watered and separated into two fractions. The heads (heavier material) were buddled, then concentrated in kieves (barrels in which the pulp was agitated then allowed to settle). The tails (the lighter material from the primary settling pits) were mixed with leavings from the other processes and treated in trunks (a variety of buddles) and elongated settling pits and then on inclined slimes frames. The resulting concentrates were mixed, roasted to remove sulphides, then rebuddled and, if warranted, further concentrated by sieving, rebuddling or jigging before being dried and bagged.

Throughput was constrained by the volume and head of water available to run the stamps' waterwheels, and by the reliance on manpower to move material from one process to the next – tolerable on a small mine, but with serious implications for larger undertakings. The proportion of tin recovered remained dependent on the skill of the master dresser in judging which fractions to retain and which to re-treat at each stage.

The 19th century saw far greater application of mechanical power to dressing, and the automation of

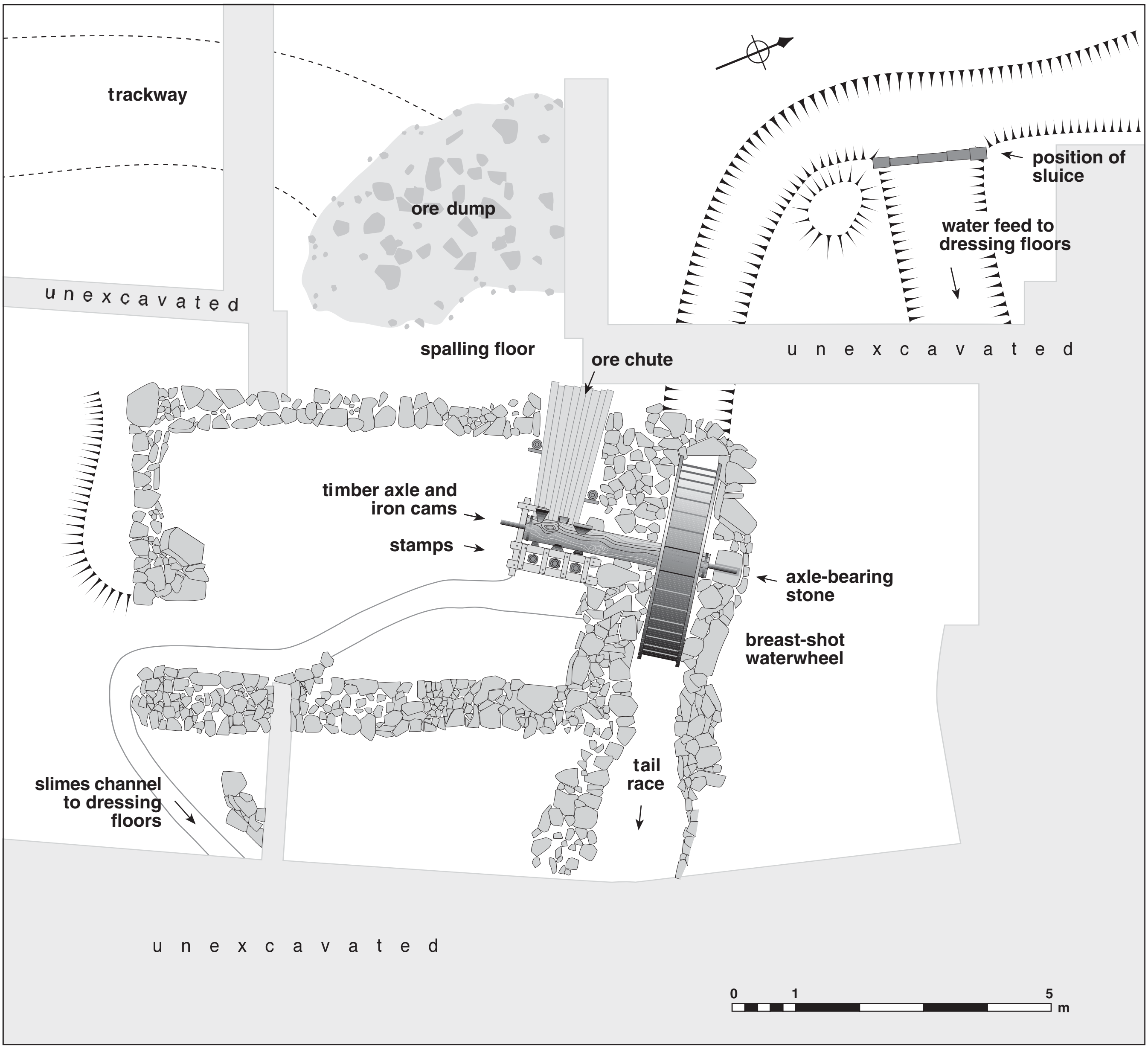


Fig 64 *The excavated stamping mill at Colliford (SX 17887106) during one phase of its long and complex history (after Gerrard 1983). This site underwent a number of changes in its arrangement and operation, probably the most significant being the conversion from dry to wet stamping. The building is typical of known examples of this type, being a simple but strongly constructed rectangular roofed structure with an adjacent waterwheel pit. The waterwheel, ore chute and stamps have been reconstructed to show their position and arrangement. Ore was prepared on the terrace above the mill, hand-fed via the chute to the stamps, where it was crushed to a pulp which could be washed to buddles and other settling features. (Drawing © Rosemary Robertson, after Austin* et al *1989, fig 3.23, and esp 3.37)*

individual processes. Stamps driven by massive waterwheels (Fig 62) or by steam engines allowed far greater throughput of material, whilst terraced dressing floors allowed material to be moved from stage to stage as a water-borne pulp. Buddles undertook the bulk of separation processes (Fig 65), though were being superseded by the early years of the 20th century by vanners and shaking tables. Classifiers (which separated material by size) and large-scale tailings treatment plant all helped to improve recovery rates, allowing the mining of large reserves of poor grade material and improving recovery from the slimes which had previously run to waste. Calcination of tin ore in burning houses is documented from the 16th century, but towards the end of the 19th century the arsenic driven off during this process became a valuable product in its own right. Most of the Bodmin Moor mines had closed by this time, however, and only Mary Consols (SX 187674) and Lemarne (SX 256777) are recorded as producing any appreciable quantities of arsenic. Many mines continued to erect 'burning houses' to remove sulphides from the dressed tin (Fig 66).

The development of shaking tables and other modern dressing plant came too late for all but a handful of Bodmin Moor mines. The rapid decline of mining on the Moor at the end of the 19th century had

Fig 65 The development of the round buddle during the 19th century allowed the mechanisation of some dressing processes. These examples, at Hardhead, Cardinham (SX 14697151; see *also Fig 6), were associated with a small-scale late reworking of the lodes under the hillslopes to the east. (Adam Sharpe)*

not encouraged investment in equipment, and where new plants were established in the early decades of the 20th century, they were generally small-scale and old-fashioned – the only notable differences being in the use of concrete as a construction medium, the installation of water-turbines or gas engines for power and the use of crushing plant instead of stamps. The only large-scale new dressing floors on Bodmin Moor were built for the Prince of Wales' Shaft reworking of Phoenix United Mines.

Other dressing facilities

As well as dressing floors on mines, other facilities had existed on the Moor. Small floors established by independent tributers to dress ore for mines too small to warrant their own plant or to rework mine dumps probably existed from the late medieval period onwards and were documented throughout Cornwall into the 20th century. Most were water-powered and consisted of little more than a small set of stamps feeding one or two buddles. Most sites were probably small-scale and temporary, and have left few traces. One such site, on the north side of Caradon Hill (SX 277717), was established in the 1970s to re-treat tailings. Constructed mostly from scrap, it consisted of little more than a rotating screen feeding a self-powered buddle (Sharpe 1989a, 198–200).

Material with a small particle size had always been problematic to dress. Evidence for the reworking of tin streamworks suggests that initial recovery rates were relatively low, whilst crushing lode-derived ore inevitably produced large volumes of tin-bearing sands and silts. While high grade lodes were being worked, mines could be viable even when high proportions of fines were lost with the tailings. Where dressing floors were large (as at Phoenix United) or several discharged their tailings into watercourses, the amounts of tin being carried could be substantial enough to support specialised plants reworking the material carried by the streams. The majority of these tailings works were constructed along the Red River north of Camborne and the Carnon Stream above Devoran, but the tailings stream flowing from Phoenix Mine was tin-rich enough to support three extensive works downstream.

The floors stretched for well over a kilometre (*see* Fig 67), the upper works (SX 267727) probably being operated by Phoenix Mine, the central area being the Darley works (SX 269728), the lower section (SX 273730) the Oakbottom works. Each site was worked in a similar fashion: large quantities of silt-laden water were diverted into holding ponds and elongated settling tanks where the material in suspension was settled out. Once a tank had filled and the majority of the water had been drawn off, the contents were passed to further tanks, again being settled according to density. Tin-rich muds and sands were then concentrated in smaller tanks, on slimes frames,

Fig 66 The reverberatory arsenic calciner at Hardhead Mine (SX 14707149; see *also Fig 6) is of an unusual pattern and a rare example of this site type on the Moor. The term 'hardhead' was given to tin which had been made brittle because of impurities in the ore – often arsenic – and may explain why such a structure was required on these dressing floors. (Adam Sharpe)*

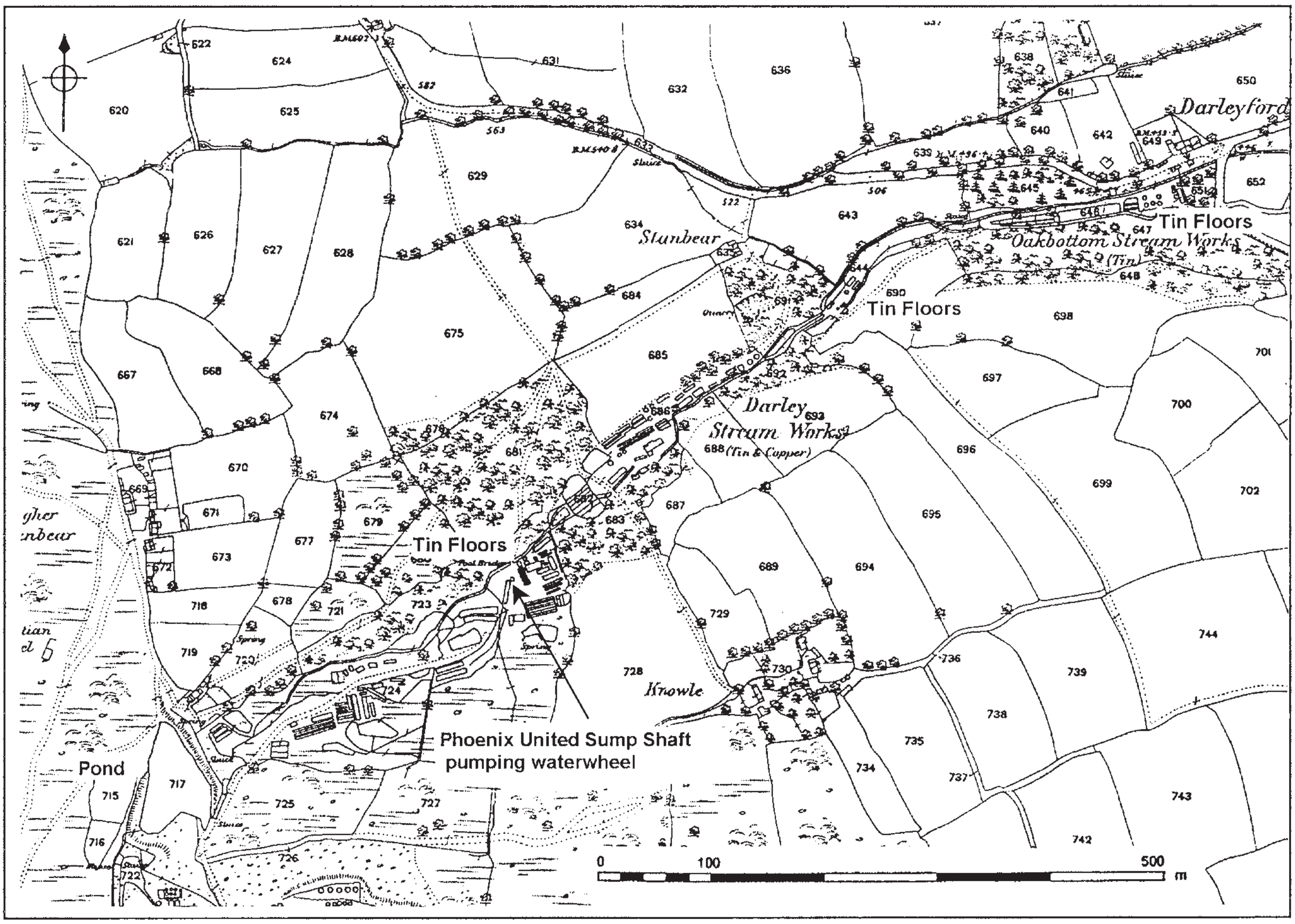


Fig 67 Even on the largest and most efficient 19th-century mines, recovery rates for fine particle tin ore were relatively poor, and provided a good living for the operators of tailings recovery plants downstream. Although most Cornish examples were sited in the Red River near Camborne, the quantities of fine ore carried by the Phoenix tailing stream evidently encouraged the construction of this very extensive system of ponds, tanks and leats in the valley downstream. Similar, but smaller-scale plants operated in Caradon Coombe to exploit the Wheal Jenkin tailings. (From 1883 OS 1:2500 map, 1 edn; sans serif labels added)

buddles and round frames, the remainder of the material being returned to the river. At the downstream end of the site the resulting concentrate was dried and packed for shipment. The volume of the primary settling tanks determined the maximum amount of silty water which could be treated at any one time, and the remainder flowed on, to be tapped further downstream, or allowed to run to waste.

Similar but much smaller sites bordered Caradon Coombe, reworking the tailings from Wheal Jenkin, Cornwall Great United Mines, the floors at Mutton Corner (SX 268714) and those associated with Dunsley Wheal Phoenix (SX 272716), each comprising a couple of settling tanks feeding a few buddles. Evidence for small sets of water-powered stamps suggests that some may have supplemented tailings from the river with dump material.

The locations of dressing floors

Large quantities of water were needed to power waterwheels and for the various washing processes, whether for tin or copper, many hundreds of litres being required for the dressing of a single kilogram of concentrate. Valley bottoms were favoured sites, floors being served by simple leats and header ponds tapped directly from the river. The development of floors employing gravity flow between processes favoured hillslope sites, where water might have to be supplied by extensive leats. Such dressing floors might be some distance from the mines they served, particularly where the terrain near the hauling shafts was unsuitable.

The introduction of steam to power pumps, stamps and other machinery allowed miners to lay out floors distant from natural watercourses if adequate supplies of water could be pumped from the mine into holding ponds. Where water supplies were short or unreliable, dipper wheels were installed to recycle water back through the plant (as at Wheal Jenkin, SX 265713). In almost all cases, dressing-water leats were carefully laid out to minimise falls, and the water leaving one plant was routed to others downslope before being returned to the river.

Whilst the sites of 19th-century dressing floors can usually be located from early editions of the Ordnance Survey 1:2500 maps and have often survived in the

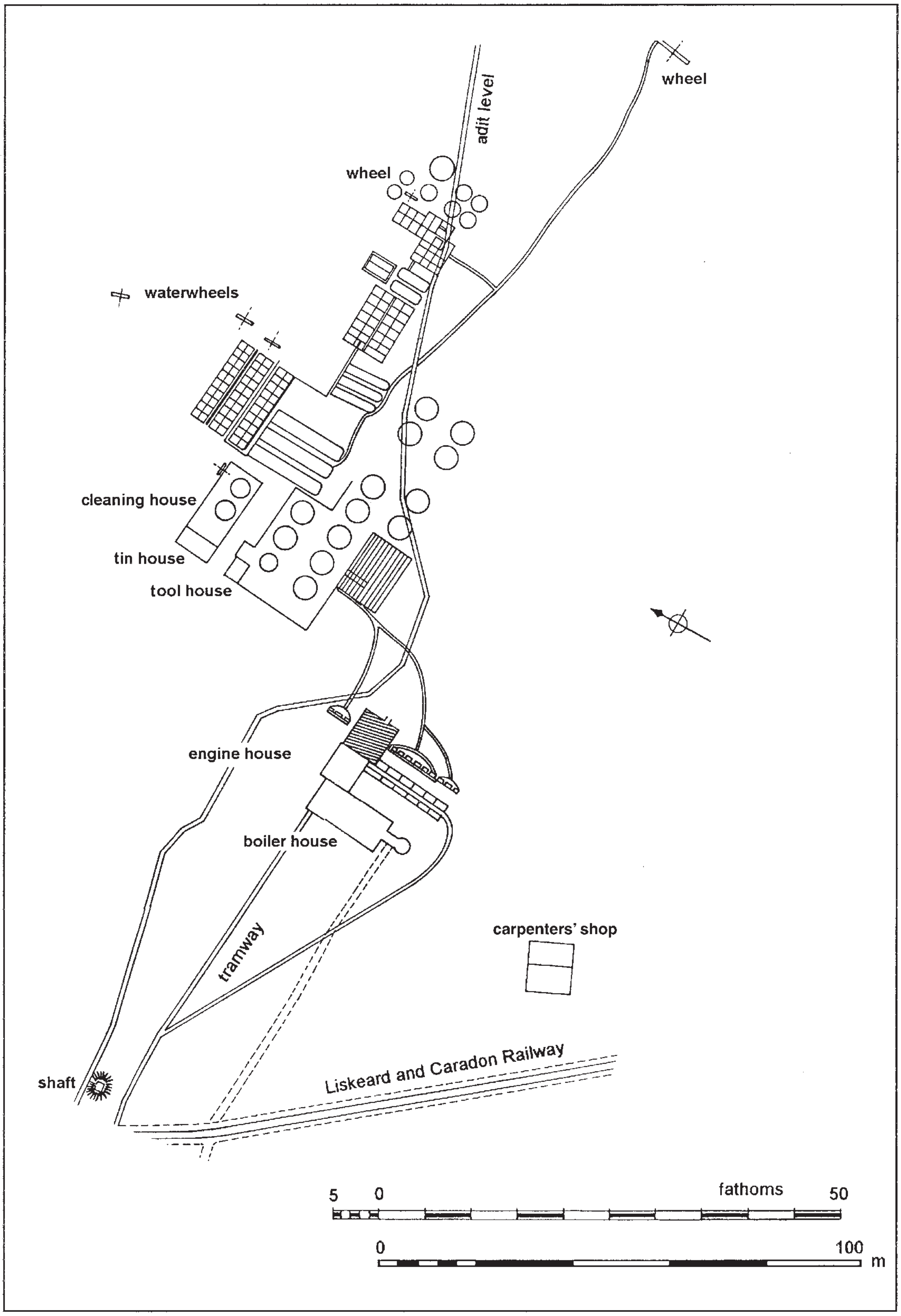


Fig 68 *This tracing of an archive plan of Wheal Jenkin Mine (SX 266712) gives some idea of the layout of a typical late 19th-century tin mine's dressing floor. Stamps, buddles and settling tanks formed the basis of the plant, as they had done for centuries; at Wheal Jenkin the only difference was of scale, and the degree to which much of this plant had been mechanised. (After CRO, M4/10a/5)*

field, no more than a handful of sites were found which could be associated by location, documentation or apparent technology with earlier mining or streaming activity. It is evident from the large number of extractive sites mapped during fieldwork that these few dressing floors can represent only a very small proportion of those constructed. It is likely that these early dressing floors were small-scale and of ephemeral construction. Abandoned for many centuries, their sites are now likely to have become little more than areas of slight terracing associated with silted leats, and will be located only through detailed survey.

Early dressing floors

Gerrard's surveys of the area now flooded by Colliford Reservoir identified some apparently early sites. The only conclusive evidence for early dressing practices was recovered from Colliford Mill: a site which had developed over a period of perhaps three centuries, during which it had been converted from dry stamping to wet stamping and had been abandoned for so long on one occasion that it needed extensive rebuilding (Fig 64 and *see* Gerrard 1983; Austin *et al* 1989). Such patterns of use and abandonment probably indicate a fairly typically intermittent reworking of tin deposits, probably related to variations in price, and tinners may have preferred to refurbish existing dressing facilities rather than to create new ones from scratch.

Herring identified an additional site from earthwork remains at Treveddoe (SX 15086976), where the presence of a trapezoidal buddle and shallow rectangular tanks adjacent to a wheelpit on a small platformed area suggest a date no later than the 18th century, whilst Gerrard noted one to the west of Brown Willy (SX 15037890) where a small dressing floor is overlain by an apparently medieval boundary feature. The first site was almost certainly associated with an early phase of operations on nearby outcrop workings, the second probably served one of the nearby streamworks. The 17th-century blowing house at Coombe (SX 122706) had a set of stamps (Fig 63), but these may have been used for re-treating slags, as opposed to ore dressing.

Further detailed survey is clearly required. Given that these early sites would be sited near watercourses, a careful search for discrete areas of terracing, particularly those associated with leat channels on the lower slopes of stream and river valleys should result in the discovery of many more examples. Lacking an adequate population of such sites, few meaningful comments can be made concerning their distribution, except that they are likely to have been close to extraction sites and probably consisted of small sets of water-powered stamps feeding one or two settling pits and buddles, the concentrate being finished in granite-built burning houses, probably sited off-Moor and adjoining blowing houses.

Later dressing floors

Eighteenth and early 19th-century tin mines on Bodmin Moor seem to have been small-scale and are likely to have used water-powered dressing floors little different from their predecessors. With the development of deep mining, these existing facilities would have been incapable of handling any greatly increased throughput, and whilst some were probably redeveloped and enlarged (as perhaps at Dunsley Phoenix, SX 272717), entirely new floors were constructed for most of the new deep mines. Some idea of the scale of operations can be gauged from the 1883 Ordnance Survey plan of the combined Phoenix and West Phoenix floors and a description from the same date.

> 'From the shafts, the skips … are run direct to a Blake's stone-breaker which reduces the stuff for the stamps immediately below. Of these there are 96 heads on the Phoenix side … driven by a double 26" engine … something like 100 tons of stuff has to be stamped a day. The stamped stuff is treated in the usual way, with buddles and frames. Of buddles, there are on this side 75, the great majority convex, and of frames 24. There are a couple of burning houses of the ordinary type, and the water flowing thence is made to pass through a series of strips filled with scrap iron for the precipitation of the copper in solution which the calcination releases. The craze is taken from the burning houses to the pulverisers (of which there are three capable of treating 10 to 12 tons a day), and after, it is brought down, buddled and frames, and tossed and packed in the usual manner … .The arrangement of the dressing floor at West Phoenix differs in no essential degree from those at Phoenix. There is, however, a very much larger proportion of frames – 180 double frames to 45 buddles. The floors are all admirably laid out for the treatment of the stuff with the minimum of handling, and a shammel wheel is now being put in to lift back the slimes for re-dressing, and so to do away with the labor and cost of wheeling back in barrows' (Worth 1880) (locations shown in Figs 52 and 53).

Unfortunately, salvage of materials from this site after its closure has reduced most of these structures to barely recognisable overgrown low ruins and only at Wheal Jenkin and South Phoenix can the layouts of medium-sized late 19th-century tin dressing floors be appreciated in the field. An archive plan of Wheal Jenkin (CRO 2534, Fig 68) indicates the physical layout of the stages in the process. The ore was brought to steam-powered stamps on tramways from the production shaft. After stamping it was carried as a pulp to settling strips in stone-lined channels, from which it was passed to an extensive buddle floor. No calciner can be identified on this survey, the tin being finished in an enclosed yard and stored in a tin house. Fine material was treated in additional settling tanks, then passed to over 100 slimes frames on terraces on the valley sides. South Phoenix followed much the same plan (Fig 69), though in this case a calciner or 'burning house' was constructed. Most of these features were constructed of mortared granite rubble, skinned with a cement render, as was common during this period.

Fig 69 The reservoir, terraces, buddles, settling tanks and other features associated with the dressing floors of the late 19th-century South Phoenix Mine (SX 261715) can be seen from this view to have been established in the strip of unworked ground between the heavily disturbed outcrop workings of Grace Dieu and Greenhill lodes. The pumping engine house still stands, together with the miners' dry (now a cottage), but the combined stamping/winding engine (which stood on the triangular plot just downslope from the reservoir) has been completely demolished. Two branches of the Liskeard and Caradon Railway, with their cross-connections, occupy much of the ground in the lower half of the view. The 'gridiron' building foundation at lower left was associated with the early 20th-century reworking of Wheal Prosper, at one time part of South Phoenix. (CCC HES, F33/208)

The early 20th-century outputs from the moorland mines were a pale shadow of their mid-19th-century counterparts, in most cases so reduced that the expense of purchasing, erecting and running large steam-powered plant would not have been economic. Improved dressing technologies allowed miners to construct compact dressing mills, and in the Caradon area, material hauled from the Prince of Wales' Shaft was dressed using pneumatic stamps feeding vanners (or shaking tables) and buddles, the power source being a horizontal steam engine (Fig 56). A site plan in the Cornwall Records Office (CRO, TL54) shows no provision for treating arsenic.

Several small-scale tin-dressing floors were built during a phase of reworking in the early 20th century, portable steam plant, water turbines and gas oil engines providing the motive power in most cases. Examples of these small-scale terraced floors, most of them originally roofed, were constructed at Hobb's Hill (SX 186694; Fig 4), Halvana (SX 211789), Bowithick Marsh (SX 180824) and Hawk's Wood (SX 270755). The atypical site at New Phoenix (SX 253781), where a beam stamping engine was installed, probably treated alluvial and shallow lode material, whilst the late 19th- or early 20th-century floors at Hardhead (SX 418713) may have reworked streamwork dumps (Figs 6 and 65).

Smelting

Tin was the only metal whose ores were ever smelted on or adjacent to Bodmin Moor. Copper required very large quantities of fuel to achieve its reduction to metal, and although an important smelting house was worked at Hayle between 1758 and 1819, almost all copper ores were transported out of the county for smelting – most going to works near the South Welsh coalfields. The collection of impure arsenic 'soot' from

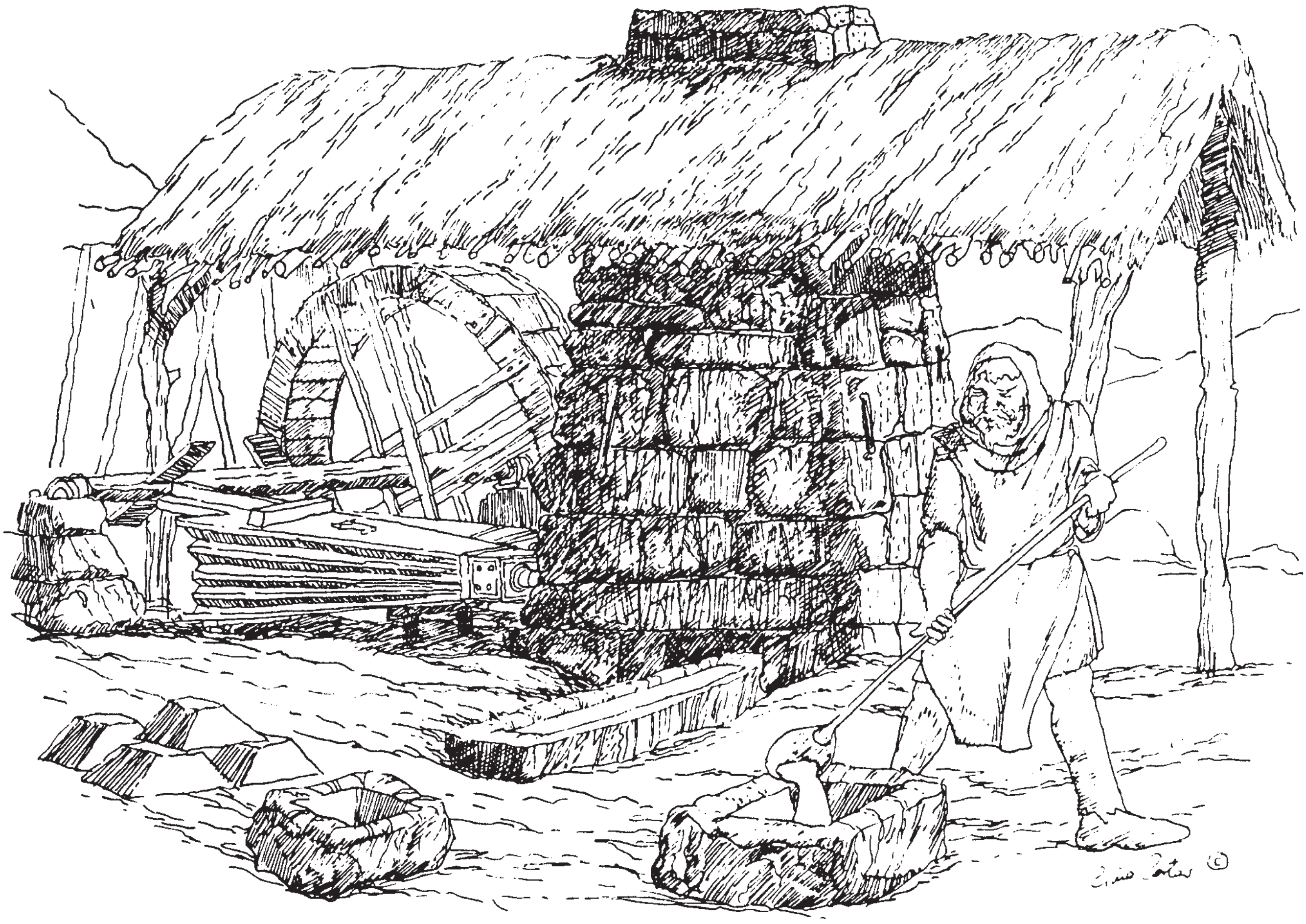


Fig 70 This reconstruction of a small blowing house gives some idea of the appearance of most of these buildings. The furnace, strongly built of massive granite blocks, rarely survives, for given the mobility of the molten metal, it usually proved worthwhile for the ground beneath the hearth to be excavated to recover tin which had made its way through cracks in the clay lining. Often only the wheelpit, granite mould stones (often built into nearby hedges), and overgrown dumps of the black, glassy slag which was a byproduct of smelting operations survive. (© Clive Carter)

calcining plant is recorded from a few late moorland mines: it was probably sent to refineries near Callington and Gunnislake in the Tamar Valley. Other metals were sold in the form of ore concentrates.

In prehistory, and through the early medieval period, dressed tin ore was probably smelted in small, single-use clay-lined bowl furnaces whose superstructures would have been demolished to recover the ingots, leaving little archaeological trace other than fragments of their baked clay linings. No examples have been located in Cornwall.

By the late medieval period, all black tin was converted to white tin (smelted) in blowing houses – being smelted using a reduction process with charcoal to liberate the tin metal from its oxide. These furnaces, generally constructed within roofed buildings, were constructed of massive granite slabs and were force-draughted using waterwheel-operated bellows (Fig 70). Kilns were charged with alternate layers of charcoal and ore (up to 300lb for an efficient furnace), sometimes mixed with crushed quartz as a flux. The black tin had usually been re-buddled so that different grades could be smelted separately at the most appropriate temperatures. The furnace temperature was gradually raised to about 1,100°C, a reducing atmosphere being maintained by adding charcoal. As the tin melted over the course of about twelve hours (a 'tide'), it formed into small droplets which gradually coalesced, percolated through the charge and collected on a channel-section stone, a 'float stone', set across the base of the furnace and projecting from its mouth, from which it was ladled into large rectangular cut stone moulds. Once the ingot had cooled, the mould would be tipped over to release the heavy block, which, after coinage, was sold to tin merchants who refined it and ran it into smaller bars or ingots more suitable for manufacturers.

All fuel and labour costs were met by the tinners, but the blower retained ownership of the 'ashes' remaining in the hearth – material which sometimes contained appreciable amounts of tin in the form of prills (blobs) within the viscous slag. This was usually stamped and re-smelted. Fine tin dust blown away from the charge by the draught became trapped in the thatch of the blowing house and was periodically recovered by burning the roofing materials; the flues in later furnaces incorporated dust collectors. Molten tin is very mobile, and often percolated through hearth bases. It was therefore traditional to excavate beneath furnaces on their abandonment, inevitably resulting in their destruction.

The operation of blowing houses required good supplies of fuel – about two tons of high quality charcoal to every ton of finished tin – and abundant supplies of running water, neither of which was readily available on the Moor itself. As a result, all the known Bodmin Moor blowing houses were built in river valleys around its periphery. Gerrard estimated that there would have been about 120 blowing houses in Cornwall during the post-medieval period, but only a few such sites have been located, mostly through documentary references. The remainder must have been lost through long abandonment, deliberate demolition of the furnaces, or conversion to other uses, perhaps as grist mills. Sixteen blowing house sites located from documentary references around Bodmin Moor (mostly near its southern edge) were visited, but field remains were found at only three: St Neot (SX 184678), Trekeive (SX 228701) and Hurdon (SX 210823). An additional site was identified from the Cornwall SMR (Longlake, SX 188752), whilst fieldwork in 1988–9 by Herring revealed two more: Coombe, Millpool (SX 123707) and Treswallock (SX 105781), the last a doubtful one. In most cases remains are vestigial. The St Neot site is known from place-name evidence, though displaced mould and mortar stones survive; at Longlake an ingot mould was found, at Treswallock a float stone. Both have been displaced and at none of these sites are there upstanding walls or earthworks. The remaining sites are rather better preserved: Hurdon is a low earthwork approximately 7 × 4m in plan, Trekeive retains three low drystone walls and its wheelpit, whilst at Coombe (operating in 1659 – according to Henderson 1924, 132, quoting from the Arundel Archives) walling defining a structure 3.2 × 4.5m can still be seen, together with an infilled wheelpit, a stamps mortar stone and some slag in the nearby stream bank. None of these sites has been excavated, and the extent and quality of their below-ground survival is unknown. A few still-unvisited documented sites may have surviving remains.

Although blowing houses continued to be used into the 19th century, most had long disappeared, to be replaced by more efficient reverberatory furnaces. Large-scale reverberatory smelting furnaces were a late 18th-century development, but even by the mid-17th century, the earlier blowing houses were being supplemented by 'tin kilns' working on the reverberatory principle, where the ore did not come into direct contact with the fuel (Anon 1670, 2111–2). By the late 18th century mining on Bodmin Moor had declined to such a degree that the most easterly large tin smelting works in Cornwall was at St Austell, all of the remainder being in the thriving mining fields to the west. It is possible, however, that some small-scale tin smelting still took place around Bodmin Moor even at this late date.

5 Quarrying

by Peter Herring

1 Introduction

Durable Bodmin Moor granite has been used in major monuments and buildings for around 6,000 years. Nineteenth-century lighthouses, London bridges and dockyards, and 20th-century war memorials and granite-clad office blocks had precursors on or near the Moor itself: Early Neolithic chambered tombs and long cairns; Later Neolithic and Early Bronze Age standing stones, stone circles, stone rows and burial cists; early medieval inscribed stones and crosses and later medieval wayside crosses, bridges and churches. Domestic buildings from at least Tudor times also utilised granite for lintels, jambs, mullions, thresholds and other principal stones (Chesher and Chesher 1968). Farmers used granite for gateposts, field rollers, salting troughs, pig troughs, cider mills and presses (Worgan 1811, 12–13; and *see* Fig 71); millers used it for their stones and others (including tinners and claymen) who needed strong, hard stone also employed granite.

Until the 19th century granite was obtained entirely from surface exposures, from the tors themselves or, more often, from 'grass rock' or moorstones, the dislocated and weathered blocks littering many of Bodmin Moor's hill slopes. In *c* 1800 the method of granite splitting by plug-and-feather was invented (*see* below, *Splitting methods*) and appears to have been a key factor in transforming granite working from a relatively casual affair, in which farmers and masons themselves probably undertook some of the splitting and working, into first a small-scale industry and then from the 1840s into one of the Moor's major extractive industries. The use of gunpowder to dislodge large blocks, cranes to hoist and manoeuvre them, and tramways and railways to transport the finished or part-finished blocks to docks enabled Bodmin Moor's quarries, alongside those on Dartmoor, Hensbarrow and, most importantly, Carnmenellis, to participate in the lucrative trade for

Fig 71 Coombe Mill, St Breward (SX 088763) in 1996. Cider apple mill base (two pieces of granite, presumably from Bodmin Moor) with milled roller stone and oak spindle and beam (truncated) in place. Now displayed on the roadside, this will have been set up in a pound house, the spindle fixed to a strong cross-beam and a blinkered horse pulling round the roller stone to pulp the apples. (Peter Herring)

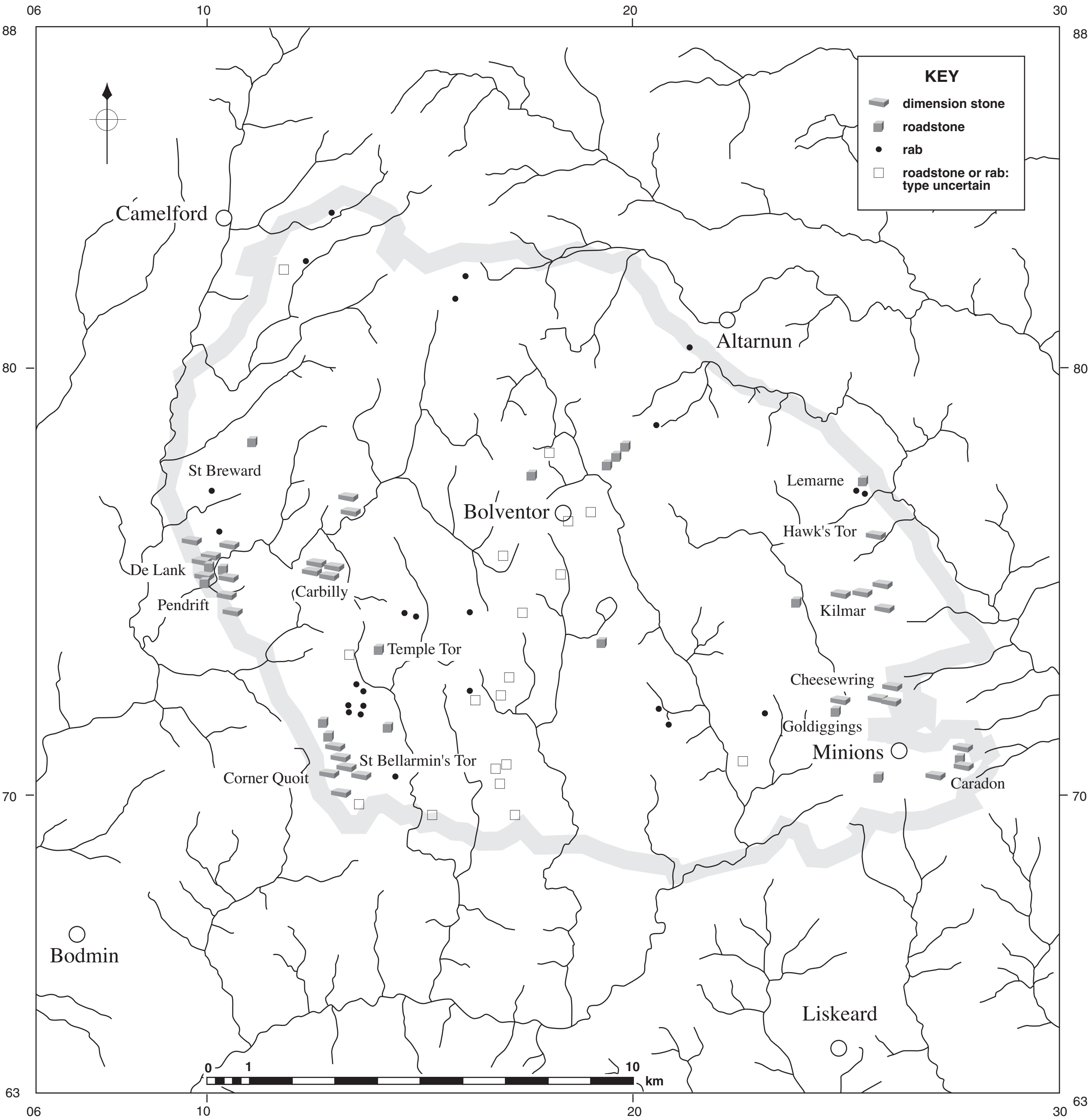


Fig 72 Distribution of quarries on Bodmin Moor. (© Rosemary Robertson)

dimension stone, the precisely shaped blocks of flawless stone needed for major civil engineering and monumental works. The history of dimension-stone granite quarrying in south-west England, and the economic and social background to it, have been subjected to detailed study for a doctoral thesis by Peter Stanier (1985a; and also 1985b; 1985c; 1986a; 1986b; 1992).

As well as dimension-stone quarries, Bodmin Moor possesses a number of late 19th- and early 20th-century roadstone or ballast quarries, exploiting the easily broken up poor-grade granite with its densely packed vertical joints and dykes of elvan (quartz-porphyry). There are also numerous rab pits, again mostly 19th- and 20th-century in date, usually located alongside the tracks and lanes onto which the granite-based gravel was spread as a firm and durable surface. (*See* Fig 72 for the distribution of quarries on Bodmin Moor.)

Most of Bodmin Moor's dimension stone, roadstone quarries, and rab pits were recorded by sketch survey onto a 1:2500 OS base which also contained information gathered from the 1 and 2 edn OS 1:2500 maps (1880s and 1900s), and from aerial photographs, including the RCHME 1:2500 photogrammetric plot. Detailed field notes were also made. The Minions survey produced large-scale measured plans of Goldiggings and Caradon North-East dimension-stone quarries and plans of some structures around Cheesewring Quarry (whose

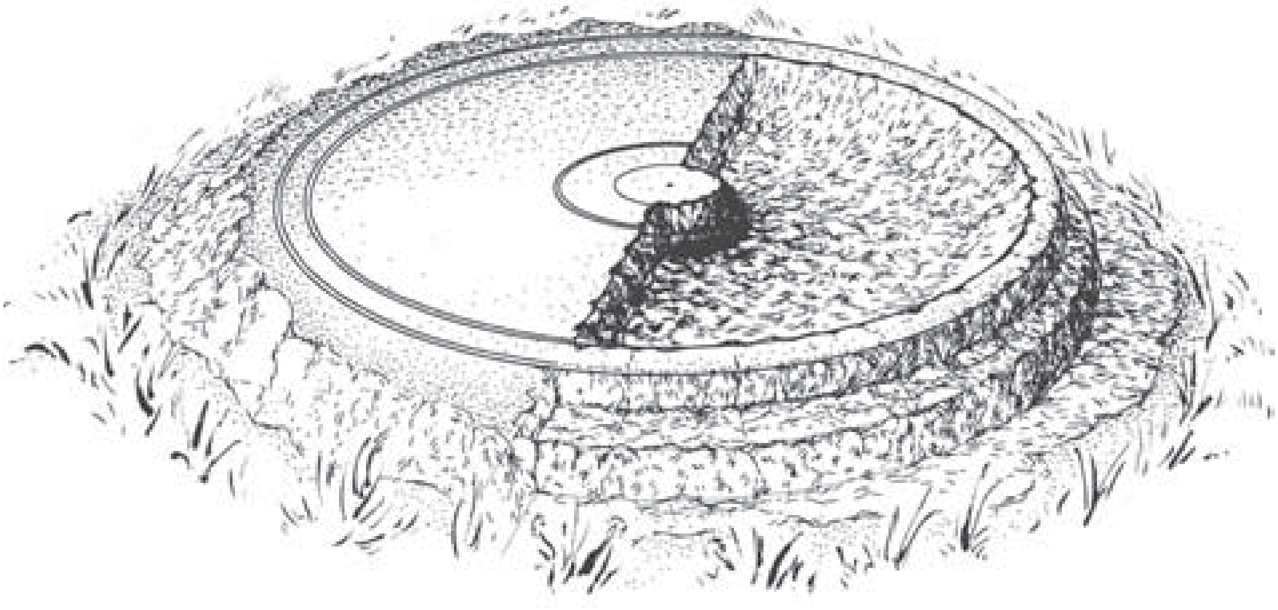


Fig 73 Unfinished pig trough near Goldiggings Quarry (SX 24867242). Concentric rings scribed into the moorstone guided the mason. (Drawing © Rosemary Robertson; based on Sharpe 1993, fig 89)

interior had been planned by the Cornwall Committee for Rescue Archaeology in 1984, before partial destruction through reworking for stone to reinforce the breakwater at Mount Batten in Plymouth). The RCHME had previously surveyed two quarries on the eastern and western slopes of Stowe's Hill as part of their recording of Stowe's Pound prehistoric enclosure (*see* Johnson and Rose 1994, fig 6).

2 Stone splitting

Most of Bodmin Moor's tors, clitter streams and scatterings of moorstones have been visited by stone splitters, even remote hills like Carey Tor (SX 230770) and Leskernick (SX 185803). The evidence lies mostly along the edges of the blanks left on the removal of blocks of stone, in the form of lines of neat hand-drilled holes (for plug-and-feather splitting – *see Splitting methods*, below) and, more rarely, the wedge-shaped grooves of pre-1800 splitting. Occasionally unfinished objects are found – cider-press bases, millstones, pig troughs (*see* Figs 71 and 73) – abandoned by their makers on encountering flaws in the granite. Sometimes the shapes of objects to be sculpted have been carefully scribed into the rock – on Hawk's Tor in Blisland (SX 14147553), one half of a cider mill base (Margaret Lawrence, pers comm) – and then left unworked, the splitters realising their error before cleaving commenced. In other places stones failed to break along desired lines, leaving plugs and feathers embedded and now rusting in the parent rock (a good example on Bray Down, SX 18778223; *see* Fig 76).

There is a likelihood that highly skilled stonemasons worked Bodmin Moor granite professionally over the last several centuries. An early appreciation of granite's commercial value appears in the Duchy of Cornwall assession roll for Rillaton Manor of 1427: 'if anyone shall get mill-stones or stones for the pressing of apples within the lordship there, he shall pay for every place in which he shall dig stone 1d [one penny], by the acknowledgement of the tenants' (translated and cited by Concanen 1831, Appendix, p149). By 1510, 'stones for grinding or pounding apples' – the bases and rollerstones of cider mills – were added to the list for which a penny was to be paid (*ibid*, Appendix, p172). In Hamatethy manor in the 15th century the lord took 2d [two pence] for each millstone (Fox 1994a, 154). Such objects, which had to be perfectly finished to work satisfactorily or at all – the surfaces of pairs of moving stones operating on each other – are unlikely to have been made by their principal users, millers and members of the farming families whose little orchards provided the apples to be pulped, pounded and pressed. Instead, it seems that later medieval and post-medieval Bodmin Moor would have been home to specialist stonemasons. Dr Harold Fox has calculated that it will have taken some 20 days to manufacture a millstone, and that masons would probably have made just two or three a year (*ibid*, 155). The abandoned half-finished stones indicate that the granite was dressed at the quarry sites to reduce economic loss suffered on failure, but Fox's calculations indicate how keenly such a loss would have been felt.

To determine if these stonemasons were full-time rural artisans requires further research. Some may have been farmers making use of quieter seasons and the most celebrated, the 18th-century Daniel Gumb, was also an amateur mathematician and surveyor (Stanier 1986c, 101–4). There is evidence at Slades (SX 156803), towards the northern end of the western flank of Brown Willy, that a 19th-century farming family supplemented their household economy by cutting and selling granite; no less than 66 carefully split posts, all *c* 2m long, lie in and around a mass of small stone-splitting pits dug into moorstones on the slopes

Fig 74 Slades, St Breward (SX 154803). Several granite posts split from a single moorstone. (From Herring 1986, plate 41)

immediately uphill from the farm's fields (*see* Fig 74). Baring-Gould's fictitious Roger Kerneu, a character presumably based on a real stonecutter, was, however, a specialist eking out a miserable living 'nogging out' gate posts and window sills, even obtaining his wife Polly Postes in exchange for two good linhay supports (Baring-Gould 1898a). On the other hand, the masons building the south aisle and porch of North Petherwin church, in 1506–11, and the north chantry chapel in 1518–24, obtained their granite themselves, from 'Rowtor' (Rough Tor, St Breward) and 'Altarnun' respectively, on payment of 2d (two pence) and 2s (two shillings) for licence 'to have a way' (Mattingly 1996, 26–7, and appendices 2 and 3).

Moorstone or 'grass-rock' splitting continued into the 20th century; much of that visible on the western flank of Nailaborough (SX 127744) was done by quarrymen laid off during the 1926 General Strike (Morley Rowe, pers comm).

No systematic search has been made for abandoned shaped stones; most of the 37 millstones, 4 cider mill bases and 1 pig trough recorded in the Cornwall HER were casual finds made during other surveys. Many more no doubt await discovery and they will reinforce the impression of a once extensive industry given by the 23 millstones and 3 cider mill bases so far found on the 2 neighbouring hills of Roughtor and Louden in St Breward. That specialists were at work here is suggested by the clustering of 13 millstones on the higher slopes of Roughtor and the grouping of all 3 cider mill bases on the lower slopes between the two hills. The 2 ruined smithies and numerous revetted loading ramps built along the Kilmar and Bearah extensions of the Liskeard and Caradon Railway are products of intensive working in the 1860s and 1870s of the Kilmar Granite Sett when about 80 men were preparing stones for Portsmouth Docks and the Spithead and Thames forts (Stanier 1985c, 44).

Grass-rock splitting for major public works in London, Plymouth and Liverpool was undertaken on Roughtor and Brown Willy in the 1850s (*see* Dimension-stone quarries, below). The portion of a column head and three suspected lighthouse sections lying on the south-west slopes of Stowe's Hill (SX 25557254) were cut from moorstones or 'grass rock' (*see* Leese 1947, 51) by later 19th-century stonemasons working in the nearby Cheesewring Quarry (Stanier 1985c, 47; Sharpe 1993, 255–6).

Splitting methods

The earliest known description of stone splitting in Cornwall, made by John Norden in 1584, may be the source of the erroneous tradition that, until *c* 1800 when the percussive plug-and-feather (or tare-and-feather) method was developed (*see* below), granite was split by the expansion of wooden wedges inserted into chiselled grooves and soaked with water (eg Stanier 1985b, 171–2). Norden, writing on

Fig 75 Wedge-and-groove marks on exposed bedrock on Showery Tor, St Breward (SX 148814). Three lines of grooves have been chiselled but only that to the left has had a granite post split away from it. (Peter Herring)

moorstones, noted that, 'the Country people have a device to cleeve them with wedges like loggs of wood, of verie great length, and of what quantitie of bodye they liste' (Norden 1584, reprint of 1966, 17).

There seems little reason to doubt that the wedges were in fact iron and the stones were split, as stubborn logs of wood were, by hammering in the wedges. Carew writing shortly after, in 1602, recorded miners using flat-headed pickaxes 'to drive certain little iron wedges wherewith they cleave the rocks' (reprint of 1969, 86) and the west country miners accompanying Martin Frobisher on his second and third voyages to the North-West Passage took pickaxes, scores of iron wedges and sledgehammers to cleave the hard rocks of Baffin Island (Hogarth 1993, 142). Norden was clearly impressed by the control exercised over length and volume of the blocks removed from moorstones. A knowledgeable stonemason could predict a stone's likely cleaving ways and the chiselling of closely spaced narrow grooves (0.08–0.15m long, 0.06–0.08m deep, 0.025–0.04m wide, and 0.06–0.1m apart) along those planes further reduced the risk of failure (*see* Fig 75). Nevertheless the chiselling must have been extremely time-consuming and when it was discovered that granite could be reliably split using holes which could be drilled, the old wedge-and-groove method was rapidly replaced.

Independent archaeological confirmation of the wedge-and-groove splitting method comes from three sources. A moorstone blank recorded on Kit Hill (SX 37597187) has a row of wedge-marks alternating with plug-and-feather drill-marks on the same plane; any wedges used here must have been struck by the same sledgehammer as the tares (*see* Herring and Thomas 1990, fig 35). The rusting remains of a wrought-iron wedge have been found trapped at the bottom of one of a line of grooves along which a stone on West Moor (approximately SX 19318039) failed to split (Tony Blackman, pers comm). Water applied to wedges in the grooves cut into the vertical face of a moorstone on Hendra Beacon (*c* SX 20017949) will have simply run out.

Little work has been done on the date of the introduction of the wedge-and-groove method but no Cornish church or castle granite work earlier than the 16th century appears to display its distinctive marks.

Although the invention of the tare- or plug-and-feather splitting method has been credited to Richard Trevithick, faced in 1813 with the problem of efficiently cutting stone for the Plymouth breakwater (J Hodge 1973, 19), by 1803 Dartmoor granite was being split using drilled holes (Worth 1953, 366). Inspection over the last 15 years of numerous late 18th- and early 19th-century granite-built structures throughout Cornwall has not shaken the belief that plug-and-feather splitting was developed in *c* 1800.

Fig 76 An abandoned attempt at plug-and-feather splitting of exposed bedrock on Bray Down, Altarnun (SX 18778223). Four pairs of wrought iron feathers survive within hand-drilled holes; a plug is clearly visible in the second left hole. Distinctive drill holes can be seen at the top right along a face from which a post was successfully split. (From Herring 1986, plate 40)

Peter Stanier believes it was introduced around then from America (pers comm).

A line of circular holes, each 0.075–0.1m deep, and 0.1–0.15m apart was drilled along the intended cleavage line by either giving hand-held stone borers or chisels part-turns between hammer blows, or, when working on a horizontal face, by lifting, part-turning and dropping 'jumpers', centrally weighted and balanced wrought-iron bars with stone-chisel ends. Holes drilled in the first half of the 19th century tended to have larger diameters (0.028 to 0.035m) than more recent ones (0.015m), probably reflecting the availability of hardened steel and the development of drill/jumper technology and the appreciation of an optimum diameter for a plug-and-feather hole. Iron 'plugs', short chisels, were placed between pairs of thin iron feathers reaching the bottoms of the holes (*see* Fig 76). As the plugs were cleanly struck in turn by a sledgehammer the percussive pressure was thereby applied to the sides of the holes, and thus the heart of the stone, and the granite was split more efficiently (*see* Sharpe 1993, 25–6, for a vivid account).

Plug-and-feather splitting was not confined to moorstone quarrying; it was also used in dimension-stone and monument-granite quarries for primary reduction of blocks to desired shapes; lines of holes can be seen on quarry faces and along the edges of boulders on waste tips.

3 Dimension-stone and monument-granite quarries

These are dramatic, even beautiful sites: gorse-topped and rust-stained quarry faces mirrored in the still water of flooded pits; frightening fingers of precariously balanced, potentially mobile, angular waste rocks extending over heathland and fields; and sheets of corrugated iron flapping and banging on roofs of decaying smithies and masons' sheds. They are also important historical sites where highly skilled local men toiled in the pursuit of perfection. Nothing less was acceptable to the purchasers of the stonework for a lighthouse, a London bridge or a West Hartlepool dockhead. Stones either fitted together precisely or were rejected. Not all of the quarries are deserted; granite is still lifted, now cut by thermal lance rather than dislodged by delicately controlled gunpowder charges, from the great St Breward pit of De Lank (SX 100115). It is sawn and polished to clad metropolitan office blocks and provides high-quality memorial monuments. There are small-scale operations at Bearah Tor (SX 25937444) – now in the workyard only – and, just outside the study area, at Notter Tor, Linkinhorne (SX 27247378). However, Hantergantick (SX 103757) and Tor Down, St Breward (SX 09417659) have closed.

There are 40 separate dimension-stone excavations on Bodmin Moor, at 29 sites: several complexes have more than one pit. They are mainly found towards the edge of the Moor, concentrated into three groups (*see* Fig 72)

1 along the De Lank valley in St Breward and Blisland, from Pendrift to Leaze

2 on Caradon Hill and Twelve Men's Moor, as far north as Hawk's Tor

3 on St Bellarmin's Tor, Corner Quoit and Fore Downs in Cardinham.

All quarried hills are topped with tors of large blocks of granite with well-spaced vertical joints. Quarrymen presumably sought these as they could be expected to yield large blocks of flawless stone at depth. Hills in the heart of the Moor with promising-looking granite were most likely not worked because of prohibitive transport costs; Kilmar, Bearah, Cheesewring and the Caradon quarries would probably never have opened if the Liskeard–Looe railway line had not been extended on to the Moor to serve the copper and tin mines of the Minions area (Stanier 1986b). Similarly, the Wenford Bridge branch of the Bodmin–Wadebridge line allowed the De Lank valley quarries to move their stone to the sea relatively cheaply (Stanier 1985b). Certainly the granite of Treswallock Down, Roughtor and Brown Willy was considered worth advertising for letting for quarrying in 1856 (Barton 1972, 18) although, apart from a desultory roadstone pit on the former (SX 11267782) and some moorstone splitting on Roughtor and Brown Willy, there is no sign of any deep working having taken place. The 1858 Mineral Statistics record Roughtor granite being shipped from Wadebridge to London for 'building and paving' and to Plymouth for the breakwater. Brown Willy granite went to Liverpool for use in the new docks (Hunt 1858, 134–5). The quarries were, however, never more than grass-rock workings (*see* above). The same 1856 advertisement also offered the right to search for and work granite on any part of the extensive Hamatethy Commons in St Breward. Again, nothing substantial appears to have come of this.

Documentation for early dimension-stone quarrying on Bodmin Moor is poor but it seems unlikely that any pit was opened before 1840, significantly later than Dartmoor and Carnmenellis. Tor Down and De Lank Quarries were probably started in the early 1840s (Brewster 1975, 338; Taylor 1988a, 90; Methven and Bousfield 1988, 101) and Cheesewring (SX 25847236) in 1845 (Stanier 1986b). The Cheesewring Quarry was able by 1851 to send a column and some obelisks to the Great Exhibition and over the next 50 years provided granite for docks, breakwaters and forts in Britain and beyond (Stanier 1985b, 175). De Lank Quarry, as well as working the same markets, also developed a reputation for supplying granite for lighthouses, most famously Douglass's Eddystone (1878–82; *see* Edwards 1882) after which the quarry was for a time renamed, and also for Bishop Rock, The Needles and Beachy Head (Stanier 1985b, 176 and 189). Providing for such an unpredictable market as architectural and civil engineering projects led to wildly fluctuating fortunes for Bodmin Moor quarries (*ibid*, 176). Some sought security in more stable business such as monumental masonry; by 1906 Bate and Sons of Millpool were making 'Saxon crosses' to order (*Kelly's* 1906, 68), no doubt imitations of the famous early medieval cross in nearby Cardinham churchyard.

Whatever its uncertainties, there appear to have been plenty of Victorian entrepreneurs prepared to enter the granite quarrying business and several other quarries opened on Bodmin Moor in the second half of the 19th century:

Bearah (SX 260744) and Kilmar (SX 24887470 and SX 25337487) after northward extensions of the Liskeard–Caradon railway in 1858 (Stanier 1985b, 175)

Stowe's Hill, the eastern and western quarries (SX 25907276, and SX 25707250) probably some time before 1871 (Sharpe 1993, 274–5)

At least one of the quarries around St Bellarmin's Tor, supplying stone for Bate and Sons, stonemasons of Millpool from at least 1883–1939 (*Kelly's*, Cardinham, *passim*). Possibly the quarry at Corner Quoit (SX 12517082) labelled 'old' on the 1881 OS 1:2500 map. A quarry called 'Cardinham' had supplied granite for the County Hall, Bodmin (Hunt 1858).

Goldiggings (SX 24917236), established some time between 1863 and 1883 (not on Symons Map of the Caradon and Ludcott mining districts, but on the OS 1:2500 map, 1 edn). Possibly the quarry in St Cleer owned by George Bate in 1878 (*Harrod's*, 947).

Caradon Quarry (SX 26957049), shown on the 1883 OS 1:2500 map, 1 edn (Sharpe 1993, 86).

Bedwithiel Quarry (SX 12737547) on Carbilly Tor, shown on the 1906 OS 1:2500 map, 2 edn. Probably that operated by F Armstrong and Sons, 'stone masons, dealers in rough and finished granite' (Lewis *et al*, 1988, 64). Open by the 1890s when worked by Nicholas Robins of the North Cornwall and Wadebridge Sculptured and Architectural Granite and Marble Works (Stanier 1999, 34).

Pendrift (SX 10087479), shown on the 1907 OS 1:2500 map, 2 edn, and probably owned in 1906 by Nankivell and Sons

(*Kelly's* 1906, 32) as they certainly owned it in 1914 (*Kelly's* 1914, 54). Recorded as working from 1904 to 1910 (Stanier 1999, 34).

In the first decade of the 20th century British quarries experienced keen competition from Scandinavia; Scottish and south-western English quarries relied to a degree on protectionism to win contracts (Stanier 1986a, 7), and more businesses turned their investments and masons to monumental work. Joseph Sweet of Liskeard very successfully converted his Goldiggings and Caradon quarries and greatly increased both workforce and output (*ibid*, 8). Nevertheless, this was a difficult time for Cornish quarries, exacerbated by industrial disputes, and the First World War dealt it further severe blows with the removal of labour and demand, and a great increase in the critical cost of transportation; most quarries ground to a halt (*ibid*, 9).

The war did, however, come briefly to the industry's rescue as communities throughout Britain commemorated their dead and wounded through the erection of memorials, many of granite. Around 100 men were at work at De Lank in 1920 and several new quarries were opened, notably Hantergantick and Tor Down Upper (Stanier 1986a, 9 and 22). Improved road transport allowed more remote quarries to operate with some success; new workings were opened at Carbilly Tor in 1918 by the Bodmin Granite Co Ltd (Stanier 1999), and William Nankivell and Sons were working the most remote monument granite quarry on the Moor, at Leaze (SX 13457704), by 1926 (*Kelly's*, 55)

After this brief flurry of activity, the two factors which had weakened the industry before the Great War, foreign competition and industrial disputes, beset it again and many quarries closed in the late 1920s and 1930s before war once more led to the shutting down of nearly all the others (Stanier 1986a, 9–11). History repeated itself with another post-war granite-quarrying boom as Britain's ravaged cities, towns and villages were rebuilt (*ibid*, 11–12); this extended even to Limehead in St Breward whose fine Methodist Sunday School, destroyed by German bombs in 1942, was rebuilt with Cornish granite in 1957 (Champion 1988, 81–3). With reinforced concrete dominating architectural work from the mid-20th century, the market for granite changed to decorative cladding. The underlying 20th-century trend (ignoring post-war flushes) of concentrating south-western quarries into a handful of sites continued, so that by 1984 there were only six quarries still lifting granite in Cornwall and Devon. Bodmin Moor had become the centre of the regional industry, containing the two largest works (Hantergantick and De Lank, as well as Tor Down), and employing 53 of the 100 men then at work in quarries (Stanier 1986a, 12–15); by 2001 only De Lank was operational.

Quarrying methods and typical components

Dimension-stone and monument quarries extracted large blocks of flawless granite and reduced them by splitting, sawing, scappling, axing and dunting to very precisely defined shapes and sizes. Processes were therefore fairly simple but the methods and machinery used to dislodge, hoist, shift and dress the stone developed rapidly through the later 19th and the 20th centuries.

Delicately controlled blasting with gunpowder lit by safety fuse was used from the outset in Bodmin Moor's quarries. Charge holes sunk very carefully to horizontal joints or 'headings', but not beyond them, were drilled by three men working a hand-borer, one holding it and giving it a half-turn between sledgehammer blows administered by the other two. This was slow work; at De Lank in 1898 a typical 2½in-diameter hole would be sunk just 6–8ft in a nine-hour day (Stanier 1985b, 179). Larger quarries, like De Lank, used pneumatic drills from the 1890s (but many continued to drill by hand well into the 20th century – *ibid*, 181). Quarrymen preferred Merchant's blasting powder, produced locally in explosives works like Herodsfoot (SX 206605), as it 'heaved out' solid blocks just an inch or so from the work face without shattering them (*ibid*). It was stored in small, secure powder houses or magazines, usually a little way from the main quarry (that still used at De Lank is *c* 150m from the pit), but sometimes surprisingly close (Carbilly's two well-preserved concrete and granite magazines are both less than 50m from their quarries; *see* Fig 77). That at the Cheesewring (SX 25907224) is almost as close to the quarry – 60m away – but was inserted into an old moorstone pit and protected by an enclosure wall as well as the quarry's overburden dumps (Sharpe 1993, 128, fig 51).

Seeking good working faces with widely spaced joints, the quarrymen drove into hillsides, creating scoops up to 180m across (De Lank, the face from Gully to Middle Crane quarries; *see* Fig 79) with cliffs up to 35m high (De Lank and Cheesewring). Most sites, however, were shorter-lived and their remains are more modest in scale, typically 30 or 40m across, with cliffs 8 to 15m high in which charge holes are clearly visible (there are three good examples on Carbilly Tor; *see* Fig 77). Most of the larger quarries had pits sunk into their floors to reach cleaner, more flawless granite; Cheesewring and De Lank's Eddystone Quarry (SX 10157521) are notable exceptions. Drained by syphoning and later by portable pumps, one extant at Hawk's Tor Quarry, North Hill (SX 25577632) and another at Caradon Quarry (SX 26957049) both flooded on abandonment. Several quarries developed multiple pits; Bearah Tor had three interconnected openings, as did Goldiggings, while Fore Downs (SX 12947009) and Tor Down both had two discrete pits, and in the mid-20th century Carbilly Tor was worked by three different companies, each with its own pit and plant (*see* Brewster 1975, 343; and Fig 77). De Lank, however, has the most complex site with six dimension- and monument-stone quarries (those in the gorge named Silver Hill, Eddystone, Oak Tree, River, Middle Crane and, the one still working, No. 1 or Gully) and five narrow roadstone/ballast quarries (*see* Fig 79).

Heaps of overburden – soil and the spoiled top metre or so of rock – were arranged around the tops of cliffs, often overlapping as quarries pushed on upslope.

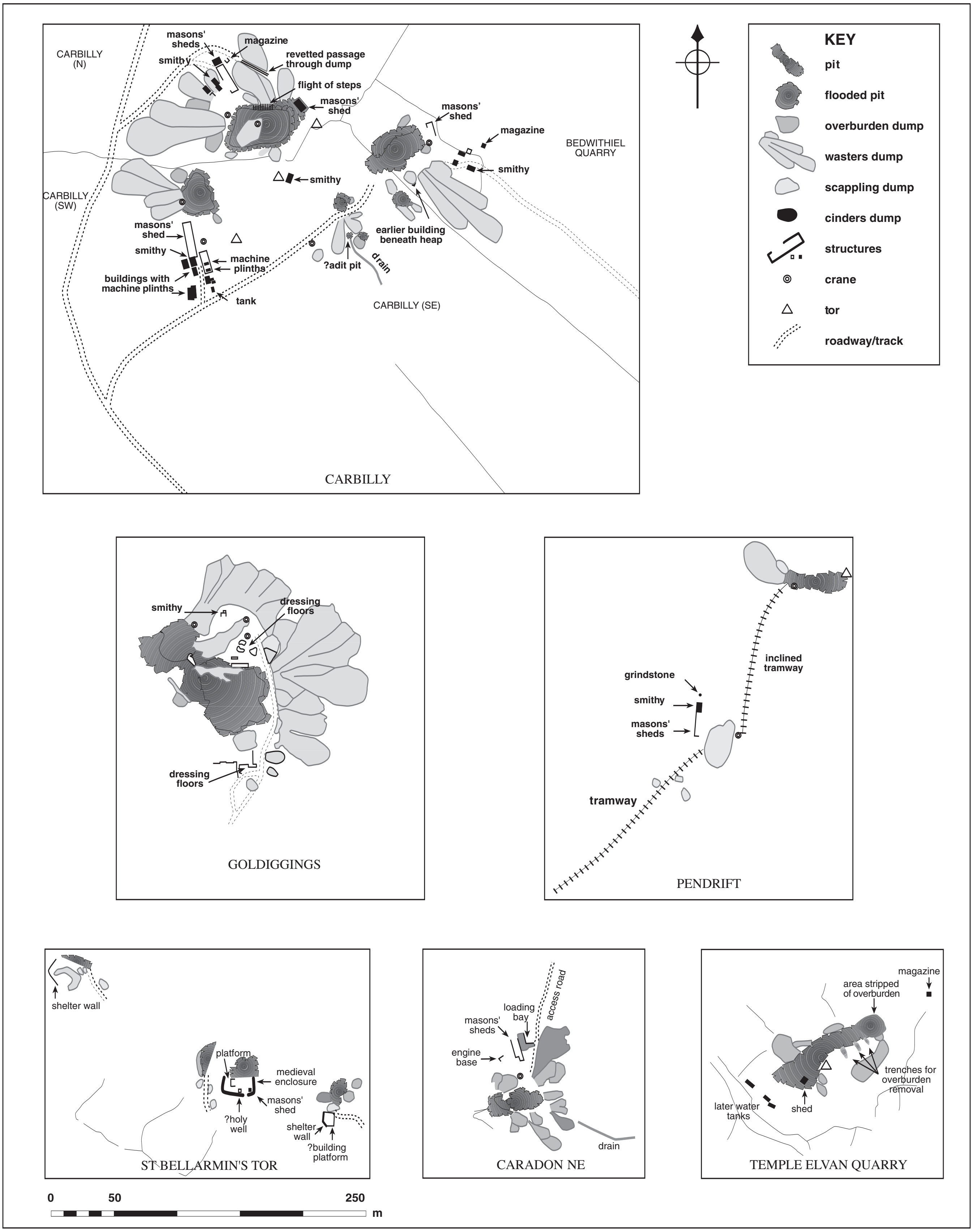


Fig 77 Schematic plans, based on 1:2500 sketch surveys, of typical medium and small quarries on Bodmin Moor; Carbilly (SX 125754; see also *Fig 7), Goldiggings (SX 24917236), Pendrift (SX 10087479), St Bellarmin's Tor (SX 130708), Caradon North-East (SX 27757097) and Temple (SX 13957342). All were granite dimension-stone quarries, except Temple which was for roadstone. (CCC HES, Bodmin Moor Industrial Survey, SX 1275, 2472, 1074, 1370, 2770, 1373)*

Fig 78 Bearah Tor Quarry, North Hill (SX 25937444), in 1979 when granite from the quarry and elsewhere was being dressed in the sheds. Note the three cranes – two fixed derricks and one hand-crane (more distant; brought to the site from a local railway station) – and the tramway running between the two nearer cranes on to a finger dump out of picture to the right. (Peter Stanier, copyright reserved)

Many are finger dumps, up to *c* 8.0m high on steep slopes (as at De Lank) with tramway or barrow-way slots clearly visible along their backs; others are ramped barrow dumps or simple side dumps. In one or two cases, as at Fore Downs Lower, the overburden was stripped in an area never subsequently worked, and on one site, Pendrift, which opened up a tor, there is no sign of any overburden removal at all.

More spectacular are the dumps of large angular wasters generated by the reduction through plug-and-feather splitting of the often enormous blocks of granite dislodged by blasting. (One block of about 1,000 tons was recorded at the Cheesewring Quarry in 1858 – Barton 1972, 40.) Mast- and derrick-cranes hoisted both the pieces selected for further dressing and the wasters out of working areas or pits and placed them onto tramway trucks for crowbarring along to, respectively, dressing floors and dumps. The latter, taking about 90 per cent of the granite extracted (Stanier 1985b, 183), were invariably arranged either at or below the level of the quarry mouth, usually as patterns of finger dumps reaching 200m in length and 15m in height (as at the Cheesewring Quarry). There are good examples at the Carbilly Tor quarries, and Bearah Tor has lengths of tramway rail still in place (*see* Fig 78) while there are granite sleepers with rail spikes along the main dump at Hawk's Tor Quarry and one of the eleven at Goldiggings (Fig 82). Unfortunately the finest patterns of dumps, at the Cheesewring and Goldiggings quarries, have been recently damaged (Sharpe 1993, 125). At De Lank, with nine quarries opening into a narrow gorge, there were serious problems of waste disposal and greater efforts were made from the turn of the 20th century to process and sell it as street setts and, when crushed, as roadstone (Stanier 1985b, 183; and *see* Fig 80). Even so the floor of the gorge was infilled with wasters to the level of the mouths of the quarries, itself determined by the contour of the complex's principal track and, from the late 19th century, the tramway to the railway sidings at Wenfordbridge (SX 08597509).

The drilling of plug-and-feather holes for block reduction was still done by hand, with jumpers and hand-drills, in most Bodmin Moor quarries into the 1920s and 1930s; only the larger concerns like the De Lank and Cheesewring quarries had the capital to install compressors for the pneumatic drills available to quarries by *c* 1895 (Stanier 1985b, 182). When breaking up a large block, the quarrymen followed three naturally occurring lines of weakness in the granite. Horizontal 'floors' or 'quartering-ways' followed the pseudo-bedding planes and were the easiest both to recognise and split along; next easiest were the 'cleaving-ways', vertical lines usually running NNW and recognised by the flow of the feldspars; and most difficult were the 'tough-ways', at right angles to 'cleaving-ways' (Leese 1947, 2; Stanier 1985b, 180). The latter often required holes to be drilled both deeper and closer together to ensure that the granite split along the desired line.

Cranes and derricks were vital pieces of equipment in granite quarries, shifting blocks around and hoisting them onto trucks and wagons. Most were either sold or scrapped on the closure of quarries but some were abandoned and six timber derricks survive in various states of disrepair in Bodmin Moor quarries; three are at Bearah Tor (Fig 78) and the others are at Caradon North-East, (SX 27757097), at Corner Quoit where the collapsed machine is labelled 'American Hoist and Derrick Co., St Paul, USA' and at Caradon. The last comprises the recently damaged fragments of one of three made on site by the employees of Joseph Sweet (Stanier 1992, 19). The iron column of a hand-crane stands on a platform which is now an island in the flooded quarry at Carbilly North (SX 12557554). Crane bases, usually revetted sub-circular platforms, have been recorded at other quarries: 'a number' at Caradon (Sharpe 1993, 87), two at Cheesewring (there were seven until recent damage on the quarry floor – *ibid*, 127), three at Goldiggings, one each at Carbilly South-West and South-East (SX 12507545 and SX 12647544), and two at Pendrift, one at the quarry mouth and one at the base of a short incline, beside masons' sheds. Some of these will have supported mast-cranes; their guy anchors have been noted at Bearah, Caradon, Cheesewring, Goldiggings and Carbilly North and South-West and no doubt more of these wrought-iron rings fixed into bedrock await recording around Bodmin Moor quarries.

Once reduced to a hoistable and workable block, the granite was passed for dressing to the stonemasons whose open-sided sheds were either close by, on site, or, if the risk of damage to finished work while in transit was considered too great, in distant granite yards in railway sidings (Wenfordbridge and Moorswater) or on wharves (Wadebridge and Looe). De Lank's were at Wadebridge until, in the late 19th century, a tramway linked the quarry with the Bodmin and Wadebridge Railways terminus at Wenfordbridge and new sheds were built in 1887 close to the quarry (Stanier 1999; and Fig 80), their machinery worked by an 1889 Gilkes turbine powered by the 130-ft head of water in the De Lank canyon (Stanier 1985b, 182, 186; and *see* Fig 79). On a smaller scale, Pendrift Quarry also had on-site masons' sheds with a tramway leading off towards the sidings at Merry Meeting (SX 08947311; *see* Fig 77).

Blocks were roughly shaped by scappling, reduced to within an inch of the final shape with a blocking hammer, before chisels, chop axes or patent axes were used to produce a 'fine axe finish'. Pneumatic drills, hand tools and dunters took their place from around the turn of the 20th century (*see* Stanier 1985b, 184). Thin slabs were sawn, at first extremely slowly (3in [76mm] per week!) by sand-fed frame-saws, then from *c* 1882 at about 10in (254mm) per day with shot-fed frame-saws. Carborundum circular saws of the 1940s and great wire-loop saws of the 1960s were replaced by computer-controlled diamond-tipped circular saws in the late 1970s (Stanier 1986a, 16–18). De Lank also had a large steam-powered lathe for working columns of granite to approximately 24ft (7.6m) long, 4ft (1.2m) diameter. Machinery for polishing surfaces was also improved through the 19th and early 20th centuries (Stanier 1985b, 184–5; Stanier 1986a, 17–18).

Most abandoned masons' sheds have lost their superstructures, usually timber and corrugated iron, and survive as either concrete floors with machinery beds and plinths (excellent mid-20th-century examples at Carbilly South-West and Goldiggings) or low granite footings (as at Carbilly North and Corner Quoit). Standing granite or concrete buildings, some roofed, survive at De Lank and Bedwithiel. Smaller quarries lack formal structures and scattered heaps of scappling chips and other dressing waste indicate the sites of dressing floors either within or very close to quarry mouths, as at the small later 19th-century quarries on St Bellarmin's Tor (SX 12857107, SX 12897090, SX 13007083 and SX 13097081; *see* Fig 77) and those on Kilmar.

Stone-dressing waste was often used to bed both internal tramways, those taking blocks to waste dumps and masons' sheds (eg at Bedwithiel and Corner Quoit), and also the railways, tramways and trackways taking the scappled or finished stones away to remote masons' sheds or the market.

Railways:	Kilmar, Bearah and Cheesewring;
Tramways:	De Lank and Pendrift;
Trackways:	Leaze, Carbilly North, South-West and South-East, Bedwithiel, Corner Quoit, Fore Downs, Hawk's Tor, Caradon North-East (the latter running to a track on a disused railway).

Most quarries had their own smithy for sharpening jumpers and drills and manufacturing other equipment. Typically approximately 5 × 3m internally, they are recognisable by the remains of chimneys, usually above rectangular forges *c* 1.8m square and *c* 1.3m high. Bedwithiel Quarry's smithy is still roofed and the stumpy chimney at Carbilly South-West is a local landmark (Fig 81). A detached smithy on the high southern slopes of Trewortha Tor (SX 24637581) was the first forge of North Hill blacksmith 'Johnsir' Smeeth, long dead by the 1930s (North Hill Old Cornwall Society Record Book, February 1931; Spooner 1931), who presumably served the 19th-century moorstone quarrymen working the tors and

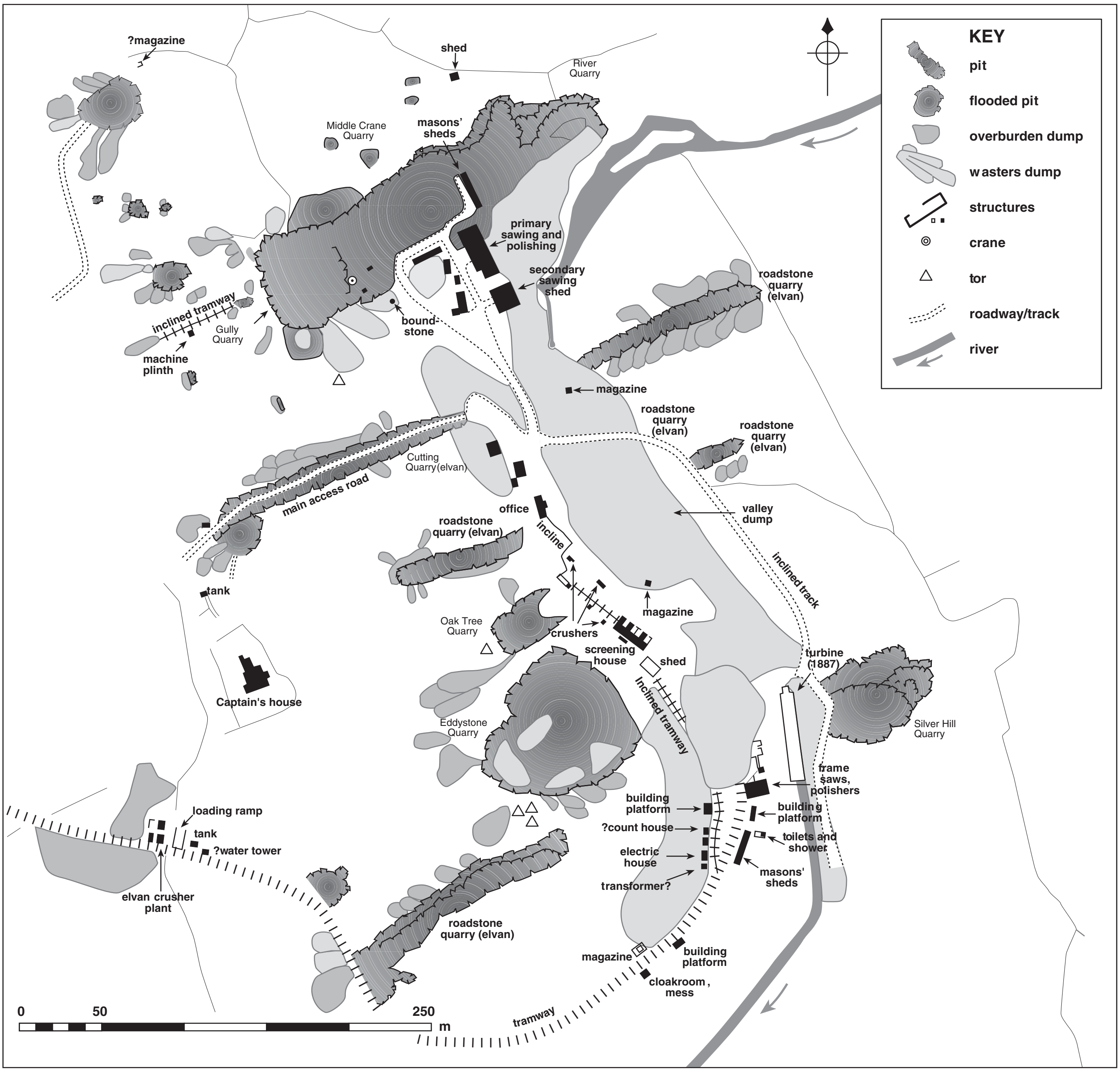


Fig 79 Schematic plan of the De Lank quarries (SX 101752), based on 1:2500 sketch survey of 1989. The quarry still operates and the abandoned buildings in the southern complex are being gradually submerged in the valley dump. Note how the granite dimension-stone quarries are distinguished by shape from the long, narrow elvan roadstone ones (labelled). Only Gully Quarry (still active) is cut down below the level of the entrance platform. The tramway linked with the Bodmin and Wadebridge Railway. (CCC HES, Bodmin Moor Industrial Survey, SX 1075) (© Rosemary Robertson)

Fig 80 De Lank granite quarries, St Breward (SX 10157521), viewed from the south-east in September 1907. The main active quarry then, as now, was in the distance, behind the line of dressing sheds built onto earlier dumps. A curving inclined plane (with a wagon at its foot) linked these to the Wenford branch of the Bodmin and Wadebridge Railway, extended from the Wenford Bridge terminus. Saw frames, polishers and a large lathe (for turning granite columns) were in the large corrugated-iron building by the lower siding; the smaller building behind to the right housed the compressor powered by the turbine whose iron pipe carried water from the De Lank River which had otherwise been culverted beneath the main dump. Another major dump was extended by a level tramway above the incline (to left). Some waste, chuted down from the upper dressing yard, was being crushed in the plant opposite the large dressing building. See *Fig 79 for a plan of the surviving features at Bodmin Moor's most important quarry complex. (Reproduced courtesy of the British Geological Survey. IPR/101-16CX. T C Hall, 1907 A00515)*

clitter of Twelve Men's Moor. Two more ruined smithies survive at Kilmar, one among the tors (SX 25367475), the other on the downs to the south-west (SX 24847429 – *see* Stanier 1985c, 45).

Example Sites

***Carbilly Tor* (SX 125754; Figs 7, 77 and 81)**

Although not as long lived, nor as large as the great dimension-stone quarries of De Lank and Cheesewring, the complex of four quarries arranged around the summit of Carbilly Tor can now be regarded, through not having been redeveloped and robbed, as the most important survival of this industry on Bodmin Moor. It possesses good examples of all the typical features (*see* above) and each quarry (Bedwithiel, Carbilly South-West, South-East and North; *see* Fig 77) has a fairly simple and understandable layout. They were established in an area which had seen considerable tor and moorstone splitting, with many pre-1800 wedge-and-groove marked stones.

Early industrial-scale exploitation appears to have been prohibited by distance from the nearest railhead, at Merry Meeting, 4km to the south-west. The 'Bradford Quarry' was first recorded in 1897 (*Kellys* 1897, 482) and is likely to be that labelled Bedwithiel Quarry on the 1907 OS 1:2500 map. The Armstrong family of Wenford Inn are known to have been quarrying on Carbilly from at least 1897 to at least 1926 (Lewis *et al* 1988, 64) while the Bodmin Granite Co worked the hill from 1918 (*Kelly's* 1923–39; Stanier 1999). Malim in 1936 deplored the destruction of the hill's beauty (1936, 54). Bradford/Bedwithiel was reopened in 1940 to supply monument and building stone to London and Birmingham and this quarry, together with the two larger Carbilly ones (South-West and North), under the ownership of the Bodmin Granite Co and H Squires, worked until the early 1960s (Brewster 1975, 343).

Fig 81 Ruined smithy at Carbilly South-West quarry, Blisland (SX 12507545), viewed from the south in 1988. The rendered granite chimney above the forge has been raised by four courses of concrete blocks. All other walls were of corrugated iron and the impressions of corrugated-iron walls can also be seen on the sides of the concrete floors of dismantled masons' sheds to the right. (CCC HES, GCS 5833)

Bedwithiel Quarry **(SX 12737547)**
An oval excavation, 50 × 30m, now flooded, with cliffs up to 5m above the pool. This is a slight lateral expansion of the pre-1907 quarry; most of the 1940–60s working appears to have been through sinking the pit. The three finger dumps, 80m long, and up to 8.5m high, also overlie and destroy the single dump of the first working. One corner of the pre-1907 smithy survives, visible beneath a later dump, also a larger rectangular building (7 × 4m) immediately to the east of the pit; the latter's drystone footings survive to 0.8m high and may be the masons' shed of the first working. A fragment of a crane made by Harvey & Co, Hayle was recorded beside this building in 1988 (Rose and Herring 1990, 492). Three roofed buildings, including the later smithy, now all reused as field barns, stand beside the well-made track leading south-east away from the quarry. The magazine, 50m south-east of the pit and facing away from it, has two parts, a small concrete block built inner room just 0.7m square and 0.9m high internally reached via a granite lobby 0.8m square and 1.9m high.

Carbilly South-East **(SX 12647544)**
A partly paved granite track, 3m wide, approaches this small, water-filled quarry, 10m in diameter, from the south-west. A blocked drainage adit opens 25m south of the pit. The quarry cliffs have plug-and-feather marks as well as charge holes. Two small finger dumps, just 20m long and 3m high have scapplings laid along their backs for tramway ballast. A semicircular revetted platform (2.9m diameter, 0.3m high) beside the track 30m from the quarry appears to be a crane base; a small heap of wasters downhill to its south can be regarded as a crane dump. The quarry's smithy, about 3.9 × 3m internally, built against a nearby tor, has a forge in its north-east corner with a 1.1m wide, 0.3m high flue within a rectangular structure 2 × 1.1m.

Carbilly South-West (SX 12507545)
A branch track from that leading to Carbilly South-East passes between rows of ruined masons' sheds and other buildings to reach the south-west corner of this triangular water-filled quarry, 38 × 25m, with faces rising 3m above the pool. Both charge holes and plug-and-feather marks are visible. A guy ring for the quarry's now lost mast-crane is fixed to a large granite block 6m south of the quarry, and there is a revetted triangular crane-base against its west side. Four overlapping finger dumps, reaching 60m long, 10m high, run downslope to the west.

A long rectangular platform (28 × 5m) immediately south of the quarry held the masons' sheds. Concrete flooring retains the impressions of corrugated-iron walls at its edge. The smithy, to its south, was relatively large, 5.8 × 2.8m, with a well-preserved forge and chimney. The forge block is 1.8 × 1.2m, raised 0.7m above the floor and provided with a stone hood. One of the five other buildings to the south and east which held various granite dressing machines (there are numerous machinery plinths, tanks, etc) retains its corrugated-iron roof.

Carbilly North **(SX 12557554)**
The largest of the four quarries, with a flooded, roughly rectangular pit, 50 × 40m, above which quarry faces with plug-and-feather and charge holes rise 14m. Three finger dumps to the north (reaching 60m long, 9m high) were created when the quarry edge was higher than at the final working. In the final working three more major finger dumps were laid out to the west; these reach 80m long, 12m high. A passage 2.5m wide was carved through the largest of the northern dumps; its revetted sides rise to over 5m high on each side and a tramway bridge was laid across the passage.

A mast-crane's guy ring was fixed to a large waster high on the quarry's eastern edge and the iron column of a hand-crane stands on an island within the pool; this island would have been a tall stack when the quarry was operating and pumped dry. Another crane base, a block with a square socket, stands just 5m from the pit's western edge; the derrick would have swung stones onto trucks for the dressing floors or the waste dumps.

To the east of the quarry, above the northern finger dumps, are the remains of a rectangular masons' shed (some 6.5m long) and platform, with heaps of scappling waste. This was left high and dry when the quarry edge was lowered to the north-west and new dressing floors were laid out on the tops of finger dumps. The ruined smithy is at the core of this complex; it has a collapsed forge in the northern of two rooms and a large drill-testing stone with many holes. A track to the quarry separates it from a long ruined building, 17 × 5.5m, in two steps, containing seven machinery plinths.

The well-preserved magazine with a single pitch roof is just 35m north of the pit but hidden behind dressing sheds and a finger dump. It is 1m square with a reinforced concrete interior and a granite outer shell. It faces away from the quarry.

The access track runs away to the south-west, joining that to Carbilly South-West and South-East.

Goldiggings **(SX 24917236; Figs 77 and 82)**
The quarry was surveyed at 1:500 during the Minions Project (Sharpe 1993, 132–6, figs 53–5). It is a poorly documented but fairly extensive and well-preserved dimension-stone and monument-granite quarry established in an area previously worked by moorstone splitters. It has two flooded excavations, traces of four cranes or derricks, two on-site dressing floors and a smithy. Shown with just one pit (the northern part of the larger southern one) on the 1883 and 1906 OS 1:2500 maps, it was apparently operated from the later 19th century until at least 1939 by Joseph Sweet of Liskeard alongside his Silver Grey Quarry on Caradon (Stanier 1985c, 49). There are photographs of the quarry working in the 1920s (Bishop 1987, plates 49, 54 and 57).

The quarry appears to have been first expanded southwards after the 1906 map was made (removing a building shown roofless on that map – possibly a smithy) to create a pit roughly 50m square, with faces up to 14m high above the pool, and then by a second excavation to the north-west *c* 30 × 50m, whose waster dumps also appear to respect those of the southern pit; some waste from the northern pit was also dumped within the southern one.

Overburden dumps are relatively slight and mainly of ramped dump (barrow) form. Waster dumps, however, are massive; the 11 fanning out from the southern pit reach 55m long and 11m high and the seven from the northern pit 55m long, and 6m high.

The bases of three fixed derricks, with traces of guying points for stays about 10m from socketed stones, were recorded on the fringes of the northern pit's dressing floors, while the former existence of a mast-crane in the southern pit was noted from the four guy rings around its edges.

The dressing floors, one on a platform created on waster dumps east of the northern pit, the other west of the main access track south of the southern pit, survive as patterns of concrete-floored platforms supporting machinery bases and plinths. The northern floors also contain horizontal flues leading to a metal chimney, and there is a ruined smithy, the only stone-built structure on the site, to the north of the northern floors. No magazine was recorded.

The access way to the quarry was a roughly metalled track running south-east for nearly 1.5km to the railhead at Minions, intended as a railway, but never finished and called 'Traction Road' from traction engines which preceded two Foden steam wagons which used to ply to and from the quarry (Peter Stanier, pers comm, and *see* Sharpe 1993, 135).

Caradon North-East **(SX 27757097; Fig 77)**
Surveyed at 1:500 in the Minions project, this well-preserved small quarry appears on no known map or document. It is not on either the 1880 or 1907 OS 1:2500 maps, but as its 2m-wide trackway leads to the Caradon Hill diversion of the Liskeard–Caradon Railway and its drain was carefully culverted under the railway, the quarry is likely to have worked before the branch's closure in 1917. Peter Stanier, however, has been informed that the quarry was opened by the Sweets after the First World War as a trial (Stanier, pers comm); the railway bed would then have been a useful track.

Faces rise 4.5m above a water-filled pit, 20m east – west by 15m. A collapsed timber derrick lying near the northern edge would have hoisted both waste blocks onto tracks running along the back of the main waster dump, 45m long and 11.4m high, and blocks for dressing into the dressing floors immediately to the north. These are revetted edged rectangular platforms; an engine plinth stands to their south.

Fig 82 Goldiggings, St Cleer (SX 24917236) from the north-east. Note the tramway's sleeper beds on the back of the finger dump to the right and the granite sleepers on that extending furthest to the left. A finger dump of smaller, partly dressed stones can be seen amongst those to the right. The site has unfortunately been disturbed by reworking since this photograph was taken in 1987; most of the finger dumps have been pulled apart to obtain reusable blocks and some structures have been destroyed, including the smithy whose gable wall is visible in the well created between dumps towards the right. (CCC HES, F10/58)

The quarry appears to have been abandoned precipitately. Overburden was stripped from an area 10m wide uphill from the quarry face. Eleven overburden dumps of finger form, between 13 and 25m long and between 1.8 and 3.2m high, are arranged around the edge of the quarry (for further detail *see* Sharpe 1993, 113–114 and fig 42).

4 Roadstone, ballast and building stone

While dimension-stone granite from Bodmin Moor was in some instances shipped halfway round the world, the market for roadstone and building stone was very local. An elvan quarry at 'Pounds Caunse' (probably at SX 11857132) owned in 1858 by the Corporation of Bodmin (4km to the south-west) provided stone 'for local buildings' and another at St Neot provided elvan for 'ovens in Bodmin and local buildings' (Hunt 1858, 134–5). Structures at the Glynn Valley clayworks were constructed with stone excavated from an on-site quarry (*see* Fig 93)

Elvan (quartz-porphyry) dykes, and vertical weaknesses in granite appear to have been exploited from about the middle of the 19th to the third quarter of the 20th century for both building stone and ballast, the hardcore used in roads and railways. The De Lank granite quarry was in 1906 advertising its 'good "elvan" stone for road making and mending' (*Kelly's* 1906, 48) and a large disused crusher's screening house still stands in the centre of the quarry complex (*see* Fig 79). The five narrow roadstone quarries at De Lank, including the one now reused as the main access canyon, all postdate the 1905 OS revision, as do most other long narrow roadstone quarries, including those on the western slopes of Colvannick Tor (SX 1276 7149 and SX 1290 7109) and that at Temple Tor (SX 1395 7342).

These cuttings rarely exceed 10m in width and normally range from 2.5 to 6m in depth at their inner ends although those at De Lank reach approximately 20m. They were driven into hillsides on the level, the finances of these ventures not permitting the pumping of water from pits, and they have relatively few features beyond vegetated overburden dumps (finger, ramped and side) and small, simple buildings, probably smithies. Only De Lank has evidence of on-site processing – the three 1960s crushers (producing gravel) and an earlier, pre-Second World War crusher beside the tramway on the hill's western side – and the other quarries' product appears to have been used direct from the work face. Charge holes are visible in some rock faces but most are featureless, as explosives would have been used not only to dislodge rock but also to break it down into small pieces.

Locations of roadstone/building stone quarries are of course partly determined by the existence of elvan dykes or suitably fractured granite, but a severe limiting factor appears to have been transport costs as all are close to pre-existing roads or metalled tracks. Some have had short lengths (less than 300m) of levelled and roughly metalled trackway brought in to them, as at Colvannick Tor and Gillhouse Downs (SX 19337396). A number of roadstone or ballast quarries were created immediately alongside the roads or railways which received their stone. Three small quarries spaced out along the north side of the Launceston–Bodmin road between Palmers Bridge and Higher Cannaframe (SX 19307770, SX 19457779 and SX 19657800) may have been created in the 18th century when the ancient road was improved after it became a turnpike in 1769 (*see* Chapter 11 – they have all been destroyed by recent improvements to the road, now the A30); a narrow elvan quarry near Smallacoombe Parks in St Cleer (SX 23877470) clearly provided ballast for the unfinished railway to Altarnun.

Example Site

Temple Tor **(SX 13957342; Fig 77)**

A fine early 20th-century elvan roadstone quarry, apparently closed by the late 1930s (pers comm from a former owner of Temple Tor farm), was reviled when active by Malim (1936, 55) as it was cut so close to Temple Tor, whose cheesewring stands within a metre of the southern cliff face. It is 95m long and generally 10m wide although it expands to 25m immediately west of the tor. The faces, up to 8m high, are essentially vertical but ragged, their facets (many with visible charge holes) catching the afternoon light, and the floor is clear of waste. A small concrete block and corrugated-iron shed now used as a store within the expanded part of the quarry may have been used as a smithy and crib hut. Around the cutting is a good pattern of overburden dumps, including several short finger dumps which run over earlier ramped (barrow?) dumps. An area *c* 18 × 12m at the uphill end of the quarry has been stripped of overburden to a depth of approximately 1.4m in readiness for the next expansion into the hill. Further east, *c* 25m from the quarry, is the magazine/detonating shelter. A small concrete block building (1.6m square internally, 1.8m high), it has a corrugated-iron roof given a concrete topping, and a viewing hole at the top of its western wall, facing the quarry.

5 Rab pits

Even more local in their 'market' than roadstone/building stone quarries were the pits dug into the granitic head, locally rab or 'growan', to obtain yellow, orange or red gravels used for surfacing tracks. The pits tend to be cut into the slope immediately adjacent to the track or road and are scoop-like, usually flat-bottomed with entrances wide enough for vehicles (ie approximately 3m wide). Their crumbling sides are normally between 1.5 and 3m high. Floor areas vary considerably, from approximately 10 to 40m across. Most appear, from studying 1st and 2nd edition OS maps, to be of the mid 19th and early 20th centuries, although the most impressive pit, as much as 6m deep, at Lemarne (SX 25457753) was recorded as 'sand pit' on the 1840 North Hill Tithe Map. One or two pits are still used (eg at Lower Langdon, SX 20817204). Rab pits were not systematically recorded on Bodmin Moor.

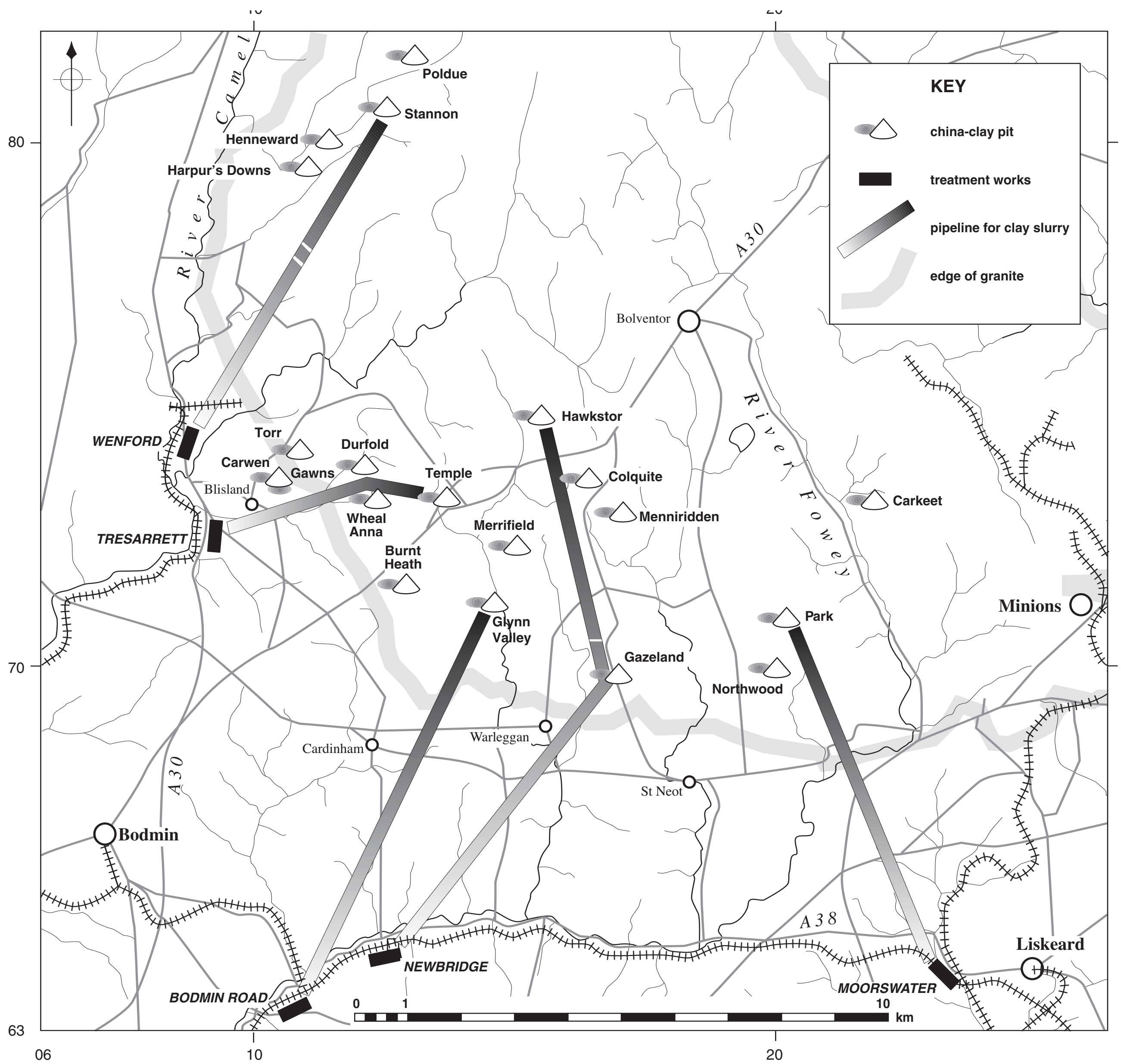


Fig 83 *Distribution map of Bodmin Moor china-clay works and off-Moor treatment works. The pipelines from the pits are shown schematically, and are not intended to represent the actual line of the pipe. (© Rosemary Robertson)*

6 China clay

by John R Smith

1 Introduction

The commercial exploitation of china clay in the west of England has a relatively recent history, William Cookworthy's recognition of the material in Cornwall at Tregonning Hill and St Stephen in Brannel being generally dated to around 1745 (Barton 1966, 18–19). China clay (or Kaolin) is the result of a partial decomposition of the granite mass in localised areas. The process, known as kaolinisation, results in the conversion of the feldspar component of the granite to aluminium silicate which is accompanied in greater or lesser proportion by the unaltered mica and quartz in the form of sand. The soft, talc-like china clay forms an essential ingredient in the production of hard-paste porcelain; the other necessary mineral is china stone, granite in which the feldspar has been partially kaolinised. The extraction of china clay involves washing the material in a stream of water followed by subsequent gravity separation of the waste products, whereas china stone is quarried in the same manner as any other rock.

In addition to its original uses in the ceramic industry, china clay has since the late 19th century been used as a cheap, inert filler in paper-making, pharmaceuticals, cosmetics and the production of rubber and plastics. For use in all these industries, the purity and quality of the processed material is of vital importance, and the clays found on Bodmin Moor are often notably inferior to those extracted in the Hensbarrow uplands north of St Austell. In particular, they contain large amounts of mica ('white fly') which is difficult to separate from the clay. As a product of low intrinsic value per ton (unlike tin or copper ores), the cost of transport to the nearest port or railway was always a vital factor in determining the commercial viability of any workings, and in this respect also the Bodmin Moor area has always been at a disadvantage.

Cookworthy's discoveries in the mid-18th century on Hensbarrow led to a gradual expansion of what was in 1790 a very localised and small-scale industry to one which by 1858 was producing 65,600 tons per annum in Devon and Cornwall (Barton 1966). By far the greater part of this output was produced in the St Austell area, although other deposits had been recognised in the granite masses elsewhere in the county: at Leswidden and Towednack in Penwith, the original deposit at Tregonning Hill, and also in Devon on Lee Moor. Although tinners had probably been aware of the existence of similar deposits on Bodmin Moor for many years, no commercial attempt had been made to exploit them before 1860 (*ibid*); there is, however, evidence from the Tithe Maps for Blisland and St Breward to suggest extraction on a very small scale before 1842.

China-clay working on Bodmin Moor was thus very late in comparative terms. When it did eventually occur, it was in most cases localised, small-scale in character, and often extremely short-lived. Hampered by primitive roads and far greater transport costs to the nearest ports than the industry in the St Austell area, and by greater technical difficulties in the refining of the finished product, the many small works which sprang up on Bodmin Moor in the 1860s and 1870s quickly collapsed over the next two decades as they failed to realise a profit for their owners. Out of the 18 works known to have been established in the closing years of the 19th century, only one would appear to have been active in 1905 (OS 1:2500 map, 2 edn), although some were later reopened. In 1997 two works, at Stannon and Park, were actively producing china clay on Bodmin Moor. These have both since closed, Park in 1997 and Stannon in 2000.

2 The extractive method

Prospecting and preparation

The extraction of china clay has always been a hydraulic process. The extent and nature of the clay deposit was first determined by sinking a series of shallow excavations or prospecting pits, in the same manner as for any other mineral (*see* Chapter 4, Section 3). From the area of the sett to be worked the surface soil or overburden was removed to reveal the kaolinised granite, the top layer of which, discoloured by leached minerals, would also be discarded. This material would be barrowed to one side of the working area to form overburden dumps.

Stream and strake (shallow pit)

The early method of extraction was by stream and strake; a stream of water was directed over the exposed clay ground, washing the kaolinised material, including the lighter sand and mica, away from the unaltered rocks or stent. Workers using shovels (and short picks known as dubbers) stood in the clay stream and broke up the material; the stream deepened the channel in the working face, and formed a gully or strake. In the early phase of extraction hillside sites were chosen for preference and the clay flowed by gravity from the pit to the process area; as the pit deepened and this was no longer possible, it was necessary to drive an adit from the bottom of the pit to a process area downslope. Most of the workings on Bodmin Moor during the period 1860–1914 would have been worked by stream and strake; the archaeological evidence to support this can be seen in the form of the complex leat systems crossing the Moor at Glynn Valley. The actual feed to the strakes would have been by means of wooden launders and will have left no trace.

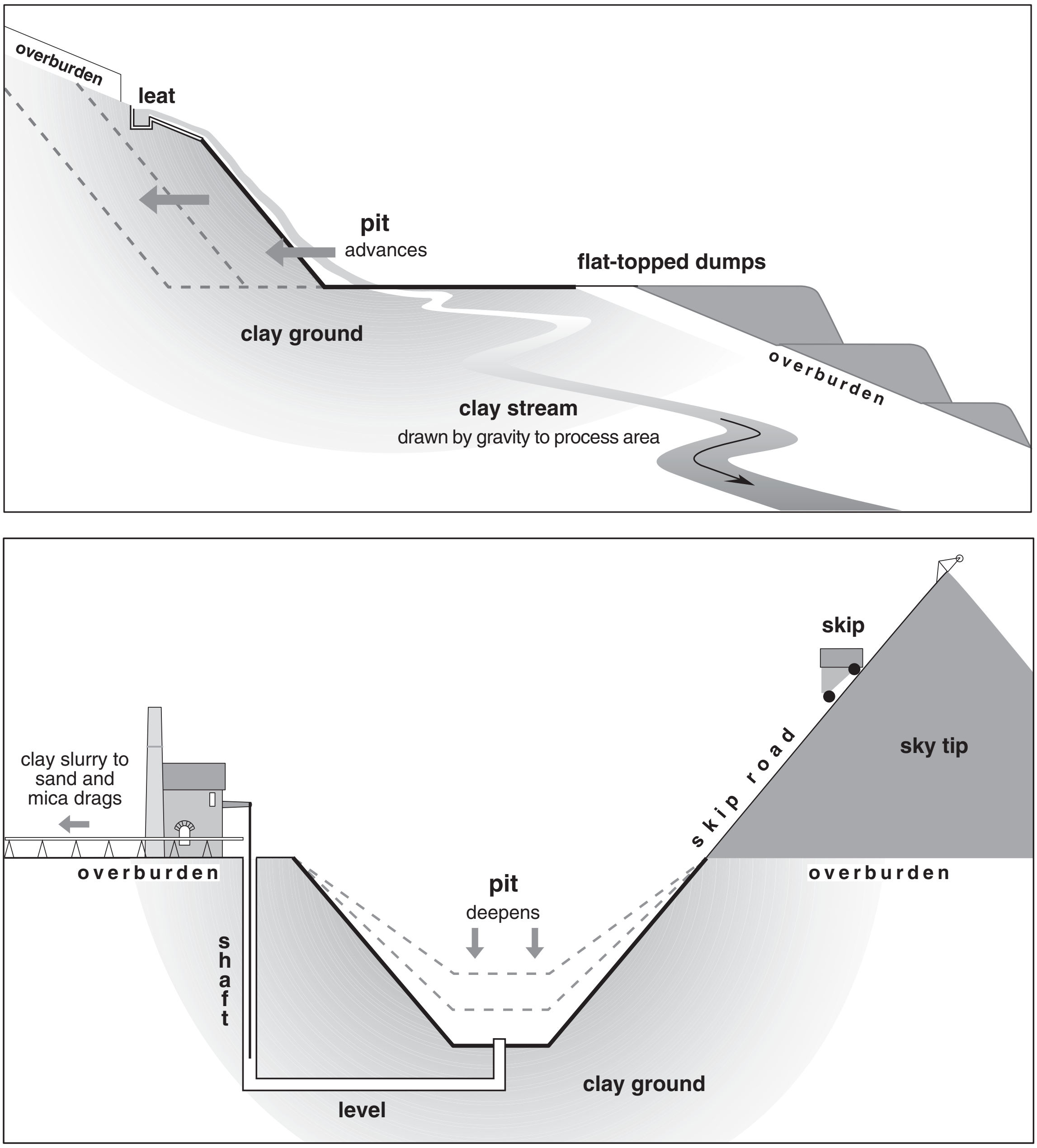


Fig 84 *Cross-sections of stream-and-strake china-clay pit (top) and deep china-clay pit (bottom). Most early china-clay works exploited hillside deposits as represented in the upper figure, in order to avoid the cost of pumping the clay out of the working area. This can be regarded as a development of tin-streaming technology, and may well be directly derived from it. Deep pits, as in the lower figure, were needed to exploit the many clay deposits found in the flatter upland areas or in valley bottoms, and were dependent on mechanical pumping (by waterwheel or steam engine) to recover the clay slurry. (© Rosemary Robertson)*

Deep pit

As these early pits deepened to the point where gravitational flow of the clay stream was no longer possible, or where clay was to be worked without the benefit of a natural slope, it was necessary to adopt a different strategy for extraction.

A shaft was sunk on the edge of the clay ground, and a level or adit driven from the bottom of this to a point below the centre of the intended work area. A rise was then driven up to the surface, by then stripped of overburden, and a button-hole launder placed in this shaft. This device was in essence a vertical wooden pipe of square section, having a series of holes bored in one face throughout its length; the holes were normally plugged by a series of wooden pegs. The top plug was removed to allow the clay stream to flow through the adit to the pumping shaft, and as the pit deepened so further pegs were removed. The clay was now washed from the working face in the same way as previously described.

The first pumps used were simple hand-operated plunger devices made from hollowed logs; while the depth of the openwork was shallow this sufficed, but as the works deepened and expanded a waterwheel would be installed to drive a series of lift pumps similar to those used in underground tin and copper mines. The remains of lift-pump installations of this type can be found at Glynn Valley (water-powered) and Temple (steam-powered).

If water was unavailable in sufficient quantity on site to drive a wheel for pumping, this could be sited some distance away and the drive transmitted via a series of reciprocating iron rods, or flat rods. The pits at Temple, Hawkstor, and Burnt Heath were pumped in this way. Failing this, a steam engine would be installed for the same purpose. The use of steam engines for pumping was very limited on the Bodmin Moor clayworks, presumably because of the cost of transporting coal on to the Moor. Only Northwood and Temple appear to have installed steam pumping engines. In 1927 the first centrifugal electric pumps were installed on Hensbarrow (Barton 1966, 183), and this method of pumping direct from the sump or lowest part of the openwork is now universal.

Pressure hose

The first use of a high-pressure hose to wash the clay from the working face was at Blackpool Pit (on Hensbarrow) in 1890, using a Merryweather fire-engine as the source of power. Special high-speed pumps were developed to perform the same role, often fed from older flooded workings. By the mid-1920s this method was accepted practice in the Hensbarrow area (Barton 1966), and would presumably also have been in use in the works then active on Bodmin Moor. Modern development of this concept has resulted in the monitor, a high-pressure jet directed by remote control from a weatherproof cabin.

3 Processing

Gravel and stent

Primary separation of the heavier waste elements took place in the strake itself, the men removing the stent as they worked. The coarse gravel was eliminated from the clay stream before pumping to surface by running the stream through a series of pits, the gravel depositing in them and the clay running off the top. At intervals the stream would be diverted to another pit and the waste material dug out. These gravel pits in time became more sophisticated and incorporated a certain amount of mechanisation to speed emptying, but the basic principle remained unchanged until recent years.

Disposal of these wastes from shallow workings was originally performed by shammelling, the material being dug by hand and thrown back up a series of stepped excavation platforms. This back-breaking labour was replaced by mechanical haulage up a tramway incline or skip road, power for this being provided by a horse whim, waterwheel, or steam engine.

The dispersal of the sand, gravel and stent at surface displays an evolution through two distinct phases. Initially the wastes were barrowed out along flat-topped dumps which spread, fan-like, from the margins of the excavation to cover the nearby moor. Barrows were in time replaced by tramways and hand-pushed skips to speed this process. These finger dumps are a notable feature of many of the Bodmin Moor works, as would be expected from their small-scale nature; in particular, Burnt Heath and Temple have good examples.

As the bounds of the sett became pressured by the expansion of the excavations and increasing amounts of dump material, so it became necessary to rationalise the methods of waste disposal. In an effort to conserve available land, the skip road from the pit was extended upwards and the material dumped directly off the top; as the mound of materials grew, so the skip road was extended, resulting in the characteristic conical mound of white sand, or sky tip. This also eliminated the labour-intensive tramming by hand of material along the flat-topped dumps. On Bodmin Moor, Glynn Valley has excellent examples of dumps of this type.

Modern practice is to remove coarse wastes by large diesel trucks to flat-topped dumps, each arranged in the manner of a stepped pyramid.

Sand and mica

The clay stream arriving at surface, although purified to some extent, still contained large quantities of waste materials, consisting of fine quartz sand and even finer mica. The original method of separation involved the use of three rectangular pits, stepped one below the other; as the stream slowly flowed through the pits the waste was deposited in each, sand in the first, fine sand and some mica in the second, and mica only in the third. The stream was then allowed to flow to settling pans for thickening.

The clay thus produced was far from pure, and it became necessary to improve the method of separation as consumers demanded a higher quality product. The processing of the clay therefore evolved into a system which became standard practice from the 1860s to the late 1960s. The clay stream was run into a relatively deep, narrow channel, in the bottom of which the quartz sand was deposited. At intervals the stream would be diverted and the sand dug out from the bottom of this sand drag.

From the sand drag the clay flowed through a broader, shallower series of channels, sectioned by boards to further divide the flow. As the clay stream slowed so the fine mica was deposited in these mica drags, and the pure product was then run through mesh screens to remove humic material. There are good examples of early, small mica drags at Durfold and Burnt Heath. In later years these mica drags were considerably expanded in size and complexity, often covering large areas of ground; on Bodmin Moor, the finest extant examples of this late type are at Glynn Valley (Fig 86).

The current technique employed in handling these wastes involves the pumping of the clay stream through hydrocyclones which separate the material by centrifugal force.

Sand was despatched to the dumps or burrows (as for the coarser material from the bottom of the pit). Mica from the drags is a very fluid material, and on

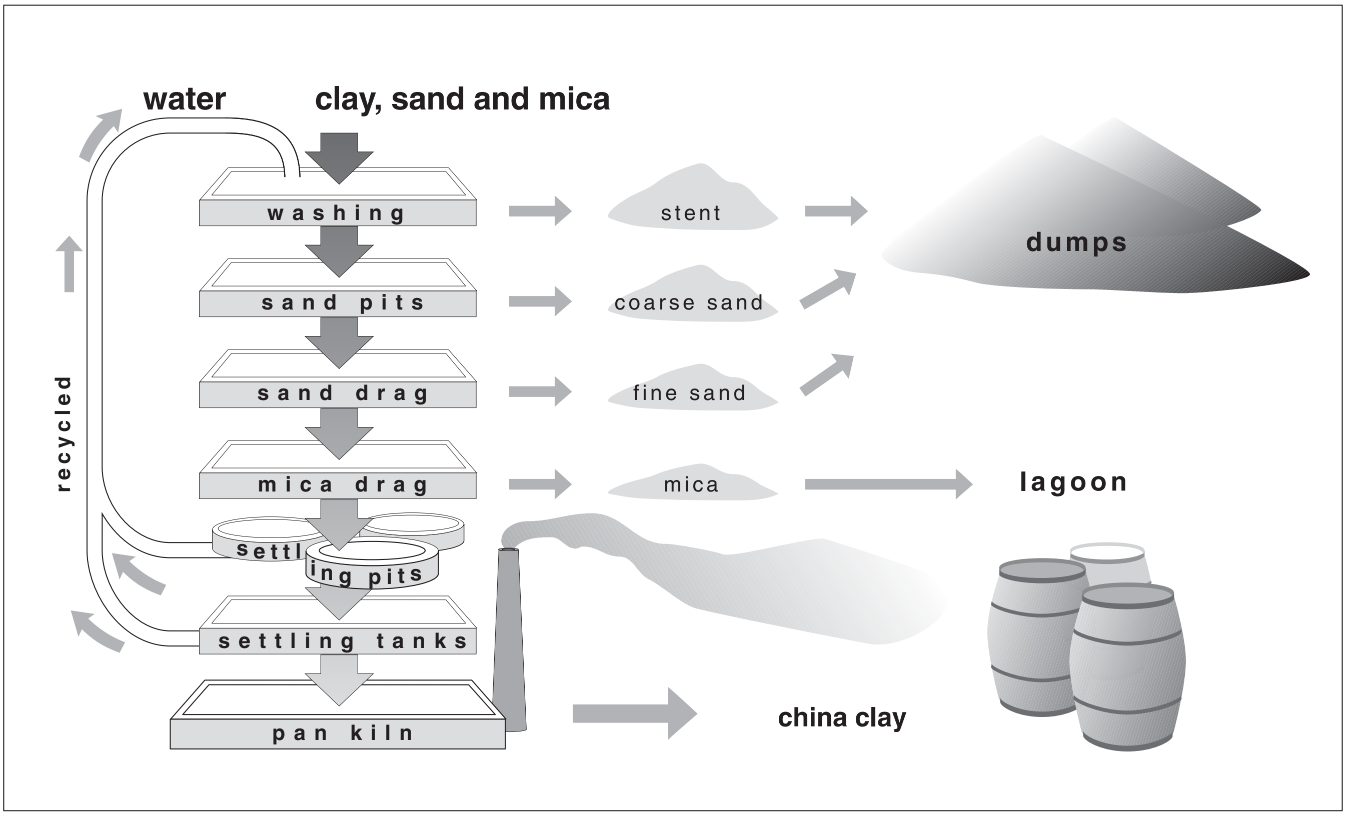


Fig 85 *China-clay production flow-chart. China clay is washed from the working face of the clay pit and enters the production cycle at the top of the diagram. Sand and mica are separated in pits and drags; the purified clay is then de-watered in a three-stage process of pits, tanks and the heated pan. (© Rosemary Robertson)*

Hensbarrow was normally directed to the nearest convenient watercourse and allowed to find its own way to the sea. This had three immediate results: the destruction of all aquatic life in the stream, the silting of ports and harbours, and the establishment of numerous small mica works downstream of the large producers. In the mica works, a small pan kiln would be used to reprocess the waste material and produce a marketable low-grade clay. On Bodmin Moor, the available evidence would indicate that this simple method of waste disposal was not allowed by the riparian owners. Most of the sites so far investigated show that micaceous waste was either thickened and dumped in burrows as at Durfold, or impounded in mica lagoons as at Glynn Valley. Lagoons are the current method of dealing with this material. As far as is known, there are no examples of downstream mica works reprocessing waste material on Bodmin Moor.

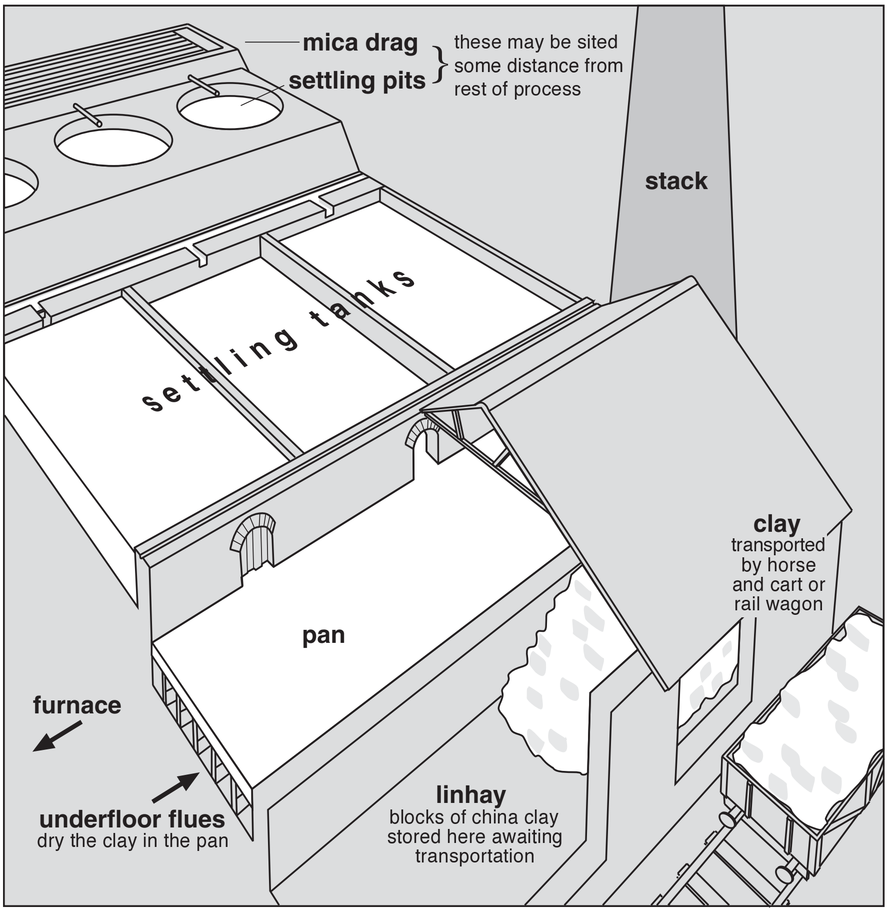
Water removal

Before the clay could be presented for sale it had to be dried. The first stage of the process was to run the slurry into stone-lined settling pits; these might be rectangular or circular in shape. There are many good examples of such pits on Bodmin Moor, at Burnt Heath, Durfold and Henneward. Here the clay was allowed to settle and the clear top water run off via pin-hole launders (similar to button-hole launders but with smaller holes). When the clay had thickened by the required amount it was run off via a sluice in the base of the pit to the next stage in the process (known as 'landing'). The earliest settling pits were of relatively shallow section, and these led in turn to clay pans where the clay was allowed to dry gradually in the open air. When sufficiently de-watered to be cut into blocks, it was removed and stacked in open-sided sheds or air dries until ready for sale.

This method of working, used in places on Hensbarrow until the 1920s, was inherently slow and labour intensive. There is no evidence for its use on Bodmin Moor, other than the possible remains of shallow pans at Burnt Heath. In the 1840s the pan kiln was introduced to the industry (Barton 1966, 121–3) At the extreme rear of the kiln were settling tanks into which the clay was landed from the settling pits and further thickened before being run on to the pan. Usually built into a slope to take advantage of a natural

Fig 86 *(Opposite, top) Glynn Valley mica drags (SX 144715) viewed from the north. A good example of a late-period (c 1920) set of drags, constructed with concrete channels. Early drags often had wooden channel dividers, and these leave little trace in the archaeological record. (John R Smith, copyright reserved)*

Fig 87 *(Opposite) Sectional view through a typical pan kiln. Although most pan kilns follow the same general design, there are many variations. (© Rosemary Robertson)*


mica drag
settling pits
these may be sited some distance from rest of process
stack
settling tanks
clay
transported by horse and cart or rail wagon
pan
furnace
underfloor flues
dry the clay in the pan
linhay
blocks of china clay stored here awaiting transportation

gravitational feed through the process, the kiln had as its lower front portion a linhay or storage area for the clay. The raised portion to the rear formed the pan; here a series of brick flues connecting a furnace at one end of the kiln with a chimney or stack at the other were covered with semi-porous earthenware tiles. These formed a heated floor onto which the fluid clay was run, the moisture being driven from the clay by means of the hot gases circulating beneath.

On Bodmin Moor there is only one visible episode of de-watering technology (although, as noted above, Burnt Heath has the remnant banks of what is possibly an air-drying process floor). On the basis of cartographic evidence, it would appear that almost all the works on the Moor had their own, often small, pan kilns, and there are good extant examples at Glynn Valley, Gazeland and Henneward. The lack of examples of air-drying technology may be due to the relatively late introduction of china-clay working on the Moor.

To further speed the de-watering process, filter presses were introduced in the 1920s as an intermediate stage between the settling tanks and the pan kiln. These reduced the water content by subjecting the clay slurry to hydraulic pressure, the resultant 'press-cake' being dried on the pan in the usual fashion. Present-day practice is to thicken the clay slurry in large (42m diameter) settling tanks, and then to dry the material in rotary or 'Buel driers'. A certain proportion is also delivered to consumers in slurry form.

Packing and distribution

Until the mid-20th century, china clay was always delivered to the consumer in bulk form. The blocks of clay were loaded from the linhay into carts or directly into railway wagons and transported to the nearest harbour. Some clay intended for shipment overseas was packed into 5cwt (254k) casks. The works on Bodmin Moor would have shipped their material through the ports of Wadebridge, Padstow or Fowey, and the cost and difficulty of transport to these relatively remote outlets was a major factor in constraining the growth of the industry in the area.

In the late 19th century, the condition of the roads on the Moor would have made the movement of clay to the ports (and the return load of coal to the kilns), extremely slow and expensive (*see* Chapter 11). The principal producers were soon forced into the construction of lengthy and expensive pipelines to carry the liquid clay to the nearest railway. Pipelines are today a vital component in the distribution and processing of china clay.

Examples of purpose-built clay transport systems on the Moor are the stone roadway and rail incline at

Fig 88 Glynn Valley china-clay works (SX 143718) viewed from the south. The stack in the foreground (i on Fig 92) is at the end of a flue from the pan kiln; behind are the sky tips (b on Fig 92). (John R Smith, copyright reserved)

Durfold, the pipelines from Temple, Glynn Valley, Hawkstor and Stannon, and the proposed (but never built) railway to Temple.

4 Pre-1914 workings

(All references to the history of individual clayworks in this Section and in Section 5 are from Brewster 1975.)

The china-clay sites on the Moor can be separated into two main types: those where development was limited and their working lives brief, and those where continued exploitation resulted in complex and multi-phase sites. Where pits are currently active, at Stannon and Park, modern processing methods and the disposal of waste products have resulted in the destruction of all early features; at Hawkstor the re-use of the waste dumps for block-making has also removed all evidence of early activity.

The date of 1914 is used in this study to divide those works which closed before or during the First World War (and did not reopen) from those which continued beyond it; the latter group in general display more advanced technology and have more complex site histories. A characteristic of the early clayworks in the area is the often very small-scale development of the pits. In some cases, as at Menniridden and Merrifield, it would appear that very little material could have been prepared for sale; in others such as Burnt Heath the flooded openwork has a larger surface area but the insubstantial nature of the dumps implies that it is relatively shallow. All these are indications of workings which had short lives; this proposition is backed by the available documentary evidence, and in some cases it would appear that such sites were little more than speculative trials.

Water power was the prime source of energy for these works; in only two cases, at Temple and Northwood, is there evidence for pumping or winding by steam. Where possible, as at Carwen, Gazeland and Durfold, the clay was gravitated from the pit to the process floors by adit. In other cases waterwheels were utilised for pumping, often transmitting their drive to the pit over some distance by means of flat rods as at Burnt Heath, Temple and Hawks Tor in the later period.

On the basis of the available evidence, almost all the works on Bodmin Moor originally had their own processing facilities, including coal-fired pan kilns. There would appear to have been virtually no recourse to the earlier method of air-drying; this, while appropriate to the relatively late date for the inception of the industry in the area, is perhaps a little surprising when the cost of transporting coal is taken into account. The extant kiln types in general follow the conventional form, but are small in scale as would be expected; an interesting exception to this is the kiln at Menniridden. Here a pan kiln of large dimensions has been provided for an openwork which is little more than a trial, suggesting grand but unfulfilled ambitions. Other more elaborate kilns dating from the pre-1914 period are to be found at Glynn Valley, Tresarrett and Henneward.

As expected, the process areas serving the simple kilns are small in size and primitive in type; there are examples of sand and mica drags, settling pits and tanks on most sites, all of which preserve an early stage in process technology rarely found elsewhere in Cornwall.

Cornwall has relatively few famous entrepreneurs, but one who was well-known in his own time within the china-clay industry was Frank Parkyn. He was born in 1850 at Collon near Lerryn (in St Veep), the son of a prosperous wool merchant. His health was delicate when a youth, and he was sent to live on Bodmin Moor in the hope that this would effect a cure; while there, he became interested in prospecting for china clay. As a result of this, during the 1870s Parkyn became one of the first to exploit the Bodmin Moor deposits, at Carwen, Durfold and Temple. In 1884 he went into partnership with Woodman Peters, to form the company of Parkyn and Peters, which later expanded to the Hensbarrow area to work pits at Blackpool, Halviggan and Biscovillet. Parkyn lived for many years at Penquite Manor, Golant, and involved himself in the village life of Lerryn, organising the Regatta and laying out a park on the edge of the river. He never married, and died at his St Austell house ('Glenview') in September 1940, aged 90 (*Royal Cornwall Gazette*).

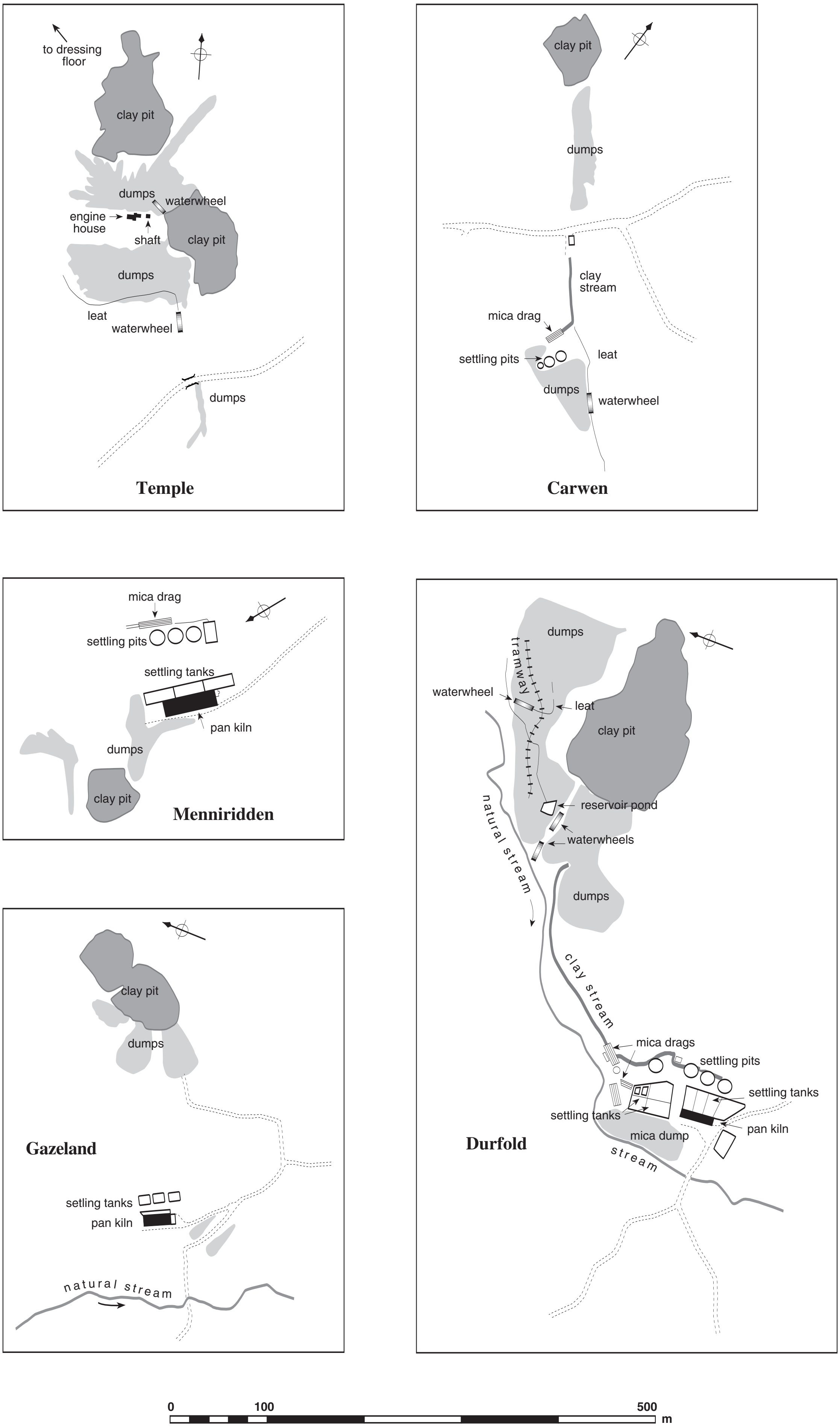
***Burnt Heath* (SX 128722; Figs 90 and 91)**

Burnt Heath was first worked in the 1870s, and was leased by Frank Parkyn in 1893 (Brewster 1975); the works were marked as disused on the 1907 OS 1:2500 map, 2 edn. Evident on the 1882 OS 1:2500 map, 1 edn, are the pit, flat-topped burrows, and a process area comprising settling pits and tanks.

Only the process area at Burnt Heath was surveyed in detail. An investigation of the remainder of the site revealed that power for pumping from the pit to surface was provided by a waterwheel in the valley below, driving the pump via a series of flat rods. The area where the pump and shaft were shown on the 1880 OS 1:2500 survey is now flooded and inaccessible. The dumps at Burnt Heath are flat-topped finger dumps, probably formed by barrowing the waste sand rather than tramming.

A notable feature of the site is the remnant bank system ((a) on Fig 90), partially overlain on the east by the later process area. These banks would appear to represent an earlier air-drying process floor; if so, they are the only example so far recorded on Bodmin Moor. Shallow rectangular pits and low platforms of this type are evident on the early OS 1:2500 maps of Hensbarrow, and the features at Burnt Heath may be a genuine survival of early process technology.

The remainder of the process area is conventional in form, though small in scale as might be expected. The clay stream from the pit was pumped up through a shaft located at (b); power for this pump was transmitted from a waterwheel in the valley below by flat rods. The stream then flowed through the deep, narrow channels at (c) (the sand drags) before entering the head of the mica drags at (d); these drags at present show no evidence of internal subdivision apart from a cross channel, but wooden boards were normally used to serve this function in early mica drags.


to dressing floor
clay pit
dumps
waterwheel
engine house
shaft
clay pit
dumps
leat
waterwheel
dumps
Temple
clay pit
dumps
clay stream
mica drag
settling pits
leat
dumps
waterwheel
Carwen
mica drag
settling pits
settling tanks
pan kiln
dumps
clay pit
Menniridden
clay pit
dumps
Gazeland
setling tanks
pan kiln
natural stream
dumps
tramway
waterwheel
leat
clay pit
reservoir pond
waterwheels
natural stream
dumps
clay stream
mica drags
settling pits
settling tanks
settling tanks
pan kiln
mica dump
stream
Durfold
0
100
500
m

The relatively shallow (1m deep) rectangular pond (e) may have served as a secondary mica separator, but on the basis of present evidence its function is unclear. The four circular settling pits (f) are granite-lined and average 2m deep; they are small by comparison with most examples on Hensbarrow, ranging in diameter from 8–10m. Unusually, they are here sited at a slightly lower level than the kiln, and so their contents would have had to be pumped out to the next stage of the de-watering process (rather than 'landed' by gravity, as was normal practice). Socketed granite stones adjacent to each pit are interpreted as mountings for simple plunger pumps, perhaps driven by flat rods from the waterwheel in the valley below. The settling tanks (g) at the rear of the kiln are again of granite with earth mortar. Another, larger tank (h) to one side of the kiln has no direct communication with the pan. This tank may perhaps be a water reservoir to provide a supply for washing the clay in the pit, rather than a settling tank associated with clay processing. The kiln itself is very small, with a narrow pan only 3m wide; the overall width of the kiln to the front wall of the linhay is only 8m. The chimney has been felled, but the base of the collapsed stack (j) is clearly visible.

Burnt Heath is a well preserved example of a small and idiosyncratic clayworks of the mid-19th century. Nothing comparable survives on Hensbarrow, but care must be taken if adopting the site as a model for clayworks of the same period elsewhere. Many of the features found at Burnt Heath seem far from typical, and may reflect an individual response to the particular site and its topography rather than general practice of the period.

***Carwen* (SX 110737; Fig 89)**

Prospecting had taken place in this area as early as 1838, but no exploitation of the deposit was attempted. The sett was granted to R Veale in 1862 (perhaps the first to be established on Bodmin Moor) and the Carwen pit was worked by Truscott from 1869. From 1873 the works were owned and operated by Frank Parkyn, and connected by pipeline in *c* 1890 to dries at Tresarrett; Carwen did not reopen after the First World War.

The 1882 OS 1:2500 map, 1 edn, shows a site north of Carwen Farm as 'Carwen China-Clay Works (Disused)'. This area, characterised by shallow workings and overgrown dumps, presumably represents the site of the original works, and the lack of any further development, as portrayed by the 1907 OS 1:2500 map, 2 edn, would indicate that they were not reworked after this date. If these are the original Carwen Works, relating to the period before 1882, then there remains the problem of establishing the site of the Torr works, which are also supposed to be in this area. The site south of Carwen Farm at SX 110737 does not appear on the 1882 OS 1:2500 map, 1 edn, but does appear on the later 1907 1:2500 map, 2 edn. This, together with an associated process works at Lower Polpry (SX 112734), is assumed to be the later site for Carwen. Site investigation in April 1986 revealed an area of overgrown dumps with flooded pit, and at Lower Polpry the remains of a small process area. This as far as can be seen included only facilities for primary processing (mica drags and settling pits), and would accord with the use of pipelines to despatch the clay to drying facilities at Tresarrett.

***Durfold* (SX 119738; Fig 89)**

The works at Durfold were well established by 1864, with a process area at SX 116736. Durfold was worked by Frank Parkyn after 1870, and was the first works on Bodmin Moor to lay pipelines to the nearest railway, in this case at Tresarrett (Stump Oak) on the Bodmin and Wadebridge Railway. The works were disused by 1906. The 1882 OS 1:2500 map, 1 edn, shows the pit, dumps, a process area including settling pits, tanks and a pan kiln, and a tramway connecting the process area with the road above the valley. Investigation in April 1986 revealed a complex and multi-phase site; the remains of the process floor survive intact except for the kiln, of which only fragments are now extant. The clay stream from the pit was gravitated via an adit and open leat to mica drags and settling pits in the normal fashion. Other features of interest are three wheelpits and reservoir, extensive dumps with tramming ways, and a cartway formed of large granite setts leading from the process area to the road at SX 112735. Evidence on the ground would suggest that the process area was expanded after 1907 to deal with mica waste, at this time possibly piped from Temple (Brewster 1975, 326). Adjacent to the process area at this point is the dam which fed the leat for the Gawns Wheel. This very large waterwheel, 50ft (15.3m) in diameter, was built to power pumps at Temple china-clay works.

***Gazeland* (SX 166698; Fig 89)**

This sett, comprising 120 acres (48.5ha), was established by the Gazeland Clay Company in 1873. There is a possibility that clay had been worked on a small scale in this area before 1842. Clay was despatched from a private siding at Doublebois station on the Cornwall Railway, but the company was unsuccessful and the works were sold in 1874 to T Pearse. The 1882 OS 1:2500 map, 1 edn, shows the works as disused, as does the 1907 2 edn and there would appear to have been no development in the interim. In 1910 the works had been reopened by the Gazeland China-clay Company and a pipeline laid to dries at Newbridge on the Great Western Railway. The works did not reopen after 1918. The OS survey for 1907 records shallow openworks, settling tanks and a kiln. A site visit in April 1986

Fig 89 *(Opposite) Examples of china-clay works on Bodmin Moor, from OS 1:2500 maps, 2 edn, various dates around 1905. Reproduced to the same scale, the five examples illustrate a variety of approaches to clay extraction. Durfold (SX 119738) (in its early phase), Gazeland (SX 166698) and Carwen (SX110737) drained their pits by adit to processing areas downslope; Menniridden (SX 168731) and Temple (SX 136732) pumped the clay from their pits by waterwheels and the latter also employed a steam engine.*

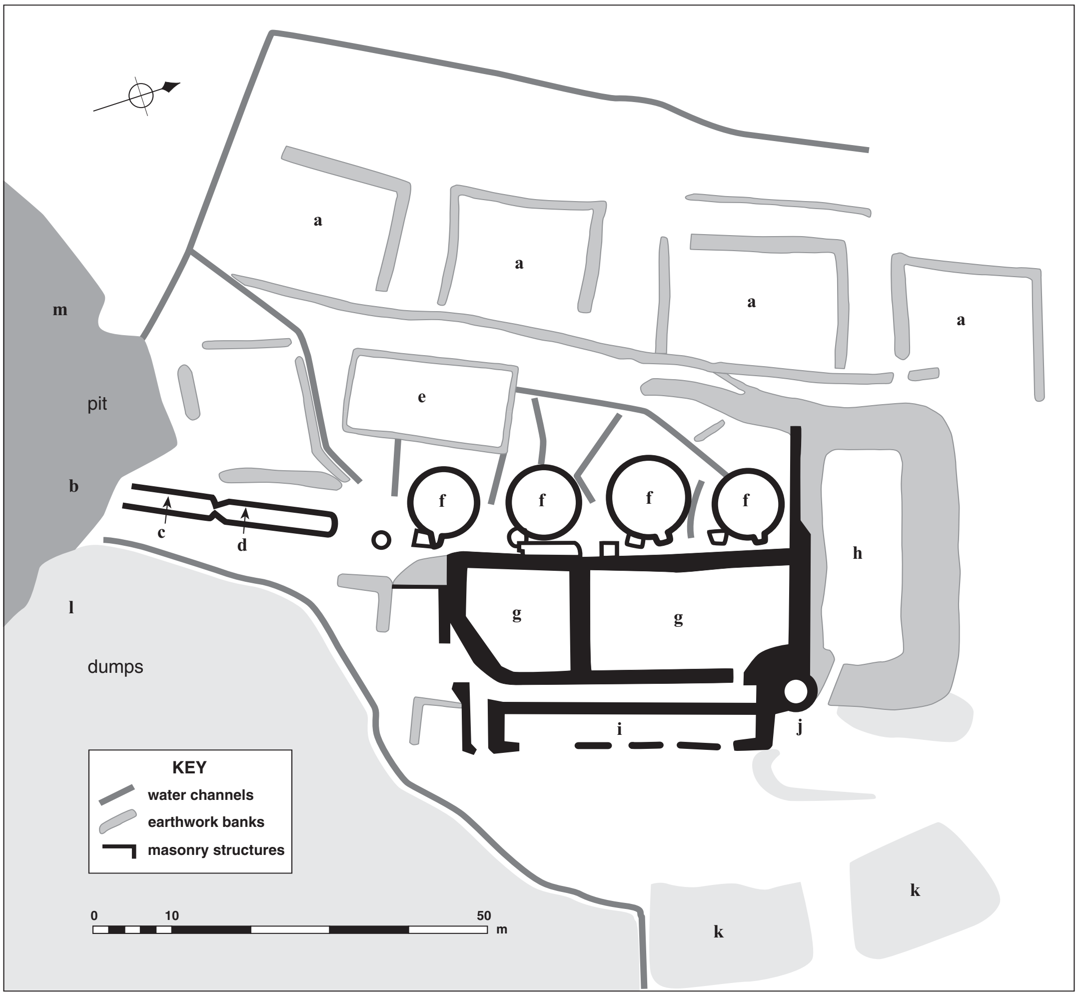


Fig 90 Burnt Heath china-clay works (SX 128722). The shallow tanks (a) may be the remains of early air-drying lagoons; they certainly predate the other features on the site. The clay stream was pumped from the now flooded shaft at (b) through the sand and mica drags (c) and (d) to the settling pits (f), where clear water was drawn off as the clay thickened and settled. The slurry was then thickened again in the settling tanks (g) before being dried in the pan kiln (i). The stack (j) has been felled. The shallow pond (e) has no obvious function; the large reservoir (h) probably supplied wash water to the pit. Mica waste appears to have been dumped to the front of the site at (k). The flooded pit (m) is relatively small (and probably shallow, as the main dumps (l) are neither extensive nor high). (CCC HES, GRE 121)

revealed the following features: two small clay pits, interconnected by adit, overgrown dumps, settling pits, and a small pan kiln with upstanding walls to a height of 3m.

***Henneward* (SX 112800)**

Henneward was first worked in the 1870s, but was disused by the time of the 1882 OS 1:2500 map, 1 edn, which shows a flooded openwork and small dump, circular settling pits and rectangular structures. There was no change at the time of the 1907 OS survey. A site visit in 1986 revealed further development on the same site in the form of a well-preserved pan kiln with remote stack, settling tanks, and settling pits at a higher level. None of these structures would appear to relate to the 1906 map evidence, and must represent a later phase of working.

***Menniridden* (SX 168731; Fig 89)**

Menniridden was worked by the St Austell and Bodmin China-Clay Company for a very short period and was shown as disused on the OS Survey of 1882. Evidence on the ground and from aerial photographs would suggest that development was very limited, despite the reasonably extensive process area of the

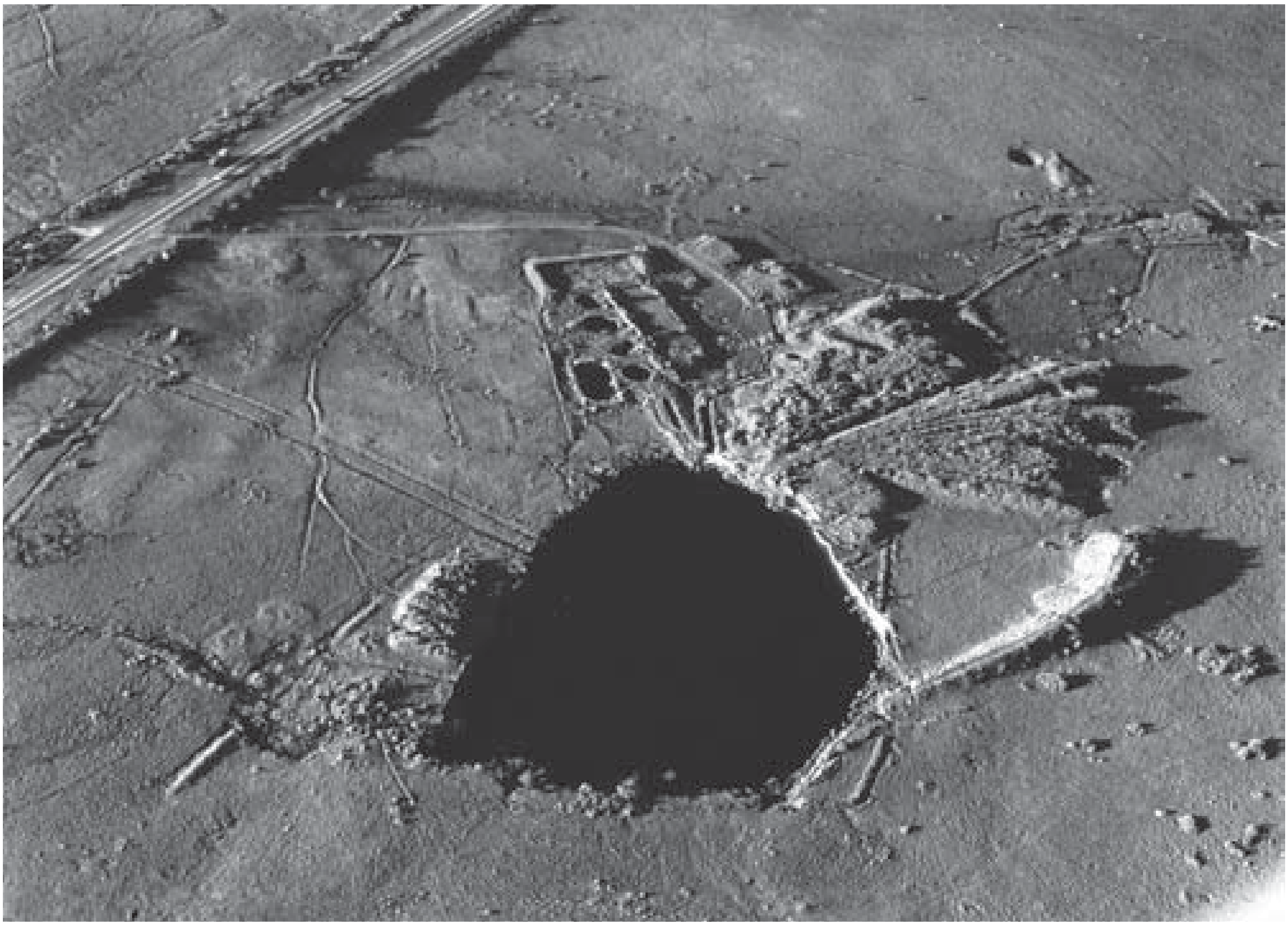


Fig 91 Burnt Heath (SX 128722) from the air, looking north-east in 1991. The pattern of finger dumps is clearly visible on the right-hand side of the pit; the single dump below is probably an overburden dump. (CCC HES, F33/262)

1882 mapping, including settling pits, tanks, mica drags and kiln. The site is now partially flooded by the Colliford reservoir.

Merrifield **(SX 147732 and SX 146725)**

Trials were noted in this area in 1866. By 1870 the works shown on the OS surveys of 1882 and 1907 were established, but had become disused by 1880 and seem never to have been reworked. The structures shown on the OS map are somewhat enigmatic; site investigation during May 1986 revealed a shallow openwork and dumps, round settling pits and a lower process area which may have incorporated a pan kiln.

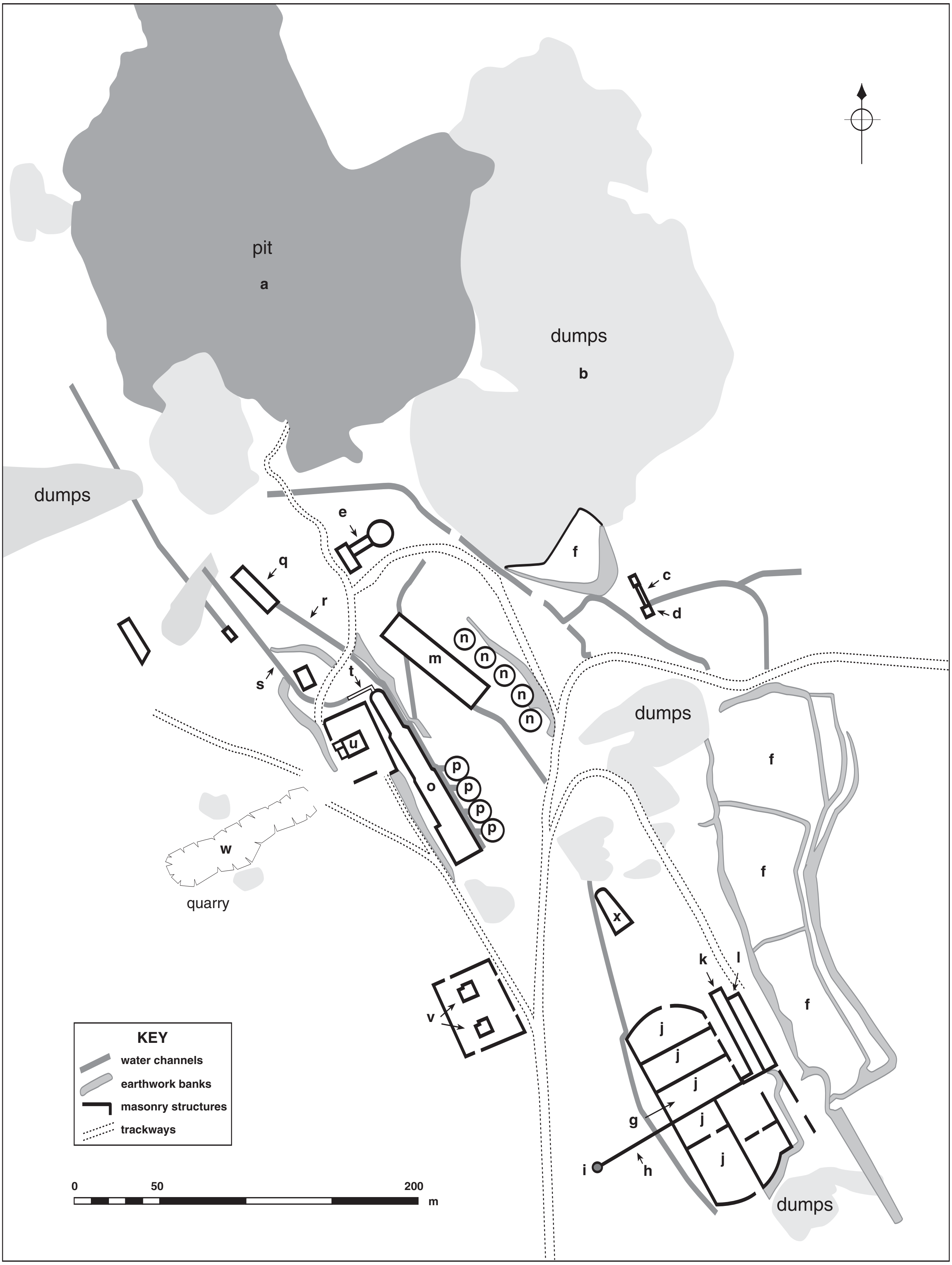
Northwood **(SX 197703 and SX 200697)**

The pit was originally worked in association with the Northwood tin mine, but would appear to have been unsuccessful. In 1878 the sale of the works was the subject of an action for fraud (*Royal Cornwall Gazette*, 1 March 1878), and they were again for sale in September when the assets included a 12in-horizontal engine, clay tanks and kiln, and a clay shed on the railway siding at Doublebois. The works were shown as disused on the OS surveys of 1882 and 1907; the 1:2500 survey of 1907 records the pit, linear dumps and tramroad, shaft and pumping engine, mica drags, tanks and pan kiln. There is evidence of considerable expansion between the two OS mappings, which would indicate that the pit was worked between the two dates. In 1908 the pit was reopened and connected by pipeline to new kilns constructed alongside the railway depot at Moorswater, near Liskeard. The works closed again in 1921.

A site visit to the Northwood works at SX 197703 revealed few extant structures, as the site has been overdumped and graded by the present owners, ECCI. Northwood is also referred to as Hulker or Carboulf; there is another clayworks to the south, nearer Northwood Farm. This is also shown on the OS maps, and is marked as disused in 1882; the map shows a small pit, and a processing area including tanks and a small pan kiln. A site visit revealed that the kiln and tanks remain but have been converted to a dwelling house and garden.

Poldue **(SX 132816)**

Poldue was opened in association with the nearby sett at Stannon in 1870, but by 1875 both works were disused. The 1882 OS 1:2500 map, 1 edn, shows a small clay pit, various rectangular tanks, and a small kiln. Site investigation during May 1986 revealed extant stone-lined tanks, and a wheelpit associated with the claywork.


pit
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earthwork banks
masonry structures
trackways
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m

5 Post-1914 workings

(All references to the history of individual clayworks in this Section are from Brewster 1975.)

Those pits which were reworked after the First World War display a more complex, multi-phase development than their predecessors. At Temple there are at least three episodes of working, each with a different power source for pumping. Glynn Valley is dealt with in detail below. Stannon, Hawkstor and Park were not included in the fieldwork for this volume as they were active at the time of the survey. All these works display a common feature: the abandonment of on-site de-watering and the use of pipelines to carry the clay to kilns built adjacent to railways off the Moor. That so few of the Bodmin Moor clayworks survived beyond the First World War is indicative perhaps of the poor quality of the clays, and the superior communications infrastructure of the St Austell china-clay district.

***Glynn Valley* (SX 143718; Figs 92 and 93)**

Glynn Valley was commenced in 1875, owned by D S Warne and worked by the Glynn Valley Kaolin Company. The works were sold in 1877 to Mr A Crichton, and again in 1879 to Frank Parkyn (Brewster 1975); by 1907 the works were disused (OS 1:2500 map, 2 edn). A new company (Cornish Kaolin Ltd) was formed in 1912 to work the Glynn Valley pit; the works were modernised and had reached the production stage when development was halted by the outbreak of war in 1914. The mineral rights were acquired by Tehidy Minerals Ltd in 1919, and the works were again re-equipped and a pipeline constructed to extensive dries on a private siding at Bodmin Road station. In 1924 the works were re-sold to Cornish Kaolin, which was absorbed by the English China Clays group in 1929. The clay at Glynn Valley was not of good quality, suffering from excessive contamination by white mica, a common failing of the Bodmin Moor clays (Barton 1966, 175). The pit was closed by a Board of Trade order in 1942 and never reopened.

The OS 1:2500 map of 1907 shows the pit, extensive leat system, settling pits and tanks, and a kiln with flue and remote stack. Glynn Valley was the subject of a detailed survey at a scale of 1:1000 during May 1986 (*see* Fig 92).

Unlike Burnt Heath, which is a compact site occupied only for a short period of time, Glynn Valley displays the evidence for a long and complex development as would be expected from the documentary record. For the purposes of this study only the process area was surveyed in detail, not the flooded pit ((a) on Fig 92) or the waste dumps (b). The pit is now considerably larger than that shown on the 1907 OS map, and the extensive development between then and 1942 is confirmed by the size of two distinctive sky tips which are now such a prominent feature of the landscape. There is no evidence on the site for power sources other than water before 1914, although a chimney and associated building shown on the 1st edition 1:2500 map may perhaps indicate the presence of a steam engine on the site in *c* 1880. This feature was not located in the 1986 survey, and from the map evidence would appear more likely to be a small kiln. A substantial stone-built wheelpit (c) housed a wheel which pumped from a shaft (d) connected by a level to the bottom of the pit. This waterwheel probably also provided power for winding sand and gravel onto the dumps. After 1918, a now ruinous concrete structure (e) may have housed an oil engine and generator, which would have replaced or supplemented the waterwheel for pumping and waste removal.

The process areas serving the pit have progressively moved upslope with successive changes of ownership. A set of small mica drags, three circular settling pits, and a series of rectangular tanks were shown on the 1882 and 1907 OS 1:2500 maps. These are associated with the first phase of development (1875–1900), but there is now no evidence of these features on the ground. The position which the tanks and pits occupied has been overlaid by mica-waste lagoons of a later period (f). This early process area in turn supplied the pan kiln (g). The kiln, which pre-dates 1882 (OS 1:2500 map, 1 edn) displays many unusual features. It would appear to have been designed as a double kiln, with two pans sharing a common flue (h) and remote chimney stack (i). Only the northern half of the kiln was ever completed, however, where the settling tanks (j), pan (k), and linhay (l), with five cart-bays, are all well-preserved. The kiln was in use during the first phase (1875–1900), and again in 1912–14; after the First World War clay was piped to new dries at Bodmin Road Station.

The process area belonging to the second phase (1912–14) does survive (partly obscured by the third phase works), as a set of mica drags (m) and a series of circular settling pits (n). The area is now overgrown and the pits are infilled. The final phase (1919–42) process area survives almost intact as a set of concrete mica drags (o) and four circular settling pits (p). Water for flushing the pits came from a tank (q) via a channel (r). Clay from the working face was fed into the head of the mica drags via a channel (s) which also incorporates a small sand drag.

Fig 92 *(Opposite) Glynn Valley china-clay works (SX 143718), a large and complex multi-phase site. The clay stream from the pit (a) ran in the first phase through a simple set of mica drags (x) to the pan kiln (g). The kiln has the usual settling tanks (j), heated pan (k) and linhay (l). The stack (i) in this instance is remote from the kiln, and connected to it by a flue (h). In the second phase a new set of drags (m) and settling pits (n) were built, which in turn were replaced by the third phase drags (o;* and see *Fig 86) and settling pits (p). In this last phase of operation the clay was sent by pipeline to a set of pan kilns at Bodmin Road station, and the pan kiln became redundant. Mica waste was impounded in the lagoons at (f). The waterwheel at (c) pumped from a shaft at (d) and also wound sand onto the sky tips (b). This power source was later replaced by an engine at (e). The quarry at (w) provided stone for all the structures on site. This pit is unusual for having workers' accommodation (v) and a manager's house (u), necessitated by its remote location. (CCC HES, GRE 95)*

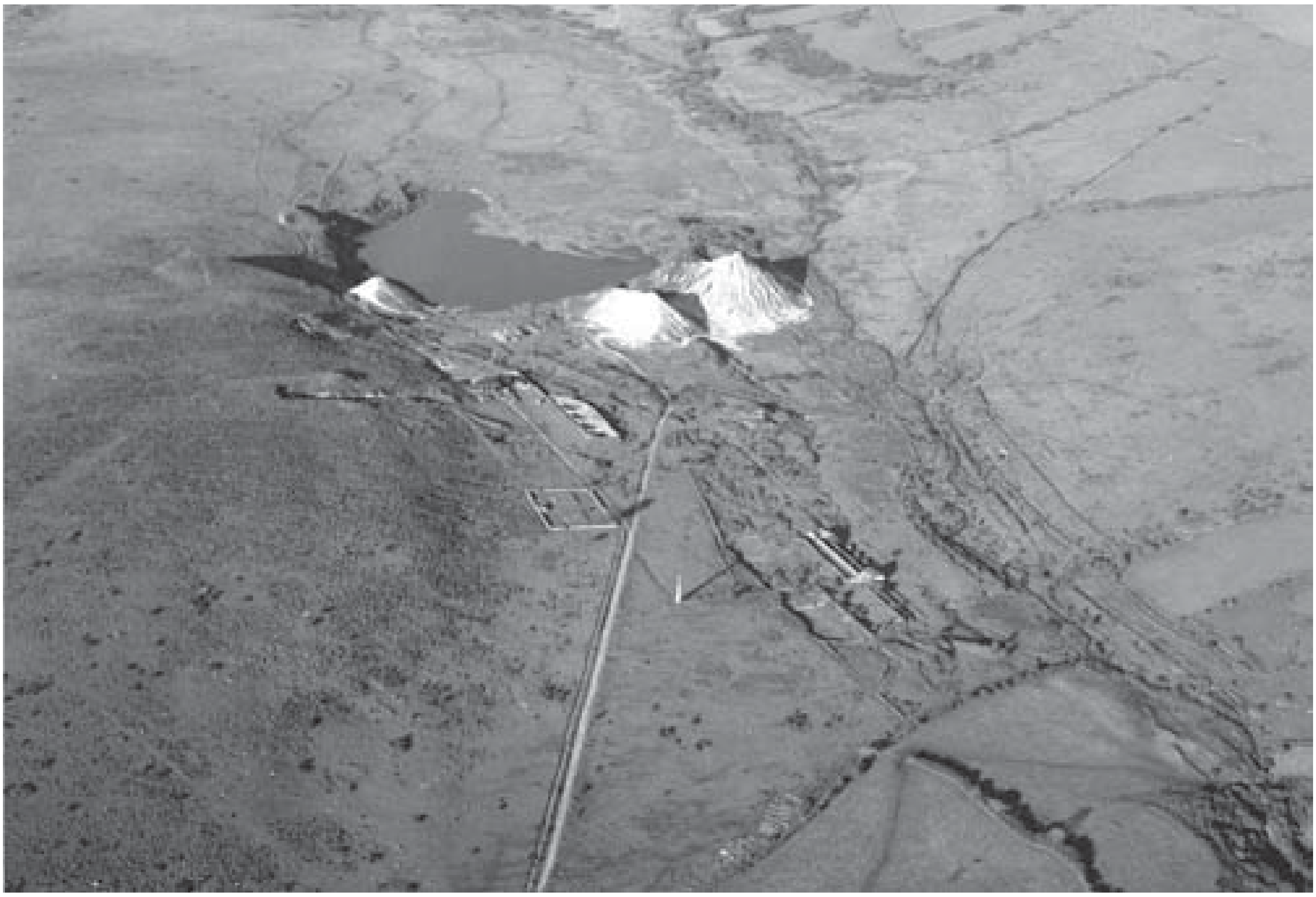


Fig 93 Glynn Valley china-clay works (SX 143718) from the air, looking north, in 1985. This view sets the works into its landscape context: Hardhead Down is on the right, Great Care Hill on the left. (CCC HES, F4/18)

Perhaps due to its remote location, the site also included a manager's house (u) and two cottages (v). The manager's house is complete, but the cottages survive only as foundation platforms. A quarry (w), is presumed to have provided stone for all the buildings on the works.

The survival of this extensive and complex site has largely been due to the absence of reworking since 1942, and the lack of any pressure for redevelopment in this remote area of the Warleggan Valley. Comparable sites in the St Austell area or the remainder of the South-West are rare. Once again, however, in many respects Glynn Valley is not typical of general working practice in the china-clay heartland of St Austell during the same period (1880–1940). In the St Austell area a works of this size would have used steam for pumping and winding by 1900 at the latest, and the design of the kiln at Glynn Valley has no documented or surviving counterpart on Hensbarrow.

***Hawkstor* (SX 150745)**

China clay was discovered at Hawkstor in 1864 (Brewster 1975, 328) and the pit was actively worked from 1870 until *c* 1900; the 1907 OS survey shows Hawkstor as disused. Frank Parkyn was the owner after 1880. The 1882 OS 1:2500 map, 1 edn, shows pit, dumps, an extensive leat system, sand and mica drags, settling pits, tanks and a pan kiln. In 1929 the Hawkstor pit was reopened by the Onslow Clay Company, and worked until 1931 when the Company failed; during this period pipelines were laid to new dries at Onslow Siding on the GWR main line near Newbridge, incorporating the earlier run of pipes laid by the Gazeland works. From 1933 Hawkstor was worked by the Great Hawks Tor Company but closed again by order of the Board of Trade in 1942. In 1945 the pit was reopened by the Bowaters China Clay Company, and worked until 1971 when the sett was acquired by ECLP and closed as a producing unit.

***Park (also known as Parsons Park)* (SX 195708; Fig 94)**

The first reference for clay working on this site is to a St Neot works in operation in 1869. However, the OS surveys of 1882 and 1907 do not record any evidence of workings on the site now covered by Park pit. Either the original works were very minor, or the 'St Neot Works' refers to the small site south of Northwood. The Park works were reopened in 1918, using the same pipeline to Moorswater as the Northwood works.

The works closed during 1942 and reopened in 1945; Park continued to be a major producer for the owners, ECCI until closure in 1997.

***Stannon* (SX 126807)**

The original works were closed in 1875, and the 1882 OS map, 1 edn, records a small pit, circular settling pits, tanks and pan kiln. In 1906 the pit was reopened

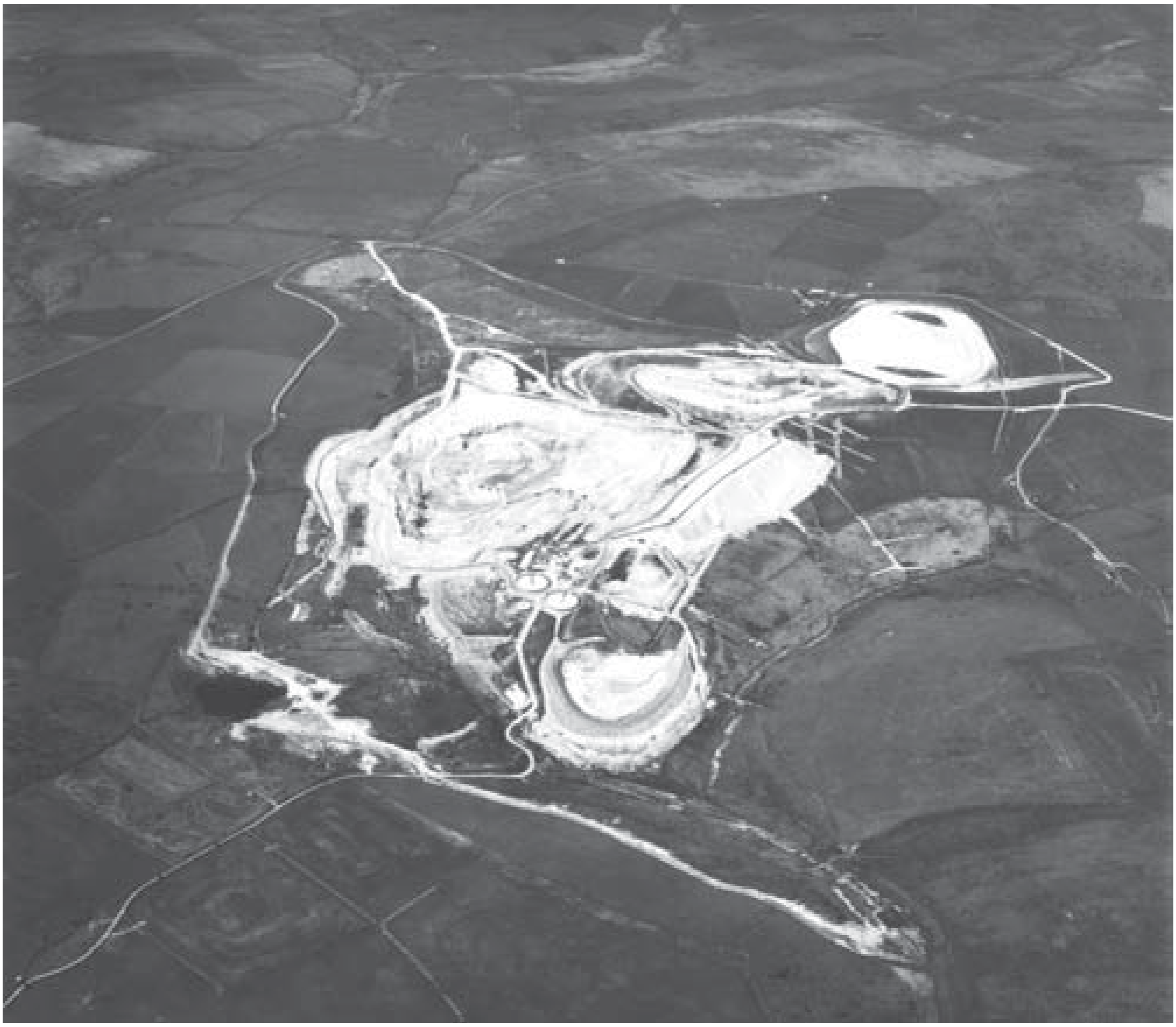


Fig 94 Parsons Park china-clay works, SX 195708, viewed from the south-east in 1977 when still operational. The extensive nature of modern clay extraction on Bodmin Moor is very apparent from the air. The works have now closed. (NMR, 1970/1, 1132. Crown Copyright Reserved)

with a large injection of capital, and a pipeline laid to new dries on the Wenford Branch of the LSWR at Penpont. Stannon closed in 1942, reopened in 1946, and was a major producer for ECCI and then Imerys until closure in 2000.

Temple **(SX 136732; Fig 89)**

The first recorded working at Temple is by Frank Parkyn in 1876. By 1907 the works were shown as disused on the OS survey; the 1882 map records two pits, one in use as a water storage reservoir, a leat system with two smaller reservoirs, an engine house and shaft, but no processing area on the site. At this date there was a process area shown to the north of Temple at SX 132735, but this was marked 'disused'. Only settling tanks were shown, and there is no evidence for a kiln on the map or on the ground. From the cartographic evidence it would seem probable that clay extraction was in progress at Temple well before 1876.

Temple was reopened in *c* 1908 (Brewster 1975, 335), and *c* 1919 was operated by power transmitted from a large waterwheel some distance away via a system of flat rods. A leat was taken off the stream at Durfold by a weir; about a quarter of a mile to the south is the wheelpit for the Gawns Wheel. At 50ft (15m) in diameter, this was one of the largest erected in Cornwall. It was built by Frank Parkyn to pump the clayworks at Temple, and transmitted its power 1¼ miles across Trehudreth Downs by means of flat rods. This extraordinary arrangement was not particularly successful, as much of the power was wasted in friction and lost motion. Parkyn scrapped the flat rod system, and built a generator beside the wheel (the house for which can still be seen). Wires then transmitted the current to Temple for electric pumps.

A site visit to Temple in 1986 revealed many extant features including two wheelpits and associated leats, remains of the engine house, the shaft with rising main

Fig 95 *Carkeet brickworks (SX 218732) viewed from the south-east, probably in the 1950s or 1960s. The remains of the downdraught kiln and its chimney stack can be seen in the foreground; the building at the left rear probably housed a pug mill and drying floors. (HG Ordish; copyright reserved)*

and pump rod *in situ*, and large amounts of wire rope. North of the pit at SX 132735 the settling tanks of the 1880 period survive, together with the remains of a pipeline and a later adit driven in the direction of the pit. South of Temple are further wheelpits, leat systems and dams across the streams feeding the Warleggan River; the purpose of this complex system is at present unclear, but it may represent part of an arrangement designed to transmit power to Temple or Glynn Valley.

6 Brickmaking from china clay

Following the general introduction of pan kilns during the 1870s, brick and tile making became established as an ancillary industry in the St Austell area. Providing bricks for chimneys and furnace arches, and bricks and tiles for the hypocaust and floor of the pan, they served the china-clay industry until the introduction of new processing technology in the 1960s made them redundant.

The material used for brickmaking was the poorer quality or discoloured china clay, in which a proportion of quartz sand and mica was allowed to remain; it was found that this mixture fired to form a naturally refractory or heat-resistant brick, well suited to its use in furnaces and kilns.

Examination of the china-clay works on Bodmin Moor has confirmed that Cornish bricks predominate where found; all the bricks used for pan kilns on the Moor would have been brought in from Hensbarrow or Lee Moor in Devon.

The only brickworks to be set up on Bodmin Moor itself was at Carkeet (SX 218732; Fig 95); this was in operation for a short period *c* 1890–1900 and would appear to have been a very small-scale enterprise. Marked as a disused clayworks on the 1907 OS 1:2500 map, the evidence would indicate a brickworks rather than china-clay processing. The 1882 OS 1:2500 survey, 1 edn, does not show the brickworks or pits. Site investigation in April 1986 revealed shallow openworks and small dumps, the remains of two small beehive kilns, one with a square stack, a linear structure, wheelpit and process buildings. The bricks made at Carkeet are red and marked 'Liskeard'; many are scattered around the site. The works probably consisted of a pugmill, moulding shed, drying shed, and two beehive kilns.

7 Turf

by Peter Herring

1 Introduction

The cutting of peat, or 'turf' as it is called locally, for fuel has been a strangely neglected aspect of Bodmin Moor's history; only three brief accounts have been prepared (Quinnell 1984; Herring 1986; Christie and Rose 1987). Turf played a crucial supporting role in medieval tinning – its charcoal being used in primary smelting (*see* below) – and it had later and lesser industrial uses in drying china clay (Daniell 1880, 79), storing Dozmary Pool ice and firing the Ice Company's engine house boiler (*see* Chapter 8, Section 2). More importantly, turf has been the principal domestic fuel in moorland homes from at least the 12th century (Henderson 1935, 126), still being used on a small scale in the Bolventor area. The viability of medieval and post-medieval settlements must, to some extent, have depended on the availability of fuel. Archaeological remains of turf cutting – the extensive cuttings and hundreds of turf steads (or peat platforms: *see* below) – also contribute much to Bodmin Moor's historic landscape. Many lanes and hollow-ways opening on to downlands were made as much for carrying home turf as for enabling livestock to move on to grazings. Turf rick stands survive in farmsteads, as do some turf houses.

Photogrammetric plotting for the Bodmin Moor Survey recorded details of turf cutting on Pridacoombe and Codda Downs (SX 165776 and SX 17507948) and located most moorland steads; these were then systematically recorded and measured by the RCHME. Croft Andrew excavated three steads in advance of the construction of Davidstow airfield and also undertook oral history fieldwork amongst moorland farmers concerning the steads' date and function (*see* Christie and Rose 1987). Documentary research has been pursued by Peter Herring (1986) and oral history in the Bolventor area continued by Herring (between 1979 and 1984), Jacqueline Nowakowski (between 1981 and 1984), and most recently and extensively by Tony Blackman (1995). The late Mr Will Lemin of Pinnock's Hill (SX 18497462) also wrote a valuable account of turf cutting and use (Lemin, nd).

2 Nature of the turf

Peat cut on Bodmin Moor can be divided between that dug in pits and that skimmed off the surface of downlands; the former can be further split into valley and blanket bogs. Each type was named and harvested differently (*see* Figs 96 and 98).

As early as 1285 the turbaries of Twelve Men's Moor could be separated into 'dry and wet' (Hull 1987, 209), presumably blanket and valley bog respectively, later to be termed hill and marsh, or 'mash' turf (eg Lemin nd); and in 1758 Borlase distinguished between 'black soil … cut up in thin turfs for firing', and bogs yielding 'thick brick turf … which, when thoroughly dryed, makes a strong fuel' (Borlase 1758, 59). The 'thin turfs' were later called vags (Marshall 1796, 6) or tabs (in an 1813 court case – Barton 1970, 42) and more recently tobs (when particularly long and used for thatching – Keast 1995), skimmies (Jack Parkyn 1995), moor, shovel, or spade turf (Lemin nd; Hosken 1995; Harold Rich 1995) or vellin turf (Keast 1995). The last was named from the velling share or velshare used in the 20th century to plough turf from downlands, an activity recorded on Pridacoombe Downs, Tolborough and in the Fowey valley (Tapp 1982; Bunney 1995; Thompson 1984, 66, respectively; and *see* Fig 96).

Bodmin Moor turf was generally of poor quality, only the bottom parts of hill and marsh turves, the 'black' or 'coal' ends, shedding water once dried (Davey 1995). The rest, including the whole of skimmies, was absorbent and liable to 'go back' to a sodden state if allowed to get wet (Ernest and Mary Rich 1995). Edward Hosken of Trezibbett when visiting Shetland marvelled at the quality of peat there compared with that of Bodmin Moor but also noted, significantly, that 'they didn't build their ricks so well as us' (Hosken 1995). William Marshall in 1796 also recorded, again significantly, that Cornish peat was not 'firm enough, it seems, to be charred (as on Dartmore)' (Marshall 1796, 6).

3 Turf charcoal

There is, nevertheless, later medieval documentary evidence for turf charcoal production on Bodmin Moor. Cornish tinners' liberties to 'dig turves to melt their tin … anywhere in the lands, moors and wastes of us and of others whomsoever' were confirmed in charters of 1201 and 1305 (Concanen 1831, xv and appendix, 198). John Hatcher attributed the close correlation between the fortunes of tinners and turbary in the manor of Helston-in-Kirrier to the turf being used to produce charcoal for the tinners' first smelt. He also found in the 1359/60 account of that manor receipts from selling ***turba carbonum*** (turf charcoal) (Hatcher 1970, 186–8). The pattern of receipts from the turbary of Helstone-in-Trigg manor (essentially upland Advent) largely echoes that of Helston-in-Kirrier and it seems reasonable to suppose turf charcoal was also being produced there to service the tinners of Bodmin Moor (*ibid*, 186–9). 'Turbarie Cole', presumably turf charcoal, was certainly being sold from 'a more called Fowaymore' in 1476 (Maclean 1886, 33). ('Foweymore' appears confined at this date to central and south-western Bodmin

Fig 96 *Turf cutting around Goodaver stone circle, Altarnun (SX 208751) viewed from the north in 1955. The broader, deeper, and more irregular cuttings are of hill turf or blanket bog, cut with the turf iron (*see *Fig 97), and the narrower, shallower and straighter cuttings are of skimmies, cut with either the breast spade or the horse-drawn velling plough. A small turf stead lies close to the right side of the stone circle (upper centre of photograph). Note how the cutting appears confined to the turbaries delineated by the pasture boundaries. (Cambridge University Collection, QC 64; copyright reserved)*

Moor; Herring 1986, fig 29.) This was a decade after the 1466 grant to Cornish tinners of turbary and pasturage in Dartmoor forest because their 'moors and woods had been so much wasted, that fuel for melting tin could not be obtained in sufficient quantities, or at reasonable prices, and the coinage had consequently fallen off three hundred marks and more' (cited in Smirke 1843, Appendix, 30), a document widely used to indicate the virtual exhaustion by then of Cornish peat (eg Hopkins 1980, 248; Quinnell 1984, 12; Sharpe 1993, 258). Richard Carew, however, was still able to record in 1602 the converting into 'coal' of 'dried turfs', 'to serve the tinner's turn' (Carew 1811, 69) although by 1733 Tonkin, footnoting Carew's text, stated that 'our tinners do not at present chark the turves to blow their tin' (*ibid*, 70).

Bearing in mind the poor quality of Bodmin Moor peat for charcoaling, it seems likely that the 1466 charter recognised the significant economies to be made by giving Cornish tinners access to Dartmoor's extensive valley and blanket bogs with their firmer and deeper peat, of 'superior quality … admitting of being charred' (Marshall 1796, 25). Dr Harold Fox has chased *carbonarii*, people who dug 'turves for charcoal in order to sell it' to tinners through the Dartmoor account rolls, from 1297 when 27 were recorded, through the 14th century when numbers often exceeded 100; the 1477 account roll separates out the Cornish *carbonarii* (Fox 1996). 'Innumerable' sites of 'meilers', primitive kiln-type structures in which mounds of turf bricks were reduced to charcoal, have also apparently been found on Dartmoor (Woolner 1965). Archaeological remains of the turf charcoal industry have also been sought in Cornwall and the numerous platforms, close to both turf cuttings and tin streamworks on Bodmin Moor and also near turf cuttings on the downlands of the Lizard have been suggested as medieval stands for stacks destined to be charred (Quinnell 1984) although there are now doubts about this interpretation (*see* below). What is certain, however, is that large quantities of charcoal were required for smelting stream tin – some 250 tonnes being suggested for Foweymore and Blackmore for the year 1305 alone (Sharpe 1993, 258) – and also that Bodmin Moor's medieval turbaries were of considerable economic importance, second only to tenancies in raising revenue. Goosehill in Helstone-in-Trigg manor produced 25s 4½d (£1.28) in 1296–7 (Christie and Rose 1987, 179); Hamatethy's turbary was worth 40s (£2) per year by 1432 (Maclean 1873, 357); and Blisland manor's 'outmoores' yielded the lord up to £20 per year in the early 15th century (*ibid*, 89).

Much of the turf cut in the medieval period and virtually all that cut in later times on the Moor was, however, for use as heating and cooking fuel and it is with the domestic aspect of the industry that the remainder of this chapter is concerned.

4 Turbary

A right to turbary has been a necessity for moorland households into the 20th century. Medieval tenants, however, often had to pay for their turf; the 1432 extent of Hamatethy manor records free tenants' payments for turbary (Maclean 1873, 357) and while Blisland's customary tenants had from 1596 'reasonable turbary, to be burnt in their owne houses' free in the 'outmoores' and for 1d per year elsewhere, free tenants paid 3d per year for outmoores turf (*ibid* 89, 91). By the 18th century, however, turbary rights in specified places were generally incorporated into leases without separate payments being made: a typical clause was that in a lease of 1837 for Pridacoombe, 'with full and free liberty … at all reasonable times of the year to cut on Pridacoombe Marsh … any quantity of turf for fuel to be consumed in the Dwelling House' (CRO, RD 200). Some people living on the Moorland edge or within villages bought turf. In the mid-20th century Gordon Williams' uncle, of Five Lanes, bought turf from near Bolventor (Williams 1995) and cottagers at Bolventor itself bought from Jim Pollard of Meadows (Winn and Winn 1995). Others paid local men to cut them 'journeys' of turf, usually 2,000 hill turfs per day (Mona Parkyn 1995; Goodenough 1995). Turf was also apparently taken from the Moor to Liskeard by ox cart earlier this century (*ibid*), and in the 1930s in lorries from Meadows Downs 'for sale in the towns' (Wherry 1995).

Fig 97 *Turf iron from Dairywell Hill, Altarnun, SX 179770. The four pieces of wood are bound together partly by the mild steel blade, partly by nails. The blade's wing (left) and feather (right) were sharpened to a fine edge so that when pushed down via the spitting iron (here supported by strips of leather) and the long handle (here with rubber protection at its top), the tool cut a neat rectangular block of turf;* see *Fig 98. (Drawing © Rosemary Robertson; based on Herring 1986, fig 9)*

5 Harvesting turf

Cutting

Surveyable remains of turf cutting are confined to hill and marsh turf; skimmies leave only slight differences in vegetation. Pits, often waterlogged, as much as 1.5m deep and with vertical edges, are most impressive in blanket bog. The most extensive and best preserved are on Pridacoombe Downs (SX 165776), but other good examples are on Codda, Meadows and Minzies Downs (SX 17507948, SX 178740 and SX 179186), and on Shallow Water Common (SX 149765). Marsh cuttings tend to lose definition through reabsorption, although relatively clear examples survive in Watery Marsh (SX 234774), and beside the Fowey at Wimalford (SX 21137350) and Higher Langdon (SX 21107310).

Hill and marsh turf was cut with a turf iron (Fig 97), similar to Irish underfoot slanes and Scottish peat spades or irons (Evans 1957, fig 62; Grant 1961, fig 36; Fenton 1986, 104–32), but with a more pronounced feather and the wing, perpendicular to the main blade, more slender and downward pointing (*see* Fig 97). Many moorland farmers retain their irons and examples are exhibited in Launceston, Bodmin and Camelford museums. Either left or right handed, modern irons were hammer-and-chisel cut from sheets of ¼in (3mm) mild steel by local smiths – 'shape them, turn up, pull up wing and sharpen afterwards' – and provided with shaped long handles made from 6 by 2in (150 by 50mm) timber (Harold Rich 1995). Ley smithy (SX 174663) made irons for farmers in moorland parts of St Neot and Warleggan, and occasionally re-laid them, or fitted new handles and spitting irons (account books 1895–1935, held by Peter Kent and analysed by Tony Blackman).

The turf iron cut a rectangular slice, typically 5¼in (90mm) square and between 2ft and 2ft 6in (610–760mm) long (Lemin nd). Hill turf was cut and landed by one person in two movements, the first to break the 'ream' (the top 6in [150mm] or so), the second to push right down and land (Keast 1995). Rows of ten turves were cut, often with five landed in the pit and five 'on land', with every tenth row thumb-nicked so that turves could be easily counted in hundreds (Lemin nd). Cutting marsh turf, often waterlogged, was particularly hard work and usually involved a second person as 'lander', marsh turves being up to 4ft (1.2m) long (*ibid*; and *see* Fig 98). The lander, often a woman, stood in the pit piling them onto the bank, 'a dirty business' (Mona Parkyn 1995). The turves were then often pulled by dray, a simple sledge, to the drying ground; hill turf was dried alongside the pit. Turf irons had to be regularly sharpened (Winn and Winn 1995), usually with a barker, a rounded stone 8–10in (230–290mm) long, narrowing at each end (Williams 1995).

Until the late use of skimming or velling ploughs whose flat shares, *c* 10in (290mm) wide, had sharp triangular wings brazed onto the leading angle (Hosken 1995), skimmies were cut with the round-ended vell shovel (Harold Rich 1995) with 'handle pitched to work it nicely' (Hosken 1995), or with the breast spade/plough (Keast 1995). The vell shovel was 'wiggled' under the turf which was levered up (Carey 1995) while the breast spade's cross-bar was pushed from the thighs, often with the help of a second person pulling on a rope, 'twitching the spade' (Keast 1995). Both methods were extremely laborious, reflected in the number of skimmies cut in a 'journey', or accepted day's work; 800, compared with 2,000 hill turves

Fig 98 *Cutting marsh turf* c *1942, probably on Pridacoombe Downs, Altarnun (SX160781). Each turf is lifted on the broad wooden back of the iron's blade (*see *Fig 97) and then tossed into its place in the lines of turves. (From the archive of CK Croft Andrew, held at CCC HES)*

Fig 99 Jack Parkyn thatching his farmstead turf rick with rushes at Wimalford, St Cleer (SX 214736) in 1995, showing the use of broken and short turves to form the apex of the rick. (Tony Blackman; copyright reserved)

(Ernest Rich 1995). A moorland household usually required *c* 10,000 turves per year (Lemin nd) so the cut took between 5 and 13 days.

Cutting took place in springtime, before hay harvest. 'Turf was May Month' to some (eg Lemin nd; Vickery 1995) but others cut a little earlier. Edward Hosken cut mid- to late April, weather permitting, and John Goodenough 'when the sap began to rise' (Hosken 1995; Goodenough 1995).

Drying

Women were usually responsible for the turves between cutting and carrying (Lemin nd). Marsh turf was drayed from pit to drying ground, a slight slope, preferably with heather rather than grass (Leigh 1937, 197). Drays were simple sledges; side-timbers approximately 4ft (1.2m) long and 3ft 6in (1.05m) apart had 3in (70mm) wide and ½in (12mm) thick iron bottom runners and cross members fixed at 1ft (300mm) intervals (Hosken 1995). They were drawn by horse or pony attached with fore-horse harness and with chains from the collar at shoulder height running through back and loin straps to reversed crooks at the front of each side timber of the dray (Harold Rich 1995).

The turves were laid out between 2in (60mm) and 5in (130mm) apart, in rows (Lemin nd; Ernest Rich 1995; and *see* Fig 98) and turned when part dry, when the ends turned up, in good drying weather (hot sun, keen 'turf dry' winds) about a fortnight after cutting (Malim 1936, 23). Some people turned by hand (Goodenough 1995) but most used some sort of tool to avoid bending down to around 10,000 turves. The 'titch crook', a hoe handle with iron ferrule and two perpendicular tines approximately 5in (130mm) long, was the tool for the job, the crook just catching or 'titching' the turf (Keast 1995); but turnip hoes were also widely used (eg Bunney 1995), and even a stick with two nails (Davey 1995). If the season was wet turves were 'crossed', groups of four set up, coal ends down, to get them off the wet and to let the wind blow through them (Mona Parkyn 1995). Skimmies, larger and flappier, were turned with more difficulty using a turf pike (Carey 1995).

Saving and ricking

Given reasonable weather, the turf would be dry and ready to 'carry' or save sometime in June (Vickery 1995). Dryness was assessed by weight or breaking a turf open (Hosken 1995). Saving was most effectively undertaken with four people, a woman or child passing turves to a man loading the cart at the drying ground and a woman or child passing turves to a man building the rick in the farmstead. While the cart was away the woman or child would heap turves on the Moor ready for the next load (Hosken 1995). Vehicles were either two-wheeled tipping carts

*Fig 100 Jack and Bernard Parkyn spooking (pinning) skimmies through the rush thatch, to hold it in place, on the Wimalford farmstead rick (*see *Fig 99). Skimmies are the heavy flat turves skimmed from hill slopes with a breast spade. (Tony Blackman; copyright reserved)*

drawn by one horse or, later, by a tractor (eg Winn and Winn 1995), or four-wheeled undershot wagons drawn by two horses in tandem (Wherry 1995; and Hartley 1935, plate 24). Carts were also used in the medieval period; William Best of St Clether was accused in the 13th century of taking no less than 300 cartloads of turves from a turbary at Newhouse next to Dozmary Pool claimed by Launceston Priory (Hull 1987, 36).

The ricks were built close to the house, often 'out the back' (Mona Parkyn 1995), sometimes in the mowhay (Leigh 1937, 197), sometimes a special 'turf mowhay', as at Newton in Blisland (SX 12377388). Here the enclosure, sheltered by stone hedges, fronted the house and had an entrance wide enough to admit a wagon. It also contained a well and 'must have been the centre of domestic life' (Leigh 1937, 192). Most ricks were built on rectangular stone platforms, 'steads', standing *c* 9in (230mm) above the ground (Ernest Rich 1995), remains of which survive at several farmsteads (eg Slades, SX 15408029, Dairywell Hill, SX 17927703 and Middle Pridacoombe, SX 16597642). Considerable skill was involved in rick building; this was usually a man's job, with women and children handing and tossing him turves (Hosken 1995; and *see* Figs 99 and 100). Two rows of turves were laid all the way round and all the way up, to about the height of a man (Hosken 1995), black or coal ends poking out as the grass ends would 'soak in the rain, when the black ends run it off' (Lemin nd and also Davey 1995, Keast 1995). Turves were laid sloping outwards to cast water (Davey 1995) and the rick walls sprung (built leaning out slightly) to prevent it entering (Jack Parkyn 1995; and *see* Fig 101). Turves on end were carefully stacked in the centre of the rick which had a hipped 'roof' thatched with rushes scythed from a nearby marsh, the first 'course' or layer overhanging by *c* 6in (150mm), and laid stub ends down, all other layers ears down. The top was a row of bundles of rushes bent over the apex and 'spared' (speared) in on each side (Hosken 1995). Like other farm ricks, the thatch was often held down with cord (made on site with a twister) either running from end to end and spoked or spared at the ends (Hosken 1995) or round-roped and weighted with heavy stones (Davey 1995). Alternatively 'tobs', breast-spade cut turves as long as the rick were laid and spooked along its length, across the thatch (Keast 1995; and *see* Fig 100). Rick corners were vulnerable and often protected with timbers, branches or faggots (Ernest Rich 1995; Wherry 1995). In the last few decades turf was sometimes stored in buildings, 'turf houses', often reused farm buildings (eg Davey 1995, Harrison 1995).

Fig 101 Rick built c *1940 on a turf stead at the cutting grounds, possibly Pridacoombe Downs, Altarnun (SX 164773). The stacked turves were cut with a turf iron and those holding down the rush thatch are skimmies (*see *also Fig 100). Note how the quoins are carefully bound in with overlapping turves and the rick's sides are sprung to protect it from the elements. The stead has been reused as the ditch has not been freshly cut. Grazing animals were kept at bay by the single strand barbed-wire fence. (From the archive of CK Croft Andrew, held at CCC HES)*

Temporary ricking on the turf grounds

Two or three days of good weather were required to save a year's turf supply (Leigh 1937, 196) and June, generally the preferred month, was also, of course, the time when farmers were engaged in the hay harvest, a job taking precedence over turf carrying in terms of use of both labour and vehicles (Keast 1995, Wherry 1995). There were years when poor weather at this critical season prevented turf being saved (Vickery 1995). For others, 'poor farm hands', industrial labourers, and cottagers, the problem was a lack of vehicles to carry the turf; farmers would provide a cart or wagon later in the year when they were free (Robb Hambly 1942, cited in Christie and Rose 1987, 184). However, both sets of people, those with no vehicles and those caught out by poor weather and committed to the hay harvest, needed temporarily to save their carefully dried turf. This they did by building ricks in the drying ground (*ibid*; Tapp 1982; James 1982, cited in Herring 1986, 61; Heller 1995; Mona Parkyn 1995), a practice seen in most other British turf-cutting regions and neatly described in the Yorkshire Dales; once stacked, turf 'did not spoil and could be led (carted) after haytime or even the following year' (Hartley and Ingilby 1968, 65). Angus Winchester has recorded huts, peat-scales, used for this purpose in the peat-cutting grounds of the Lake District (Winchester 1984) and platforms similar to those on Bodmin Moor on the north-western slope of Cruachan Treshnish (around NM 345475) on the Isle of Mull (Angus Winchester, pers comm).

The principal difference between Bodmin Moor turf and that cut from deeper, more homogeneous blanket bogs elsewhere in Britain was in its absorbency, its tendency to 'go back' if allowed to get wet. While Irish, Scottish and Northern English turf cutters could simply heap their dried turves, angling the top ones to shed water (eg Hartley and Ingilby 1968, 65; Glassie 1982, 476–8; Fenton 1986, 139–140), those on Bodmin Moor were obliged to build stacks on the Moor essentially similar to those built in their homesteads, carefully laid, black ends out, and with thatched tops and sprung walls (*see* Fig 101; and Christie and Rose 1987, fig 16 which shows a moorland rick thatched with overlapping skimmies) (Keast 1995; Hosken 1995). It is perhaps significant that Mull peat was also considered to be relatively poor compared with that of other Hebridean islands and although 'it was a quite adequate fuel … it had to be stacked up for transport home from the moors' (Macnab 1970, 136).

With few stones in turf grounds, the stackers usually built straight on to the land, although there are moorland steads partly built of stone (eg SX 16227747 on Pridacoombe Downs). The great majority, however, simply had a ditch dug once the rick was built to take eaves water, to keep the rick base dry, and to keep

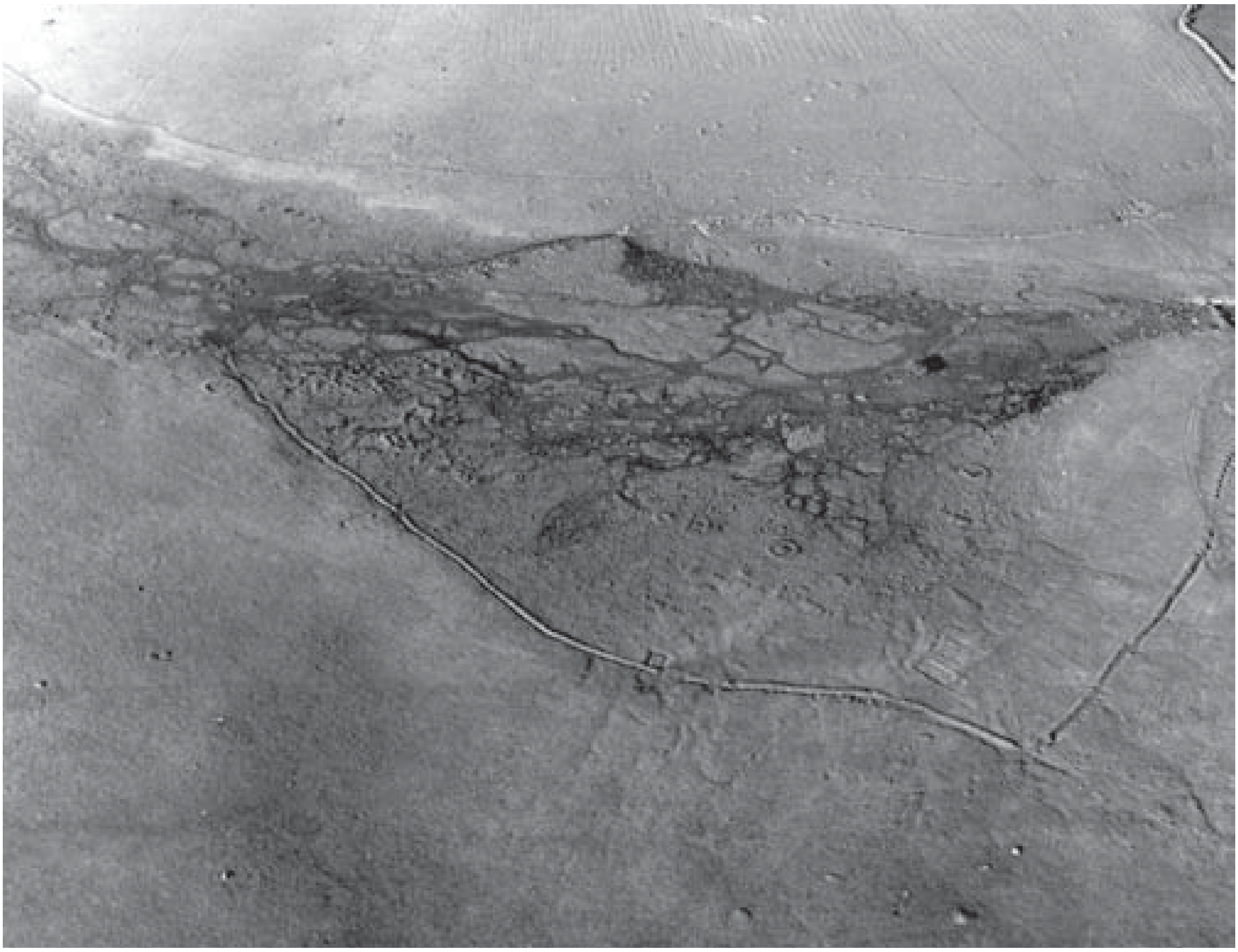


Fig 102 Turf steads in a variety of shapes and sizes around Watery Marsh, North Hill (SX 234774), viewed from the west. (CCC HES, F33/180)

grazing animals at bay (some were also enclosed by barbed wire fences, *see* Fig 101). The ditch upthrow bank was therefore external. These steads are found in large numbers throughout Bodmin Moor, in areas where hill and skimmy turf was cut and on the slight slopes around bogs where marsh turves were drayed and dried. They survive as grassy platforms usually of playing-card shape (*see* Figs 102 and 103), occasionally circular, typically 5 × 3.5m, rarely more than 4.5m wide because of the roofing method, with ditches *c* 0.5m wide, *c* 0.3m deep, and outer banks *c* 1.2m wide, and 0.3m high. A number of extremely long steads have been recorded (eg 14 × 3.2m at SX 16508120 on High Moor or on the moors around Minions) which presumably stored the turf of several households.

No less than 1,172 steads were recorded on Bodmin Moor, mainly by the RCHME from photogrammetry, and most had key dimensions measured by Norman Quinnell and Martin Fletcher, fieldworkers with the RCHME in 1983–5 (Johnson and Rose 1994, 14). Others can be expected to be found and the total will probably exceed 1,200. Most are in loose groups, rarely closer than 10m apart (*see* Map 1).

It is probable that many more moorland ricks were built by poor people lacking carts than by farmers caught out by poor weather: the former would be greater in number and would have to rick every year. With this in mind it can be suggested that most steads will be modern, of late 18th, 19th and 20th-century date, coinciding with the establishment of labourers' smallholdings in the heart of the Moor and industrial villages on its edges. No stead has been recorded as securely primary in relation to either medieval or early post-medieval features, and the earliest reference found to a moorland rick is in 1813 when one cottager of Altarnun was accused by another of stealing from a rick on a nearby common (Barton 1970, 42). In the early 20th century they were a common sight on Bodmin Moor – 'in June and July numerous stacks of peat will be seen when it is drying' (Breton 1912, 7) and seen from Brown Willy the Moor was 'chequered with peat stacks' (Folliot-Stokes 1912, 74). When visiting Dozmary Pool in 1935 Margaret Leigh saw on the nearby downs 'one or two looming ricks of turf, big as haystacks, which lay remote from any house' (Leigh 1937, 109).

The dried turf, so carefully protected in these stacks, was clearly not the firm stuff from which charcoal was

Fig 103 Turf stead near northern edge of Roughtor Marsh (SX 15688232), looking south with Brown Willy to left and Roughtor to right. (Graeme Kirkham)

made and it is therefore not necessary to associate the stacks with medieval and early post-medieval tinning (cf Hopkins 1980; Quinnell 1984; Sharpe 1993). No artefacts were found in Croft Andrew's excavations of three steads at Davidstow (Christie and Rose 1987, 184) and the large irregularly shaped platform excavated at Trelan in the Lizard produced in the higher fill levels of the ditch a sherd of pot 'too simple to be diagnostic' (Smith 1984, 8).

6 Turf in the home

Until the 1930s Bodmin Moor's farmsteads would always have been shrouded with the 'acrid-sweet tang of peat-smoke' (MacArthur 1948, 15), the open turf fire kept burning throughout the year. There are traditions of fires kept in at farms like Lord's Waste (SX 17147472), Menniridden (SX 17207249) and Gillhouse (SX 18627316) for 60 and 50 years (Winn and Winn 1995; Heller 1995; Davey 1995), the ashes heaped up, dampened turves placed over them at night, and the ashes then raked out and glowing turf 'coals' revealed and banked up in the morning, often with a skimmy wrapped around them (Davey 1995; Harrison 1995; Mona Parkyn 1995). Cooking practices recorded in recent oral history fieldwork can probably be applied to the 19th century, at least (*see* Jenkin 1945, 354–7). Chimney crooks suspended 'tay kettles' and ham and laundry boilers over the fire (Mona Parkyn 1995; Winn and Winn 1995) and brandises set up at the side supported pots for stews (Mona Parkyn 1995). Baking was 'down under', in the fire's heart using a 'baking iron' with either a 'baker' or a 'dish kettle or kiddle'. The iron was a flat circular piece of cast iron approximately ½in (6mm) thick and 2ft (610mm) diameter (Lemin nd), normally kept within or under the fire (Mona Parkyn 1995); it was swept clean when needed and set on a bed of hot ashes. When sprinkled flour went 'nice brown' (*ibid*) it was ready for baking; the pasties, biscuits or yeast cake were placed, sometimes on a tray or sheath, on the iron and covered by the baker, a flattened cast-iron dome (Bunney 1995; Davey 1995). The join was sealed with ashes, more hot 'coals' and new turves were heaped over it, and the whole was left for an hour or so or until an ear placed to a poker reached in to touch the baker could hear the food 'frizzin' (Hosken 1995). The food tasted better than anything cooked in an oven (Mona Parkyn 1995). Bread, cakes and roasts were baked under the dish kettle, similar to the baker but a complete dome, often with one or more handles and

Fig 104 Reused 17th-century open fireplace and 19th-century cloam oven (left) in the ruined 19th-century cottage at Slades, St Breward, SX 154803, in 1983; see *Fig 117. (From Herring 1986, plate 29)*

sometimes with three spikes against which hot turves could be laid (Davey 1995; Keast 1995).

Cloam ovens, built into the sides of many moorland fireplaces (*see* Fig 104), were rarely used in living memory (Tony Blackman, pers comm) and it is possible that the cast-iron baking irons, bakers and kettles replaced them in the late 19th and early 20th century. Before cooking, the cloam oven was heated by kindling a fire of furze, chaff or brouse (hedge cleanings, etc) within it. The embers were then swept out, the food placed inside and the door (either cloam or iron) closed and sealed (*see* Jenkin 1945, 356).

William Lemin describes mouth-watering moorland cooking on turf fires: bacon, eggs and potatoes in a frying pan; boiled vegetables and soups in a saucepan – both on the brandis – potatoes 'roasted in their skins in the firey ashes'; 'mackerel marinated in vinegar in a dish and covered by a baker and ashes and left in the ashes all night, also red herrings roasted in front of the fire' (Lemin nd).

Ricks were opened at their leeward ends (away from the prevailing winds) and the turf brought in sacks (Barton 1970, 42; Davey 1995), baskets (*ibid*) or as 'yaffles', as much as a 'wrapper', a rough over-apron, could take when its bottom two corners were brought to the waist (Keast 1995).

Other moorland fuel included sticks of furze (gorse), locally 'crinnicks', recorded as a Cornish domestic fuel since the 16th century (Pounds 1978, 40; Norden 1584) and mentioned in property extents since at least the mid-15th century (eg *Feet of Fines,* vol 2, no 1069), and bog oak found in marsh turf pits. Bog oak was divided into 'nuttalls' and 'moats', the former small sticks, 'little bigger than your finger' which made 'good fires', the latter large pieces, a foot or so across and very hard – 'you could not drive in a nail if you tried' (Lemin nd). These would be dried for Christmas Eve when the family would 'sit around and enjoy a lovely fire' (*ibid*).

A rapid decline in the use of these traditional fuels set in during the 1930s when they were replaced by Welsh or pit coal burnt in Cornish ranges and more recently by Rayburns. A 'Direct Supply Coal Company' was operating from St Breward by 1939 (*Kelly's* 1939, 53) and increased commercialisation of moorland farming in the Second World War brought seed, fertiliser and coal merchants up the long lanes, introducing the luxuries of modern life (Keast 1995). The coal cost money but it removed several onerous tasks from the farming year; turf-cutting had involved a 'lot of handraulics' (Goodenough 1995) and there was a heart-felt moorland saying concerning turf: 'Turf would keep you warm three times: first when cutting, second when burning, third when carrying out the ashes' (Ernest Rich 1995).

A small group of farming families cut turf into the 1980s and early 1990s, but by 1996 only the Parkyns of Wimalford (SX 214736; *see* Figs 99 and 100) were cutting, drying, saving, and burning the fuel of the Moor (Tony Blackman, pers comm).

8 Other uses and activities

by Peter Herring

1 Introduction

This short chapter draws together evidence for several non-industrial and non-agricultural uses made of Bodmin Moor's resources in the post-medieval period. They reflect the Moor's properties but have also helped establish its historic character, leaving distinctive and important remains. Water is plentiful and has been easier to manage here than in the more densely occupied lowlands of Cornwall. Woodland has also been either encouraged or planted in parts where it has been expected to give better returns than farming. The Moor's open spaces and low population made it attractive for military activities (mainly during the Second World War), and facilities have been provided since at least the 18th century for recreational visitors drawn to its natural and cultural features. A closing section briefly reviews modern appropriation and restoration of earlier monuments on the Moor.

2 Water

Public water supply

Clean and cold, Bodmin Moor's streams have attracted those concerned with supplying domestic water to east Cornwall's towns and villages since the mid-19th century. The Liskeard Water Works Act of 1859 led to the building of a storage reservoir and treatment works on St Cleer Downs, taking water from the Tremar, Hendrifton, Siblyback and Crylla streams (Brewster 1975, 300). Crylla leat itself, watering the Liskeard–Looe canal, was fed into the Liskeard system in 1861, and by 1893 a marsh near Hamatethy was being tapped to supply Bodmin and parts of St Breward village (*ibid*).

Before the Second World War water was piped from intakes on moorland streams to small storage reservoirs. For example, in the 1920s a North Cornwall Joint Water Board intake at Crowdy Marsh passed water to Lower Moor filter house (SX 12788318) from whence it was gravity-fed to two service reservoirs at Delabole. Intakes at Rushyford (SX 22187616) and on the Withey Brook (SX 23857514; Fig 105) served Bastreet filtration plant (SX 24427651) which then gravity-fed water all the way to the South-East Cornwall Joint Water Board reservoir on Kit Hill (Brewster 1975, 301).

The possibility of building reservoirs on Bodmin Moor had been considered since the 1930s; only the war prevented one approved in 1938 being built at Crowdy (SX 148835). A particularly persistent proposal was for a large reservoir on the De Lank capable of supplying all of mid-Cornwall as far as the Lizard. Fortunately for the extremely important archaeological remains in the Upper De Lank valley (*see* Johnson and Rose 1994, maps i and ii), drillings in the 1950s found the suggested site unsuitable and water from Bodmin Moor continued to be abstracted direct from the rivers.

Important new intakes were established at Leaze (SX 13327661) and Trekeivesteps (SX 228699) in 1955 and 1957 respectively, the former including a treatment works (Brewster 1975, 302–3).

Water authority mergers in the 1960s made major capital projects like reservoir-building more feasible and in 1965 the East Cornwall Water Board authorised Siblyback Reservoir, completed in 1969 (SX 234708; Fig 106), to work as a regulator for intakes on the Fowey at Trekeivesteps and Restormel, and on the Withey Brook at Bastreet. The North and Mid-Cornwall Water Board ordered Crowdy Reservoir (SX 145835) in 1969 (completed 1973), alongside the expansion and improvement of Lower Moor works (Brewster 1975, 303–4).

From the late 1960s the Cornwall River Authority commissioned feasibility, engineering and cost surveys, with a major Bodmin Moor reservoir in mind, capable of supplying Cornwall's foreseeable water needs in mind. Three sites – Scribble Downs (SX 143774), Lamelgate (SX 223706) and Colliford (SX 180710) on the De Lank, Fowey, and Loveny respectively – were whittled down through the 1970s to Colliford, and this reservoir was built by 1986. In 1991, after several particularly dry summers, a relief pipeline was run from the water works at Leaze to Lower Moor.

Private water supply

Although most farm leats took water from moorland streams to power barn machinery via waterwheels (*see* Chapter 9), a small number of others appear to have carried water for more general agricultural and domestic use. A simple weir, stones heaped across the bed of the stream, below the Lower Moor water works (SX 13038351) fed a leat, *c* 1.4m wide and 0.9m deep, with a downhill bank 2m wide and 1.5m high, which ran through the fields and farmsteads of Parkwalls (SX 11938312) and Aldermoor (SX 11468276) before reaching Treclago (SX 10838280). It is shown on the 1882 OS 1:2500 map.

Three more leats originated in the marsh to the south of St Bellarmin's Tor (SX 130706) and watered some of the farms between Millpool and Cardinham. The highest leat ran for nearly a mile along the slopes of Fore Downs to Little Bury Farm (SX 13226947). Traces of stone-lining are visible, and simple granite slab bridges allowed grazing animals to cross the leat without breaking its banks. In places farmers cleverly adjusted the lines of field walls and culverted the leat beneath them to give livestock in as many fields as possible access to the water, and elsewhere tiny tributary leats were run down to drinking troughs in

Fig 105 Withey Brook waterworks (SX 23857514), from the north-west in 1997. (Peter Herring)

Fig 106 Siblyback (SX 234708), built in 1969, the first reservoir on the Moor, viewed from the south c *1978. (Peter Herring)*

fields. This leat, extant by 1881 (OS 1:2500 map), replaced another running parallel approximately 30m downhill which was overlain by the earlier 19th-century fields of Fore Downs Farm.

Another water supply leat, also extant by 1881, was taken from the stream south-east of Bury Castle and run through the fields of Higher Treslea (SX 13546888) to Penpoll Farm (SX 12746904) – possibly powering farm machinery here – before being passed through the satellite hamlet, with the National School (SX 12286894), established around the crossroads 200m north of Cardinham churchtown.

In the mid-20th century, some farmers used hydraulic rams to force stream water along pipes to supply themselves and their animals. Most are on the moorland edge, at places like Higher Treslea (SX 13666878), Treveddoe (SX 15086948), Greenwell (SX 16366912) and Brightonwater (SX 13136813), but there are the remains of one in the valley to the south of Cannaframe on the high moors (SX 20667860), and Lower Gillhouse (SX 18687322) had a ram feeding spring water to a reservoir (Davey 1994, 5).

Most farms and settlements were provided for by wells, usually in domestic courtyards (*see* Fig 126) or under cover in dairies, although in the heart of the Moor, around Bolventor and Dozmary Pool, water supplies were scarce (Davey 1994, 5). At Dozmary Pool Cottage (SX 19087438) the 40ft-deep (13m) well, with a hand windlass, went dry every summer; until they left in 1982 the Parkyns had to carry drinking water from the neighbouring farm at Pinnock's Hill (SX 18887482), at first in buckets, then in a milk churn on a horse-drawn cart; washing water was taken from the Pool itself (Mona Parkyn 1995).

At Outer Pridacoombe is a well-preserved butterwell (SX 15857659), shown on the 1883 OS 1:2500 map, on the edge of a stream-side marsh, 80m west of the farmhouse. It is a neat stone-built structure (1.5m square externally) with stone roof covered with turfs, and with wooden door and wooden shelves; its floor is always water-covered. Other butterwells are known at Higher Trenant, St Neot (Jill Thomas, pers comm), Cabilla, Cardinham, and in parkland close to the now lost great house at Trebartha, North Hill.

Ice works

One of Bodmin Moor's more unusual industrial sites was the English Natural Ice Company's Works at Dozmary Pool (SX 19377469) which took advantage of the significantly colder winters of the late 19th and very early 20th century to harvest ice from the surface of the pool. In 1880 the works had been 'recently established' by Capt Henderson of Truro (Daniell 1880, 169; prospectus issued in 1880, CRO, RD 667). Henderson had already, by 1876, set up another ice works on Sourton Tor, on the north-west edge of Dartmoor (H R Hodge 1973, 21). According to Hodge, the Dozmary Pool ice was taken in wagons down to Dozmaryhill (SX 19847541) on the Fowey valley road, and via Redgate to Liskeard, and finally to Looe, where it was used to pack fish sent by rail to London (*ibid*). Henderson had intended to supply fish buyers from St Ives to Torquay, as well as private families. He described in his 1880 prospectus structures already in place on his one acre poolside plot, among them 'a large well-constructed and timber-lined store, capable of holding 500 or 600 tons of Ice … . A new Engine House, containing a new engine and boiler [worked by means of turf (peat) taken off the moors in the vicinity], hydraulic press, gun-metal ice-box, and every appliance for compressing Ice on a large scale … . A jetty has been constructed to facilitate the removal of the Ice from the lake, and lines of tramway, with turn-tables … and a substantial House has been built, in which the Overseer of the Works resides' (CRO, RD 667).

Between 10 and 20 local farmers worked together saving the ice, splitting it into blocks with gads (wedges), floating them to the bank where they were hauled by horse up a ramp, and then packing them in the ice pit. The pit was then carefully covered with turf (peat) and left until the ice was required in the summer (H R Hodge 1973, 21) when the equipment itemised in the 1880 prospectus (above) was used to prepare block ice.

The extent and complexity of the 'Ice Works' as depicted on the 1883 OS 1:2500 map, 1 edn (Fig 107) suggests that there was indeed more than just a turf-covered mound of ice here. This map confirms that the house and buildings which later became Dozmarypool Farm were constructed for the Ice Works, which was protected against cattle grazing Dozmary Downs by a small rectangular enclosure.

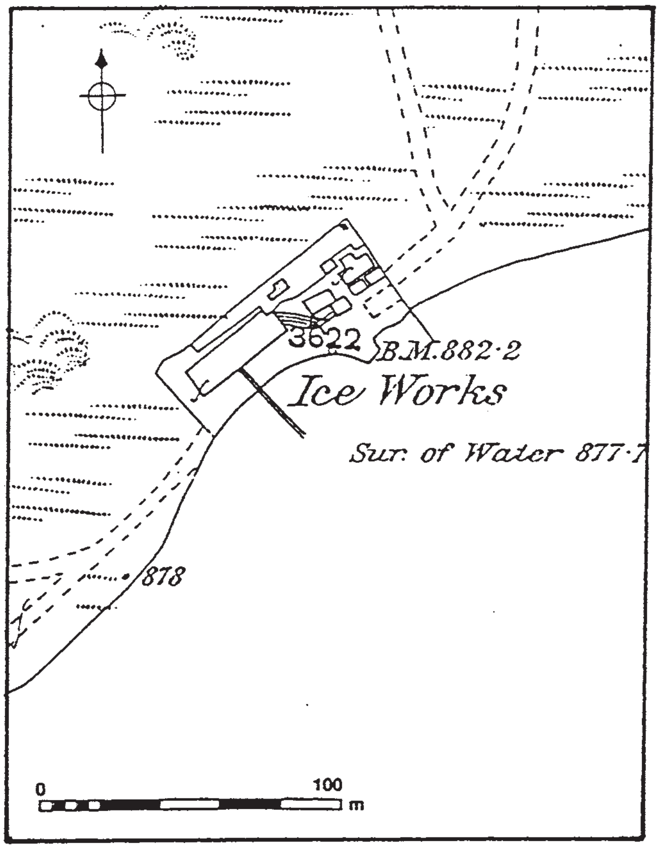


Fig 107 Dozmary Pool Ice Works (SX 19377469) as shown on the OS 1:2500 map, 1 edn. (Cornwall Series 21.15, 1883)

Fig 108 Dozmary Pool, SX 193746, under 8in (200mm) of ice on 5 January 1997, viewed from the north-east. The ice works are to the left of the single-storeyed overseer's house, now Dozmarypool Farm. (Peter Herring)

Being so dependent on cold weather, the ice works' fortunes fluctuated, doing particularly well in the blizzard year of 1891 and again in 1895 (H R Hodge 1973, 23); unfortunately, an account book has been destroyed (*ibid*). The works were apparently closed some time around 1900 (*ibid*) and by 1906 the buildings were part of Dozmarypool Farm (OS 1:2500 map, 2 edn).

Remains of the ice works are fairly well preserved although, apart from the standing buildings, reused since *c* 1900 as farm buildings, they are largely confined to the rectangular enclosure, or 'pit', in which the ice was stored. This is approximately 28 × 5.5m internally, and is defined on three sides by stone-faced walls, and by a revetted cut 1.2m deep along the north-west side. As in contemporary ice houses, much effort was put into excluding water which would have accelerated melting, and the 2.5m wide, 1.5m deep cutting or channel to the south-west of the ice pit was apparently designed to achieve this. A now lost drainage pipe (Wolter Noorlander, pers comm), shown on the 1883 map, projected approximately 20m into the pool from the centre of the pit.

The 1883 OS map shows four closely spaced parallel lines, presumably the tramways, leaving the pit at its north-east end and running to the nearest building. The ice-workers' boat was presumably moored by the jetty which was probably about 20m west of the pit (Wolter Noorlander, pers comm); there is no sign on either the 1883 or 1906 OS maps of the later boathouse (shown in Folliott-Stokes 1912, plate facing p74).

Hydro-electricity

Remains of farm hydro-electric generators of the late 20th-century survive beside streams at Outer Pridacoombe and in Watery Marsh above Industry, and probably also elsewhere. A dam, 15m long and 1.8m high, now breached, stored water piped to the now removed waterwheel (pit 1.7m × 0.8m) at the latter site (SX 23527721; *see* Fig 102). At Outer Pridacoombe (SX 15847652) the disused iron waterwheel, 1.5m diameter, 0.8m wide, survives downstream from a curving dam, 25m long, 3m wide and 1m high.

3 Woodland and forestry

Since later prehistory, and until the 20th-century conifer plantations were established, woodland on Bodmin Moor has been largely confined to willow-dominated scrub along moorland valley bottoms and oak-dominated broadleaf woods in the steep-sided valleys at the Moor edge. The latter can be divided into ancient and secondary woodlands, following as far as sources allow the distinction drawn by the former Nature Conservancy Council (now English Nature) in the *Provisional Inventory of Ancient Woodlands in Cornwall* (Lister and Walker 1986). Here ancient woodland conflates managed relicts of the natural tree cover or 'wild wood' (Rackham 1976, 40–8), which developed after the last glaciation, and woodland developed on land probably cleared at some stage in prehistory (Lister and Walker 1986, 2), while secondary woodlands are those established in recent centuries. On Bodmin Moor the Nature Conservancy Council's survey sources establish firmly only the post-1813 date of secondary woodlands.

Several ancient and secondary woodlands were part or clear-felled in the Second World War and have since been replanted, at least partly, with conifers. Apparently intact ancient woodlands, however, do survive: Cabilla and Redrice Woods in Cardinham above the middle Fowey, Lavethan Wood to the south of Blisland, parts of Helsbury Park Woods along the Camel, fragments of Castick Wood on the Trebartha estate, Treovis Wood further down the Lynher, and large parts of Draynes and Bowden Woods on the southern edge of the Moor. Draynes Wood may be regarded as typical. It has been managed for timber, underwood grazing and coppice since at least the 11th century, when three 'acres' of woodland and three of underwood were recorded at Draynes in Domesday Book (Thorn and Thorn 1979, 5.10.2, 5.24.1). Common and sessile oak mixed with ash, hazel,

Fig 109 Hawk's Tor, North Hill viewed in 1964 from the north, from Lemarnedown Plantation, SX 254773. (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Charles Woolf [64/125/219] © RIC 2008)

Fig 110 Halvana plantation, Altarnun (SX 210785) in 1964, viewed from the north, from Tregirls with Poldhu farm, a 19th-century intake in the centre (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Charles Woolf [64/125/95] © RIC 2008)

beech, holly and the more recently introduced sycamore flourish here (Brewster 1975, 268). Little systematic archaeological fieldwork has been undertaken in these ancient moorland edge woods, but the remains of scores of charcoal-burners' platforms and substantial woodland banks dividing properties or holdings were recorded in Cabilla and Redrice Woods (Parkes 1997), and similar features can be expected to survive in most of the others.

Among the most important Moor-edge woodlands are those concentrated around Trebartha Hall in North Hill. They are a mix of ancient woodland (Castick, Upton, Bowdanodden, Hawk's Wood) and post-medieval plantation (*see* Fig 109), intended to provide both timber and a shelter belt for the park and farmland, and also to beautify the prospect from the great house (Latham 1971, 18). When Trebartha was visited in 1940 before wartime fellings, Stonaford Plantation, mainly fir and spruce, included a clump of 50 monkey-puzzle trees planted in the 1880s; Lemarne Plantation was mainly beech and oak; Sterling Wood was well-grown spruce, and Castick Plantation fir and spruce. The beautiful American Gardens had Pacific coast trees – Douglas Fir, Western Red Cedar and Sitka Spruce (*ibid*, 20). Francis Rodd's diaries record woodland management on the Trebartha estate in the 18th century. In 1787 oak and beech were planted in Nickey's Ham (near Trekernell), Hawk's Wood was weeded, and sycamores at Bearah Wood were felled for the carpenter (*ibid*, 60).

A waterwheel-driven sawmill (SX 25667796) was established by the estate at Stonaford some time before 1884 (OS 1:2500 map, 1 edn) and probably in the decade between 1851 and 1861 (Herring and Berry, 1997, 166). The surviving cast-iron overshot wheel (6.2m diameter, iron buckets, cogged rim) made in 1887 by Bose of Launceston is clearly a replacement. Water brought by leat from the Withey Brook and carried to the wheel on a slate and concrete-lined launder empties into the stone-lined pit. This mill was extended in 1940 and again in 1943 as part of the war effort to turn Trebartha timber into sleepers, lorries, packing cases, furniture, etc. The waterwheel was disengaged and replaced by two portable engines which powered racksaws, edging saws and cross-cuts; 'lumberjills', members of the Women's Land Army, provided much of the labour (Latham 1971, 152–9). After the war the mill was taken over by its manager, Mr Knowles, working 'windblows' into gates sold to the estate; it still operated in 1971 (*ibid*, 178).

On the open moors large plantations and smaller windbreaks of Sitka Spruce were established from the 1930s to the early 1980s, firstly by the Forestry Commission and since 1965 by the Economic Forestry Group and private individuals (Brewster 1975, 269–73). Halvana plantation in Altarnun (Fig 110) was the earliest (1932–58) (*ibid*) and Butterstor in St Breward (1984) the last. In total *c* 10.5sq km of previously open heathland or reverted rough pasture

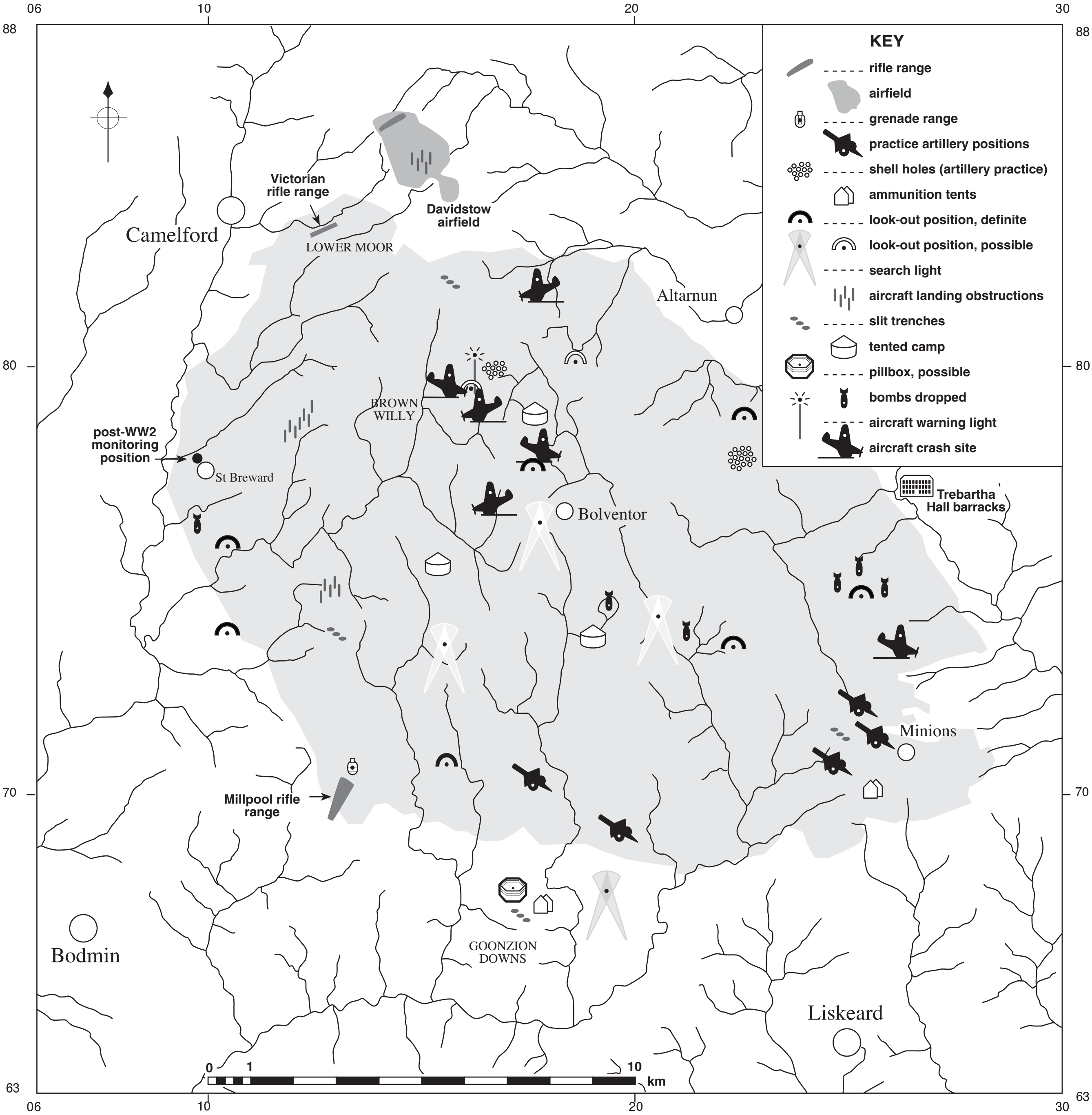


Fig 111 Distribution of military remains, sites and features, as recorded by 1995. Dots (black or white) on certain symbols indicate precise locations. (© Rosemary Robertson)

has been planted with conifers; their landscape impact, however, is out of all proportion to their area (*c* 5 per cent of the study area).

Planting ridges, fire-breaks, roughly metalled timber haul-roads and deep drains are the principal physical features of these plantations.

4 Military uses of Bodmin Moor

Compared with north-west Dartmoor, Bodmin Moor has been relatively little affected by modern military activity and, apart from a Second World War airfield on Davidstow Moor (SX 150850) and a still operational shooting range at Millpool (SX 13417052), remains are largely ephemeral and easily missed (*see* Fig 111). Most relate to Second World War training and exercises.

On the slopes below Lower Moor waterworks (at SX 12958339) is a well-preserved Victorian Volunteers' Rifle Range (shown on the 1882 OS 1:2500 map) with rectangular, granite-faced shooting platforms, approximately 5 × 2.8m, and 0.4m high with ditches 1.3m wide, and 0.3m deep on their western sides, at 100yd-intervals from 100–800yd (91–732m).

Fig 112 Davidstow airfield's control tower (SX 154853) viewed from the north-west in 1996. (Peter Herring)

A track from the Camelford road leads to a small granite building with hipped slate roof beside the 600yd-shooting platform. The target and butts, at the eastern end of the range, have been damaged but survive as earthworks with a stone-lined trench in which targets would have been erected in front of a 600yd-high (2.5m) ramped butt. The range was still in use in 1907 (OS map, 2 edn) by which time a warning flagstaff (of which there is now no trace) had been erected about 20m south-east of the targets.

The remains of RAF Davidstow Moor dominate the extreme northern end of the study area. Flat-roofed concrete and brick buildings, including an Air Traffic Control tower (Fig 112), are concentrated around the northern edge of a large triangular airfield with three broad, criss-crossing concrete runways enclosed by a continuous perimeter circuit, to which are attached a total of 51 nodular or 'panhandle' aircraft dispersals (Fig 113). Britain's highest operational Second World War airfield (296m, 970ft), it was vulnerable to persistent low cloud driven off the Atlantic. It nevertheless made 'a vital contribution to the Allied victory in Europe' (Walford 1989, 113).

After opening in October 1942, it served initially as a 'staging-post' for refuelling and bombing-up Flying Fortresses and Liberators based in eastern England and flying on bombing missions to Occupied France; activity was probably as great on the return flights, when RAF emergency services at Davidstow Moor earned a good reputation for dealing efficiently with casualties. By April 1943 RAF and USAAF bombing was switched to Germany itself and Davidstow Moor became more involved in maritime warfare; Coastal Command Wellingtons patrolling the Bay of Biscay

Fig 113 Panhandle aircraft dispersals attached to taxiing runway at Davidstow airfield (SX 152845), viewed from the south-west in 1993. (CCC HES, F41/154)

sometimes worked far out into the Atlantic (Walford 1989, 114; Ashworth 1990, 76–7). In February 1944 a score of new lifeboat-carrying air-sea rescue Warwicks took over from the Wellingtons and these were joined in May by two squadrons of Beaufighters (RAF and Royal Canadian Air Force), as efforts were concentrated on D-Day preparations. Perhaps Davidstow Moor's greatest military success was on D-Day itself and subsequent days when the Beaufighters successfully forced three German destroyers into Brest and away from the Normandy landing area, 'a key engagement which more than justified Davidstow's establishment' (Walford 1989, 115).

As the War moved east across Europe, Davidstow Moor Beaufighters became increasingly involved in work against German shipping, until in September 1944 the field was abandoned by operational aircraft, put on a 'care and maintenance' footing, and used as a training camp until October 1945; it was finally closed in December 1945. Since then it has been used variously for RAF helicopters, aircraft involved in forestry spraying, powered gliders and microlights, and for motor-racing (Ashworth 1990, 77–8). In spite of encroachments from conifer plantations, a cheese factory and minor roads, the complex is very well preserved.

The level of wartime investment in what would always have been a fairly minor airfield still startles, and it takes little imagination to picture heavily laden Flying Fortresses lumbering off southwards across the Moor towards France. The site is as moving a memorial to the astonishing bravery of those who fought in the War as the gift in 1951 by Sir Richard Onslow to the National Trust of 174 acres on Roughtor as a memorial to the 43rd (Wessex) Division.

At least one aircraft failed to return to the airfield, crashing into the east side of Brown Willy (*c* SX 161796), leaving a now overgrown crater and scattering fragments of twisted aluminium. A red beacon had been fixed to the hill's summit (MacArthur 1948, 17).

The threat of German invasion earlier in the War led to the erection of aircraft-landing obstruction posts on Treswallock Downs (SX 117784, John Hutton, pers comm), and aircraft landing obstruction pits on Manor Common, west of the Trippet Stones (SX 130750; Fig 114; Morley Rowe, pers comm). Searchlight stations were established at Harrowbridge in the Fowey valley (SX 20627437), St Neot (uncertain location) and Blacktor (SX 15747351) (Jack Parkyn, Jill Thomas, and Donald Bousfield, pers comms).

Preparations for D-Day and other exercises produced Millpool rifle range, still used by the Territorial Army, with targets, butts and firing positions, and flagpoles on St Bellarmin's Tor and Great Care Hill. Artillery training also took place and there are remains of gun emplacements on Penkestle Moor around SX 174703 (Gerrard 1986), Berry Down, St Neot (Jill Thomas, pers comm) and just north and west of Minions around SX 253712 (Sharpe 1993, 274). These are shallow, roughly levelled excavations, approximately 1m deep, each shaped like a bow-sided trapezium about 6m across and with low external banks. Guns pointed in the direction of the emplacements' longer straight sides; in all groups this was towards Brown Willy, 10km north-north-west of Penkestle Moor and 13.5km north-west of Minions. Shell-holes, often water-filled now, are found on Brown Willy's eastern slopes and on the southern side of High Moor. The guns and gunners were American – 'tales are still told of American gun-carriers disappearing into the oblivion of bogs during moorland manoeuvres' (Munn 1972, 67). The Americans dismantled the railway bridge at Minions (SX 26367136) to allow their equipment through (Sharpe 1993, 274) and half-track vehicles damaged field boundaries at Ninestones, St Cleer (Tony Blackman, pers comm). Large numbers of Americans were in temporary camps at Shallow Water Common (Morley Rowe, pers comm), Gillhouse and Dozmary Pool, General Patten also having stayed at Bolventor. They are remembered with great fondness as brave boys horribly apprehensive of what D-Day would bring them (Davey 1995). British evacuees from Dunkirk preceded another American regiment at Trebartha Hall (Latham 1971, 143–151).

Slit-trenches, one-man shelters dug by hand, are found on High Moor, near the Hurlers, and on Manor Common in Blisland. They are rectangular pits, *c* 1.5 × 0.7m, with low banks along one side. Other groups no doubt await discovery.

Bodmin Moor's elevated hills made useful observation posts. Observer Corps had bases on Fox Tor, Altarnun (Latham 1971, 129) and in a disused mine shaft at Mine Hill, St Breward (Pamela Bousfield, pers comm), the latter reused to monitor nuclear explosions, and there were Home Guard look-out stations on Kilmar Tor, North Hill (Tony Blackman, pers comm), Tolborough Tor, Altarnun (Walter Hambly, pers comm), Hill Tor, St Cleer (Jack Parkyn, pers comm), Lady Downs, Blisland Beacon (Morley Rowe, pers comm), and Carburrow Tor, Warleggan (Torr Keast, pers comm). The last-named, shared by the Home Guard of Warleggan and St Neot parishes, is perhaps the most elaborate. Steps were fashioned on three sides of the larger of the two Bronze Age summit cairns, presumably to ease night-time movement up its stony sides, and a rectangular drystone shelter was built against its western side. Others look-outs are suspected on Leskernick, Altarnun and Brown Willy, St Breward, where modern-looking summit shelters exist.

The Moor did not escape enemy attention, partly because it was beneath the turning flight path of German bombers attacking Plymouth (Tony Blackman, pers comm). St Breward was bombed (Champion 1988, 83) and bomb craters exist on Brown Gelly and Twelve Men's Moor (Tony Blackman, pers comm); bombs are also believed to have been dropped into Dozmary Pool (Munn 1972, 67). Fragments of the American transport plane which hit Sharp Tor, Linkinhorne in 1944 were salvaged (Bishop 1987, plates 702 and 703) as was the engine of the Seafire which hit Codda, Altarnun in 1948 (*see* Earl 1995, 118). A number of other Allied aircraft met their ends on Bodmin Moor hillsides including a transport plane which crashed into the south-eastern side of Pridacoombe Downs,

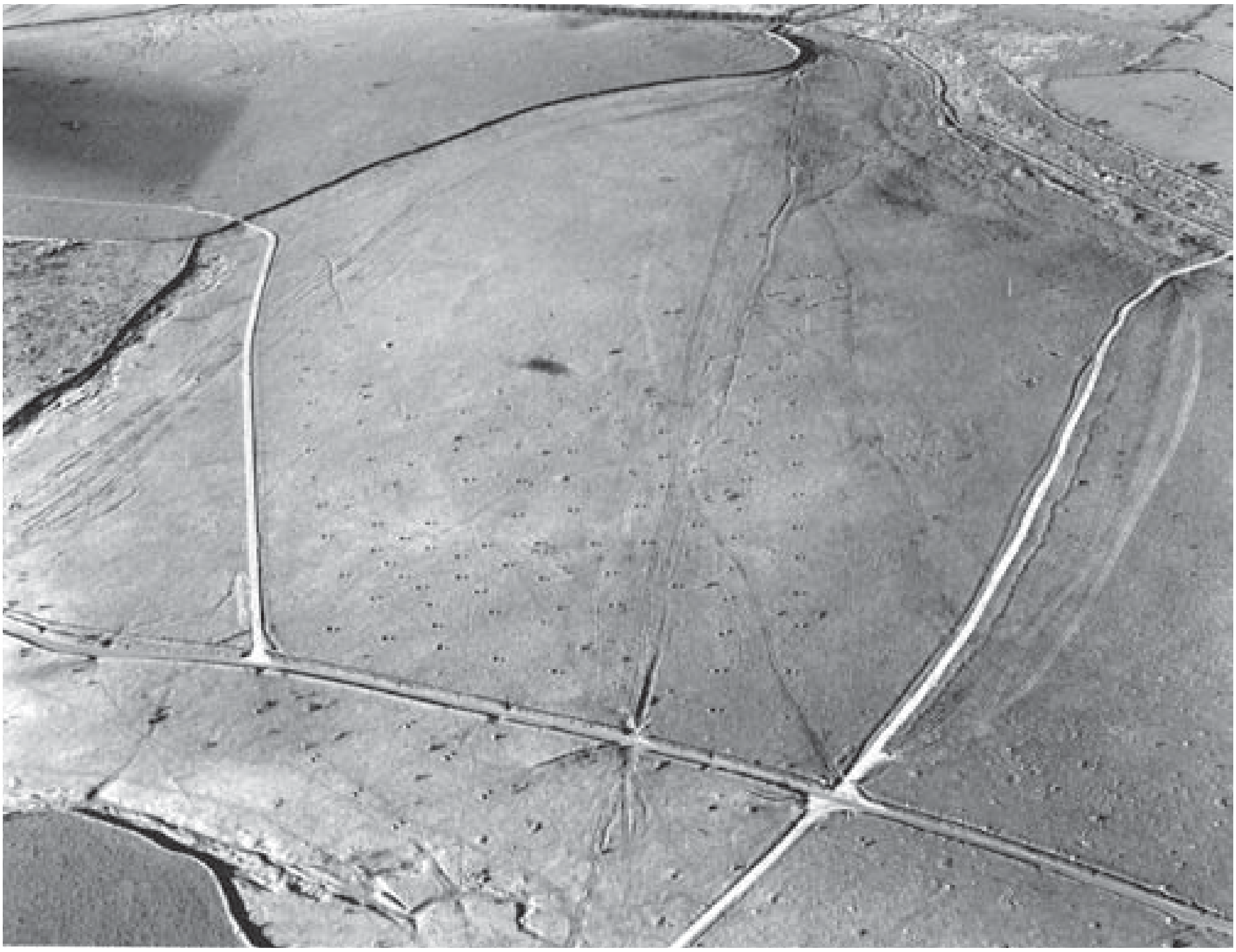


Fig 114 Aircraft landing obstruction pits on Manor Common, Blisland (SX 130750), to the west of the Trippet Stones stone circle, viewed from the south-west. (CCC HES, F33/119)

Altarnun and a Bristol Blenheim which crashed into the north-eastern part of Buttern Hill (Richard Herring, pers comm).

Just north of the Millpool rifle range is a concrete flat-roofed building (Fig 115), a grenade-training site of immediately after the Second World War (Robin Hanbury-Tennison and Morley Rowe pers comms).

5 Recreation

The world's first cheap fare railway excursion was run by the Bodmin and Wadebridge Railway on 14 June 1836; no fewer than 701 people paid the shilling fare and spent three hours in the afternoon at the Wenfordbridge terminus (SX 08587509), below St Breward (Clinker 1973, 31). The trippers would have caught glimpses of Bodmin Moor, a landscape still dismissed then as 'only heathy moors, brown and monotonous' (Redding 1842, 50). Tourists have briefly forsaken Cornwall's coastline to visit some of the dozen or so picturesque places repeatedly publicised in later 19th and early 20th-century guides (eg *Murray's* 1859, 162–6 and 234–8; Tregellas 1878, 53–6; Hope Moncrieff 1898, 33, 38–40, 54–7; Breton 1912). Many visitors stayed at the Cheesewring Hotel at Cheesewring Railway (now Minions), and visited the Cheesewring, the dramatically precarious natural rockpile on Stowe's Hill (SX 25777241). They made a day of it by also taking in the Hurlers Stone Circles (SX 25817140), Daniel Gumb's Cave – the reconstructed primitive dwelling of the eccentric 18th-century stone-cutter, philosopher and mathematician, and his large family (Stanier 1986c, 103–4) – and some of the mining and quarrying complexes, many of which would have been busily working when the hotel was built, sometime before 1883 (OS 1:2500 map, 1 edn).

Other 19th-century hotels were established around the south-eastern edge of the Moor, and would have served as many commercial travellers as tourists. They included the Stag and Market Hotels in St Cleer (SX 248681), the Caradon at Upton (SX 27987230) and the Victoria at Pensilva (SX 290697). Visitors would otherwise have been put up in Moor-edge inns although those intent on seeing another popular attraction, Dozmary Pool, would normally have sampled the 'comfortable though somewhat rude accommodation' offered in 1859 by Jamaica Inn, SX 18337678 (*Murray's* 1859, 163), the 18th-century posting house on the

Fig 115 Grenade training site on Cardinham Moor (SX 135707), built shortly after the Second World War, viewed from the south in 1986. (Peter Herring)

Bodmin–Launceston turnpike, which is itself now a more important attraction than Dozmary, largely because of Daphne du Maurier's novel.

Charlotte Dymond's memorial, an inscribed granite pillar erected by public subscription close to Roughtor Ford (SX 13898178) where the poor servant girl was murdered in April 1844 was another unusual attraction, perhaps visited mostly by intrigued local people. Her lover, the farm-servant Matthew Weeks, was hanged for the crime but the case caused considerable unease (*see* Munn 1978 for a thorough review). Roughtor, Golitha Falls, Kilmar Tor, Devil's Jump and Brown Willy have also been popular sites since the late 19th century. Brown Willy has even been provided with a Dartmoor-style visitors' post-box. From the same period rather smaller numbers of people have visited the better known archaeological sites (notably the stone circles) and the numerous medieval churches, crosses and holy wells, mainly around the edge of the Moor.

The later 20th century, with cars allowing people to be so much more mobile, has seen recreational use of the Moor greatly extended. Several caravan and chalet parks have been established around its edge and it is now unusual to spend a fine day on the open moors without seeing several other walkers or horse-riders enjoying the present *de facto* free public access tolerated by owners and commoners. The three modern reservoirs (Siblyback, Crowdy and Colliford) provide angling facilities, and canoeists and sailors also use Siblyback. Car parks for visitors have been provided at the three reservoirs and at Roughtorgate, Draynes Bridge (for Golitha Falls), Minions, and Halvana plantation. A private country park has also been established at Lord's Waste.

6 Nineteenth-century treatment of Bodmin Moor sites and antiquities

Many wayside crosses were moved in the 19th century, mainly to the gardens of vicarages and landlords' country homes by antiquarian collectors. Some had been abused and their removal can be seen as benign – the Altarnun vicarage cross-head had been 'found on a farm in this parish doing duty as a pig's trough, for which purpose the back had been hollowed out' (Langdon 1896, 84) – but many *in situ* wayside crosses were clearly seen as fair game for cross hunters. Two brought to Capt Morshead's Lavethan gardens (SX 096730) had been removed from 'Blisland Moors', one from the roadside near the Carbilly Cheesewring (Maclean 1873, 25). Other gardens decorated by appropriated medieval crosses were at Sir Warwick Morshead's late 19th-century eyrie residence at Tregaddick (SX 087736), Mr Collins' home at Lank (SX 089755), the Rodds' residence at Trebartha (SX 264774), and St Neot vicarage (*see* Langdon 1896).

Several crosses were respectfully restored either *in situ* or in parish churchyards. Middle Moor cross in St Breward (SX 12517929) was re-erected in the later 19th century (Langdon 1896, 240) but after falling again was shortened and re-erected by the Bodmin Old Cornwall Society in 1938 (Langdon 1992, 22). The two in Cardinham churchyard were rescued from the fabric of the church during its restoration in 1872 and that at Warleggan was brought there in the later 19th century after being first recorded when used as a gatepost near Carburrow in 1858 (Langdon 1896, 23–4; 58. See *ibid* and Langdon 1992 for details of other cross restorations and movements).

Bodmin Moor had no equivalent of the Dartmoor Exploration Committee and 19th and early 20th-century investigation and restoration of prehistoric and medieval monuments, away from churches and chapels, was limited (*see* Volume 1, Appendix 1). The Bronze Age stone circle at Nine Stones (SX 23617814) was restored by Francis Rodd of Trebartha in 1889 (Rodd 1889, 496); and Goodaver stone circle (SX 20877514) was found and restored by the Rev Malan in *c* 1906 (Croft Andrew 1937–8, 61).

9 Agriculture

by Peter Herring and Colum Giles

1 Introduction

by Peter Herring and Colum Giles

Until the great changes wrought on Cornish and British agriculture by the years of depression in the 1930s, farming on Bodmin Moor had always been mixed, albeit with a pronounced emphasis on the pastoral (Johnson and Rose 1994, and Chapter 3, Section 8). So all the mid-19th-century intake farms and smallholdings, and the farms with medieval origins, had an arable element, as shown in the land use columns of the 1840s Tithe Apportionment schedules, and seen in the mowhays and threshing barns of the farmsteads. Grain-growing Bodmin Moor farmers must, however, always have felt severely constrained. Soils were thin, granite-based, peaty and acidic (*see* Staines 1976 for a detailed soil survey of northern Bodmin Moor); the land was largely treeless and exposed (the granite Moor a massif standing 100m above the surrounding slate lowlands). It was wet and windy (Brewster 1975, 152–6 for recent climate) and most of it was remote from centres of population, markets and services (*see* below).

In the 19th century Bodmin Moor was an area with numerous landowners and an even greater number of tenant farmers. No one estate dominated; the Duchy of Cornwall owned land in the north-west (Helstone-in-Trigg) and south-east (Rillaton) and other large estates with upland holdings included those of Trebartha, Pencarrow, Rosecraddock and Glynn. There were a few owner-occupiers, the Daniels family at Carkeet (SX 219733) being perhaps the most notable. Farms varied widely in size. Many were little more than smallholdings; two farms at Littleworth (SX 196756), for example, were each of just 18 acres (7.2ha) in 1842 (St Neot Tithe Apportionment). Most farms had between 40 and 200 acres (16 and 81ha), and a few were larger; Carkeet had 467 acres (189ha) in 1840, and Siblyback (SX 235726) was nearly 900 acres (364ha) in extent in the same year (St Cleer Tithe Apportionment). Much of the acreage of these large farms was downland used for rough grazing.

The resources available to these 19th-century farmers varied enormously. While those owning or renting large farms had the capital to purchase farm machinery, and were able to employ agricultural labourers, many of the 19th-century intakes were being worked by men in time spare after doing their principal jobs in local mines, quarries or clayworks. Much of the work on these small, poor farms, in the most marginal locations, would have been done either by hand or using simple hand tools (pug mills, biddaxes, visgays, hoes, shovels and scythes) and would probably have been done mainly by children and women (*see Commission* 1867, 177–80).

On Bodmin Moor in the 19th and early 20th centuries cereals were subordinate to the requirements of livestock. Oats were probably the major cereal crop throughout but they and other crops – roots, cabbage and so on – were grown primarily as fodder, and the straw of cereals was also important for supplementing hay as fodder and bracken (or 'ferns') as bedding (*see* Marshall 1796, Vol 2, 6 and Herring 2004). Bodmin Moor's main agricultural product in this period was probably fatstock cattle, sold on for further fattening and some destined for the Navy victualling yard at Plymouth (Worgan 1811, 138). The association of Cornwall with dairy farming is a late development; in the late 18th century milk cows were 'kept chiefly for the sake of rearing young stock, the dairy being very little attended to', and in the early 19th century it could be stated that, 'the dairy does

Fig 116 Joe Halls entertaining Leslie Chegwin in one of the farm buildings at Carkeet, St Cleer (SX 219733), in c *1950. Note amongst other details the horse collar, the scythes, and the trapped or shot rabbits hanging from the joists, the sacks of laying pellets (for poultry) and the reused sacks worn to protect Joe's shoulders and back and Leslie's middle. (Print copied from one held by Tony Blackman; copyright reserved)*

Fig 117 Slades, St Breward (SX 154803) viewed from the south-east. A 19th-century farmhouse built on the site of an abandoned medieval settlement on the slopes of Brown Willy and abandoned again in the middle of the 20th century. See *Fig 103 for its fireplace. Its simple asymmetrical facade and limited accommodation (two rooms on each floor) are typical of earlier 19th-century houses on the Moor. (From Herring 1986, plate 28)*

not constitute a very important department in the husbandry of Cornwall' (Fraser 1794, 45; Worgan 1811, 140). Most Bodmin Moor farms had large enclosed blocks of rough pasture beyond their arable fields and many enjoyed rights of grazing on the unenclosed commons. Sheep were also important, especially as a way of gaining a return from the poor moorland grazing.

Trends towards amalgamation of holdings and greater specialisation in Cornish agriculture, visible by the late 19th century, were emphasised and accelerated in the dark inter-war years. Debt-ridden farmers either sold up to neighbours, allowing farmland to be amalgamated and farmsteads to be abandoned (Fig 117), or turned in desperation to sometimes inappropriate specialisation. Margaret Leigh (1937, 83–90) vividly documents this period when battery poultry farms, dairy farms, and large-scale ranches blossomed and often rapidly withered. Dairying, with the security of a monthly cheque from the Milk Marketing Board (Leigh 1937, 85), was the most widespread development, being adopted to some degree by a large number of farms. Places as marginal as Colquite (SX 165738) and Pridacoombe (SX 166769) had their cow houses concreted out for dairying, and outhouses fitted up with coolers. Ranching, however, was the longer-lasting development.

Most post-war farmers on Bodmin Moor concentrated on extensive beef and sheep farming, with several holdings thrown together, the arable element dropped, silage replacing hay, and the commons being more intensively exploited. The practice of wintering cattle on the Moor was not entirely a 20th-century development: 'The Heaths support the cattle in summer, and great part of the winter months' (Marshall 1796, Vol 2, 6); but it has nevertheless been so greatly increased through the use of supplementary feeding that it can now be termed over-wintering. Associated developments flowing from ranching have seen the neglect and removal of internal field boundaries (some in the Pridacoombe area to provide weathered granite for sale), the abandonment of small-scale stone farm buildings or their replacement with large prefabricated covered yards, and the abandonment of many dwellings. The consequent depopulation of the Moor has contributed to the decay of services, notably the closure of schools and chapels. In the late 20th century many abandoned farmhouses were rescued, restored and turned into commuters' homes or holiday homes.

2 Field systems

by Peter Herring

Medieval-derived fields

The farms and field systems of Bodmin Moor in the period under consideration can most usefully be divided into those which are medieval-derived (as shown on Johnson and Rose 1994, map ii) and those which were newly created in the 19th century as intakes, the latter being discussed below and shown on

Fig 118 Landholding patterns in medieval-derived field systems based on subdivided strip fields at Bowithick, Altarnun (SX 182828) and Pendrift, Blisland (SX 100743) in 1840. Each tone represents a different holding; note how those at Bowithick were more consolidated into blocks than those at Pendrift. White ribbons are tracks; white patches in the settlements are townplaces or, in Pendrift field system, are fields attached to another settlement. (Derived from parish Tithe Apportionment Maps and Schedules; for details of the holdings see *Herring 1986)*

Map 1 included with this volume. Most medieval farming settlements on Bodmin Moor were small cooperative hamlets, whose arable lands were subdivided, normally in strip-based field systems. They were also generally sited in the more sheltered and better-drained locations, usually in the valleys. Hamlet shrinkage, often to single farmsteads, and field system reorganisation via enclosure of the previously 'open' fields, had begun in the later medieval period (*see* Johnson and Rose 1994) and by 1808 there were no subdivided field systems operating on the Moor. Some of the surviving hamlets, however, still had farmers' holdings intermixed in the closes, many of which retained the medieval strip shape (eg Pendrift in Blisland, SX 100743; Fig 118). Others had, through exchanges of strips, achieved more consolidated holdings within the field systems, with several adjacent strips forming blocks of fields held by individual farmers; some of these strips had then been split by cross-walls (eg Bowithick, SX 182828; Fig 118, and Treclago, SX 108828). This process was to lead to some dispersal of settlement from the nucleus or hamlet to isolated farms established more conveniently in these blocks of fields (medieval examples at Slades and Higher Brown Willy – *see* Johnson and Rose 1994, 107–9; post-medieval example at Irish, SX 113771).

Most medieval-derived field systems, however, were farmed in the 19th and 20th centuries as single units, with farmers at liberty to reorganise them (remove hedges etc.) along lines determined by their practical farming needs, largely the convertible or ley husbandry regime still practised by farmers throughout Cornwall. Traditionally, two or three years' cropping were succeeded by three to 10 years' ley grass (normally around seven years); there was no clean fallow and grass was sown with the final grain crop (*see* Fox 1971, 102–4; Jewell 1981, 95–7; Herring 1986, Vol 2, 152–3). A typical field might be subjected to a 10-year rotation and in any one year between a quarter and a third of the farm's fields would be broken (*see* Roberson *et al* 1941, 418). A farmer would therefore be able to operate efficiently with around 10 cropping units or arable fields, as at Wimalford and Leaze (11 and 8 arable fields respectively in 1840 – *see* Fig 119).

Modern intakes

Bodmin Moor's farming landscape was transformed in the 19th century by a process of enclosure and settlement the intensity of which outstripped even that of the later medieval recolonisation (*see* Rose 1994, 77–80). No less than 48 per cent, ie 168 out of 348, of the discrete settlements in the Bodmin Moor survey area with roofed buildings in 1904–7 (OS 1:2500 map, 2 edn), were established after 1808 (the Volume 1 cut-off date, and the date of field drawings for the OS 1in map, 1 edn).

Virtually all were taken out of heathland apparently never previously improved. A few were remote from other settlements and remained isolated (eg Hawkstor Farm, SX 14427553, Camperdown, SX 12357910, Leskernick, SX 18267960 and Rushyford Water, SX 22007622), while several others attracted just one or two neighbours (Mount Pleasant and Priest Hill, SX 137779, the two Butterstor farms, SX 165784, and the two Smith's Moor farms, SX 212763). Most, however, were either accretions on to previously enclosed land (like Dozmaryhill, SX 212763 and Higher Harrowbridge, SX 203746 in the Fowey valley) or the new settlements pushing up from St Neot's several

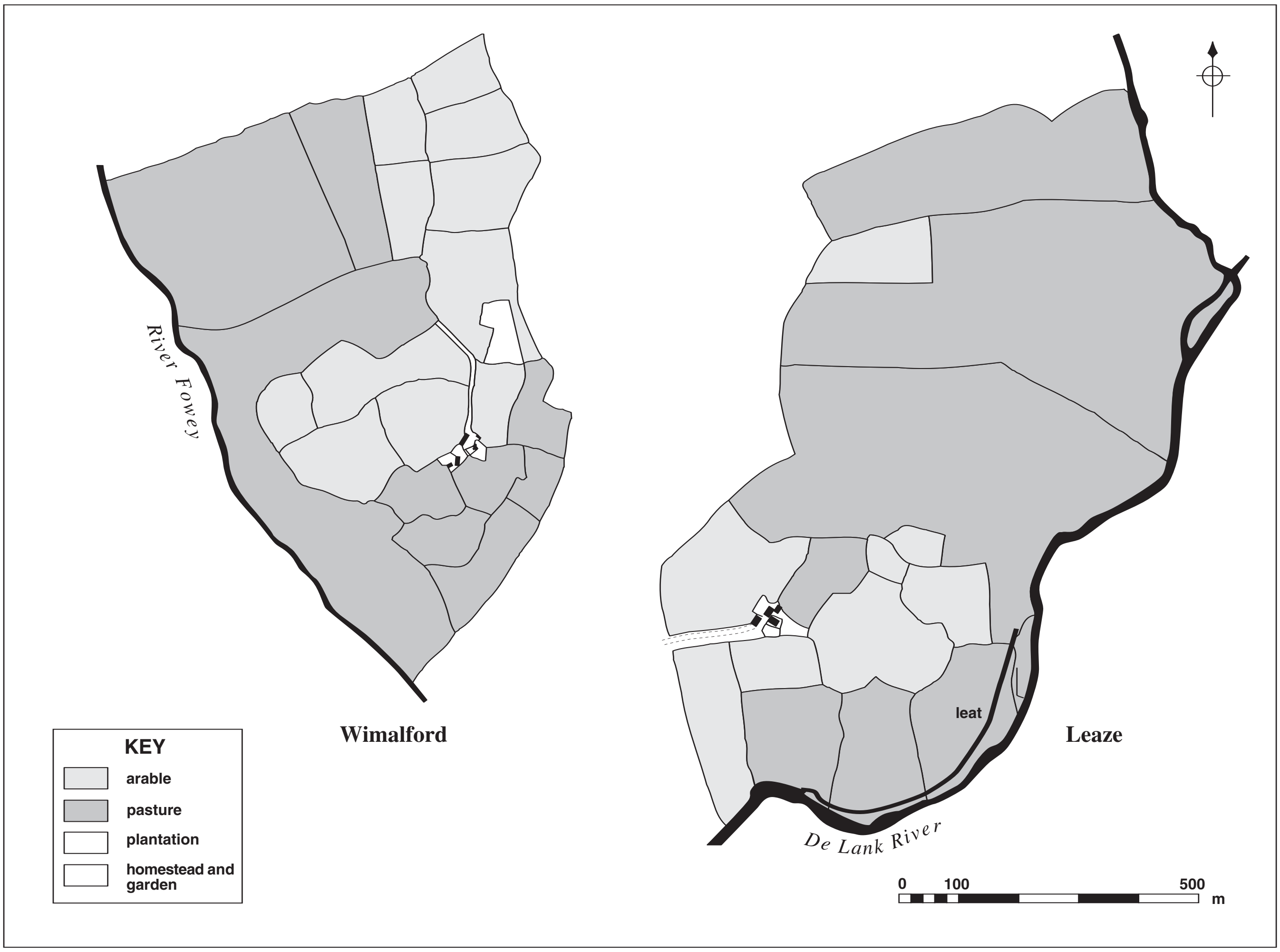


*Fig 119 Land use at Wimalford, St Cleer (SX 213736) and Leaze, St Breward (SX 133769) in 1840 as recorded on the parish Tithe Apportionment Schedules. Arable indicates land in a ley or convertible husbandry rotation (*see *Section 3). Both farms, like most on the Moor, will also have had access to rough grazing.*

valleys on to Searle's Downs (SX 170703) and Mutton's Downs (SX 194700), or elements in wholly new groupings of several contiguous farms and smallholdings. The most important of the latter was in the centre of the Moor, with 46 new farms cut out of the rounded hills around Bolventor, from Black Hill and Outer Pridacoombe to Simon's Stone and Pinnock's Hill. Other groups of new settlements were in the north-east part of Advent; around Trevillian's Gate in Davidstow; and on the lower slopes of Stowe's Hill, Linkinhorne (*see* Map 1).

The intake process had two main stimuli; the need to accommodate the gradually increasing volume of labourers working in the Moor's several extractive industries, and the desire by landowners to increase returns from relatively unproductive land. Much of the heathland enclosed had been common, and the willingness of lords to deprive established tenants of pasture and turbary clearly signals their interest in the process. While most industrial labourers were housed near their places of work in the cottages and terraces of the new industrial hamlets (*see* Chapter 10, Section 1), significant numbers accepted the opportunities presented by landlords to increase income and improve living conditions by enclosing and improving rough ground and erecting dwellings and farm buildings. Philosophies of self-help and thrift promulgated by politicians and popularised by the various strands of nonconformist Christianity were made manifest in such settlements (also *see* Herring and Smith 1991, 39–43).

Farming families would also have taken advantage of the enclosure of heaths, as they did in most other parts of Cornwall (Countryside Commission, 1996), but the documentary evidence indicates that most of Bodmin Moor's new settlements were indeed created by families whose adult males, and often several other members, worked in local streamworks, mines, quarries or clayworks. For example, in the Bolventor area most new tenants were apparently streamworkers, recorded in the 1851 Census returns as either tinners (St Neot) or 'tinstreamers' (Altarnun), and clearly distinguished from miners. They no doubt worked the extensive alluvial streamworks in the upper reaches of the Loveny, Fowey and De Lank rivers (*see* Table 5 and also Michell 1833, 15, who recorded that between 60 and 80 men were then working 'three streams' near Dozmary Pool, presumably the Loveny's three upper tributaries, now the three arms of Colliford Lake reservoir).

Table 5 Occupations of inhabitants of post-1808 settlements in the Bolventor area as recorded in the 1851 census returns

Farmer	6
Herdsman	1
Miner	1
Farmer and miner	1
Tinner or tin streamer	25
Farmer and tinner/streamer	5
Pauper	1
Total	*40*

The new holdings were generally smaller than pre-1808 farms, many of which had been worked in the later medieval period by several households living in small hamlets (Rose 1994, 83–7). Acreages of 32 farms in the study area were recorded in the 1843 estate atlas of the Rodds of Trebartha Hall, one of the Moor's most important improving families (Henderson Calendars, RIC). The average extent (including privately held rough ground) of the 14 pre-1808 farms was 103.5 acres (42ha), ranging from 22 acres (9ha) at Bastreet, SX 244765, to 235 acres (95ha) at Gillhouse, SX 187732, while the 18 post-1808 farms averaged only 42 acres (17 ha): from just 11 acres (4.5ha) at Clitters, SX 244785, to 103 acres (42ha) at Blackadon, SX 187778.

The 19th-century farmsteads were also modest, often with the principal farm building, the chall barn (threshing barn and loft over cow house/shippon, *see* Section 6), attached to one end of the dwelling (*see* Fig 120, Tolborough Barton) and small stables, cow houses or shippons, pigsties and cart sheds arranged around cobbled yards with mowhays (rickyards for hay, corn, turf, bracken and furze) and gardens beyond (*see* Fig 121 and Section 6 below for Bodmin Moor farmsteads generally). Fields usually had four perfectly straight sides but were rarely rectangular, their shapes determined by landlords' stewards who pegged them out with local topography in mind. Boundaries were stock-proof and a mixture of drystone walls (or stone-faced stone walls in the Bodmin Moor Survey – *see* Johnson and Rose 1994, fig 12), Cornish hedges (stone-faced earth walls) (*see* Figs 122 and 123), and turf banks, the form chosen dependent on materials immediately to hand (Herring 1986, vol 2, 44).

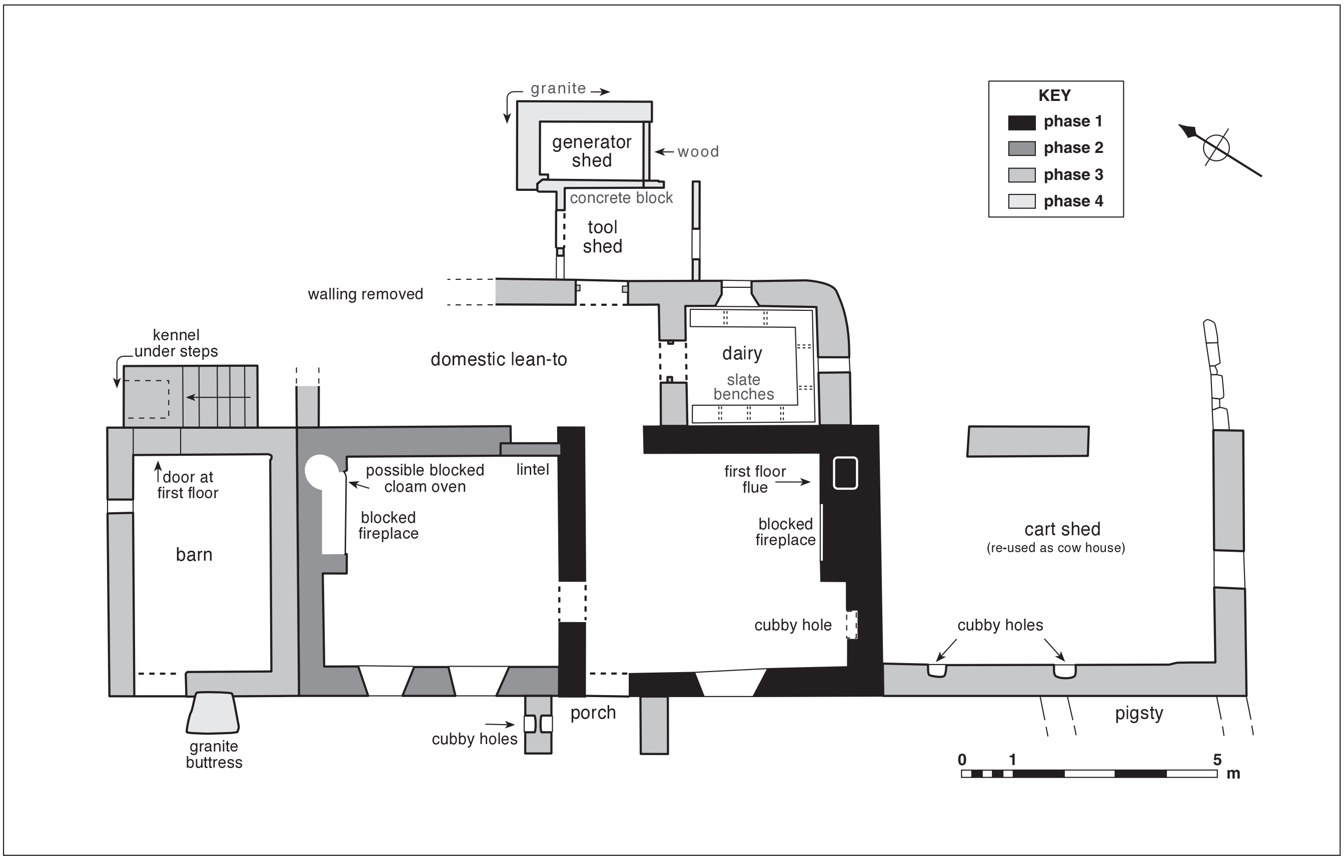
Pridacoombe and Tolborough area (SX 1776; Fig 124)

Nineteenth-century enclosure can be closely observed in this south-western corner of Altarnun parish, set in the rolling rounded hills north and west of Bolventor which appear never to have been cultivated in either prehistoric or medieval times (Johnson and Rose 1994, maps i and ii). Francis Hearle Rodd of Trebartha Hall had purchased the area, with nearby Codda, in *c* 1830 as part of an estate-building campaign (Henderson Calendars, RIC). Just a year after Francis' death in 1836 (Latham 1971, 96) his brother and heir, the Revd Edward Rodd, began to improve the area, leasing seven blocks of 'about 20 acres' in Pridacoombe and Stanning Hill between March and November 1837 (CRO, RD 200–10). Typical of the new tenants was William Jory, a 'labourer', who on 29 May 1837, leased for £2 per year for 3 lives (ie held on specified terms until after the deaths of three named individuals following which the lease would have to be renegotiated), 'about twenty acres' of 'wastrel lands' in what is now Middle Pridacoombe, SX 166764, 'now marked out and intended to be fenced off' (CRO, RD 200); the contemporary lease of neighbouring Pridacoombe, SX 167769, refers to land being 'marked or staked out' (CRO, RD 202). Jory also obtained turbary on Pridacoombe Marsh adjoining. He was obliged to build within 12 months and at his own expense but subject to inspection by Revd Rodd, 'a finished and substantial dwelling house … of stone and mortar and of good and durable materials … together with such barn, stable, chall or other outbuildings necessary for farming' (CRO, RD 200).

It is possible to judge the progress made by the settlers in their first four years through inspection of the 1841 Altarnun Tithe Map. Middle Pridacoombe had already passed out of William Jory's hands to John Harper but the house and barn were built and 26.5 acres (11ha) enclosed in four fields. Farmers at Pridacoombe, West Tober (SX 168763), Stanning Hill (SX 170756) and Roughlands (SX 170767) had made equally good progress (between 26 and 33 acres, 10.5 and 13.5ha enclosed) but although there were buildings at Outer Pridacoombe (SX 159765) and South Pridacoombe (SX 164763), each had only 7.5 acres (3ha) enclosed. Two of the 1837 lessees, Henry Hodge and Arthur Philip, who should have enclosed the west side of Stanning Hill and the far southern end of Pridacoombe (between South and Outer Pridacoombe) respectively, had clearly abandoned their projects before beginning and these two farms were never established.

The difficulties faced by poor workers with minimal capital can be appreciated through the description of the taking in of Todda Park (SX 189766) from Dryworks Down (a mile east of Pridacoombe) by a Mr Keast in the later 19th century, as recounted by his grandson Thomas (Keast 1984; 1995). He took the lease of 75 acres (30ha) from the Rodds while foreman at Goodaver Mine (closed 1891), agreeing to take in so much land per year and to erect £300 worth of buildings. Field boundaries were built with the help of neighbours and fields were often named after those who helped, eg Jim Nottle's Field (*ibid*). Improving the land was also 'all muscle work'; a breast spade was pushed by one person and pulled by another, often a child, to pare the turf from about half an acre a year; the parings or 'bait' were dried and burnt and the ashes spread over the ground before ploughing (*ibid*; and *see* Dodgshon and Jewell 1970, for a full description of paring and burning or beat-burning). Much of this work was done by the women – 'it was not uncommon to see a woman twitch the spade' (Keast 1984; also Sleep 1984) – presumably while the men were at work in the mines. Stone cleared in the process would be saved for use in the buildings which were often built 'by lantern', after a day's work (Keast 1995).

William Nottle at Pridacoombe Farm was able to erect his buildings within seven months of taking up his lease and then to use them in October 1837 as



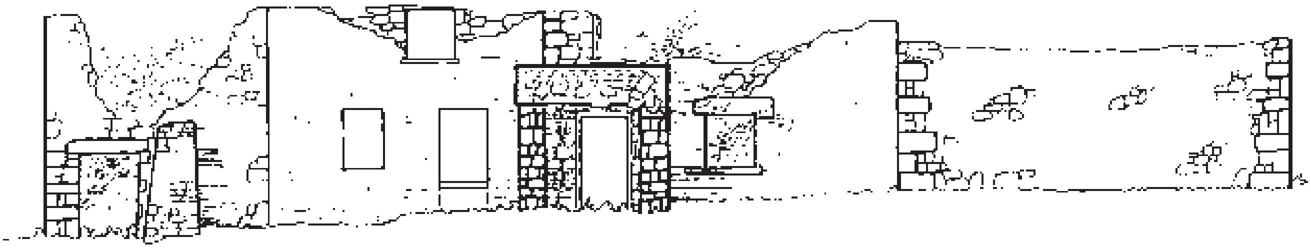


Fig 120 Tolborough Barton, Altarnun (SX 176772); plan of the farmhouse range. Phase 1, a very small cottage, probably built in the 1830s when Squire Rodd of Trebartha leased the land for the intake, and all the rest with the exception of the dairy, tool shed and generator shed, were in place by 1883 (OS 1:2500 map, 1 edn). The front of the house was concrete rendered (with a fairly typical incised block design) in the mid-20th century distinguishing it from the granite rubble build of the small barn to the left and the outhouse to the right. The house was burnt out in the 1970s. (Elevation © Rosemary Robertson; based on a drawing made by Jacqueline Nowakowski in 1982)

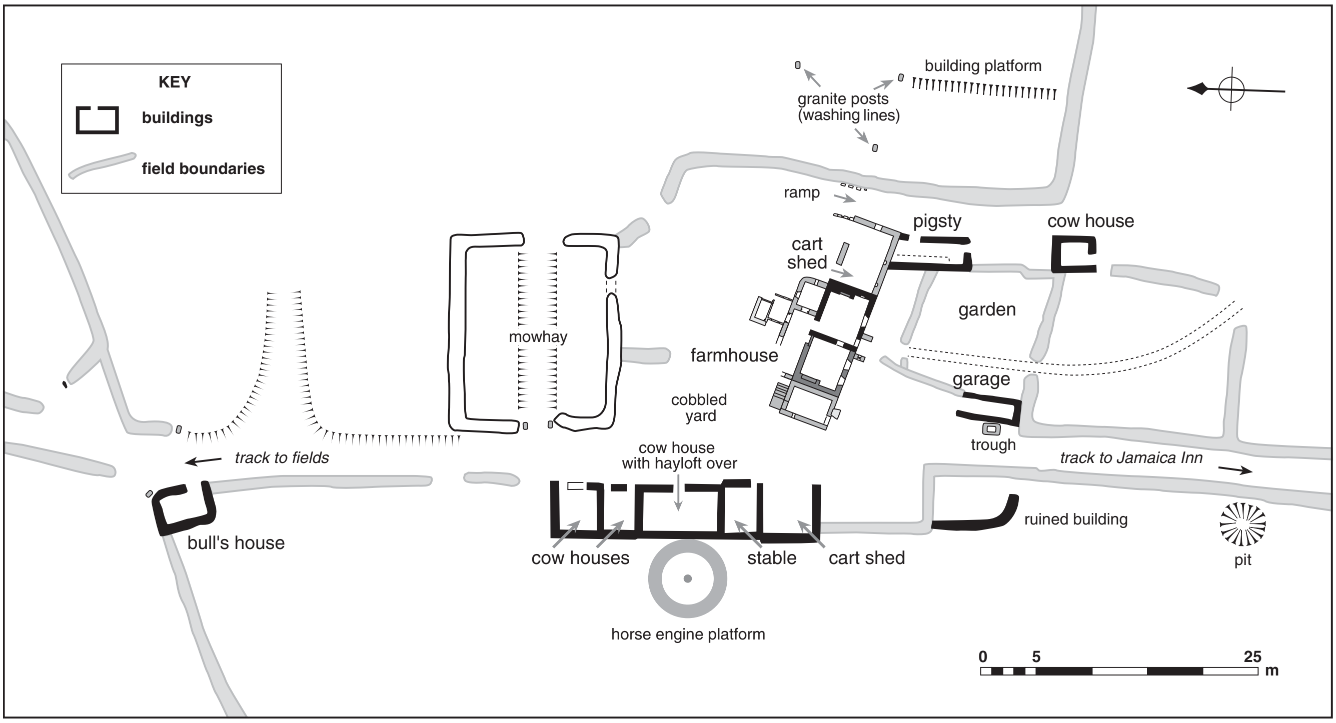


Fig 121 *Tolborough Barton, Altarnun (SX 176772); farmstead plan. Phase 1 of the farmhouse in the centre (*see *Fig 120) was the only structure extant in 1840 (Altarnun Tithe Map). The cart shed (now a garage), bull's house and the small cow house (south-east of the dwelling) were in place by 1883 (OS 1:2500 map, 1 edn) as were the barn and cart shed attached to the dwelling. All other buildings and enclosures (with the exception of the farmhouse's rear northern outshuts) existed by 1906 (OS map, 2 edn). The horse engine platform behind the main cow house is not recorded on maps but survives as a circular platform;* see *Fig 133 for a reconstruction of such an engine. (Based on a sketch made by Jacqueline Nowakowski in 1982)*

Fig 122 *Drystone walling in the 19th-century fields at Slades, St Breward (SX 153804). It appears likely that the wall, which would have been stock-proof, was supplemented by a fence; note how much taller the plug-and-feather split gatepost is than the wall. (From Herring 1986, plate 5)*

Fig 123 Cornish hedge (stone-faced earth bank) forming the southern perimeter of Mount Pleasant farm, a late 19th-century intake in St Breward (SX 137776) in 1994. The farm buildings are among the shelter trees at the left. The conifers to the right and in the middle distance, in front of Roughtor, were planted mainly as windbreaks in the second half of the 20th century. (Peter Herring)

security for a £20 mortgage (CRO, RD 203). This gives a useful indication of the increase in value these improvements earned. More significantly, Nottle's lease was surrendered to the Rodds by the mortgager in 1860 (CRO, RD 204) and five years later in 1865 the Rodds leased the farm again, to Thomas Nottle, for £4 11 shillings (£4.55) per year after payment of £60 consideration (CRO, RD 205). This small and distant patch of wastrel land had therefore earned the Rodds through rent and consideration £106 in 28 years and was now to provide them with more than double the initial rent.

By 1883 (OS 1:2500 map, 1 edn) all the farms, including South and Outer Pridacoombe, were well established, all with more than 20 acres of improved land in between 8 and 19 fields and with hedged lanes and open paths running through them to wells, and the turbaries and rough grazing (on Pridacoombe Down, Stanning Hill and Shallow Water Common). The regrator's shed at the end of Roughlands Lane (SX 17487634) was also in place by 1883; here butter and eggs from the several farms of Pridacoombe and Tolborough were left for collection by the travelling middle-man (Wallis 1984).

Between 1883 and 1906 (OS 1:2500 map, 2 edn) one or two new fields were added to Outer Pridacoombe, West Tober and Stanning Hill farms, while two wholly new settlements were established; Higher Tober (SX 172769) and the single-storey house 100m to its north known in recent years as 'The Old Lady's House' (SX 17247706).

3 Arable

by Peter Herring

Most crops on Bodmin Moor in the 19th and 20th centuries would have been grown as winter fodder for livestock. Wheat and barley are not normally viable in an exposed landscape with wet summers and acid soils, so oats and dredge (oat and barley mix) were the principal grain crops (Herring 1986, vol 2, 149–50). They were threshed, winnowed, sometimes milled, and perhaps had their chaff cut in preparation for the manger, usually by hand until at least the mid-19th century when water, horse and steam convertible husbandry (movable) powered machinery were introduced (*see* Section 6). Turnips and other fodder were also grown; root stores were recorded at Bowden (SX 202689) and Carkeet (SX 219733) in 1910 (PRO, IR58/72101, 95 and 531).

In consolidated holdings the farmstead was usually located close to the arable fields, which were often grouped together and referred to as the 'inbye land'. In a fairly marginal landscape arable ground had to be carefully selected and was generally the best-drained and most sheltered land, its aspect usually to the south of east and west (*see* Fig 119 for Leaze).

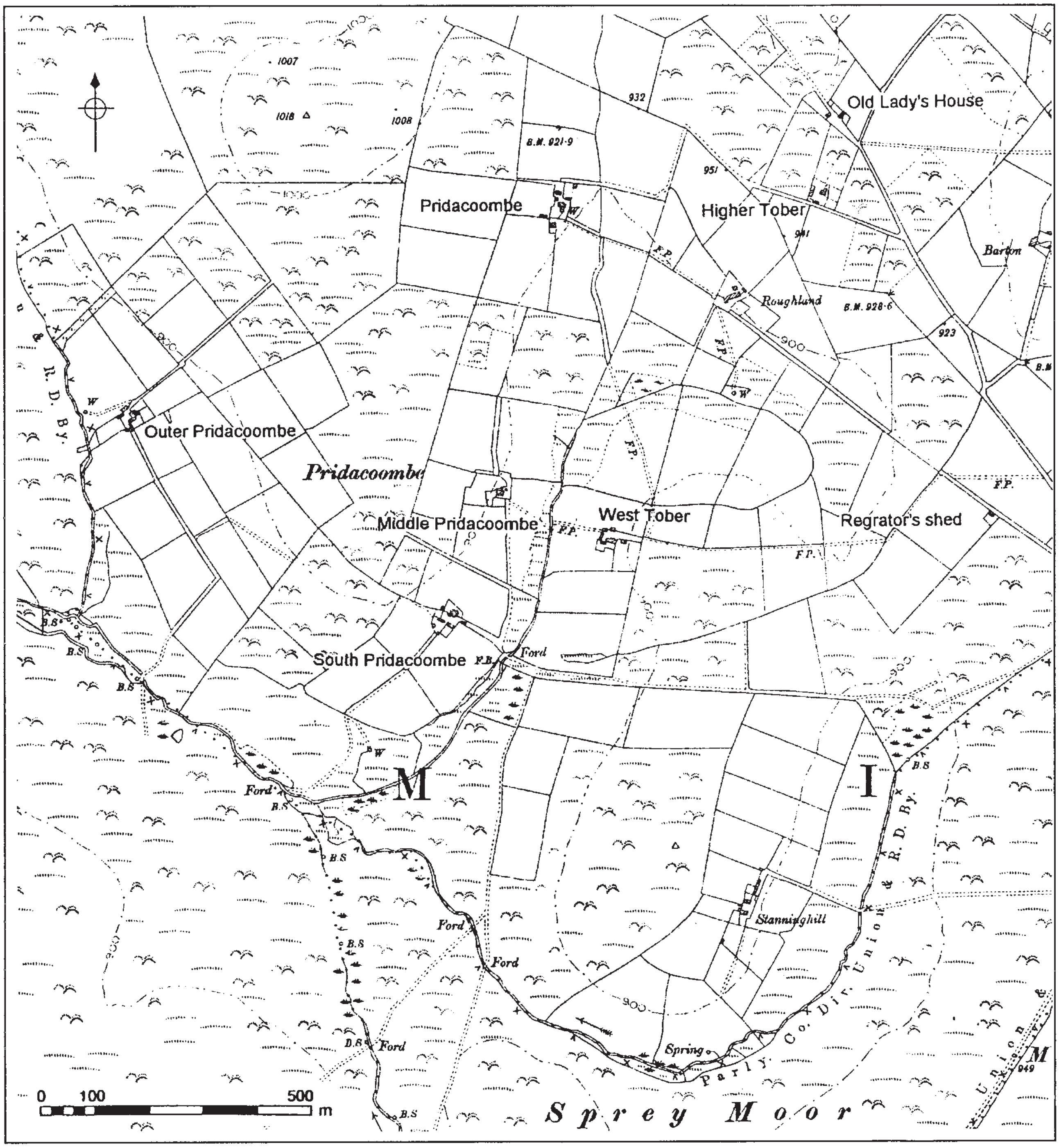


Fig 124 Intakes in the Pridacoombe area of Altarnun as mapped in 1907. (OS 1:10 560 map, 2 edn; settlement names added in sans serif lettering)

Arable land in farms had to be prepared in the year before cultivation, as a thick grassy turf developed during the ley period. The first stage in Cornwall until the early 20th century involved the laborious task of beat-burning. Using a biddax (broad-bladed mattock) or a pug mill (a human-pushed skimming share – simply called a 'spade' at Gillhouses, SX 186733; Davey 1994, 14), the turf would be pared off in April or May. Turned occasionally by titch-crooks (*see* Chapter 7, Section 5), it was left to dry (Dodgshon and Jewell 1970, 82; Jewell 1981, 98), then heaped into 'beat-burrows' and fired with wisps of rough straw (Chope 1918, 274). The ashes were scattered over the ground, reducing acidity, mineralising nitrogen compounds, and increasing phosphoric nutrients (Hatcher 1970, 12–13). All this was very hard work; one person clearing about an acre per week (Jewell 1981, 99) and the work was often done communally, 'a

Fig 125 Domestic well in its own small enclosure close to the dwelling at Pridacoombe, Altarnun (SX167769) in 1981. (Peter Herring)

kind of harvest work, bustle bustle, for a month or six weeks' (Worgan 1811, 67–8). As well as increasing fertility, beat-burning, by removing the tough turf, eased the passage of the plough and removed most weeds and pests (Dodgshon and Jewell 1970, 84–6). Fertility would have been further increased by the addition of dung from cow houses, piggeries and stables, burnt lime from kilns on the navigable stretches of the Fowey, Looe, Tamar and Camel rivers (*see* Davey 1994, 14), and calcareous sea-sand brought from Cornwall's coasts (Borlase 1932); a scatter of plough-smashed beach-flints found at Higher Tober (SX 17247731) was interpreted as having been introduced with loads of soil-sweetening sea-sand (Herring and Lewis 1992, 11).

Oats are spring-sown and on Bodmin Moor were hand-sown on many farms into the 20th century. 'A sling was put over the shoulders and a man would take a cut at a time to sow it as in bible times' (Davey 1994, 15). The ground had been horse-ploughed and harrowed and was harrowed again once the seeds were sown; Lilian Davey's grandfather, refusing to 'accept the new inventions as they came along … .used to pull a furze bush through the shivers of a gate to do the job' (*ibid*). Harvesting was also largely done by hand into the 20th century on farms in the heart of the Moor; it is noticeable how few 'machines' (reapers of various kinds) were repaired by the Kents of Ley smithy (SX 175663), and how many 'sythes' (scythes) were re-laid for farmers in the upland farms of St Neot, places like Deweymeads (SX 167737) and Colquite (SX 162737) (Ley smithy account books for 1901 and 1902, held by Peter Kent).

See Section 6, below, for the storage and processing of the grain within the farmstead.

4 Pasture

by Peter Herring

In a pasture-biased mixed farming economy like that of post-medieval Bodmin Moor, providing sufficient grazing and winter feed for livestock was of paramount importance. Saving the hay was as important as harvesting the oats, and the few meadows and the arable's ley grass were carefully husbanded. Access to summer grazing (May to October), whether as a shared right to medieval-derived commons or as enclosed and privately held rough ground, was also essential, as much to get stock off the hayground as to exploit a seasonal resource. The rough ground was also vital in supplying fuel, both turf and furze (*see* Chapter 7) and bracken for bedding (*see* Herring forthcoming).

Common land on Bodmin Moor was considerably reduced by the 19th-century intakes described above (Section 2), all of which were achieved without Acts of Parliament and thus illegally (Brewster 1975, 209). The 1876 Commons Act made further enclosure costly and difficult, and the extent of Bodmin Moor commons has been effectively frozen since that date at *c* 75sq km. Bodmin Moor's commons were and are mainly the property of moorland fringe manors of medieval origin; so most tenants or freeholders with common rights, as registered for the purposes of the 1965 Commons Registration Act, also lived and continue to live just off the Moor (Brewster 1975, 224–32; Herring 1986, vol 1, fig 29). Most modern intakes were provided with common rights but sometimes confined to turbary (eg the Pridacoombe and Tolborough area described above in Section 2), denying pasture rights – perhaps to appease the ancient tenants whose rough grazing had already been reduced by the enclosure.

In June 1936 the Cornwall Commoners Association was established to take over responsibility for managing the commons from the manorial courts, by then defunct. Amongst other practical improvements, such as the prohibition from the commons of stallions over one year and bulls over nine months old, they have, with the approval of the Ministry for Agriculture, Fisheries and Food, organised the fencing of certain dangerous bogs (Roughtor Marsh, Newton Marsh and Kenniton Bog), the provision of fencing against the A30, and the installation of a number of cattle grids (Brewster 1975, 233–5).

During the 20th century the privately held rough pastures were greatly reduced through improvement, falling from 160 to just 46sq km between 1938 and 1975 (*ibid*, 213).

Farmers from lowland Cornwall had from at least the 15th century paid to turn their animals out onto Bodmin Moor's commons (Maclean 1886, 33) and privately held rough grazings, from 2 to 21 shillings per head of cattle and 1 to 3 shillings per score of sheep in 1811 (Worgan 1811, 106). Local newspapers regularly took advertisements from moorland landowners in the 19th century. For example, in February 1812 there appeared in the *West Briton* the following. 'Farms and summer pastures to be let … Hawke's Tor, Kerkees [Carkees], Druglets and Scrible [Scribble Downs] in the parish of Blisland, all inclosed and contiguous to each other, containing upwards of 800 acres of the best summer pastures for cattle and sheep in Cornwall, constantly supplied with large streams of fresh water, to which cattle always have access. A considerable sum has lately been laid out in clearing the leats draining and fencing these pastures. There is a dwelling house for a herd on these premises' [probably the ruin at Druglets, SX 141761; *see* Johnson and Rose 1994, fig 75] (Barton 1970, 26). Three years later in 1815 the same pastures were advertised again but this time it was announced that 'Proper herdsmen have been appointed' (*ibid*, 57). Such herdsmen were an important element of the moorland population; the 1851 census returns record herdsmen at Ninestones and Wimbleford (Wimalford) in St Cleer and Trezelland, Tober, Goodaver, Zebet (Trezibbett) and Dryworks in Altarnun.

Livestock were predominantly cattle and sheep, the former being the most visible archaeologically through the cow houses and shippons of the farmsteads (*see* Section 6 below) but there are also a number of sheep creeps, allowing sheep movement between fields whose walls and hedges controlled cattle and horses (eg at Pridacoombe, SX 165770 and Ivey, SX 131764). Horses were kept on every farm, for traction and for use on the downs (rounding up, etc); there were between two and six stalls on every farm in 1910 (PRO, IR58/72021). Virtually every farm had pigs, converting surplus or waste from the dairy, garden and house into meat. Geese and goats were also important, the former shut up overnight in stone-lined gooseholes built into the bases of yard walls (good examples at Codda, SX 18037841; and *see* Fig 126), the latter turned out onto the moors – the 'large herd' on Brown Willy giving 'quite an Alpine touch to the mountain scenery' (Breton 1912, 18). 'Troops of unbroken and half-wild ponies … roaming at large on the moor' (Leigh 1937, 149) can still be seen and over 700 were sold at Five Lanes market alone in 1973 (Brewster 1975, 258).

Cattle in the 19th and 20th centuries were predominantly beefstock although there was a period when dairying was more than at a subsistence level and became commercial, largely during the 1930s depression. This was the heyday of milkstands, the Excelsior Milk Co and the Milk Marketing Board, when cow houses were fitted out for milking (*see* Leigh 1937). Milking before the expansion was usually done by the women and girls, by hand, often in the open yard, as at Codda (SX 180784) in the early 20th century, when Gladys Sleep and her sisters helped her mother (Sleep 1984). The bulk of the milk produced at Codda then was consumed on the farm. Butter was made every two days from scalded cream and some was sold, along with cream, eggs and other small-scale farm produce via the regrator. Most of the milk, however, was fed to pigs and other livestock (*ibid*).

Bodmin Moor sheep are and were hardy, 'the mongrel flocks … not nice in feeding, for I have seen them cropping the furze and the heath, as well as depasturing the grass', but they yielded 'very good' mutton and fleeces 'of moderate quality' (Worgan 1811, 151).

A typical holding of about 50 acres (20ha) on Bodmin Moor in 1941 could be expected to support about 8 or 10 Devon cows and their young stock, and about 20 Longwool ewes and their lambs. Most farmers with sufficient capital would also run hardier animals entirely on the downs (ie over-wintering): Galloway or Scotch cattle and Scotch or Cheviot sheep (Roberson *et al* 1941, 451). When Margaret Leigh took over the rundown 44 acre (18ha) holding at Newton in 1935 she inherited 5 Devon cows in milk, 3 heifers, 3 yearlings, 8 Longwool ewes, 9 lambs and 25 hens, together with a cart mare and pony (Leigh 1937, 62).

The forms of post-medieval pasture boundaries, like those in the contemporary fields, reflect materials to hand. So ditched turf banks can become drystone walls or Cornish hedges as they enter stonier areas (good examples of variability on Butterstor and Tolborough Tor). Lines are often perfectly straight, determined by surveyors (eg on Pridacoombe Downs and Smith's Moor in Altarnun).

Management of the rough pasture was minimal beyond occasional swaling, or controlled burning, aimed at promoting fresh growth of heather and gorse (Roberson *et al* 1941, 450).

Livestock were removed from the Moor to lowland farms for about a month each year, usually in the spring, as, 'a remedy against Moor sickness … which checks the progress of immature beasts and lowers the yield of milk cows' (Leigh 1937, 102), now recognised and treated on the Moor as cobalt deficiency (Brewster 1975, 244).

The farmer would always try to save as much hay as possible as this was the basic fodder on which the winter well-being of the cattle (housed from October or November till May; Karkeek 1845, 452) depended. In the first week of May the meadows and as many ley fields as could be spared were hained, that is cleared of stock, sometimes manured, and left to grow the grass which was to be the hay. This was mown in late June or July, traditionally with a long-bladed scythe (Jack Parkyn, pers comm) but, from the late 19th century, with a horse and then tractor-drawn 'grass machine' or mower. When dry the hay was saved in a horse-drawn lathed wain and ricked in the mowhay, an enclosure near the threshing barn, usually with two wagon entrances, one for entering, one for leaving (*see* Fig 121). The rick was built on a haystead, a rectangular stone-lined platform (eg at Leaze, SX 13367684, across the mowhay from the staddle stones of the corn rickstand). Pikes and

Fig 126 Goosehole built into the thickness of the yard wall at Pridacoombe Farm, Altarnun (SX 167769) in 1981. The large stone would have been rolled in front of the hole each evening to keep foxes and other predators from the sleeping birds. (Peter Herring)

prongs were used to throw the hay up to the ricker; they were briefly replaced on a few farms (eg Wimalford, SX 21377364, Gillhouses, SX 186733) by the horse-operated hay pole, a four-guyed pole with pulley through which ran the rope which, when pulled by horses, lifted a large grab of hay from the wain onto the rick (Jack Parkyn and Tony Blackman pers comms, and Davey 1994). This device was in turn made redundant by balers and Dutch barns. Hay ricks were thatched with rushes scythed from nearby marshes, bundled and laid stubby ends down (Davey 1994).

5 Agricultural dwellings

by Peter Herring

As with field systems (Section 2, above) so with dwellings; there is a distinct difference between Bodmin Moor farmhouses in post-medieval intakes and those in medieval-derived settlements. Indeed several of the latter are essentially pre-19th-century structures: houses like Mennabroom (SX 163706), Codda (SX 180784), Dryworks (SX 194767) and West Carne (SX 202822). Often with larger holdings, in more favoured agricultural locations, the older farms were generally wealthier and their occupants had greater social aspirations. Dwellings here, whether old or not, are often rather more detached from the farm buildings than those in the recent intakes. Many of the latter are actually attached to the principal farm building, the chall barn (*see* Section 6, below), sharing the same roofline although, unlike medieval longhouses (Johnson and Rose 1994), having separate entrances for people and animals; these buildings have been termed chall houses (*see* Herring and Smith 1991, 130; and Fig 120).

Although the 19th century ought to be post-vernacular in terms of dwelling architecture, many of the farmhouses on Bodmin Moor built then owe much of their design to pre-19th-century tradition (*see* also Chesher and Chesher 1968, 114). It is rather surprising to see the variety in layout and styles (chimneys, windows etc) within the group of 'well-built dwellings' erected by those who took Rodd's improving leases in 1837 in the Pridacoombe–Tolborough area (*see* Section 2, Modern intakes). No two houses are identical in this valley; most are chall houses but their domestic ends were apparently built with fairly personal views of what constituted a well-built dwelling although most had simply-porched front doors opening directly into kitchens (*see* Fig 120). A little later in the 19th century, new houses were more standardised, often detached and with symmetrical facades and equal-sized windows (eg Higher Tober, SX 17207692).

Building materials for houses were fairly standard across the Moor; the local granite for walls, and imported slate, from Delabole, Carnglaze and other off-Moor quarries, for roofs and occasionally for cladding; thatch appears by the early 20th century, at least, to have been confined to farm buildings and even then was being rapidly replaced by corrugated iron (PRO, IR58/72021; 1910 survey). Lilian Davey (1994, 18) recalls her father carting slate back to Gillhouses across Roughtor and Brown Willy. Rushes were sometimes also used to thatch buildings – they were the usual material for thatching ricks – and turf is recorded as roofing a cattle shed at Toddy Park (SX 189760) in 1910 (PRO, IR58/72101, 474).

Not all farmsteads in the Bolventor area have mains electricity and the sound of oil-fuelled two-stroke generator engines, once widespread across the Moor, still echoes around the Pridacoombe Valley. Generator sheds, either purpose-built and detached, as at Slades and Tolborough Barton (SX 17647717), or incorporated into earlier buildings, as at West Tober (SX 16797630), are common features of moorland farms.

The 19th-century Bodmin Moor farmhouse was usually provided with gardens, both ornamental and vegetable, the former usually small, walled and in front of the house, with a short cobbled path from gate to door, the latter larger, to the side or rear, and enclosed by a substantial Cornish hedge. Fertilised by farmstead dung, this was a source of much food – vegetables and soft fruit – and also of cutting flowers for display in house, chapel and church. Privies were often built in far corners of vegetable gardens and the washing lines which replaced the convenient gorse bush were sometimes established here although they were more often in townplaces, or adjacent meadows. Slender granite clothes-line posts (over 2m tall) survive at Blackadon (SX 187778), Tolborough Barton (SX 176772, *see* Fig 121) and Pridacoombe (SX 167769), but the finest example is at Clitters (SX 244785).

Trees – beech, ash, oak and sycamore, as well as thorn – were planted and nurtured in many farmsteads as a source of shelter. There were, however, very few fruit trees.

Most farms would have had working dogs whose kennels sometimes survive (built under barn steps at South Pridacoombe, SX 164762 and Tolborough Barton, SX 176772) and farmyard poultry. Gooseholes have been noted above (Section 4, Pasture) but fowls, ducks, guinea fowl, turkeys, etc would have also been put into houses every evening (J Parkyn, pers comm).

6 The farmsteads of Bodmin Moor

by Colum Giles

The 19th-century rebuilding of the Cornish farmstead

The surviving farm buildings on Bodmin Moor date mainly from the 19th century, but archaeological evidence provides a picture of the typical pre-1800 farmstead. Before 1500, the longhouse, combining an area for human occupation with a shippon for livestock, was the dominant type of dwelling, and the cattle accommodation provided in these buildings was commonly supplemented on medieval farms by one or more agricultural structures, at some sites including a corn-drying barn (Johnson and Rose 1994, 83–90). In the 18th century, longhouse derivatives were developed, with no connection between the house and the attached agricultural building (*ibid*, 98–100).

The early forms of farmstead were replaced in a widespread process of rebuilding in the early and mid-19th century. Some new farmsteads were created (*see* Section 2), but many new buildings of this period replaced earlier structures. This process of improvement was described by Worgan; writing in 1811, he noted traditional farmhouses being replaced by 'modern farmhouses … built upon a more liberal plan, the walls of stone, and the roofs of slate' (Worgan 1811, 23–4). Worgan implies, however, that the process of farmstead rebuilding was in its early stages, for in a discussion of cattle accommodation he criticised, 'the general deficiency of house room and comfortable farm yards throughout the county … all cattle, particularly young stock sustain much injury for want of more generous food, and, what is almost equal to it, warm shelter' (Worgan 1811, 146–7).

The remaining structures on Bodmin Moor belong to Worgan's improved category of farmstead, being built of local stone and roofed with slate. Few are closely datable, but it is unlikely that many date from before 1800. The parish Tithe Maps of the early 1840s show, however, that a significant number of surviving buildings were present at that time, implying that they resulted from a far reaching process of improvement and rebuilding in the preceding decades. This rebuilding continued for some time after; Carkeet, for example, was rebuilt in the late 1840s, and Nodmans Bowda (SX 267752) was a new foundation after 1840, albeit on the site of a former farmstead.

The farmsteads vary in size and layout, but conform in so far that they were designed to serve a mixed system of husbandry. Large and small farmsteads, closely grouped and dispersed farmsteads, all had provision both for arable storage and processing and for livestock accommodation. Worgan describes the plan adopted in the improved Cornish farm building as, 'to throw every convenience possible under one roof. The building is called a chall-barn; the ox and cow challs being under the chamber for thrashing corn' (Worgan 1811, 24). This contemporary testimony is an accurate description of the dominant Cornish farm building, known widely to students of vernacular architecture as a bank barn. The building departs radically from the types of farm building known from excavation, and may well have been newly adopted in Cornwall in the years after 1800.

The chall barn

As Worgan implies, the chall barn was a dual-purpose farm building, its design being perfectly suited to the needs of the Cornish farmer. In the smaller farmsteads, few other buildings were required; at Nodmans Bowda, for example, there are two small animal shelters and a stable in addition to the chall barn, and at Tresellern (SX 236769) the chall barn acts almost as a farmstead in itself, being supplemented only by minor outbuildings. Even at a large site such as Carkeet, the chall barn is the only large farm building, forming a courtyard plan with an open-sided shed and the farmhouse.

As the major farm building, the chall barn provided shelter for the most important aspects of the farming economy. It was often built into a hillside to allow easy access to both levels; livestock entered through a doorway in the front wall, and the barn was reached from the higher land at the rear, either directly or with the assistance of a ramp or steps up to the doorway.

Livestock in the chall barn

The chall barns of Bodmin Moor show some variety in layout of livestock accommodation (Fig 127). Certainly by the middle of the 19th century, standard types had developed, but difficulties of dating make it unclear if there was a chronological as well as a typological evolution. At Lower Bowden (SX 202688), the small chall barn may have had two separate cow houses, each perhaps with the beasts tied to face into a feeding passage inside the rear wall (a). At Great Hammett (SX 188696), the livestock were housed in two rooms, one almost certainly a shippon, the other perhaps an ox house or stable (b). Neither room had a feeding passage, making it less convenient than the plan at Lower Bowden. Beasts were tied in rows across the width of the building. At Littleworth, the two ground-floor rooms were both probably shippons; there is no feeding passage, and the cows were tied to face the central dividing wall (c).

The most convenient layout for the housing and feeding of livestock was one in which cows were tied in rows across the building to face into a feedwalk. The plan is shown at its simplest at Nodmans Bowda, where the original building has three ground-floor doorways, the outer ones opening into shippons and the double-width central doorway to a feedwalk (d). The plan could be extended to meet the requirements of the individual farm; Carkeet, for example, has a large central double shippon and two end shippons, the three areas being divided by two feedwalks (e). The wide feedwalks in chall barns were probably used for the storage and processing of fodder, which from the early 19th century at least included roots, which might have required chopping, and straw, which needed to be cut into short lengths to make it manageable for the cattle. The feedwalks were divided from the shippons by low slate or granite partitions. These made it easy to drop fodder into troughs or mangers set against the partitions. There was no direct connection between the feedwalks and the first-floor barn, either by stair, ladder or trapdoor. This must have led to some inconvenience, for the functions of the two areas were closely linked. It is likely that straw produced by threshing was dropped down from the barn's front doorway into the yard outside the feedwalks, and brought inside for short-term storage and for processing.

The shippon inside a Cornish chall barn was a dark and functional area (Fig 128). Windows were rarely provided, and slit vents, usually sited at the head of each row of cattle, provided a flow of air. Raised standings had cobble or rubble floors, sloped to allow liquid manure to drain into a sunken path or gutter. Troughs or mangers were raised slightly from the standing, and cattle were tied to wooden stiddle posts. The width of the

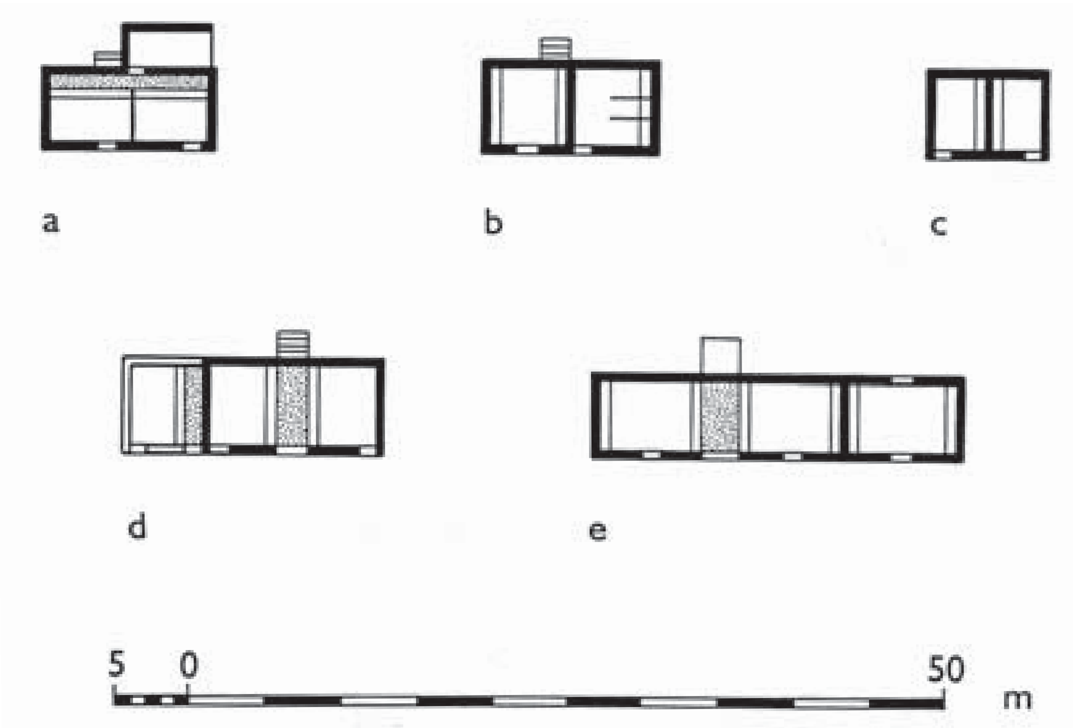


Fig 127 Ground-floor plans of chall barns (feedwalks shaded): (a) Lower Bowden, St Neot (SX 20226879); (b) Great Hammett, St Neot (SX 18866967); (c) Littleworth, St Neot (SX 19607557); (d) Nodmans Bowda, North Hill (SX 26737523); (e) Carkeet, St Cleer (SX 21987330). (Allan T Adams)

typical chall barn allowed perhaps five or six cattle to be tied in each row. The milk cows and perhaps some of the better fatstock would overwinter inside the chall barn.

Until the mid-19th century and beyond, the haulage and fieldwork on Cornish farms was commonly shared between oxen and horses. From the mid-century, horses began to replace oxen, despite one contemporary description of the local breed as 'a weedy, trashy race' (Karkeek 1845, 453). It is very likely that many of the chall barns were built to accommodate oxen, either in the shippons described above, or in separate rooms. At Carkeet, for example, the smaller of the two ground-floor rooms may well have been used originally for oxen, for the surviving stable fittings are clearly later in date, and the separate rooms at Great Hammett and Wimalford may have had the same use originally.

Storing and processing the grain crops

The farmsteads of Bodmin Moor testify to the importance of arable husbandry within the farm economy, for the first floor of the chall barn and the adjacent area to the rear of the building were devoted to the storage and processing of grain crops. The area next to the barn, called a mowhay in Cornwall, was used to stack unthreshed crops awaiting processing. Carkeet retains the base of a rickstand, formed by short granite posts and horizontal bearer beams, on top of which was a grid of iron bars (Fig 131, p 156). This structure raised the stack off the ground, reducing the damage caused by damp and by vermin. The stacks were broken up at need as corn was taken into the barn for processing. The barns are of simple form. They are open to the roof, and usually have opposed doorways in the front and rear walls, sheltered by canopies to prevent the worst of the rain being driven in. Some have windows, others ventilation slits. Some barns are very small, but others have a large storage capacity, allowing space perhaps for some unthreshed crops and for straw.

The principal function of the barn was to house grain processing. On many farms, threshing and winnowing appear to have been performed by traditional hand-powered methods until a late date, for there is no evidence for mechanised working before the era of the small internal combustion engine

Fig 128 The interior of the shippon at Carkeet, St Cleer (SX 21987330). The ground floor of the chall barn is low and dark. This view shows the stone partitions between the feedwalk and the shippon, the stiddle posts to which the stock were tied, and (against the right-hand wall) the gear wheel transmitting drive from the external waterwheel to a pulley wheel and thence to the threshing machine on the upper floor. (RCHME, BB95/10758; Crown Copyright Reserved)

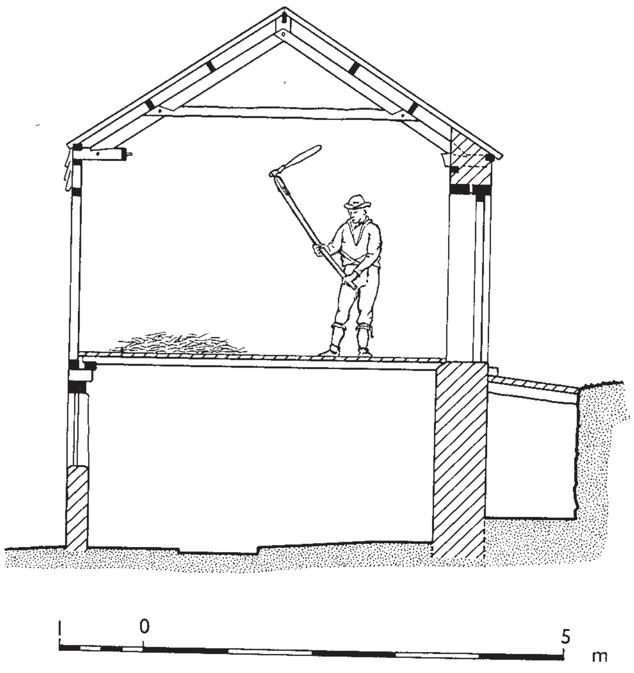


Fig 129 Section through the chall barn at North Bowda, North Hill (SX 24817739). The section illustrates the way in which chall barns were commonly built into a hillside to allow easy access to both levels. The first-floor barn is reached from the rear (right) by means of a small bridge. The trusses in the central area, between the opposed doorways, have truncated tie beams which allow headroom for the operation of a hand flail for threshing. (Allan T Adams)

or electric motor. Hand threshing is implied in the structure of one barn, that at North Bowda (SX 248773); here the roof trusses have tie beams except over the threshing floor, thus allowing headroom for the free operation of a hand flail (Fig 129). In virtually all barns, winnowing was assisted by the opposed doorways, which produced a through draught for separating grain from dust. It is likely that some grain was stored in the barn either before sale or, in the case of oats and barley, before use as fodder for the farm's livestock. Some of the larger chall barns have a separate first-floor granary or fodder store, either as part of the original building, as at Carkeet, or as a result of an extension, as at Nodmans Bowda and North Bowda.

From the early 19th century, mechanised processing became more common. As early as 1811, Worgan was able to state that, 'threshing machines are become very general, few farms of any consequence being now without them; they are mostly wrought by horses, a few by water, and I have heard of one of them by steam; but I believe it has not answered'. He also described and illustrated a threshing machine designed to be operated by hand, although his judgement was that this machine did not 'answer well in practice' (Worgan 1811, 43–4). No farmstead on Bodmin Moor appears to have installed mechanised processing at such an early date, and indeed it seems likely that even the bigger farms used hand power until the middle of the century; at Carkeet, for example, the large barn of the late 1840s appears to have been built for hand threshing. The heavy investment in a water-power installation, which included not only the wheel and all its gearing, but also earthworks designed to store water and lead it to the wheel, placed mechanisation beyond the reach of most small farmers. It is no coincidence that the two examples of water-powered operation within the survey area are located on the largest farms, at Siblyback and Carkeet.

Inspection of the first edition OS 1:2500 maps (1880s) found another 20 examples of water-powered barn machinery (waterwheels either against barns or remote from them in low-lying fields, with the power transferred along flat rods) within a 2-mile wide band around the Moor but only one other site, Lower Langdon (SX 213723), on the granite itself (Peter Herring, pers comm).

The water-power system at Carkeet can be reconstructed in some detail (Fig 130). Added to a barn which may originally have been designed for manual processing, and later perhaps for threshing using the power of horses, this system, dating probably from the third quarter of the 19th century, comprised a leat taking water from a stream, a small storage pond, a launder supported on granite piers leading water over a track to the barn, the wheelpit and waterwheel itself, and a tailrace taking away from the site water which was reused in Carkeet brickworks (*see* Chapter 6, Section 6). The hub of the overshot wheel survives, as does the gearing mechanism which transmitted the rotative motion of the wheel into the barn (Fig 132). Here a wooden pulley wheel drove a belt connecting with a threshing machine, still *in situ* within the barn. Whether the wheel also powered fodder preparation machinery – a chaff cutter, a root chopper, or oat bruiser – is not known. The waterwheel at Carkeet appears to have been open to the elements for a good part of its life, but that at Siblyback was contained within a building.

Horse-powered operation required a much smaller capital expenditure and was adopted more widely than water power. Many farmsteads in the area to the east of the Moor have or had horse-engine houses, distinguishable on large-scale maps as apsidal or rectangular projections from barns. On the Moor, no farmsteads appear to have had such structures, and the two examples of horse-powered operations recorded during the survey were both simple open-air installations. That at Toddy Park (SX 187760), probably erected in the late 19th century, comprised a small horse wheel, anchored to a granite base. The horse trod a circular paved path around the wheel, which turned a shaft leading into the barn just above ground level (Fig 133).

Inspection of the 1880s OS maps found 42 probable horse engine houses, 34 in the 2-mile band around the Moor's edge and 8 within it. In addition, several more open-air sweep-type engines, as at Toddy Park, have been recorded on farms in the heart of the Moor, including Tolborough Barton (*see* Fig 121), Outer Pridacoombe and Wimalford (Peter Herring, pers comm).

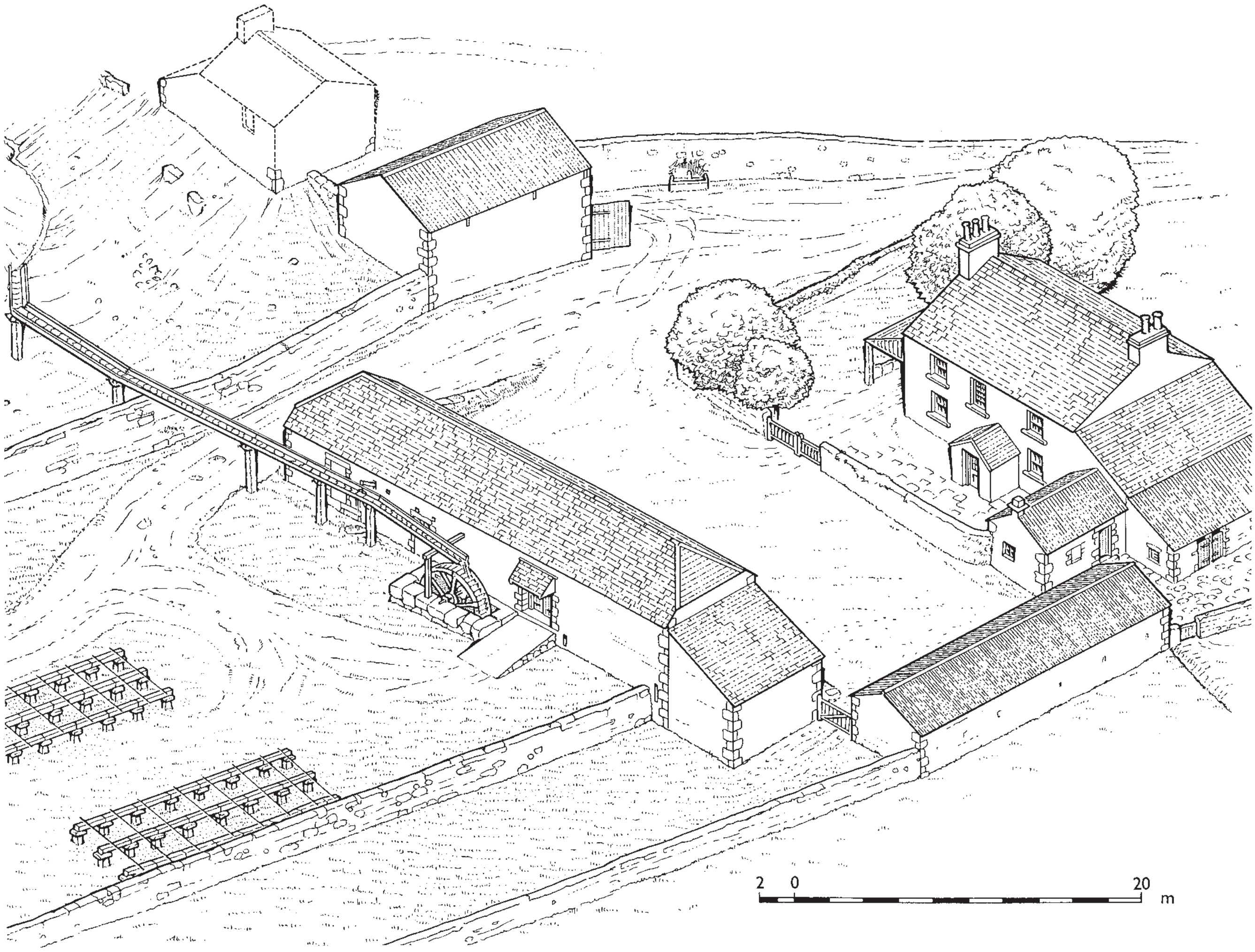


Fig 130 The water-power system reconstructed in this drawing, at Carkeet, St Cleer (SX 21987330), included a launder, raised on granite posts, leading water to an external waterwheel against the barn. In the mowhay are two rickstands. Viewed from the north-west. (Allan T Adams)

Stables, cattle sheds, calf houses and pigsties

Where the requirements of the farm could not be answered by the chall barn, other structures were grouped around to provide the required accommodation. The additional buildings were primarily for livestock rather than for arable storage or processing. Stables were built, sometimes as a linear extension to the chall barn, as at North Bowda, sometimes as a detached structure, as at Lower Bowden. The stables were usually small, having room for at most three or four horses, and had a hay or fodder loft over them. On some farms, added cattle accommodation provides evidence for a mid-19th-century consolidation of the livestock aspect in the farm's economy. Shippons were single-storey buildings; at Carkeet a lean-to shippon was added to the chall barn, and at Great Hammett an L-plan range abutting the chall barn was largely occupied by cows but also included a root house. Open-sided shelters also appear to have been provided for cattle. At Carkeet a seven-bay shed bounded the lower side of the yard; its situation and size make it unlikely that it was used as a cart shed, and the later addition of a front wall to convert it into a shippon may well represent an improved means of accommodating cattle.

Many farmsteads on the Moor included calf houses and pigsties, often sited near the house to facilitate feeding, using waste from the dairy. A range of single-storey buildings on one side of the yard at Lower Bowden provided a calf house and two double sties, and at Great Hammett is a range of sties with a covered feedwalk (Fig 134). Sties were commonly divided internally by half-height blue slate or granite slabs, and some but not all connected with small yards.

The layout of the farmstead

The relationship of the different buildings making up a farmstead is dictated, at least in part, by the flow of processes performed within it, and in Cornwall this flow is fairly simple (Fig 135). Arable crops were stacked in the mowhay and processed in the barn; grain was stored either in the barn or in a granary, and straw was stored in the barn. Feed grain and straw were dropped down to the ground-floor feedwalks, where along with roots they were processed into fodder for livestock – cattle, oxen and horses – housed in the chall barn and perhaps roaming also in the yard and sheltering in sheds. The straw used in bedding was taken out to a midden, probably most often sited in the

Fig 131 (Opposite, top) The mowhay at Carkeet, St Cleer (SX 21987330), retains the tangled remains of a rickstand, formed from short granite posts, granite bearer beams, and flat iron bars. In the background is the chall barn, with the wheelpit to the left of the large doorway. (RCHME, BB95/10748; Crown Copyright Reserved)

Fig 132 (Opposite, bottom) The interior of the first floor of the chall barn at Carkeet, St Cleer (SX 21987330). The pulley wheel to the right turned a belt which powered the wooden threshing machine to the left of the doorway. This is a rare survival of an arrangement that must once have been common in the larger moorland farmsteads. (RCHME, BB95/10757; Crown Copyright Reserved)

centre of the yard. The few dairy cows provided milk for domestic consumption, and dairy waste was fed to pigs and calves. The few carts and wagons required on the typical farm were stored in a shed.

The generally small size of most Cornish farms meant that the relationship of buildings was less critical in terms of efficient working than was the case, say, on a large integrated lowland farm; the range of processes on the two types of farm was similar, but whereas slight inefficiencies would constitute a major loss on the large lowland farm, on Bodmin Moor they could be tolerated because the farmsteads were so much smaller and because it was rarely economically practical to remodel the layout to eliminate minor annoyances. The farmsteads of Bodmin Moor varied considerably in the way in which they accommodated the range of functions required on the typical farm. The size of the farm, the date at which buildings were constructed, and the terrain all influenced whether the layout of the complex permitted efficient working.

The dominance of the chall barn, which, it has already been noted, on some farms is the only really substantial structure within the farmstead, makes it difficult to discuss layout in the way that is possible for farm complexes in

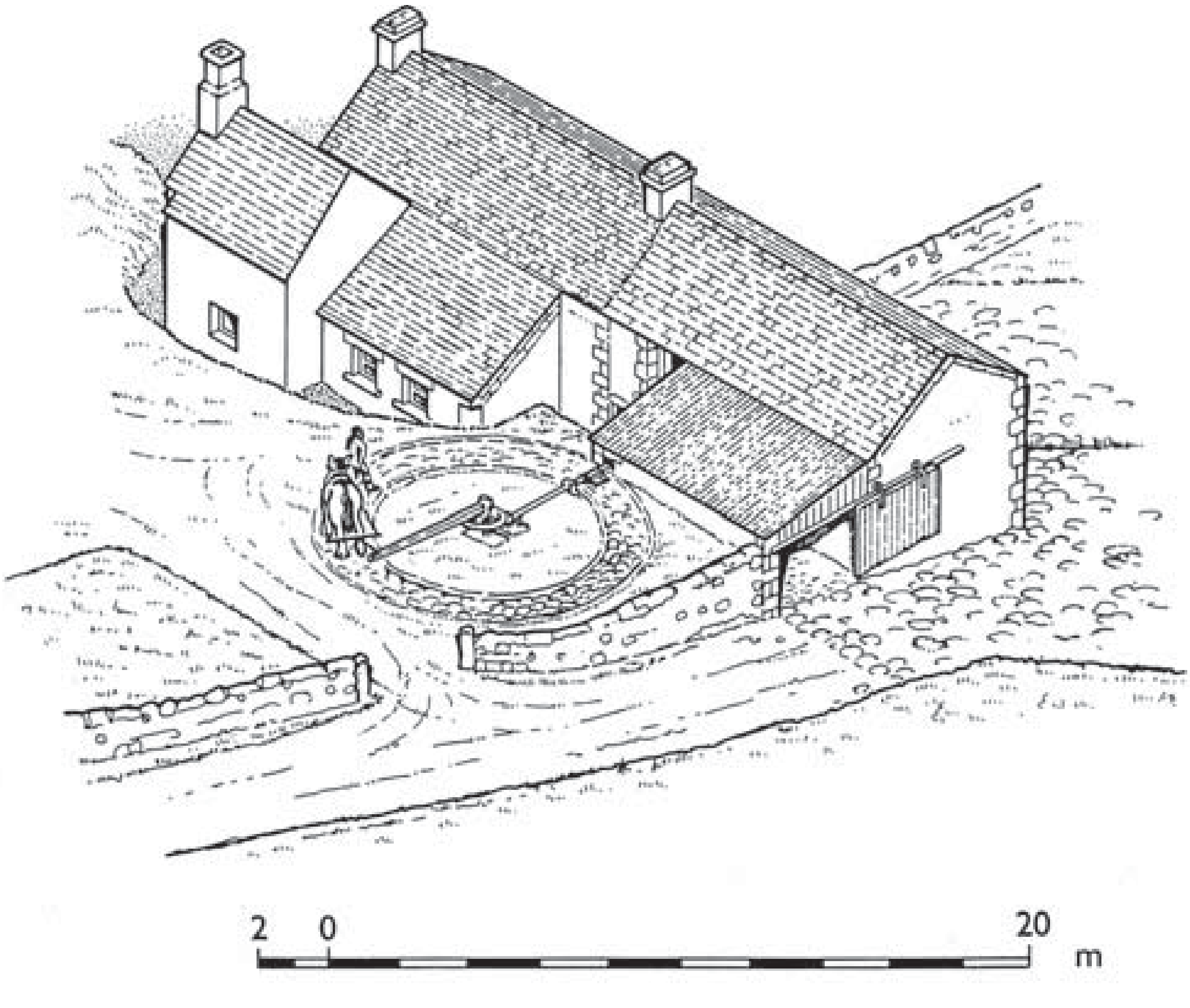


Fig 133 Toddy Park, St Neot (SX 18737607), retains part of the circular walkway trodden by horses employed in powering threshing machinery. This reconstruction shows a small horse wheel geared to a drive shaft taking power into the first-floor barn. (Allan T Adams)

other parts of the country. The typical Cornish farmstead has an irregular grouping of buildings, constructed at different times (Fig 136). At St Lukes (SX 194764), for example, the chall barn is attached to the dwelling, and there are a number of animal shelters disposed across a wide area over the awkwardly sloping site (a). The convenience of this system, perhaps apparent as each new building was added, is now difficult to envisage; the feeding of livestock must have occupied more time than in a compact farmstead, fodder having to be carried to all the dispersed structures or prepared in more than one location. Hopsland (SX 243694) shows a perhaps traditional means of combining the major buildings, with a stable, cow houses and a chall barn in one long range sited along the contour and built in a number of phases. In other small farmsteads the different buildings are grouped around a yard. At Lower Bowden, the chall barn, stable, pigsties and calf house form a compact layout, advantage being taken of a gently sloping terrace on the hillside (d). Full or partial courtyard layouts, either built in a single phase or evolving from a number of different periods of construction, are found; Carkeet probably results from a single phase in the late 1840s (e), but Lamelgate (SX 219708) represents a partial rationalisation of an earlier dispersed farmstead (f).

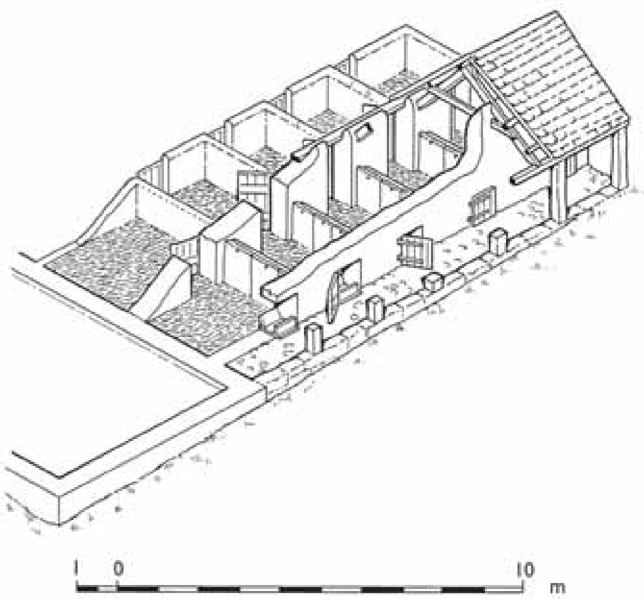


Fig 134 At Great Hammett, St Neot (SX 18866967), the pigsties have small yards on one side and a covered feedwalk on the other; fodder was passed through feeding hatches into a trough in each sty. (Allan T Adams)

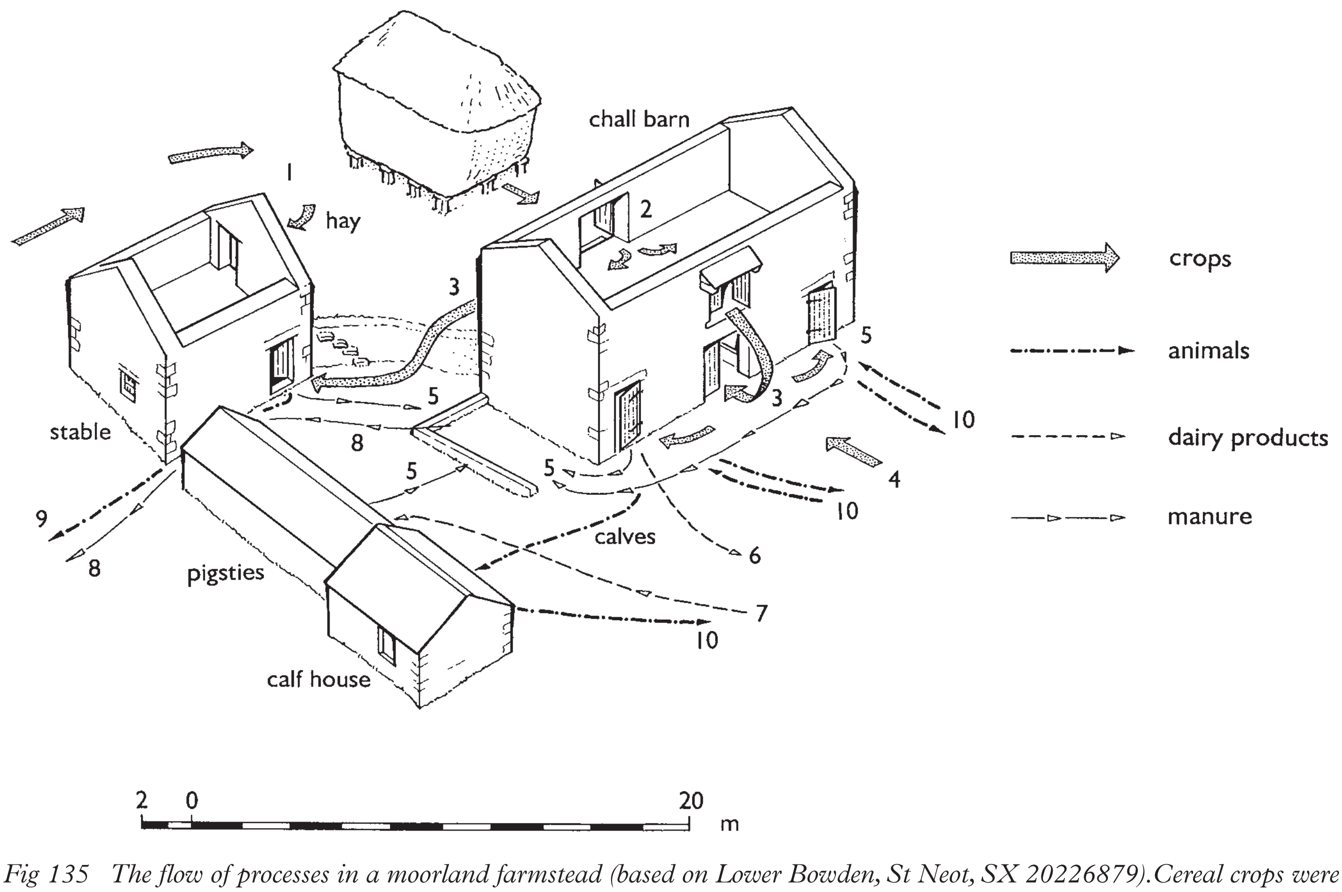


Fig 135 The flow of processes in a moorland farmstead (based on Lower Bowden, St Neot, SX 20226879). Cereal crops were stacked in the mowhay (1) before being taken into the first-floor barn (2) for threshing. The resulting straw is dropped down to the feedwalk (3), part being used for litter and part for fodder. Roots (4) are also processed into fodder for the livestock, which includes fatstock in the ground-floor shippons and horses in the detached stable. Manure and litter are removed from the animal houses to the midden (5). Milk is taken from the shippons to a dairy (6), usually within the farmhouse. The waste from the dairy is fed to young stock and pigs (7). Manure is removed from the farmyard to the fields (8), horses move between the fields and the stable (9), and livestock leave the farm for sale at the market (10). (Allan T Adams)

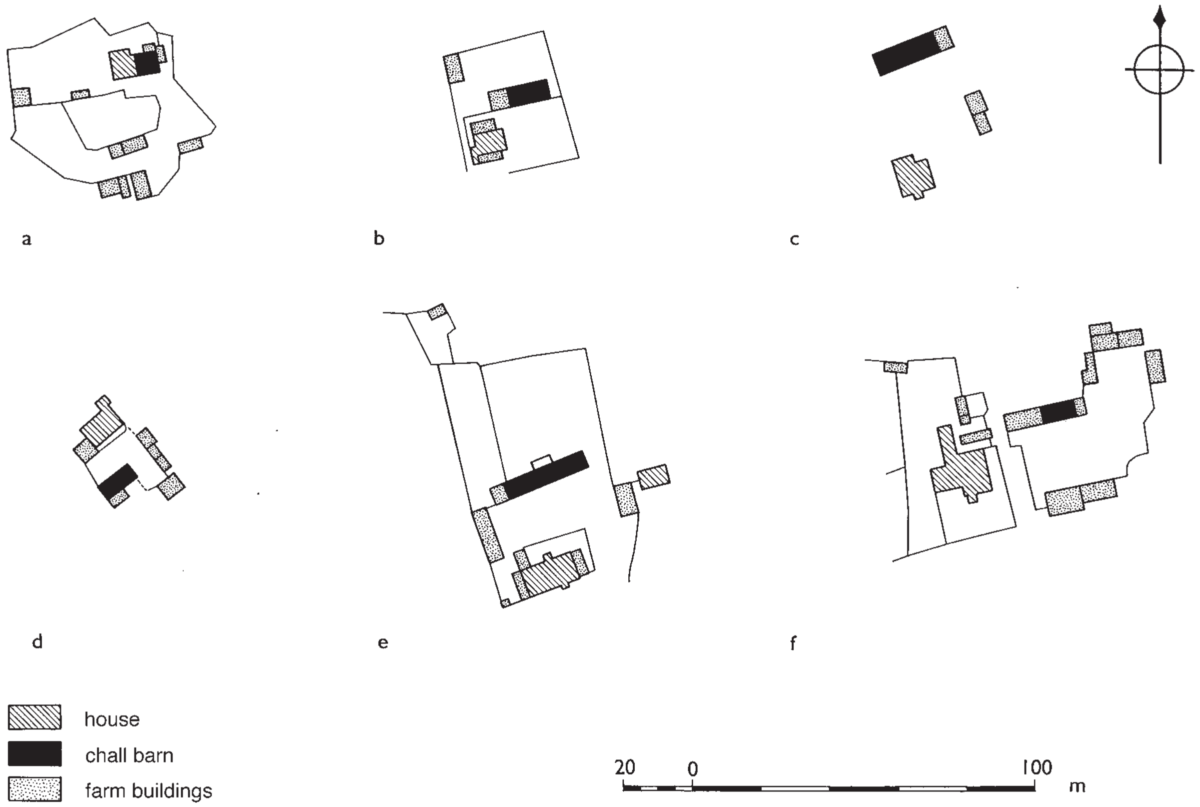


Fig 136 The layout of moorland farmsteads: (a) St Lukes, St Neot (SX 19457642); (b) Nodmans Bowda, North Hill (SX 26737523); (c) Tresellern, North Hill (SX 23607688); (d) Lower Bowden, St Neot (SX 20226879); (e) Carkeet, St Cleer (SX 21987330); (f) Lamelgate, St Neot (SX 21937081). (Allan T Adams)

7 Farms in a wider community

by Peter Herring

Some of the services which farming people used are discussed in Chapter 10. Mills, smithies and fairs served farmers more directly and are considered below.

Post-medieval farming families, while much more independent than those in the medieval communal hamlets, still relied until very recently on help from neighbours at certain times of the farming year – beat-burning, hay and corn harvesting, sheep-shearing, etc – and when sickness or infirmity disabled a household. The community was also brought together as mobile threshing machines did their rounds and the operators were given hospitality; as regrators collected the farms' surplus eggs, butter, cream, etc for re-sale; as the peculiar emergencies of being in a country remote from conventional help were lived out – such as Leslie Chegwin's tonsils having to be removed early in the 20th century on Todda Park's kitchen table (Keast 1995); and as the dead were carried by the community across the moors to churchyard and cemetery.

Water mills

There is neither archaeological nor documentary evidence for corn mills, medieval or later, in the heart of Bodmin Moor. Those still operating in the early 1880s (OS 1:2500 map, 1 edn) were all in the steep moorland-edge valleys where a good head of water for overshot wheels was obtained with a relatively short leat (*see* Fig 137). They were conveniently placed not only for farmers working the better arable land of the lowlands, but also in relation to the old estate centres to which many had been attached by manorial custom in the medieval and earlier post-medieval periods. They were, of course, very inconveniently located for moorland farmers, being up to 7km distant. In the 1930s, the Davey family from Lower Gillhouse would 'call at the mill at Treverbyn [SX 20566742, 6.5km away] to collect the grain he would have crushed while we were at the station', then at Doublebois, putting the week's butter and eggs on the train (Davey 1994, 7). In the same way, medieval tenants in farmsteads at Codda (SX 18027839) and Brown Willy (SX 15387940) would no doubt regularly have trundled wagons or guided teams of pack-horses laden with grain over the 10km to Moorland Mill (SX 16516963) (extant by 1241), *en route* to their manor court at Fawton. Such awkward arrangements illustrate again the marginality, relative poverty, and lack of readily available capital among the farming communities of Bodmin Moor.

Several mills, again all at the moorland edge, had been abandoned by the 1880s, some apparently shifting from old, manorially convenient locations to new, more commercially advantageous ones, closer to population centres like churchtowns or the 18th- and 19th-century industrial villages. So Hamatethy Mill (first recorded 1422) appears to have been replaced by that at Row

Table 6 Equipment worked on during 1902 by Mr Edward Kent of Ley smithy, St Neot

January	Plough, tiller [seed drill] Plough culters [coulters] and velshares Bidex [biddax] and visgay
February	Double furrow plough, chisler, harrow, tomentor Skim culter [feather of velshare?] Wagon wheel Gun Pick
March	Plough, chisler, 'trebble harrow', harrow, trundle Hay knife, bidex, visgay, prong
April	Roller, drill [seed-drill], chain harrow, chisler Turf cutter, visgay, bidex Pail
May	Digger plough, harrow, chain harrow, turnrest plough Cart, wagon, manure slide Gate hinges Bidex, visgay, shovel Kettle Bull ring Gun Jumpers
June	Wagon, cart, barrow, wip [whippletree?] Hoe, visgay, bidex, pick
July	Machine [reaper], mower, knife [from 'machine'] Wagon Pike, visgay, bidex, hoe, scythe Pail
August	Harrow, reaper, hoist machine Wagon Pulley Visgay, bidex, prong
September	Harrow, wip spreaders [whippletree], turnrest plough, single plough Shovel Gate nails Mole trap Fire shovel, dripping tin
October	Digger, single plough, plough Culter, velshare Cart Gate crook Bridle Brandis leg
November	Trundle, drill Velshare, coxcombe Shovel, pick, visgay, hacker Wedge
December	Plough, chisler Culter Visgay, bidex, prong Spring to gin [trap] Gate hinges Kettle, lantern

Source*: Account books held by Mr Peter Kent*

(SX 095766), Ta Mill at SX 18598482 (1394) by that at St Clether (Basil) at SX 20578412, and Gimble (SX 24316985) and Trekeive (SX 23147034) by that at Trenouth, near Crow's Nest, Darite and Tremar. Algarismylle and Trewint Mills in Advent, recorded in 1337 and 1400 respectively, are lost sites (early documentary references from Gover 1948).

Mills were not visited in any element of the Bodmin Moor Survey, and the recording of architectural or archaeological remains of this important rural service industry is still to be done. Tucking or fulling mills, where coarse cloth was 'dipped, cleansed and dressed' (Henderson 1935, 205), have also not been surveyed by archaeologists or historians (Fig 137). Charles Henderson noted early documentary references to tucking mills at Treclago in Advent (1291), Fenteroon in Lanteglos (1569) – hence nearby Valley Truckle from Cornish *Velyn-Druckyn*, Tucking Mill – and Lavethan in Blisland (1654), as well as that to 'James the Fuller' in St Breward in 1282 (*ibid*, 207); the latter probably worked at Tuckingmill (SX 09127792) just east of Gam Bridge where traces of a leat and a recently infilled wheelpit have been noted (Taylor 1988a, 58). A fulling mill was recorded at Milltown, St Neot (*c* SX 165696?) in 1537 (CRO, RD 656) and a tucking mill at Rosecraddock (*c* SX 265676?) in 1717 (CRO, BK 25). There are also other Tucking Mill place-names in the parishes of Davidstow, Cardinham and St Neot (Gover 1948). Like corn mills, all of these tucking mills are located at the moorland edge even though most of the sheep whose wool provided their raw material would have grazed the higher moors.

Smithies

Smithies, where horses were shod and tools and machinery made and mended, were generally located towards the moorland edge, in the larger settlements and at crossroads, and in mining areas (Fig 137). A short-lived early 20th-century smithy at Jamaica Inn (Davey 1994, 5) was the only real exception, although some moorland farmers will probably have had their own forges and could also have gained access to the smithies of quarries and mines. Most smithies have been either demolished or converted to other uses and well-preserved examples like those at Redgate (SX 22746853) and Cardinham (SX 12356891) are now rare.

The accounts books for Ley smithy (St Neot, SX 17426637) for the period 1895 to 1935 (held by Peter Kent, son of the last smith) reveal not just the variety of tasks undertaken by a typical rural blacksmith, but also the extent to which farmers operating in an increasingly mechanised world depended upon them.

For example, in addition to the regular horse shoeing, Mr Joseph Ford of Fawton (SX 169683) had work billed to him by Ley smithy on 31 separate days in 1902. These items varied from mending a lantern in December to repairing a double furrow plough in February. It is clear that, as would be expected, farmers resorted to the smith when equipment was

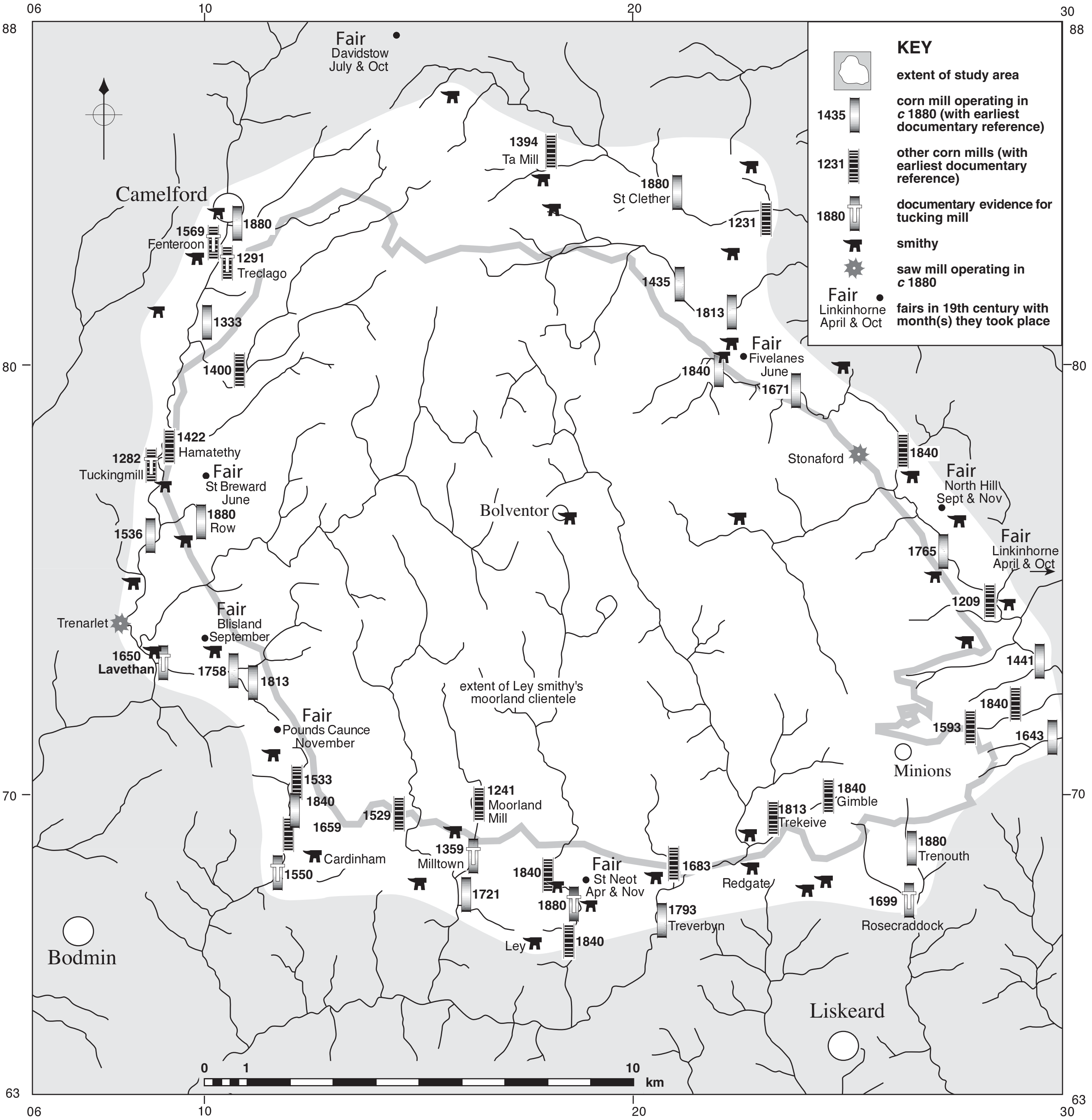


Fig 137 Distribution of the mills, smithies and fairs serving Bodmin Moor farmers in the 19th century. Mills by then defunct are also shown. (Sources: Tithe Maps of c 1840; OS 1:2500 maps, 1 edn, of c 1880; Lysons and Lysons 1815; du Boulay 1878; Ley smithy account book of 1902; CCC HES, HER) (© Rosemary Robertson)

either in use or about to be used and the accounts will be very valuable in recreating the typical Bodmin Moor farmer's year. *See* Table 6 for a summary of the repairing, sharpening, fitting or selling done in the smithing year of Mr Edward Kent of Ley in 1902.

Fairs and feasts

While physical remains of mills and smithies do survive, there are no physical remains of the parish fairs at which farmers sold their livestock and other produce, procured material for the farm and home, and had an exciting day meeting neighbours, eating well and enjoying the travelling entertainers. Most of the eight fairs recorded on or around Bodmin Moor in 1814 were for cattle (Lysons and Lysons 1814, xxxix; fig 137). One (St Neot) was in April but most were either at the height of summer (St Breward, Altarnun, Davidstow) or in the autumn (Blisland, St Neot, North Hill and Davidstow), the former to sell young stock born in the spring, the latter to reduce livestock on farms before winter. A few parishes (St Neot, North Hill and Davidstow) had two or more fairs. It can be assumed that fairs took place at or near the churchtowns, just off the Moor, although that at Altarnun was held at Five Lanes (SX 225806) and one of Blisland's at Pounds Caunse (SX 120715), possibly for the convenience of the moorland farmers. By 1878 Pounds Caunse and Linkinhorne fairs were no longer recorded and St Neot had lost the one on 3 May (du Boulay 1878).

Each parish also had its feast, 'the great day of the year' (Jenkin 1945, 395), which often stretched out for several days, even a week (as at St Breward and St Neot; *see* Boase 1899, col 1587–96, and Table 7), and involved laying on for both natives and visitors to the parish the best fare and cheer the farmers and smallholders could provide. Wheaten flour rather than the usual barley was used in the masses of bread baked on turf fires; saffron, seedy and potato cake, pasties, fuggans and gingerbreads were other essentials made on moorland hearths, and fattened lambs were slaughtered for the great lammy pies (*see* Jenkin 1945, 395–7).

Table 7 Fairs and feasts of the parishes of Bodmin Moor

Parish	*Fair*	*Feast*
Altarnun	Monday after 2nd clear Sun after Midsummer Day (Five Lanes)	Not known [? St Nonna, June 15th] Not known
North Hill	September 8th; 1st Thursday in November	None
Linkinhorne	Last Thursdays in April and October	Not known [? St Melorus, January 3rd]
St Cleer	None	Not known [? St Clarus, November 4th]
St Neot	1st Tuesday in April, May 5th, and November 5th	Last Sunday in July, for 7 days
Warleggan	No information	No information
Cardinham	None	Whitsuntide, Sunday to Tuesday
Blisland	1st Monday after September 22nd Last Monday in November (Pounds Caunse)	September 22nd or Sunday next after
St Breward	Thursday after Midsummer Day	February 9th–15th
Advent	No information	No information
Davidstow	July 12th, October 5th Sunday before Midsummer Day	
St Clether	No information	No information

Sources*: Lysons and Lysons 1814; Du Boulay 1878, published in Boase 1899; Cornish Church Guide 1925 [in square brackets]*

10 Industrial settlement and public amenities

by Peter Herring

1 Industrial housing

Caradon's flourishing mines and quarries produced a five-fold increase in the population of the rural parish of St Cleer in the 50 years from 1811 to 1861, from just 780 to 3931 (published censuses). Very few of the workers in St Cleer lived on new farms or smallholdings (compare with the Bolventor area, *see* Chapter 9, Section 2); instead the miners and quarrymen and their families were housed in the terraces and cottages of the swollen or new settlements of Tremar (SX 258681), Tremar Coombe (SX 254687), Darite (SX 259694; briefly called Railway Terrace from the Liskeard and Caradon Railway which ran through it), Common Moor (SX 240693), Crow's Nest (SX 264693) and St Cleer churchtown itself (SX 248681). Many houses were shared; almost every household in Tremar in 1841 had at least one lodger (Deacon 1986–7, 95) and there are still traditions that at least at the start of the great population influx – mainly of miners from west and mid-Cornwall (*ibid*, 88) – barns were used and shared beds were 'always warm', one miner replacing another as cores or shifts ended (Sharpe 1993, 30–2).

Most of the industrial housing in the hamlets and villages of the Caradon district was constructed between 1836 and the mid-1860s. In Linkinhorne parish, Minions (SX 261711, formerly Cheesewring Railway; Figs 138 and 139), Upton Cross (SX 281721), Henwood (SX 266734) and Higher Stanbear were the more important industrial settlements, although there was a smattering of isolated labourers' cottages throughout the Cheesewring–Caradon area. To the east of Caradon the down called Bodminland in St Ive parish was transformed in less than 20 years to the sprawling village now called Pensilva (SX 290697) (Sharpe 1993, 32). By 1867 Mr Dingle, vice-chairman of the Liskeard Board of Guardians would state, in evidence to a Parliamentary Commission, that in the mining district of Linkinhorne there were 'cottages enough for the supply of labour. Some are very good, but in many cases they are too small, and have not sleeping rooms enough for the separation of the sexes. I have not observed much direct evil results in morality in consequence. Water is plentiful in this neighbourhood, and generally within easy reach of the cottages … .They have generally good gardens' (*Commission* 1867, 180). Elsewhere he noted that most cottages had 'two rooms up and two rooms down, sometimes with an outhouse. The drainage is not good, and there is not sufficient supply of privies' (*ibid*, 179).

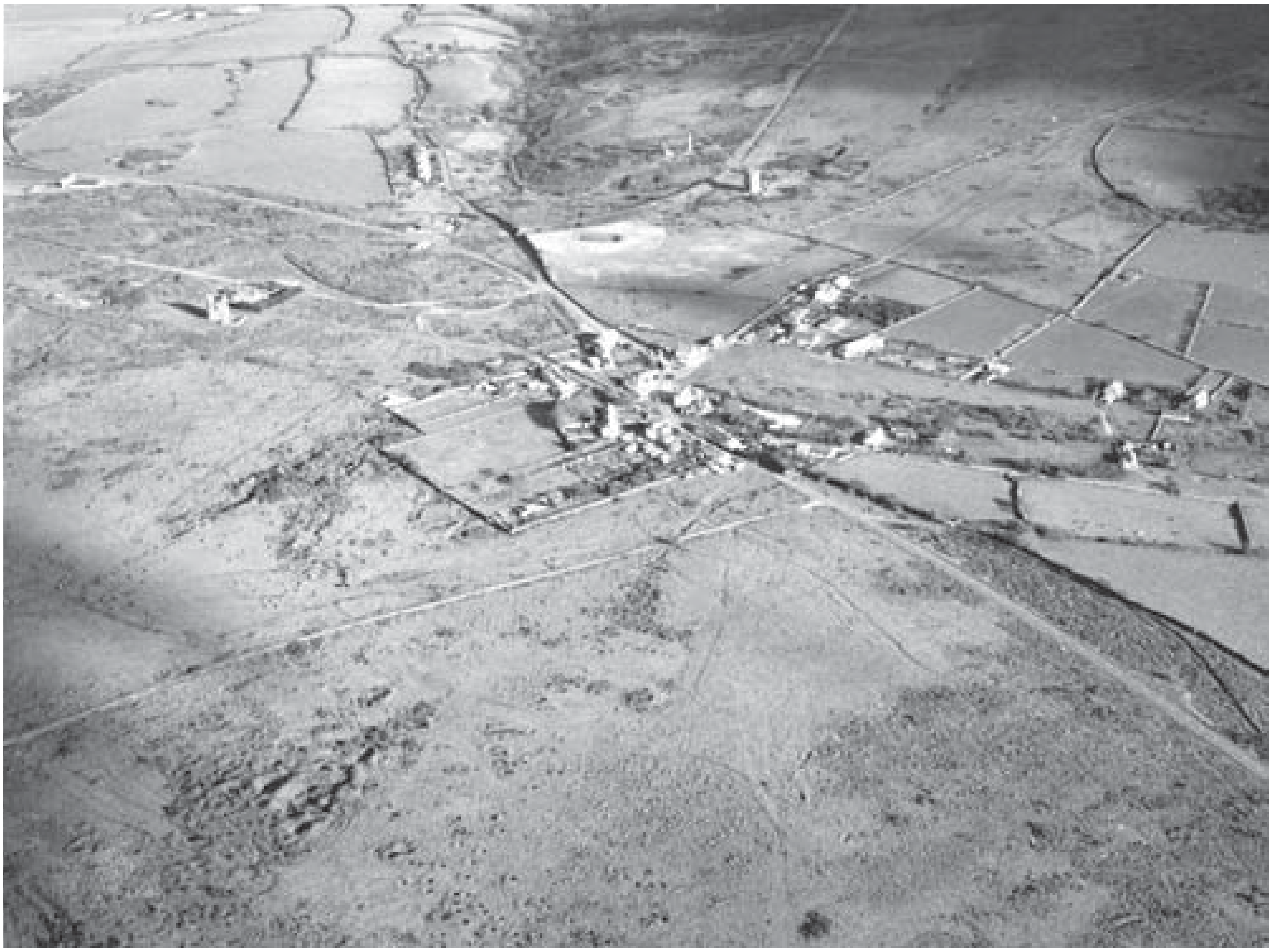
There are other 19th-century industrial hamlets in the quarrying district of St Breward parish, principally Limehead and Row (Fig 144) but with some labourers' cottages in Lower Lank (SX 092752), Penquite (SX 098763) and St Breward itself (SX 097774). Elsewhere, there are small china-clay workers' hamlets in Advent parish at Highertown and Watergate (centred SX 119814) and in the centre of the Moor Bolventor (SX 184767) housed tinners and, more recently, china-clay workers (from Park works). Trewint (Altarnun, SX 220805), Mount (Warleggan, SX 147680) and St Neot churchtown (SX 185678) all owe some of their housing to 19th-century industrial labourers.

The most distinctive form of Cornish industrial housing is the terrace, or locally 'row', 'essentially … an urban style' transposed for reasons of economies of space and materials to the countryside (Chesher 1981, 6–7). The earliest were usually built piecemeal, new cottages tacked onto their ends, with resultant admixtures of chimney and window styles and internal layouts, but later 19th-century terraces tended to be more uniform, often built by the mine or quarry itself. For example, workers at each of the two most important dimension stone quarries, Cheesewring and De Lank, were provided with neat, well-built terraces. The row of eight at Cheesewring (SX 26027225), demolished in the 1960s (Sharpe 1993, 129; and *see* Fig 140), was built in 1864 by the Freeman and Cheesewring Granite Co (Stanier 1985b, 183 and *see* Bishop 1987, 87, plate 235) and two rows of six (still occupied) were built at Penvorder (SX 09567577) in 1899–1900 to house those taken on by De Lank to work granite for the Beachy Head lighthouse (Stanier 1985b, 184).

The 19th-century population explosion not only provided a valuable market for local suppliers and purveyors of food and drink, but it also coincided with or produced significant social and political changes which saw the spread of religious nonconformity and the provision of services, like schooling, aimed at enhancing the individual child's knowledge and understanding and also expected to increase the future worker's productivity.

2 Schools

Later Victorian Board Schools, high-gabled granite and slate products of the 1870 and 1880 Education Acts, were mainly built either in or close to the churchtowns and, in the more heavily populated south-eastern part of the Moor, in the principal mining villages (Upton Cross, Pensilva, Darite; *see* Fig 143). Some replaced earlier private or National Schools; St Breward's National School had been built in 1853 and by 1868 was provided with an extra classroom (Maclean 1868, 376). Squire Rodd's 1846 National School for Boys and Girls at Bolventor became a Reading Room when replaced by the 1879 Board School.




CHEESEWRINGRAILWAY

Fig 138 (Opposite, top) Minions (SX 261711) from the west. An industrial hamlet established in the 19th century at the heart of the Caradon copper and tin mining area and formerly called Cheesewring Railway, as it developed around the point where the Doublebois to Rilla Mill road crossed the Liskeard and Caradon Railway. Its layout was also to some extent determined by the remains of early mining (left of the main block of gardens) and streamworks (the rectangular green to the right of the hamlet's centre). Outlying terraces and labourers' cottages can be seen beside the road running away towards Upton Cross and in the shallower Seaton Coombe running to the right towards Gonamena and South Caradon mines. Two chapels, a short-lived school, a public house and a post office were built in the hamlet. (CCC HES, F4/20; see *Sharpe 1993, fig 12 for the development of Minions)*

Fig 139 (Opposite, bottom) Two of the mid-19th-century terraces at Minions, then Cheesewring Railway, photographed in c *1900. The ruined engine houses are part of South Phoenix Mine. Note how the continuous roofline gives a deceptive impression of uniformity to the nearest terrace. Closer inspection confirms that the right-hand cottage, with its brick chimney and window surrounds, was added later, its roof slates of a lighter shade. Its neighbour, with the first-floor slate cladding, may also have been added to that to the left as its plan is different (central door presumably opening into a passage with room each side, rather than end passage with one room to the side). Its chimney is also of brick whereas the one to the left (probably earlier) is of granite. The slate-clad house appears from the signage and the jars in the window to have served as a shop. (Postcard held by Adam Sharpe)*

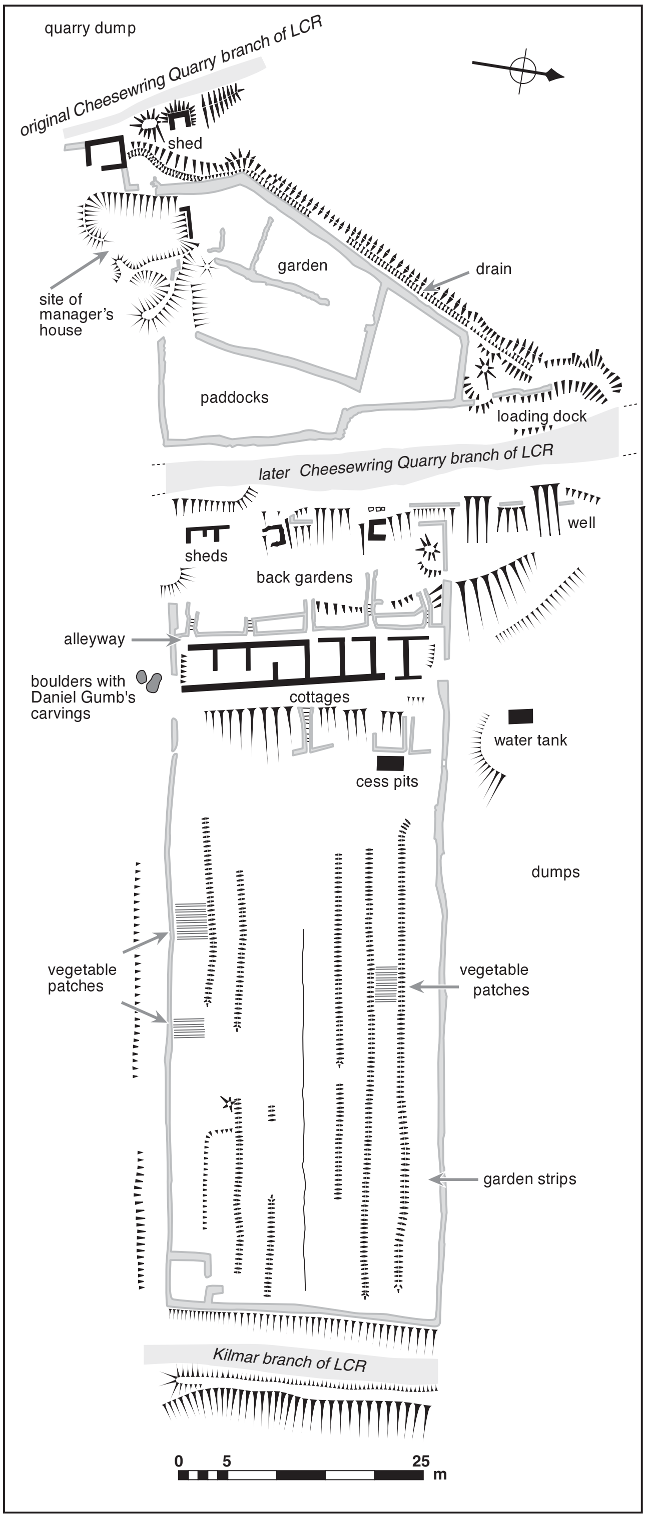


*Fig 140 (Right) Plan of the ruined terrace of eight small cottages, SX 26027225, built by the Freeman and Cheesewring Granite Co in 1864 to house the families of men working in nearby Cheesewring Quarry, showing their backyards with sheds/earth closets, and their long front gardens. Uphill to the west, and separated from them by the Cheesewring Quarry branch of the Liskeard and Caradon Railway (LCR), was the more substantial house of the manager with its associated gardens and paddocks. Two boulders with carvings possibly by Daniel Gumb (*see *Chapter 5, Section 2 and Chapter 8, Section 5) lie to the south of the cottages. (Based on Sharpe 1993, fig 52)*

The need for a system of universal education had been brought home to legislators by reports such as that in 1867 by the Commission on the Employment of Children, Young Persons and Women in Agriculture. Children as young as nine years in the Liskeard district, including the moorland parishes of St Neot and St Cleer, were earning sixpence (2.5 new pence) a day 'driving horses, drawing turnips, cutting weeds, picking stones etc' (*Commission* 1867, 177). Schooling was minimal, centred on Sunday Schools and private schools for which parents had to pay fees, and was biased towards both boys and the quieter winter months; so, in Linkinhorne parish, 20 boys and 13 girls were registered at schools in the summer and 36 boys and 24 girls in the winter (*ibid*, 179). The recorder for Linkinhorne stated that 'as a rule' the children of small farmers, holding from 20 to 30 acres (8 to 12ha), 'are very badly educated, and are taken to work very young indeed, and do harder work than the agricultural labourers' (*ibid*, 179). He advocated compulsory education but, like many others who gave evidence to the Commission, noted that the farmers themselves were afraid that this would lead to their paying a rate to support a local school (*ibid*, 179).

Bolventor's 1846 school still stands, bought by local people in *c* 1980 and now used as the Village Hall (Keast 1984). The Board School, which had 120 pupils in 1906 (Kneebone 1966, 9) struggled through the 1960s and 1970s with just a handful until closure in the early 1990s. Another moorland community, at the bottom of the Fowey valley, had an elementary school as its focus, at Trekeivesteps (SX 22697000).

3 Chapel and Church

The simple granite cottage at Trewint (SX 22008049), where John Wesley's companions John Nelson and John Downes were given hospitality by Digory and Elizabeth Isbell early on Wesley's first Cornish tour in 1743 and where Wesley himself stayed on several later occasions, already 'piously preserved' by 1867 (Polsue 1867, 19), is now a place of Methodist pilgrimage (Shaw 1991, 45). It can be regarded as typical of the many 18th- and early 19th-century dissident Meeting Houses recorded in Cornwall but now either lost or unrecognisable as such. In Advent parish a Meeting House for Protestant dissenters was registered at Tresinney (SX 103815) in 1819, and two more for Bryanites or Bible Christians (formed by William Bryant of Luxulyan in 1815) at Treclago (SX 108828) and Whitewalls (Widewalls, SX 119807) in 1821 and 1822 respectively (Maclean 1876, 284, 286). The medieval chapel at Tregenna (SX 09587422), shown roofed on the 1840 Tithe Map, had been fitted up for reuse by Wesleyan Methodists in 1798 by Mr John Rogers (Maclean 1879, 415).

The Methodist society which had continued to meet at the Isbells' cottage built a Meeting House (SX 22408118) in Altarnun churchtown in 1795; when enlarged in 1836 the famous sculptor Neville Northey Burnard, born in the cottage next door, worked a bust of John Wesley which was placed over the Meeting House door (Shaw 1991, 4). The building was, however, still an essentially functional one – external steps leading to a main room over storage cellars (Stell 1991, 22) – and a couple of decades later in 1859 it became the Sunday School of a 'well-designed' (Gothic) Wesleyan chapel, complete with granite pinnacles (Polsue 1867, 19). From the first or second decades of the 19th century Bodmin Moor Methodists were generally replacing Meeting Houses with Chapels, some with attached or nearby Sunday Schools and a few with burial grounds. The surviving chapels (many are closed, some demolished or ruined, others converted to other uses) are simple but neat, most with plain arched windows; pinnacles and other adornments are rare (Fig 141). The 1846 hipped-roofed Bible Christian chapel at St Cleer, known as Hocking's House (SX 24316820), is an excellent survival with its internal fittings of box pews, leaders' pew and gallery on three sides intact (Stell 1991, 46).

Fig 141 Bible Christian chapel in the clayworkers' hamlet of Highertown, Advent (SX 12028217) in 1996 (Peter Herring).

Fig 142 Temple church (SX 147733) in 1994. Rebuilt in 1883 to a design, made without charge by Silvanus Trevail, it reused the ground plan of the medieval church (Peter Herring).

Like other rural services, nonconformist chapels are mainly distributed around the edge of the Moor with a dense cluster in the heavily populated south-eastern corner and a thin scatter on the higher ground (*see* Fig 143). In the northern half of St Cleer and the western half of Linkinhorne parishes no less than 23 chapels were open by 1883 (OS 1:2500 map, 1 edn), 7 Wesleyan, 7 United Methodist, 6 Bible Christian and 3 Primitive Methodist. Cornwall's industrial labourers and poorer farmers appear to have found succour in the teachings of Bible Christians, United Methodists and Primitive Methodists as their chapels tended to be established in the county's more marginal and industrialised corners. The Wesleyans on the other hand found congregations in established churchtowns or hamlets.

The Anglican Church, despite the overwhelming competition from nonconformists, did not noticeably decline in the 19th century. Indeed, to some extent

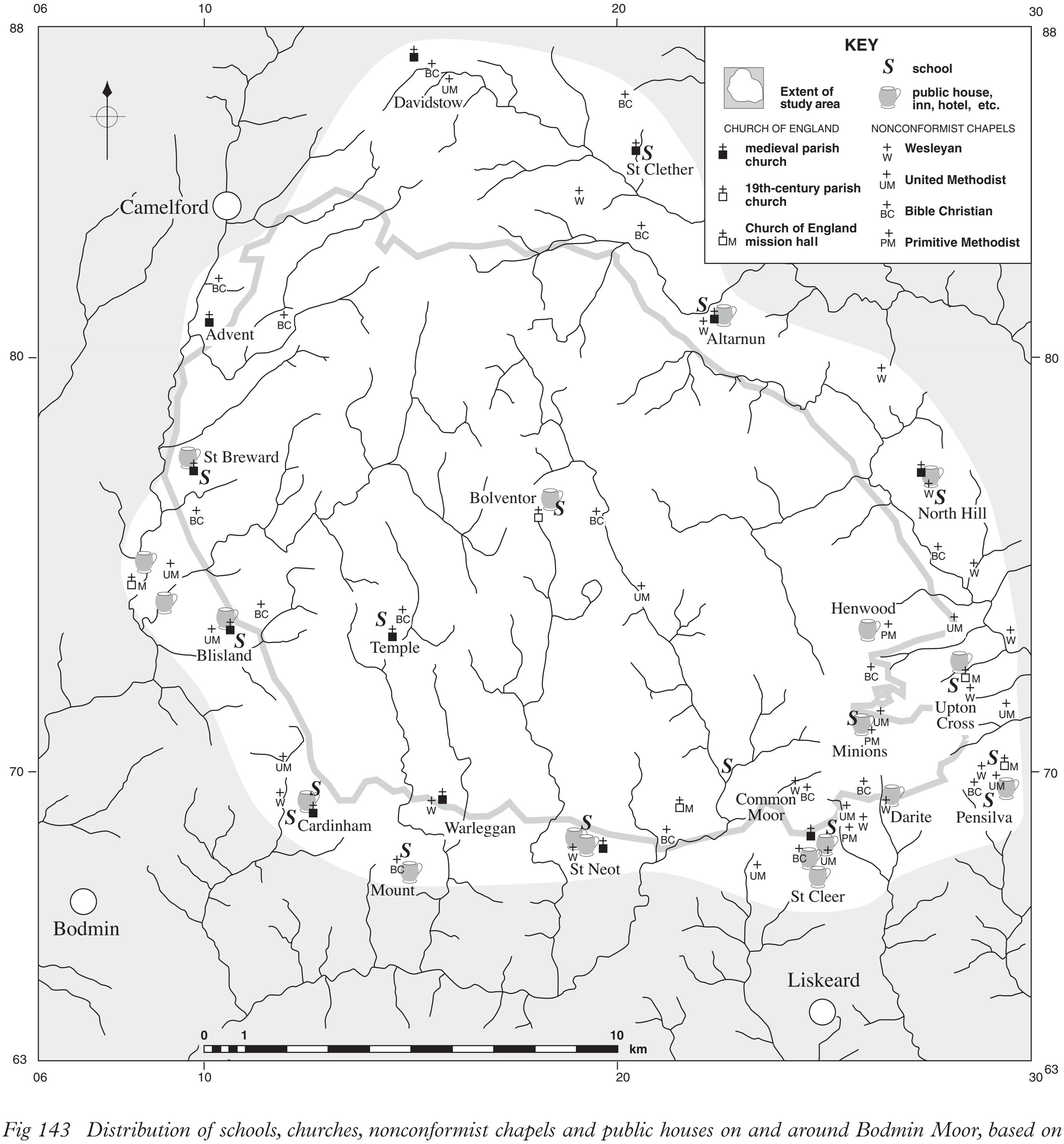


Fig 143 Distribution of schools, churches, nonconformist chapels and public houses on and around Bodmin Moor, based on the 1st and 2nd editions OS 1:2500 maps (c 1880 and c 1906). (© Rosemary Robertson)

inspired and reorganised by the zeal of Henry Philpotts, Bishop of Exeter from 1830 to 1869, and with the support of wealthier parishioners, it was able to restore all the decaying medieval church buildings between 1847 (Advent) and 1904 (St Cleer). Regrettably, the earlier restorations saw the loss of much medieval woodwork, plaster and even stonework. The whole of St Clether church, except the 15th-century tower, was rebuilt in 1865 in Early English style (Cox 1912, 80) and the fine Norman arcade at St Breward was rebuilt in 1864 during the £1,100 restoration by J P St Aubyn which also involved the construction from dismantled, painted and gilded bench ends of a reredos deemed 'tasteful' in 1867 (Polsue 1867, 142), but 'tasteless' in 1912 (Cox 1912, 70). Only Altarnun, Blisland and Cardinham churches survived the century largely intact (*see* Sedding 1909, Cox 1912 and Brown 1973 for details of restorations).

In addition to the restorations the ruined church at Temple was entirely rebuilt in 1883 (Fig 142), with Silvanus Trevail as architect. Mission Chapels were established at Upton Cross (Linkinhorne), Draynes (St Neot) and Penpont (Blisland), and a Mission Church, School and Parsonage at Pensilva (St Ive) (Henderson 1925). A whole new parish, Bolventor, was cut out of

Fig 144 The conjoined quarrying settlements of Row and Limehead in St Breward (centred SX 096765), from the north in 1992. Unlike Minions (Fig 138) which was established in fairly open country, these settlements were constrained by pre-existing medieval-derived field systems and roads, hence the much more irregular layout. Tordown Quarry, with its finger dumps and flooded pit, is centre right and in the De Lank valley in the distance can be glimpsed the great quarries of De Lank itself (right) and Hantergantick. It is noticeable that a distance was kept between these quarries and the homes of their workers; even the Penvorder terraces (towards the right), built by De Lank to house men taken on for the Beachy Head lighthouse contract in 1899–1900, were over a quarter of a mile from the works. The Row and Limehead community was served by a Bible Christian chapel (centre of Row) and an elementary school (H-shaped building towards camera). (CCC HES, F43/70)

the moorland extremities of Altarnun, St Neot and Cardinham, by Squire Francis Rodd of Trebartha. He paid £666 in 1846 for the construction of the small cruciform church with bell turret over the crossing, consecrated by Bishop Phillpotts in July 1848 (Polsue 1867, 18; Brown 1973, 62). It was reunited with Altarnun in 1978 as an occasional Chapel of Ease (Kneebone 1966) but is now closed and boarded up. The nearby 'cottage-style parsonage' promised in Rodd's initial letter to the Church Building Commission (CRO, RD 1161) was built in 1851 (Polsue 1867, 18).

Church and lay people combined to restore several later medieval well houses and chapels. Most notable among these restorers were Capt Rogers at St Cleer (1864) and the antiquarian-clergymen Revd Sabine Baring-Gould and Revd A H Malan at St Clether (1897–8) (Baring-Gould 1898b; Meyrick 1982, 31). Other ancient chapels were neglected, even dismantled; decorated stones from that on Roughtor were taken in 1836 to Trevillian's Gate (SX 16628393) by Mr H C Vosper and incorporated into the newly built Britannia Inn (Maclean 1873, 376).

4 Public amenities

In the later 19th century some of the churchtowns and industrial villages began to receive services, some, such

Fig 145 Bolventor Methodist chapel's annual tea treat on the registered village green on the north-west shore of Dozmary Pool in the 1950s. The boat was brought out of the boathouse beside Dozmarypool Farm (formerly the ice works) and sunk for a week before this summertime event to swell the wood and make it watertight for the trips given to the children and any interested adults. (Print copied from one held by Tony Blackman; copyright reserved)

as watering troughs and pumps (Treverbyn, St Cleer and Five Lanes), supplied by benevolent estates or individuals, others by institutions and nascent local authorities. Parish rooms, Reading Rooms and Institutes intended to divert, enlighten and entertain were established in North Hill, Cardinham, Mount, Upton Cross, St Cleer and, most surprisingly, beside a quiet lane near West Draynes. There was a Police Constable in the Minions area by 1881 (Sharpe 1993, 33) and St Cleer churchtown had a police station by 1883 (OS 1:2500 map, 1 edn).

Perhaps most revealing of later 19th-century local settlement and service foci, and the best-used lanes and trackways, are the post offices and letter boxes, shown on the 1st edition OS 1:2500 maps (early 1880s). Offices were in the larger settlements and boxes at strategic points in the more remote places.

5 Public houses and beerhouses

Alcohol consumption has long exercised the consciences and arms of the inhabitants of Bodmin Moor. Publicans and beer sellers set up booths to serve the less committed among the 10,000 who gathered in July 1844 for the Roughtor Monster Meeting or teetotal festival; drunken and riotous behaviour duly ensued (Lewis *et al* 1988, 62). A 'great revel' had been advertised for Midsummer Day 1773 at Dozmary Pool in the *Sherborne Mercury*, a 'good boat' having been procured for gentlemen and ladies; those refusing to pay the penny per horse admission to be charged with trespass (Douch 1966, 63). A mile to the north a more permanent drinking-place, Jamaica Inn, was established as a posting house some time before 1785 (CRO, RD 1582/1, 2), the Launceston–Bodmin turnpike having been built shortly after the Turnpike Trust was established in 1769 (Axford 1975, 25). Other Inns were located on thoroughfares just beyond the Moor's edge, the Indian Queen (1771), later the London Inn (1781) at Five Lanes and the London Inn at Pounds Caunse (SX 12067155) on the same Launceston–Bodmin turnpike, the London Inn at St Neot on the old Bodmin–Liskeard road (SX 18556786), the Rising Sun (SX 21598246) near Trelawney on the old Launceston–Camelford road, and the Keybridge Inn (SX 08687390, first recorded in 1726) on the old Bodmin–Camelford road (*see* Douch 1966). These were modest hostelries, the Pounds Caunse inn 'depended upon customers' misfortunes whilst travelling more than any predilection they may have had for the accommodation' (Douch 1966, 178) and, as noted above (Chapter 8, Section 4), even Jamaica Inn in 1856 afforded only 'rude accommodation' (Murray's 1856).

Some churchtowns had anciently established public houses, the Old Inn at St Breward first recorded in 1806 but probably substantially earlier (Lewis *et al* 1988, 64), the Ring and Bells at Altarnun, Ring o Bells at North Hill, the Blisland Inn and one of the three St Cleer houses (a John Adams of St Cleer having been prosecuted in the 17th century for allowing 'drinking and tippling' – Douch 1966, 20). Later, in the 19th century, houses were licensed in the quarrying and mining areas, the Wenford Inn (SX 08577515) at the terminus of the Bodmin–Wenford railway, and seven in the south-east corner of the Moor including the Sun Inn at Crow's Nest, the Cheesewring Inn at Henwood, the Cheesewring Hotel at Minions and the Caradon Hotel at Upton. In addition there would have been numerous beerhouses, less visible in the cartographic record than inns, where citizens could benefit from the 1830 Beerhouse Act and sell ale and cider from their own houses. So Joseph Hocken, a carpenter, also sold beer at St Breward in 1856. The pressure for temperance was brought to bear on the Billings, a mother and daughter team, when in 1883 the Methodists successfully opposed a licence transfer of their alehouse from Onslow Cottage in St Breward churchtown to Laburnum Cottage in more populous Row (Lewis *et al* 1988, 63).

The Methodists were clearly concerned by events such as those at the third annual sheep-shearing match in the field adjoining The Rising Sun in Altarnun in 1865 which was attended by the 'usual evils … a love of idleness and debauchery. Several fights were commenced' (Douch 1966, 44). In 1871 John Colwell, landlord at the Wenford Inn, was in trouble for allowing drunkenness and was fined £2 for allowing gambling in 1872. In the same year there was a stabbing in the nearby St Breward Old Inn. When Colwell died his widow took over the Wenford Inn but had her licence endorsed in 1884 for allowing further drunkenness (Lewis *et al* 1988, 63–5). All was not so dire; in the year before the stabbing the Old Inn had hosted two concerts by the Yorkshire Glee and Concert Party, and the Wenford Inn under the Armstrongs (1897–1926) served important community functions. Clay wagoners obtained bed and breakfast there, the workers in the Wenford dries used it as a crib hut, and in the upper room the football team had tea and splits (plain buns split horizontally and eaten with butter, jam and cream). Pasties were made for railwaymen and spectators at the wrestling bouts held in the field across the road. There was also a skittle alley, and the inn was even used as a bolthole by poachers on the river (*ibid*, 64).

Fig 146 'HENRY PEARCE, dealer in Foreign Spirituous Liquors'; the 19th-century licensing sign attached to the north wall of the former Soldier's Arms public house at Mount, Warleggan (SX 14796800). (Peter Herring)

11 Transport and communications

by John R Smith

1 Introduction

Remote upland areas such as Bodmin Moor are characterised by two distinct types of communication systems. There are those which have their origin and destination outside the Moor itself, and which simply traverse it as an obstacle *en route*, and there are the internal, local routes that provide a communications infrastructure within the upland area and between its settlements. The survey area contains both types of communications; the principal long distance route is the A30 road, which is still in a state of improvement and change. Another, to the south of the Moor, is the Cornwall Railway of 1859, which did not directly impinge on the upland area but had some indirect influence on the development of the moorland china-clay works in later years (*see* Chapter 6). Local roads abound and by their nature have preserved many early features, such as bridges and fords, intact to the present day.

The Moor has roads, tracks, tramways and railways within the area covered by this survey, but no canals. Green lanes and roads have left their mark on the landscape, their banks and stone walls contemporary in many cases with the development of associated field systems. The horse-drawn tramways and railways, often serving mines and quarries, have left their own earthworks and monuments as part of the fabric of the upland area. In the 20th century the airfield at Davidstow added its distinctive military archaeology to the landscape of the northern Moor (*see* Chapter 8, Section 3).

2 Roads, tracks and bridges

Throughout the prehistoric occupation of Bodmin Moor there would undoubtedly have been informal, local paths and tracks linking settlements to each other and to sources of water, food, and fuel. Whether any of these prehistoric tracks are on the line of present day green lanes, footpaths or roads is unproven, but it is possible that some are genuine survivals. In the medieval period some of these tracks and paths were marked by crosses intended to act as guides for the moorland traveller (Johnson and Rose 1994, 103). Also recorded are numerous swarms of hollow-ways where trackways were continuously re-routed once they had become unusable.

Bridges

Bridges, by their nature, are likely to have left not only a substantial archaeological record in the landscape, but also a documentary one. Early references include Harrowbridge (SX 206744) on the

Fig 147 Delford Bridge, over the De Lank River (SX 114759) from the south-east in 1988. A moorland clapper bridge of post-1800 build. (CCC HES, GCS 5828)

Fig 148 Palmers Bridge toll house (SX192775) in 1967, since demolished for road-widening. This was one of the toll houses set up along the route of the new turnpike after 1769. (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Charles Woolf [67/125/59] © RIC 2008)

Fowey in 1330 (the present bridge is modern), and Helland Bridge (SX 065715) in 1381 (the present bridge is a 15th-century rebuild) (Henderson and Coates 1928, 111). During the medieval period responsibility for the building and upkeep of bridges usually rested with the Church; in 1531 the Statute of Bridges established the responsibility for their maintenance with towns and counties. In 1555 the Highway Act made road maintenance the responsibility of the parishes.

Although Palmers Bridge (SX 19197760) and some others have their origins in the medieval period, many bridges on the Moor are much more recent, despite their often elemental appearance. For example, the clapper bridges on the De Lank River are 17th-century or later, and Carkeet Bridge dates from 1852 (Henderson 1928). It is probable that the regular destruction of bridges by floods (during severe winter or summer storms) has contributed to the replacement of these structures more often than would otherwise be expected. The moorland storm in the following account may have had many other counterparts in earlier times:

‘On 16th July, 1847, a waterspout burst on Davidstow Moor, the watershed where the Camel and the Inney (despite their opposite destinies) take their rise. The water collected in the valleys and forced a passage in two directions, down the Inney and the Camel. A wall of water from 12 to 18ft above the usual level of the river swept down the Camel carrying everything before it. It was a hot sultry afternoon with a clear sky, and men working in the fields at Gam Bridge could hardly believe their senses when they saw the water approaching them. Gam Bridge stayed the flood for a moment but soon gave way and the infuriated water attacked Wenford Bridge with a regular bombardment of tree trunks and other things plundered from the meadows. A mineral train happened to be in the station at Wenford Bridge, and the driver with great presence of mind drove his engine at full speed down the valley shouting to people to leave the riverside. He was not a moment too soon. Wenford Bridge broke beneath the strain and Poleys Bridge followed suit. Tresarrett Bridge was swept away.

Fig 149 Fivelanes and its garage (SX 225806) in the 1950s. The turnpike in the age of the motor car, but before widening and improvement. Fivelanes has now been bypassed by the modern A30. (Cornwall County Council)

Helland Bridge showed that the medieval bridge builders knew their business, for despite the depth and narrowness of the valley, the waters failed to break it, but rising above the parapet, swept on and brought their battery of trees and hayricks against the ancient bridge of Dunmere. This was soon swept away together with the railway bridge by its side. A train was approaching the bridge at the moment of its destruction but the driver was able to bring it to a standstill. The lowest railway bridge at Pendavey floated gaily down the stream and would have done much damage to Wadebridge had not men in boats secured it with ropes and chains.' (Henderson 1928, 109).

The A30

It has been generally assumed that the present day A30 road may represent the route of a prehistoric or early medieval ridgeway. The case for this hypothesis is strengthened by a documentary reference of *c* 950 to this road (Ravenhill and Padel 1991, 28). Other possible early references to a main route across the Moor occur in a charter of 1239, as a 'Great Road of Wagons' (Henderson and Coates 1928, 71), and in 1260 as the 'Royal Cornish Way' (*ibid*, 12).

Despite its grand title, it would seem that the 'Royal Cornish Way' (today's A30) was little better than a muddy cart-track by the beginning of the 18th century. In places it may well have had no defined edge or surface at all, leaving travellers to struggle as best they could in mist or darkness. In 1742 posts were set up at quarter-mile intervals to mark the route from Bodmin to Launceston. Elsewhere in Britain, the new Turnpike Trusts were being set up throughout the 18th century, and in 1769 the Bodmin Turnpike Trust was formed to improve the route over the Moor. The Jamaica Inn at Bolventor was established as a coaching inn, and Bodmin Moor entered the age of the mail coach. By 1800, the turnpike road was well-metalled and drained, and would have been a secure all-weather route across the Moor. Journey times for the average traveller were, however, far from quick by today's standards:

> 'Wednesday May eighteenth 1796. Set out at 2 o'clock from Truro and arrived at the Indian Queen 12 miles near St Columb by 4 o'clock, the road good but rather hilly. Killas in many places. The country on this side of Truro well cultivated and for the most part open. Near St Columb are some stream works but not very considerable –

Fig 150 Realignment and widening of the A30 on the west side of Colvannick Tor at Pounds Caunse (SX 121715) in 1965. (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Charles Woolf [65/125/14] © RIC 2008)

went to Bodmin 11 miles. Dined at the White Hart. The country about Bodmin and from St Columb very open and part heath – road very good. At 7 o'clock set out for Launceston 21 miles, road very hilly at first and afterwards in many places. Did not get to Launceston till near 12 o'clock.' (Raistrick 1967, 44).

The coaching inns and mail coaches had their heyday in the 1830s, when average speeds of 10 mph were achieved on the fastest routes, and coaches were timed to the minute. Horses were changed at Bodmin, Bolventor, and Five Lanes.

In 1859 the Cornwall Railway was opened from Plymouth to Truro across the Royal Albert bridge over the Tamar. As a result, the coach service over Bodmin Moor came to an end, the mails now being carried by train. Between 1871 and 1885 the Turnpike Trusts were abolished, and the maintenance of roads became the responsibility of the newly created County Councils. For some years afterwards the old turnpike roads deteriorated, carrying only farm and local traffic as they had done before the coaching era, and the new railways attracted almost all long-distance travellers. The railway age in all its Victorian solidity and certainty proved nonetheless to be ephemeral. In Cornwall the last passenger line was opened in 1905 (Chacewater to Newquay), but branch lines and minor railways in the county were already being closed by 1930. By the 1950s the railways were in financial difficulty, with declining receipts and dwindling freight tonnage. Thus they enjoyed a very short era of commercial dominance. Following the cautious introduction of the motor car and lorry after 1900, the old roads once again became strategic arteries. After the First World War a ready supply of cheap war-surplus lorries encouraged local carriers to compete with the railways, and by the 1930s a new programme of road surfacing and improvement was well underway. Today the A30, realigned with dual carriageways, carries modern travellers from London as it did in medieval times, to Dunheved (Launceston) and on across the high Moor *en route* to Bodmin.

*Fig 151 A view over Allansford, Advent (SX 110800) in 1962, with Stannon china-clay works and Roughtor in the background in 1962. The lane on the left is typical of the minor roads which connect the small farms and tenements of the moorland rim. In the middle distance is the stack of the Henneward pan kiln (*see *Chapter 6). (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Charles Woolf [62/125/367] © RIC 2008)*

3 Lanes and minor roads

Before the 18th century, wheeled traffic was rare in Cornwall; the *Victoria County History* (1908, 22) cites 1790 for the introduction of the first wagon in the Liskeard district. As late as the 1830s, pack horses and mules were the general means of transport for goods throughout the county, once off the turnpike roads. The narrow lanes and tracks that connect the moorland rim villages such as St Neot, St Cleer, Cardinham and Blisland to each other and to the wider world would have presented no obstacle to mules and donkeys, but were in general so narrow and poorly surfaced as to be impassable to wheeled traffic. Some idea of their character may still be found in the many green lanes which lead up onto the open Moor from the farms and settlements on its margins, as at Millpool, Wortha, and Codda. These roads were dusty in summer, muddy and sometimes flooded in winter, and were maintained only as a matter of necessity by those cottagers and farmers who used them.

After the Reformation an Act of Parliament made all these roads the responsibility of the parishes, and parishioners were obliged to contribute their labour for a fixed number of days each year to the upkeep of their roads (Ransom 1984, 21). This regulation was honoured more often in the breach than in the observance, and the only attention a lane might receive from one year to the next would be a grudging load of stone from a local farmer, placed in the worst muddy hollow. Although there were substantial bridges at the most important river crossings, in many cases a simple ford sufficed to cross the moorland streams. The improvements of the 18th century and the turnpike era had no effect on these minor lanes, which at the beginning of the 20th century were much the same as they had been 400 years before.

The introduction of motor vehicles produced great pressure for road improvement in the years following the First World War, as the rock-strewn surfaces of the lanes were now a serious hindrance to the users of cars and motor lorries. In the 1930s a massive programme of resurfacing with tarmacadam altered almost all of Cornwall's roads beyond recognition, save for the few which remained as bridleways and green lanes. Despite this, the archaeology of their routes, banks, walls, and bridges remains virtually intact, as these minor roads have suffered little of the widening and realignment affecting main trunk roads in recent years.

4 Tramways and railways

Cornwall was not an ideal county for railway builders. Its dispersed rural population, small towns, and hilly topography did not encourage early rail or canal companies to chance their luck in the county, and it was not until 1859 that Cornwall got its main line link to the rest of Britain. This did not dissuade local promoters from constructing tramways and railways to serve purely Cornish needs, and the first was the Poldice Plateway of 1809–12. Other horse-drawn tramways followed in the 1820s, usually built to serve mines and quarries, but Cornwall did not see a locomotive-hauled train until 1834, although one of its most famous sons (Trevithick) had invented and built the first steam railway locomotive in 1804.

The Bodmin and Wadebridge Railway

Although the Bodmin and Wadebridge Railway (B&WR) did not provide access to the high Moor, terminating as it did in the Camel valley below St Breward, it was nonetheless intended to serve the moorland farmers. The line was surveyed in 1831, and was opened in 1834 to convey calcium-rich sea-sand from Wadebridge up the Camel valley to Wenford Bridge, where it was much in demand as a manure to sweeten the acid soils of the moorland intakes. There were also short branches to the county town of Bodmin, and to Ruthern Bridge.

Built to the standard gauge of 4ft 8½in, this was the first railway in Cornwall to be worked by a steam locomotive, although horses were often employed when the engine was unavailable. In other respects the line followed standard tramway practice of the day, with wrought-iron rails resting on granite setts. The line was successful from its inception, but never officially carried passengers on the section from Bodmin to Wenford. The main receipts were from sand traffic in the early years (Whetmath 1967, 14).

The B&WR was purchased by the London and South Western Railway (LSWR) in 1845, but not physically connected to its system until 1895, when the North Cornwall Railway had been completed from Launceston to Wadebridge. By this time the emphasis in goods traffic had shifted from sea-sand to include increasing quantities of granite (from De Lank) and china clay (from Durfold). In 1906 the North Cornwall Company built a large number of new clay kilns at Wenford to serve its pit at Stannon, and these were to provide a continuing source of traffic for the rest of the line's existence. The last sea-sand was carried in the 1920s, but the little wharves at Dunmere, Helland Bridge, and Tresarrett continued to serve local farmers with artificial manures, machinery, and seed potatoes until the 1960s. At Wenford Bridge Terminus there was a staple traffic in coal. The section of the line from Bodmin to Wenford Bridge closed to all traffic in 1983. The archaeology of the line through the Camel valley remains mostly intact, with its cuttings, bridges and wharfingers' cottages; the trackbed is now part of the Camel Trail cycle path.

The De Lank tramway

This mineral tramway connected the granite quarries at De Lank to the Wenford Bridge terminus of the B&WR, and was constructed in 1881 (Stanier 1999, 32). It ran from the quarry to a point above the railway terminus, to which it descended by means of an inclined plane. Wagons were hauled from the head of the incline to the quarry by horse until *c* 1920, and by a petrol locomotive in later years. The tramway was disused by 1939.

The Liskeard and Caradon Railway

by Adam Sharpe

The Liskeard and Caradon is the only true moorland railway within the study area. It not only reached the fringe of the unenclosed Moor at Minions, but ran eventually to the very heart of it at Kilmar, and might have gone further still had grander proposals been successful. The construction and eventual demise of the Liskeard and Caradon Railway was closely linked to the changing fortunes of the Caradon Mining District of south-western Bodmin Moor. It also crucially facilitated the development of industry in a relatively remote corner of south-west Britain. Unlike the majority of the early independent railways and tramways of Cornwall, the Liskeard and Caradon Railway did not begin life as a self-sufficient transport system, but was intended to complement a canal from Looe to Liskeard first proposed in the late 18th century. The canal was designed to facilitate the movement of agricultural products from the east Cornish hinterland to the sea, and of fertiliser and lime in the opposite direction. A number of routes for the canal were surveyed between 1777 and 1823, and the last, which gained Royal Assent, was constructed between 1825 and 1830, terminating at Moorswater below Liskeard.

The first of the Caradon copper mines opened in 1836, and others quickly followed. Within a few years ore and coal traffic between the mines and the canal terminus had grown to massive proportions, but it soon became evident that the existing road network to the north of Liskeard was inadequate and expensive, and was becoming an active brake upon profitability and expansion. It was not long, therefore, before a group of local mine owners had sponsored a railway line to replace the existing road link. Work began in 1844, and the company almost immediately ran into problems with local landowners and with the effects of an inaccurate initial survey. Nevertheless, the line was completed by 1846, connecting the canal at Liskeard to the Caradon mines and the newly opened granite quarries at the Cheesewring (incorporating an inclined plane at Gonamena). A proposed branch to the East Caradon and Marke Valley Mines (the Tokenbury Branch) remained unbuilt at this time.

Once again, the line was standard (4ft 8½in) gauge, and of iron rails on granite blocks. The experience of

Fig 152 A china-clay train on the old Bodmin and Wadebridge Railway near Helland Bridge (SX 065714) in the early 1980s, shortly before closure of the Wenford Branch. (John R Smith, copyright reserved)

the Bodmin and Wadebridge Railway was not enough to persuade the Directors to adopt steam traction, however, and the railway was exclusively horse-drawn in its early years. Despite acute financial problems during construction, the line was almost immediately profitable, carrying over 7,000 tonnes of copper ore, 3,000 tonnes of coal and many hundreds of tonnes each of worked granite, timber, sand, lime, castings, machinery and other goods in the year following its opening.

By 1858, the Cheesewring Granite Company had constructed an extension line northwards to Bearah and Kilmar Tors where additional quarries were being started (*see* Fig 153), whilst to the east of Caradon Hill the growing success of Glasgow Caradon Consols, East Caradon, and the Marke Valley Mines resulted in a pressing requirement for the completion of the Tokenbury branch.

The limitations of the existing line, particularly those imposed by horse haulage, lightweight rails and the presence of the Gonamena Incline (which lay at the southern end of a burgeoning industrial area) were beginning to make themselves very apparent by the late 1850s. In 1860 the Liskeard and Caradon Railway Act was passed, the Kilmar Branch was purchased and the Tokenbury Branch begun. A decision was made to use

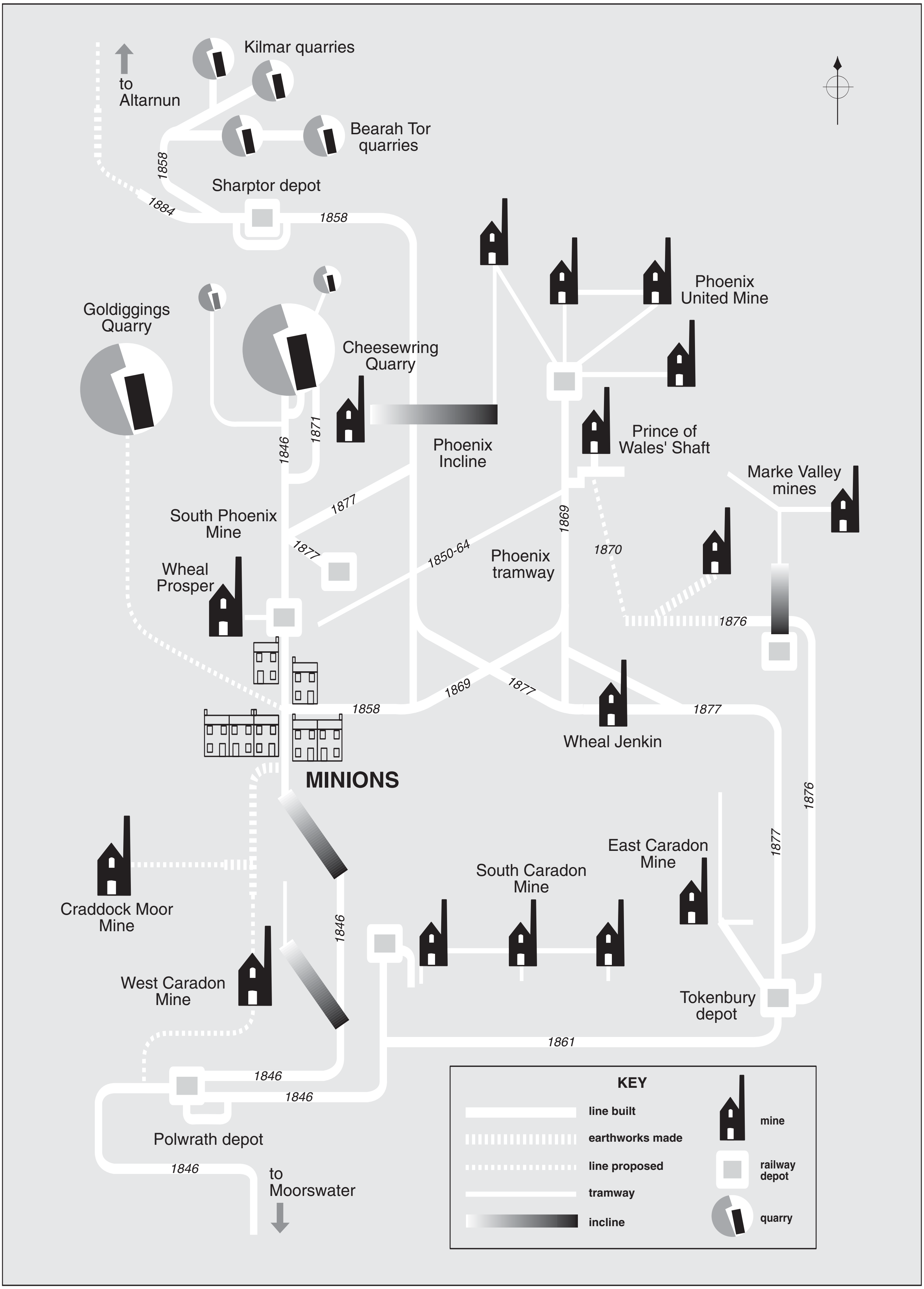

Kilmar quarries
to
Altarnun
Bearah Tor
quarries
1858
Sharptor depot
1884
1858
Phoenix
United Mine
Goldiggings
Quarry
Cheesewring
Quarry
Prince of
Wales' Shaft
Phoenix
Incline
1871
1846
Marke Valley
mines
1877
South Phoenix
Mine
1869
1877
1850-64
Phoenix
tramway
1870
Wheal
Prosper
1876
1869
1877
1858
1877
Wheal Jenkin
MINIONS
1876
East Caradon
Mine
1877
South Caradon
Mine
Craddock Moor
Mine
1846
West Caradon
Mine
Tokenbury
depot
1861
1846
1846
Polwrath depot
1846
to
Moorswater
KEY
line built
earthworks made
line proposed
tramway
incline
mine
railway
depot
quarry

Fig 153 (opposite) Schematic diagram of the railways and tramways of the Caradon area. Dates of opening are shown for each section. All the railways were part of the Liskeard and Caradon Railway, which passed to the Great Western Railway in 1909; the lines north of Moorswater were abandoned after 1917. (© Rosemary Robertson)

steam locomotives, and two were purchased ('Liskeard' and 'Caradon'), but the Gonamena Incline effectively prevented their use on the northern section of the line. To the north of the Incline, however, the Cheesewring Quarry operations continued to expand. An attempt to connect the Phoenix mines directly to the Tokenbury depot was abandoned, and the decision made to bypass the Gonamena Incline by means of a detour to the east of Caradon Hill, additionally connecting Marke Valley and Wheal Jenkin Mines to the network. A gradual decline in freight traffic became evident as the copper mines gradually worked out their richest lodes of ore. A plan to counter this was put forward by the Railway in the 1880s by means of a spur from the Kilmar Branch northwards towards Launceston, the aim being to provide a passenger and freight route across the heart of the Moor. Whilst the Liskeard to Looe section to the south was upgraded for this purpose, the Kilmar to Trewint line (a part of the Launceston route) was started in the early 1880s but never completed.

Through the 1880s the Caradon copper mines went into a sharp decline, and by 1890 even South Caradon had collapsed. Phoenix United, the last of the large mines of the area, was on the brink of closure and despite the expansion of traffic from granite quarries at Cheesewring, Caradon and Goldiggings the eventual closure of the railway was inevitable. The line became moribund and was eventually acquired by the Great Western Railway (GWR). Although the GWR relaid most of the Moorswater to Caradon section with new rails after 1910, during the First World War much of the track was lifted and shipped out to the Western Front. In 1931 the line was officially closed to all traffic and abandoned.

The Cornwall Railway

Although the Cornwall Railway of 1859 did not cross Bodmin Moor, instead skirting its southern fringe between Liskeard and Bodmin Road Station, it nonetheless provided a new transport opportunity for mineral producers on the Moor itself. This opportunity could not be fully realised until 1892, however, as until that date the Cornish main line was of broad (7ft ¼in) gauge. This effectively limited through rail traffic from Cornwall to destinations on lines built and operated by the Great Western Railway (GWR) and its associated companies. After the gauge conversion of 1892, it was possible not only to load direct on to the GWR at Bodmin Road but also to transfer traffic from the old

Fig 154 Rails on granite setts on the Liskeard and Caradon Railway, near St Cleer (SX 2568), undated but early 20th century. Flat-bottomed rail is spiked directly to the setts at this location. (Photograph reproduced with the kind permission of Royal Institution of Cornwall. Liskeard–Caradon 7 © RIC 2008)

Bodmin and Wadebridge Railway via the GWR branch to Bodmin (General), opened in 1885. Eventually, much of the china-clay and granite traffic, which had hitherto been sent north from Wenford and Tresarrett to Wadebridge for shipment, went south instead to the GWR at Bodmin Road Station. In the 1900s, several clay companies built new dries on the main line at Bodmin Road and Onslow Siding, and piped their clay from the moorland pits direct to these new railheads (*see* Chapter 6).

Lines proposed but never built

The various proposals for railways which were never built make an intriguing footnote to the transport history of Bodmin Moor in the 19th century. As already mentioned, the proposed northern extension of the Liskeard and Caradon Railway surveyed in 1881 to 1883 would have extended the Kilmar branch to Altarnun and Camelford, linking there with the North Cornwall Railway from Launceston. Had it been built, it might have prolonged the life of the Liskeard and Caradon beyond the First World War, although it is hard to see the route ever assuming much importance. However, it would have provided a spectacular view of the most remote parts of Bodmin Moor for the hardy traveller.

The Bodmin and Wadebridge Railway also had proposals to extend its own line; in 1864 various branches were surveyed to St Breward and St Tudy, and in 1872 a grand scheme was produced to extend the line from Wenford to Bude, Launceston, and Okehampton.

Others which were little more than paper schemes include the Delabole and Boscastle Railway of 1864, which would have run from St Teath to Forrabury with a branch on to the Moor at Davidstow; and the Temple Mineral Railway of 1873, proposed as a line from Blisland to Temple, with an extension to the Cornwall Railway below Warleggan.

In general, those railways which were last to be built were the first to be closed in the rationalisation of the 1960s, and any railway constructed in an area of low population with limited goods traffic would have had little chance of success in the long term. Whereas moorland roads are essential, railways were a luxury; in the era of the motor lorry their expensive infrastructure and operating costs ensured that they were soon part of the archaeology of the moorland landscape.

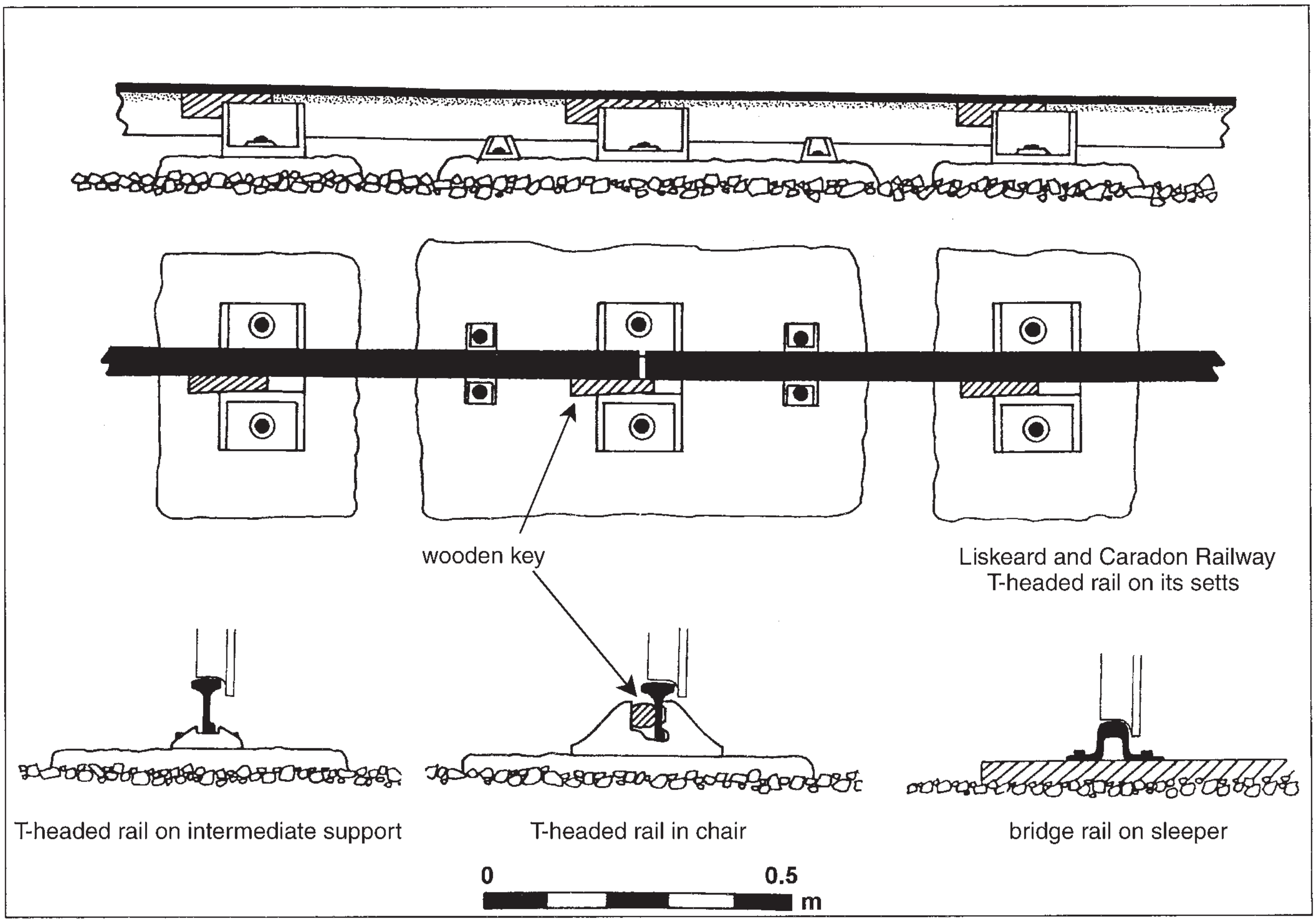


Fig 155 Rail fixings from the Caradon area, found during the Minions Survey. The T-head rails come from the Liskeard and Caradon Railway; the lighter section bridge rails to the right are more likely to have originated from internal mine tramways. (Based on Sharpe 1993, fig 36)

12 Recommendations for further work

by Peter Herring, Adam Sharpe and John R Smith

1 Mining

by Adam Sharpe

Streamworking

As a result of the survey work undertaken for this volume, the morphology of streamwork types established by Gerrard can be accepted (with some minor amendments) as a useful typological basis for the description of streamwork earthworks, whilst photogrammetric survey, followed by Herring's fieldwork has probably ensured that almost all on-Moor streamworks have been adequately identified and described. A number of problems remain, however.

The first is that of dating. The documentary and field evidence do not always agree with Gerrard's supposition that most streamworks are medieval. Most streamworks (both on and off the Moor) remain entirely undated at present. This problem might be resolvable through further analysis of documents, through detailed survey (where relationships might be identifiable), through excavation, or through other physical interventions.

The second opening for further research concerns tinners' buildings. Their distribution is uneven, and it is unclear whether this patterning is genuine or a result of these small, often slumped earthwork features being missed through necessarily rapid sketch survey. They remain by and large undated – indeed, even their functions remain unclear. Further targeted survey followed by evaluative excavation seem unavoidable.

The third concerns stamping and blowing sites. Almost none were found within the study area – almost certainly because their physical requirements tended to make off-Moor sites virtually mandatory. As a result, a very significant aspect of this industry remains unstudied. This could be rectified by selective research and survey.

Mining

The Bodmin Moor Survey area was largely determined by the requirements of surveying prehistoric and medieval remains for the first volume of the Survey, and hence missed out almost all of the important St Neot valley mining zone. This needs examination at a level of survey consistent with that used for the remainder of the Moor, since it was the site of some of the earliest documented true mining in the Bodmin Moor orefield.

Investigations undertaken during safety engineering works elsewhere in the county are beginning to throw much useful light on the forms and development of early shallow mining activity. Although there is both scope and need for the use of Land Reclamation Programme funds (LRP, formerly Derelict Land Grants) to assist in safety works, in consolidation works and in interpretation, especially in the Minions area, such approaches tend to be inherently destructive, resulting in the loss of shaft head features, the fragmentation of once coherent structural complexes and the blurring or destruction of important landscape contexts. The use of LRP on Bodmin Moor will need to be carefully considered and detailed assessment surveys of sites considered for treatment in this fashion must be a prerequisite.

There is some potential for English Heritage survey involvement in the recording of larger, more complex landscapes given that the Minions survey recorded only small sections of very extensive sites. Most mines are almost completely unrecorded with the exception of photogrammetric plots supplemented by sketch survey.

2 Quarrying

by Peter Herring

Dr Peter Stanier has already undertaken considerable documentary research on the great 19th- and 20th-century dimension stone quarries and their economic geography (*see* Bibliography), and Cheesewring, Goldiggings and Caradon North-East have been subjected to measured survey (Sharpe 1993). Other sites which would repay measured survey and photographic recording more detailed than the 1:2500 sketches prepared so far include the Carbilly Tor complex, Bearah Tor, Corner Quoit and the Kilmar quarries. De Lank is still active but its extensive abandoned remains should also be recorded before they are lost to continued dumping. Oral history might concentrate on recording the detail of working methods, and conditions within the quarries. Early photographs of working quarries will also be valuable.

Moorstone and grass-rock splitting, more dispersed and elusive on the ground and in the records, would richly repay research. Drs Harold Fox (1994) and Joanna Mattingly (1996) have shown the potential that later medieval documents have for revealing granite's early masons and markets, giving economic and social contexts for stone working to set alongside those for tinstreaming and early copper and tin mining. Archaeological fieldwork, such as that commenced by Tony Blackman and the Cornwall branch of the Young Archaeologists' Club, can be directed at the hills where masons chipped away: plotting and photographing abandoned pieces; identifying likely 'setts'; and studying changes in techniques, not just in splitting, but also in propping the stones up and in their reduction, shaping and dressing – perhaps with the help of experimental archaeology. The transition from grass-rock splitting to the fully industrial 19th-century dimension stone works via the so-called proto-industrial quarries (Herring and Thomas 1990, 84) can also be documented.

3 China clay

by John R Smith

Only the works at Burnt Heath and Glynn Valley were the subject of detailed survey for this volume. Certain other sites would benefit from further study and detailed record: Durfold, Henneward and Temple have the greatest potential for such an exercise. The documentary and historical record for the Bodmin Moor china-clay industry offers great scope for further work; other than Carolyn Brewster's review (1975), there is little accessible information on the subject. The history of most of the works is obscure, and in comparison with the St Austell area there would seem to be few photographs of the industry when the small works were active.

4 Turf

by Peter Herring

Further documentary and archaeological investigation of the industrial use of turf in the medieval and early post-medieval periods may best be pursued in the accounts of the Duchy of Cornwall manors of Rillaton and Helstone-in-Trigg and in searching Bodmin Moor for any equivalents of Dartmoor's 'meilers', the structures in which the turf was burnt to make charcoal. At present, documentary research appears most likely to be fruitful. Given that tin output figures appear to have been moderately well recorded, experimental turf charcoal burning (followed by the smelting of tin ore using this fuel) would assist in calculations of the quantities of charcoal manufactured in the past and thus the likely impact of the industrial use of peat on the moorland landscape. (The most useful turf for charcoal will have been in the marshes and in the fairly limited blanket bogs.)

Beyond preserving examples of the tools and equipment for cutting, drying, and saving turf, and the utensils for cooking with it, there may be little left to do on the material record of domestic turf cutting and use. Instead effort could be concentrated on securing any more early photographs of winning and using turf, including its other uses (thatching, storing ice, etc), and on establishing (through leases, oral history, etc) the locations of the turbaries attached to farms and cottages. The spring and autumn movements of turf-cutters could then be recreated and the surviving moorland steads linked to the homes of their makers.

Of special value would be extending the re-establishment of the practices of cutting, drying and saving marsh turf at Wimalford (*see* Figs 99 and 100) by Jack Parkyn and his family in 1995 and 1996 – with the encouragement and help of Tony Blackman – to harvesting hill turf and skimmies. Close liaison with English Nature would be required as most of Bodmin Moor's turbaries are now Sites of Special Scientific Interest (SSSIs).

5 Other uses of the Moor

by Peter Herring

Public water supply

A photographic record of the structures of present-day and earlier reservoirs and water treatment works may be accompanied by documentary research (newspapers, etc) and oral investigations into public responses to proposals for large reservoirs to see how official and public attitudes to the drowning or damaging of historic and semi-natural landscapes on Bodmin Moor have changed in the last half century.

Private water supply

One of the least studied elements of Bodmin Moor's landscape history; there is a need to identify all farm watering leats, distinguishing them from both those used in industry (tinning, clayworking, etc) and those serving farm waterwheels, and then to record their 'furniture' – bridges, drinking troughs, any bullseyes (holed stones placed at junctions to side-leats on Dartmoor to divert a fixed amount of water to a particular farm; *see* Worth 1953, 414). A survey of the wells recorded on early OS maps will yield more butterwells and well-houses which could then be recorded (photography; selected measured survey).

Ice works

Oral testimony regarding methods may still be sought from any surviving children of Dozmary's ice-workers and early photographic archives may also be trawled as it seems unlikely that no contemporary photographs were taken of an intriguing business on the shore of the much-visited Dozmary Pool. Closer examination of the buildings and the pit, perhaps including keyhole excavation in the latter, and study of the rusting machinery scattered around the site will improve our understanding of the place's mechanics.

Woodland and forestry

Fieldwork in the steep-sided wooded valleys at the Moor's edge should not only search for and record remains of woodland management – trackways, boundaries, charcoal burners' platforms, etc – but should also seek the elusive blowing houses, stamping mills and tucking mills. The early plantations of the designed landscape at Trebartha can also be studied through the Spoure/Rodd archives.

Military activities

The subsection in Chapter 8 should be regarded as provisional and as a stimulus to further oral history fieldwork, particularly on Second World War activities. Photographic records ought to be made of Davidstow airfield, the Lower Moor rifle range, the Cardinham Moors grenade range, and other structures. American artillery positions can be plotted and measured and the spread of shell-holes on Brown Willy and High Moor sketched to home in on the targets.

Fig 156 Jack Parkyn, born and bred at Wimalford, St Cleer (SX 21407365), has helped considerably with the turf chapter of this volume (Chapter 7), and he and various neighbours shared their knowledge of earlier 20th-century moorland farming practices. Jack, in 1995, stands beside six 'square' hay bales built into a pyramid to shed rainwater while they wait to be moved into the Dutch barn behind, the twine's knots always on the undersides of the bales to prevent water from seeping into the hay. The replacement of square bales by the much larger round ones which can only be moved by machine is rapidly removing one of the last of the Moor's communal activities, when neighbouring farmers help each other save their hay. (Tony Blackman, copyright reserved)

6 Agriculture

by Peter Herring

Chapters 9 and 10 could easily have been expanded, with additional fieldwork and research, to form a third volume on Bodmin Moor's historic landscape. Much work can still be done on the 19th- and 20th-century agricultural economy on Bodmin Moor, its interconnections with industry, and the society it generated and interacted with. Changing emphases within the mixed farming regime and their causes can be documented and discussed in greater detail and the methods, equipment and structures used (buildings, field systems and boundaries) can be more closely recorded and analysed. Typical farming years may be recreated for various sizes and types of farm on Bodmin Moor, at different periods, and the regrators, markets and fairs brought back to life. The people (landlords and tenants) involved in establishing intakes, and the stimuli for the process can be more clearly defined, as can the extent of the use of the Moor's commons into the 19th and 20th centuries by farmers living both on the Moor itself and also in the surrounding lowlands. The important practice of local herdsmen looking after lowland animals in return for payment also needs closer study.

Research should not only tap documentary, cartographic and oral history sources but ought also to include more archaeological recording. Farmsteads, the foci of agricultural activity, and the abode of much information on farming regimes, investment, methods, scale and success, will continue to yield the quantity and quality of data obtained by the RCHME survey reported on in Chapter 8, Section 6. The RCHME's individual surveys can serve as guides to the basic recording and analysis of either all or a selection of the remaining Bodmin Moor farms. Particularly important or revealing farmsteads (like Codda, Carkeet and Wimalford) might be recorded in greater detail. Greater emphasis may be placed on oral testimony and on showing how the farmsteads worked in relation to trackways and the fields and pastures beyond.

Examples of locally made agricultural tools and equipment should be preserved, and detailed oral accounts of their use secured. Documents such as the late 19th- and early 20th-century accounts of Ley smithy will bear much closer analysis than the cursory examination reported in Chapter 9, Section 7. The smithies and mills that served moorland farmers were not visited in this survey and they await their recorders and historians.

Inscribed boundstones (mainly of the late 18th and 19th centuries) have been very sporadically recorded even though most are plotted on early editions of the OS 1:2500 maps. The late Frank Smeeth visited and described most of the manorial boundstones in the Moor's north-west quarter (maps held by David Attwell, North Cornwall District Council), and one or two in the Minions area have been drawn, alongside mine and quarry boundstones and railway and road markers (Stanier 1986c, 105–8; Sharpe 1993, figs 107 and 108). Photographs and descriptions of all such stones will provide a valuable record which will assist in ensuring their conservation, and will help recreate early modern manorial subdivisions of the Downs.

7 Industrial settlement and public amenities

by Peter Herring

Photographic recording of the cottages and terraces inhabited by the families of miners, streamers, clayworkers and quarrymen should be encouraged, especially as original sash and casement windows and scantle and rag slate roofs reach the ends of their lives and are replaced by standardised modern materials. The various public buildings and features will also be most appropriately recorded photographically. Maps, census returns and official reports are probably the best sources for documenting the growth of hamlets (eg Sharpe 1993, fig 12) and the provision of public services.

8 Transport and communications

by Peter Herring

Both railways, the Liskeard and Caradon and the Bodmin and Wadebridge, have been closely studied both archaeologically and historically, but work remains to be done on recording their detail. The De Lank tramway's incline and connection to the Bodmin and Wadebridge line at the Wenford Bridge terminus also require examination.

Much more work is needed on the roads and trackways of the Moor; very little was undertaken in the various surveys reported on here and in Volume 1. Early maps will help to identify the sequence of principal routes while the study of aerial photographs and archaeological fieldwork will put hollow-ways, fords, bridges, milestones and signposts on to the map (*see* Fig 157). Once this is done the directions and volumes of movement of people, animals and vehicles can be reconstructed and other ancillary features may be better understood. Such work will also contribute greatly to any phenomenological studies made of medieval and post-medieval life on the Moor.

9 Potential for further archaeological fieldwork and historical research generally

by Peter Herring

Although the various Bodmin Moor surveys now make this perhaps the most closely documented upland in Britain, there are still areas within it which can be expected to yield important archaeological remains; prehistoric, medieval, post-medieval and industrial. This potential was confirmed when the examination of the De Lank quarries during the Industrial Survey revealed a hitherto unrecorded early prehistoric tor enclosure, SX 100 753 (Herring 1992) and the Minions Area survey found a well-preserved medieval strip field system among intensive mining remains in the Caradon Coombe, SX 276717 (Sharpe 1993, 230–3).

Moorland edge valleys, particularly those whose floors have been shrouded by woodland and made invisible on aerial photographs, can be expected to contain the remains of mills, leats and woodland management. Elsewhere there are hills and downlands which have been less intensively inspected than others; a recent survey of Scribble Downs, SX 142772, across the valley from much-visited Garrow and Leaze, identified five cairns, a menhir, and a stone setting (Cole 1997, 152–6), none of which was recorded in the main Bodmin Moor Survey (*see* Johnson and Rose 1994, map i). Among others the following hills and downs can be noted as having felt the tread of archaeological fieldworkers' boots less often than, say, those in the north-western and south-eastern quarters:

Cardinham Moors (occasionally out-of-bounds because of the Millpool Firing Range) (SX 1371)

Trehudreth and Manor Commons (SX 1374)
Draynes Common (SX 212708)

Hill and Newel Tors and Carkeet Downs (SX 2374)

Shallow Water and Brockabarrow Commons (SX 1576)

The eastern hills of West Moor (SX 2080)

The southern hills of East Moor (SX 2277)
Warleggan Downs (SX 157699)

Hardhead Downs (SX 152716)

In addition to the potential for discovering and recording new sites and features there are of course considerable opportunities to analyse, re-interpret and review the information collected and mapped to better understand the history of Bodmin Moor and the people who have lived and worked on it, or crossed its surface. The Bronze Age remains presented in the first volume of the Bodmin Moor Survey have, for example, been subjected to a careful re-evaluation by Dr Christopher Tilley of University College London (Tilley 1995): this has led to several seasons of research excavation and landscape analysis on and around Leskernick Hill (eg Tilley, Bender and Hamilton 1995). A more wide-ranging assessment of the Moor's present historical landscape character was undertaken by Peter Herring of CAU to inform a landscape assessment, sponsored by the Countryside Commission, of the Bodmin Moor part of the

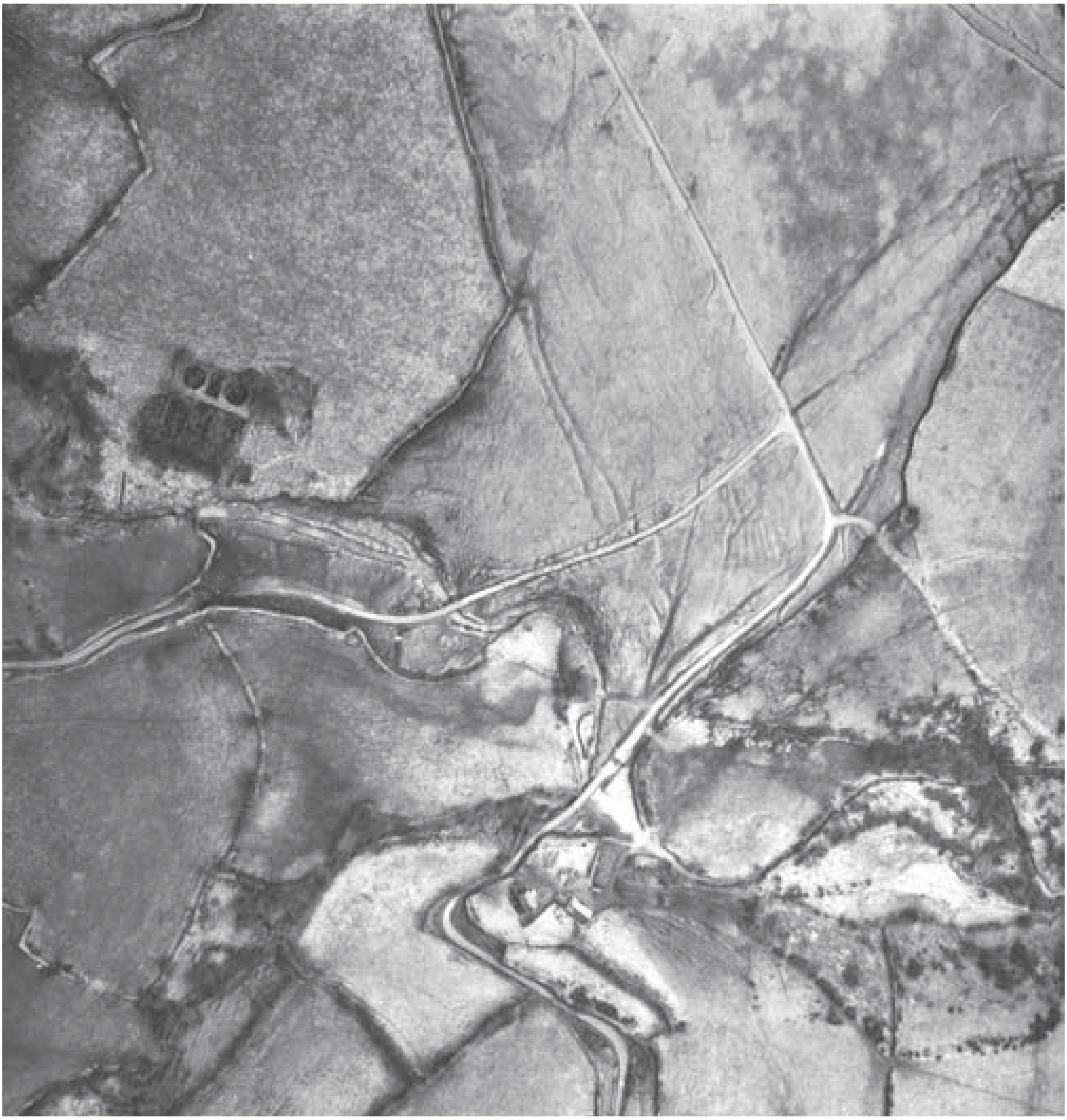


Fig 157 Allansford (SX 110800) in 1979, south to top of page. The foreground view of Fig 147 from vertically above showing modern roads replacing earlier more dispersed hollow-ways fanning out onto Harpurs Downs from the old fords, now both bridged. Hedged lanes ran through the medieval-derived fields. Henneward clayworks' dressing floor with its settling tanks, two circular and one rectangular, is towards the left. (NMR, 1456; Crown Copyright Reserved)

Cornwall Area of Outstanding Natural Beauty (Countryside Commission 1994).

10 Place-names

by Peter Herring

'Space becomes time as people turn earth into landscape and claim it with names' (Glassie 1982, 609). An aspect of Bodmin Moor's history, well-used in the second part of volume 1 to document the recolonisation of the Moor (Rose 1994, 77–80), but capable of sustaining closer, more particular study, is that of its place-names. Countless names will have been received, accepted, adapted and given. As well as the settlements and fields recorded on the Tithe Maps (*c* 1840) and early Ordnance Survey maps, it should be expected that local people will have named as landmarks, as places more or less frequently visited, or as places used or worked in, a great variety of features, natural, semi-natural and created: rocks, tors, hills; trees, groves, pastures; springs, marshes, streams; fords, bridges, tracks; and of course structures and earthworks, in use or ruined. Not only might careful oral fieldwork yet allow us, in the early 21st century, to transform the fairly spare record inherited from the 19th century into a map 'all black' with names (cf Robinson 1990, 186), but any newly recaptured names can also be expected to shine strong light on past land use and also on local people's perceptions of the history and features of Bodmin Moor, itself otherwise known as The Cornish Moors, Temple Moors, Foweymore, or *in nostra lingua* (ie Cornish) Goen Bren (*see* Herring 1986).

Whole hills on Bodmin Moor appear from published maps to be nameless; for example that on East Moor north of Greymare Rock (SX 224777), or that on West Moor north-west of Westmoorgate (SX 201807). The long low hill, part of Manor Common (SX128743), overlooking Deacons appeared unnamed until Morley Rowe (pers comm) called it Nailaborough while discussing 20th-century stone splitting, and the hillock to the north-east of Bolventor, recently sliced through by the A30 improvement (at SX 187773) was named, in passing, Donkey's Park by Jack Parkyn (pers comm).

Appendix: List of mine sites

by Adam Sharpe

Notes

The following table is intended to list and locate (either as primary sites, or through cross-references) all recorded mining ventures either on or immediately bordering Bodmin Moor. The principal source (the Justin Brooke archive, CRO, X745) includes flotations, prospectuses, changes from cost book to limited companies, renamings and regroupings of mines, trials which did not result in development, and mines which appear to have produced no recorded output. From this initial list, the off-Moor lead, zinc, manganese and ochre mines have been excluded whilst sites noted by Gerrard (1986) and Dines (1956) and additional sites included in the Cornwall and Isles of Scilly Historic Environment Record (held by CCC HES) have been added. The list of mines resulting from this amalgamation of sources was subsequently rearranged to reduce duplication. Given the nature of the sources, some mines remain unlocated, and the list cannot be regarded as complete. Details of dates of working have been subsumed within key periods under which the known or likely metals produced have been shown.

Key to minerals:

Sn	Tin
Cu	Copper
As	Arsenic
W	Wolfram
Zn	Zinc
Pb	Lead
Fe	Iron
Mn	Manganese
Au	Gold

Table 1 Documented Cornish tin output AD 1200–1900 (various sources)

Site	*NGR*	*Output pre-19th century*	*Output 1800–30*	*Output 1830–70*	*Output 1870 –1900*	*Output in 20th century*	*Comments*
Agar, East	SX 261695			Cu			Was Wheal Agar
Alexandra	SX 120821	Sn?		Cu			
Altarnun Harvenna	SX 215786			Cu			May have been reworked within Altarnun Consols
Altarnun Wheal Brothers	SX 213789?			Cu?			May have been reworked within Altarnun Consols
Ambrose Lake Consols	SX 192673			Sn Cu As			Part of Wheal Mary Great 1853–73
Annie and Treburland	SX 234793	Sn			Sn W		Probably = Burland. Worked in Great Tregune Consols
Bella	Unknown			Sn? Cu?			No work undertaken?
Berriow	SX 270670			Cu Zn			Caradon and Phoenix Consols 1863–
Berry Downs	SX 196698	Sn				Sn	South Mount Boppy Gold Mining Co 1906–17
Bickford	SX 152696	Sn		Sn			Or Beckford. Worked within Treveddoe
Blisland Consols	SX 127747?	Sn		Cu Sn			Possibly = Treswigger?
Bodmin Moor Consols	Unknown			Cu Sn			A small undertaking with a grand name
Bowden	SX 205687						
Bray	SX 198823		Sn?	Cu			
Bray Down	SX 186619	Sn?	Sn			Sn W	Includes alluvials. Uranium found 1953
Brockabarrow Common	SX 1575	Sn					
Brown Gelly	SX 193724	Sn		Sn			
Brown Willy	SX 1578	Sn		Sn			20th-century proposals for reworking alluvials
Buttern Hill	SX 157783	Sn			W Sn	W Sn	Late output = alluvials. Au found 1946

Site	*NGR*	*Output pre-19th century*	*Output 1800–30*	*Output 1830–70*	*Output 1870 –1900*	*Output in 20th century*	*Comments*
Butters Tor	SX 157783			Sn	Sn W	W Sn	1892–3 Wheal Rosa and Brown Willie
Cabilla	SX 149695	Sn	Cu	Sn			Recorded 1749–82
Cannaframe	SX 195784	Sn?				W	Cornish Minerals Trust 1916–33
Caradon	SX 270708			Cu			1812 Curradon Mine? The Caradon 1844–52
Caradon Consols	SX 255696			Cu			
Caradon Copper	SX 267685			Cu			Trethevy 1844–53
Caradon, East	SX 278702			Cu	Cu		One of the longer-lasting Caradon mines
Caradon, Glasgow	SX 282703			Cu	Cu		One of the longer-lasting Caradon mines
Caradon Great Consols	SX 297707			Cu			
Caradon, New	Unknown				Cu		
Caradon, North	SX 103817						Almost no development
Caradon, South	SX 265697		Cu	Cu	Cu		The most important copper mine of the Caradon area
Caradon, South New	SX 275689						
Caradon, South Wheal Hooper	SX 273697			Cu			
Caradon United	SX 247692						= Caradon Hill
Caradon, West	SX 262700			Cu	Cu		New West Caradon 1880–89; Caradons Ltd trial 1907
Caradon, West South	SX 248691			Cu			Also known as Caradon Hill Mining Co
Carburrow	SX 150790?	Sn					
Cardinham Moor	SX 136720	Sn			Sn Cu		
Cargibbett	SX 293710			Cu			
Carkeet	SX 218734	Sn					
Carkees Downs	SX 134764				Sn		
Carnglaze	SX 187667					Sn	Tin prospect 1944
Carn Vivian	SX 157686	Pb		Pb Sn			A lead mine in the Fowey valley which produced a little tin
Carpuan	SX 206689				Sn	Sn	South Mount Boppy Gold Mining Co 1906–17
Clanacombe	SX 265723	Sn	Sn				Reworked as Phoenix United
Coad				Sn			
Colliford	SX 175711	Sn		Sn		Sn	1841 Colliver may be the same mine
Colquite (*see* Westcott)							
Combe Park	Unknown	Sn					(St Neot), 1613
Cornwall Great United Mines	SX 264713 SX 265723	Sn		Sn			Worked Wheal Jenkin, Wheal Prosper, Wheal Julia, Clanacombe stream and adit, Green Hills
Craddock Moor	SX 256700			Cu			
Craddock Moor, West	SX 242208			Cu			Probably equivalent to Crylla
Crennis	Unknown			Sn			
Crylla	SX 242208	Sn					Worked in 1513, possibly retried as West Craddock Moor
Cutcare Wood	SX 277670?		Cu				NGR is for farm, not mine
Darley	SX 273734			Cu	Cu		
Dewey Trod	Unknown			Sn			
Dora	SX 246723			Sn Cu			
Dorothy	SX 196788	Sn			Sn		
Dozmary Pool	SX 194743	Sn	Sn				1826 adit work

Site	*NGR*	*Output pre-19th century*	*Output 1800–30*	*Output 1830–70*	*Output 1870 –1900*	*Output in 20th century*	*Comments*
Dreynes (Victoria) and Netherton (East)	SX 225685	Sn		Sn Cu	Sn		
Dunsley Wheal Phoenix	SX 268713			Sn			1846–50 as Great Wheal Frederick
Esther United	SX 155700			Sn	Sn		Also known as Tremoreland and Shabra; included North Wheal Esther (Maidenwell), East Esther United, Carburrow/Carburrow Tor from 1863. Parts worked as New Treveddoe 1871–3
Gazeland China Clay	SX 166698	Sn		Sn		Sn	= Whitborough Tor; produced some tin
Gilbert, East & Merrymeeting	SX 088733			Sn			
Glasgow Caradon Consols	SX 281702	Sn		Cu	Cu		Reworked parts of Old Tokenbury and Yolland Consols. From 1888 included South Caradon and East Caradon.
Gonamena	SX 263704	Sn		Cu			Early production = streamworks and stockworks
Gonamena, East	SX 265704			Cu			Location uncertain
Gonamena, West	SX 262704			Cu			Location uncertain
Good a Fortune	SX 155697	Sn					Also unspecified 19th-century workings
Goodaver	SX 207744	Sn		Sn	Sn		As Tin Era 1887–96
Goonzion	SX 177677	Sn		Cu Sn	Sn?	Sn	Originally as Goonzion/Goonzion Downs; to 1836 as West Wheal Friendship Consols; 1836–9 part of St Neot & St Cleer Consols; included North Wheal Grylls United 1886–92
Grace Dieu	SX 260712	Sn					Reworked in South Phoenix
Greenhill	SX 262715	Sn					Reworked in South Phoenix
Grylls	SX 170671	Sn		Sn	Sn As		Probably included sett of Little Carbarlye or Kitt's Nest, worked 1630
Halvana & Fox Tor	SX 217786	Sn		Sn	Sn	W	Included Alvenny Mine. Little output from late operations
Hammett	SX 186696	Sn		Cu Sn	Sn		
Hardhead	SX 149715	Sn		Sn		Sn	
Harrowbridge	SX 206744	Sn					
Harvannah, South	SX 215785			Sn?			Probably South Halvana
Hawks Wood	SX 268755					W	To 1944 worked by East Cornwall Mines Ltd; 1944–56 with parts of Berriow
Hawkstor	SX 150745			Sn			Possibly output from clay pit
Hendra Downs	SX 204795			Sn		Sn	
Herbert	SX 185688			Sn?			
High Moor	SX 162817					Sn W	Includes alluvials
Hobb's Hill	SX 185694	Sn		Sn Cu		Sn	Reworking of stanniferous elvan
Hollow Marsh Wood	SX 154693			Cu			Limited output
Hurlers Work	SX 257714	Sn					Reworked in South Phoenix
Jane (Altarnun)	SX 200789		Sn?	Sn?			Some alluvials
Jenkin	SX 265713	Sn	Sn	Sn	Sn		Part of Rosedown, worked within Cornwall Great United, Caradon Mine, finally Marke Valley
Julia	SX 264722	Sn	Sn?				Incorporated into Phoenix United

Site	*NGR*	*Output pre-19th century*	*Output 1800–30*	*Output 1830–70*	*Output 1870–1900*	*Output in 20th century*	*Comments*
Killham	SX 205672			Sn		Sn	1872–3 as Wheal Coryton; 1899–1909 Associated Tamworth Mines Ltd; part as Pensilva Tin Mines Ltd 1910–21
Lamelgate	SX 218706	Sn		Sn			1843–6 Lanbel Gate
Lampen	SX 185673	Cu	Cu?	Cu			
Lantne(y)	SX 162686	Sn					Or Lantewey
Larkholes	SX 234689	Sn		Sn?		Sn?	With Penhale 1906–13, openwork and mine
Leather, Wheal	SX 180661	Sn		Sn			
Lemarne	SX 256777	Sn Au			Sn W As	Sn W	Trebartha Lemarne. Reopened 1953–60.
Leskernick	SX 187799	Sn					Later alluvial output?
Lestow	SW 166651	Sn					NGR is for farm, not mine
Luskey	SX 260770				Cu Pb		
Marke Valley	SX 277718	Sn	Sn	Cu Sn	Cu Sn		Included Lawns and Leywood; parts of Rosedown and West Rosedown. *See* also Wheal Jenkin
Marshall	SX 239696	Sn		Sn Cu	Cu		Included Wheal St Cleer. With Bullen Downs worked as New South Caradon 1880s
Mary Consols	SX 186674		Cu	Cu Sn Pb As			1845–8 with South Wheal Mary; 1848–50 with Wheal Sisters; 1850–1 as Wheal Caroline. 1853–73 Wheal Mary Great Consols included Wheal Mary, Ambrose Lake, Lampen, Higher and Lower Coombe House and Wheal Sisters. Part as Tin Valley 1869–75
Mary, Wheal South	SX 185673	Fe As					= Pauldiss. Later incorporated into Wheal Mary Consols
Messenger	Unknown			Sn?			
Metal Lake	SX 283708		Sn Cu				
Morshead	SX 233690			Sn Cu			Adjoined Larkholes. Trial only?
Newland Lane	SX 274720	Sn					(Linkinhorne) = Happy Chance
Noble, Wheal	Unknown			Sn?			
Norris	SX 244698	Sn		Sn			
North Wood	SX 202696	Sn?	Sn	Cu Sn			1815 as Narrada Down
Onslow Great United	SX 093775			Cu	Cu		= Simonsward Mine, Included East Onslow Consols, Hengar Wood; formerly Great Wheal Michell
Park China Clay	SX 1971					Sn	Tin veins in clay pit being worked
Parson's Pit	SX 1971	Sn					Possibly same site as Park china clay
Penhale and Trecarne	SX 242689	Sn		Sn Cu		Sn W	Caradon United 1844–5, Penhale and Trecarne United 1858–60, West South Caradon 1860–, with Larkholes 1906–13
Phoenix	SX 267722	Sn	Sn	Cu Sn	Sn Cu	Sn	1730? – 1813, 1823 Stowe's (End), 1825, 1831 Stowe's, 1907–13 Prince of Wales. Included Clannacombe = Wheal Trelawney, Wheal Julia
Phoenix, East	SX 273721	Sn		Cu Sn			

Site	*NGR*	*Output pre-19th century*	*Output 1800–30*	*Output 1830–70*	*Output 1870 –1900*	*Output in 20th century*	*Comments*
Phoenix, New	SX 233793				Zn Mn		Or Wheal Annie?
Phoenix, North	SX 272734			Cu			
Phoenix, South	SX 262715	Sn		Cu Sn	Cu Sn		Reworked earlier setts in the moorland north of Minions, including Wheal Prosper and Greenhill
Phoenix, West	SX 252721	Sn		Sn Cu	Sn Cu		= Witheybrook, not Stowe's, which was referred to as the West Phoenix section of Phoenix United Mines
Pollard	SX 245700	Sn		Sn			
Prosper	SX 260713	Sn					Reworked in Cornwall Great United and South Phoenix
Providence, North				Sn Cu			
Recovery, Wheal	Unknown	Sn					(Warleggan) 1795, may be at Treveddoe
Robins	SX 182682			Sn Cu			
Rosedown, West	SX 274712	Sn		Cu			The Caradon to 1852; Caradon Great Consols
Roughtor	SX 163827			Cu Sn			
St Cleer Consols	SX 242692			Sn Cu			Probably included Wheal Marshall
St Neot	SX 185669			Sn		Sn	
St Neot & St Cleer Consols	SX 178677		Cu	Sn Cu			Included Goonzion, Tin Hatches, Wheal Bank (at work 1819), Killham and Trengale. Output from Goonzion only
Sedley	SX 293712			Cu Pb			Caradon Vale 1862–
Shallow Water Common	SX 154761				Fe		Late Haematite working
Sharptor	SX 272734			Cu			East Sharptor 1850–52
Sharptor, West	SX 259732	Sn		Cu			
(Great) Shilstone	SX 262716	Sn					Reworked within South Phoenix
Silver Valley	SX 254715	Sn				Sn W	Early workings on Grace Dieu lode?
Sisters	SX 192674			Cu Sn			1862–7 as Caradon United Mines
Spettigue	SX 215715					Sn W	
Stanbear Cott	SX 270729					W	1943–51
Stowe's	SX 260721	Sn	Sn				With Phoenix United as West Phoenix
Temple	Unknown			Sn Cu			Parish location only
Tin Vale	SX 188673			Sn Cu			Tin Vale (Consols) 1840s and 1850s
Tinners' Lane	SX 181698	Sn					
Tokenbury Consols	SX 286707			Cu Sn			With South Yeoland; Wheal Caradon 1851–2
Trebinnick	SX 882700	Sn					= Tremorken, 1650
Treburland	SX 237793				Sn W	Sn W	Probably Burland/Berlyn, see Tregune
Tredaule	SX 233811	Sn?					
Tregeagle	SX 178683	Sn		Cu Sn	Sn	Sn	1857– Tregeagle Moor
Tregelland	SX 187785					Sn	
Tregune	SX 225796	Sn		Sn Cu	Sn Cu		Also worked as East Alvenny, Burland before 1853, ?Berlyn in 1880s
Tregune, East	SX 230795?			Cu			
Trehudreth Downs	SX 125732	Sn					
Trekeive, South	SX 233694	Sn					At work 1357 = Bulland Downs?
Tremaddoc(k)	Unknown				Sn		

Site	*NGR*	*Output pre-19th century*	*Output 1800–30*	*Output 1830–70*	*Output 1870 –1900*	*Output in 20th century*	*Comments*
Tremar	SX 254688			Cu?			Location uncertain
Tresellyn and Scaddick	SX 187788	Sn		Sn Cu	Sn	Sn W	Included Wheal Tresellyn, Tresellyn Consols; Duchy Tin 1880s, General Mining Company 1919–22
Tresellyn, West	SX 185788?			Sn			On Scaddick Hill
Treslea Downs	SX 138614	Sn					NGR gives general location only
Treswigger (*see* Blisland Consols)							
Trethin & Archer	SX 103817		Cu? Pb?	Cu Pb			Kennall Mine 1826; Great North Caradon 1872–7, little output
Treveddoe	SX 152696	Sn	Sn	Sn Cu	Sn Cu	Sn	1851–3 Treveddoe and Cabilla Consols; 1858–69 Great Treveddoe and Cabilla Mine. Assayed 1942 by Liskeard Mines Company
Treveddoe, East	SX 154697				Sn		Short-lived operation
Trevenna	SX 180685	Sn		Cu Sn	Cu Sn		As West Wheal Robins 1852 for tin and copper
Trevenna, South	SX 179683?			Sn Cu			
Trewint	SX 210799	Sn			Sn	W	Included Horseburrow & New Hendra; East Cornwall Wolfram Syndicate 1931–
Trewitten	SX 2271				Sn		General location only
Union Mine	Unknown		Sn?				(St Neot) No details of output
United Mine	Unknown		Sn Cu				(Warleggan) at work during this period. May be at Treveddoe
Venland	SX 285680	Sn		Sn			
Vincent	SX 209793	Sn		Sn Cu	Sn	Sn W	Also known as Altarnun Consols; East Alvenny 1846–50
Warleggan	Unknown	Sn		Sn Cu			1850–3 Warleggan Consols Tin and Copper Mining Company
Westcott	Unknown			Cu Pb			= Colquite
Westerlake	SX 209720	Sn		Sn			Or Westlake (Gerrard)
Whisper	SX 152697	Sn	Sn?	Sn			First worked 1786? Name continued to be used for openwork at Treveddoe
Wilhelmena	SX 210795?			Sn			As Wilhelmena and Trewint 1860s–80s
Witheybrook	SX 254721	Sn					= Ward Mine. Reworked as West Phoenix
Yeoland	6SX 288702	Sn		Cu Sn			= Yolland
Yeoland, South	SX 285705			Cu Sn Pb			As Wheal Caradon from 1851.
Wimbleford	SX 207741		W				With Spar (quartz)

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Glossary

by Peter Herring, Adam Sharpe and John R Smith

NB Words in ***semi-bold italic*** within the glossary are either terms used elsewhere in Britain, or alternatives to the main entry.

adit n. A level or shallowly sloping tunnel driven into a hillside in order to give access to a mine; and used for drainage and sometimes for access and ore haulage. Elsewhere in Britain a ***level, drift*** or ***sough***. Also used in china-clay works and quarries to drain pits.

adventurer n. One with a financial stake in a mine, usually one of the partners of a **cost book company**.

air dry n. An open-sided shed where china-clay blocks were stacked to dry naturally; the roof might be thatched or boarded.

alluvium n. or ***alluvial deposit*** Material deposited on the beds of watercourses or other low-lying land which has been transported by streams, rivers or other bodies of water, in general consisting of silts, sands and gravels, but often incorporating organic material and, on Bodmin Moor, weathered **shoad** in ***placer deposits***.

angle bob n. The mechanical device with which power operating in one direction is converted to power in another direction, either horizontally or vertically. It can take the form of a rocking beam (usually counterbalanced if at a shaft, *see* **balance bob**) or of a horizontally set ***bell-crank***.

assay n./vb. The process of identifying the chemical constituents of an ore sample, usually by chemical means.

backs n. The outcropping or uppermost part of a **lode**.

baker n. A cast-iron dome with a flattened top which was placed over a heated **baking iron** on an open fire.

baking iron n. A flat circular piece of cast iron, *c* 1in (25mm) thick and 2 ft (600mm) diameter upon which pasties, bread and cakes were baked. It was heated in an open fire, food was placed on it, and then covered by a **baker** or **dish kettle**.

balance bob n. One of the rocking beams (or **bobs**) and associated balance-boxes used to counter the weight of the pump-rods in a shaft, thereby easing the load on the **waterwheel** or **beam engine**.

bar vb. To move a truck along a tramway by levering with a crowbar.

bargain n. The arrangement by which a group of miners undertook to work a section of a mine for a proportion of the value of the ore. Also refers to the area being bid for. *See also* **pitch** and **tribute**.

barker n. A sharpening stone made by Barker Co; a composite stone which replaced whetstones.

batholith n. A large dome-shaped intrusion of igneous rock.

beam n. *See* **openwork**. An old-fashioned term, generally applied to relatively wide excavations; compare **coffin**.

beam engine n. A type of steam engine much used in Cornwall for pumping, winding, and treating ores on mines. Power from a large cylinder set vertically in the engine house was transferred via a rocking beam or bob (usually mounted on the front or bob wall of the house) to the pumps in the shaft outside; for winding and crushing, the bob drove a **flywheel** and crank. In the case of all-indoor engines, the beam rocked on a cross wall or joist within the house; the crank and **flywheel** were within the building. The cylinder of **Bull engines** was inverted, the piston rod being attached directly to the pump rods, whilst in inverted engines, the beam was mounted under the cylinder.

beat-burning n./vb. The paring-off, drying and then slow burning of the turf, the potash-containing ashes then being scattered on the ground as fertiliser. A South-Western term. Also **paring and burning**.

beehive kiln n. A brick kiln of vaulted form. The green (unfired) bricks were stacked in a chamber which was connected to a furnace and stack; hot air circulated through the kiln to fire the bricks.

beuheyl n. An archaic term for a linear deposit of concentrated **shoad**.

biddax n. From beat-axe, a broad-bladed mattock used to pare turf in **beat-burning**.

black tin n. Dressed ore, ready for the smelter.

blanket bog n. Peat formed in waterlogged conditions on higher ground (cf **valley bog**) where drainage is impeded. On Bodmin Moor blanket bog was usually found on the rounded hills with convex profiles where water stood on their backs.

blowing n./vb. The process of converting dressed **cassiterite** into tin metal in a forced-draught furnace.

blowing house n. A structure containing a charcoal-burning furnace whose draught was provided by waterwheel-driven bellows. Used from the later medieval period to the early 19th century for smelting tin.

bob n. A Cornish term for the ***beam*** of a **beam engine**.

boiler house n. A building constructed to contain the boilers for a steam engine on a mine or other works; usually associated with an adjacent chimney stack.

bounding n./vb. The process by which the limits of an area within which a miner was entitled to work were established and maintained on the ground. *See* **bounds**.

bounds n. The agreed boundary of a defined area, often marked by distinctive features, natural, specially made or reused.

brandis n. A three- or four-legged wrought-iron stand for supporting pots, etc, when cooking either in or immediately beside an open fire.

breast n. The upper part of the working face in a streamworks, over which the washing water ran.

breast-shot adj. A **waterwheel** in which the water enters the buckets above the centre line of the wheel on the side nearest the feed **launder**, causing the wheel to rotate against the direction of flow.

breast spade/plough n. A sharp-bladed tool with upright **wing** for de-turfing **ley** or unbroken ground, or for cutting **skimmies** of **hill turf**. A cross-bar was pushed from the thighs. It was often also pulled by a second person, using a rope attached to a handle.

bronze n. An alloy usually comprising copper and tin.

brouse (phonetically 'bruss' on Bodmin Moor) n. Dry twigs, hedge-cleanings, etc, used to give rapid heat in **cloam ovens**.

bryle n. The meaning of this long-obsolete term is obscure but it would seem to mean either the **backs** of a lode or the overlying topsoil.

bucking n./vb. The process by which copper ore was reduced to a consistent fine grain size using hammers on an anvil or other hard surface.

buddle n. A tank or pit within which fine tin ore was separated from waste on the basis of its density. Early buddles were trapezoidal in shape, and were manually agitated; by the mid-19th century they took the form of lined circular pits, tin ore in pulp form being fed either into the centre of a convex-based pit, the denser material settling near the centre, or with the feed at the periphery of a concave pit, the waste drain being at the centre. A fully mechanised variant for treating very fine material was the wooden ***Cornish round frame***.

buddle vb. To separate fine grades of tin ore by relative density on a **buddle**.

bull engine n. A compact form of **steam engine**, devised in 1791 by Edward Bull. It dispensed with the need for a beam by inverting the cylinder and attaching the pump rods directly to the piston rod. The design had serious technical drawbacks, however, and in 1874 was judged to infringe Watt's Patent; an injunction issued to prevent the construction of any more of these engines brought an end to Bull's work.

burning house n. A furnace in which tin ore was heated to drive off impurities such as arsenic. Most were reverberatory, that is, the ore was heated by the flue gases rather than by contact with the burning fuel.

burrow n. Another term for a dump of waste material.

butterwell n. A stone-built structure with a stone roof, in or beside a stream or marsh and with water either flowing through or standing on the floor, the water cooling dairy produce stored on slate or wood shelves within.

button-hole launder n. A square-section wooden pipe placed vertically in a **settling tank** or **pit** to draw off clear water. A series of holes plugged by wooden pegs could be progressively uncovered as the water level dropped.

calciner n. A furnace and heating chamber in which ores were roasted to drive off impurities such as sulphur and arsenic. The ***Brunton*** and ***Oxland and Loam*** versions were mechanised.

capstan n. A manually operated winding drum, usually installed on a mine to raise **pitwork** from the shaft for maintenance or repair.

cassiterite n. The native tin dioxide SnO_2.

chair n. *See* **saddle**.

chall barn n. The most important building on a 19th-century Bodmin Moor farm, with ox and cow houses (challs) beneath a threshing loft.

chall house n. A dwelling and barn, with a cow house or stable under, built as a single range under one roof. There were separate entrances to each part (cf where access to both parts was shared).

chark vb. To burn turf, wood, etc until it becomes charcoal.

china clay n. A powdery white mineral produced by the decomposition of feldspar in granite, a process known as ***kaolinisation***. It was extracted from the remaining quartz and mica by directing a stream of water over the kaolinised mass, the resulting clay slurry then being purified and dried.

chisler n. A wheeled scarifier; an agricultural machine with prongs for loosening but not turning soil (Charke 1931, 36).

chop axe n. A hand tool used to produce a fine finish on shaped granite after initial **scappling**. It was replaced by the **patent axe**.

churchtown n. The small nucleation of dwellings and amenities around the parish church. It was often the largest settlement in a Cornish parish.

classifier n. A range of ore-dressing devices which separated fine materials suspended in water on the basis of their particle size.

clitter n. A bouldery material liberated from the parent granite by sub-surface weathering and carried downslope by gravity once exposed at the surface, often creating a bouldery spread around the slopes of tor-capped moorland hills.

cloam oven n. An earthenware oven, usually built into the back or side of a chimney. It was heated with furze, **brouse**, etc; the ashes were removed and food inserted; the door (earthenware or iron) was then sealed until baking was complete.

coal end n. The bottom part of a ***marsh*** turf; dense and black, and capable of shedding water. The best part of the turf for burning and the end exposed to the elements when rick building.

cobbing n./vb. Size reduction of copper ore after **spalling**, and resulting in material about the size of walnuts, ready for **bucking**.

coffer box n. The enclosed metal-reinforced box, fronted by a pierced metal screen, within which ore was stamped.

coffin n. Alternatively ***coffen***, ***goffin***. A local term for an **openwork**, usually referring to a narrow feature; cf **beam**.

coinage n. Each **stannary** had a coinage town to which all smelted tin was taken to be taxed, anciently Liskeard, Lostwithiel, Truro and Helston. Twice a year Royal officers came to receive taxes and assay or test the tin by chiselling corners (coins) from the ingots. Once approved, the ingot received the Duchy stamp of approval.

commons n. Lands or resources owned by one person in which others have rights.

convertible husbandry n. An agricultural regime in which two or three years cropping were succeeded by between three and ten years grass (**ley**) and preceded by **paring and burning** of the grass. Grass seeds were usually sown with the last grain crop. Also called **ley husbandry**.

core n. A shift at a works (usually a mine). Alternatively the group of workers on that shift.

cornish hedge n. A stock-proof boundary having two battered stone faces and an inner core of earth and small stones (*see* Fig 123).

cost agreement n. The arrangement by which mines and other undertakings were financed by a group of partners, each of whom was responsible for paying a contribution necessary for establishment and operations in proportion to their stake in the venture, and who equivalently shared in the profits. Each member had unlimited liability for debts incurred by the partnership. *See also* **cost book company**.

cost book company n. An unlimited liability partnership established to work a mine or other undertaking. *See also* **cost agreement**.

cost and spale n. An earlier version of **cost book** working. Partners in a venture such as a tinworks were responsible for their share in the cost of operations, and for fines (**spales**) incurred if they failed to (or chose not to) meet their responsibilities.

costeaning n./vb. *See* **prospecting**.

count house n. The mine office where not only day to day affairs were managed, but where the mine **adventurers** met to discuss the mine accounts, etc, and where **pitches** were auctioned on **setting day**.

country rock n. The unmineralised rock within which the **lode** was contained.

coxcombe n. The metal **wing** attached to a **velling share** in the shape of one part of a jester's cap (Jack Parkyn, pers comm).

crazing n./vb. The crushing of ore using millstones.

crib n. A Cornish dialect word for a snack eaten away from home, usually during a break from work.

crinnicks n. Sticks of furze (gorse) collected as a domestic fuel. Usually subjected beforehand to a rapid burn to remove prickles.

crook n. A hooked wrought-iron bar suspended from a frame within a chimney, and ratchetted to allow it to be lowered and raised. Vessels were suspended over the fire for cooking, boiling, etc.

crop n. The highest quality tin ore.

cuesta works n. The term devised by Gerrard (1986) to describe a form of alluvial streamworking in which ranks of ramped dumps were created, probably by barrowing waste from the tye. The term ***ramped-dump working*** is used in this publication.

dead ground n. Rock which had to be broken in order to allow ore extraction, but which contained no economically valuable minerals.

decrepitation point n. The temperature at which chemical compounds break down into their constituents.

dimension stone n. Precisely shaped blocks of flawless granite produced according to blueprints for civil engineering and monumental work.

dish kettle/kiddle n. Similar to a **baker** but its dome was not flattened. It was used for roasts and larger items of baking. It was sometimes made with three spikes on top to help keep turves in place.

drag n. *See* **mica drag**.

drage n. A mixed-quality copper ore (*see* **dredge** for the agricultural origin of the term).

dray n. A simple sledge used on Bodmin Moor to pull **marsh turf** to drying grounds. Typically it had side timbers *c* 4ft

(1.2m) long and 3ft 6in (1m) apart with iron runners and cross members at *c* 1ft (300mm) intervals.
dredge n. Fodder crop; a mix of oats and barley.
dressed adj. Stone tooled to give a smooth finish.
dressing n./vb. The series of processes through which metal ores excavated from a mine are concentrated.
dressing floors or **floors** n. The area on which ore was dressed (processed and concentrated). Later tin-dressing floors were generally terraced to allow ore to pass from one process to the next as a water-borne pulp. Areas of copper-dressing floors were often cobbled to provide a surface on which ore could be broken, and from which fine material could be recovered by sweeping.
drift n. A term sometimes used in the past to describe a horizontal tunnel underground, as distinct from an **adit**. *See also* **drive**.
drive n. A horizontal tunnel, generally along the **strike** of a lode, used for prospecting and development, rather than access or water management.
dry n. or *change house* The building within which mine staff changed from surface to underground clothes and vice versa. Sophisticated drys were heated by steam pipes and might contain baths or showers.
drywork n. A term used to describe **eluvial** streamworks, but could also have been applied to **shoad works**.
dunting n./vb. Reducing a roughly shaped block of dimension stone to the desired shape.
dyke n. Igneous mass forced into a fissure in rocks. *See* **elvan**.

elementary school n. A school in which elementary subjects were taught to young children. It was made universal in Britain by the 1870 and 1880 Education Acts.
eluvial deposits n. Cassiterite detached from the lode, weathered and often transported but not sorted by alluvial action; cf **alluvial deposit**.
eluvium n. Material detached from the parent rock by weathering and transported by **gelifluction** before redeposition.
elvan n. An igneous rock, usually of quartz and orthoclase and normally found as a **dyke**. Quarried in Cornwall for roadstone and ballast.
endothermic reaction n. One in which a chemical reaction, once started, liberates enough energy to continue the process without the need for additional energy input.
engine house n. A building designed to contain a steam, gas, or oil engine on a mine or other works.
essay hatch n. An alternative term for a **prospecting pit**.

farm n./vb. The arrangement by which productive use was made for the use of land (including ore deposits) by other than the owner, usually in return for rent.
fast country n. A term used by tinners to describe undisturbed subsoil and rock, as opposed to eluvial, colluvial or alluvial deposits such as **head**.
fathom n. A standard measurement used in mines equivalent to 6ft (1.8m).
feather n. The triangular part of a **turf iron** blade which cuts the inner side of the turf block (*see* Fig 97).
filter press n. An hydraulic device for de-watering china-clay slurry. Produces press-cake for the **pan kiln**.
fine n. A sum of money paid by an incoming tenant in consideration of a relatively low rent.
finger dump n. A linear dump of waste material from a mine or quarry, flat-topped to allow material to be barrowed or trammed along it to extend it.
flat rods n. Iron (or less often, timber) rods used to transfer power from a steam engine or waterwheel to a remote location.
float stone n. A piece of granite in the form of a spout projecting from the **blowing house** furnace mouth, on which tin collected and from which it was ladled into the moulds.
flywheel n. A wheel attached to a crank driven by a reciprocating engine, used to store energy and smooth the transfer of power.
fuggan n. Simple pastry of flour, lard and currants, criss-cross incised, and about 1in (25mm) thick.
fulling mill n. A water-driven mill where coarse cloth was dipped, cleansed and dressed.

gad n. A short chisel or point, used with a hammer for prising out rock or similar material.
gelifluction n. The geomorphological process by which accumulations of weathered material are transported laterally by gravity, either as ***soil creep*** or in mud flows, resulting in **eluvial deposits** such as **head**. Prevalent during warming during inter-glacial or post-glacial periods in areas subjected to permafrost.
gossan n. The upper part of a sulphide lode, from which the copper minerals have been leached, leaving a mass of hydrated iron-rich material. Sometimes known as ***iron hat***.
grass n. Term used by miners to refer to the surface of a mine, as opposed to its underground parts.
grass-rock n. Surface granite.
gravel pit n. A pit or box used to separate gravel from the clay stream in a china-clay pit. Normally it was emptied by hand at intervals, and the waste removed to dumps.
grewt n. An obsolete term for soil, subsoil; the term survives as *grout* in concrete mixes.
grist n. Corn for grinding, hence grist-mill. Grist often referred to animal fodder rather than baking flour.
growan n. A local form of **rab**.
guy ring n. A wrought-iron ring fixed into exposed bedrock or a large boulder at or beyond the perimeter of a quarry to which one of the many supporting guys of a **mast-crane** were secured.

hain vb. To save or bring home the dried hay.
halvans n. Poor-quality copper ore.
hatch n. A pit or shaft.
hatch or **hatchwork** n. A form of alluvial streamwork; a large pit or quarry with associated spoil heaps.
hay pole n. A four-guyed pole with a pulley at the top through which a rope pulled by horses ran to hoist a large grab of hay to the top of a rick.
head n. **Eluvium** or colluvium deposited by **gelifluction**.
hill turf n. A local term for **blanket bog**; also included particularly humic soil.
hollow-way n. A lane or trackway which has, through intensive use, become lower than the surface of the surrounding ground.
holocrystalline adj. An igneous rock in which crystals of the constituent minerals have formed.
horizontal engine n. A steam engine where the cylinder(s) are laid on a horizontal bed and the piston rods are attached to a crank and **flywheel**.
horse whim n. Similar to a **capstan**, but in this case the power was supplied by a horse walking around a circular platform applied to an overhead cable drum; frequently used for winding from small shafts on Cornish mines.
hushing n./vb. The prospecting technique which employed a torrent of water to wash away soil and subsoil to reveal bedrock, potentially exposing the outcrops of any mineral lodes.
hydrocyclone n. A device used to separate sand and mica from liquid clay by centrifugal force.

inbye land n. Fields closest to the farmstead. These received most dung and were generally the more intensively cultivated.
incline or **inclined plane** n. An earthwork which enables a tramway or canal to ascend a steep rise; laid with rails, and usually powered by water or steam.
interfluve n. The line separating the catchment areas of adjacent river systems.

jig n. A large automated sieve, operating partly submerged in water used in ore dressing.
journey n. An amount of work an employer expected to be achieved in one day. The term can apply to a length of walling

or hedging to be constructed, or to the number of turves to be cut and landed.

jumper n. A centrally weighted and balanced wrought-iron bar with tempered stone-chisel ends. It was lifted, part-turned and dropped repeatedly on the same spot to create a drilled hole in granite in preparation for **plug-and-feather** splitting.

kieve n. A strong barrel, within which the final stages of tin dressing took place, separation of the pulp being by density within water.

killas n. A general and inclusive Cornish dialect term for slaty sedimentary rocks.

labyrinth n. The convoluted flue attached to an arsenic calciner on whose walls the arsenic vapour was condensed, from where it was periodically collected for sale.

land vb. Placing turf on either the side or the floor of a cutting.

landing n./vb. The process of running liquid clay from one de-watering stage to the next.

lathed adj. Of a wagon or cart; having removable wooden ladders (with two or three cross-pieces) fitted to front and rear, allowing a large load of hay or corn to be carried.

launder n. A wooden or metal trough used to carry water across or around an obstacle, and also to feed water on to the buckets of a waterwheel.

leat n. An artificial watercourse, serving streamworks, mills, clayworks and processing floors. It was often originally lined with stone, clay or wood, and usually had a downhill bank.

level n. A term sometimes used to refer to a horizontal tunnel underground. *See also* **drift**, **drive**.

level n. The drainage channel in a streamworks.

ley n. Grass sown with the last of 2 or 3 years' grain crops. Used for hay and as best pasture for 5–10years as the recuperative part of the typical **ley** or **convertible husbandry** regime.

ley husbandry n. An alternative term for **convertible husbandry**.

lime kiln n. An upright kiln used to roast limestone in the manufacture of agricultural or building lime.

linhay n. The storage area at the front of a china-clay **pan kiln**.

loading n. The masonry platform in front of an engine house (or elsewhere on a mine) on which machinery such as cranks, **flywheels** and **angle-bobs** were mounted.

lode n. A linear area of mineralisation within the **country rock**. In other parts of Britain a ***vein***.

lode back working n. A series of shallow shafts dug into the upper part of a mineral lode from the surface and providing access to a **stope**.

longhouse n. The principal peasant house of Cornwall in the later medieval period. A cross-passage between two opposed entrances separated the cow house from the residents' quarters, animals and humans sharing the same door. Substantial, well-built and comfortable.

machine n. A local term in the late 19th century for a horse-drawn mower, or binder.

magazine n. A small strongly built store containing explosives (gunpowder or dynamite); sometimes circular, sometimes with additional enclosing walls to contain accidental blast.

magma n. Liquid rock formed by a combination of extreme pressure and temperature at the crust/mantle interface. Accumulations of magma may rise, balloon-like, through the crustal rock to form **batholiths** of granite, or may emerge at the surface through volcanic vents, etc.

man-engine n. An adaptation of a beam engine by which miners were carried underground. Steps were attached to the reciprocating rod attached to the nose of the engine **bob** and running down the shaft. To descend, miners stood on these steps while the rod was on its downward stroke, stepped onto platforms in the side of the shaft when the rod was on its upward stroke. By repeating this process miners were able to descend to the desired depth. Some engines had twin rods, one ascending whilst the other descended. By travelling on alternate rods, the speed of descent (or ascent) could be doubled. In practice they were difficult to install in most twisting, narrow Cornish mine shafts, and only a handful were ever erected.

marsh/mash turf n. A local term for peat fuel from **valley bog**.

mast-crane n. A quarry crane with a boom fitted to a rotating timber mast which was supported by a socketed base stone on which the crane turned, and held in place by an array of chain or cable guys running to **guy rings** around the perimeter of the quarry.

meiler n. Primitive kiln-like structures found on Dartmoor, where **turf charcoal** was manufactured in the medieval period (*see* Woolner 1965).

mellior stone n. A large block of stone at the centre of a **horse whim** whose central hole formed the bottom bearing for the vertical axle.

mica drag n. A series of shallow channels into which the china-clay stream was run. Early examples were built from masonry with wooden dividing boards; later examples are concrete. As the clay stream slowed in the drag, so fine mica was deposited in the base of the channels.

mica lagoon n. A settling pond with earth banks, used to impound fluid mica waste from clayworks.

mine n. As used in medieval descriptions, the term included openworks and lode back workings.

moats n. Larger pieces of wood found when cutting turf in bogs.

monitor n. A powerful water-jet, directed against the working face of a china-clay pit to wash the clay from the face. Nowadays remotely controlled and often automated.

moor n. Medieval and post-medieval writers often used this term (a form of ***mere***) to refer to low-lying, marshy ground. Upland open heathland was usually referred to as ***downs***.

moorstone n. A Cornish term for granite recovered from the surface or just under the surface of the ground.

moor work n. An alluvial streamwork.

mowhay n. An enclosure on a farm where ricks of corn and hay were built.

mundic(k) n. Iron or Arsenical Pyrites, a common contaminant of tin ores.

newcomen engine n. An early form of steam engine working at atmospheric pressure. Slow, expensive and inefficient, though far more powerful than most other available power sources. Improved by Watt, Trevithick and others.

nogging out vb. To produce regularly; probably derived from 'knocking out'.

nuttalls n. Bits of hazel wood; the word was also used for small sticks of wood found when cutting turf in bogs.

openwork n. A mineral extraction site open to the surface rather than underground; similar to a quarry. *See also* **beam**, **coffin**.

outshut n. A roofed projection from a building's main plan.

overburden n. Earth and subsoil removed in the process of opening or extending a quarry, streamwork, openwork or claywork.

overhand stoping n./vb. A method of excavating ore from a lode by mining the roof of an excavation. Broken ore formed a platform from which the lode in the roof of the **stope** could be re-attacked. At intervals, ore was drawn off from the stope via ***draw-holes*** in the roof of a level under the base of the stope. Replaced **underhand stoping**.

overshot adj. A waterwheel in which the water enters the buckets above the centre line of the wheel on the side furthest from the feed launder, causing the wheel to rotate with the direction of flow.

pan n. A floor heated from below via a series of brick-lined flues in a **pan kiln**.

pan kiln n. A process building used to dry china-clay slurry on a floor heated by warm air from a coal-fired furnace.

panning n./vb. A method of manually separating small amounts of fine ore from waste, usually as a form of

prospecting or primitive **assay**. Mixed material was swirled around in the pan with a little water, then given a particular flipping motion to force the separation of denser from lighter material. Little used in Cornwall.
paring and burning n./vb. An alternative form of **beat-burning**.
patent axe n. A hand tool whose head had several iron plates bound together. It was used in granite quarries to prepare a fine finish on **dressed** stone by perpendicular strikes. The patent axe replaced the **chop axe**.
pay gravel n. An alternative term for **shoad**.
peat n. Brown or black altered vegetable matter, cut and harvested as fuel. Generally called **turf** on Bodmin Moor.
peat platform n. An alternative, archaeological name for **turf stead**.
pike n. A hay fork with two prongs.
pioneer n. An unskilled or semi-skilled mine labourer working with a pick or shovel.
pitch n. The defined area of a mine worked by a small team of **tributers** for a fixed term and for an agreed proportion of the value of the ore gained by their efforts.
plug-and-feather n. Tapered steel plug and wedges used to split rock when inserted into a drilled hole and hammered tight; also known as **tare-and-feather**.
pneumatolytic adj. Changes to the granite and surrounding rocks brought about by the actions of hot, volatile gases emitted from the residual magma, including steam, boron, fluorine, sulphur dioxide and carbon dioxide.
prills n. Pure pieces of copper ore; small blobs of smelted tin trapped in the slag, or recovered as drips.
prong n. A hay fork, usually with four tines.
prospect n. A prospecting feature such as a pit or trench.
prospecting pit n. A small pit dug in order to test ground for the presence of economically valuable minerals.
pug mill n. A crushing and mixing device intended to combine and condition the clay and other ingredients used in brick-making.
pulp n. Miners' term for a mixture of fine ore and water during the dressing process.
purser n. The individual responsible for the running of the accounts and other business of a **cost book company**.

rab n. Granite-based gravel; periglacial head. Widely used for surfacing tracks and creating hard standings.
rag and chain pump n. A primitive pump in which an endless chain was passed through a length of pipe (often wooden) and wrapped at intervals with greased cloth to form a series of water-holding chambers. By immersing the base of the pump in water and drawing the chain through, water could be brought to the top of the pipe.
rag frame n. A gently sloping surface set on a tipping frame on which very fine tin ore was dressed. Also *rack (frame)*.
rag slate n. Unshaped roofing slate.
reduce vb. To break down ore to a smaller size by mechanical means.
regrator n. A person who buys and sells locally produced goods (on Bodmin Moor eggs, butter, cheese, etc). A valuable middle-man.
re-lay vb. To affix by welding a new piece of iron to the blade or point of a tool or component of an implement. Undertaken by blacksmiths.
revetment n. A stone facing to a bank or earth face.
rise n. A shaft driven to intersect a **level** or **adit** running from the base of a clay-pit. The shaft was used to pump the clay stream to surface.
rotative engine n. A **beam engine** where the reciprocating motion of the beam is converted to rotary motion via a **sweep rod**, crank, and **flywheel**.
round frame n. A rotating hybrid of the **buddle** and the **slimes frame**, these circular constructions were developed to recover tin from the finest grades of ore during the late 19th century and continued in use into the 20th century.

saddle n. Support for tramway rails, usually of cast-iron. **Chair** in 20th-century usage.
sand drag n. Channel used for the separation of sand from the china-clay stream. As the clay passed through this deep, narrow channel, it was slowed and the heavier sand was deposited in the bottom.
sand-fed adj. Of a stone saw. Sand was used as an abrasive in frame saws, in which iron plates moved to and fro across the stone. Replaced by the more efficient **shot-fed** saws.
scantle slate n. Small random-sized roofing slates, often laid in diminishing courses.
scappling n./vb. Rough shaping of blocks of granite to within an inch of final shape in **dimension stone** quarries, using a variety of hand tools.
sett n. A granite or other stone block, used to pave a road or to support rails on a tramway.
sett n. The legal boundary within which a mine or quarry could extract minerals.
setting day n. The day, generally once every six months, on which **bargains** would be auctioned in front of the **count house** of a mine, and bid for by **tributers**.
settling pit n. A normally round or sub-oval masonry-lined tank used for the primary de-watering of china-clay slurry.
settling tank n. A masonry-lined open tank at the rear of a pan kiln where china-clay slurry was allowed to settle and thicken. The tanks were usually rectangular in form.
several n. A piece of enclosed land, in the past usually farmed communally but now in separate ownerships.
shaf n. A vertical or near-vertical mine tunnel, connecting to **levels** and **stopes** and used for pumping ventilation, access and haulage.
shaking table n. A rectangular table-like surface inclined from the horizontal to a small degree on both its long and short axes to which a regular reciprocating action was imparted by mechanical means. Fine grade ore mixed with water was fed on to the table along its uppermost edge, relative density being used to separate the higher grade from lower grade ore. In general three products resulted – a high grade ore which stayed near the top edge of the table, a low grade which was washed across the lower long edge of the table and a middle grade which was collected for reprocessing. Shaking tables formed the basis for most 20th-century tin dressing operations.
shambles n. A term equivalent to **shammel**, but having the specialised meaning (when applied to shoad works) of a dense and apparently disorganised arrangement.
shammel n./vb. The platforms within a shaft, openwork or claywork created to assist in raising excavated material, this being shovelled from one to the other by men, hence the platforms were set roughly 2m apart. Shammeling came to be applied to any process where material was lifted in a series of steps, and was thus applied to mine pumps where the output from one became the source for the next vertically above.
sheath n. A thin plate of iron on which pasties, cakes, etc were sometimes placed when cooking under a **baker**.
sheep creep n. A lintelled passage through a field boundary through which sheep could pass but cattle and horses could not. It could be blocked as required with stones.
shelf n. As **fast country**, the undisturbed subsoil and rock, particularly where found in a streamwork or in a prospecting pit.
sherd n. A fragment of pottery.
shippon n. A cow house (East Cornwall).
shoad or **shode** n. Tin ore detached from its parent lode by weathering.
shoad works n. A term used to describe the working of a **shoad** deposit by excavation in a series of pits.
shot-fed adj. Of a stone saw, chilled shot being used as an abrasive in frame saws. Replaced **sand-fed** saws.
sink n. An area in the floor of a quarry which has been excavated below the surrounding level.
skimming plough n. A plough whose share is low and flat with a sharpened triangular **wing** fixed on to the leading angle. Used for skimming off a thin turf. Also **velling plough**.

skimmy n. A thin slice of **hill turf** skimmed off with a **breast spade** and dried for fuel. Alternative names: **vag**, **tab**, **tob**, **vellin turf**.
skip road n. An inclined rail track laid from the bottom of a clay-pit to the dumps above, and used to remove waste sand and rock from the pit.
sky tip n. A conical pile of waste material from a china-clay pit; replaced the earlier **finger dumps**.
slad n. An area of *in situ* granite which has been chemically altered to china clay, the term generally being applied to deposits which could be economically exploited.
slane n. An Irish peat spade; equivalent to a **turf iron** on Bodmin Moor.
slimes n. Fine-particle waste material containing a small proportion of tin ore.
slimes frame n. A device consisting of a gently sloping surface over which fine-particle ore-bearing material was washed in order to separate ore from waste. The amounts of tin in the material being treated were low and slimes frames were generally installed in large numbers to maximise recovery. The principal variant of this type was known as the **rag** or **rack frame**.
spale n. A fine. *See* **cost and spale**.
spalier n. Technically, this term denoted a labourer whose presence at a tinwork was as a substitute for one of the mine partners working under a **cost and spale** agreement, but sometimes it was applied to a mine labourer working on a temporary basis.
spalling vb. The process of breaking ore using heavy sledgehammers, prior to stamping or further dressing.
spitting iron n. A horizontal strip of iron on the wooden step of a **turf iron** designed to reduce wear when the iron is pushed into the turf by foot.
split n. A small bun-shaped yeasty loaf, split horizontally and then buttered and served with cream and jam or treacle, usually as a treat.
spook vb. To pin with short, sharp wooden pegs, as in fixing thatch to ricks.
sprung adj. Of a turf stack; having its walls built slightly corbelled outwards to keep rain off lower courses.
stack n. An industrial chimney, used to carry away smoke or fumes from boilers, furnaces and calciners. Often situated at the end of a flue.
stamps n. A mechanical device for crushing ore-bearing rock to a fine sand. Heavy vertically-set iron-shod wooden beams were lifted and dropped on to the rock by a series of cams mounted on a rotating drum; usually driven by a waterwheel or rotative steam engine. Later medieval to modern.
stannary n. One of the administrative districts of the Cornish tin mines.
stannary law n. A code of practice established in 1201 and repeatedly updated governing the registration and administration of tin mines, the activities of its employees and those who dealt with them, their taxation (tinners being exempt from normal taxation), the maintenance of standards of quality for smelted tin, and the administration of justice.
stead n. A platform, often stone lined, upon which a rick is built.
stent n. Waste, including rocks, thrown aside in streamworks, or removed from a mine or clayworks.
stiddle n. A tethering post in a cow house.
stiling n. The stone revetment to a loose mass of earth or stone, particularly in a streamwork.
stope n. The linear excavation produced underground during the extraction of ore-bearing rock from a **lode**. Also the area in a china-clay pit which is being actively worked.
strake n. The gully formed in the working face of a china-clay pit by water running down it.
stream n. A bed of stones impregnated with tin within an alluvial deposit.
stream vb. To wash, used in dialect form in Cornwall until recently, as in 'streaming clothes'.
stream and strake n. The earliest method for extracting china clay. A stream of water was directed down the working face of the pit; workers stood in the stream and broke up the clay-bearing ground with hand tools.
streamwork(s) n. A tin working exploiting ore weathered from lodes and using water to help to remove **overburden** and to separate the heavy **cassiterite** from the gravel and sand with which it was found. Characterised by extensive cuttings containing dumps of **stent**, often in patterns, and drainage gullies, together with associated leats and reservoirs.
strike n. Direction of lode being worked.
strip n. An elongated shallow settling channel, used in separating material crushed by the **stamps**.
sump n. The lowest part of a mine or clay-pit, from which water was pumped.
swale vb. To burn heathland in springtime to remove rank heather and grass and encourage more nutritious growth.
swarm n. A dense group of many small objects (by analogy with bees), here used to describe groups of **shoad** collection pits.
sweep rod n. The bar used to connect the beam of a **beam engine** to a crank and **flywheel**.

tab n. An alternative name for **skimmy**.
tailings n. The waste sand and slime from **dressing floors**, not containing workable quantities of mineral. Also *tails*.
tailrace n. The channel along which water flows after having passed over or under a waterwheel and is then returned to the river.
tare-and-feather n. An alternative term for **plug-and-feather**.
tay kettle n. A cast-iron pot for boiling water for tea-making and cooking.
teem vb. To remove or bale out water, as with a ladle or bucket.
ticketing n. The system by which copper ores were sold by tender. In Cornwall the use of this system led to the formation of a cartel of smelters who controlled ore prices.
tide n. The period of twelve hours taken for tin smelting in a **blowing house**.
tin ground n. The stratum of gravel, sand, etc within the **alluvium** or **eluvium** which contained a concentration of **shoad**.
tin-hatch n. A **prospecting pit**.
tin stream n. A term for a linear deposit of rich tin ore or **shoad**, equivalent to **beuheyl**.
tinner n. Legally, one who was employed within the tin mining, dressing or smelting industries, or in an associated industry – such as a tin dealer – and subject to **Stannary law**. In practice, several grades or degrees of tinner were recognised to separate those physically involved in extraction and dressing, and those with a financial or commercial interest.
tinners' shelter n. A small building, drystone or turf built, within or alongside a streamworks or other early tinworks. Used as shelters or stores.
tinwork n. A general term for both **streamwork** and outcrop work, including **openworks**.
titch crook n. A hand tool with a long handle and two-tined head used for turning either drying fuel turf or turf pared in **paring and burning**.
tob n. An alternative name for **skimmy**.
tomentor n. A local form of *tormentor*; horse-drawn cultivator.
townplace n. Open and usually public spaces in farming settlements.
tramway n. A railway constructed to a lighter or more temporary standard than that accepted for 'main-line' routes. Often, though not always, powered by horses; on mines, small wagons were **barred** or pushed by hand.
trayning n. A term used by some late medieval writers for **prospecting** using pits or trenches.
tribute n. A system of work within mines under which a small group of self-employed miners bid at auction on **setting day** for the right to work a **pitch** in a mine for a percentage of the value of the ore raised. *See* **bargain**.
trundle n. Probably a low agricultural truck or carriage on small wheels used for carrying heavy loads.

trunk n. An early form of buddle consisting of an elongated rectangular or trapezoidal pit or timber structure.
tucking mill n. An alternative for **fulling mill**.
turba carbonum n. A medieval Latin term for **turf charcoal**.
turbary n. A common right to dig, dry and save turf (peat) for domestic consumption as fuel. The term is also used to describe an area where turf is cut either by commoners or by others (eg tinners) with rights to cut; a source of profit for medieval manors.
turf n. A Bodmin Moor term for peat; divided into **hill turf** and **marsh turf**.
turf charcoal n. Charcoal made from dried turf, principally in the medieval and early post-medieval periods, and used for first smelt of tin. Appears in medieval documents as **turba carbonum**.
turf house n. A farmstead building either built or reused to store dried turf.
turf iron n. An elongated spade with pronounced **feather** and slender, downward pointing ***wing*** and long wooden handle used to cut and land **marsh turf** and deep **hill turf**. Broadly similar to the Irish **slane** and the Scottish peat spade.
turf mowhay n. A homestead enclosure used specifically for ricking turf.
turf pike n. A two-pronged fork used for turning drying **skimmy** turf.
turf stead n. Post-medieval subrectangular and circular platforms, usually on the open moor, on which dried turf was stacked until it could be brought back to the homestead. A ditch (with an external upcast bank) was dug for drainage and to protect the rick from grazing animals. An alternative archaeological name is **peat platform**.
turnrest plough n. A local form of *turnwrist* one-way plough (*see* Jewell 1981, 102).
tutwork n. A system of work within mines generally applied to development work such as shaft sinking or the driving of levels. Teams of self-employed miners bid to undertake such work on the basis of a certain level of payment for an agreed rate of progress.
twister n. A simple hooked and bent wire with rotating handles used by moorland farmers to twist straw, hay or similar materials into rope or string.
tye n. The extractive area within a **streamworks** in which primary ore washing was undertaken using a trench excavation through which a stream of washing water ran to the **level** or drain. The term is also applied to the gently sloping board on which this separation process took place.

underhand stoping n./vb. An early form of excavation on a lode, where the floor of the excavation was progressively mined downwards, often in a series of steps. This proved problematic for drainage and ore retrieval, and the more efficient method of **overhand stoping** gradually replaced it.
underlie n. The angle which a lode varies from the vertical. The lower wall of a **shaft** or **stope** following the lode is known as the footwall, the upper the hanging wall.
undershot adj. Of a wagon with a fixed rear axle but with its front axle capable of turning a full half circle.
upcast n. Material thrown up from an excavation or pit.

vag n. An alternative name for **skimmy**.
valley bog n. Peat developed in waterlogged valleys, often where streams were re-channelled during tin streaming. Known locally as **marsh** or **mash turf**.
vanner n. A mechanised tin dressing device where ore placed on an inclined continuous belt was agitated and washed by a stream of water. Heavier ore remained on the belt, lighter ore was washed down it.
vanning n. A primitive form of mechanical **assay**, performed with a special form of shovel, using a process similar to **panning**. A skilled vanner could perform a very accurate assay with little more than a shovel, a handful of crushed ore and a bucket of water.
vellin turf n. **Hill turf** harvested with a plough fitted with a **velling share**. In form similar to **skimmy**.
velling plough n. As **skimming plough**.
velling share n. A flat plough share, *c* 10in (*c* 250mm) wide, with a triangular **wing** brazed onto the leading angle. An alternative name is **velshare**.
vell shovel n. A spade or shovel with a rounded blade, 'wiggled' under **hill turf** to cut **skimmies**.
velshare n. An alternative name for **velling share**.
visgay n. A two-bladed mattock with the edge of one blade parallel to the handle; used to cut roots, etc.

washing n./vb. The process of **ore dressing**. The treatment of a batch of ore was termed a ***wash***.
wastrel n. A form of unenclosed commons over which some individuals had specific rights, such as **turbary**.
waterwheel n. A wheel fitted with buckets or paddles around its periphery, and driven by the force of a stream of water directed onto them.
wedge-and-groove marks n. Lines of chiselled grooves to take iron wedges for splitting; the pre-1800 method of splitting granite, replaced by **plug-and-feather** splitting.
weed n. Poor quality ore, not mined; or contaminants within ore being dressed.
wheelpit n. A structure built to house a waterwheel, often excavated and stone-lined, but sometimes freestanding.
whim n. A winding machine used for hauling from a shaft; consists of a power source and a winding drum. *See* **horse whim**.
whim plat n. The level and usually circular platform on which a **horse whim** was sited.
whippletree n. A crossbar to the ends of which traces are fastened in a cart, plough, etc.
white tin n. Smelted tin.
wind hatch n. An archaic term for a winding shaft.
wing n. The sharpened, knife-like projection attached to the long side of the **feather** of a **turf iron**, to cut the side of a turf block (*see* Fig 97). The sharpened side is downward pointing.
wolfram n. The principal ore of tungsten. A complex tetraoxide of iron, manganese and tungsten $(FeMn)WO_4$.

yaffle n. A quantity of material (eg turves) which could be carried when the bottom two corners of a wrapper, a rough over-apron, were brought to the waist.

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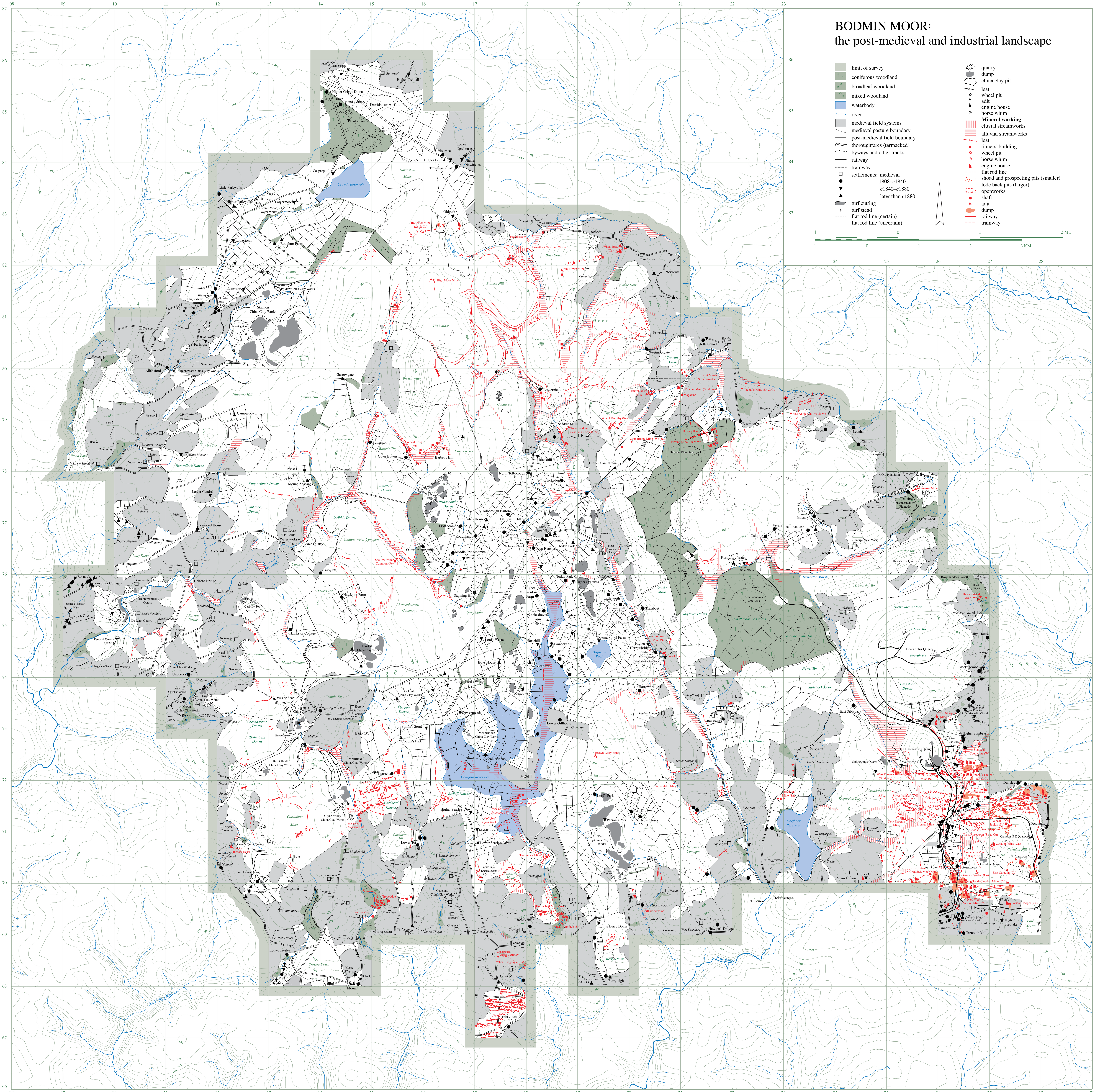

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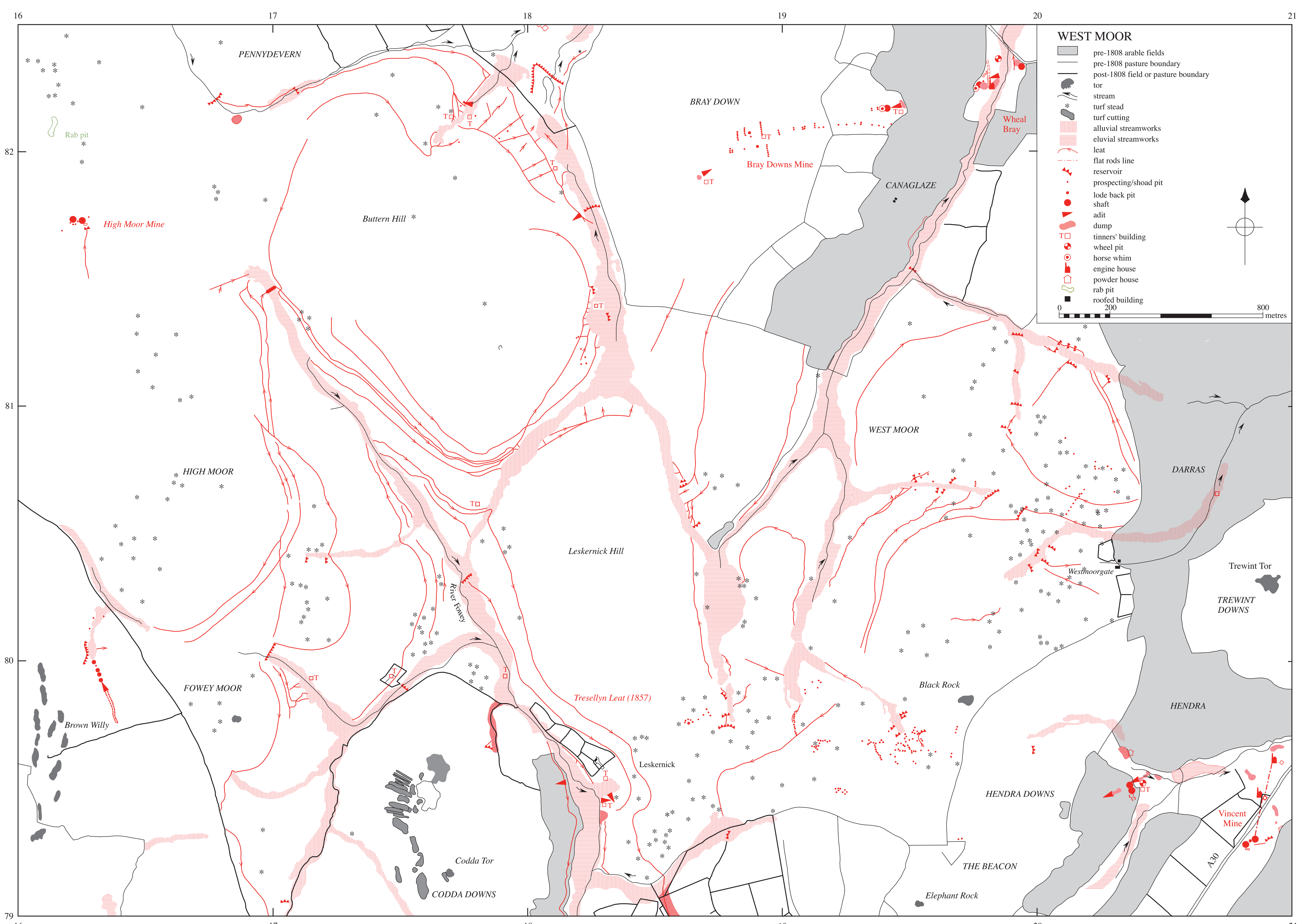

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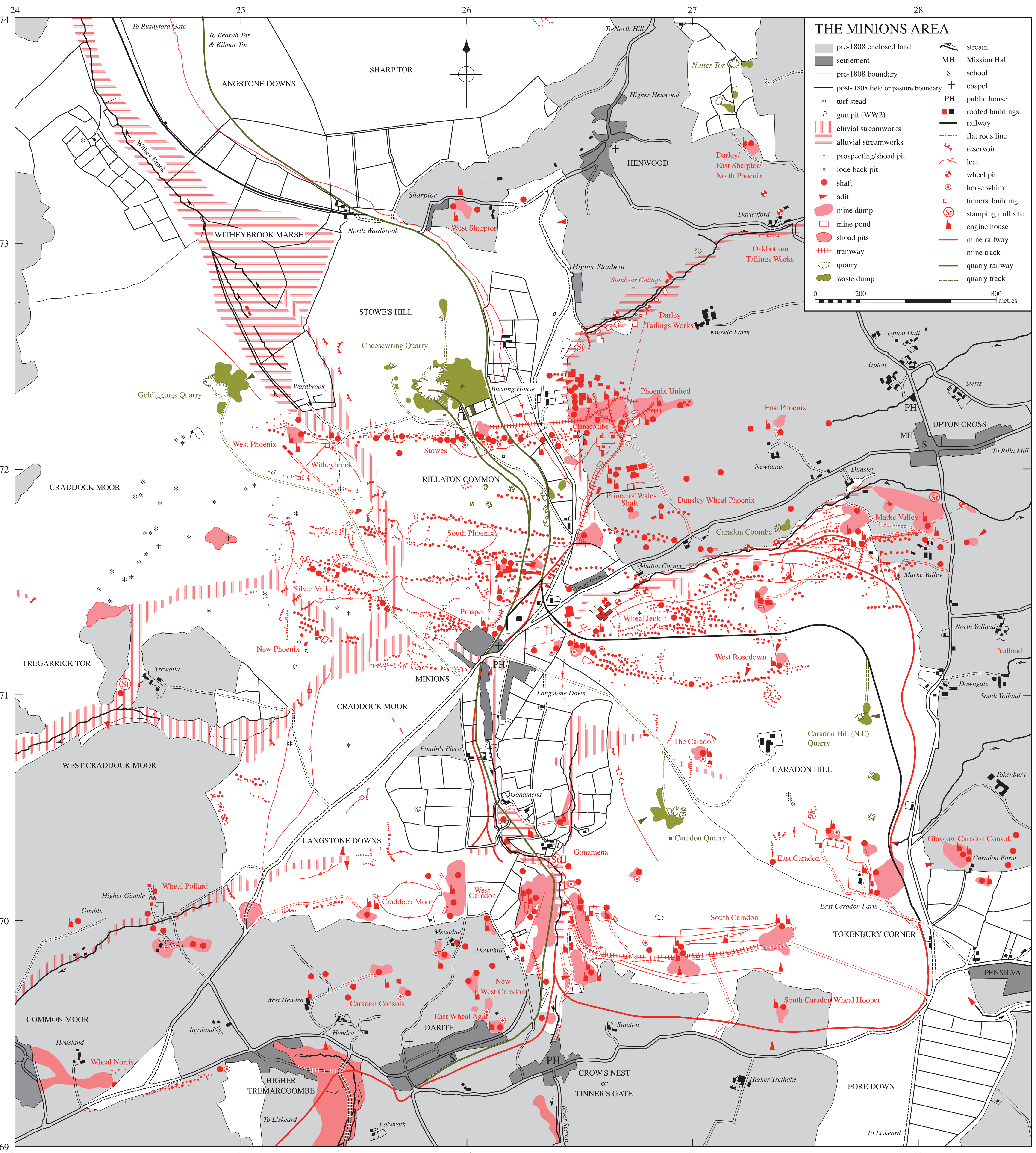

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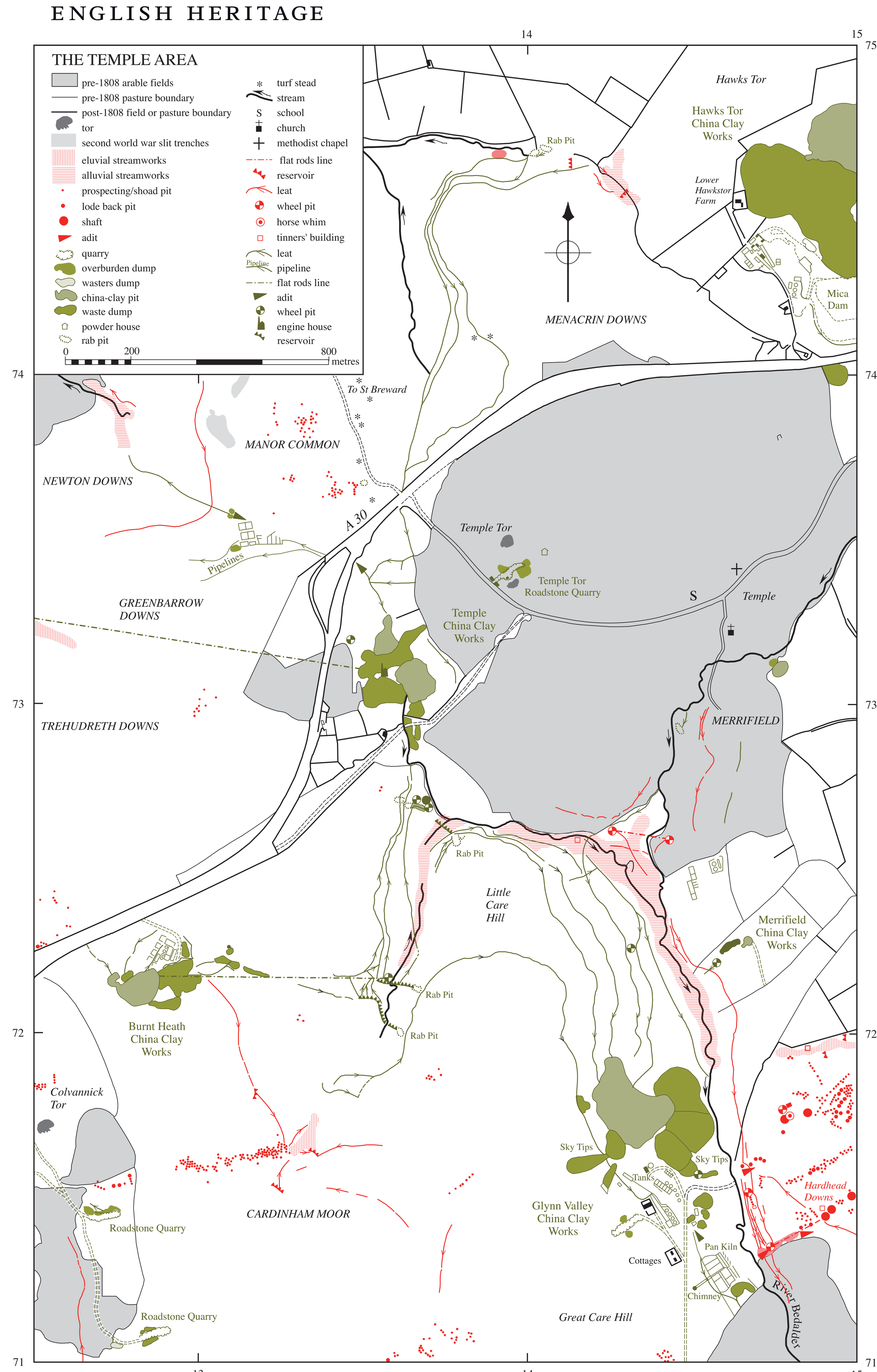

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Map 4 Temple area (1:10000). (This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or criminal proceedings. English Heritage 100019088. 2008)

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Front cover
Northern slopes of Caradon Hill from the north. The bed of Liskeard and Caradon railway curves through the remains of Wheal Jenkin tin mine: Bellingham's Shaft pumping engine to the right and stamping engine with dressing floors to the left. The quality of preservation of earthworks of other, ruined buildings, boiler ponds, tanks, prospecting and surface working, and leats and tracks is typical of mining sites on Bodmin Moor.
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