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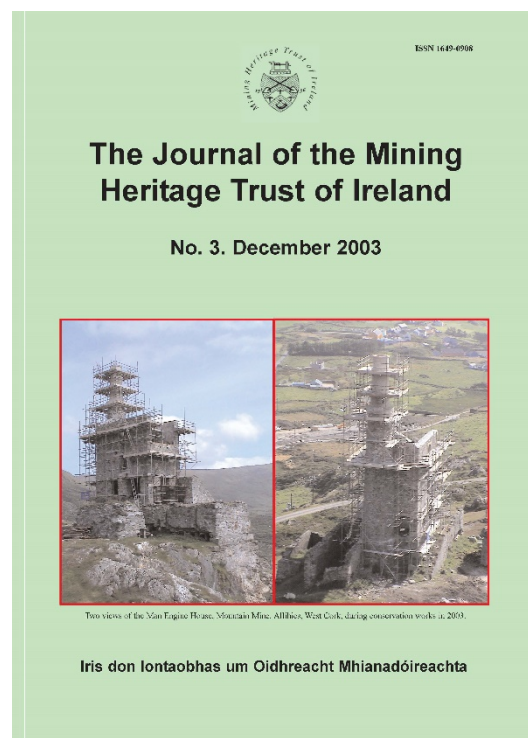
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AN HISTORY OF QUARRYING AND MINING IN IRELAND UP TO 1700

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Abstract: There have been people in Ireland for approximately nine thousand years. For the first half of that span there were the various stone ages without any knowledge of metals. Such slight evidence as there is of quarrying that stone is presented here. Much of what is known about the early metallic ("bronze") age comes from the pioneering work of Dr. William O'Brien. There are huge gaps in both the archaeological and written records thereafter and only in the 17th century does a clearer picture begin to emerge, particularly of iron mining. *Journal of the Mining Heritage Trust of Ireland*, 3, 2003, 25-32.

INTRODUCTION

Because of the sporadic nature of archaeological evidence and medieval references it is not possible to put together a comprehensive overview of early quarrying and mining activity in Ireland, and indeed it is probable that the activity itself was sporadic. Consequently, this introductory review presents little more than a trawl through the sources to find mentions of quarrying and mining and attempt to collate them. The closing date of 1700 has been selected because it represents a lull in building and mining before the advent of the industrial revolution in 1760 produced an expanding demand for raw materials.

The following "time-line" diagram (Fig. 1) presents a framework of key social, cultural and economic developments in Ireland over the last 9,000 years, as a template against which quarrying and mining activities may be considered. The early impact and pivotal role of such activities in pre-historic Ireland, in particular, is indisputable - the names of our earliest cultural ages, Stone, Bronze and Iron stand as mute testimony to that intimate relationship - a relationship which, in the 21st century,

we now choose frequently to ignore, even though modern society still remains totally dependent upon earth resource materials to maintain economic activity.

STONE AGE AND LATER QUARRYING

The earliest inhabitants of Ireland were largely nomadic Mesolithic hunters and gatherers whose stone requirement were largely for projectile points, knives and scrapers. Remains of their settlements are scattered around various parts of Ireland, but they are most notably concentrated in the north-east where a ready supply of flint, for extraction, directly or indirectly, from the flint-bearing, Cretaceous age, chalk deposits found primarily in that region only (Stout and Stout 1997, Lyle 2003). The most outstanding example is Mount Sandel, Co. Derry, which has been dated to about 6650BC (Mitchell and Ryan 2001). The location of some other settlements, for example in the Dingle peninsula, appear to reflect the availability and use of chert and rhyolite as an alternative to flint (Stout and Stout 1997), and, similarly, siliceous concretions in limestone provided a readily available, local substitute for flint, and slate for

axeheads, at Boora Bog, Co. Offaly (Mitchell and Ryan 2001).

About 4000 BC the first farmers arrived which allowed the development of settled Neolithic communities. Some

Figure 1. The cultural ages of Ireland (based upon information provided in O'Brien 1996, Aalen et al. 1997, O'Brien et al. 2000, Mitchell and Ryan 2001, and Lyle 2003). Dates cited for the beginning, or end of several ages are somewhat variable, for example, for the beginning of the Bronze Age (2500 or 2000BC), and the end of the Iron Age (450 or 500AD).

Cultural Age	BC	AD		Some key attributes
Mesolithic	7000-4000			Hunter-gatherers (Sandelian 7000-6000BC; Larnian 6000-c.4000BC).
Neolithic	4000-3500		Early	Development of agriculture; start of forest clearance; first megalithic tombs
	3500-3000		Mid	Céide Fields, Co. Mayo (3720-3220); Newgrange and other megalithic tombs (3260-3080). Dolmens
	3000-2300		Late	Wedge tombs (and into Bronze Age)
Bronze Age	2300(Irl)-1500		Early ("Copper Age")	Extensive deforestation, development of blanket bogs.
	1600-1200		Mid	Gold and bronze artifacts
	1200-400		Late	Stone circles (and into Iron Age)
Iron Age (Celts)	400	500		First kingdoms (e.g. Tara, Emain Macha); linear and circular earthworks : stone forts. Ogham stones. Iron smelting
Christian		500-1200		Ringforts; crannóga; souterrains; Gold working. High crosses, round towers, stone churches.
Medieval	Early	1200-1500		Norman conquest 1169 and subsequent construction of mottes (1170-1230), boroughs, fortified settlements and castles; rapid expansion of European monastic, abbey building orders (e.g. Cistercians from 1142); towerhouses (15/16 th centuries); Little economic activity between 1300 and c. 1450
	Late	1500-1600		Beginnings of mine exploration
Early Modern		1600-1700		New planters exploit forests for iron-smelting

of the most beautifully crafted stone artefacts, stone axes in particular, as well as a greater range of flint implements, date from this period. The Irish Stone Axe Project (Cooney and Mandal 1998) has done much to quantify and detail not only the wealth of such Neolithic artefacts in Ireland, but also to rigorously document their design, rock type, and most interestingly, their source. They note, for example, that about 54% of the total known number of Irish stone axes (c.13,500; 18,000 cited by Mitchell and Ryan 2001) are composed of porcellanite, a very fine grained, blue-grey coloured rock found, and extracted, from small quarries at only two, relatively obscure locations in NE Ireland: at Tievebulliagh, Co. Antrim and at the Brockley Plug on Rathlin Island (Lyle 2003). Lyle notes the sophisticated, industrial scale of this activity, postulating that fire setting (O'Brien 1996) was used to extract blocks, which were partially prepared on site and finished elsewhere. They were widely distributed throughout Ireland and exported to Britain, for use both as implements, and for ceremonial purposes. Axheads composed of the very distinctive "Lambay Porphyry " form yet another very distinct group, all of which can be related to a single "quarry/axe factory" source on Lambay island, just off the Co. Dublin coast (Stillman 1994, Mitchell and Ryan 2001).

Their most striking achievements, however, are their megalithic (=large stone) tombs, of which some 1,350 have survived throughout Ireland (Mitchell and Ryan 2001). The gleaning of stone was, therefore, an important part of their culture. Newgrange (Fig. 2), dated to c.3100BC (Harbison 1992), and other Boyne Valley tombs are undoubtedly the best known examples, reflected in their designation as an UNESCO World Heritage Site. Most interesting from the perspective of sources of building material is the brilliant white quartz, which has been used as a facing material at Newgrange (Fig. 2). Veins of quartz do occur in the local bedrock in the region, but these are relatively insignificant and unlikely to have been an adequate source for the large volume, and size, of quartz blocks used in the construction. Instead, Mitchell and Ryan (2001) note that they may be preferentially selected and transported from the fringes of the Wicklow Mountains, where quartz is far more common and abundant, both in situ in bedrock, and as loose boulders. In contrast, all of the 95 kerbstones, most of which weigh in excess of one tonne, are almost certainly glacial erratics (Mitchell and Ryan 2001), and all but two of them are com-



Figure 2. Newgrange tomb, with white quartz faced front. Photo Dúchas.

posed of greywacke. However, latest research confirms a complex pattern of stone sourcing as indicated by Stout (2002).

Less well known is the older double court tomb, at Cohaw, near Cootehill in Co. Cavan (Fig. 3), dating from between 4000-3000BC (Mitchell and Ryan 2001). The surrounding landscape is dominated by drumlins, primarily composed of boulder clay. The boulders therein are, however, generally of variable composition, shape and roundness, and most are quite small (less than 80cm maximum dimension). In contrast, the tomb is constructed entirely of quite noticeably angular, and frequently elongate blocks of greywacke, some of which are very large (up to 1.5m x 1.2m x 1.2m above ground dimensions; Fig. 3). The blocks show no evidence of ice smoothing, nor are any of them obviously striated. This strongly suggests that they were quarried, rather than preferentially selected glacial erratics, or blocks from the boulder clay. Instead the source could be almost right beside the tomb. Greywacke, identical in all respects to that used in the tomb construction, is exposed in two small, relatively shallow quarries about 30m SW of the tomb, between it and the main road. Might these quarries be of Neolithic age, or perhaps have first originated at that time, with or without subsequent re-working, for example as a source of road material in the 19th century? There are a great many other passage graves and dolmens in Ireland but their constituent stones have not been examined in their local geological contexts and therefore nothing can be said about their origins.

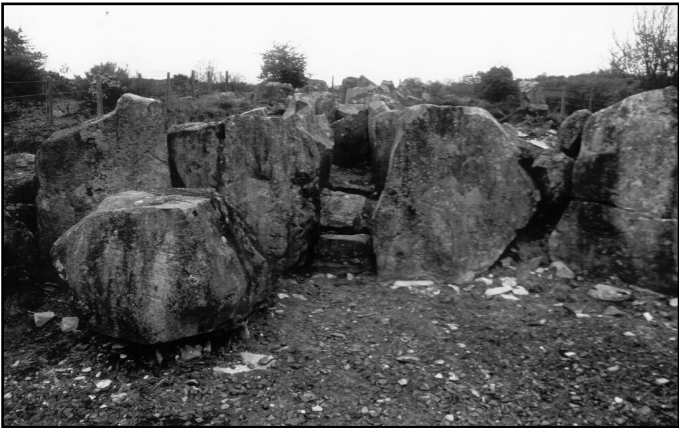


Figure 3 above and 4 below. Cohaw tomb, Co Cavan. Photos John Morris.



Ireland has no equivalent of the enormous quarrying and transportation that went into the building of Stonehenge during the Bronze Age. There was little use of stone either for over a thousand years of Iron-age history, exceptions being the great stone forts such as Dun Aengus (Aran Islands), Staigue (Kerry) and the Grianan of Aileach (Donegal). This would imply skill at quarrying local stone and building with it. However, the great Christian "stone age" began in the 9th century with the creation of high crosses and erection of round towers. As far as is known, no systematic study has been done of the sourcing of the stone for these, nor indeed of the first stone churches constructed from about 1100 onward.

With the arrival of the Normans in 1169, quarrying activities increased dramatically to supply masonry for the construction of castles and monasteries, and for walling towns. Again, little research has been done on this and it is obvious from some locations that huge quantities of stone had to be extracted and transported from some distance away. This may be exemplified by Kells Augustinian Priory, Co. Kilkenny, founded by Geoffrey fitz Robert in 1193. Construction proceeded over a 150 year period, starting in 1202, although it was sacked on at least three occasions during the period up to 1350, this, no doubt, being the principal reason why a fortified curtain wall surrounds the entire complex: in 1252, in 1316 and again in 1327 (Tietzsch-Tyler 1993). The repeated cycle of destruction and reconstruction would have added greatly to the demand for supply of building materials, most of which, it might be reasonably surmised, would have been sourced locally. The precise source of the bulk masonry has yet to be determined, but it appears probable that at least some of the roofing slate was extracted from the Ormonde slate quarry, near Ahenny, Co. Kilkenny, as the Prior of Kells was granted a 49 year lease to extract slate from this site in 1348 (James Power, Ahenny, 1997, unpublished history). First reference to this substantial and very impressive quarry, and the nearby Victoria slate quarry, dates, however, from 1337, and slate from here was used to roof the Tudor Manor House in Carrick-on-Shannon c.1565, and other houses in that town in the 17th Century.

Construction of Assaroe Cistercian Abbey in Donegal commenced in the late 12th century using local limestone. However, the quarry for the sandstone used for dressing doors and windows has been located, about twenty miles to the north across Donegal Bay. The monks or lay brothers followed the sandstone underground and obligingly left a stone lamp in one of the levels (Parkes et al. 2001). The knowledge of practical geology which the Cistercians had can be exemplified by their Holy Cross monastery on the flat lands of Tipperary. Here they seem to have diverted the river Suir and quarried the rock from the river bed (Carville 2002).

FIRST METAL MINING: THE BRONZE AGE [C.2500 - 400BC]

The Bronze Age mine workings on Ross Island, Lough Leane, in Killarney National Park, Co. Kerry, dated between 2400-2000BC are the oldest known such workings anywhere in northwest Europe (O'Brien 1996a). Bronze Age workings are found at three other sites in this area, a second on Ross Island, one on Crow Island, and another at Cahirnane (O'Brien 2000).

Mining at all locations concentrated upon a copper rich ore horizon, containing chalcopyrite and tennantite, a copper-arsenic mineral, within Carboniferous age limestones. The mineralization also contains a significant amount of silver but there is no positive evidence of its use.

Much about the mining methodologies, as well as living conditions of the miners, has been revealed by very detailed archaeological excavations initiated in 1992 by Dr. W. O'Brien, and published in summary form in 2000 (O'Brien 2000). The copper minerals were extracted by "fire setting" - lighting of wood fuelled fires against the rock face to heat the rock and induce fracturing, an effect perhaps enhanced by dousing with cold water (Figure 5). The fractured material was then hammered out with stone cobbles, thousands of which have been found on the Ross Island site. Constant repetition of this process ultimately produced a characteristically smooth faced, concave roofed cavity, some of which were extended downward into underground workings which have now flooded.

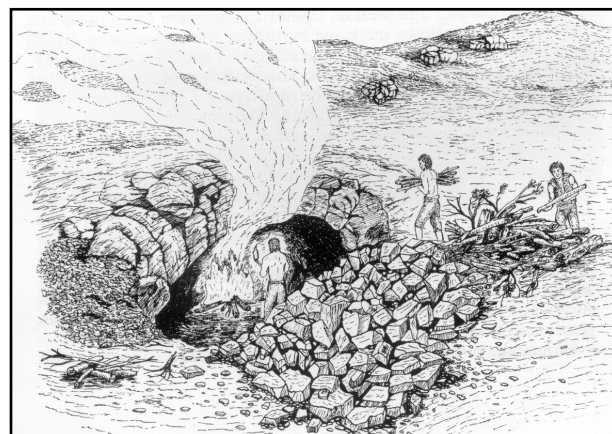


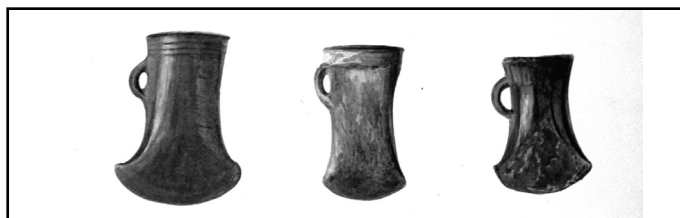
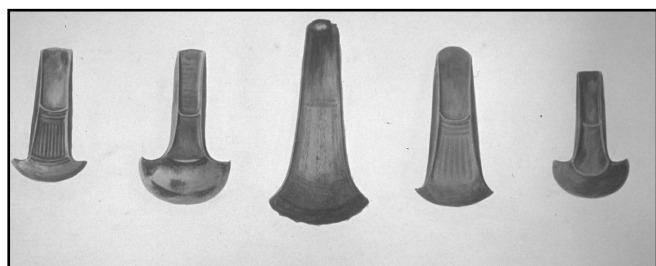
Figure 5. A sketch from Billy O'Brien's work of Bronze Age firesetting.

The extracted ore was hand sorted to remove as much waste limestone as possible, and then crushed finely, using stone hammers and anvils, after which it was smelted in charcoal fuelled smelting pits, to produce droplets of pure copper metal. These were aggregated and re-smelted to form ingots, an example of which was found in a bog near Killarney. The smelting pits are the oldest known examples of their type in Ireland, and the copper metal contains a noticeably high level of arsenic, derived from one of the copper ore minerals (tennantite). Arsenic forms a natural alloy with copper, to yield a metal slightly harder than pure copper, enhancing its usefulness in axeheads and blades. These copper-arsenic alloy artefacts achieved a wide circulation throughout Ireland and further afield, clearly suggesting that for a brief period, between about 2400-2200BC, Ireland was one of, if not the principal source of copper in Ireland and Britain and perhaps northwest Europe - a period which W.O'Brien has informally termed the "Copper Age" (O'Brien 1996a; W.O'Brien pers. comm. 1997). That period did not last long, however, as it was soon eclipsed by the advent of the much more robust alloy of copper and tin - bronze.

Apart from the record of mining and smelting activities, the Ross Island sites have also yielded information about the lifestyle of the mining community (O'Brien 2000). Remains of



Figure 6. Mount Gabriel, in west Cork



Figures 7 and 8. Two images of Bronze age tools which were painted by the Geologist, George Victor Du Noyer, from the Ordnance Survey of Ireland's work in Fermanagh, in the late 1830s. [originals in watercolours]

circular and sub-rectangular, presumed timber construction huts have been discovered, along with remains of cattle, pig and sheep bones, some worked bone tools, flint artefacts and fragments of pottery vessels. The evidence suggests that this specialised mining community was supported by agriculturists in surrounding settlements, though none of the latter have yet been discovered. The settlement appears to have been used only intermittently, perhaps seasonally, or maybe for longer periods, rather than continuously.

Evidence of later Bronze Age mining is known from Mount Gabriel, Co. Cork, where thirty two individual mine sites have been documented, all intact and undisturbed by mining activities in subsequent centuries (O'Brien 1996a). Again, detailed research by O'Brien (1994) has revealed much about these mines, the implements and processes used, as well as radiocarbon dating of wooden implements and other materials which indicate a production period over the 200 year period from 1700-1500BC. Some other postulated sites have also been recorded in county Cork, for example at Boulysallagh, Callaros Oughter, Carrigacat, and Ballyrisode on the Mizen Peninsula; and at Crumpane, Tooreen and Canshanavoe (radiocarbon dated) on the Beara Peninsula. Mitchell and Ryan (2001), suggest that the distribution of wedge tombs and distinctive stone

circles in west Cork and Kerry is directly related to mining activities in that region.

Elaborate and exquisitely produced Bronze Age gold ornaments typify the age to most people. Gold ornaments have been found in various "hoards" in different parts of the country, for example the Mooghaun hoard found in Co. Clare during the construction of the famous "West Clare Railway" in the 19th Century. The number and richness of these artefacts has frequently been taken to indicate contemporaneous gold mining in Ireland. But, if so, and despite much debate, as well as documentary and metallurgical research, the source of the gold still remains elusive - and an Irish source unproven (Cox, M. 1999: see McArdle in this Journal). Perhaps the most tantalising occurrence, was the chance discovery in the mid-1990s of coarse native gold nuggets in dry stone walls near Tipperkevin, Co. Wicklow, close to the location where gold smiths tools were discovered at Blessington, and proximal to the Glen of Imaal and Spinans Hill, both associated with Bronze Age activities. A local provenance is now known, with further investigations ongoing, by the current exploration licence holders.

EARLY AND MEDIEVAL MINING

"The different kinds of minerals too, with which the hidden veins of earth are full, are not mined or put to any use ... Even gold ... is brought here by traders".

[Giraldu Cambrensis, c.1200]

There had of course been well over two thousand years of metal use in Ireland before Cambrensis' time. However, there is very little evidence of whatever mining took place in the fifteen hundred years or so of the "Iron Age" before the arrival of the Normans. The many metal artifacts of the Christian age go unprovenanced. Some evidence of smelting does suggest local sources of ore. For instance, there is suggested evidence of copper/iron working within the hill fort at Freestone Hill, Co. Kilkenny (Jackson 1969 and Bersu 1981) but other comment would pose some doubts about it (Raftery 1969).

Iron is mentioned in medieval monastic and legal literature, as well as copper and possibly silver. While there is no known archaeological evidence of any of these being actually mined, there is evidence of iron smelting from various liosanna and monastic sites all over the country. In the southern counties there are thirty six such sites, but it is probably significant that iron-rich Antrim alone has exactly half that number (Scott 1990). The likelihood, therefore is that iron was "mined", from hard pans in bogs or from enriched ferruginous surface outcrops. An early 16th century reference sums up the position as it might have been at any time over the previous 1500 years or so: *"there beth so many mynes of yron that Irishmen do occupy [sic- use?] no yron but such as they make them self"* (The Red Book, p. 13). This, however would leave little archaeological or topographical evidence.

Very recent archaeology may throw more light on this when the background research is complete. An Early Christian period smelting site was discovered in 2000 and excavated in County Waterford near Kilmacthomas (Dr. Peter Claughton, pers.

comm., 2003). On the evidence of the furnace bottoms and associated slag, this has been identified as an iron smelting site, using a furnace type other than a bloomery. It has been dated to the 5-7th century. However, an examination (by the materials laboratory at Oxford) of slags from another furnace on the site, dating to the 7/8th century, suggests they are copper smelting residues. An ore sample has been recovered from the site but no analysis has been done which might tie it in to the area of the Knockmahon copper mines on the coast. The river Mahon runs below the smelting site and may have been navigable for small boats in the 7/8th century, providing a route for the import of ore

The only specific iron age location for copper is given as being at Bantry but the source is too vague to identify whether this could possibly be a reference to Allihies or to the West Carbery showings (The Red Book). There is also a strange reference by a tenth century Welsh monk, Nennius, to the mineralogy of Killarney which does suggest that somebody in Ireland at the time had a practical interest in such matters (quoted by Brash, p. 527). O'Brien (2000) notes the discovery of an inferred Early Christian period metal working complex at Scrahane, at which Ross Island ores have been identified. This, as well as the furnaces on Ross Island, clearly indicates that mining was undertaken on the island, even though the actual workings have yet to be identified. One possibility is that the known, and currently inaccessible underground extensions of the Bronze Age workings may have been undertaken or continued during the Iron Age and/or Early Christian periods. However, there seems to be no other suggestion of copper mining in southern Ireland up to the later middle ages. Neither is there any specific record of gold or silver deposits being worked before then, even though three published articles have titles which intimate that they were but their contents indicate no locations (Brash 1874, Ryan 1980 and Whitfield 2000)

Nineteenth century assumptions that the Danes opened various mines in Ireland can be dismissed for lack of any positive evidence that they did. There are however some strange reports of early mining at unspecified dates based on 19th century investigations. English mining engineer, John Taylor, described breaking into old workings at Milltown, county Clare in 1836 and discovering oak shovels, huge iron picks as well as the remains of fire-setting for splintering the rock (Kane 1844). G.H. Kinahan (1878) records workings at Kilnafinch near Toomavara where the chemical changes on the walls of the mine led him to believe they were "very old". He makes similar comments about Tynagh. At Garrykennedy, near Lough Derg (Co. Tipperary) he states that tools of stone and wood were found and he also mentions a skeleton buried under a heap of stones. For Rathnaveogue in the same county he is less specific about an "old" copper mine there. He reported further on "very ancient" workings for iron at Ballybrennan, county Wexford and Knocknamohill, County Wicklow, as well as old workings in west Carbery (Kinahan 1878). Whatever the dates, Geraldus Cambrensis, quoted above, certainly did not believe there was any mining by the time he arrived.

The main economic interest of the Normans was agricultural and commercial. Within their published records there is no

mention of any interest in the country's mineral potential until the reign of Edward I (1239-1307). The earliest references found, in 1264, is to two small operations each involving four miners and a smelting expert. One is described as being at "the mines near Waterford" while the other is at a place named Oulys (Oola, Co. Limerick or the unknown Waterford site?) (Pipe Roll, Ed. II). A subsequent reference in 1289 notes, perhaps significantly, that Florentine and Genoese experts had to be brought into Ireland to test and operate a silver prospect, most probably at Silvermines, Co. Tipperary. These operations lasted for 14 years before being suspended due to civil unrest, which was to characterise the 14th Century (Cowman 2003). There may have been another attempt to revive it some three decades later (1336) when the name "Meinanarge" or "Silvermines" was applied to it. However, since all precious metals belonged to the monarch, there should have been official records. The only known surviving one is an application by the Butler overlord of that territory for royal permission to reopen Silvermines in 1375 followed by over 250 years of silence. It can be surmised, however, that the survival of the name Silvermines suggests an awareness of the area's latent potential and it would be surprising if unofficial attempts, at least, were not made to exploit them over the intervening years (see Cowman 1988).

EXPLORATION AND METAL MINING IN THE 16TH CENTURY

"The mountains would yield abundance of metals"
(F. Morrison, c.1600)

Tudor victory in 1485, and the consolidation of royal power may have sparked off interest in filling the royal coffers with the putative gold and silver resources of Ireland. There is a printed mineralogical survey with attributed date of 1497 in the Calendars of State Papers. It is most comprehensive and if the date were true (it may be later), it would indicate a very active interest in promoting mining in Ireland in the late 15th century (Hamner Papers). This seems to be borne out by a reference c.1500 when, reportedly, "There is in the Earl of Desmond's country a mine of gold and part of the ore was brought to Waterford and sayne (=seen/assayed?) by the Recorder and others". Mention is also made of silver "in great quantities" in or near Waterford city, in Knocktopher and in another unidentified location in Ormond (probably Silvermines) (The Red Book, Introduction p. v and p. 13). Strangely, however, Clonmines in Wexford is not mentioned (unless it is the one attributed as proximate to Waterford city); it must have been known of in the early 16th century before serious operations started there in 1551 with a view to supplying the royal mint with silver. Quite detailed records have survived about this shortlived operation involving German miners. The fact that it was a most expensive failure, £474 worth of silver procured for the crown at a cost to it of between £5000 and £8500, did not inhibit a second unsuccessful attempt to work Clonmines between 1862 and c.1865 (Cowman 1978, 1986, 1987).

What seems to be another version of the survey mentioned above survives from the early 17th century and may represent a renewal of interest in Ireland's mineral potential in the decades

before (Anon 1822). However, there are few corroborative references to possible mining operations in the later 16th century. A dispute about mining rights at Clontarf c.1580 does suggest that lead was being mined there (CSPI 1574-'85). This would not necessarily be the case for the reference to a silver-showing at an unidentified "Colam(h)ir" (or possibly "Belameir") which was "in the West Carbery district, from the city of Cork 36 miles ---". Dating to the same decade are two references to copper showings. The first is "within Berhaven" in one reference, and at "Ghyny-boid" near Bantry in another (linking back possibly to the earlier medieval "Bantry" reference given above). Reference to known locations, however, is not proof that any of them were actually mined (Anon c.1586). The second reference, of 1584, possibly refers to Ardmore, described as "a copper mine near Youghal discovered by a Cornish miner" (CSPI 1574-'85). The presence of a Cornish miner in Ireland at that period is interesting and may be connected with the second mineralogical survey mentioned above.

That there was an active interest in Irish mineral wealth in the late 16th and early 17th century is attested by a series of references to such within the state papers although the most specific of them merely grants mining rights within the Pale (Anon c.1600). One would have expected that knowledge of Irish mineral resources would have led to reports of attempts to develop them, but such does not seem to be the case. Foynes Moryson c.1600 ventured the opinion given above, exhorting that the "abundance of metals" should be exploited (Moryson). Others presumably agreed but for speculators to consider investing in mining development, a greater degree of administrative and agrarian stability was needed than the late 16th century afforded. A survey c.1600 reported on lead near Glenerought near Kenmare (Lansdowne Papers) and this was possibly the mineral lode that had been granted to "Mr. Brochas & Co." in 1610 as later reported (CSPI 1625-32). The following year (1611) there is mention of "a long since inti-

mated Silvermine" which may have refer to a rediscovery of Silvermines abandoned nearly 300 years previously. A further twenty years however pass before there is more specific reference to them but they seem to have been developed very rapidly in the 1630s by Sir George Hamilton. There were "five hundred Englishmen and divers strangers" reportedly employed there in 1640. This ended in 1642 when, despite the protection of the local Kennedy clan, fourteen of the miners and their families were killed and the mine badly damaged. It lay unworked for the rest of the century apart from a brief attempted revival in the 1680s (Figure 9, Cowman 1988).

Mineral rights in Ireland were granted about 1627 to one Endymion Porter and in 1631 the mines of Munster were given to Whitmore and Webb who had "taken much trouble in finding out divers mines royal", but there is no further reference to any mines he might have developed (CSPI 1625-'32 and 1633-'37). There is mention of only one other worked mine in the 1630's. This was by Richard Boyle at a mysterious location near Youghal (the one discovered by the Cornish miner in 1584?) - "On the shore, about two miles from Youghal, on the road to Ardmore and Dungarvan". Nonetheless, by 1630, Boyle was reported to have been exporting argentiferous lead ore to England (Wadding 1630). The following year he leased the mine to a silver refiner named Burgh who apparently was to smelt the lead locally (Townsend 1904). However, no detail survives about that enterprise. Whether all these references could refer to the existing mines at Ardmore is explored elsewhere (Cowman 1993).

There was a renewed search for minerals once peace was restored following the difficulties of the 1640s. A refiner from Silvermines inspected other silver/lead showings including one at Ardmore (no mention of it being restarted, however), in Clare, "near Tralee", at Knocktopher, in an unidentified location in county Cork and indeed under the streets of Dublin. He was also told of the copper at Killarney (Powell c.1655). Another survey by Boate of about the same time added no new mineral locations though it did throw a little light on some of the earlier operations, particularly those at Silvermines, which were "yea. Castle deep" (Boate 1652). Also considered about this period was the lead showing at Clontarf (CSPI 1660-62), while a later reference states that "there have been mines" at Ballynatray (the mysterious one near Youghal?) in west Waterford (Anon c.1690). "Mines" in all of these references may simply mean tested showings, and indeed it is unlikely that any of these locations was worked methodically. One contemporary report, suggesting reasons for inactivity, was doubtful about where the profits would go since any mineral containing traces of precious metal automatically belonged to the monarch (CSP Dom 1671-'72 and see Cowman 1988).

17TH CENTURY IRON MINES

"The opinion of many knowing persons (is) that the mountains of Ireland are full of metals --- perhaps even the gold itself" (G. Boate c.1650)

"The iron works in Kerry, invented in hell (which they resemble) have wiped me cruelly and the misery is I must go on". (William Petty, c.1660)

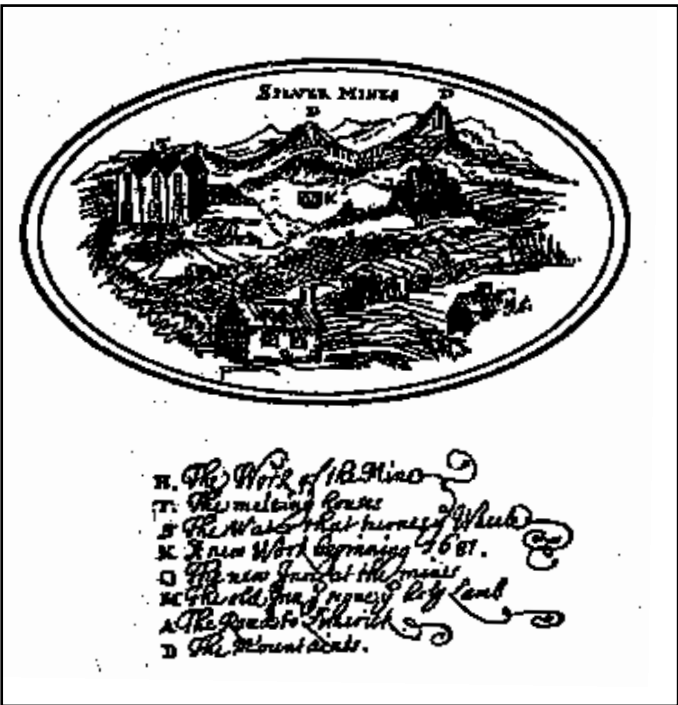


Figure 9. A drawing of the mines produced by Thomas Dinelly who visited the mines on his tour of Ireland in 1681.

Gold may have been the dream but 17th century reality was more prosaic. Both Ireland and Britain had plenty of iron, but Ireland still had vast forests left to provide charcoal for smelting. Apparently, nobody considered replanting as they hacked down the forests so that this was doomed to be a short-term enterprise. Iron was particularly accessible in the sandstone belt running through Waterford and Cork. Even before the Munster Plantation, it seems Sir Thomas Norreys and others were actively interested in an unspecified way in promoting iron mining on the border between those two counties (Norreys c.1580). A later report suggests that Sir Walter Raleigh worked the iron deposit at Dumslig, near Dungarvan (Kinahan 1878). Possibly no active steps were taken until 1610 when a royal grant of £3000 was made, some of which went to a Mr. Tockefeyld who had already by 1610 established ironworks on the Shannon, possibly at Scarriff (CSPI 1608-10). More of it may have gone to the East India Company which seems to have mined and smelted for a short time on the river Bandon at Dundaniel (CSPI 1611-14).

The main iron mining operation in Munster, however, was that conducted by the Earl of Cork in west Waterford and around Bandon in the quarter century from about 1612. The bulk of the evidence from then relates to the smelting operations using some imported ore, but known mining locations in west Waterford are listed as at Cappoquin, Ballyregan, Mocollop, Araglen, Kilmacoe and Lisfinnon (Townsend 1904). Near Bandon, the Earls agents about 1624 "found a rich vein of ore in a mountain --. They traced it for three miles, sunk shafts sixty feet deep and took out many thousand tons". It was smelted locally and made into cannon. However, it is clearly the availability of fuel for smelting that dictated the location of mining operations and indeed reportedly (no authority cited) iron ore was imported from Wales for the furnaces in the Wexford area (McCracken 1958). That there was no policy of replanting felled trees is clear from near contemporary comment about west Waterford - "no care was taken in cutting down the timber to preserve a sufficiency for the carrying on of these works -- _all was destroyed here and a universal havoc made of root and branch" (Cox, R. 1690) and by the time the upheavals of 1641 came, many of their iron-working operations were probably doomed anyway.

Sir Charles Coote was responsible for developing iron works in the midlands and North-west. Iron works are known to have existed in Drumshanbo as early as the 15th Century, but expanded rapidly during the early 1600s, centred upon and around "Slieve an Iarainn", the "Iron Mountains" of Counties Cavan, Leitrim and Roscommon. By 1621 Coote reputedly had employed 3,000 English and Dutch (but no Irish) workers at charcoal fuelled smelting works, which by then had been established at various locations including Ballinamore, Arigna, Garrison (Co. Fermanagh) and Creevelea (McAuley, Cahill 2000). The Drumshanbo works were destroyed in the 1641 rebellion, but restarted in the 1690s along with other works at Dromod, Ballinamore and Creevelea. Most of these works had ceased by the early 1700s, largely due to the exhaustion of timber supplies for charcoal production. Coote was also involved with the development of iron mines and iron works in the Monasterevin - Mountmellick region of Counties Kildare and

Laois (Carville 2001). Iron works were established in that area by 1620, using two types of ore, both locally derived: a "white ore" dug out of the ground (bog iron ore presumably) and a "rock-iron" ore mined at Dysert. As at Drumshanbo, these operations also fell victim to the events of 1641. They were revived again in the 1660s and had ceased by the end of the century due to the exhaustion of the forests (Carville 2001).

Whatever forests were left were exploited by the new Cromwellian planters, so iron works and mines were established in various new locations. Most notable among them was William Petty's operation in various parts of Kerry, at Glenerought, Kenmare, Mucross and Killarney. His comment, quoted above, gives some insight into the difficulties in running such an industrial enterprise in an area that had no previous experience of such (Lansdowne 1937). The same may well have been true of the re-started operations in Wexford at Enniscorthy and Shillelagh (CSPI 1660-'62), "The Owls" near Sligo (Borrishole?) and in Scarriff (CSP Dom 1695). However, by the end of the century "almost all the woods in Ireland have been destroyed and chiefly by the many iron works" (CSP Dom 1699-1700). That effectively ended iron mining, at least in the southern half of Ireland. The main phases for the development of Irish mines then lay in the 18th and especially in the 19th centuries concerning copper, lead-silver and from about 1850 "new" minerals such as zinc and barytes.

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