A study of some genetically determined features in the population of the features in the population of the former country of Pembrokeshire

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A STUDY OF SOME GENETICALLY DETERMINED FEATURES IN THE POPULATION OF THE FORMER COUNTY OF PEMBROKESHIRE

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CONTENTS

APPENDIX

CITED RESULTS

SECTION 1

SECTION 2

Page

SECTION 2 (CONTD.)

SECTION 2 (CONTD.)

SECTION 2 (CONTD.) Page

SECTION 3.

<u>SECTION 3 (CONTD.)</u>

<u>SECTION 4</u>

SECTION 4 (CONTD.)

ABSTRACT

The research covered in this thesis was carried out to test the hypothesis that genetic differences exist between the populations of North and South Pembrokeshire, due to their different cultural histories, and to the cultural and linguistic divide which exists between them. For convenience the work has been divided into four sections.

Section One considers the history and geography of the county, going on to look in detail at parish records, Pembrokeshire surnames and present-day demographic data. The latter part of this Section considers previous genetic studies made in Wales, and, finally, the partitioning parameters used in the genetic surveys are discussed.

Section Two covers the dermatoglyphic survey, initially describing the methodology used and going on to discuss and interpret the results obtained. Univariate and multivariate statistical techniques have been used.

Section Three considers the skin pigmentation study and includes a brief description of the methodology and discusses the results and the genetic and environmental effects on skin colour.

Section Four covers the serology survey. The methodology is described briefly, and the Pembrokeshire results are discussed and compared with the results for other European populations.

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CHAPTER 1

GEOGRAPHY AND TOPOGRAPHY OF PEMBROKESHIRE

The former county of Pembrokeshire, together with west Carmarthenshire and south Cardiganshire, forms the most westerly peninsula of Wales. It is an area with a long, oomplex geological history during which there has been deposition of sediments, volcanic activity, folding and faulting of rocks due to earth movements, and the forming of landscapes by erosion.

The present landscape may only be related to a minor degree to the geological structure of the area. Investigation has shown that the great variety of rocks and the complexities of folding during the Caledonian and Hercynian orogenies, are unrelated to the appearance of the topography, erosion being the factor mainly responsible for the moulding of the scenery.

Much of the Pembrokeshire landscape, especially in the south, appears flat. Near the coast 'erosion surfaces' may be clearly seen, for example on the Castlemartin peninsula. It is inferred that Pembrokeshire (like much of Wales) was uplifted and it is the eroded sea floor which is now exposed to form the coastal plateau, rising in steps from heights of less than 200 ft. to well-developed flats at about 600 ft. south of Stumble Head and north-east of Newport. Isolated hills which stand above the low coastal plateau are relics of higher platforms fragmented by erosion, many of these summits being approximately concordant. The coastal margins of the plateau are indented, and show remnants of a raised beach a few feet above the present high water mark. Bays have been formed where wave action has eroded softer sediments, and headlands have formed from harder strata.

Although important, the effects of glacial erosion were not so pronounced in S.W. Wales, as in other areas of Wales. This was because the peninsula lies very near the southern limits of the Pleistocene glaciation. A world-wide rise in sea-level followed the melting of the ice at the end of the Ice Age, about 12,000 years ago. Evidence for this in Pembrokeshire (and elsewhere in N.W. Europe) is shown by the drowned peats and associated sediments which occur in many of the bays. The rise in sea level caused drowning of the coast and converted the river mouths into estuaries, minor ones in Newport Bay and Solva Harbour and the major rise of Milford Haven and its tributaries.

The topography of North Pembrokeshire, then, is one of low hill summits or Monadnocks, of the Precely range standing above the coastal plateau. The south is mainly an area of lowlands. Soils in both areas are derived for the most part from rock outcrops in situ, giving areas of medium to heavy, silty loams associated with older Palaeozoic rocks, and fine, fertile loams associated with the carboniferous limestones and old red sandstones. The third soil type is thin, greyish-brown and shaly, formed on the outcrops of the millstone grit and the coal measures (Bowen 1957).

The climate of Pembrokeshire is dominated by oceanic influences. On the western coastal margins the climate is mild and moist; these conditions penetrate inland but deteriorate rapidly over high ground. The contrast between the high moorlands and the coastal areas is illustrated in the distribution of mean annual rainfall. Means as low as 25 in. per annum have been recorded in the extreme south-west at Dale and Stackpole, whilst in the Precely range 60 in. per annum has been recorded. Tenby, in the south, has the highest recorded average hours of bright sunshine for anywhere in Wales, 1,611 hours, followed closely by Haverfordwest with 1,606 hours (Howe 1957). At higher altitudes, where the mountains are shrouded in cloud for days on end, there may be up to 300 hours less sunshine per year than in the areas to the south-west (Howe 1957).

Differences in climatic conditions lead to contrasting vegetation types between the coastal plateau and the monadnock country. The former is mainly under cultivation or is improved pasture, with some remnants of woodlands in protected valleys free from exposure to salt-laden sea winds. The north characteristically shows a moorland vegetation, very much in its natural state.

Agriculture is the chief industry of S.W. Wales. Arable farming dominates the coastal zone, which runs from the Moylegrove area in the N.E. down to include the lower basins of the Nevern and Gwaun; and then on to include the coastal area bordered to the east by the valley of the Wester Cleddau as far as Treffgarne. It includes the greater part of South Pembrokeshire, S.W. of the line running from Treffgarne to Saundersfoot. North of this line there is less arable farming.

North Pembrokeshire is characterised by mixed farming usually on small farms, while in the south the accent is on arable farming and less stock rearing and dairying is practical. Climatic conditions and soils are more suitable for arable farming in the south than in the north. In S.W. Pembrokeshire climatic conditions are favourable to the growing of early vegetables and flowers. Pastoral farming is practised in the interior areas. Dairying dominates on land below 600 ft. and sheep rearing on hills above that level.

The second most important industry is the transport industry.

This fact is not related to a high population density but is tied in with agricultural mechanisation and the export of agricultural products from the area. A large number of railway workers are found at the coastal terminals of Milford Haven, Neyland and Fishguard Harbour. Milford Haven also has a large number of refinery workers, an industry which has recently attracted people from other areas of Britain into South Pembrokeshire. The coal mining industry, important in the eighteenth century, ceased after the development of the South Wales coalfield.

Prior to the nineteenth century woollen processing in Wales was a cottage industry allied to a few scattered fulling and washing mills. Many of these became mechanised in the 19th century; tweeds and flannels being produced. The southern slopes of the Precely range around Maendochog and Mynachlogddu had several of these factories, but the main concentration was the middle Teifi valley. In 1957, Lockley (1959) noted twenty-three such factories mainly on the southern flanks of the valley.

There is little in the way of occupation opportunity to attract any large concentrations of population, except at some of the more specialised seaports (e.g. Milford Haven). Most of the industries are essentially rural. There are marked differences between the patterns of population settlement in the north and south of the county. The south is an area of nucleated villages and castle towns, whilst the north is an area of dispersed settlement. Differences in population density between the two zones are related to the intensity of the communication system and its associated settlements.

CHAPTER 2

THE PREHISTORY AND HISTORY OF PEMBROKESHIRE

The Palaeolithic Period

No remains of early man have been discovered in Wales before the cave-dwellers, the first immigrations being dated between 15,000 and 10,000 B.C. (Wheeler 1925).

It is thought that the number of Palaeolithic men invading Britain was small, and that these men were hunters who spread through the British Isles during the warmer intervals of the Ice Age (Fleure & James 1916). Only from the second millenium B.S. is there evidence of the spread of civilization into Pembrokeshire.

The first settlements in Pembrokeshire were associated with caves in the carboniferous limestone outcrops of the south (Grimes 1973). The main sites are situated in the Tenby area; at Hoyle's Mouth and Longbury Bank in Ritec Valley; at Nanna's Cave on Caldey Island and to the west at Catshale Quarry cave situated on the Pembroke river.

Stone implements and food-bones have been found in the soil of the cave floors, the bones coming from animals now extinct in Britain such as the reindeer. The presence of such species is evidence of a cold, dry climate. These conditions gave rise to typical tundra and steppe vegetation, which provided a habitat suitable for herds of hoofed grazing animals, the chief source of food for the Palaeolithic hunters.

Discoveries at Nanna's Cave have shown that at the end of the Ice Age in Britain (about 8,000 B.C.), people of the Creswellian culture were still living in Pembrokeshire. During this period the climate gradually changed and conditions became warmer and wetter.

This led to changes in vegetation types and, associated with this, a change in animal species, red deer, ox and pig, replacing reindeer and horse. Archaeologically this period is referred to as the Mesolithic or Middle Stone Age.

The Neolithic Period

Neolithic man came to Britain at a time when climatic conditions were very similar to those of the present day. They were not a small group, but a large population which colonised part of Asia, Northern Africa and the whole of Europe.

During the Ice Age in Britain, the Mediterranean region and the Sahara had experienced a fairly cool climate. As the Ice Age diminished there was a northward shift of the climatic belts, and this led to North Africa becoming drier and less suitable for human habitation and a good deal of migration occurred at this time.

The passages northward from the Mediterranean region would have been limited by remaining ice barriers; ice sheets still remained on the Alps, the Illyrian mountains, the Balkans and the Carpathians (Fleure & James 1916). Therefore migrations from the eastern Mediterranean and the Adriatic coast would have been restricted.

To the west there existed a passage between the Alps and the Pyrenees, though the Rhone valley would have probably been blocked and the route not used until later. However, further westward there was a route across bare, open limestone country lying on the northern flank of the gate of Carcasonne. In the north-west a route existed running from Narbonne along the western edge of the Massif, central of France, along one of the ancient trade routes into the western Mediterranean area.

Another line of migratory movement was along the coast of the Iberian peninsula, though it is generally thought that this route was not in use until late in the Neolithic period (Fleure & James 1916). A possible alternative route is via the western end of the Pyrenees, and up the Biscayian coast of France into Brittany.

The movement of people into Britain from the Mediterranean region occurred either across a dry land portion of the English Channel, or involved a short sea crossing via a strip of water probably narrower than the present day. They settled mainly in the English uplands, for example on the downland of the south. In England the Neolithic people were generally distributed to the south of the Mersey-Humber line and to the east of the Quantock and Blackdown hills (Fleure & James 1916).

Because of the difficulty in crossing the river basins of the Dee and Severn, Wales was somewhat isolated. Routes open to migratory movement were from the Clent hills, Cannock Chase and Wenlock Edge, and across the Longmynd and surrounding highlands onto the Welsh moorlands. Another important area of immigration was on the west coast of Wales via the sea routes; settlers coming to the western peninsula of England, the west Wales coast and to Ireland.

For over a thousand years Pembrokeshire saw the invasion of groups of settlers who established themselves on sites suited to their needs as primitive cultivators and stockbreeders. These groups were fairly generally distributed over the coastal areas including the shores of Milford Haven and along the southern foothills of the Presely range (Grimes 1973).

Pembrokeshire has many examples of tombs dating from the Neolithic period. Their chief areas of concentration are in the north of the country, namely the coastal strip and hinterland between Fishguard and

St. Davids, in the Nevern Valley and in the southern foothills of the Preselys. To the south there are scattered examples around Milford Haven, and between Angle and Manorbier (Grimes 1973). Another source of archaeological evidence has been the settlement site at Cleggr Boia, where remains of huts were discovered. This site yielded hand-axes and pottery, the material used for the axes being of local origin, and identical with that of implements collected from other widely scattered sources. It seems likely that they are all products of the same axe-making industry, the site of which has as yet not been identified, though the eastern end of the Presely range is considered the most likely area (Grimes 1973).

The pottery found at Cleggr Boia consisted of round-bottomed bowls. These have also been found in some of the chambered tombs and parallels exist in Ireland and in Cornwall. This suggests that the Neolithic settlers of Cleggr Boia were probably of the same group as the tomb-builders and linked culturally with the peoples who had settled the country bordering the Irish Sea.

Fleure and James (1916) in their anthropometric survey of the Welsh people, describe a long-headed, brunet type found on moorlands and inland valleys, and suggest these people had their origins in a Mediterranean race which invaded Wales during Neolithic times. The purest examples of Neolithic types are said to have survived in Wales because of its relative isolation.

In West Wales, including Pembrokeshire, traces of the oldest waves of Neolithic immigrants have been traced, that is Neolithic types possibly with Palaeolithic admixture (Fleure & James 1916).

With the coming of the Neolithic people, agriculture and stock-breeding were introduced into Britain. These people grew wheat, barley, oats and rye, bred domestic animals (ox, horse, cow, sheep), wove cloth and made pottery. Like the men of the Palaeolithic Age they had no knowledge of metal working but they greatly improved the making of stone implements.

The Bronze Age

Towards the end of the Neolithic period there was considerable movement of people and intercourse between groups. The populations of late Neolithic Britain and Ireland were varied, and successful in establishing occupation over wide areas. However, the density of these populations have been difficult to assess (Coles & Harding 1979).

Abundant evidence has been found for a variety of Bronze Age activities in the British Isles and sites have revealed artefacts such as bronze axes, and pottery some of the 'Beaker' type. archaeological investigations have shown the Bronze Age populations worked in stone and wood and were well versed in copper and gold metallurgy.

Although no Bronze Age sites have been found in Pembrokeshire (Coles & Harding 1979), pottery dating from the period has been found at South Hill, Talbenny where a burial mound yielded pottery of the 'Beaker' type, and at Linney Burrows, Castlemartin (Grimes 1973).

A feature of the Bronze Age was the development of long distance trade. Commerce was greatly increased, especially the movement of metal, and long-distance trading channels were established. It has been suggested that the populations who settled in eastern Britain attempted to reach Ireland, possibly via a cross-Britain trade route, lured by the rumours of Irish gold. Britain at this time was still heavily forested so movement westward would have been difficult, except for small trading groups. There is evidence of intercourse and trade along this route, which possibly explains how the Bronze Age pottery reached Pembrokeshire.

Another feature of this period was the building of megaliths or dolmons, by the second wave of Bronze Age immigrants during the second millenium. As well as their burial sites, examples of which are found in North Pembrokeshire, 'religious' sites were also developed, including the re-development of Stonehenge. The 'blue' stones used in the building of Stonehenge originated from the Preceli mountains, which indicates that Bronze Age groups must have visited the area.

The Iron Age

It is difficult to date the beginning of the Iron Age, as changes from one period to another are gradual, but the prehistoric Iron Age may be said to have begun by about 500-400 B.C. (Grimes 1973). Movements of continental origin, involving both migration and trade, which had begun at the end of the Bronze Age, continued into the Iron Age. Much of the movement was centred on Ireland.

It is thought that in the early Iron Age the lower Rhine Valley became a highway from West Switzerland, Burgundy through the Rhone Valley to the Mediterranean, and through the forests of Northern Gaul towards Britain. It is generally agreed that iron did not reach Britain before the La Tène period (about 400 B.C.).

It is probable that the early Iron Age invaders settled first on the east coast of Britain while to the west the Bronze Age people remained dominent. Gradually there was movement westward, hillside roads were developed, and people moved along the valley sides of the Severn and Wye into Wales. It seems likely that Wales was little affected by these people before the Roman invasion, when pressure from the new inflow drove them westwards.

These new settlers were tall individuals, with fair or red hair and probably spoke a Brythonic dialect. They had developed the use of iron for tool-making, and had a generally higher standard of civilization than the earlier inhabitants. If, as has been suggested, the early Iron Age people were the first Brythonic speakers to reach Britain, then it is quite possible that the Brythonic languages (Welsh and Cornish, characteristic of Western Britain) were not spoken there until Roman times. The earlier inhabitants probably spoke a Celtic language, possibly of the Godeilic type, the type to which Erse, Manx and Scottish Gaelic belong (Fleure & James 1916).

Archaeological evidence suggests that small groups of Iron Age people from south-west England crossed the Bristol Channel and settled on the west coast of Wales and the east coast of Ireland. A series of potsherds found on Caldey Island have been identified with the Iron Age 'A' groups of southern England. Similar pottery has also been recovered on Gitlar point near Tenby, on Grassholm Island and from one of the hut floors at Fael Drygern. This type of pottery is usually associated in southern England with a settled farming population, but there is little evidence of this in Pembrokeshire where only a few coastal sites have been discovered. Very few Iron Age 'B' finds have been discovered in Pembrokeshire, only a few at Penbryn and near Cardigan (Savory 1964).

Analysis of Iron Age earthworks in West Wales suggests that developments began not much later than in southern England. The people settling in Dyfed could have come from southern England or have come from the Marches and Brecknock to the east. With the coming of the Iron Age invaders, the earlier settlers were pushed to upland areas. There developed a situation in which people using iron and speaking a Brythonic language lived in the valleys and the upland people lived at a pre-iron stage of culture on the high moorlands (Fleure & James 1916).

The Demetae had more success than any other early Iron Age tribe in settling in west Wales, settling to the west of the Silunes (see map 2). Archaeological evidence shows the existence of a distinct cultural region in west Wales, more closely linked with Ireland than with other parts of Wales and this began to be apparent even at the end of the Neolithic Age. The area contrasts with the Welsh marshes, but is linked with Ireland in having a profusion of Iron Age defended homesteads, but very few large hillforts. (Savory 1964). West Wales appears to occupy an intermediate position both culturally and geographically between the west country of England and southern Ireland.

The Roman Invasion

The Romans entered Britain in 55 B.C., and had considerable influence on the way of life of the indigenous people, though their dominance was not so great in West Wales. Carmarthen is the most westerly known Roman fort and on present evidence there appears to have been no Roman military occupation in Pembrokeshire. It has been suggested that, unlike the other Welsh tribes, the Demetae, the inhabitants of Pembrokeshire atthe time of the Roman invasion, accepted Roman occupation peacably, thus rendering the building of military posts unnecessary.

At this time South Wales was divided between two tribes, the Demetae to the west, and the Silures to the east as far as the River Severn. It may be that the Silures, who represented the old Neolithic pre-Aryan stock had got the upper hand on the Demetae, so the latter were glad to accept Roman occupation as a means of protection from the Silures.

The main effect of the Roman occupation in South Wales was the opening up of trade routes and trails of coins and pottery of Roman origin have been collected along these tracks. There are no actual Roman roads in Pembrokeshire, though several routes have been referred to as such in the past; for example, older maps label the Ffordd Ffleming as a Roman road, though it is in fact prehistoric in origin (Grimes 1973).

It is thought that as the Demetae were not under Roman rule, withdrawal of the Roman army in the fourth century may not have affected the way of life in Pembrokeshire very much. The most serious effect would have been the loss of the coastal patrols of the Roman fleet who protected western Wales from the invasion by Irish sea-raiders (Grimes 1973). There is no direct evidence for such a fleet, but indirect evidence suggests that it existed and was based at Milford Haven.

As Roman influence diminished the western Celtic culture revived and links with the European continent were renewed. In fact this was a return to conditions which had existed throughout the prehistoric ages and at this time both Goidelic and Brythonic speakers lived in Pembrokeshire.

The Post-Roman Period

The Roman forces finally left Britain in 410 A.D. and in Highland Britain the tribal leaders rose to power once again. In the lowland zone, after a century of Saxon raids, Frisian settlements sprang up along the North Sea coast. These were the first of many; a century of migration followed, beginning in the mid-fifth century. There were movements from Jutland (Jutes and Angles), north-west Germany (Saxons) and the low countries (Frisians); all these people speaking similar languages. These settlers introduced the cattle rearing and corn growing economies of their homelands into lowland Britain, settling on the good farmland of the coastal plains, river valleys and lower slopes of the downland. They appear to have had very little contact with the tribal groups in the west.

During the post-Roman period the sea routes were once again in great use. There was intense activity in south-west Wales, missionaries from the Celtic church passed through on journeys to and from Ireland, Cornwall and Brittany. Many sailed inland up the tidal creeks and estuaries to establish little cells or oratories, which later developed into churches. These churches still bear the names of their early founders, the most famous being St. Davids.

In the third and fourth centuries A.D. the Deisi tribe from County Waterford in Southern Ireland, attacked Pembrokeshire. These people eventually colonised the area influencing the way of life and the language of the native Welsh. Although the Deisi were important for several centuries, none of their settlements have as yet been identified in Pembrokeshire. Irish influence continued to be important during the sixth and seventh centuries. As well as the inflow of more settlers, the introduction of Christianity also came from this direction.

The archaeological evidence for early Christianity comes almost entirely from inscribed and carved stones (Grimes 1973). The script on these stones appears to have been invented in Ireland by the fifth century A.D.; its language is Goideilic, the Irish version of Celtic. These so-called Ogam stones mark the intrusion of the Irish people into

Pembrokeshire and demonstrate the strength of Irish influence during the post-Roman period. There are 120 such stones in Pembrokeshire, with the largest concentrations in the north of the county, apart from a group at Penally. Very few bear only an Ogam inscription and on most of them are inscriptions in Latin and Ogam which is evidence for the strength of Roman influence in the early church.

By 600 A.D. the Anglo-Saxons had occupied the lowland zone of Britain, displacing many British families to the highland zone. There was a marked valley-ward movement of people throughout western Britain but especially marked in some areas. In south-west Wales, the eastern part had higher relief than the west and here the Vale of Towy became the meeting place of the hill people and, as such emerged as a political unit in the seventh and eighth centuries. At this time a series of small kingdoms was being formed in Wales.

Ystrad Tywi (approximately the area now referred to as Cardiganshire and Carmarthenshire) was demarcated from Dyfed (the land of the Demetae) by a natural frontier formed by the lower Towy; and to the south the sea (and later a frontier dyke) separated Carmarthen from Dyfed. Dyfed therefore formed a western area, distinct from Ystrad Tywi, and in which the predominant influence was Irish.

Viking influences

The Norsemen first invaded in 795 A.D. Emigrants from Norway travelled west and north-west plundering the coasts of the Orkneys, Shetlands, Hebrides, Scotland and the Isle of Man, whilst the Danes sailed southward along the east coast of Britain, rounding the south of England possibly as far as the Bristol Channel (Charles 1934). Charles suggests that Wales, like Ireland and western Britain, was mainly in contact with the Norwegian raiders, especially as the earliest raids originated from Norse settlements in Ireland. It is not known whether the raiders landed in Pembrokeshire, but they must at least have sailed along its coast.

The early raids from Ireland changed in the first half of the eleventh century into an alliance between Norse and Welsh, against a common enemy, the English. In 833 A.D. the Norse, assisted by the West Welsh (these were not natives of West Wales but Cornishmen) began to raid England. The army was defeated and withdrew into Wales where they received a welcome from their allies.

In 866 A.D. three Norse leaders landed with a large army on the east coast of England. From here they organised expeditions which lasted for fourteen years and swept the country far and wide, eventually reaching Milford Haven. The name 'Hubba's' Tarn is found in two places in Pembrokeshire, one on the western shore of Milford Haven and the other near Angle.

The year 966 A.D. saw a new wave of immigration into Pembrokeshire. Goidels, originally of Irish stock, sought refuge after being driven from North Wales, in preference to returning to Ireland, a land in which they would be strangers after so long an exile. The ruler of Dyfed tried to evict these immigrants, but intervention from the English prevented this.

Pembrokeshire was still subject to Viking raids and in 981 A.D. they destroyed the city of St. Davids, and in 1021 Olaf Haroldson, the King of Norway, ravaged the county. Little is known of their actions after this date.

Archaeological evidence for the settlement of the Norse in Pembrokeshire does not exist. There are no traces of buildings nor of earth works. Charles (1934) suggests that it was almost inevitable that Norse traders would have settled on the coast because of the attraction of such ports as Milford Haven and other authorssupport this view, particularly as Pembrokeshire has many place names of Norse origin. Examples of Viking names are those of the islands, Gateholm, Grassholm, Skokholm Caldey and Skomer.. The Royal Commission on Ancient and Historical Monuments concluded that the Norse had settlements in the Hundreds of Castlemartin, Rhos and part of Narberth.

Charles (1934) suggests that the strength of Norse influence in Pembrokeshire is illustrated by the fact that in several instances new Norse names replaced the old Welsh ones. Because it is the headlands, creeks and coastal villages, etc. which bear these names he deduces that the Norsemen who visited Pembrokeshire were mostly sailors. However, when these sailors were on a Viking expedition, they carried with them their livestock and household possessions; and the chieftains may have been accompanied by their wives. Therefore these travellers would have had the wherewithal for the beginnings of a settlement, and single members might have found wives among the native inhabitants; however these are points of conjecture.

The Normans

At the time of the Norman Invasion Pembrokeshire formed part of the Kingdom of Deheubarth, the kingdom of Dyfed having been incorporated into Deheubarth, but retaining its old land divisions as units of administration. Rhys ap Tewdor, the last prince of South Wales, died in 1093, leaving the kingdom with no leader. Internal unrest within the tribes of Deheubarth weakened resistance to the Norman armies who invaded from England, and the southern area was under Norman control by the end of the year (John 1976).

There were two Norman invasions of Pembrokeshire, one in the north led by Martin de Tours, and another in the south led by Arnulph de Montgomery. Martin de Tours settled in Fishguard, making Newport his headquarters and from here he set out to subjugate Cemaes and the north marcher lordship was established at Cemaes, with its administrative centre first at Nevern, and after 1191 A.D. at the new garrison town of Newport. To the west lay the episcopal lands of St. Davids (Dew island) and in east Pembrokeshire those of Llawhaden. These areas were respected by the Normans because they belonged to the church; but the Welsh inhabitants were still under the control of Norman bishops and knights, and at least eleven manors were established there. However, there appears to have been no widespread settlement of Anglo-Saxons or other immigrants coming in the wake of the Norman invaders.

Northern Dyfed has a very different topography to the southern part, and it has been claimed that this is the reason the Normans did not settle in the north in large numbers. John (1976) suggests that it was more likely to have been administrative difficulties than physical ones which prevented large-scale settlement.

The Normans held complete control of southern Dyfed during the first half of the twelfth century; motte and bailey forts were built, later replaced by stone castles. Major fortresses were established at Pembroke and Haverfordwest, and frontier castles built along the zone between North and South Pembrokeshire as defence against the Welsh who held control in the north and east. These fortresses were situated at Roch, Wiston, Llawhaden, Narberth and Amroth. This barrier zone served to cut Pembrokeshire in two, with 'Little England' to the south and a predominantly Welsh community to the north.

The most direct effect of the Norman occupation in the south was the development of the manorial system. The compact arrangement of the English manor, with lands and dwellings of the tenantry closely associated with those of the lord, may still be identified in South Pembrokeshire. Other manors are more scattered, as is the general case in Norman manors established in Wales (Rees 1924). There was considerable modification and even obliteration of older native institutions; and tribal districts were broken down (Jones Pierce 1972).

Prior to the Norman invasion the land had been for common use by the community, though land tenure and certain rights were handed down by inheritance as the country became more populated. In the ninth century Hywel Dda (the law-giver) had developed a system of tenure which included the law of Gavelkind by which land passed from father to each son equally, so that fields and ploughlands became divided into narrow strips, each owned by a separate, but related family. With the introduction of the manorial system considerable modification occurred (Lockley 1957).

At least one hundred and twenty villages and hamlets were established in South Pembrokeshire during the twelfth century, many on the sites of old Welsh settlements. They may be identified by their Anglo-Saxon names, for example Rudbaxton, Monington and Picton. However, some Welsh place names did survive in the south (Llangwm Pwllcrochan, Rhoscrowther).

By the thirteenth century non-Welsh settlement had spread north of the military zone with its fortified castles, and these new areas of settlement may be identified by their non-Welsh names. Villages were established in the southern foothills of Mynydd Presely up to an altitude of about 700 ft. (John 1976). In North Pembrokeshire the Normans had less effect on the way of life and over much of the area the old strip system of farming remained, and villages and hamlets kept their Welsh names.

It was the Norman occupation of South Pembrokeshire which makes it, even at present, unique in Wales. During Norman times the south had a way of life characteristic of the English rural scene, farms and villages were given English names, and English was the language spoken; in fact it became 'Little England beyond Wales'. In the north the Welsh way of life was maintained, Welsh place names were used and the Welsh language was spoken, So, two contrasting provinces developed, with a linguistic and cultural barrier between them which may still be identified today (John 1976). (See also Chapter 3 - The Landsker).

The Flemings in Pembrokeshire

About 1107 A.D. it is reputed there was a tidal wave which inundated part of the Flemish seaboard destroying both homes and land (Laws 1888). Either for this reason, or because of political unrest in their own country, many Flemings emigrated to England (Owen 1895). They found a good number of their fellow-countrymen already established through the favour of William I's Queen, Matilda of Flanders. Owen (1895) suggests that during the first three Norman reigns many Flemings settled in different parts of England.

The chronicles of Henry I tell of the settlement of Flemish in the Scottish borderlands east of the Tweed; and of their subsequent removal to the hundred of Rhos, in the county of Pembroke. In the Welsh chronicles, the Annales Cambriae, it is stated that the Flemish seized the hundred of Rhos and entirely expelled the inhabitants. How completely they were driven out is illustrated by the absence of Welsh place names in the area.

From the Hundred of Rhos (an area which included the present towns of Pembroke, Tenby and Haverfordwest), the Flemings soon spread over the area to the south of Milford Haven. Isolated colonies also existed in the Hundred of Castlemartin, but in this area their influence was much less.

The Flemish people were farmers and traders, as well as forming part of the feudal armies which were present to subdue the Welsh.

Many Flemish leaders rose to positions of importance. Flemish influence moved further north and Anglo-Flemish villages were established on the southern foothills of the Preselys. These may be identified by their non-Welsh names, for example, Little Newcastle, Henry's Moat, and Ambleston. By the thirteenth century there was a substantial non-Welsh settlement north of the Landsker, and the fortified frontier castle ceased to be of any military significance.

Norman Times to the Twentieth Century

The settlement of the Normans in West Wales altered its whole political structure. By the twelfth century Pembrokeshire consisted of a series of feudal lordships, and formed part of the Welsh Marches. This arrangement lasted until the Act of Union in 1536, so that throughout the Middle Ages each feudal lordship evolved separately, only being subservient to the king. Some of the elements of the previous Welsh administration were retained by the Norman lords and incorporated into the feudal structure, so that the pattern of life, especially in rural areas, was not unduly disturbed.

In South Pembrokeshire, where Anglo-Norman influence was more pronounced, the indigenous Welsh population was not so much displaced as absorbed (Jones 1973). Jones suggests there may have been intermarriage between the Normans and the Welsh and that this led to a stabilisation of 'Little England'.

The Lordships of Dewisland (St. Davids) and Llawhaden differed inasmuch as their overlord was the Bishop of St. Davids. The Normans who respected the property of the church spared Dewisland, when annexing other parts of Pembrokeshire.

Before the Norman invasion there were no towns in Pembrokeshire. With the Norman's arrival, castles were built in strategic positions and towns sprang up around them. Apart from building castles in places which provided natural protection, they built on sites suitable for seaborne reinforcement. These places were also suitable for seaborne trade and during the Middle Ages many of these developed into flourishing trading towns, for example, Pembroke, Tenby, Haverfordwest and Newport (Jones 1973).

Throughout the Middle Ages life in Pembrokeshire was reasonably settled and its geographical position in the extreme south-west of the country meant that it was removed from places where political conflicts were decided.

The year 1536 saw the Act of Union and it was at this time that Pembrokeshire was formed. The distinction between crown lands and Marcher Lordships was swept away and the whole county came under English law, the king being supreme over all.

Pembrokeshire now consisted of seven administrative hundreds, Cilgerran, Cemaes, and Dewisland to the north, Roose, Daugleddy and Narberth in mid-county and Pembroke in the extreme south below the Haven. In 1542 Haverfordwest was formed into a county in its own right, as well as remaining the county town of the whole shire, and Laugharne and Llanstephen, initially parts of Pembrokeshire, were transferred to Carmarthenshire. This arrangement remained relatively unchanged until 1973, when Pembrokeshire, with Cardigan and Carmarthen, were amalgamated to form Dyfed. Throughout the political changes, the division between the English and Welsh speaking areas remained clear.

The Pembrokeshire economy during these times was based on seaborne trade and agricultural production. The woollen trade flourished during the Middle Ages, but by Tudor times, when this had past its peak, coal mining, tanning and other ancillary industries became more important.

The Tudor period saw another influx of newcomers into the county. Some settled on lands made vacant by the dissolution of religious houses, others came as administrative officials, and many Irish came looking for employment or fleeing from disturbances in Ireland. During the Stuart period the county continued to flourish and, despite disturbances caused by the civil wars, emerged without appreciable damage to its economy. (George Owen's "History of Pembrokeshire" gives an insight into Pembrokeshire at this time).

The eighteenth century was a period of steady economic growth. The towns continued to flourish and ports played an important role in the economy. During this period landing stages, quays, kilns and storehouses were built in places like Abercastell, Solva, Porthgain, Fishguard and Stackpole, for ships to discharge cargoes of coal, limestone and other goods, and to take on grain and other products. Pembrokeshire exported goods up the coast of Wales, to the east coast of Ireland, to the south-west peninsula of England and sometimes as far as London. (George 1964).

The industrial revolution led to greater productivity in the coal industry in South Pembrokeshire. (The main mining areas were Kilgetty, Saundersfoot, Hook, Freystrop, Landshipping and Cresswell) (Gilpin 1960). Also it was a time of agricultural prosperity and increased trade through the ports. Up to the beginning of the nineteenth century the town of Milford did not exist; however in 1794 permission was granted by the government for a port to be developed on the Haven. By the end of the next decade a town had sprung up. The first inhabitants were seven Quaker families from Nantucket Island (Gilpin 1960). They depended on the sale of spermaceti oil, and it seemed as though Milford was destined to become a whaling port. Gradually, however, trade increased to include the traffic of coal, limestone and corn; and shipbuilding began with the granting of a contract by the admiralty.

In 1813 the Naval Board's base of Milford dockyard ended and the Admiralty base was moved across the Haven to Pembroke Dock, where a new town was built. At first men in the dockyard travelled in from the surrounding areas (i.e. Milford, Llanstadwell, Burton, and Hundleton) but, gradually, as houses were built, moved into the new town. In 1836 the Irish Packet Service was moved from Milford to Pembroke Dock and by the 1840's shipbuilding had become a thriving industry and dockyard workers came in from other parts of the British Isles. By 1841 the population changes were greater in Pembroke Dock than in other places around the Haven.

Population increases were also occurring in wholly rural parishes at this time, in contrast to later decades. In the early nineteenth century most people in rural areas were employed in agriculture or fishing. However, population increase was greatest where there was mineral deposit, e.g. limestone as in Carew, and anthracite as in Freystop, Martletwy and Coedcamlas.

The nineteenth century was an important time in Pembrokeshire history, both politically and economically. It was also a time of prosperity and advances in industry. Population statistics show that in 1801 the population of Pembrokeshire was 56,280, but by 1861 it stood at 96,278. However, by 1901 it had fallen to 87,894 due to emigration of workers from rural areas to well paid industrial jobs mainly in Glamorgan. By 1921 the population had again increased to 91,480 but during the depression between the two world wars it sank again to stand at 85,400 in 1941; at the 1971 Census the population stood at 98,968. (Jones 1973).

The early part of the twentieth century saw little change in Pembrokeshire, but the second world war and its aftermath brought the establishment of military and other government installations. Large oil terminals were built around the shores of Milford Haven, which in turn brought many workers into the area from other parts of the British Isles. Also the tourist trade became profitable, attracting large numbers of visitors to the county.

On the whole there was a change from subsistence farming to primarily profit-making industries. This increase in industry helped to counteract losses caused by a dwindling fishing fleet, the closure of numerous railway installations, the marked decrease in coal-mining and the closure of the dockyard in Pembroke Dock. However, it must be emphasised that these changes had far more effect on the way of life in Southern Pembrokeshire and to the north farming was and still is important, the economy being boosted by the tourist industry.

CHAPTER 3

The Landsker

The name 'Landsker' is given to the ancient frontier which has marked the linguistic and cultural divide between north and south Pembrokeshire for about a thousand years. However, it has been suggested that a primitive settlement divide existed along the same line even in prehistoric times (Davies 1939). There was possibly a physical divide, a damp forested belt situated in central Pembrokeshire, which was unsuitable for settlement, other sites being better adapted for agriculture of pastoral farming.

Maps of Neolithic and Bronze Age finds appear to show a sparsely settled belt of country in the position of the Landsker zone. Iron Age finds, however, are widely distributed so it seems unlikely that two separate cultures existed at this time (John 1976).

The Norman invasion produced marked changes in Pembrokeshire especially in the south. Here the invaders gained complete control, set up the manorial system, built castles and introduced the English language, thus creating 'Little England beyond Wales', whereas North Pembrokeshire retained its Welsh identity.

The position of the Landsker has changed a number of times since its establishment. The original divide passed between Pebidiog and Rhos in the west, thence further east between Cemais and Daugleddau and it then appears to have followed the northern boundary of Narberth, passing eastward to the Taf estuary in Carmarthenshire (see map).

The frontier castles built during Norman times mark the Landsker in part, but during the medieval period the position changed several times depending on the extent of Anglo-Norman influence (John 1976). Davies (1939) has suggested that because of the political instability of the Landsker zone, it represented a 'no-man's land' between the Englishry and the Welshry.

That the Landsker persisted into later times, even up to the present day, is surprising for it has had to withstand the influence of economic and administrative changes which have affected the whole country.

The most recent survey to establish the status of the Landsker was carried out by John in 1971. This field study showed that the inhabitants of the Landsker zone were still well aware of the linguistic divide. Within the zone 58.1% were Welsh speakers, against 41.9% who were not (John 1976), a higher percentage of Welsh speakers being found in the more isolated rural areas.

The position of the present day Landsker may be accurately defined in some areas, but in others there is some difficulty. The accurately positioned sections include the Treffgarne ridge section in the west and the Afon Syfynwy section to the east. In the centre there appears to be a diffuse zone in the parishes of St. Dogwells, Ambleton, Spittal and Walton East (John 1976). The distribution of English and Welsh place names is also less distinct in this section. John has suggested that the Landsker zone may be divided into three distinct sections namely:-

> "(a) a western section where the linguistic divide is sharp, running along Brandy Brook and the Treffgarne ridge;
>
> (b) a central section where the linguistic and cultural loyalties are difficult to define, running from the Treffgarne Gorge to the southern end of Llys-y-fran parish;
>
> (c) an eastern section where the linguistic divide is easier to recognise, coinciding in part with the course of Afon Syfynwy and in part with administrative boundaries". (See map 4)."

John (1976) has compared the position of the Landsker for the years 1603,1931, 1961 and 1971 and has shown that on the whole the linguistic divide shows remarkable stability. George Owen, the well known Pembrokeshire historian, was able to plot the position of the Landsker accurately in 1603. He found seventy-four English parishes to the south and sixty-four Welsh parishes to the north, the remaining six Landsker parishes being of mixed linguistic and cultural loyalties.

Results from the census survey of 1931, 1951 and 1961 show that the Welsh-speaking area is gradually being eroded from the south. In 1931, the zone of transition between the 'Welshry' and 'Englishry' was a relatively narrow one, for the most part consisting of the large Landsker parishes (namely Roch Camrose, Rudbaxton, Wiston, Llawhaden, Lampeter Velfrey and Llandewi Velfrey). By 1951 the transition between monoglat English in the south and bilingualism in the north was much wider, though between 1951 and 1961 there appears to have been very little change.

The recent survey by John in 1976 suggests a slight present-day retreat of the 'Welshry' in the parishes of St. Dogwells, Ambleston and Walton East, and a further retreat northward in the lowland region between south Pembrokeshire and South Carmarthenshire.

The Dialects of North and South Pembrokeshire

The 1961 census gives a percentage of Welsh speakers in Pembrokeshire of 24.4 in a total population of 94,124, as compared with percentages of 74.8 and 75.1 for the neighbouring counties of Cardigan and Carmarthen respectively.

Thomas (1973), in his study of the linguistic geography of Wales, shows that the Welsh speakers of Pembrokeshire belong to the south-west Wales speech area. This area includes the Tywi valley, the Teifi valley and Pembrokeshire, the latter forming a major sub-area. He suggests that present-day dialect movements are leading to the penetration of typically south-east forms into the Teifi valley and into Pembrokeshire. This replacement of the indigenous south-west forms may indicate simultaneous movement into the south-west from the Teifi valley and from the coastal regions of Carmarthenshire. Important communication routes pass through both these areas.

Thomas observes that in the south-west there are a number of unexpected borrowings from English (e.g. swits (sweets), swt (soot)). These borrowings are centred on the Teifi valley and northern Pembrokeshire and are therefore isolated from any immediate contact with non-Welsh speaking areas (except possibly South Pembrokeshire).

The English dialect of South Pembrokeshire is somewhat unusual since, because of its remoteness from other English-speaking areas, it is less adulterated by the influence of other languages. It appears that very few words have been introduced into the dialect by later influences in the British Isles because of its remote position on the far south-west peninsula. Valentine-Harris (1960) suggests that many of the words are pre-Chaucerian in origin, and have fallen into disuse in other areas. Harris states that the vast majority of South Pemborkeshire words can also be found in the Danelagh (that area of England settled by the Danes, including East Anglia, much of Mercia and most of Northumbria). He suggests that there are also resemblances between the dialect of South Pembrokeshire and those of Gloucester, Hereford and Hertford. For example 'f' and 's' become 'v' and 'z' respectively, as they still do in the English west country.

The pronounciation of many words of the old Wexford dialect have affinities with that of South Pembrokeshire (e.g. aggre (again), bryne (brain), gryne (grain), pyle (pail)). The Flemish element may be discerned in words like poor (boor), plenty (blenty)m ten (dten) etc. (Valantine-Harris 1960).

Other Pembrokeshire words are found elsewhere only in Caithness, the most northerly county of Scotland; Harris believes that this is a certain indication of their Norse origin.

Few Welsh words are incorporated into the South Pembrokeshire dialect, the chief influence of the Welsh language being its effect on intonation and sentence construction.

South Pembrokeshire words, possibly of Flemish origin

S. Pembrokeshire	English	Dutch	English
To clap (N.B. also found in Carmarthenshire Welsh dialect)	To tell tales	Klappon	To gossip
Coylin	Small stone used in children's game	Kogellain (archaic derivitive)	A small ball
Drang	A narrow alley	Drang	A crowd
Vang	To save water from washing	Vang	To catch
Velge	A fallow	Vaal	Fallow
Voor	A furrow	Voor	A furrow

After Laws (1888)

James (1958) suggests several others, namely:-

S. Pembrokeshire	Dutch	English
A bully bo	(Bullebok)	A bogey
Bleeze	(Blaas)	A bladder
A Druke	(Drukken)	A handle
A Disle	(Distal)	A thistle
To pile	(Pyl)	To throw stones
A preen	(Priem)	A knitting needle
Leat	(Laat)	An artificial water trench
All a'both	(Allebei)	Altogether

CHAPTER 4

Parish Registers

The majority of the parish registers for Pembrokeshire are held at two centres, the National Library of Wales in Aberystwyth and the County Offices in Haverfordwest. Unfortunately, as is the case for many areas of England and Wales, the registers are far from complete, and when selecting parishes for study every effort was made to choose those which had the most complete records over the longest possible time period. It was discovered that records were far more complete from parishes situated in the southern half of the county. As far as possible parishes were selected where intact records existed from 1750 to the present day. The year 1750 was chosen as the starting point as it was found that records prior to this date recorded only the names of the couple to be married and gave no indication of their parish of residence.

Because of the limited time available only the marriage registers were used in this study and, as this was the case, one assumption had to be made, namely, that individuals were born in the parish in which they were resident at the time of marriage. However, since mobility was limited, at least up to the present century, it is hoped that this has not caused any great margin of error.

From the parish registers it was possible to collate the following information:-

(1) The number of marriages per parish in a set time period. (A period of 30 years was used to represent one generation).

(2) The percentages of endogamous/exogamous marriages which occurred.

(3) The number of marriages which occurred across the Landsker.

(4) The percentage of English to Welsh surnames for each time period in each parish, and the inflow of new families (indicated by the appearance of a new surname in the parish,

but showing the bearer of the surname as a resident).

N.B. It must be noted that this was only possible in the case of new English surnames, the Welsh surnames occurring so frequently as to make this distinction impossible

The map (p269) shows the parishes selected for close study. For North Pembrokeshire the parishes are Nevern, Ambleston and Bletherston, Nevern being in the far north, and the latter two parishes closer to the Landsker. In the south a similar pattern was used, Castlemartin lying in the extreme south, Hubberston situated on the Haven, Burton and Begelly to the centre of Southern Pembrokeshire, and Slebech just to the south of the Landsker parishes. The Landsker parishes of Camrose, Wiston and Llawhaden were also studied. Fewer parishes were studied in North Pembrokeshire because of the incompleteness of the records.

Table 1.1 shows the percentage endogamy, in three categories as:-

(1) Within the parish

(2) Within the parish and with a neighbouring parish

(3) Within the other two categories and within North/ South Pembrokeshire (depending on whether the parish lies in the south or the north).

It will be noted that the Landsker parishes have not been included in this table but treated separately.

Table 1.2 shows the percentage of marriages which occurred across the Landsker from each parish for each time period. Again the Landsker parishes are not included, as it was impossible to ascertain marriages across the linguistic line as only parishes are listed in the register and not the actual place of residence within the parish.

The diagrams on pages 37 to 42 represent marriages occurring in the Landsker parishes for intervals of thirty years. The figure in the centre circle fives the percentage endogamous marriages, i.e. within the parish. Each exogamous marriage is shown as a 1 mm. wide line pointing in the direction of the parish concerned. The length of the lines approximately representing the distance the parish is from the Landsker parish being studied, and a dotted line being used for places outside Pembrokeshire. No attempt has been made to calculate marriages across the Landsker for reasons previously stated, but the diagrams give an idea of the areas from which marriage partners were selected.

Table 1.3 shows the percentage of Welsh and non-Welsh surnames listed in the parish registers for each time period, the percentages being expressed as percentage Welsh and English surnames for each sex.

Conclusions

Table 1.1 shows that the number of endogamous marriages within a parish is very variable for both North and South Pembrokeshire, the highest figure being in the period 1750 to 1780 in the North Pembrokeshire parish of Nevern. This is a large parish with a large population in a rural area; a large population means more choice of marriage partners within the parish and the lack of urban settlement means there is little to attract visitors to such things as markets. Endogamy will be affected by the type of settlements within the parish and whether there are attractions such as employment, entertainment or business centres to bring visitors into the parish.

Marriages within the parish or between individuals from neighbouring parishes explain a large number of the marriages which occurred in most parishes for the complete time span considered. The exception is

Hubbertston prior to 1840. After this date the population in this parish increased markedly and, as the marriage registers give only the place of residence of the couple at the time of marriage, it is impossible to tell how long individuals had been resident in Pembrokeshire. However, sudden large increases in the population size of a parish suggest influxes of people into the area. This table gives an overall picture of a relatively inbreeding population, with a strong tendency for marriage partners to be selected from the immediate neighbourhood. The table below gives the Census figures for parish populations. The biggest population increases are in the parishes of Hubberston and Burton. There is a population decrease in all the parishes except Begelly where there was a slight increase.

Census Data

Parish	Census Dates 1801	1831	1871*	1891	1921	1961
North Pembrokeshire						
Nevern	1,283	1,558	1,424	1,209	885	617
Ambleston	421	574	541	443	371	299
Bletherston	235	300	267	236	171	108
South Pembrokeshire						
Burton	457	694	909	1,027	894	575
Begelly	354	526	535	439	448	419
Slebech	288	353	362	339	303	211
Hubberston	641	1,013	1,458	1,517	Parish divided	-
Castlemartin	338	487	381	381	267	166
Landsker						
Wiston	569	745	691	673	629	559
Llawhaden	371	657	556	547	458	355
Camrose	831	1,259	1,011	833	627	703

* No Census for 1861.

Table 1.2 shows the percentage of marriages across the Landsker. In all cases this figure is very low, the highest value being 9.09% for Ambleston, a parish close to the Landsker for the period 1840 to 1870. The results suggest that the geographical position of a parish in relation to the Landsker affects the frequency of marriages across this linguistic barrier. The further the parish is from the Landsker, the lower the frequency.

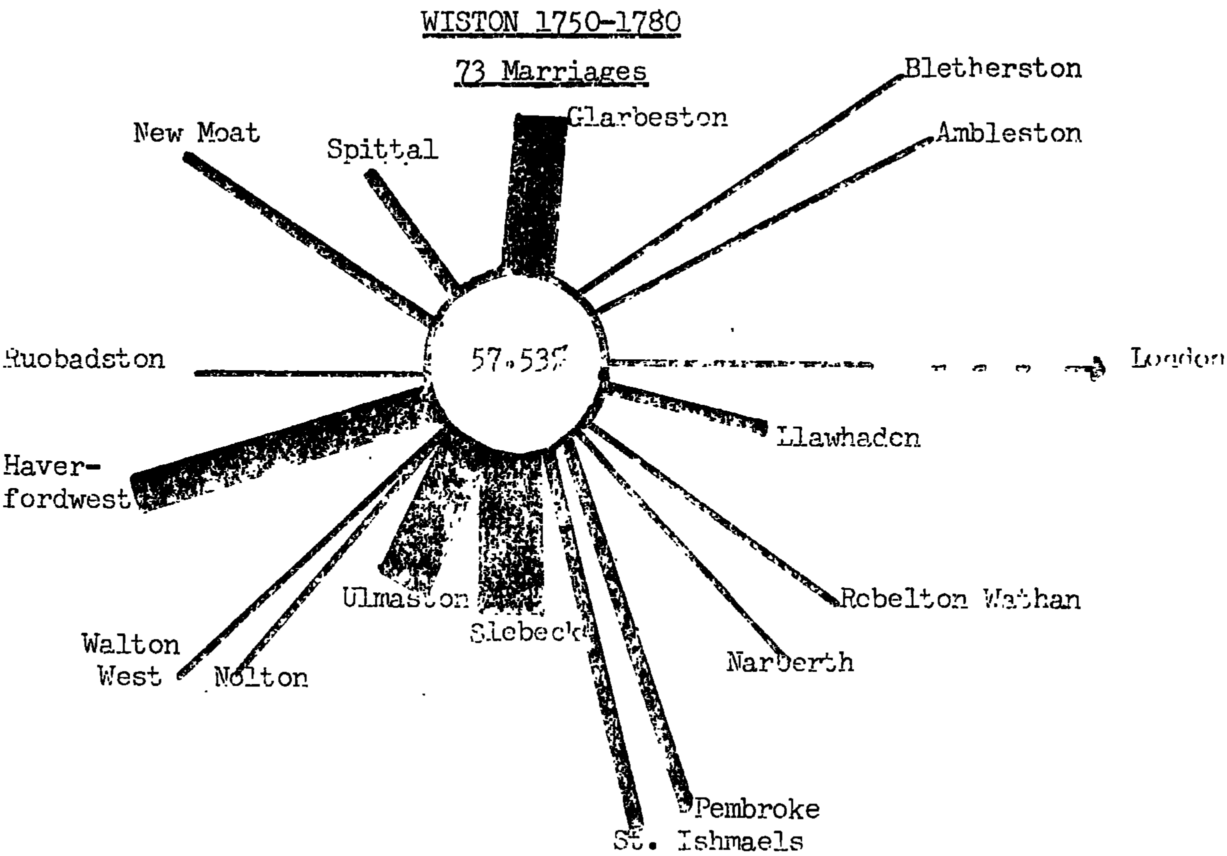
The diagrams on pages 37-42 consider the Landsker parishes. Marriages in the parish of Wiston, prior to 1840, involved individuals from north and South Pembrokeshire. Between 1780 and 1840 a large number of the marriages were with residents of other Landsker parishes and this continued at least up to 1870. Other marriages in the period 1840 to 1870 involved individuals resident in South Pembrokeshire, and only one marriage involved an individual from a North Pembrokeshire parish.

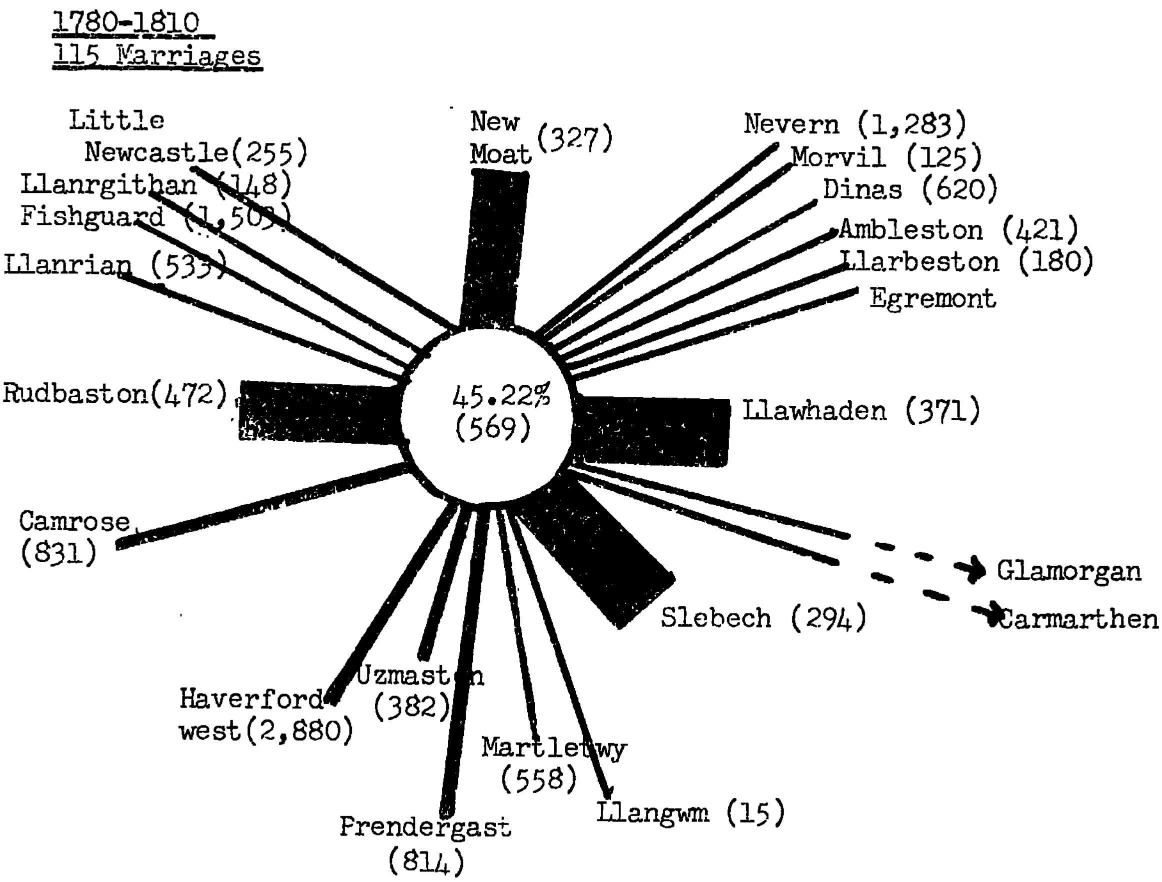
For the parish of Llawhaden, those individuals who chose a marriage partner outside Llawhaden tended to marry someone from another Landsker parish or from South Pembrokeshire, with some individuals marrying outside the county especially people from other parts of Wales.

Camrose, for the period 1750 to 1780, shows a higher frequency of marriages with North Pembrokeshire. However, in the period 1780 to 1810, there were a large number of marriages between the people of Camrose and those of Roch, and there were fewer marriages with North Pembrokians and an increase in the number of marriages with South Pembroke individuals.

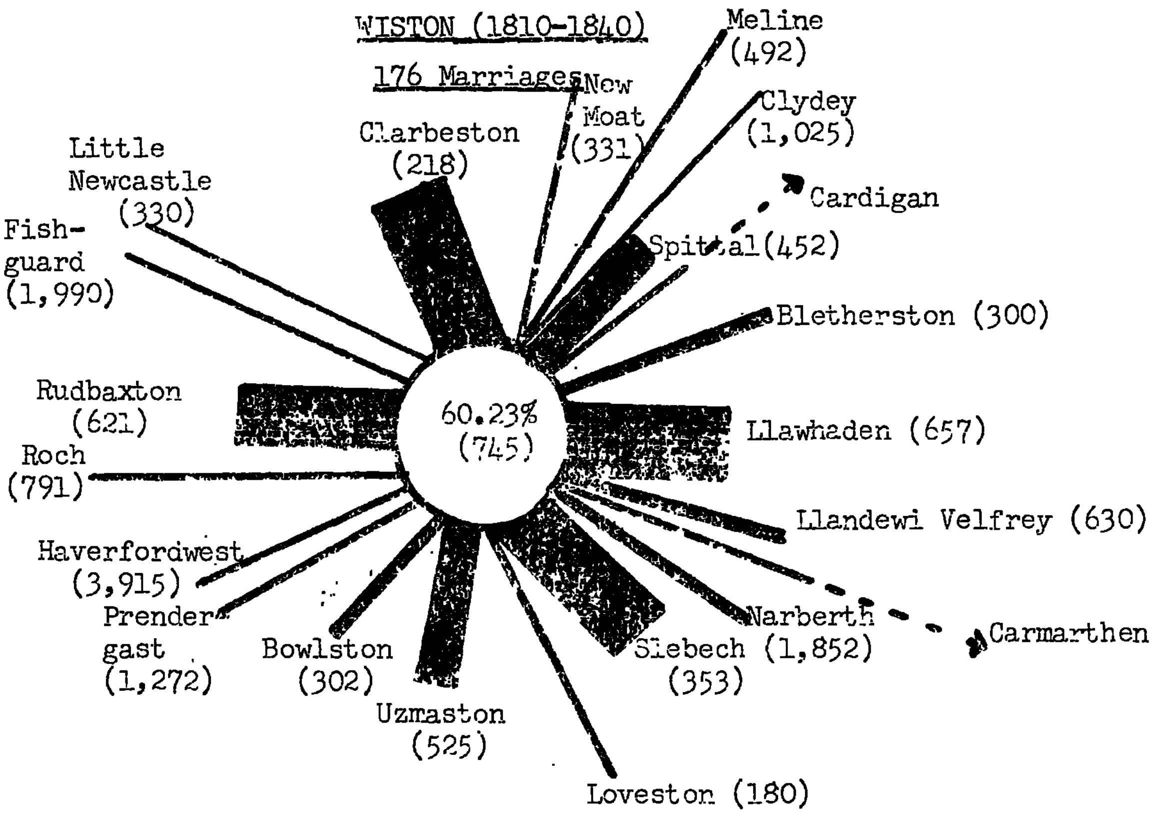
These trends continued in the period 1810 to 1840.

Table 1.3 shows the percentages of Welsh and non-Welsh surnames occurring in the parish registers. Welsh surnames predominate in North Pembrokeshire, the values dropping slightly for the Landsker parishes. The parish of Slebech, just south of the Landsker, still has a high percentage of Welsh surnames, though it should be noted that the registers for this parish are for from complete, none being available after 1810. In the more southerly parishes the values fall further, the lowest figures being for the parish of Hubberston. Hubberston is especially interesting since the registers for this parish show many marriages between girls who were resident in the parish and sailors who visited the dock there. The non-Welsh surnames listed are of English, Scottish and Irish origin, the Irish surnames being those commonly associated with Ireland's east coast and with the counties of Wexford, Waterford and Cork.

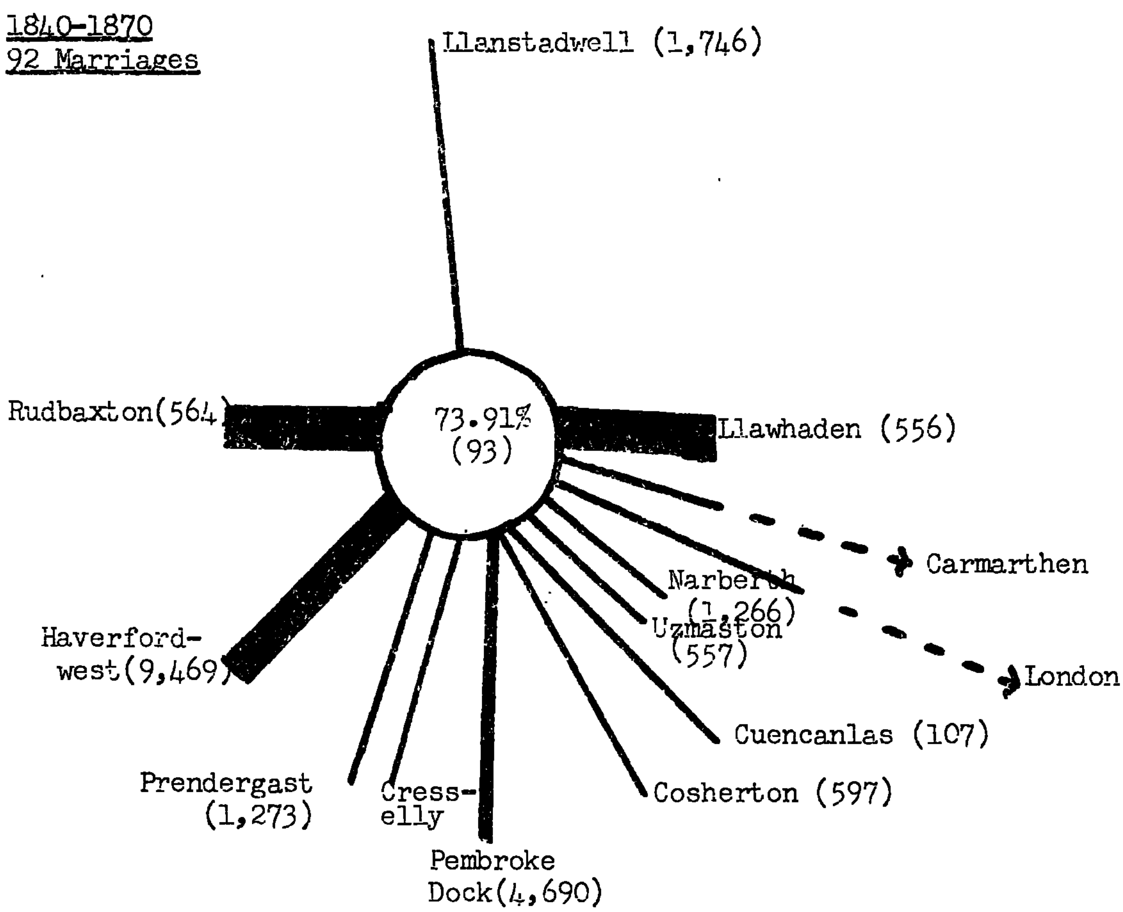




Figures in brackets give parish populations from 1801 census.

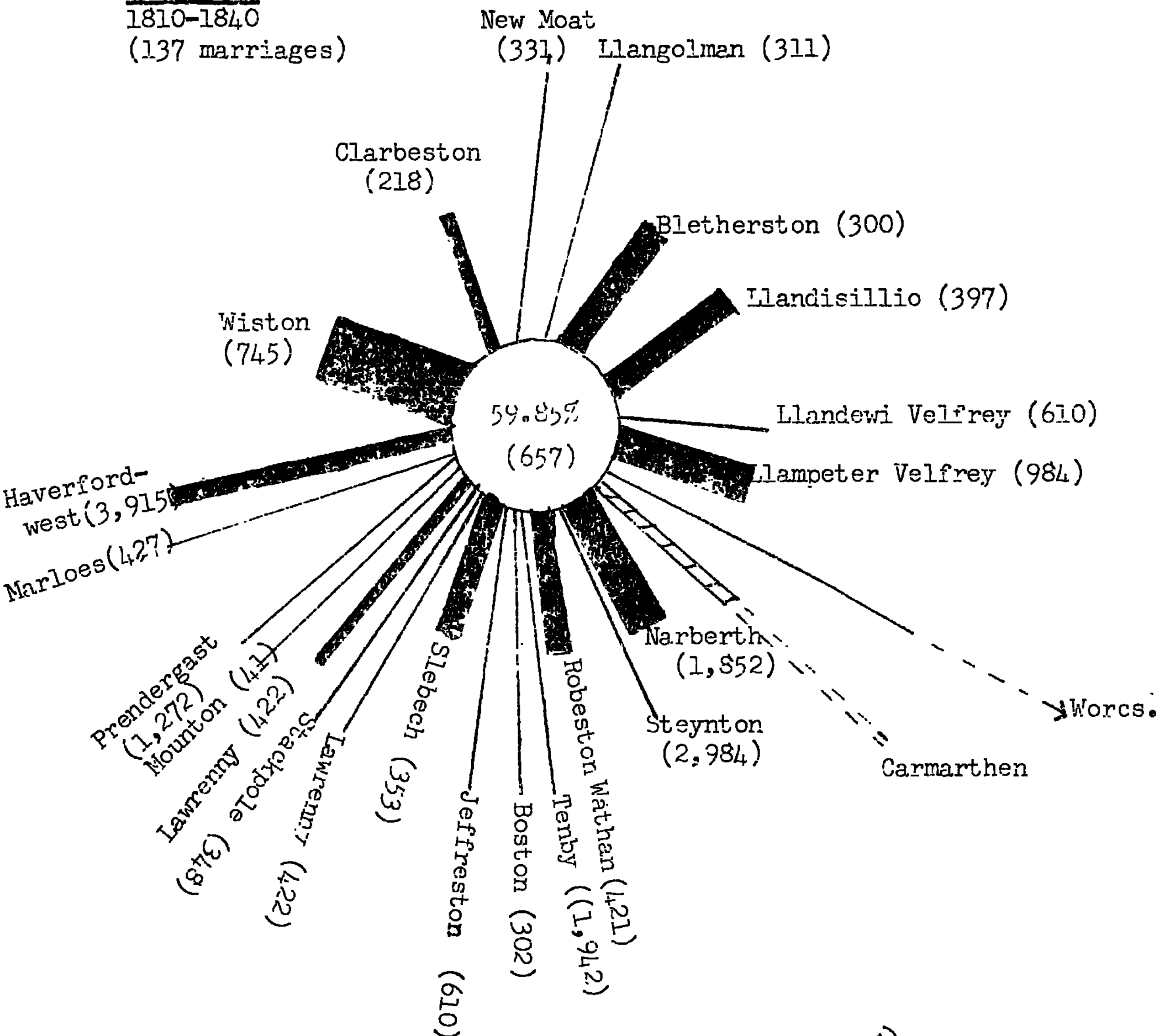


Census figures from 1831 Census.

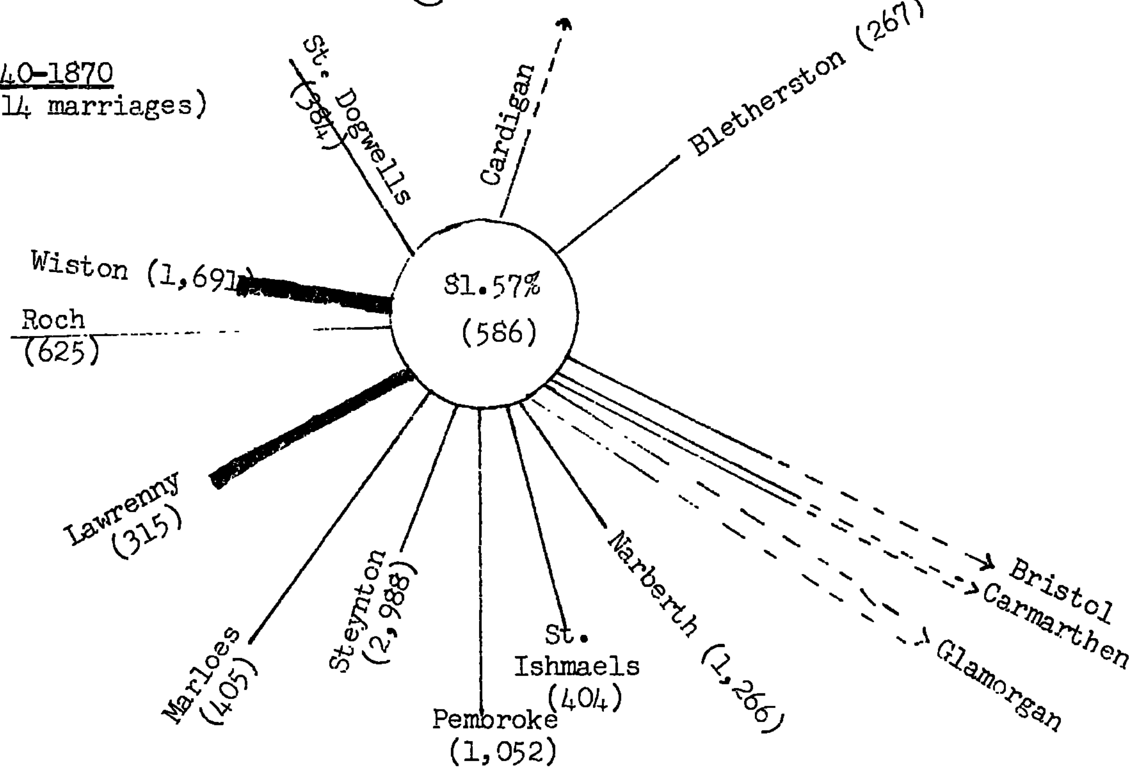


Census Figures from 1871 Census.

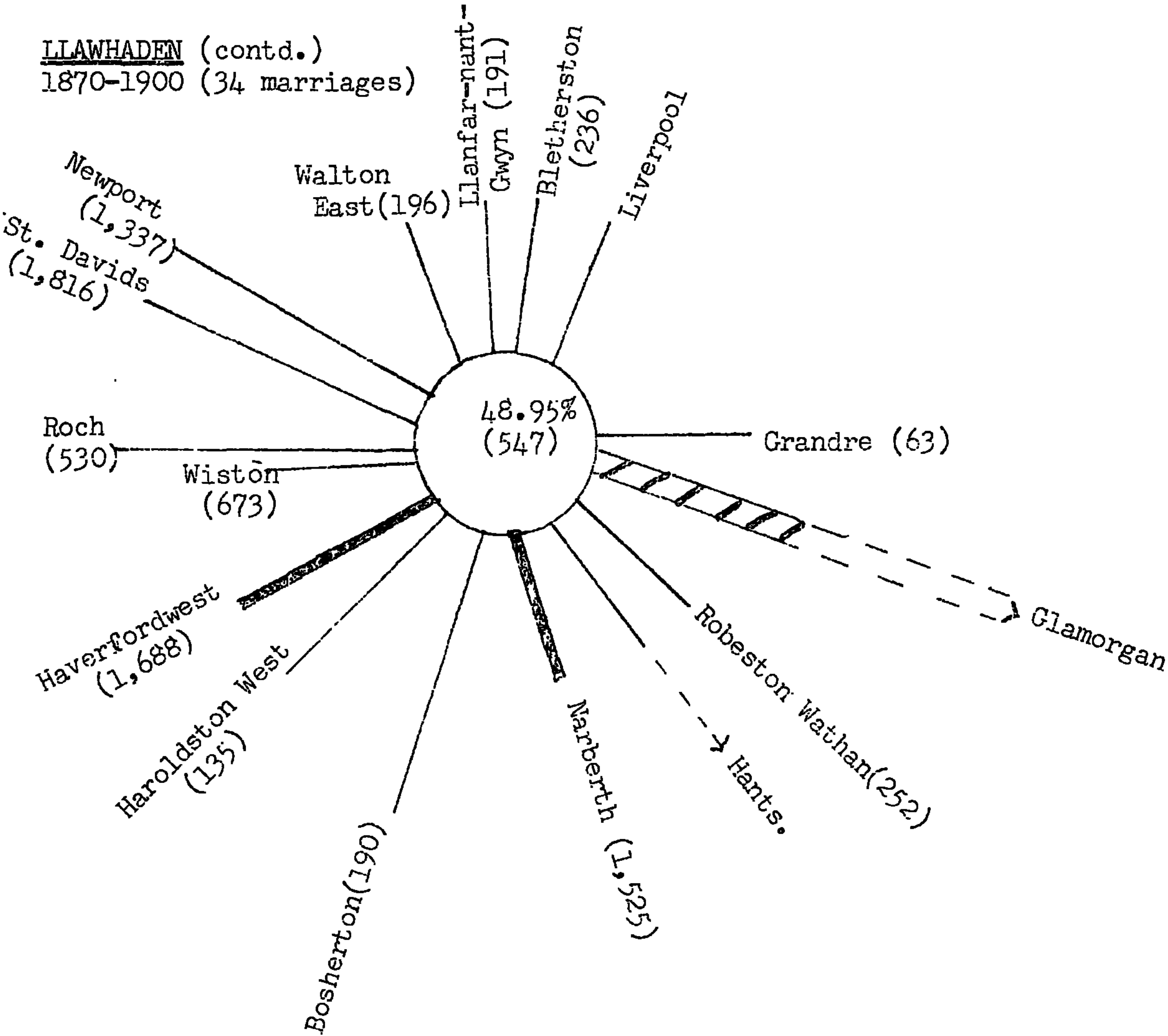
LLAWHADEN
1810-1840
(137 marriages)



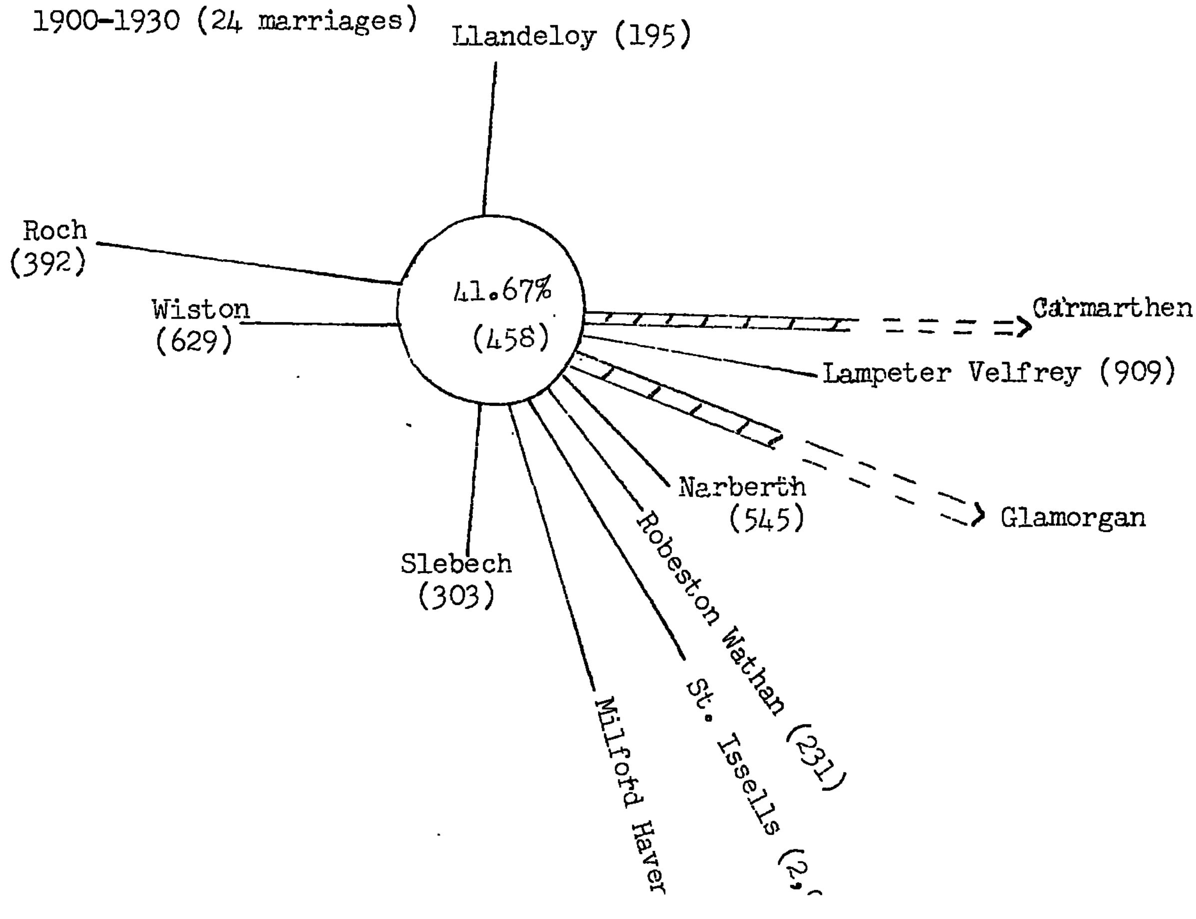
1840-1870
(114 marriages)



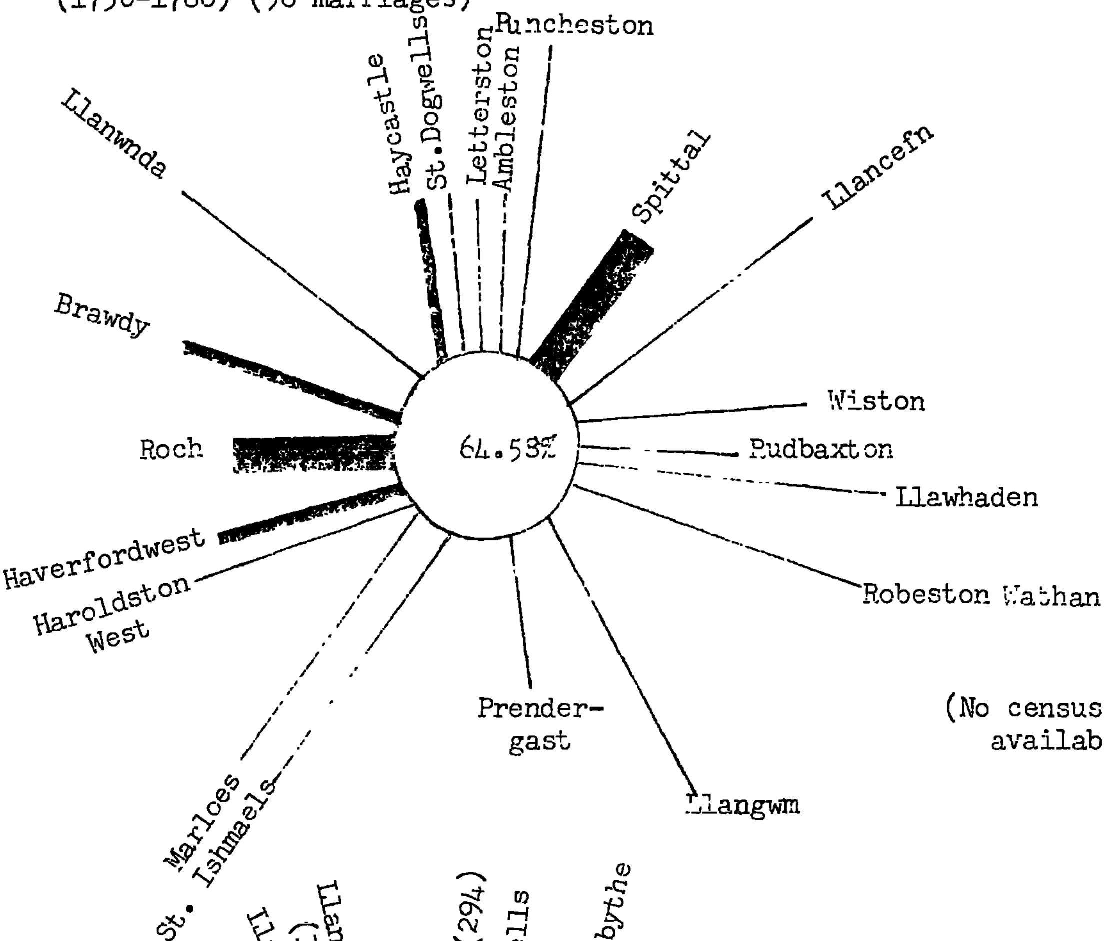
LLAWHADEN (contd.)
1870-1900 (34 marriages)



1900-1930 (24 marriages)

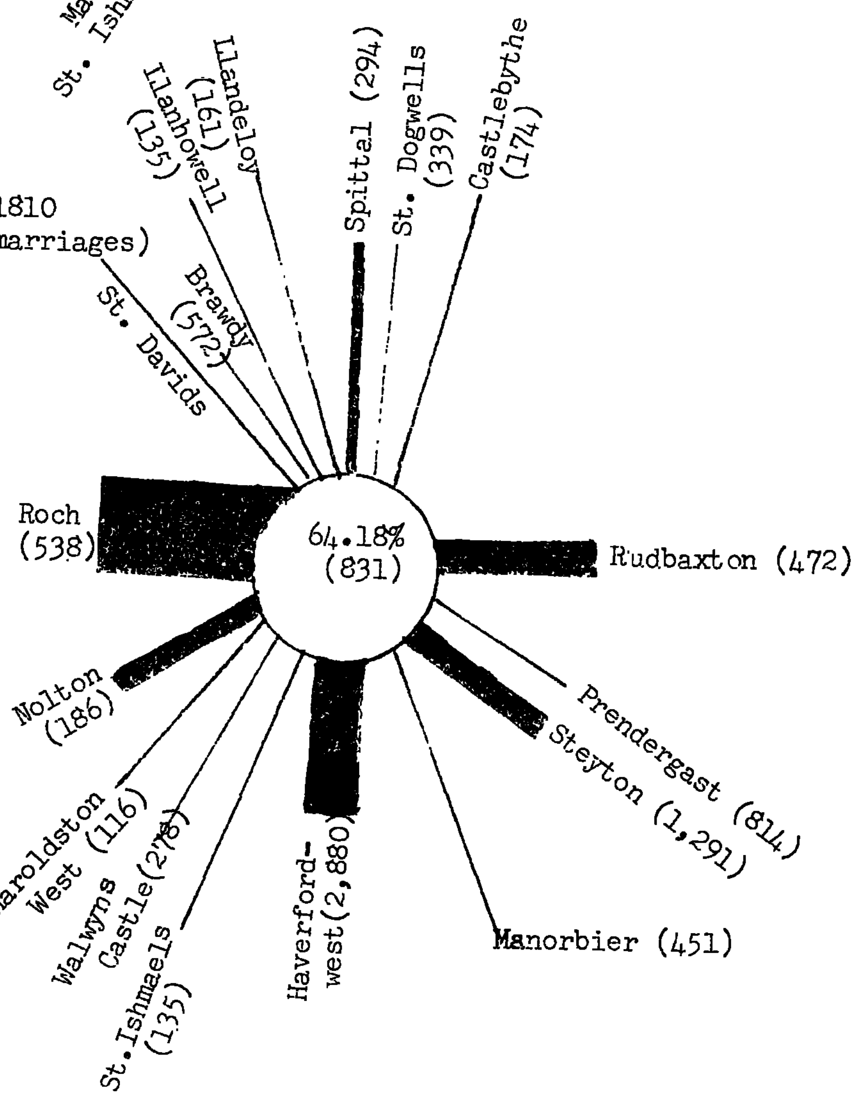


CAMROSE
(1750-1780) (96 marriages)

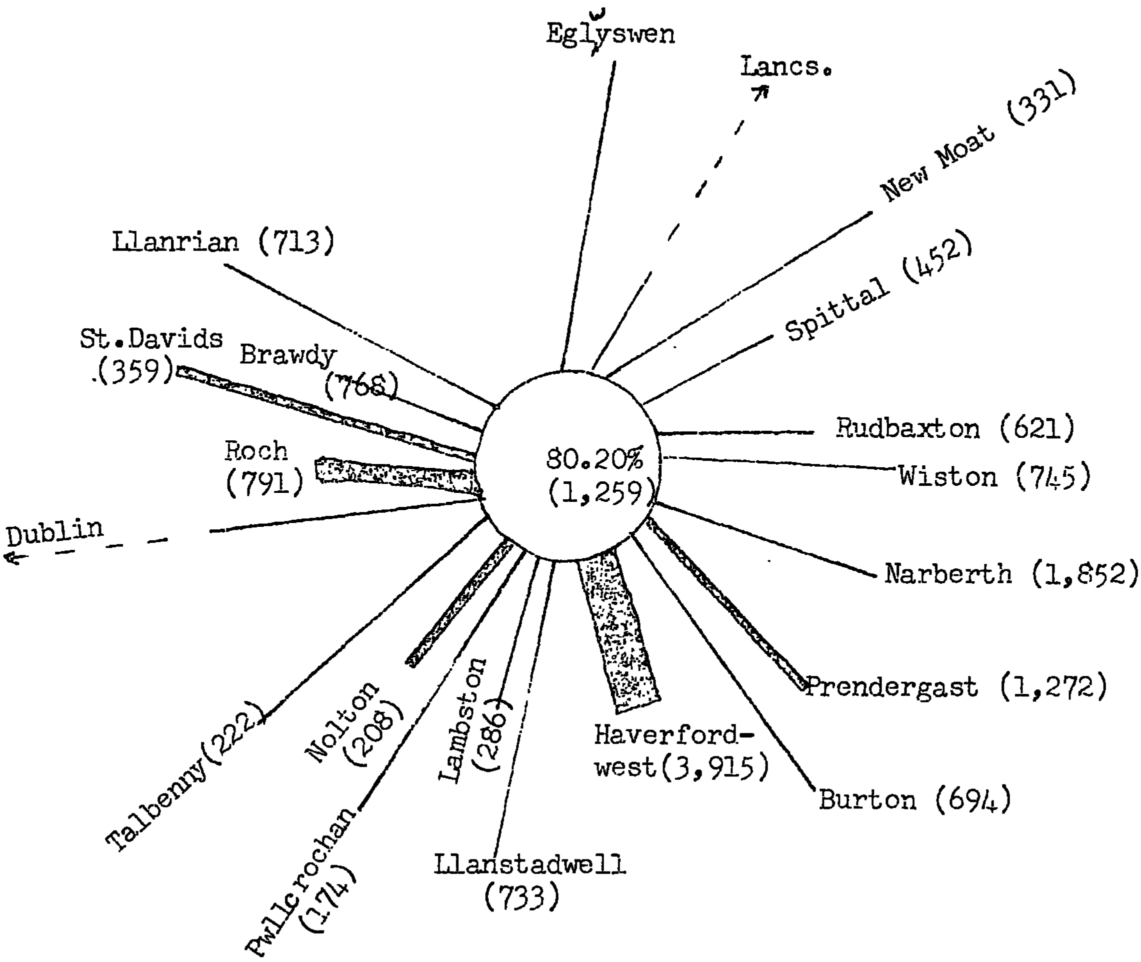


(No census figures available)

1780-1810
(134 marriages)



CAMROSE (contd.)
1810-1840 (202 marriages)



CHAPTER 5

DEMOGRAPHY

Demographic data was collected as part of both the dermatoglyphic and the serological surveys to establish the geographical history and ancestry of each individual concerned. In the case of the dermatoglyphic study, a questionnaire was sent to the parents of each child and those who were willing for their child to participate in the study were asked for the following information concerning the family:-

(1) The birth place (by parish) of the child, his/her parents and grandparents

(2) The religion of the family

(3) The occupation of the father, father's father and mother's father

(4) The ability of family members to speak Welsh.

In the serological survey, each individual willing to participate was asked his/her birth place, and the birth places of their parents and grandparents. Again the surnames of the four grandparents were collected as far as possible, though this proved difficult as many of the older donors did not know the answers.

As well as being useful in the subdivision of genetic data into separate groups depending on birth place and ancestry (see Chapter 8), information as to the stability of the population may be gleaned from a closer study of demographic data. In effect, the two studies have, by their nature, selected individuals from at least two generations.

Dermatoglyphic prints were taken from school children, the eldest being eighteen years old, whereas the blood donors were aged between eighteen and sixty-five years, the majority of donors being under fifty years of age.

Because in both studies a small number of individuals represented the population of a parish (except in the case of urban parishes) it was impossible to treat each parish as a separate population. However, it was possible to measure the degree of endogamy within North Pembrokeshire and South Pembrokeshire, the number of marriages across the Landsker, and the number of marriages between a Pembrokeshire resident and someone resident elsewhere in the British Isles.

The table below gives the number of marriages across the Landsker in both surveys for:

(a) the parental generation

(b) the grandparental generation

(Figures in brackets give total number of marriages)

	Dermatoglyphic Study	Serology Study
(a)	69 (1,435) 4.81%	36 (933) 3.86%
(b)	94 (2,870) 3.28%	7 (1,866) 0.37% (many missing results)

The next table gives the percentages of exogamous marriages involving persons born outside Pembrokeshire. Again the two generations are used and the county divided into North and South.

	Dermatoglyphic Study		Serology Study	
	North	South	North	South
(a)	165 40.7%	224 41.48%	72 28.9%	232 36.48%
(b)	197 24.32%	257 23.80%	47 9.44%	130 10.22%

The Tables on pages 212 to 217 show the frequencies (as percentages) of individuals and their relatives born in each parish for both the dermatoglyphic and serology surveys. Column eight of these tables lists the population of each parish as given in the 1971 Census. The frequencies for the dermatoglyphic demographic data reflect the population sizes, that is to say large numbers (and therefore higher frequencies) in parishes with larger populations. However, the serology demographic data show a bias towards the urban populations. Blood donor clinics were situated in the larger towns so the local people could easily visit them. However, individuals resident in the remoter rural parishes would have to travel some distance to a donor clinic, and this obviously was enough to dissuade members of the rural communities from attending. Considering the dermatoglyphic survey, 42% of the individuals born within Pembrokeshire were born to the north of the Landsker, 7.2% in the Landsker parishes, and 50.8% to the south of the Landsker. Similar percentages are found for the parents and grand-parents. Although the population of South Pembrokeshire is much larger than that of the north, many of the South Pembrokeshire residents were not born within the county but had come to the area with incoming industries or to work at the oil terminals in the Haven. This explains why the number of individuals whose prints were collected included a high percentage of children not born within the county, and therefore not included in the statistical analysis.

The demographic data from the serology study, shows that 27.2% of the donors were born in ~~South~~ NORTH Pembrokeshire, 2.8% in the Landsker parishes, and 70% in South Pembrokeshire. These frequencies reflect the difference in population size between the north and south. It should also be pointed out that the population in North Pembrokeshire is far more scattered, many people living in the remote rural parishes and unable to reach a donor clinic with ease.

Both studies show a low frequency of marriages across the Landsker but relatively higher frequencies of marriages between a Pembrokeshire born individual and someone born elsewhere. This is true for both the north and south of the county for both the generations considered.

Table 1.5 shows the ability to speak Welsh for all members of the family, the highest incidence of Welsh being spoken in North Pembrokeshire as would be expected. No monoglot Welsh speakers were found. The results show that in 60.3% of homes in North Pembrokeshire, the Welsh language is in common use compared with 4.6% in the south.

Religion

Though details of the family's religion was collected as part of the dermatoglyphic survey, this was not used as a partitioning parameter. However, analysis of the data did show that Methodism was the predominant religion in North Pembrokeshire, whereas the Church of Wales was most widely supported in the south.

Conclusions and Summary

Several pieces of important information may be deduced from the demographic data:-

(1) Sample sizes for each parish for the dermatoglyphic survey, reflect the population size of the parish.

(2) Samples sizes for each parish for the serology survey show a bias towards the urban areas and parishes surrounding urban areas.

(3) In both surveys the frequencies of marriages across the 'Landsker' are low and confirmed the trend shown in the parish records.

(4) The continued existence of a linguistic divide, is illustrated by the difference in Welsh-speaking ability between North and South Pembrokeshire.

CHAPTER 6

Surnames and the Use of the Surname as a Genetic Marker

The population of Wales, and of Pembrokeshire in particular, is heterogeneous, comprising the Welsh descendants of people who have long inhabited the area; and immigrants who have more recently settled there from various localities at different times.

Morgan-Watkin (1956) and Ashley and Davies (1966) have shown that a strong association exists between the possession of Welsh surnames and the possession of a Welsh cultural background (i.e. the ability to speak Welsh, attendance at Welsh churches and a general interest in Welsh affairs). Ashley and Davies were able to show genetic differences between two groups, one Welsh and one non-Welsh, separated by using the surname technique. Morgan-Watkin, working in Pembrokeshire, discovered that in the main 'Little England' had adopted the Welsh surname pattern. Only about fifty English surnames were commonly found there.

In addition to surnames of English and Welsh origin, traces of other groups, namely the Flemings, Normans and Vikings are found in Pembrokeshire. The effect of these immigrants on the population cannot be readily assessed by studying the number and distribution of surnames of different racial origin because of the masking which occurred when Welsh surnames came into general use in the latter part of the eighteenth century. Prior to this date surnames were not used in Wales, except amongst the gentry who adopted theEnglish idea of surnames. From the days of the Welsh princes until Tudor times it was customary for all Welshmen of however low status to have their pedigrees embodied for about nine generations in their ordinary names e.g. 'Llewelyn ap Dafydd ap Lewis ap Griffith ap Meredith ap Eynon ap Morgan ap Owen ap Llywarch' (ap = son of). These long and cumbersomé titles were gradually curtailed due to the influence of the clergy and law court officials, and a shorter form used; for example, Llewelyn ap David, was universally adopted. That is, the father's christian name, normally became the son's surname, the 'ap' or 'ab' meaning 'son of' eventually being dropped. However, this surname was not hereditary for when the son had a child, it would take the son's christian name as its surname. This system of surname changing in each generation continued in certain parts of Wales until the middle of the nineteenth century. This use of baptismal names as surnames explains the overwhelming predominance of the patronymic type of surname in Wales.

Surnames which may be called truly Welsh, that is those which have arisen from the Welsh language, do exist and examples include Baugh, Bengough, Dunne, Floyd, Gittins, Gwilt, Howell, Lugy, Vaughn, Yorath etc. Others have originated in Wales and are derived from Welsh place names such as Breckon, Conway, Neath, Powys. However, a high percentage of surnames categorised as Welsh are in fact baptismal names. A list of surnames considered to be Welsh is included in the Appendix, the list being drawn from the works of Morgan-Watkin (1956) and Guppy (1890)

Viking Surnames in Pembrokeshire

The Scandinavians were responsible for many of the names of islands and of villages round the coast of Pembrokeshire. Norse surnames also exist in Pembrokeshire, largely in the southern half of the county, and examples of these are given below.

Pembrokeshire	Scandinavian equivalent	Meaning
Athoe	Aethoe	Isle of eider ducks
Codd	Koddi	A pillow
Cole	Kollr	A hill
Coleby	-	Hill house
Havard	Havaror	-
Protteroe	Broaroe	Brother's island
Scall	Scalld	A poet
Scourfield	Sker-fel	Rock-fall
Stubbs	Stubbi	A stake
Skyrme	Skroeme	The name of a giant
Taskar	Taska	A pocket

(After Laws 1888)

Some of these derivations have been questioned by later authors and alternatives offered.

Norman Influence

The Normans reached Pembrokeshire from central Wales in the last decade of the eleventh century. It is known that during the twelfth century few noble Welsh families were not connected to the Normans by ties of blood. The Welsh common people, however, never made peace with the foreigners however long they remained there.

A Norman settlement in North Pembrokeshire was made by Martin de Tours, a marcher earl, in the town of Newport. Norman surnames still found in north Pembrokeshire are Martell, Miles, Mortimer, Devereux and Reynish. There is evidence that there were English men in de Tour's force and possibly it is these men whose names are remembered in such surnames as Picton, Sayle, Selby, Mabe and Battin.

Norman surnames found mainly in South Pembrokeshire are Vale or Dale, Perrott, (De)Bonville and Cantington (Owen 1902).

The Flemish Influence

In about 1108, Henry I transferred large numbers of Flemings to South Pembrokeshire from the north of England. This initial settlement is thought to have been followed by others in 1113 and 1155. Lloyd (1939) suggests the hundreds of Rhos and Deugleddy, but Laws (1888) suggests they also settled in Pembroke and Tenby and possible Angle, that is in S.E. Pembrokeshire. Evidence suggests that the Welsh did not welcome the newcomers, and that intermarriage, at least at this time, was unlikely. Surnames of Flemish origin may still be found in Pembrokeshire, for example:-

Noot	from the Dutch, meaning a nut
Prendergast	(this also occurs as a place name)
Walin	
Wys, Wiston	from 'Wizo' the Fleming (Wiston is also a place name
Tankard or Tankred	
Alywin	
Godebert	
Wobald	

Irish Influence

Many Irish surnames occur in the populations living around the shores of Milford Haven. In the parish registers of Hubberston (see Chapter 4), many of the individuals bearing Irish surnames were sailors. The Irish surnames encountered are in the main characteristic of the east coast of Ireland, especially the counties of Wexford, Waterford and Cork. Examples are Sinnott, Furlong, and Daly.

The Use of Surnames in the Present Genetic Studies

The foregoing text gives some idea of the variety of surnames to be encountered in Pembrokeshire. In the preliminary survey of ancestry the surnames were divided into seven categories, namely Welsh, English, Norman, Flemish, Viking, Irish and Scottish; other 'foreign' names not being included. Table (1.6) gives the frequency of occurrence of each in North and South Pembrokeshire. If the names are categorised as Welsh and non-Welsh, then there is a predominance of Welsh surnames in the north and south but in the south far more non-Welsh names are found.

The surnames of the four grandparents of each individual were collected as part of the demographic data for both the dermatoglyphic and serology surveys (for details see previous chapter). A surname was designated as Welsh if it occurred more frequently in Wales than in England. A list of 110 surnames accepted as being Welsh is included in the Appendix, and is based on the works of Morgan-Watkins (1956) and Guppy (1890). Any names not included in this list were considered non-Welsh, and for the purpose of statistical analysis amalgamated to form one category. From the demographic information it was possible to determine whether the four grandparents of any individual possessed Welsh or non-Welsh surnames. Thus each person could have an ancestry of zero Welsh grandparents up to a possible four Welsh grandparents, zero Welsh grandparents representing pure 'English', and four Welsh grandparents pure 'Welsh'. Each individual was assigned a 'Degree of

Welshness' (DW) of between 0 and 4, 0 being 'English' and 4 being 'Welsh'. The numbers of individuals falling into these two extreme categories were smaller than was desirable (even though this would have maximised the differentiation between English and Welsh). Therefore categories 0 and 1 of DW were amalgamated, as were categories 3 and 4, the former being essentially English and the latter essentially Welsh.

Carrying out a chi^2 test of 'Degree of Welshness' against birth place of the individual produced the following results:-

	Dermatoglyphics Survey		Serology Survey	
	DW = 0, 1	DW = 3, 4	DW = 0, 1	DW = 3, 4
North Pembrokeshire	18.0%	82.0%	15.8%	84.2%
South Pembrokeshire	45.2%	54.8%	64.8%	35.2%

$\chi^2_1 = 75.729$ (p) = .001 $\chi^2_1 = 103.585$ (p) = .001

These results show a high frequency of Welsh surnames in North Pembrokeshire. In the south, considering the older age groups covered by the serology survey, there is a greater incidence of English names than Welsh, whereas in the dermatoglyphics survey, more Welsh names were recorded, that is more individuals with three or four Welsh grand-parents. There is no evidence from the demographic data that there has been any breakdown of the cultural barrier, the frequency of marriages across the Landsker being low for both sets of data. It may be that people having Welsh surnames have moved into South Pembrokeshire from other parts of Wales, and their children have been born in the county. Certainly the Table on page 210 , would suggest a relatively high frequency of exogamous marriages, involving a Pembrokeshire resident and an 'outsider'. However, the difference in the frequencies of English and Welsh surnames between the two surveys may be a product of random factors.

By identifying 'English' and 'Welsh' using the surname technique, the genetics data could be divided into subsets using both the birth place of the individual and his/her ancestry. Thus four subsets were created, namely 'Welsh' in North Pembrokeshire, 'English' in North Pembrokeshire, 'Welsh' in South Pembrokeshire and 'English' in South Pembrokeshire. For a full discussion on the use of these subsets see the Chapter entitled 'Partitioning Criteria').

When considering the genetic data, 'ancestry' has been used as a criterion, using only two subdivisions, namely 'Welsh' and 'Non-Welsh' (classified as 'English'). Although surnames were categorised into the seven categories previously listed, difficulties were often encountered in finding the actual origin of many of the so-called English surnames. It may well be that some should have been included in other categories. Because of this only the two categories were used and Table 1.6 should be treated with caution.

CHAPTER 7

PREVIOUS PHYSICAL ANTHROPOLOGY STUDIES IN WALES

1. Anthropometry

In 1916 Fleure and James reported the results of their survey of 'those of purely Welsh descent'. This survey involved the collection of anthropometric data, skin colour data, eye colour, hair colour and various facial measurements, the data being collected only from males. From their results they concluded that local types still survived in Wales; and these markedly differed from each other. They suggest that the relative isolation of much of Wales has prevented admixture of the Neolithic element with incoming populations. Inflow of Normans and Flemings into South Wales led to the subjugation of the indigenous population who tended to migrate to high ground. They also point out that social and economic changes have affected the relative proportions of the various types, as has the spread of disease, which has led to the differential elimination of the different types deliberated.

In 1958 this study was reviewed (Fleure and Davies 1958). The authors divided Wales into eleven regions, one of these being South Pembrokeshire onto which bordered 'Teifiside' and 'Carmarthenshire'. They showed the male population of South Pembrokeshire to be taller than the general average for the Welsh, but shorter than the lower population. Their study of hair colour showed a value of 14.5% for individuals with red hair in South Pembrokeshire, compared with 7.2% for Teifiside (Northern Pembrokeshire and South Cardigan) and 9.1% for Carmarthenshire.

They concluded that the Welsh population overall included elements which came as the result of very ancient migrations from the east and south-east, and that these drifts brought genes of very early British ancestry to Wales, which still survived on the high moorlands. Also it is suggested that South Wales received immigrants from south-west Europe in very early times, but that North Wales proved an unsuitable habitat for these incomers.

2. Tasting of Phenylthiocarbamide (P.T.C.)

The first survey of P.T.C. tasting ability in a Welsh population was carried out by Beach (1953), who compared the population of the Plynlymon area with that of the rest of Wales. In the general Welsh samples the individuals tested were from all parts of Wales and of Welsh ancestry, this condition of Welsh ancestry being met if a subject's parents were both born within Wales. The Plynlymon Moorland sample consisted of subjects of local ancestry. The results obtained showed that neither sex showed significant differences between regions. However the X^2 values for between-samples heterogeneity were very near the borderline value of significance. A larger percentage of non-tasters (44%) was found for the Plynlymon sample than for the general Welsh sample (29%) and when the results for both sexes were amalgamated then significant differences were found. The gene frequencies for the recessive t-gene (non-taster) being 0.4152 (± 0.0638) for the general Welsh sample and 0.5533 (± 0.1190) for the Plynlymon Moorland populations. Beach suggests that these differences may be due to environmental effects. The gene frequencies reported for the Plynlymon area are comparable with those given by Tanner et al (1964) for the English population.

Partridge, Zeki and Sunderland (1962) tested for taste-blindness in the Black Mountains (Carmarthenshire) and found the frequency of non-tasters to be 43.3%, the surrounding areas having values more comparable with those of England and North-west Europe (35.14%). Cartwright and Sunderland (1967) showed that the gene frequencies of non-tasters varied throughout England but were never higher than 40.3%. The unpublished data of Fraser-Smith and Sunderland for North Wales gives much lower frequencies of non-tasters - for all North Wales a figure of 20.5% is given. These lower values are akin to those found for the Northern Irish.

In 1963 Pullin and Sunderland (1963) investigated taste-blindness in the population of Pembrokeshire, comparing samples of individuals born to the north and to the south of the Landsker. No regional variation was detected and no sex difference. However, the North Pembrokeshire sample had the higher non-taster frequency of 40.2%, compared with a value of 34.1% for South Pembrokeshire. The North Pembrokeshire figure is close to that found by Partridge et al (1962) for the Black Mountains (Carmarthenshire), whereas the South Pembrokeshire figure is closer to that given for England and North-west Europe.

3. <u>Colour blindness</u>

An investigation into colour blindness in the population of Pembrokeshire was carried out by Pullin and Sunderland (1963). 530 males and 479 females were tested using Ishihara cards. The survey compared individuals with both parents born north of the Landsker or with one parent born in North Pembrokeshire and one elsewhere with those children having both parents born south of the Landsker, or one parent born in South Pembrokeshire and one elsewhere. For both sexes no significant differences were found between the two populations. The mean frequency for colour blindness was 6.98%. For North Wales, Fraser-Smith and Sunderland (unpublished) found higher frequencies of colour blindness, with a value of 10.0% for Anglesey and 11.6% for Caernarvonshire. However, North Wales as a whole showed a lower value. Regional variability in the British Isles was suggested by the study made by Vernon and Straker (1943) who found values ranging from 5.27% in West Scotland up to 9.47% in South-west England.

4. ABH Secretor Statos

The antigens, A, B OH of the ABO blood group system are found in the body fluids, for example in saliva. Not all individuals secrete their corresponding ABH substance; some are non-secretors. The frequencies of secretors and non-secretors in the British Isles have been measured by several workers. Lincoln and Dodd (1973) quote a figure of 22.7% given by McConnell (Race and Sanger 1968) but suggest this value may be false for the Scottish and Irish populations. Ikin et al (quoted by Mourant 1954) gives values of 28.46% and 31.13% for the Scottish and Irish respectively. A more thorough survey by Lincoln and Dodd (1973) gives values of 29.87% non-secretors in Scotland, 30.08% in Northern Ireland, 32.18% in Eire and 24.30% in London.

A study of ABH secretor status in the population of Pembrokeshire was carried out as part of the present study (Sunderland and Murray 1978). Saliva samples were collected from 482 schoolchildren resident in all parts of the county. A non-secretor frequency of 29.82% was found for South Pembrokeshire, and one of 28.74% for the north, there being no significant difference between the two. The frequency of

29.25% for Pembrokeshire as a whole (se gene frequency = 0.541) compares with the frequency of 0.516 found by Drummond (1969) for Glamorganshire and the figure of 0.52 for the Welsh given by Mitchell (1976). The Pembrokeshire values resemble those for the northern and western Celtic populations.

5. Serology

The ABO blood group system

The first extensive survey made in Wales was by Fraser-Roberts in 1942 who studied the ABO gene frequencies exhibited by blood donors resident in North Wales. He used a technique, initially developed by Fisher and Vaughan (1939) to separate the donors into Welsh and non-Welsh by virtue of their surnames. The inhabitants of the counties of Caernarvonshire, Flintshire and Denbighshire were shown to have a high O gene frequency. (Percentage gene frequencies given are O = 76%, A = 19% and B = 5%).

In their paper of 1952, Mourant and Morgan-Watkin state that "Wales displays significant variations in the frequencies of the O, A and B genes". Their study shows B gene frequencies exceeding 10% in the Black Mountain area of Carmarthenshire, whereas in the Welsh Marches frequencies were below 5%. High O gene frequencies, 70-75%, similar to those found in Scotland and Ireland, were found in North Wales; and in a few mountainous regions in South Wales, one of these being around the Precelli mountains of Pembrokeshire. Morgan-Watkin (1952) carried out further research throughout the Principality and reported the following blood group characteristics for Wales, based on his own research and on earlier studies:

(i) O Gene Frequency - High O gene frequencies are reported in North Wales, in the counties of Denbighshire, Caernarvonshire and Flintshire, with significantly lower frequencies in Anglesey, the Conway Valley around Llanrwst and Trefriw and around the mouth of the river Clwyd.

In Merionethshire, on the coastal plain of Ardudwy and in the peninsula around Penrhyndeudraeth, high O gene frequencies are given in the Bala cleft, the Perwyn mountains, Montgomeryshire and North Cardiganshire, the O gene frequency reported is slightly lower, 72-73%.

In South Wales, the only area of very high O gene frequency is given as the Black Mountains of Brecknock and in the adjacent Wye Valley as far up as Builth Wells. To the west the area of high O gene frequency in North Wales is found to come to an abrupt end between Aberystwyth and Aberayron.

Morgan-Watkin concludes that the reason for the high O gene frequencies is that they have not been subjected to the human migrations which have affected the southern half of the country. He suggests that the ancestors of the northern Welsh possibly originated from North Africa or as far east as the Caucasas where the inhabitants have O gene frequencies similar to those of North Wales, Scotland and Ireland.

(ii) A gene frequency - The highest frequency, 33%, is given for the areas around Narberth, Pembroke and Tenby in Pembrokeshire. This value contrasts with that of 19% found in Flintshire. A frequency of 27% was reported for the inhabitants of Rhyl and Prestatyn, a figure substantially higher than for populations living further inland. Morgan-Watkin suggests that the high A frequencies may indicate Viking settlements, as high A gene frequencies have also been found in the region of Chester, a known area of Viking settlement.

(iii) B gene frequency - High B gene frequencies were found in the Black Mountain area of Carmarthenshire compared with low frequencies for the inhabitants of the Clun forest, Kerry Hills and Newtown, Montgomeryshire. Morgan-Watkin cites the anthropometric study of Fleure, in which the suggestion is made that the population of the Black Mountain of Carmarthenshire is of palaeolithic origin. The distribution of areas with high B frequencies coincides with that given by Fleure for the Palaeolithic and early Neolithic populations.

Morgan-Watkin (1960) carried out a detailed survey of the ABO blood groups in Pembrokeshire. Blood group data was collected with the co-operation of the National Blood Transfusion Service for Wales which held clinics in towns throughout Pembrokeshire. Members of the armed forces and their relations, and holiday-makers and temporary residents were excluded from the study. Each donor was questioned as to his place of birth and those born in Pembrokeshire, and possessing a Welsh surname, were included in the survey for both North and South Pembrokeshire. Morgan-Watkin showed three distinctive areas within Pembrokeshire: S.E. Little England, N.W. Little England and North Pembrokeshire. South-east Little England was shown as an area characterised by an exceptionally high A gene frequency, with a corresponding fall in the O gene frequency, the B gene frequency being higher than in Southern England, but closely resembling the values found by Fraser-Roberts (1955) in Cumberland and Northumberland. North-west Little England differed from South-east Little England and North Pembrokeshire, having A gene frequencies between 25 and 30%, compared with greater than 30% and less than 25% for the south-east and North Pembrokeshire respectively.

Morgan-Watkin offers explanations for the differences in the ABO gène frequencies in the different regions of the county. South-east Little England shows a high A frequency compared with the other two regions, and the adjacent region of Carmarthenshire. Fisher and Taylor (1940) encountered no similar frequencies in southern Britain, nor were such values found by Fraser-Roberts (1948) in the S.W. peninsula of England. An island of high A frequency has been found around Chester, an area of Viking settlement, and Morgan-Watkin suggests that there may have been a Viking settlement in South-east Little England although there is no archaeological evidence to substantiate this claim. He further states that the high A frequency found in the south-east closely resembles the values for the A gene frequency found in present-day Scandinavia.

CHAPTER 8

PARTITIONING PARAMETERS

For the creation of subsets within a data set certain partitioning criteria must be used and it is most important to accurately define these criteria. Though the criteria used throughout this thesis were on the whole very similar, one slightly different set of parameters was used for the serology data compared with those used for the breakdown of the dermatoglyphics and skin pigmentation data.

1. Partitioning Criteria for Dermatoglypics and Skin Colour Data

The overall data was split into two initial data subsets by sex, since previous studies of dermatoglypics and skin pigmentation have shown significant differences between the sexes. These differences were also shown by the results of the present study.

Subsequently several other criteria were used for the creation of subsets. The first criterion took into consideration the birth place of the pupil for inclusion in any further analysis. Any child born outside Pembrokeshire was excluded. Of those born within the county, a percentage was born in the northern parishes, some in the 'Landsker' parishes and others in South Pembrokeshire, so three separate groups could be created using the criterion of birth location.

The second criterion considered was the birth place of the parents, only children having both parents born within the county being included in any analysis. This criterion was used further to produce two subsets dependant on the two parents being born in either the north or the south of the county, thus excluding individuals with one or both parents born outside Pembrokeshire, and children with one parent born in the north and one in the south of the county. Initially it was hoped to use the three groups created by birth location, but unfortunately the number of individuals who were born, or whose parents were born, within the Landsker parishes were too small to be statistically viable. Therefore, those individuals who fell within this subset were omitted from the statistical analysis. As the Landsker runs through the parishes, rather than on the borders, it was impossible to place these individuals in any other subset, as only the parish of birth, rather than the exact birth location, was given in the demographic data.

The third criterion used was that of ancestry or 'Degree of Welshness' (DW), discussed fully in Chapter 6, and is based on the surnames of the four grandparents (the maiden names of the father's mother and mother being used). Those individuals with three or four Welsh grandparental surnames made up the 'Welsh' subset, and those with three or four English grandparental surnames made up the 'English' one.

The partitioning of child's birth place (BP) and parents' birth place (PBP) allowed any association between data variables and the North or South Pembrokeshire populations to be made clear, whereas the criterion of ancestry (DW) showed any associations with the 'Welsh' or 'English'. Since the 'English' population is on the whole made up of individuals born in South Pembrokeshire, we would expect correlations between the results obtained using these two criteria. With the 'Welsh' the association with the north or south of the county is less clear.

Subsets were also created using dual partitioning parameters which took into account both the child's birth place and his/her ancestry. The parents' birth places could not be included in the dual partitioning breakdown, as the subsets created were too small to be statistically useful.

Dual partitioning produced four subsets, namely 'English in North Pembrokeshire' (EN), 'English in South Pembrokeshire' (ES), 'Welsh in North Pembrokeshire' (WN) and 'Welsh in South Pembrokeshire' (WS). Unfortunately, the sample sizes for both sexes of 'English in North Pembrokeshire' were small and all results involving these subsets should be treated with caution. For the skin pigmentation only the three latter subsets were used in the analysis.

SAMPLE SIZES

DERMATOGLYPHICS DATA

		Males n = 712	Females n = 723
Single Parameters		North Pembs.	South Pembs.
BP	M	202	283
	F	203	260
PBP	M	135	112
	F	114	110
		Welsh	English
DW	M	439	269
	F	434	283
Dual Parameters		Male	Female
	ES	124	122
	EN	33	40
	WS	160	138
	WN	167	164

N.B. For individual variables these numbers may vary very slightly.

For multivariate analysis only. The single parameter BP used three birth locations N, SW and SE. (See Serology breakdown).

SKIN PIGMENTATION DATA

Males n = 533 Females n = 529

Single Parameters		North	South
BP	M	148	225
	F	148	204
PBP	M	93	94
	F	86	90
		Welsh	English
DW	M	320	206
	F	317	208
Dual Parameters		Male	Female
ES		87	84
WS		138	110
WN		118	115

(Skin pigmentation data was also partitioned into two age groups and this is discussed in Section 3).

Serology Data

No significant differences between the sexes have been shown in previous serology studies, of which there have been many. Therefore in this study the data was not divided by sex.

Again, the criteria of individual's birth place and parents' birth place were used, as described previously. However, the 'Degree of Welshness' criterion could not be implemented because of the incomplete nature of the demographic data. Many of the older blood donors could not remember their grandparents' surnames. Therefore when partitioning the data by ancestry, the surname of the donor (SD) only was used, instead of 'DW'. For the dual partitions the donors' birth places and their surnames were used rather than birth place and 'Degree of Welshness'.

Single parameters

Sample Sizes (n = 938)

		N	S
BP	(a)	249	636
PBP		165	357

		N	SW	SE
	(b)	249	311	325

	E	W
SD	326	556

Dual Parameters

2 birth locations

ES	280
WN	204
WS	322

3 birth locations

WN	204
WSW	160
WSE	162
ESW	135
ESE	145

CHAPTER 9

THE COLLECTION OF DERMATOGLYPHIC DATA

In any sampling design the sample of individuals must represent the total target population. The target population selected is dependent on the research objectives. In this case the objective was to test the hypothesis that the populations of North and South Pembrokeshire represented two separate gene pools and for this reason the aim was to collect data from individuals indigenous to Pembrokeshire.

Finger and palm prints were collected from children attending schools throughout the former county of Pembrokeshire, and in the towns of Newcastle Emlyn, Whitland and Cardigan which lie on the former county boundaries (children who are resident in Pembrokeshire attend these three schools).

The practical advantage of collecting data from schoolchildren is that the children represented a 'captive' sample. As the children were collected together, there was no need to visit each household individually. The children represented a narrow age range, eight to eighteen years, only a fraction of the population. However, in sampling the children, attributes having a genetic basis were indirectly accessed in their parents and grandparents. Selection with age has never been shown to affect the frequencies of dermatoglyphic variables, so it was not thought that sampling a narrow age range would in any way bias the results of the survey.

Categories of individuals not available for sampling were:-

1. Unmarried adults and those with no progeny.
2. Couples with children not of school age.

The only criterion for selection of individuals was the family's willingness for their child to participate in the study.

Dennis (1977b) explains the theory, laid down by geographers, which underlies the suitability of using schools for this type of population study and therefore this will not be considered in detail here.

To implement this study, the Director of Education for Dyfed was approached initially for permission to contact the headteachers of the Pembrokeshire schools. Permission was granted and subsequently a letter was sent to each of the relevant schools. Some of the infant and junior schools in Pembrokeshire had very small numbers of pupils so these were omitted unless they were situated in rural areas which had only small populations. The idea was to collect, in the limited time available, a sample representative of the total population.

(Map 5 shows the distribution of the schools used in the study).

Not every school contacted was willing to participate in the survey. Of the schools contacted 27 out of a total of 35 agreed to samples being taken from amongst their pupils. Only one school had to be omitted from the collection timetable due to lack of time.

To obtain permission to take prints from the pupils, two forms were sent via the headteacher to the parents of each child. These took the form of a letter explaining the nature of the research in layman's terms, with a detachable lower part to be returned to the school with acceptance or rejection of the request, and a questionnaire asking for demographic data concerning the family. Both of these were written in English and Welsh, and it was left to the discretion of the parents as to which language they used to complete the forms. Examples of both the letter and the questionnaire are given in the Appendix. Confidentiality was impressed on the headteachers and parents at all times.

After allowing sufficient time for the forms to be returned to the schools, arrangements were made with each headteacher for a suitable time for visiting the school. The number of acceptances was noted so that the appropriate amount of time could be allocated to each school. Each headteacher was asked to arrange the questionnaires in classes, to facilitate the finding of individuals at a later date; and so that pupils could be removed from their lessons, a class at a time, so causing as little disruption as possible in the school routine.

Each school was asked to provide a suitable place for taking the prints, which also allowed space for pupils to wait without causing any inconvenience to other members of the school. Finger and palm prints were taken from all pupils whose parents gave permission, and no familial relationships were taken into account.

Each set of prints and questionnaire was given a common number to ensure all information remained confidential. Only at the time of coding the demographic and dermatoglyphic data for computation was information from the prints and questionnaires united.

In all, 1,435 sets of prints were collected, using the 'Kleenprint' method. The collections were made between March 1976 and September 1977. A complete list of schools, headmasters and sample sizes is given in Table 1.7.

Dermatoglyphics Methodology

Since 1892, when Galton put forward the first method for Analysis of Dermatoglyphic Features numerous attempts have been made to formulate an accurate and complete method of classification. Notable among these were the work of Wilder (1922), Bonnevie (1924) andthe classic book in the field of dermatoglyphics, 'Finger Prints, Palms and Soles' by Cummins and Midlo (1943).

From the work of these and other investigators, Penrose (1970) and Penrose and Loesch (1970) developed their method of classification which has since been used by numerous research workers. The method of dermatoglyphic classification used in this thesis is that of Dennis (1977a) which draws on two main sources. The palmar dermatoglyphics are based on that of Penrose and Loesch (1970), the topological systems being extended to give a further classification of palmar pattern features, additional standardisation being taken from Penrose (1968).

This methodology is fully explained by Dennis (1977a), and will therefore not be described here in detail. The following is a brief outline and readers should consult the complete documentation.

Finger Pattern Types

The patterns on the finger tips were categorised into eight separate types, a separate record being made for each digit.

1. TRUE ARCHES - Patterns containing no triradial point, the ridges running across the digit approximately at right angles to the long axis of the digit.

2. TENTED ARCHES - This category covers patterns which have a single triradial point, situated at or near the mid-axis of the digit. The distal radiant ends blindly, and shows no looping in either the ulnar or radial direction.

Arches and tented arches may be distinguished from loops and whorls by the lack of ridge count.

3. ULNAR LOOPS - Loops have only one triradial point. The ridges curve around one extremity of the pattern, ending at the same side of digit to where they started. The opening of the loop is towards the ulnar side of the hand.

4. RADIAL LOOPS - The same in definition as ulnar loops, but having the opening of the loop towards the radial side of the hand.

5. TRUE WHORLS - Patterns with two triradial points, with the ridge systems forming concentric circuits around a core in the interior or, terminating in a spiral point at the centre of the pattern. Two ridge counts may be made for whorls on both the radial and ulnar sides of the pattern (Penrose 1968). If the smaller of these two counts is greater than half the larger count then the pattern is categorised as a true whorl.

6. ULNAR CENTRAL POCKET LOOPS - Two ridge counts may be made, as for the previous pattern. If the ulnar count is less than or equal to half the radial count the pattern is categorised as an Ulnar Central Pocket Loop.

7. RADIAL CENTRAL POCKET LOOPS - If the radial count is less than or equal to half the whorl count, the pattern is categorised as a Radial Central Pocket Loop.

8. DOUBLE LOOPS - Patterns with two triradial points, but the cores of the ridge systems do not form circuits or a spiral, but may be distinguished as two separate loops, their courses lying side by side.

Occasionally patterns are encountered which fit none of the eight categories aforementioned. These are patterns with three triradial points, usually a small whorl or pocket loop associated with either a radial or ulnar loop, these are categorised as accidental. Because these occur at very low frequencies, for the purpose of statistical analysis such patterns were recorded as missing data.

Finger Ridge Counts

Ridge counts were taken for each digit separately, the count being made from the triradial point to the core of the pattern in all cases. The triradial point and the central ridge were not included in the count. Both radial and ulnar counts were recorded and later calculations were based on both absolute and unilateral ridge counts.

Finger Triradii

These were not recorded separately, but were computed, since the pattern category is indicative of the number of triradial points.

PALMS

Palmar - The topological classification followed was that of Penrose and Loesch (1970). All whorls were subdivided into two loops, usually central and peripheral in direction.

Palmar Ridge Counts - ridge counts were made between the digital triradii, a-b, b-c, and c-d respectively. If the c triradius was missing a b-d count was made; this was recorded independently and used in the computation of total palmar ridge counts.

Palmar Triradii - The classification of the axial triradii used the 14% and 40% limits, as cut-off points; this method is fully described by Penrose (1968) and delimits the presence of t, t' and t''. Where more than one type occurred these were recorded independently, the multiple occurrence of these being computed.

Border triradii (t^b) were recorded, as were hypothenar ulnar (t^u) and hypothenar radial (t^r) triradii; however no objective method of classification exists for these latter two and they were rarely recorded as being present.

Triradii in the thenar area were not recorded separately as e or f, but as a combined e/f variable.

Accessory triradii in the interdigital areas were not recorded independently but as a combined single value for each hand.

A pattern intensity index was calculated using all the palmer triradii on each hand and a total pattern intensity for both hands. This was calculated for each individual.

N.B. - ATD angles and Palmar mainlines.

Although both of these types of variables were recorded, previous studies have indicated that they are of limited value. The ATD angle is subject to variability with age, the angle may change when the hand is growing. As all the palm prints for this study were taken from children of varying ages, this variable was not considered in the statistical analysis.

Williams (1978) points out the subjective nature of determining the actual termination point of any individual mainline, and suggests that although significant differences may be found between subsets of data, the validity of such results is open to question. Because of the amount of material being considered in this thesis, consideration of the mainlines has been omitted.

CHAPTER 10

DERMATOGLYPHICS

Having considered the background information for the Pembrokeshire population, it is now possible to consider the genetic data in detail.

In this section each type of dermatoglyphic characteristic will be considered under a separate heading, using univariate statistical techniques; and in the latter part the multivariate analysis of dermatoglyphic characteristics will be discussed.

UNILATERAL FINGER RIDGE COUNTS

The overall unilateral finger ridge counts for each finger show that the mean ridge counts, in all cases, have greater values for males than for females. Ranking the mean ridge counts in decreasing order of magnitude gives a ranking for the right hand of R1 > R4 > R5 > R2 > R3 for both sexes, and for the left hand a ranking of L1 > L4 > L5 > L3 > L2 for males and L4 > L1 > L5 > L3 > L2 for females. Since, on the left hand the mean finger ridge count values for digits 1 and 4 are very similar, the interchange of the ranking of these two may well be a result of random factors and have no significance.

Partitioning into three classes, dependent on the child's or parents' birth place and ancestry, and further subdivision, using 4 classes using the dual partitions previously described (page 65), gave the ranking orders listed in Table 2.1.

When considering the data divided using single parameters, it may be seen that variation in the ranking order occurs for both sexes and both hands. In the males, no trends in the ranking orders are observed using the three categories (BP, PBP and DW). However for the females, the South Pembrokeshire/English show a ranking for the right hand of R5 > R2 > R3, whereas the North Pembrokeshire/Welsh have a ranking R2 > R5 > R3.

Considering the data divided using the dual partitions, for the males on the right hand, the Welsh in the north and south of the county have a ranking R2 > R3, and the English in both the north and south are of R3 > R2. This is the reverse of the finding of Williams (1978) who studied the English and Welsh populations of Salop and Powys. However, the ranking order of the Pembrokeshire English agrees with that of Holt (1964) for her English populations.

For the females the Welsh and English in North Pembrokeshire have a ranking order for the right hand R2 > R5 > R3 and to the English and Welsh in the south one of R5 > R2 > R3. It should be noted that the sample size for the English born in North Pembrokeshire was small, and many of the individuals with so-called 'English' ancestry had family names which had existed in the north of the county for centuries. Therefore, it is reasonable to assume that inbreeding with the indigenous Welsh population has occurred. In South Pembrokeshire, the number of immigrant settlers was much larger, and again it is reasonable to accept that inbreeding has occurred between these people and the indigenous population. However, demographic evidence suggests that there has been very little intermarriage across the 'Landsker' between the populations in the north and south and therefore very little gene flow between them.

In males, the ranking order of R2 > R3 seems to be indicative of 'Welshness' and one of R3 > R2 of 'Englishness'. However, as mentioned previously, this is not true when comparing other English and Welsh populations. In females the ranking R2 > R5 > R3 is possibly indicative of 'Welshness', if it is assumed that the 'English' in North Pembrokeshire, who are few in number, have interbred with the Welsh and therefore carry 'Welsh' genes in their population. The picture in South Pembrokeshire is not clear and it may be that is because there has been little gene flow across the 'Landsker', the populations on either side have become isolated from each other. Certainly the demographic data show a tendency to marry outside the county in preference to across the cultural barrier. This would explain the results observed for the females, in the ranking of digits 2, 3 and 5. However, this is contrary to what is found in the males, where it is 'ancestry' rather than 'birth place' which is the separating factor.

Since the mean finger ridge count values for digits 2, 3, and 5 are very similar, the observations made must be treated with caution and any differences found may be function of randomness and have no significance.

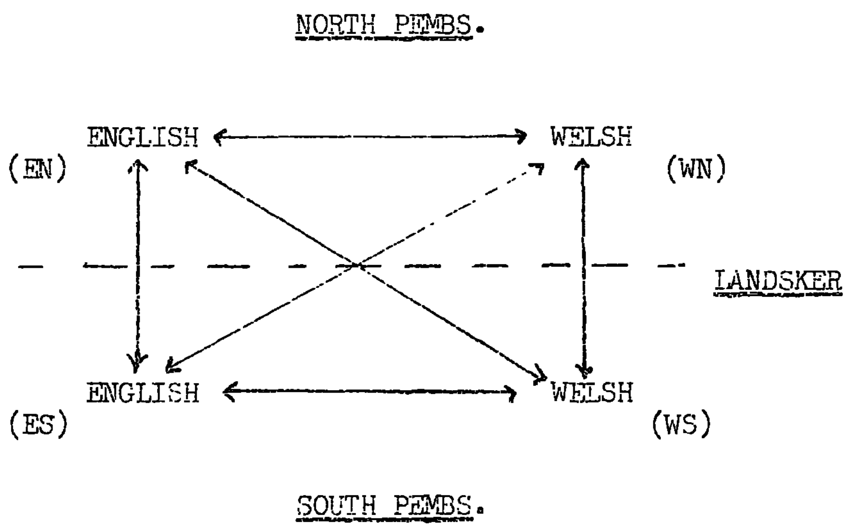
To investigate the finger ridge counts more fully, subset comparisons were made using the students t-test and the non-parametric Mann-Whitney U-test. The subsets used have been described elsewhere (Chapter 8) so will be listed briefly, the single parameters being

(a) Sub-division by child's birth place

(b) Sub-division by parents' common birth place

(c) Sub-division by ancestry ('Degree of Welshness')

In addition, six subsets were used which took into account both the child's birth place and ancestry. These are shown in the diagram below:



(Arrowed lines represent the comparisons made; the abbreviations in brackets will be used later in the text).

It should be noted that no transformation has been applied to the raw data prior to using the parametric t-test. It has been shown that if the difference between any two subsets is small, then using either the parametric t-test or the non-parametric U-test, with or without the data being transformed, gives non-contradictory conclusions (Williams 1978). When probabilities are marginal, then both transformation of the data, or application of the U-test, may be used to show if the t-test is giving significant differences which are attributable to the non-normality of the variable distributions. Transformation of data to correct for skew, tends to reduce any significant difference thus raising the probability (p) value. The Mann-Whitney U-test reduces it even further.

Conversely, if a non-normal distribution has hidden significant differences between subsets, then transformation would increase the significance and the U-test increase it still further. Since the Mann-Whitney test may be used to investigate the effect of the variable distribution on the results of the t-test, transformation has not been used on any of the raw data.

Table 2.2 shows the skew and kurtosis for the variable RT1 to LT5. In only one case, LT4, are both skew and kurtosis at a non-significant level and this is true for both sexes. In all other cases the curves show either skew or kurtosis at a significant level. Digits RT2, RT3 and LT2 show non-significant skew for both sexes. In addition, non-significant skew is found for digit LT3 for the males, and for RT5 in the females.

For full consideration of the results produced using the partitioning parameters previously listed, each sex will be considered separately. Tables 2.3 to 2.6 give full lists of the t-Test and Mann-Whitney U-test probabilities.

MALES

Right hand (RT1 to RT5)

Partitioning using the criteria of child's birthplace (BP), parents' common birth place (PBP) and ancestry (DW) gave no significant differences with either the t-test or the Mann-Whitney U-test.

Using the dual partitions, subsets ES and WS gave a significant difference for digit 3 (RT3) ($p = .041$). The U-test however removed this possible difference ($p = .077$) suggesting that a non-normal distribution may have produced a spurious result in the t-test. When subsets WN and WS were compared, and subsets WS and EN, low probabilities were found for RT3, with the t-Test. Using the U statistic, the probability values approached very close to the significance level ($p = .053$) and ($p = .052$) respectively. This suggests that non-normality of the distributions had been masking possible significant differences, when the t-Test was used.

Left Hand (LT1 to LT5)

Using the child's birth place (BP) as the partitioning criterion, a significant difference was found for digit 4 (LT4) ($p = .024$) and this difference was maintained using the U-test ($p = .019$). No significant differences were found using the criteria of parents' birth place or ancestry.

For the dual partitions, a low probability was found for digit 4 (LT4) using subsets WN and ES for the t-Test ($p = .069$). With the U statistic a significant difference was found ($p = .038$). Again this appears to be a case of non-normal distribution masking the difference between two subsets. No other significant differences were found for any of the five remaining comparisons.

FEMALES

Right hand

The first digit gave a significant difference between subsets when the child's birth place (BP) was used as the partitioning criterion ($p = .010$). This was maintained using the U-test. This difference was not found using the criteria of parents' birth place (PBP) and ancestry (DW). However, using PBP as the partitioning criterion, a singificant difference was found for digit 5 (RT5), using both statistical tests (t-Test $p = .032$, U-test $p = .039$). Using the criterion of ancestry (DW), a low probability was found for digit 3 (RT3) using the t-test ($p = .062$) with a very similar probability using the U statistic ($p = .064$).

Using dual criteria for creating the subsets when comparing WN and WS, a significant difference was found with the t-Test for digit one ($p = .025$), but using the U-test this difference was lost, suggesting that it was the non-normal distribution of the data which created the difference. A low probability for RT1 was also found when comparing EN and ES, but only with the t-Test (p = .077), the probability value increasing when the U-test was used. Comparison of subsets ES and WS gave low probabilities, using both statistical tests, for digit 2 (RT2). When comparing the English and Welsh born in North Pembrokeshire (EN and WN), a significant difference was found for digit 3 (RT3) using the t-test, (p = .044) and this was maintained using the Mann-Whitney U-test (p = .038). A low probability was found for this digit when comparing WS and EN (p = .096); a similar value being found using the U-test (p = .079).

Left Hand

The initial partitioning of the data using the single parameters revealed a significant difference for digit 4 (LT4). Using the partitioning criterion of the parents' birth place (PBP), the same probability (p = .020) was found using both statistical tests. This difference was not found using BP or DW as the partitioning criteria. A low probability was found using DW, for digit 3 (LT3), a value of p = .099 with the t-test and one of p = .081 using the U-test.

When the dual partitioning criteria were used and WN and WS compared, digit 4 (LT4) gave a significant difference (p = .006), this value being the same for both the parametric and non-parametric tests. When comparing EN with WM, and ES with WS, LT4 gave low probabilities with the t-test (p = .071 and .057 respectively.) With the Mann-Whitney U-test, significant differences were found in both cases (p = .045, p = .046).

For digit 3 (LT3), comparing EN with ES, a value of p = .047 was found using the t-test, but this became non-significant with the U-test (p = .079), suggesting that the non-normal distribution contributed to the differences found using the parametric test.

Comparing WS with EN, RT3 gave significant probability values for both statistical tests (p = .041, t-test, p = .038 U-test). Subsets EN and ES, and EN and WN, showed significant differences between their unilateral ridge counts for digit LT2, for both statistical tests.

Certain other observations may be made concerning the unilateral finger ridge counts. In general, for both sexes, the mean ridge counts for digits 1 and 2 were greater on the right hand than on the left, the reverse being true for digits 3, 4 and 5.

Comparing homologous and non-homologous pairs of digits produced the following Spearman correlation coefficients.

Males	LT1	LT2	LT3	LT4	LT5
RT1	.672	.368	.385	.415	.402
RT2	.386	.673	.581	.545	.457
RT3	.417	.563	.699	.625	.492
RT4	.410	.518	.628	.761	.620
RT5	.421	.480	.508	.636	.746

Significance = $<$ .001

Underlined figures represent correlation coefficients between homologous pairs of digits.

Females	LT1	LT2	LT3	LT4	LT5
RT1	.667	.402	.400	.352	.425
RT2	.432	.704	.519	.487	.497
RT3	.455	.603	.686	.523	.506
RT4	.380	.519	.567	.723	.570
RT5	.387	.508	.488	.562	.723

Significance = $<$ .001

Both sexes showed the highest correlation coefficients between homologous digits. For digits 1, 3, 4 and 5 the correlation coefficients were greater for males than for females, the reverse being true for digit two.

Conclusions

Considering these results overall the most important thing to notice was that where significant differences werefound between subsets, the subsets differed by the criteria of birth location, either the child's birth place or the parents' birth place. Only on one occasion, for digit RT3 for females, was the criterion of ancestry the factor which differentiated the subsets and produced the significant difference.

(b) ABSOLUTE FINGER RIDGE COUNTS VARIABLES FR1 TO FR5, FL1 TO FL5

The consideration of the unilateral maximum finger ridge counts described in the previous section is one way of considering digital ridge counts and is the one most frequently used by researchers and therefore well documented. However, another measure of digital ridge count is that of the 'absolute' count. In essence, this means adding together the radial and ulnar counts to obtain a total count for the digit. Obviously this is only possible for a digit which has two triradial points and therefore two ridge counts (digits which exhibit the patterns, whorl, double loop, and radial and ulnar pocket loops). When the pattern exhibited is either an arch or a loop, the absolute finger ridge count will be the same as the unilateral maximum ridge count.

The skew and kurtosis of the distribution curves for variables FR1 to FL5 are listed in Table2.3. The results show that, as with the unilateral ridge counts, the curves do not show normal distribution. Skew is significant for all the variables for both sexes. Non-significant kurtosis is found at digits 1 (FL1) and 4 (FL4) on the left hand for males. Again, each sex will be discussed separately. The partitioning criteria used were the same as in the previous section.

MALES

Right Hand

No significant differences were found using the single parameters. When the dual partitioning procedure was used, a significant difference was found for digit 3 (FR3) when comparing WN and ES, but only with the

U-test (p = .027). This was not revealed using the t-test. Digit three also showed low probabilities when comparing WN with WS and ES with WS, using the U-test, but again this was not reflected in the t-test results. It appears that non-normal distributions may have been masking differences between subsets.

When comparing EN with ES, digit 5 (FR5) produced a significant difference with the t-test (p = .025) and a marginally significant difference (p = .053) with the U-test. This digit also gave significant differences when comparing EN with WN and EN with WS (p = .051 and p = .032 respectively). However, these differences were not maintained using the non-parametric test.

Left Hand

On the left hand, using the single parameter of the child's birth place, a significant difference was found for digit 5 (FL4) (p = .037) using the non-parametric test, though this was not shown with the parametric t-test (p = .055). Partitioning the data using PBP or DW produced no discrimination within the data set.

Using the dual partitioning criteria produced only one significant difference, namely for digit 1 (FL1) when comparing WS and EN. This was only for the U-test. When comparing EN with ES, a marginal probability was found for digit 1 (p = .052), but again only with the U-test. Low probabilities were found when comparing other subsets, but these were never maintained for both the statistical tests.

FEMALES

Right Hand

Digit one (FR1) shows significant differences with the t-test when the data was partitioned using the criteria of BP or PBP, but not when 'ancestry' (DW) is used. These differences are not maintained using the Mann-Whitney U-test. With this the (p) values are marginal.

Using the criterion of PBP gives a significant difference for FR3 using the t-test, but not with the U-test; but for digit 4 (FR4) the probability values are significant for both the statistical tests ($p = .041$, t-test and $p = .043$, U-test). Using the same criterion two probabilities are found for FR5 using both tests. Partitioning by ancestry produced no significant differences between the subsets.

Using dual partitioning criteria, comparing ES with EN and WN with EN, digit 2 (FR2) produced significant differences between these subsets for both the parametric and the non-parametric tests, whereas digit one (FR1) gave a significant difference between subsets WN and WS, with a value of $p = .005$ for the t-test and one of .025 with the U-test.

Digit 3 (FR3), gave a significant difference between mean values, for EN compared with WN ($p = .005$ for both tests), with low probability values with the U-test when EN and ES were compared.

Digit 4 gave a significant result with both statistical tests when EN and WN were compared, and low probabilities were obtained when WS and WN were compared.

<u>Left Hand</u>

Using single parametres, only one digit, FL4, gave a value approaching the significance level, and this only when the data was partitioned using the criterion of PBP. FL4 also produced discrimination between WS snd WN giving (p) values of .035 with the t-test and .032 with the U statistics. When the subsets EN and WN were compared, low probabilities were found for this digit.

Digit 2 (FL2) showed a significant difference in the mean values between ES and EN using the t-test ($p = .013$) and this was maintained using the U-test ($p = .023$). The same pattern was shown when EN and

WN were compared (p = .002, t-test and p = .004, U-test) and when WN and WS were compared (p = .030, t-test and p = .032, U-test).

Digit 3 (FL3) showed a significant difference between subsets EN and WN for both the parametric and non-parametric tests, and low probabilities when EN and ES were compared.

As for the unilateral finger ridge counts, the strongest correlations were between homologous pairs of digits (r .729) (sig. $<$ .001) for males and (r .749) for females. Significant differences between subsets for the absolute ridge counts were shown when birth location was the criterion for differentiating the data. Although the criterion of ancestry appears to produce significant differences between the 'English' and 'Welsh' of the same birth location, in all cases subset EN was involved, so such results should be treated with caution.

(c) TOTAL FINGER RIDGE COUNTS

Variables RFRC, LFRC, TFRC (Unilateral Total Counts)
RFAC, LFAC, TFAC (Absolute Total Counts)

Having considered the unilateral and absolute mean finger ridge counts for each digit individually, the means may be summed up to produce unilateral and absolute total finger ridge counts for each hand. The mean counts for all ten digits may be totalled to produce overall total finger ridge counts for each individual.

UNILATERAL TOTAL FINGER RIDGE COUNTS
(See Tables 2.2, 2.3-2.6)

MALES

'The distribution curves for the three variables (RFRC, LFRC, TFRC) show significant kurtosis, but non-significant skews. The mean ridge counts were greatest for the right hand, though the bimanual difference was small.

Using single and dual partitioning parameters produced no significant differences between any of the subsets, for either the t-test or the Mann-Whitney U-test. This outcome suggests that any significant differences produced between subsets by individual digits have not been sufficient to affect the total ridge counts.

FEMALES

Variables RFRC and TFRC show non-significant skew. TFRC also shows non-significant kurtosis. As for the males, the greater means are on the right hand, and again the bimanual difference is small. The mean counts for all three variables are smaller for females than for males.

Partitioning the data using the single criteria produced no significant differences between subsets. Using the dual parameters produced significant differences for the left total finger ridge count (LFRC) and the overall total finger ridge counts (TFRC) between subsets EN/ES, WN/WS and EN/WN using the t-test (see Table 2.6). Using the U-test maintained the significant differences between subsets WN/WS and subsets EN and WN, but the probability value for the EN/ES vomparison was above the significance level. The results for TFRC reflected those for the two hands separately, the significant differences shown by LFRC affecting the TFRC values.

Subset EN appears in two of the subset comparisons which gave significant differences. As the population of the 'English in North' was very small, the results which these comparisons produced should be treated with caution.

ABSOLUTE TOTAL FINGER RIDGE COUNTS

The distribution curves for the three variables, for both sexes, show significant skew, but non-significant kurtosis except for RFAC in the males. As with the total unilateral finger ridge counts, the means for the right hand were the greatest, and males had higher total absolute ridge counts for all three variables.

The males show no significant differences between subsets created using single or dual partitioning criteria, with either stastical test.

For the females the criterion of parents' birth place produced significant differences for the right hand absolute total ridge count (RFAC), for both the parametric and non-parametric tests. This in turn produced low probabilities with both tests for TFAC (p = .081, t-test, p = .089, U-test). With the dual partitioning criteria, significant differences were produced with both statistical tests for all three variables when subsets WN/WS and EN/WN were compared, and for LFAC and TFAC with subsets EN/ES. The results for TFAC in all cases reflect the findings for the two hands.

DIGITAL PATTERNS

The patterns present on the finger have been considered in two ways. Firstly, by classifying the patterns by virtue of the pattern formed by the ridges, and secondly by consideration of the number of triradial points present in the pattern. The former method involved the categorising of patterns into eight types (as described in Chapter '9). The latter method led to patterns being divided into classes, giving the following classifications:

(a) Patterns with zero triradial points (True Arches)

(b) Patterns with one triradial point (Tented Arches, radial and ulnar loops)

(c) Patterns with two triradial points (whorls, double loops, and ulnar central pocket loops).

Each of these methods will be considered separately.

Consideration of Pattern Types

For all samples the pattern for each digit was recorded, using the eight possible classes discussed previously. This type of variable represents a nominal data set so that the statistics which may be used in the analysis are restricted. In this analysis the chi^2 test and the non parametric Mann-Whitney U-test have been used.

Because some pattern types occur at low frequencies, for much of the statistical analysis the pattern types were amalgamated to give three categories, Arches (True Arches and Tented Arches), Loops (Radial and ulnar loops) and whorls (whorls, double loops, radial and ulnar central pocket loops). Any composite patterns, which had been categorised separately, were omitted from the analysis, as they were too few to be statitistically viable. The parameters used for production of the data subsets were the same as for previous sections.

Sex comparisons

Table 2.7 shows the pattern type frequencies for the initial classes and the amalgamated pattern types for both sexes, and the $X^2_{(1)}$ significance values and U-test probability results obtained using the amalgamated pattern types. The results show that significant differences between the sexes occur for digits 1, 3, 4 and 5 on the right hand, and on digits 3, 4 and 5 on the left hand. The pattern frequencies show an overall higher incidence of whorls in the males, whereas arches were more frequent in the females.

It should be remembered that there are inter-correlations between digits, and that the statistical tests do not take them into account.

For consideration of the partitioned data, each sex has been treated separately.

Males

Tables 2.8 to 2.10 show the finger pattern frequencies (both for the original eight classes and the amalgamated pattern classes) obtained when the data was partitioned using single parameters. Digit four on the left hand (LP4) gave a significant difference when the data was treated categorically between North and South Pembrokeshire using child's birth place or parents' birth place as the partitioning criterion. This difference was not maintained using the non-parametric test for either criterion. Subdivision by parents' birth place also showed a significant difference between pattern types for digit 3 on the right hand (RP3), but only with the X^2 test.

Considering the data subdivided using the dual partitioning parameters gave a continuation of the trend observed with the single parameters, namely that digit LP4 showed significant differences between the populations north and south of the Landsker, both when WN and WS were compared and WN and ES, suggesting that it was the birth place of individuals which determined the separation of populations rather than ancestry. No other digits gave significant differences between subsets.

The amalgamated pattern classes, subdivided using the criteria of BP and PBP, gave subsets with the highest incidence of arches and whorls in the North Pembrokeshire population while loops were more frequent in the south. When the data were partitioned by the ancestry of the children, arches were more frequent in the 'Welsh' and loops more frequent in the 'English' whereas the whorl frequencies were the same in both cases.

The subsets created using the dual parameters showed the same trends. The higher incidence of arches occurred in the Welsh, independent of birth place, except for digit 2 on both hands, where the higher incidence was associated with South Pembrokeshire, but not particularly with the 'English' or 'Welsh'.

The higher incidence of loops was found for South Pembrokeshire, independent of ancestry, the exception being digit 5 on the left hand (LP5). Whorls, however, had their higher frequencies in North Pembrokeshire, again independent of ancestry, the exception being again LP5.

Considering the data, categorised using the initial eight classes, the results reflect those obtained using the amalgamated pattern types, patterns with a single triradial point being associated with South Pembrokeshire (this includes tented arches) and those with two triradii being associated with the North. True arches remained indicative of 'Welshness'.

Females (Tables 2.11-2.13)

Using the single partitioning criteria, only one digit, RP4, produced a significant difference in pattern type frequencies between the populations of North and South Pembrokeshire, with the subsets produced using BP and PBP. This difference was not shown using the U-test. RP4 showed no significant difference between the 'English' and 'Welsh'. The criterion of ancestry gave a significant difference between the 'English' and 'Welsh' with both statistical tests for digit RP5.

RP4 also produced significant differences between subsets WN and WS, and WN and ES, thus adding weight to the idea that it was the birth place rather than the ancestry of the individual which was important in separating the two populations.

Digit RP5 produced a significant difference between subsets WS and ES. As with the single parameter DW, it is the ancestry criteria which differs between the two subsets. Although other digits showed significant differences for some subset comparison,s no other trends could be distinguished.

The amalgamated pattern classes, partitioned by BP and PBP, gave subsets in which the highest frequencies of loops and whorls were associated with the South Pembrokeshire population. This differs from the male results which showed whorls to be associated with North Pembrokeshire. The highest incidence of arches was, as for the males associated with North Pembrokeshire and the Welsh. Ancestry shows loops and whorls to be associated with the 'English'.

When the pattern types were considered individually they reflected the results found for the amalgamated patterns. True arches showed a strong association with the North Pembrokeshire 'Welsh' population.

Tented arches showed a slight bias towards higher frequencies for the southern population. The other single triradii patterns also showed higher frequencies for the South Pembrokeshire population. Whorls showed a strong association with the south, but the other patterns having two triradii do not give such a clear picture.

Conclusions

The analysis described in this section has been carried out in an attempt to establish whether there was any evidence of particular patterns, either individually or in an amalgamted category, having higher frequencies, that is to say an association with a particular population, be it the populations of either North or South Pembrokeshire, or with the 'English' and 'Welsh'.

The following was concluded:-

1. When the data was treated categorically, the criterion of birth location produced consistent significant differences between the north and south populations for both sexes, and for both child's birth place and parents' birth place for digit LP4 for the males and RP4 for females. When birth location and ancestry were taken into account (i.e. using dual parameters), it was the difference in birth place rather than ancestry which produced significant differences for these digits.
2. Over all the digits, and for both sexes, arches showed a strong association with North Pembrokeshire and the 'Welsh', and patterns with one triradius an association with South Pembrokeshire and the 'English'.
3. The association of whorls with a particular population is less clear. In males patterns with two triradial points were more strongly associated with the north and the 'Welsh'; in females the reverse was found.

4. The use of the amalgamated pattern categories made clearer any differences between subsets.

FINGER TRIRADII

Variables R1 to R5, L1 to L5 (See Tables 2.20-2.25)

Comparing the sexes showed class one patterns to be more frequent in females, whereas patterns with two triradii had higher incidences in males. These results reflect the findings for the initial and amalgamated pattern classes discussed in the first part of this section.

Males

Examining the data categorically using the single partitioning criterion of birth place (both PB and PBP) revealed significant differences between the populations of North and South Pembrokeshire for the triradii frequencies of digit L4. These differences were not maintained by the non-parametric test. The criterion of the parents' birth place also gave a significant difference for digit R3, but only with the chi^2 test. The criterion of ancestry produced no significant differences between subsets.

Using the dual criteria of birth place and ancestry produced significant differences for digit L4 between subsets WS and WN, and WN and ES. In both cases these differences were only shown by the probability values associated with the chi^2 test. Digit L2 (Left 2) showed significant difference between subsets ES and EN, giving a marginal probability with the chi^2 test, but a significant value for the U-test. Digit L5 showed a significant difference between subsets EN and WN, again only with the U-test. It should be noted that subset EN is involved in three of the comparisons producing significant differences.

Females

The partitioning criterion of birth place (BP and PBP) revealed significant differences between North and South Pembrokeshire for digit R4, using the chi^2 test, but this difference was not maintained by the U-test. The criterion of ancestry showed digit R5 to have significantly different triradii frequencies for the English and Welsh, the difference being shown by both statistical tests.

The dual breakdown showed that significant differences existed for digit R2, with the U-test, when comparisons were made between the following pairs of subsets EN/ES, WN/WS and EN/WN. Subsets WN/WS also showed a significant difference in triradii frequencies for digit R2 with the U-test.

On the left hand, using the non-parametric test, digit one revealed differences between EN and ES, and between EN and WN; digit two between WS and WS and EN/WN, and digit four between subsets WN and WS, and digit five between ES and WS.

Bimanual comparisons showed an approximately equal incidence of patterns with no triradii, for homologous digits in the males, but far more variation in the females. Patterns with one triradial point showed close correlations for each hand, but those patterns with two triradii showed less correlation. For both sexes, patterns with zero triradii had the highest frequency in North Pembrokeshire and the 'Welsh', and patterns with a single triradius with South Pembrokeshire and the 'English'. This reflects the findings in the first half of this section.

FINGER PATTERN INTENSITY INDICES

Variable PlR (Finger Pattern Intensity, Right Hand)
PlL (Finger Pattern Intensity, Left Hand)
PlT (Total Finger Pattern Intensity)

Tables 2.24, 2.25

Finger pattern intensity indices were obtained by summing the total number of triradii, firstly for each hand separately (PlR, PlL), and then summing these two values to produce a total finger pattern intensity index (PlT). Comparing the two sexes, the males showed the higher mean finger pattern intensities. The right and left hand intensities ranged between 0 and 10, with a mean value of 6.479 for the males, and 6.097 for the females on the right hand, and 6.052 and 5.878 respectively for the left hand. These values were significantly different for the right hand.

Males -

The right hand gave the greatest intensity index, having a value of 6.479, compared with 6.052 for the left hand.

Partitioning the data using the single parameters produced no significant differences between subsets for any of the three variables. However, the dual partitioning parameters produced some differences. The total pattern intensities were significantly different for subsets EN and ES for both statistical tests. When subsets EN and WN were compared the left hand pattern intensities were shown to be significantly different with the parametric test, but this difference was not maintained with the U-test, suggesting that non-normal data distribution had contributed to the significant difference shown. Subsets EN and WS showed significant differences for all three pattern intensity variables with the t-test. These differences were maintained for the right hand and total pattern intensity with the U-test, but the probability value for PlL was non-significant.

Females

As for the males, the greatest pattern intensity was found on the right hand.

Breakdown of the data using the single partitioning parameters failed to show any significant difference between subsets. The dual breakdown showed significant differences between subsets EN/ES for the right hand, and between subsets EN and WN for all three variables, with both statistical tests. It should be noted that subset EN was involved in both these comparisons and the results must be treated with caution.

Subsets WN and WS produced significant differences between pattern intensities for variables PIR and PIT for the t-test, but these differences were not maintained by the U-test.

PALMAR RIDGE COUNTS

Variables RAB, RBC, RCD (Right Hand) LAB, LBC, LCD (Left Hand)

Table 2.26

Three interdigital palmar ridge counts were considered for analysis, AB, BC and CD. Statistical analysis similar to that used for the finger ridge counts was used, namely the parametric t-test and the non-parametric Mann-Whitney U-test.

The partitioning criteria used were the same as in previous sections.

The results show that the mean palmar ridge counts were greatest in all instances for males, but the difference between the sexes was non-significant as shown by the t-test and U-test probability values.

Differences bimanually were small for both sexes. In both, the AB count is greater on the left hand, but the reverse is true for the BC and CD counts.

Homologous pairs of ridge counts gave a high degree of correlation, as the following correlation coefficients show.

	Males	Females
RAB, LAB	r = .643	r = .632
RBC, LBC	.720	.740
RCD, LCD	.644	.676

(Significance < .001)

Males

The distribution curves for these variables all showed significant skew and kurtosis. (Table 2.26)

Division of the data using single partitioning criteria produced no significant differences between any of the subsets. Examination of the data using the dual partitions produced some significant differences.

However these results should be treated with caution, as in all cases the subset EN is involved, which has a small sample size. Significant differences were found between subsets EN/ES, EN/WN and EN/WS for the BC ridge count on the right hand using the U-test. The comparison of EN with WN also gave a significant difference with the t-test, but the other two did not. On the left hand subsets EN/ES, EN/WN and EN/WS again showed significant differences between their mean BC ridge counts and this was true for both statistical tests.

For the CD ridge count, subsets EN/ES and EN/WN gave significant differences between their means, but only with the t-test, suggesting that non-normal data distribution contributed to the significant differences shown.

Females

As for the males, the distribution curves for the palmar ridge count variables showed significant skew and kurtosis.

The single partitioning parameters produced only one significant difference between the subsets. Using the t-test, this was for the CD ridge count on the right hand, and using the partitioning criterion dependent on ancestry. This difference was not maintained with the U-test. However the non-parametric test showed a significant difference between the 'English' and 'Welsh' for the AB ridge count on the right hand, although this was not shown in the t-test.

The subsets produced using the dual parameters gave significant differences in the AB palmar ridge count on the right hand, between subsets EN/WN, and between EN/WS, with the parametric test. The latter two subsets maintained their difference with the non-parametric test. In addition, for subsets EN compared with ES, the U-statistic gave a significant difference for the AB count on the left hand.

The CD ridge count on the left hand produced significant differences when subsets EN and ES, EN and WN, and EN/WS were compared but only with the t-test. The Mann-Whitney U-test produced non-significant probability values, thus suggesting that non-normal distributions had contributed to the significant differences produced by the parametric tests.

The results for the breakdown using the dual parameters, reflect some of the findings for the single parameters. The AB ridge count on the right hand which differentiated between the 'English' and 'Welsh' with the U-test gave differences for subsets EN/WN, though any result involving subset EN must be treated with caution due to the small sample size. No other differences shown by the single parameter (DW) are reflected in the dual breakdown results.

TOTAL PALMAR RIDGE COUNTS

Variables: RPTOT, LPTOT, TPRC

As for the finger ridge counts, the palmar ridge counts may be summed to give a total palmer ridge count for each hand for each individual and the totals for the two hands added together to give a total palmer ridge count (TPRC).

The mean palmar ridge counts for each hand and the total palmer ridge counts were greatest in the males, though the differences between the sexes were non-significant.

Males

The distribution curves showed non-significant skewness in only one instance, for the left palmar total (LPTOT), but significant kurtosis for all three variables. The mean palmer ridge count for the right hand was the greatest, though the bimanual difference was small. Breakdown of the data using the single parameters produced non-significant differences between all subsets for both statistical tests.

When a dual breakdown procedure was used, significant differences were found between subsets EN/ES, EN/WN and EN/WS, for all three variables and with both tests. In each case subset EN was involved, which had a sample size of only thirty-three. Although the 'English in the North' may differ significantly from the other three populations under consideration, the confidence with which this can be stated is strictly limited because of this small sample size and the spurious results this may have caused.

Females

The distribution curves for the three variables show significant skew and kurtosis. For females the greatest palmar ridge count was found on the left hand, though, as for the males, the bimanual difference was small. Examining the data using single and dual partitions revealed no significant differences between subsets with either statistical test.

Palmer Ridge Counts - Conclusions

1. Using the criteria of birth location and ancestry, singly or dually, failed to show any association between any of the palmer ridge count variables and a particular subset.
2. The use of single partitions revealed no significant differences, for males, between any of the subsets. The dual partitions showed significant differences between subset EN and the other three subsets, but such results must be treated with caution. Since no significant differences were found between subsets WN and ES, which differed in both birth location and ancestry, it is reasonable to suggest that the results involving subset EN are spurious and that differences may be due to random factors.
3. For the female data, the results were very similar though significant differences were found using the criterion of ancestry (DW), for the individual palmer counts. However, these were not reflected by the results from the dual breakdown, where, again, it was subset EN which differed from the other three. The total palmer ridge count variables failed to reveal any significant differences between subsets.

PALMAR PATTERNS

See Tables 2.29-2.39

The classification of palmar patterns used in this thesis is described fully in Dennis (1978). Each pattern class and each sex will be considered separately, excepting the rare pattern types.

As with the finger patterns, palmar patterns represent nominal data, suitable for limited statistical analysis. For this study the chi^2 test and Mann-Whitney U-test have been employed.

Sex Comparisons

The comparison of the sexes for palmar pattern frequencies showed some significant differences in pattern incidence between males and females. Peripheral second loops on the right and left hands showed frequencies that were much greater in the males, with probability values from the Mann-Whitney U-test of $p = .001$ for the right hand and $p = .022$ for the left hand.

THENAR PATTERNS

MALES

Peripheral Thenar Loops

Variables PTR (right) (PTL (left)

This pattern in the overall male sample occurred in 4.1% of cases for the right hand as compared with 11.8% on the left. No cases of two such patterns occurred for the right hand, but 0.4% of cases showed two peripheral thenar loops on the left hand.

Subdividing the data using the simple partitioning parameters of child's birth place and parents' birth place, showed higher incidences of this pattern type, for both hands, for the South Pembrokeshire population. The parameter of ancestry showed a higher pattern frequency for the 'English'. However there were no significant differences between the subsets.

The dual partitions maintained this lack of differentiation. For the right hand the highest pattern frequency was recorded for subset EN decreasing through ES to WN to WS, reflecting the finding for the single parameter of ancestry which gave the highest incidence of this pattern in the English. The left hand had a ranking order of ES > WS > WN > EN and in this case it was the birth locations, South Pembrokeshire, which gave the highest frequencies, independent of ancestry.

Radial thenar loops

Variables RTR (right) RTL (left)

Considering the male population as a whole gave a pattern frequency of .049 for the right hand, and one of .090 for the left, as for the peripheral thenar loops, the left has the greater value. One case of two radial thenar loops was found for the left hand, giving a frequency of .001. Examining the data broken down using the single parameters revealed no significant differences between subsets with either statistical test.

Using the dual parameters, and treating the data categorically produced significant differences between the pattern frequencies on the left hand for subset WN/ES and WS/ES (associated probabilities p = .037, .021 respectively, from X^2 test). These results show a difference between the 'English' of South Pembrokeshire and both 'Welsh' populations. This may suggest an association between this pattern type and 'Englishness', as the English in the north sample was small and possibly subject to the action of random factors.

<u>FEMALES</u> - See Tables 2.35. 2.37

<u>Peripheral Thenar Loops</u> (PTR, PTL)

As for the males, the females show the highest incidence of this pattern type on the left hand, which shows a frequency of .104 compared with one of .060 for the right hand.

Examining the divided data, by the X^2 test revealed no criteria giving a significant difference between the subsets generated. The Mann-Whitney U-test maintained this lack of differentiation.

Though there were no significant differences, the greater pattern frequency was associated with South Pembrokeshire when birth location was considered and with 'Englishness' when ancestry was the criterion. The dual partitions gave a ranking of ES > EN equal to WS > WN for the right hand and one of EN > WS > ES > WN for the left hand which, to some degree, maintained this trend considering that the results for EN are open to some doubt.

<u>Radial Thenar Loops</u> (RTR, RTL)

Radial thenar loops occurred on the left hand of 7.5% of the female pupils, compared with 5.3% for the right, and no cases were found with two radial thenar loops.

Partitioning the data showed that the use of the criterion of ancestry produced significantly different subsets, with both statistical tests, for the right hand (associated probability (X^2 test) $p = .028$, U-test $p = .018$). None of the remaining divisions produced differences between the groups. The 'Ancestry' criterion revealed a higher pattern frequency for the English, and birth location a higher frequency in South Pembrokeshire.

Use of the dual parameters showed no significant differences between any of the subsets, but maintained to some extent the trend of higher pattern frequencies being associated with the English/South Pembrokeshire population. As with many of the pattern types discussed, the results for subset EN appeared to give spurious results.

INTERDIGITAL PATTERNS

MALES

Peripheral Second Loops

Variables P2R (Right) P2L (Left)

The frequency of this pattern type is higher for the right hand with a value of .069 as compared to .038 for the left hand, this being the rarest of the three peripheral interdigital patterns. No cases of two peripheral second loops were found.

Using the partitioning criterion of birth location (both BP and PBP) produced no significant differences between subsets. However when the data was divided by ancestry (DW), significant differences were found between the 'English' and 'Welsh' for both hands, using the U-test. Categorical treatment of the data gave a significant difference for the left hand and a marginal probability value for the right hand. The English having the higher pattern frequencies.

The subsets produced using the dual parameters gave a ranking order for both hands of EN ES WS WN, reflecting the results for the single parameter of ancestry; the English again having the highest pattern frequencies. No significant differences were found between any of the subsets.

Peripheral Third Loops

Variables P3R (Right) P3L (Left)

As for the peripheral second loops, the highest incidence of this interdigital pattern was on the right hand, with a frequency of .540, this being the highest frequency for an interdigital pattern for the right hand. The left hand had a pattern frequency of .280.

Sub-division of the data using single parameters revealed no significant differences between any of the subsets. The right hand gave low probability values with both statistical tests when the data was broken down by child's birth place. For birth location and ancestry, the South Pembrokeshire/English populations exhibited the highest pattern frequencies. Using the dual parameters again produced no differentiation between subsets.

The dual parameters produced a ranking order for the right hand of ES equal to WS > EN > WN, suggesting a north, south difference, with the higher incidence in the south. For the left hand the ranking order was EN > ES > WN > WS. Overall the results suggest that the higher incidence of this pattern type is associated with South Pembrokeshire and 'Englishness'.

<u>Peripheral Third Tented Loops</u>

<u>Variables P3TR (Right) P3TL (Left)</u>

The tented loop pattern shows the reverse of the ordinary peripheral third loop in having the greater incidence on the left hand.

Partitioning the data by the three single criteria produced no significant differences between the subsets. The criterion of birth location, gave the highest pattern incidences for the South Pembrokeshire population for both child's birth place and parents' birth place. Partitioning by ancestry gave the higher pattern incidence for the right hand for the 'Welsh', and for the left hand for the 'English'.

When the dual partitioning criteria were used the lack of differentiation between subsets was maintained. The right hand gave the highest incidence of this pattern type for subset EN to frequencies decreasing in the order WS > WN > ES. On the left hand the results show a ranking order of ES > WS > WN > EN. This pattern type appears to have no association with the north or south populations or with the 'English' or 'Welsh'.

Peripheral Fourth Loops

P4R (Right), P4L (Left)

The left hand shows the highest incidence of this pattern type, 65% of male pupils having a pattern in the fourth inter-digital area. This is the highest incidence for an inter-digital pattern on the left hand.

The criterion of birth place produced a significant difference between subsets when the data was treated categorically using the chi^2 test. However, this was not maintained using the non-parametric test. The single parameters produced no other differences. In all cases, except one (sub-division by BP on the left hand), the North Pembrokeshire Welsh had the highest pattern frequencies.

The dual parameters showed only one significant difference, namely between subsets WN and WS (associated probability with X^2, $p = .032$), for the right hand. The right hand shows a ranking order of EN > WN > ES > WN; again the North Pembrokeshire populations gave the higher pattern frequencies. The picture for the left hand is less clear, the ranking order was EN > WS > WN > ES. Overall the pattern type may show some association with North Pembrokeshire.

FEMALES

Peripheral Second Loops P2R, P2L

The right hand showed 3.2% of pupils having a pattern in the second inter-digital area, compared with 1.8% for the left hand. No cases with two patterns were found.

None of the divisions, with either the single or dual parameters, revealed significant differences between subsets.

The single partitioning criteria showed an association of this pattern type on the right hand with the South Pembrokeshire/English populations, the reverse being shown by the left hand, the higher incidences being found in the North Pembrokeshire/Welsh populations.

Using the dual parameters, both hands show higher incidences for the 'English', giving a ranking order of ES > EN > WN > WS. The results suggest that 'Englishness' may produce a greater pattern frequency, though this tendency does not hold for single parameter subset comparisons.

Peripheral Third Loops P3R, P3L

The inter-digital patterns in the third region on the palm were present on the right hand of over half the female pupils, 51.5%, compared with a frequency of 27.1% for the left hand. As for males, this was the most frequent inter-digital pattern for the right hand. No incidence of two third loops was found on either hand.

The data treated categorically using the X^2 test produced no significant differences between subsets using either single or dual partitioning criteria. Similar results were obtained using the U-statistic.

The greatest mean frequencies show no consistent association with any particular population.

Peripheral Third Tented Loops (P3TR, P3TL)

This pattern occurred on the left hand of 11.6% of female pupils and on the right hand of 8.7%.

Partitioning the data by the three criteria, BP, PBP and DW, produced no significant differences between subsets and selections of subsets using dual partitions maintained this lack of differentiation.

The greatest mean frequencies showed no particular association with any subset produced by any of the criteria.

<u>Peripheral Fourth Loops (P4R, P4L)</u>

The left hand had 64.6% of cases with at least one peripheral fourth loop, compared with 41.9% of cases for the right hand, of which 2.9% of cases had two loops for the left hand, and 0.3% had two loops on the right.

Dividing the data using the usual criteria gave no significant difference between subsets for either the single or dual partitions on either statistic.

The slightly greater pattern frequencies appear, from the single partitioning criteria, to be associated with North Pembrokeshire and the Welsh. The dual partitions gave the same trend for the right hand, with a ranking of EN > WN > WS > ES, but for the left hand the association is unclear (EN > WS > ES > WN).

HYPOTHENAR PATTERNS

MALES

Peripheral Hypothenar Loops

Variables PHR (Right) PHL (Left)

The left hands had a slightly higher incidence of this pattern type, the frequency of one peripheral hypothenar loop being the same for each hand, but 0.1% of cases had two patterns on the left hand.

Single and dual partitioning criteria produced no significant differences between any of the subsets with either statistical test. The pattern frequencies showed no association with any particular population subset.

Central Hypothenar Loops

Variables CHR (Right) CHL (Left)

As with the previous pattern type, the higher incidence was recorded for the left hand, a frequency of 24.4% as compared with 23.7% for the right.

Using the single parameters, the criterion of ancestry produced significant differences between the 'English' and 'Welsh' for both hands, for neither statistical test.

When the criterion of birth location was used, low probabilities were produced for the right hand for the parents' birth place for both statistical tests, but this was not shown when the child's birth place was used.

The dual parameters produced a significant difference between subsets EN and WN (associated probability, X^2 p = .031) for the left hand, and between ES and WN for the right hand (p = .033). As for the single parameter results, the differences were between the 'English' and 'Welsh'.

The single partitions showed a higher incidence of this pattern type in South Pembrokeshire and in the English, and the dual parameters gave a ranking of EN > ES > WS > WN bearing out the idea that there may be an association between this pattern type and 'Englishness'.

Radial Hypothenar Loops

Variables RHR (Right) RHL (Left)

This was the rarest of the hypothenar patterns occurring in only 4.7% of cases and having the highest frequency on the right hand.

The single and dual parameters revealed no significant differences between any of the subsets with either statistical test.

The highest incidence of this pattern type was, for both hands, found to be associated with the North Pembrokeshire population.

When the criterion of ancestry was used the 'Welsh' showed the higher incidence.

Dual partitioning gave a ranking order of WN > EN > WS > ES for the right hand and, for the left, one of WN > ES > WS > EN, and for both hands the 'Welsh in North' gave the highest frequency, supporting the results of the single partitions. As mentioned previously, the values for subset EN, should be treated with caution.

FEMALES

Peripheral Hypothenar Loops (PHR, PHL)

Peripheral hypothenar loops were more frequent on the left hand, 11.6% of cases having one pattern, and 0.4% having two. For the right hand 10.9% had one pattern and 0.3% two.

The breakdown into subsets, using both single and dual partitioning parameters, produced non-significant differences between subsets in all cases, and for both statistical tests.

Partitioning the data gave no consistent association with any particular subset.

Central Hypothenar Loops (CHR, CHL)

These are the most frequent hypothenar patterns, having frequencies for the left hand of 27.2% with one pattern and 0.4% with two. On the right hand the frequencies were 24.9% and 0.8% respectively.

The single partitioning criteria produced no significant differences between subsets, using either statistical test.

Using the dual partitioning criteria and treating the data categorically, revealed significant differences between subsets EN/ES and EN and WS, for the pattern frequencies on the right hand. As for other pattern types subset EN is involved and these results should be treated with caution.

The single partitioning parameters showed the higher pattern frequency on the right hand to be associated with 'Englishness', but for the left hand the Welsh showed the higher incidence. The dual divisions gave no clear association for the right hand, but for the left confirm an association between a raised pattern frequency and 'Welshness', with a ranking of WN > WS > EN > ES.

Radial Hypothenar Loops (RHR, RHL)

As for the males, this is the rarest of the hypothenar patterns, having a frequency of 3.7% for the right hand and 1.4% for the left. The breakdown into subsets produced non-significant differences in all cases, for both single and dual partitioning criteria.

There is little evidence for a consistent association between a raised pattern frequency and North or South Pembrokeshire, or with the English or Welsh, used either as single or dual criteria.

<u>Conclusions</u>

Considering the overall palmar pattern data, for both sexes, it becomes clear that these variables show little significant difference between data subsets produced using the criteria previously described.

However, some trends may be detected. The thenar pattern data for both sexes revealed a relatively consistent association between raised pattern frequencies and South Pembrokeshire. The second interdigital area showed the same trend. Of the other interdigital patterns, only the peripheral fourth loops showed any consistent associations, this time with North Pembrokeshire and the Welsh. On the hypothenar area, central loops show a possible association with the English, whereas radial loops may be associated with Welshness.

PALMAR TRIRADII

Tables 2.40-2.42

The triradii found associated with the pattern systems in the thenar, hypothenar and interdigital areas were recorded for each hand and for each individual. Accessory interdigital triradii were not classified separately, but an overall number of interdigital triradii was recorded for each hand (variables TDR (Right) TDL (Left)). The thenar triradii e and f were combined into a single class, but the triradii associated with the hypothenar patterns were recorded separately. In addition, the axial triradii were classified using Penrose's (1968) 14% and 40% limits for defining t, t' and t''. No cases of zygodactylous triradii were found in this study.

The data was analysed for each sex, using the criteria previously defined and statistically tested using the chi^2 test and the Mann-Whitney U-test.

A Mann-Whitney U-test comparing the sexes revealed significant differences between the total interdigital triradii for both hands. Looking at the data more closely showed that the females had a higher frequency of three interdigital triradii, 5.2% for the right hand and 7.8% for the left, compared to 3.7% and 4.4% for the males. (In a very high percentage of these cases, three triradii incidate an absence of the C triradius). Other variables which showed sex differences, with the U-test, were TBL (the triradii associated with central hypothenar patterns on the left hand), which had a higher incidence in females, reflecting the raised frequency of central hypothenar loops in this sex: and TL, the axial triradius on the left hand, situated below the 14% limit, again the females showed the higher frequency.

MALES

Thenar Triradii (TEFR (Right) TEFL (left))

The greatest triradii frequency for the thenar area of the palm occurred on the right hand.

The single and dual criteria failed to produce significant differences between subsets, except for the comparison of WS with WN, which gave a significant difference between the thenar on the right hand.

FEMALES

As for the males, the highest triradii frequency for this palmar area occurred on the left hand. The single and dual partitioning criteria produced no significant differences between subsets.

Interdigital Triradii - Accessory Triradii

Variables TDR, TDL

MALES

The accessory triradii showed very little bimanual difference, the right hand having the greater mean value.

Closer examination of the data showed that of those individuals who had one accessory triradial point, the highest frequency occurred on the right hand, but those who had two accessory triradii showed the higher incidence on the left hand. The number of individuals with more than two accessory triradii was small, and the frequencies similar for both hands.

The partitioning criteria produced no significant differences between subsets for triradii frequencies.

FEMALES

As for the males, the accessory triradii showed little bimanual difference, and the right hand had the greater mean.

The highest incidence of one accessory triradius occurred on the right hand, whilst the greater frequency of two accessory triradii was found on the left hand. Again, the single and dual breakdown of the data failed to show significant differences between subsets.

Hypothenar Triradii

Border Triradii TBR, TBL (triradii associated with CHR, RHR, CHL, RHL and tented hypothenar arches patterns)
TRR, TRL (triradii associated with PHR, PHL palmar patterns)

MALES

The border triradii showed by far the highest incidences with frequencies of .283 and .258 for the right and left hands respectively, compared with .001 for both hands for variables TRR and TRL. Because of the very low frequencies of the latter class of triradii, these were not included in any statistical analysis.

Partitioning the data by child's birth place and parents' birth place produced no significant differences between subsets. However, the criterion of ancestry showed significantly different frequencies of border triradii, for both hands, between the 'English' and 'Welsh', with both the X^2 and U-tests, the highest frequency being shown by the English. This reflects the results for the central hypothenar loops which were more frequent in the English.

The dual partitions failed to produce significant differences between subsets.

FEMALES

As for the males, variables TBR and TBL, showed the highest incidences of the hypothenar triradii, the greatest incidence being found on the right hand.

Breakdown of the data using the single and dual parameters produced no significant differences between subsets.

AXIAL TRIRADII

Variables TR, T1R, T2R, TL, T1L, T2L

MALES TR, TL

This class of axial triradii showed higher frequencies than the other two with incidences of 58.3% on the right hand and 57.7% on the left. Only one case of two triradii, occurring low on the palm, was found on the left hand, and none for the right hand.

Partitioning the data showed no differences between subsets for either hand for any of the criteria used.

T1R, T1L

This class of axial triradii showed a higher incidence on the left hand with a frequency of .430 compared with .383 for the right hand.

Examining the data using the usual partitioning criteria failed to produce significant differences between subsets.

T2R, T2L

This is the least frequent class of axial triradii, the right hand having the greater frequency.

Again, partitioning the data failed to reveal any differences between subsets.

FEMALES TR, TL

As for males, this was the most frequent class of axial triradii, having a frequency of .500 for the right hand and .521 for the left hand. No case of two such triradii was recorded.

The single partitioning criteria showed no differences between subsets for either statistical tests. Dual breakdown showed no significant differences for variable TR, but TL showed a significant difference in frequencies between subsets WN/EN, WN/ES and EN/WS, when the data was treated categorically, and between subsets.

EN and WS with the non-parametric test.

T1R, T1L

This class of axial triradii had its highest frequency on the left hand.

The single parameters showed no significant differences between subsets. The dual partitions produced a significant difference between subsets ES and WS, giving an associated probability of $p = .029$, with the X^2 test.

T2R, T2L

The left hand showed the highest incidence of this class of axial triradii. Partitioning of the data produced no significant differences between the subsets generated.

PALMAR PATTERN INTENSITY INDICES

Variables RPPI (Right), LPPI (Left), TPPI

By summing the axial triradii, the interdigital triradii and the triradii associated with thenar and hypothenar patterns, a palmar pattern intensity was obtained for each hand for each individual. Summation of the left and right hand values gave a total palmar intensity index. Comparison of the sexes failed to produce significant differences between the palmar pattern intensities.

MALES

The left hand showed the higher palmer pattern intensity index. Partitioning the data by birth location failed to produce significant differences between the subsets generated, but the criterion of ancestry produced significantly different intensity indices for the English and Welsh with both statistical tests. The three variables showed the English to have the highest indices.

Dual partitioning produced significant differences for the right hand between subsets EN and WN, and EN and WS with the non-parametric test. The left hand showed differences between subsets WN and ES, and WS and ES using the t-test, and the U-statistic maintained this difference for subsets WS/ES, but gave a non-significant value for subsets WN/ES. The total palmar pattern intensity subsets WN and ES were significantly different according to the t-test probability value, but this difference was not maintained with the U-test. The non-parametric test, however, showed significant differences between subsets EN and WN and EN and WS. This difference had not been shown by the t-test probably because of non-normal data distribution.

The single and dual parameters showed higher palmar pattern intensity indices to be associated with South Pembrokeshire and the English.

FEMALES

The single partitioning criterion failed to produce any significant differences between subsets with either statistical test. Dual partitioning produced significant differences for the left palmar pattern intensity between subset EN and ES for both statistics.

The t-test produced significant differences between WN and WS for the variables RPPI and TPPI, but these differences were not maintained when the U-statistic was used. Only with one subset comparison, that of EN/WN, were significant differences found between the mean palmar pattern intensities for both hands separately and for the total pattern index. These differences were shown for both statistical tests.

As for the males, the greater pattern intensity indices were associated with South Pembrokeshire and the English.

MULTIVARIATE ANALYSIS

The use of multivariate analysis in physical anthropology for the assessment of population affinities is now widely accepted and has been considered in detail by several workers, for example, Howells (1969) and Kowalski (1972), the latter author concentrating on the deficiencies associated with this type of analysis. The specific use of multivariate analysis in dermatoglyphic studies has been discussed by Coope (1971). Previous research has justified the use of multivariate analysis in this type of work, and will not here be considered further.

The disadvantage of the univariate analysis so far discussed is that it fails to disclose overall population relationships. However, the use of multivariate statistics allows a group of variables to be examined simulatneously usually using some form of correlation matrix. The statistical procedures of multivariate analysis are very varied. Those which have been applied to dermatoglyphic data include factor analysis, principal components and discriminant function analysis. However, in this thesis, only discriminant function analysis has been utilised, and since the two former methods are well documented they will not be considered further. The two previous surveys of dermatoglyphics in Welsh populations have used discriminant function analysis, so this method was used in this thesis so that comparisons could be made.

Discriminant function analysis was first developed by Fisher (1936) for the purpose of combining a number of linear measurements taken from the individuals of a population so that they could be categorised into one group or another. The weights for each measurement taken are computed from a function, so that a single score is produced for each individual, the computation taking into account the variance and covariance of the measurements.

Fisher's method was later modified by Rao (1952), and Majumber and Rao (1960), to allow discrimination between more than two groups. The discriminant function used is

$$D_i = \beta_{i1}Z_1 + \beta_{i2}Z_2 + \ldots \beta_{iq}Z_q$$

where:-

D_i = individual's score on the function

β_s = weighting coefficients

Z's = standardised values of the q discriminating variables

Discriminant function analysis (DFA) maximises the differences between groups using the information made available in the variates. Each discriminant function is orthoganal and successively accounts for the maximal residual variation between groups. Usually the first few functions will account for the major part of the intergroup variance. The maximum number of discriminant functions which may be derived is one less than the number of groups involved in the analysis (g - 1), or is equal to the number of discriminating variables (q) if $g > q$.

The computer programme used for the DFA is that produced by the SPSS package system and entitled DISCRIMINANT (Nie et al, 1970). Full details concerning the use and implementation of this programme may be found in the SPSS manual. The option used was (METHOD = MAHAL). This is a stepwise method of DFA, as distinct from a direct method, and concerns the selection using step-wise entry of variables containing information about group separation based on their multivariate F-ratios. By this method variables can be entered or removed at any step in the analysis. The relative importance of each variable in a function is given by the weighting coefficients.

A number of statistical tests can be implemented as part of the programme to determine the success of the DFA in separating populations. As a check of the adequacy of the discriminant functions, a classification array is produced, which is derived from the comparison of predicted group membership from individuals used to derive the discriminant and classification functions with the actual group membership.

This procedure involves the use of a linear combination of discriminating variables for each group, each case being assigned to the group with the highest probability. The classifications are expressed as percentages of correctly classified cases. The second measure of the success of the DFA is to consider the F-ratios between group peers which accompany the between-centroid distances in the transferred space. The greater the between-centroid distance, the better the separation of the pair.

The relative importance of each discriminating function may be discussed by examining the associated eigen values or canonical correlations (c.c.), the greater the canonical correlation then the greater the explained variance on that function. (Explained variance $= c.c^2$).

As well as the statistics already described, a measure of the variance and co-variance of each variable may be included in the output.

The distances between group centroids in the Euclidean space corresponds to the D^2 values in the original space, so discriminant analysis forms the mathematical basis of the D^2 statistic developed by Mahalanobis (1936).

Part of the output from the programme DISCRIMINANT is an F-matrix, with the associated degrees of freedom. From these F-values it is possible to produce a D^2 matrix. For this thesis these calculations were done on a hand calculator using the formula:-

$$D^2_{ij} = \frac{F_U X(N-g).q(N_i + N_j)}{(N-gq_1)(N_{ij})}$$

F = F-value

N = Total number of individuals in the g groups

q = Variables in final F matrix

N_i = Number of individuals in group i

N_j = Number of individuals in group j

g = Number of groups

Since D^z is scale independent with a known distribution, each D^z_{ij} between groups may have a significance test attached to it given by the formula:

$$F_{ij} = \frac{(N - g - q + 7).\ N_J.\ D^z_{IJ}}{q\ (N_I + N_J)(N - g)}$$ with (q) and (N - g - 1) degrees of freedom

$(\frac{N_iN_j}{N_i+N_j})D_{ij}{}^z$ is distributed as X^2 with q degrees of freedom (Rightmire 1969), so the magnitude of this quantity is compared with the value of the chi-square to detect the probability level at which the D^z is significant (Talbot & Mulhall 1962).

Mahalanoblis D^2 is only one of the distance coefficients developed and simpler techniques were in use prior to its development. Constanise-

Westermann (1972) has considered in detail the usefulness of the different methods, so they will only be mentioned briefly here.

The first model was that of Czekanowski developed in 1909 and termed DD. This coefficient is based on the assumption that the biological difference between two populations is expressed if the separate differences for all the variables are combined, biological difference being taken in terms of genetical affinity.

Pearson (1926), critic of Czekanowski's method, developed another distance coefficient termed 'Coefficient of racial likeness' (CRL). CRL was a measure of the probability of the two groups being compared being samples taken at random from the same population. Pearson introduced the idea of using the standard deviation as the unity in which the means and differences should be expressed. This coefficient used the squared standardised differences between the population means, since Pearson argued that the variability of various characteristics of different populations was not great. Statistically CRL has been shown to be more sound than DD. However, the correlation between the two coefficients is high.

Penrose (1953-54) devised a distance coefficient C^2H, which is a measure of the mean sum squared 'standardised' differences between two populations. For all the observed traits, the method being based on the ideas of Pearson. Penrose later developed the technique so that traits governed by shape, and those governed by size, were treated separately, thus obtaining the formula:

$$C_H^2 = \frac{r-1}{r} C^2 + C^2_Q$$

C_Q^2 = size component r = variable

C_Z^2 = shape component

Penrose (1953-54) amd Huizinga (1965) have shown high correlations between C_H^2 values and D^2 values.

Criticisms of each of the variables discussed are outlined fully by Constandse-Westermann (1972). However, one of the main criticisms against DD, CRL and C_H^2 and other earlier and later techniques was that they did not take into account inter-correlations of variables. Mahalanobis (1936) developed the D^2 to overcome this problem. In addition the D^2 statistic is scale independent, and the D value may be tested for significance (using the formula previously mentioned). Like the coefficients CRL and C_H^2, the D^2 statistic is based on the addition of squared differences between the two populations for all the traits being considered. This summation is only done after having transformed them in such a way that they may be expressed in terms of the same unity, and that all express, independent, un-correlated traits.

This method allows the difference to be shown in terms of the pooled standard deviation of the trait in question, so that everywhere in the multi-dimensional space a certain distance has the same unity, independent of direction.

The D^2 statistic differs from other distance coefficients in that the means and differences are related to the whole set of population data being compared.

Although D^2 is supposed to be independent of sample size, attempts have been made to modify the D^2 to allow for too small sample size (Van Varle (1970)). Williams (1978) suggests that D^2 is only independent when the sample sizes are greater than 200; (in this thesis, unfortunately, the sample sizes often fall below this limit), or all the groups are of a comparable size (again the criterion is not met in some cases). He suggests that the latter is more important, unless the sample sizes are very small (20).

Multivariate Analysis -- Computation

Analysis was carried out using the single and dual parameters previously described (Chapter 8). Discriminant function analysis was used, based on the SPSS programme DISCRIMINANT, option (METHOD = 4 MAHAL) (which maximises the Mahalanobis distance between the two closest groups).

For this analysis two different variable lists were used, a reduced matrix consisting of those variables with continuous distribution, and a complete matrix including all variables for the fingers and palms excluding the finger pattern types, and those palmar patterns with very low frequencies.

Reduced Matrix Variables List

RFR1 TO LFU5

RAB to RCD, LAB to LCD

RP1, LP1, RPP1, LPP1

Complete Matrix

RFR1 to LFU5

RAB to RCD, LAB to LCD

RP1, LP1, RPP1, LPP1

P2R, P3R, P3TR, P4R, P2L, P3L, P3TL, P4L

RTR, PTR, RTL, PTL

CHR, PHR, CHL, PHL

TEFR, TEFL

TR, T1R, T2R, TBR, TDR

TL, T1L, T2L, TBL, TDL

The variables include some of a dichotomous nature, namely the pattern types. However, since such data has been used by previous workers in dermatoglyphics, Dennis (1977) and Williams (1978), with some success, and the SPSS manual gives an example of the use of dichotomous data in DFA, it may be assumed that the use of these data types is acceptable.

As for the univariate analysis each sex is considered separately. Summaries of the results for each parameter are given in Tables 2.48 to 2.54.

SINGLE PARAMETERS

Males

Child's Birth Place (See Table 2.45)

Using the reduced data set revealed that significant discriminations could be achieved between the children born in North Pembrokeshire and those born to the south of the Landsker (p .001). Similar results were obtained using the complete matrix.

The reduced variable list showed the greatest discriminant function coefficients on the following variables (LFR3 (-0.82762) and LFU4 (0.82519). In all, six of the original 32 variables contributed to the function. This analysis showed an eigenvalue of 0.05161 and a canonical coefficient of 0.222, giving an explained total variance of 4.9%.

Using the complete data set, the variables carrying the greatest loadings were T1L (- 1.46760), PHL (0.65112), and the variables LFU4 and LFR3, which were also included in the reduced data function. In the latter analysis the discriminating powers of these two variables was greater. The canonical coefficient and eigenvalue produced from the analysis using the full data list were slightly greater, the former producing an explained variance on one function of 8.5%.

The reduced data matrix produced a distance between group centroids of 0.450, whereas the complete matrix produced a greater distance of 0.592 standard deviation units indicating that the inclusion of more variables gave a greater discrimination between groups. A measure of the success of the discrimination, the number of correctly classified cases, gave a value of 58.58% using the reduced data set, and one of 60.52% when the complete data set was used. Again this suggests that the complete matrix gave a better separation of the groups. However, both the case classification percentages are only slightly greater than would be expected by chance. The reduced data set produced a non-significant D^2 value; however with the complete matrix the D^2 was significant (p .005).

Parents' Birth Place (See Table 2.46)

As for the child's birth place, both the reduced and complete data sets produced significant discrimination between groups (reduced data set p = 0.14, complete data set p .001). Using the reduced set identified four variables carrying the greatest loading RFR3 (0.64929), LFR4 (0.55756) LFU4 (- 0.62382) and RCD (0.50158). The analysis produced an eigenvalue of .09492 and a canonical coefficient of 0.294, giving an explained variance on the function of 8.6%. Nine variables contributed to the D^2.

The complete data set produced an explained variance of 17.72%. The variables giving the largest discriminant function coefficients were CHR, RTL, PTL, P2L, TBR and TEFL, LFR4 and LFU4, all giving values above the 0.500 minimum. The last two variables were also included in the reduced data function.

The distance between group centroids was greater for the complete matrix, a value of 0.845 compared with 0.591 S.D.U. for the reduced data set. The percentages of correctly classified cases also shows better separation using the complete data set. Both data sets produced significant D^2 values (reduced matrix p .025, complete matrix p .005).

Ancestry (See Table 2.47)

Using the partitioning parameter of 'Degree of Welshness' again produced significant discrimination between the 'English' and 'Welsh', with both the reduced and complete data sets.

For the reduced variable list the variables giving the greatest discriminant function coefficients were RFU3 (- 0.59873) LFU3 (0.65533), PlL (- 0.64765) and LPPl (- 0.55243). The complete variable list showed that the first three of these variables carry the greatest loading. However, none of them give a value above the 0.500 minimum. So in both cases the third digit on both hands, and the left palmar pattern intensity, gave the best separation between groups.

For the reduced data set the explained variance was 4.54%, but this increased to 8.12% when the complete variable list was used, indicating that the inclusion of more variables led to better discrimination. For the complete data set 18 variables contributed to the D^2, though none of the coefficients was greater than 0.500. Significant D^2 values were produced for both data sets. The between-centroid distance and the case classifications reflect the above results, in that the complete matrix gave the greater distance and the higher percentage of correctly classified cases.

<u>Child's Birth Place (using three birth locations)</u> (See Table 2.51)

Discriminant function analysis was carried out using only the complete data set since this was only an exploratory exercise into the possibility of two distinct populations existing in Southern Pembrokeshire. The greatest discriminant function coefficients were found for the following variables RFU4 (- 0.52585) and LFR3 (0.69600) for function 1, and LFR3 for function 2. (The variable LFR3 also had a loading greater than 0.5 when two birth locations were used). The two functions gave an explained variance of 14.66%.

The percentage of correctly classified, 44.42%, was greater than would be expected by chance, suggesting the possibility of discriminating between three groups within Pembrokeshire. However, further investigations, using larger sample sizes, would be desirable.

FEMALES

Child's Birth Place (see Table 2.48)

Using the partitioning parameter BP, it was possible to produce significant discriminating functions with both the reduced and complete data sets. (Reduced matrix p = .001, complete matrix p = .001). For the reduced data set, the variable with the greater coefficients were RTR1 (0.98458) LFR1 (- 0.64753) and LCD (- 0.54704), the amount of explained variance one function being 6.4%.

The two measures of discrimination, the distance between group centroids and the percentage of correctly classified cases were 0.50915 and 60.95% respectively, these values being very similar to those for the males.

Using the complete data set, the explained variance was increased to 8.8%, the variable with the greatest loading being the same as for the reduced matrix, although, as would be expected, more variables contributed to the D^2. As for the reduced data set this was at a non-significant level.

The between group centroid distance for the complete matrix showed greater discrimination was possible when more variables were used, having a value of 0.59663, compared with one of 0.50915 for the reduced matrix. Similarly, the percentage of correctly classified cases was greater with the complete matrix. The D^2 value was significant for the complete data set only as for the males using the partitioning parameter BP.

Parents' Birth Place (See Table 2.49)

Using the partitioning parameter, a significant discriminant function could be produced for both data sets. The reduced matrix showed the variables RFR1 (- 0.75396) and RFU3 (- 0.5334) to be the main contributors to the function. It is interesting to note that the variable RFR1, also gave a discriminant function coefficient greater than the 0.500 minimum when the partitioning parameter of the child's birth place was used. The explained variance on one function was 13.1%, 10 variables out of the original 32 contributing to the D^2.

For the complete data set, 18 variables out of a possible 60 contributed to the D^2, with the greatest loading on the pattern-type variable PTR. The discrimination was greater than for the reduced matrix, with a between-centroid distance of 0.92993 as compared with 0.72299 for the reduced data set. The case classification showed the same pattern, with 67.45% of cases correctly classified in the complete matrix analysis, and 64.15% for the reduced data set. The D^2 values were significant for both data sets (reduced matrix p .025, full matrix p .005).

Ancestry (See Table 2.50)

Partitioning the data set by the criterion of ancestry produced significant discrimination between the 'English' and 'Welsh' for both the reduced variable list (p = 0.001) and the full data set (p 0.001).

For the reduced data set, those variables with the greatest coefficients were RFU1 (0.66819) and RFR3 (- 0.70644), and in all 14 variables contributed to the function out of a possible 32. The between-centroid distance of 0.46537 was slightly greater than that found for the males, but the classification of cases showed the reverse, with a percentage of 59.14% for the females and 60.44% the males. The complete data set showed the same trends, the variables showing the greatest loadings being RFU1 (0.54181), CHL (0.73521), TL (- 0.63405) and TBL (- 0.66205). Only RFU1 was included in the two functions.

The explained variance using the full variable list was 8.0% as compared with 5.2% using the reduced data set. The complete data set gave a better group separation, with a between-centroid distance of 0.57719 S.D.U. compared with 0.46537 S.D.U. for the reduced matrix. The classification of individuals showed the same pattern. The D^2 values were significant for both the reduced and complete data sets.

Birth Place of Child, using three birth locations (See Table 2.52)

As for the males, analysis was carried out using only the complete data set. The variables with the greatest coefficients were LFR1 and LFU4 for function 1, and RFR1 for function 2, the two functions giving an explained variance of 15.80%.

The percentage of correctly classified cases, 47.63%, suggests, as with the males, discrimination between two groups in South Pembrokeshire would be worth investigating further.

Conclusions

Having briefly outlined the results for both sexes produced using the three single parameters (BP, PBP, DW) it is possible to draw certain conclusions:

1. In all cases the complete variable lists gave a better separation of groups; as seen by the discrimination measures of between-centroid distance, and percentage of correctly classified cases.

2. Looking at the two parameters dependent on birth location showed that for both sexes the greatest between-centroid distances were produced when the parameter of the parents' birth place was used. The parents' birth place also produced more cases which were correctly classified on the basis of the function, and a greater explained variance, both these holding true for both sexes. Though both the parameters BP and PBP rely on birth location, the criteria for selection of individuals were different. For BP, only the child needed to be born in Pembrokeshire, and the parents' birth place was not considered. Therefore the north and south populations would have included children with one or both parents born outside the county, i.e. members of different gene pools. The parents' birth place, PBP, used the criterion of both parents being born either in the north or in the south of Pembrokeshire for inclusion in the two sample populations. Therefore the individuals selected would represent far more localised populations than for those included in the data sets produced using BP. It seems reasonable to suggest that the data sets produced using PBP were less heterogenous than those produced using BP, and that the difference between the north and south populations was more clear-cut, thus allowing better separation of the groups. When assuming that it was the differences in genetic make-up of the populations produced using the partitioning parameters BP and PBP, which gave the different power of discrimination, the possible environmental effects have

not been taken into account. That the environment in which the mother lives during her pregnancy may have an effect on the foetal life of the child is certainly a possibility, but one that would have been almost impossible to measure because of the close questioning which would have been needed. Therefore environmental effects have been assumed to be random though it seems likely that differences found between populations were due to genetic and environmental effects.

3. When considering the data partitioned by the ancestry of the individuals rather than their birth location, it became apparent that this parameter was less successful in producing discrimination between groups. For both sexes the between-centroid distances were less than for BP and PBP. For the females, DW produced the lowest percentages of correctly classified cases for both the reduced and complete data sets. For the males, however, BP produced the lowest percentages. For both sexes the explained variance on the basis of one function was lowest using DW. However, the percentages of correctly classified cases, were, for both sexes, above the values expected by chance. The lesser degree of discrimination using the parameter DW as compared with BP and PBP agrees with the observations made in the univariate analysis.

4. When comparing the variables having the greatest loadings on the function, there is little consistency between the sexes. Only digit three on the right hand appeared to contribute to both variable lists at above the 0.500 minimum. For the males, the radial and ulnar counts on

digits 3 and 4 of both hands appeared to be important in separation of the groups. For the parameters dependent on birth location (BP and PBP) one variable LFU4 appeared in both variable lists (for reduced and complete matrices) at above the 0.500 minimum. The birth location parameters and the ancestry parameter gave discriminant function coefficients which produced no common variables giving loadings above 0.500 for all three parameters. The variables with the greater loadings for DW were completely different from those produced with BP and PBP. DW showed the pattern intensities for both the fingers and the palm to be strong discriminating factors. This was not reflected by the BP and PBP results which showed the finger ridge counts alone to be the main discriminating factors, along with the thenar and hypothenar pattern types (and thus associated triradii) when PBP was used as the partitioning parameter.

Comparing the number of common variables for the females showed that the radial count RFR1 was present at both the variable lists of BP and PBP at above the 0.500 minimum. Digit 1 and 3 for both hands appear to be important in separation of the groups. As for the males, the variables giving the greater loadings, with the parameter DW, differ from those given with BP and PBP.

5. The variables producing discriminant function coefficients differ significantly between the two birth location parameters BP and PBP. For the males only 7 out of 25 variables, 28% (using the complete matrix) were common to both lists, and for the females 11 out of 22, i.e. 50%.

It has already been mentioned that by virtue of the different criteria used in selecting individuals for group membership when using the two parameters, the populations produced using BP were likely to have more heterogenous genotypes. Differences in the genotypes may well have effected a change in the choice of discriminating variables between the two parameters. Similarly, when the criterion of ancestry was used, the variable lists differed from those for BP and PBP, although some variables were common to all three. It must be remembered that since Welsh surnames showed an association with the north, and English surnames an even stronger association with the south, the ancestry parameter is hardly independent of birth location so it does not seem surprising that some variables should be common to birth location and ancestry parameters, but, as already stated, the variables with the greater coefficients differ completely from those for BP and PBP.

6. Considering the F-matrices for both sexes showed significant D^2 values for PBP and DW for both data sets, and for the complete matrices for BP. The D^2 values for the reduced data sets of both sexes were non-significant.

7. Comparing the results of the multivariate analysis and univariate analysis, revealed that birth location of the parents (and for the females the child's birth place) was the more important parameter in producing separation of subsets.

8. Multivariate analysis, using the data partitioned for three birth locations, indicated that further investigation into the possibility of two distinct groups in South Pembrokeshire would be useful.

DUAL PARAMETERS

Having considered the parameters BP, PBP and DW singly, the partitioning criteria of the child's birth place and ancestry were used consecutively to investigate the possibility of more precisely defined subsets producing greater discrimination between groups. The four groups involved were 'English in South (ES', 'English in North (EN)', 'Welsh in South (WS)' and 'Welsh in North (WN)', these subsets being produced using the criteria previously discussed.

Males (See Table 2.53)

Using the four subsets listed above, discriminant function analysis produced three functions which gave a total explained variance of 17.24% with the reduced data set, which was increased to 26.62% using the complete matrix. For the reduced data set 14 variables contributed to the function out of a possible 32, for the complete matrix and 23 variables contributed to the function.

Function 1 shows a division between the 'English' and 'Welsh' for the reduced data set, and this is maintained using the complete matrix. The greatest loadings for Function 1 were for the variables LFU4, LBC and LPP1. When compared with the results for the single parameter of ancestry, only LFU4 appears on both lists, this being below the 0.500 minimum. The second axis revealed a relationship between ES and WS, and a less clear association between EN and WN, but this is not shown when the full variable list was used. The greatest coefficients were shown by LFR3, LFU4 and LPP1. The variable list for the child's birth place shows these variables also to be present, but only LFR3 and LFU4 to be above the 0.500 minimum.

Table 2.55 shows the plotting of these two principal functions for both the reduced and complete matrices.

Function 3, which has not been plotted, showed no particular associations between subsets, the greatest coefficients being shown by RFR3, LFR2, LBC and LPP1 and, in this case, no comparisons were possible.

The complete data set produced the greater discrimination between groups, giving a percentage of correctly classified cases of 42.91% as compared with 36.44% for the reduced matrix, the subset ES having the lowest value in both cases.

Looking at the F-matrix for the reduced data set revealed significant D^2 values in all cases, the values for ES/WS and WS/WN being highly significant. For the complete matrix all the D^2 values were highly significant. The fact that the group sizes varied considerably, subset EN being a very small sample, may well have affected the D^2 results, since it is doubtful if the D^2 values were independent of sample size.

<u>Females</u> (See Table 2.54)

As for the males, the four subsets produced three discriminant functions. The reduced data set produced an explained variance of 16.49%. This was increased to 27.86% when the complete variable list was used. 13 variables contributed to the function using the reduced matrix, whereas 20 out of the possible 60 were involved using the complete data set.

Using the reduced data set revealed no explicable association between subsets for Functions 1 and 2. Function 2 showed a division between the 'English' and 'Welsh' using the complete matrix. However, Function 1 appears to split WS and EN from WN and ES, which is difficult to explain. As for the males, subset EN when plotted for the first two functions, lies apart from the other three subsets and it may well have been the small sample size which influenced the results.

Function 1 showed the greatest loadings to be on the variables RFR1 and LFR1, and the single parameter of the child's birth place also showed these variables to have coefficients greater than 0.500.

Function 2 gave the greatest coefficients for RFU2, RFR4 and RFR5. Only RFU2 also appeared on the variable list for the parameter of ancestry.

Function 3 showed for both data sets a relationship between ES and WS, and a less clear association between EN and WN, so showing a split between North and South Pembrokeshire. The variables with the greater loadings were RFR5, LFU2 and P1L. These were not present in the variable list of the child's birth place DFA.

As for the males, the complete matrix produced the greater discrimination between groups, giving a figure of 38.35% correctly classified cases for the reduced data set, which was increased to 41.86% with the complete matrix.

Considering the F-matrix for the reduced data set showed significant differences between subsets EN/NN, ES/NW, ES/WS and ES/WN; the D^2 values for WN/ES and WN/WS being highly significant. Using the complete data set produced significant D^2 values between all the subset comparisons.

Conclusions

Unfortunately, as was seen with the univariate analysis, the subset EN casts doubt on the validity of the results as for both sexes it appeared to be different from the other three subsets and appeared to give erroneous results, EN being statistically differentiated from ES, WN and WS.

For both sexes, the results with the dual parameters were less clear than with the single partitions. For the males the English/Welsh division appeared to be the most important component, whereas for the females, Function 1 gave no clear-cut picture, but Function 2 gave a division between the 'English' and 'Welsh'. As the parents' birth place parameter produced too small sample sizes to use the dual parameters of PBP and DW which would have reduced the sample sizes further, it was impossible to carry out DFA using these two parameters. This was unfortunate since the single parameters of PBP produced the greatest discrimination between groups.

Mapping of the centroids showed for the males a relationship between WN and WS, but not between EN and ES. ES showed some degree of association with WS when between-centroid distances were considered. For the females, the shortest between-centroid distance was between WN and ES, though this was difficult to explain. WS and WN show some association, but ES/WS show no association.

A Preliminary Comparison of Welsh Dermatoglyphic Studies

At the time of writing six regional studies have been carried out in the British Isles in the following localities: Oxfordshire and Berkshire (Roberts and Coope 1972), the Orkney Islands (Muir 1977), the Pennine Dales (Dennis 1976), North Wales (Frazer Smith and Sunderland unpublished), Central Wales and Salop (Williams 1978) and the South Wales Coalfield (Smith 1979). The latter three studies being the most useful for comparison with the present study.

Before comparing these studies with the Pembrokeshire data it is interesting to look at the conclusions of the respective authors as to the usefulness of dermatoglyphic traits in discriminating between sub-populations within a locality. In the North Wales study, Frazer Smith and Sunderland were unable to find significant differences between the populations of the counties of North Wales; however it must be added that this was only a preliminary study. Williams (1978) carried out a large scale survey covering Central Wales and Shropshire. He showed that regional dermatoglyphic variability existed in these regions with the best differentiation being achieved when the data was partitioned using the criterion of birth place rather than ancestry of theindividuals. The picture was most clear for females but the data for the males showed a similar trend.

The study of the South Wales Coalfield (Smith 1979) also showed heterogeneity within the region, with the best discriminating factor being the total palmar ridge count. She also concluded that birth place (in this case of the grandparents) gave the better discrimination between the major groups, in preference to using the surname technique.

The various categories of dermatoglyphic traits for the four regions of Wales may be considered separately. Firstly, if the digital pattern frequencies are compared, the Pembrokeshire, Borderland and South Wales Coalfield studies show single triradii patterns to be associated with the respective 'English' (non-Welsh) populations. With the Pembrokeshire and Borderland studies showing arches to be associated with the Welsh, however, the other two studies do not show this association.

The finger ridge counts may only be considered for the Borderland and Pembrokeshire studies. Of these two, the mean total finger ridge count (T.F.R.C.) for the Pembrokeshire population, for both sexes, is the greater. It is also interesting to note that the Pembrokeshire ridge counts are higher than those quoted by Holt (1958) for an English population and by Roberts and Coope (1972) for the East Midlands. However, the standard deviations for the Pembrokeshire data are smaller than those quoted by these other authors.

For the palmar ridge counts, the studies of the Welsh Borderland and North Wales show total palmar ridge counts which agree very closely with those for the Pembrokeshire data. The values found for the South Wales Coalfield are approximately 10% lower.

A close comparison of the various Welsh populations is impossible at this time, since different authors have used different methods of analysis of prints.

CHAPTER 11

SKIN PIGMENTATION

Introduction

The chemical and physical basis of skin colour is the same in all races of man. Four pigments are present, namely haemoglobin, carotene, melanin and melanoid (Edwards and Duntley 1939). The difference in vascular supply has been shown to alter the supply of haemoglobin in different individuals. Again, variation in vascular blood flow also affects the haemoglobin component in different skin areas of the same individual; and in the same anatomical position under different physiological conditions. However, there appears to be no significant variation in this component between races. The contribution of the pigment carotene also appears to be constant, and in such regions as the medial aspect of the upper arm the contribution of the melanoid component is negligible (Harrison 1957). Therefore when studying variation in skin pigmentation (between racial groups) it is the melanin component which is mainly being considered.

Skin colour shows a wide geographical variation, with a general trend of decreasing pigmentation with increasing latitude. However, variation within a population is small.

It has been demonstrated that in vitro melanin concentration is linearly proportional to the reciprocal of the reflectance value at any one wavelength (Harrison & Owen 1956). The most reliable results being obtained at the red end of the visual spectrum, since the relationship of reflectance to melanin concentration exists over a wider range of concentrations in this area (Jansen 1953).

Methods

For the study of skin pigmentation data was collected from 1062 school children who had one or both parents born in Pembrokeshire. Of these, 533 were male and 529 female. Skin reflectance values were measured using an EEL reflectance spectrophotometer with a nine-filter head. All nine filters were used, numbers 601 to 609, corresponding to wavelengths 425 nm', 465 nm', 485 nm', 515 nm', 545 nm', 575 nm', 595 nm', 655 nm' and 685 nm' respectively. Each filter was standardised against a clean magnesium carbonate block and a skin reflectance reading was recorded at each wavelength for the medial aspect of the upper arm and from the forehead. Ambiguous results or those at the extremes of the range for each filter were repeated several times until a consistent result was obtained.

Results

Table 3.1 shows the results subdivided by sex. For the skin reflectance readings of the arm, at filters 601 to 606, significant differences were found using the students t-test, and significant differences were also found at filters 601 to 608 using the non-parametric Mann-Whitney U test. On the forehead, however, the t-test showed no significant differences, but the Mann-Whitney U gave a significant difference at filter 607 (595 nm').

The variation in skin pigmentation with age has been reported in previous studies and is well documented (Garn et al 1956, Walsh 1964, Huizinga 1965). Therefore the results were subdivided by sex and into two age groups, namely 7 years to 11 years, and 12 years to 18 years. The former represent a pre-puberty group and the latter a post-puberty group. (Eleven years has been taken as an average age for onset of puberty by some earlier workers, Kalla 1969).

The outcome using these subdivisions is shown in Tables 3.2 and 3.3. Age variance in females was significant at filters 601 and 602 using both the t-test and the Mann-Whitney U test, for the medial aspect of the arm and at filters 603 to 609 with both the statistical tests, for the forehead.

In males, on the medial aspect of the arm, age variance gave significant results at filters 605, 606, 608, and 609 using the t-test and at 604 to 609 using the Mann-Whitney U test. For the forehead reflectance values, age variance was shown to be significant at all nine filters using both statistical tests.

Because of the significant differences found using the subdivisions of age and sex, both these have been taken into account when considering other criteria for partitioning the data.

Tables 3.4 and 3.5 (Single Parameters) show the results of subdivision of the data by birth place of the individual, that is if they were born in North or South Pembrokeshire. Any subjects born outside the county were not included. For males in age group 1, significant differences were found at filters 601, 603 and 605 to 608 using the student's t-test, and at all nine filters using the Mann-Whitney test, for the medial aspect of the arm. Fore the forehead significant differences were found at filters 601 to 606 and 609 using the t-test, and for all nine filters using the Mann-Whitney test. For age group 2 no significant differences were found at any of the filters, for either position on the body. There was a trend in both age groups for those individuals born in the North to be lighter skinned than those in the south.

In the females, for age group 1, significant differences were found at filters 601 and 605 using the t-test, for the medial aspect of the arm. For the forehead significant differences were found at filters 603 to 606 using the t-test and at filter 605 using the Mann-Whitney test. For age group 2 significant differences were found at filter 601 using both tests, this being true for both positions on the body. In addition a significant difference was found for the forehead data at filter 608 using the Mann-Whitney test.

For the males subdivision by PBP (Table 3.6) results producted reflected the findings for BP, the one difference being a significant difference for filter 606 on the forehead. This was not observed for BP. Using the single parameter of ancestry (Table 3.8), the younger age group showed significant differences for the forehead at filters 605, 606 and 607, using the t-test and this difference was maintained only for filter 605 using the U-test. For age group 2, both statistical tests produced a significant difference for the arm at filter 608, and with the U-test alone at filter 607. For the forehead, the 'English' and 'Welsh' were significantly different for the readings at filter 604, but only using the parametric t-test.

For the females, the subsets produced using the criterion PBP (Table 3.7) showed significant differences between the North and South Pembrokeshire population for age group 1 at filter 605 on the arm, but only with the parametric test. The results did not closely resemble those obtained using the criterion of child's birth place. Age group 2 showed a significant difference between subsets at filter 601 on the forehead.

Examining the data partitioned by the criterion of ancestry (Table 3.9) showed significant differences for age group 1 on the medial aspect of the arm at filters 603 to 607 with the t-test, and at filters 602 to 605 with the U-test. On the forehead the t-test showed significant differences for filters 602 to 607, 609 and the U-test maintained these differences except for filter 602, and in addition gave a significant probability value for filter 608. The elder age group showed no differences between subsets for the medial aspect of the arm. For the forehead, the t-test showed significant differences for filters 601, 602, 603 and 606, and the U-test maintained these differences.

Dual Partitions

Tables 310-13 consider the data subdivided by birth place and ancestry, and three partitions are used, Welsh in North, Welsh in South and English in South. (The sample size of the 'English in North' is too small to be considered). For males of age group 1 comparing the results for 'Welsh in the North' with 'English in South', on the medial aspect of the arm, significant differences were found at filters 601, 605, 606 and 608 using the t-test and at all nine filters using the Mann-Whitney test. For the forehead significant differences were found at filters 601 to 606 and at 609 with the t-test and at all the filters except 608 with the Mann-Whitney test.

When comparing the 'Welsh in North' with the 'Welsh in South', similar results were obtained. For the arm significant differences were found at filters 601, 605 and 606 using the t-test, and at all nine filters using the Mann-Whitney test. For the forehead differences were found at filters 601, 603 to 607 and at 609, and at all nine filters with the Mann-Whitney test. When considering the 'English in South' and 'Welsh in South' no significant differences were found for either the arm or the forehead. For age group 2 no significant differences were found for any of the subdivisions for either the medial aspect of the arm, or for the forehead.

For the females comparing the 'Welsh in North' and 'English in South', significant differences were found at filters 603 to 606 with the t-test and at filters 602 to 607 with the Mann-Whitney test for the forehead only. No significant differences were found for the medial aspect of the arm. Comparing the same groups at age group 2, significant differences were found for the arm at filter 601 for both statistical tests and at filter 604 for the Mann-Whitney test. Comparing the

'Welsh in North' and 'Welsh in South', no significant differences were found for either age group for either position on the body.

Comparing the 'Welsh in South' with the 'Welsh in North' for age group 1, only one significant difference is found, at filter 606, for the forehead using the Mann-Whitney test. In age group 2 significant differences were found in the data for the forehead at filters 601 to 603, and 606 for the t-test and at filters 601, 602, 606 and 607 for the Mann-Whitney test.

Conclusions

The results of this survey correspond with the findings of other workers in showing differences between the sexes and between different age groups. For females the results of the Pembrokeshire data agree with earlier observations which have shown that skin colour lightens during adolescence. (Previous observations have been only for the medial aspect of the arm). The forehead data, however, show the older age group to be darker than the younger. It has not been possible to compare this with any previous study, but possibly this result indicates greater activity of the melanocyte stimulating hormone after adolescence.

In the males the Pembrokeshire data for the medial aspect of the arm do not agree with previous reports, as the older age group tended to be darker skinned. In previous studies the younger males had been darker skinned. Kalla (1973) suggested that there is a pre-pubertal increase in the activity of the melanocyte-stimulating hormone, and a fall in its production during adolescence. He further suggested that the pre-pubertal increase in pigment is of longer duration in males than in females. It is known from the demographic data that a relatively high percentage of males lie in the lower end of the age range and possibly this has tended to distort the data as these individuals could still be in the pre-pubertal increase stage. The forehead data showed the same trend.

When the birth place of the individual was taken into consideration, the males showed significant differences only in the lower age group; but the differences were found at all the filters and for both positions on the body. When the data for the males were divided by birth place and ancestry the same trend appeared. All significant differences were found within age group 1, and between individuals born, and living in, different parts of the county. (The demographic data show that the individuals were very largely resident in the same areas of the county, either north or south Pembrokeshire, as those in which they were born). This would suggest that it is the environment, rather than genetic factors, which cause the differences. Those individuals born in North Pembrokeshire are lighted skinned than those born/living in the south, the lighter skin being found where the hours of sunlight are less on the high ground of the North. As the differences are only found in the younger age group, it appears that the younger males are more susceptible to environmental effects. Possibly this is due to the onset of puberty falling within this age range, which causes hormonal changes. Kalla (1973) observed that boys and girls showed an increase in pigmentation between 10 and 11 years and then lost some of the colouring. It may well be that this increase in pigmentation is governed by the amount of sunshine (U.V. light) when it is available.

<u>Regional Variations in Skin Colour</u>

Tables 3.14 and 3.15 show the reflectance values at filters 601, 605, and 609 for the medial aspect of the arm, for populations resident in various locations in the British Isles.

For both sexes, the Pembrokeshire figures resemble most clearly those of Smith et al (1973) for Merthyr Tydfil and the results for Carnew and Ballinalough (Eire) (Sunderland et al 1973). These studies all consider areas on approximately the same latitude, whereas the remaining studies were at locations further north.

CHAPTER 12

SEROLOGY

Methodology

1. Collection of Samples

The collection of blood samples from the Pembrokeshire population was facilitated by the assistance of the Welsh branch of the National Blood Transfusion Service. Arrangements were made to visit donor clinics with the transfusion units to collect samples and to interview donors. Because sample collection created extra work for the B.T.S. nurses, samples were requested only from donors having one or both parents born in Pembrokeshire. This method of collecting selected samples was not ideal, but it was important to ensure that the running of the clinics was not disrupted since they were very busy with large numbers of donors. Visits were made to all the clinics held in Pembrokeshire or on the county boundaries, one visit only being made to each clinic between February and July 1978.

Donors who fulfilled the criterion of having one or both parents born in Pembrokeshire, and who were willing to participate in the survey were asked to complete a questionnaire requesting demographic data concerning their family (for details see Chapter 5); and a 5 ml. blood sample was collected from them. There was no indication that donors of a particular blood group were requested to attend the clinics.

At the end of each clinic the samples were posted to the Department of Anthropology in Durham for immediate blood grouping.

The clinics attended were at the following locations:-

North Pembrokeshire

Fishguard	(Cardigan)
St. Davids	(Newcastle Emlyn)

South Pembrokeshire

Tenby
Pembroke
Pembroke Dock
Narberth
Milford Haven
Angle
Haverfordwest

2. Blood Grouping

On arrival at the laboratory, the red cells were separated from the plasma by centrifugation. The plasma was retained for serum protein analysis. A few drops of red cells (0.5 1.0 ml.) were separated for blood grouping purposes, the remainder being stored at -20°C. until required for haemolysate preparation.

For the blood grouping procedures the red cells were washed three times in normal (0.85%) saline, and then diluted to give a 4.0% suspension.

Three main blood grouping techniques were used, and these will be described briefly.

(a) Tile Method

Used for:- ABO system, (including A_1 and A_2)
P_1 system

This technique involves placing about 0.5 ml. (1 drop) of the 4% red cell suspension on a clean tile, with an equal volume of the relevant antiserum and mixing the two. The mixture is left for a fixed period of time at a certain temperature (these two points being dependent on the antiserum being used) and the tile inspected for agglutination, by holding it over a strong light.

(b) Tube Method

Used for:- Rh System, M and N blood groups

This technique involves placing equal volumes of a 4% red cell suspension and the appropriate anti-serum into precipitin tube and leaving at a prescribed temperature for a specified time. In the case of the incomplete antibodies, a layer of 30% bovine serum albumin was added as an overlay, after one and one and a half hours, and left for a further thirty minutes. The presence of agglutination is investigated microscopically.

(c) Indirect Coombs Test

Used for F_y^a, k, S, $\bar{S}$

This method involves incubating at 37°C. one volume of the 5% red cell suspension with one volume of the appropriate anti-serum for a prescribed period of time. The cells are then washed for a time with saline, and placed on a clean tile with one drop of anti-human globulin reagent. The mixture is then inspected for agglutination over a strong light.

3. Starch - Gel Electrophoresis

Electrophoresis was carried out for the following red-cell enzyme systems: Esterase D (ESD), Adenylate Kinase (AK), Phosphoglucomutase (PGM_1) and Acid phosphotase (AP) and for the serum protein Haptoglobin (Hp). Any weakly reacting samples were re-run, and if unreliable results were still obtained the sample was not included in the overall results.

Esterase D (ESD)

Thin layer gels were prepared using the buffers listed below, (Koster et al 1975), and before electrophoresis an aliquot of each lysate was treated with an equal volume of Clelland's reagent.

The gels were run +Ve to -Ve for 2 hours at constant voltage (300 volts) and low ampage (5 mA), and stained using 4-methylumelliferyl acetate (as described by Hopkinson et al (1973)).

Clelland's reagent (0.75% solution of Dithiothretiol) is used to eliminate any storage effect so to produce clearer electrophonetic patterns.

<u>Gel Buffer</u> (for 1 litre)

Tris	1.636 gms.	
Citric acid	0.756 gm.	pH 7.4, keep at 4° C.
Boric acid	0.272 gm.	
Lithium Hydroxide	0.016 gm.	
Distilled water	1 litre	

<u>Tank Buffer</u> (for 4 litres)

Boric acid	108.84 gm.
Lithium Hydroxide	6.72 gm.
Distilled water	4 litres

The gels were read under U.V. light.

<u>Adenylate Kinase (AK)</u>

Thin layer gels were prepared, and run anode to cathode at constant voltage (250 v.) for 4 hours at 4°C.

The gels were stained using an agar overlay, and when the agar had set the gels were placed in an 37° C. overn, electrophonetic bands appearing after about 30 mins.

Tank (Bridge) Buffer

Citric Acid 29.72 gms.

NaOH 10.6366 gms.

H_2O 1 litre

pH 4.9

Gel Buffer

Succinic Acid 1.89 gms.

Tris [illegible] gms.

H_2O 1 litre

pH 5.0

Incubation Buffer

Tris 12.12 gms.

H_2O 1 litre

Adjusted to pH 8.0 with HCl

Staining

Mixture (per gel)

2% Agar solution (in H_2O)	10 ml.
Incubation buffer	10 ml.
Glucose	18 mg.
$Mg\ cl_2$	40 mg.
A.D.P.	4.9 mg.
NADP.	3.1 mg.
M.T.T.	2.5 mg.
P.M.S.	2.5 mg.
G6 PDH	20 ul
Hexokinase	20 ul

Phosphoglucomutase (PGM_1)

The method used was that of Spencer et al (1964). The gels were run cathode to anode at constant voltage (110 v.) and 5-8 MA for 17 hrs. at 4°C. The buffers used were as follows:-

Tank Buffer

Tris	12.11 gms.
Maleic Acid	11.62 gms.
EDTA (acid)	2.92 gms.
$MgCl_2$	2.03 gms.
H_2O	1 litre

Adjusted to pH 7.4 with 40% NaOH.

Gel Buffer

Dilute Tank Buffer 1 in 15.

The haemolysates were applied using cotton inserts.

The stain (listed below) was applied using an agar overlay, and the gels placed in a 37°C. oven. PGM_1 Electrophonetic bands appeared after 30-60 mins.

Stain (per gel)

2% Agar Soln. (in H_2O)	10 ml.
Incubation buffer	10 ml.
G-1-P (containing G-1:6 di phosphate)	30 mg.
NADP	1.5 mg.
MTT	2.5 mg.
PMS	2.5 mg.
G-6 PDH	20 ul.

Acid Phosphotase (AP)

The method used was that of Hopkinson et al (1963) except that Clelland's reagent was used in place of mercaptoethanal. 2 mm. thick gels were prepared, and the haemolysates applied using ? mm. Whatman paper. Prior to electrophoresis an aliquot of each lysate was treated with an equal volume of Clelland's reagent. The gels were run cathode to anode at constant voltage (115 v.) and 40 mA, for 17 hours at 4°C.

The gels were then sliced and both halves stained by placing Whatman MMM paper over the gel and pouring on the staining solution. The gels were kept at 4°C. for one hour, after which time the bands had appeared. The gels were then read under U.V. light.

Tank Buffer

0.41 M Citric Acid	86.1615 g/l
NaOH	45 g/l

adjusted to pH 6.0.

Gel Buffer

0.0025 M Succinic Acid	0.2952 g/l
0.0046 M Tris	0.5572 g/l

adjusted to pH 6.0.

Staining

8 mg. 4-Methylomelliferyl phosphate

10 ml. Incubation buffer

(Add 0.05 M naOH to 0.5 M citric acid, pH 5.0)

Serum porteins

Haptoglobins (Hp)

The method used was that of Smithers (1955), but using the modification of a discontinuous system of buffers as described by Povlik (1957).

2 mm. gels were prepared and run cathode to anode at constant current, for 17 hours at 4°C., or until the borate line has moved about 3 ins. from the origin. (The 17 hour run at 4 mA. was found to be more successful than a 3 hour run at 50 mA).

The gels were then sliced, and the top used for the haptoglobins. Stain was applied (see details below) and the bands appeared within 2 to 3 mins.

Tank Buffer

0.06 M	NaOH	2.4 g/l
0.3 M	Boric Acid	18.55 g/l
Adjusted to pH		8.5

Gel Buffer

0.076 M	Tris	9.2 g/l
0.005 M	Citric Acid	1.05 g/l

Staining
Leuco-Malachite Green Method

Stain 100 ml. glacial acetic acid

150 ml H_2O

1 gm. leuco-malachite green

1 handful of zinc dust, powdered

The above ingredients were boiled in a 1 litre beaker until the green colour of the leuco-malachite green disappeared. The mixture was then filtered to remove the solids and stored at 4°C. until required.

The above mixture was poured over the sliced gel and left for 5 mins; the excess stain was then poured off and 10 ml. of 1/10 20 vols. H_2O_2 was poured onto the gel. The bands appeared after a few minutes.

RESULTS

The ABO Blood Group System

The phenotype and gene frequencies for the ABO system are listed in Tables 4.1, 4.2 and 4.17. The separate A_1, A_2 results have not been included in this instance, as no significant differences were found.

Although non-significant differences were found between all the subsets produced using single or dual parameters, differences were shown to exist. Of particular interest was the variation in the frequency of the A blood group. When two birth locations were considered, North Pembrokeshire showed the higher A frequency for both BP and PBP and when using three birth locations, North Pembrokeshire remained with the highest frequency, followed by S.W. 'Little England', with the lowest frequency for the S.E. of 'Little England'. Using the criterion of ancestry, however, showed the 'English' to have the higher A blood group frequency.

When the dual parameters of birth location and ancestry were considered, the subsets produced using only the two birth locations showed the highest A blood group frequency for the 'Welsh' in North Pembrokeshire, followed by the 'English' in the South, and finally the 'Welsh' in the South. However, when the three birth locations were used, the 'English' in the south-west of South Pembrokeshire showed the highest A blood group frequency, with the 'Welsh' in the North showing the second highest frequency and the other subsets decreased in frequency values as follows: 'English' in S.E., 'Welsh' in S.W. and finally 'Welsh' in S.E.

In a previous study of ABO blood group distribution in Pembrokeshire, Morgan-Watkin (1960), showed the highest A blood group frequency for S.E. 'Little England'. Since his sample included only donors with Welsh surnames, this was equivalent to the 'Welsh' in the S.E. in this study. In the present study, the reverse was found with the 'Welsh' of S.E. South Pembrokeshire showing the lowest A blood group frequency, with the south-eastern area in general giving the lower frequency of the three areas.

Considering North Pembrokeshire, Morgan-Watkin (1960) describes a higher gene frequency in the Goodwick and Llanwnda areas than around Fishguard. Again the present survey does not agree with this finding. The largest number of samples contributing to the overall North Pembrokeshire sample populations was collected in the Fishguard area, but the overall A blood group frequency was high.

Kopec (1970) found the highest A gene frequency in the Milford Haven area (S.W. 'Little England'), with relatively high frequencies for Haverfordwest (S.W. Pembrokeshire) and Pembroke Dock (S.E. Pembrokeshire). However, it should be noted that historical evidence exists which shows that many people from the Milford area moved to Pembroke Dock to work in the dockyard (see Chapter 2). Considering the migration into South Pembrokeshire, from South Wales to work in industries such as mining and the dockyards, compared with the relatively stable conditions in North Pembrokeshire in recent times, it does not seem surprising that variations exist.

Kopec's results for North Pembrokeshire show a raised A frequency when compared with the rest of Wales, with a value as high as that found in the Tenby area of S.E. Little England. In her 1973 paper she states that Pembrokeshire plus the town of Cardigan has the highest A/N found anywhere consistently over a whole series of unit areas. With all the areas of Pembrokeshire showing the raised A blood group frequencies, as compared with the rest of Wales, it is difficult to attribute this variation to the inflow of Normans and English into the area. If we are to consider Morgan-Watkin's idea of a Viking settlement, then the results of the present study suggest that S.W. Pembrokeshire (Milford Haven and Haverfordwest) and North Pembrokeshire (in particular the Fishguard area) were the sites of settlements. It was unfortunate that the North Pembrokeshire sample was so biased towards one locality, but this was unavoidable since no B.T.U. clinics were held on the eastern side of the Preceli range, except at Newcastle-Emlyn which yielded only 13 samples. THE RESULTS SHOW THE N. PEMBS., A frequency to be higher than that for Carmarthenshire (Watkin 1965), suggesting a possible coastal influence, namely invasion from Ireland, or by way of the Irish Sea, which did not penetrate inland as far as Carmarthenshire.

The B blood group frequencies are high compared with those for England (excepting Northumberland, Fraser-Roberts 1953) but resemble those found for western Wales. Morgan Watkin has suggested that the raised B frequency indicates traces of the ancient stock identified by Flewe and James (1916) on the high moorlands of West Wales.

<u>The Rhesus System</u> (Tables 4.3, 4.4, 4.5, 4.18, 4.19)

Tables 4.3 to 4.5 show the frequencies of the Rhesus phenotypes, and their related gene frequencies. Subdividing the data using the single partitioning parameter of the two birth locations showed a significant difference between subsets for both BP and PBP. This difference was maintained when South Pembrokeshire was further divided into two separate areas. In all cases, the South Pembrokeshire donors showed the higher frequencies of Rhesus negative (d) donors. Division of the data by the criterion of ancestry failed to show any significant difference between the 'English' and 'Welsh'.

Using the dual parameters of ancestry and two birth locations showed the Welsh in North Pembrokeshire to be significantly different in both the Welsh and English born in South Pembrokeshire, though these latter two subsets did not differ significantly from each other.

When the county was divided into the three areas, the 'Welsh' in the North were shown to be significantly different from both the 'Welsh' and 'English' populations of South-east Pembrokeshire, and from the 'Welsh' population of the south-west. For the 'English' population of the South-west, the X^2 value approached the significant level. In addition, the comparison of the 'Welsh' in the S.W. with the 'English' in the S.E., gave a chi^2 value approaching significance. In all cases the frequencies for Rhesus negative donors were greater for the south than for the north.

Table 4.18 compares the frequency of the (d) gene in three areas of Pembrokeshire, with the frequencies for other selected populations. These comparisons show the d gene frequency for North Pembrokeshire to be identical with that found by Race et al (1943) for Wales as a whole. The value for south-west Pembrokeshire shows no resemblance to the results for any other part of the British Isles, but lie closer to the results for Iceland and Scandinavia in having a low d gene frequency. In contrast, the d frequency for south-east Pembrokeshire is much higher than for any other population so far surveyed in the British Isles.

Table 4.19 gives the gene complex frequencies for Pembrokeshire and other selected populations, and these results give a different picture. The North Pembrokeshire population gives a cde gene frequency lower than for any other British or Irish population, whereas the results for the south-east and south-west populations give cde frequencies within the range found for these other British and Irish populations.

Overall the rhesus gene frequencies for North Pembrokeshire most closely resemble those of Sunderland et al (1973) for Carnew in Co. Wicklow, though it should be pointed out that only a limited number of studies exist with which to compare the Pembrokeshire results. The results for south-west and south-east Pembrokeshire are not closely comparable with any of the other studies.

Comparing the Pembrokeshire values with those for the Black Mountains of Carmarthenshire (the nearest locality studied for Rhesus gene frequencies) (Garlick and Pantin 1957), shows the North Pembrokeshire results to resemble the Carmarthenshire ones most clearly.

<u>The MNSs̄ System</u> (Tables 4.6, 4.7, 4.8, 4.20, 4.21)

Dividing the data using the single parameter of the donor's birth place, north and south of the Landsker (Table 4.7) produced a significant difference between subsets (X^2 11.716, sig. .039). A similar result was obtained when the criterion of parents' birth place was used. On further dividing Southern Pembrokeshire, east-west, the difference between the subsets was increased (X^2 23.417, sig. .0244), when the criterion of ancestry was used, the 'English' were shown to be significantly different from the 'Welsh' (X^2 11.864, sig. .037).

When considering the two subsets North Pembrokeshire and South Pembrokeshire (BP and PBP), North Pembrokeshire showed the higher M gene frequency for both MS and Ms. However, when the three birth locations were used the south-west gave the greatest M gene frequency, and the south-east the lowest, the greatest difference between the three groups being between these two. For the criterion of ancestry the 'Welsh' showed the higher MS gene frequency, but the English the higher Ms frequency.

When the dual parameters of birth place (2 locations) were used a significant difference was found between the 'Welsh' in North Pembrokeshire and the 'English' in the south, but not for the other two comparisons (WN/WS, ES/WS). Comparison between the five subsets produced using the criteria of the three birth locations and ancestry showed the 'Welsh' in the S.W. and the 'English' in the S.E. to differ significantly from the other three, despite small sample sizes and markedly from each other. The 'Welsh' in the S.W. showed the highest M gene frequency and the 'English' in the S.E. the lowest.

If the results for the three areas of Pembrokeshire are compared with those of other selected populations, the values for the M and N gene frequencies for North Pembrokeshire resemble those for parts of Western Eire, and are reasonably close to those of Boyd and Boyd (1937) for the whole of Wales. When the MNSs frequencies for North Pembrokeshire are compared the resemblance to the Eire results remains. The results for S.W. Pembrokeshire, show high M, low N gene frequencies; similar results having been found for Scotland (Glasgow), Malta (1937) and for Co. Wicklow, Co. Kilkenny and Co. Leix in Eire (Tills 1965), and slightly higher than for the Icelandic population (Bjarnason (1968)). The S.W. Pembrokeshire M and N gene frequencies were found to be higher than Boyd et al's (1937) figure for Wales; though not significantly so. The MNSs gene frequencies for the south-west, most closely resembled those for the Scottish Highlands (Brown 1965).

Finally, comparing the south-east gene frequencies showed the M and N values to have no close similarities with any of the other populations considered, the closest figures being those for England and the Netherlands, but even these differ significantly. These south-east gene frequencies showed a similar MS gene frequency as that of Garlick and Partin (1957) for S.E. Carmarthenshire (the Black

Mountain area) but the other three values show no resemblance to their results.

P Blood Group System (Tables 4.9, 4.10, 4.22)

Partitioning the data by the criterion of the donor's birth place for two locations (N and S of the Landsker) failed to produce significant differences between subsets and similar results were obtained using the parents' common birth place. However, when the county was divided into the three areas, a significant difference was found between the populations of the three areas (X^2 18.159, sig. .020), South-West Pembrokeshire differing markedly from the other two areas. The criterion of ancestry failed to produce a significant difference between the 'English' and 'Welsh'.

Considering the data divided by the dual parameters of birth place and ancestry failed to produce significant differences between subsets.

Comparing the Pembrokeshire results with those of some selected population showed the values for South-West Pembrokeshire to be closest to those previously recorded in Eire (Teesdale and Tills 1970, Sunderland et al 1973 for Carnew); but to be slightly higher than the figure recorded for Wales (Ikin et al 1954). The values for the Icelandic population recorded by Palsson and Walter (1967) are also close to the S.W. Pembrokeshire results.

North and South-East Pembrokeshire show P_1 frequencies lower than for any other area in the British Isles, excepting that of Palsson et al (1970) for Eire. (However, this study involved a small sample size). The nearest figure is that of Bjarnason et al (1968) for an Icelandic population. The studies of the P blood group system in localised areas are extremely limited, and it will be interesting to see if similar variabilities are observed in other parts of the British Isles.

Duffy Blood Group System (Table 4.23)

These results showed no significant differences between subsets produced using the single parameters. The subsets comparisons, using the dual parameters, produced similar results with no significant differences due to birth location or ancestry.

The gene frequencies for the Pembrokeshire populations fall within the range shown by other British and Irish population samples.

Kell Blood Group System (Table 4.23)

No significant differences were found between any of the subsets using either the single or dual parameters.

Comparing the Kell gene frequencies for the three localities in Pembrokeshire with other populations throughout the British Isles shows the Pembrokeshire frequencies to fall within the small range exhibited by the K allele; North Pembrokeshire and the south-east of 'Little England' showed the higher K allele values (.045 and .047 respectively) very close to the values for Scotland (Ikin 1954), Wales (Ikin 1954) and Ulster (Teesdale and Tills 1970), that is the Celtic populations, whereas S.W. Pembrokeshire showed a K gene frequency of .035, closer to the value for the English population (Ikin 1954).

Phosphoglucomutase (Tables 4.12, 4.24)

Using the criterion of birth location revealed a significant difference between the populations of North and South Pembrokeshire in the PGM phenotype frequencies, though using the parents' birth place removed this difference. When South Pembrokeshire was divided east-west a significant difference was found between the three areas. The criterion of ancestry, however, showed no significant difference between the 'English' and 'Welsh'.

The dual parameters showed significant differences to exist between the 'Welsh in North Pembrokeshire' and the 'Welsh' in the south (when two birth locations were used); and between the 'Welsh' in the north and the 'Welsh' in the south-east and south-west when the three locations were used.

When comparing the Pembrokeshire phosphoglucomutase gene frequencies with selected populations, the results for South-east Pembrokeshire resemble closely those for North Northumbria (Papiha 1973), though the PGM^1 frequency is higher than for the general English sample (no other 'localised' 'English' population results were available). Co. Corlow and Co. Leix in Eire have also shown similar gene frequencies as did the Icelandic population studied by Mourant and Tills (1967). The results for North Pembrokeshire showed a high PGM^1 gene frequency, comparable with those of Tills (1971) for Ulster and Palsson (1970) for Eire.

The values for the South-west Pembrokeshire population were found to lie between those for the north and the south-east populations; the closest value being that for the Icelandic population (Mourant and Tills 1967). However, when considering the S.W. population sample split by ancestry, it was the 'English' which showed a high PGM^1 gene frequency. Previous studies in the British Isles by Tills (1971 for Eire), Mitchell et al (1976 for Isle of Man, Cumbria etc.) and Papiha (1973 for Northumberland) have illustrated the variability in P.G.M. gene frequencies which may occur in localised areas.

<u>Esterase D (ESD)</u> (Table 4.26)

Subdivision of the data using the single and dual parameters failed to produce significant differences between subsets.

Comparing the Pembrokeshire results with those of other British and European populations showed them to resemble the Celtic populations in having ESD^1 values at the upper end of the range shown by this gene.

Adenylate kinase (AK) (Table 4.27)

No significant differences were found between any of the subsets produced using either the single or dual parameters.

Comparing the results with those of other selected populations showed the Pembrokeshire AK^1 gene frequencies to lie at the upper end of the narrow range shown by European populations, closely resembling the values for Co. Waterford, Co. Leix and Co. Kilkenny in western Ireland, and the gene frequency for Denmark (Lamm 1971).

Haptoglobins (Tables 4.15, 4.16, 4.28)

Partitioning the data using the single parameters failed to produce significant differences between any of the subsets. When the dual partitioning parameters were used, a significant difference was shown between the 'Welsh' in south-west 'Little England' and the 'English' in the south-east (X^2 7.767, sig. .0206), the former showing the lowest gene frequency for H_p^1 and the latter the highest. The 'Welsh' in the south-west showed a frequency of the 1-1 phenotype, much lower than that shown by any of the other subsets.

Comparing the Pembrokeshire haptoglobin gene frequencies with those of other populations (Table 4.28) showed the figures for North Pembrokeshire to be akin to those for S.W. Scotland. The south-west haptoglobin gene frequencies closely resembled those for Eire, especially the counties of Waterford and Wexford, which lie directly across the Irish Sea from S.W. Pembrokeshire.

The values for South-east Pembrokeshire are close to those found for a general English sample by Harris et al (1959). In addition similar figures have been found for some of the counties of Eire (Tills 1965).

Measurement of Genetic Distance

Edwards New E^2

Introduction

Methods of calculating distance coefficients have been developed to allow the variation in gene frequencies among populations at a large number of loci to be considered concurrently. Those distance coefficients which make use of gene frequency results may appropriately be designated as 'genetic distances' (Constandse-Westermann 1972). It is considered that allelic frequencies estimated by maximum likelihood methods are best suited for the calculation of genetic distance (Sanghvi and Balakrishnan 1972).

Most of the distance coefficients calculated from qualitative data have mainly been developed over the last ten years, and these may be roughly divided into four categories. Firstly, those coefficients based on squared differences between percentage of frequency values, initially introduced by Spuhler (1954). Secondly, those distance coefficients based on the same principles as the Chi^2 test, namely Gc^2 considered by Edwards and Cavalli Sforza (1972), and DK^2 which may be considered as a transition to a coefficient belonging to the third category. This third category includes coefficients by which the differences in percentages between populations are expressed in terms of the elements of the pooled dispersion matrix of all investigated groups. Category four contains those distance coefficients whose calculation is based on the angular transformation of the original percentages of frequencies.

The reader is referred to 'Coefficients of Biological Distance' by Constandse-Westermann (1972), Chapter V, for a detailed consideration of distance coefficients calculated from qualitative traits.

A distance coefficient belonging to category four, namely Edwards and Cavalli-Sforza's 'new' E^2, was used in the present study. This statistic was selected since it has some advantages over other measures, namely:

(i) the variances are standardised and the distance measure is strictly comparative between different data sets which use the same loci;

(ii) attribute states are decorrelated by reducing dimensions (though this point has been questioned by Balakrishnan and Sanghvi (1968));

(iii) the 'new' E^2 gives a better estimate of larger distances (as compared with the earlier E statistic devised by Edwards et al).

Use of Edwards 'new' E^2

The use of an angular transformation allows the distances to be represented in curved space, a hypersphere. The method first transforms each frequency, p, to its angular value $\sin^{-1}\sqrt{p}$, this transformation being equivalent to the plotting of the square roots of the gene frequencies, $\sqrt{p}$, along K cartesian axes. This results in the population space being the $(1/2^k)$th part of the surface of the unit hypersphere in k dimensions (Edwards and Cavalli Sforza, 1972). The curved space is then stereographically projected into a Euclidean one. Full details of the geometry are given in Edwards and Cavalli-Sforza (1972) and this will not be discussed further.

The E^2 distance may be calculated from the formula:-

$$E^2 = 8\,\frac{1 - \sum_{k=1}^{S_{j+1}} \sqrt{P_{1jk} \cdot P_{2jk}}}{\left(1 - \sum_{k=1}^{S_{j+1}} \sqrt{\frac{P_{1jk}}{S_{j+1}}} + \sum_{k=1}^{S_{j+1}} \sqrt{\frac{P_{2jk}}{S_{j+1}}}\right)}$$.

where:-

P_{ijk} is the kth class of the jth character in the ith population

S_j is the number of classes minus one.

An overall squared distance value may be obtained by adding the squared distances from the various loci. For comparative purposes, the influence of the number of alleles on the total E^2 value may be neutralised by dividing the total result by $\sum_{j=1}^{r} S_j$. (Termed the 'Standardised E^2' in the tables).

The E^2 distances were computed using a Fortran program (see Appendix, 353). The input consisted of the frequencies of each attribute stale and the 'dimensions' of the analysis, namely the number of loci and alleles being used.

The output from the program gave:-

(1) A data input reprint

(2) Individual E^2 values for each locus separately

(3) The total E^2 values

(4) The standardised E^2 value, i.e. where the total E^2 has been divided by the number of degrees of freedom.

Non-metric multidimensional scaling

This type of distance analysis depends on the production of a set of co-ordinates, usually in 2 to g-1 dimensions, displayed in map form, being produced from a distance matrix. It is possible to apply this technique to any attributes which may be arranged in rank order, and the matrix of genetic distances produced using the E^2 statistic is thus ideal for NMMS analysis.

The advantages of this technique are, firstly, that no assumption is made as to the nature of the distance value, and, secondly, the method allows data in any number of dimensions to be represented in two dimensions.

The 'stress' values, the Gottman-Lingoes Coefficients and the trustal stress coefficient, associated with NMMS, indicate the degree of contortion required to produce topology. Full details of this technique are given in Kruskal (1964).

Computation

NMMS was carried out using the OSIRIS program MINISSA-1, and using the option of minimal Kruskal stress.

Output from this program included:-

(a) Co-ordinates and co-ordination of the groups in reduced space. (2 dimensions were used).

(b) The Guttman-Lingoes coefficient of alienation and the Kruskal's stress coefficient.

Coding for NMMS co-ordinates

1 North Pembrokeshire

2 S.W. Pembrokeshire

3 S.E. Pembrokeshire

4 England

5 Eire

6 Scotland

7 Iceland

8 Flemish

Genetic Distance

Results and Conclusions

Table 4.29 shows data matrices of genetic distances produced using Edwards E^2 statistic. The populations of North, South-west and South-east Pembrokeshire have been compared with the English, Southern Irish, Scottish, Icelandic and Flemish. Unfortunately no comparison could be made with the northern Welsh as insufficient data was available.

The results show that within Pembrokeshire the genetic distance between the North Pembrokeshire and the South-west Pembrokeshire populations was less than the distances between the south-west and the south-east, and the north and the south-east, thus reflecting the results for the individual blood group systems. However, both the south-west and south-east Pembrokeshire populations showed a close relationship with the English, than with the population of North Pembrokeshire.

The North Pembrokeshire population showed no close relationship with any of the other populations being considered, the shortest distance being between it and Eire. Again, this reflects the finding for the individual systems. One unexpected result was the relatively close relationship between the population of North Pembrokeshire and the Flemish. There is no satisfactory explanation for this since the Flemish were known to have settled mainly in the South of Pembrokeshire (see Chapter 2).

The results shown in the matrix were reflected in the non-metric multidimensional scaling plot (Figure 4.30). This plot, using two dimensions (Kruskal's stress coefficient = 0.03439 in 13 iterations), showed the populations of South-west and South-east Pembrokeshire to cluster with the English. The population to the north was shown to have some association with that of the south-west, but with no other population. The Icelandic population showed no association with the Pembrokeshire populations, a finding which agrees with the Edwards

E^2 results. Although the S.W. Pembrokeshire population showed some gene frequencies close to those shown by the Icelanders, the overall picture suggests no association between the two.

Sunderland and Cartwright (1974) calculated the genetic distances between 13 populations in England and Wales, using Edwards E^2 and NMMS (and other methods of spatial analysis). Four genetic systems were used: ABO, Rhesus, PTC and colour-blindness. Two of the populations involved were those of Fishguard (N. Pembrokeshire) and Tenby (S. Pembrokeshire). Their results show considerable heterogeneity between these two populations, the Tenby population being loosely associated with the other Welsh populations and possibly having some association with N.E. England. (It is interesting to note that no southern English populations were considered in this paper). The Fishguard population showed no association with the other Welsh populations (Swansea, Anglesey and Caernarvon) or with any of the English groups, reflecting the results of the present study. As Sunderland and Cartwright state, 'the atypical results appear in North and not South Pembroke'.

Overall Conclusions

Having considered the results for the various genetic traits singly, it is now possible to look at the overall picture which these studies present. Before drawing any overall conclusions, it is necessary to consider whether such interpretations are valid, taking into account the sampling procedures used, and to point out problems which arose during the course of the research.

Firstly, considering the collection of dermatoglyphic and skin colour data. Dennis (1977b) has illustrated that school children represent a random sample of the population. However, he points out that difficulties may arise if samples cannot be collected from all areas within the survey region. In the Pembrokeshire survey, this problem did arise, since consent to sample certain schools was not forthcoming. This was overcome in urban areas with several schools, but in rural areas this meant that some parishes were not sampled, the main deficiency being in the Eglwyswrw district of North Pembrokeshire.

Subdivision of the dermal print data produced further difficulties because of the small 'English' population in North Pembrokeshire. It proved impossible to obtain anything like a satisfactory sample using the resources available. However, this fact has been taken into consideration when interpreting the dermatoglyphics rsults, and for both the skin and serology data analyses subset EN has been omitted.

The serology survey produced a further problem, namely that urban populations were more strongly represented in the sample, due to the locations of the B.T.U. clinics. This could not be overcome since, for ethical reasons, blood samples could not be taken from school children and no other sampling procedures were available.

This last point illustrates the fundamental disadvantage of the whole study, namely, that data for all the genetic traits being considered could not be collected from all individuals. In effect, the dermatogyphic/skin colour survey and the serology survey represent two entirely separate, though associated, pieces of research.

Before comparing the results for the two studies, it is interesting to consider the evidence presented by the demographic studies. Cavalli-Sforza and Feldman (1973) have discussed the relationship between cultural and genetic inheritance and have suggested that 'cultural diffusion' from parent to child may show a great resemblance to biological evaluation. Certainly in the case of the Pembrokeshire populations this would appear to be true. Analysis of demographic data has shown that significant cultural differences still exist between the northern and southern populations, notably in religion and language, and that little intermarriage occurs between them. Historical evidence suggests that the inhabitants of North Pembrokeshire looked upon the people of 'Little England' as outsiders and that marriage across the Landsker was discouraged. Conversely, the population of South Pembrokeshire was larger, with several urban centres in the area, and there was little reason for the inhabitants to visit the north of the county. The results of the survey of present-day demographic data suggests little evidence of a breakdown of this cultural separation. Therefore the transmission of 'Welsh' or 'English' cultural traditions would appear to accompany the transmission of genetic traits, with little 'genetic' or 'cultural' interchange between the two populations.

For analysis of the genetic data, the partitioning parameters of birth location and ancestry have been used, either singly or dually.

Considering the analyses overall, one fact becomes clear, namely that it is the partitioning of the data by birth location which produced subsets between which significant differences were found for some of the genetic traits investigated. Only in rare incidences were differences found between subsets created using the criterion of ancestry. Both the univariate and multivariate analyses show this trend for the dermatoglyphics data, with the criterion of the parents' common birth place producing the highest percentages of correctly classified cases and the largest D^2 values for both sexes. Similarly, the serology data showed birth location to be the more important criterion.

The results from the skin pigmentation analysis show the same trend, but in this case it is evident that environmental differences between North and South Pembrokeshire are contributing to variations in the observed skin colour. In this study it has been impossible to distinguish successfully between environmental and genetic factors.

The results of the genetic studies support the evidence shown by the demographic data in suggesting that the genetic pools of North and South Pembrokeshire do differ, as do the cultural 'pools'. In addition, the genetic evidence suggests that there might possibly be three basically different populations in North, South-east and South-west Pembrokeshire. This is well illustrated in the analysis of the serology data, and the outcome of the multivariate analysis of the dermatoglyphic data lends support to this claim. Ideally, the differences in dermatoglyphic traits between South-east and South-west Pembrokeshire should be investigated more closely, but samples sizes made this impossible.

This point leads on conveniently to the consideration of possible further research. Obviously one possibility would be to add to the samples already collected and further investigation of the traits already studied, to identify any spurious results produced due to small sample sizes.

Another useful approach would be to investigate marriage distances, possibly identifying those areas where some intermarriage across the Landsker occurred. John (1972) has shown that the exact location of the Landsker was difficult to define in some areas. It would be interesting to see whether there is an increase in social contact in these areas. Furthermore, the collection of genetic data from neighbouring 'Carmarthenshire' and 'Cardiganshire', now also parts of Dyfed, would allow further comparative work to be carried out.

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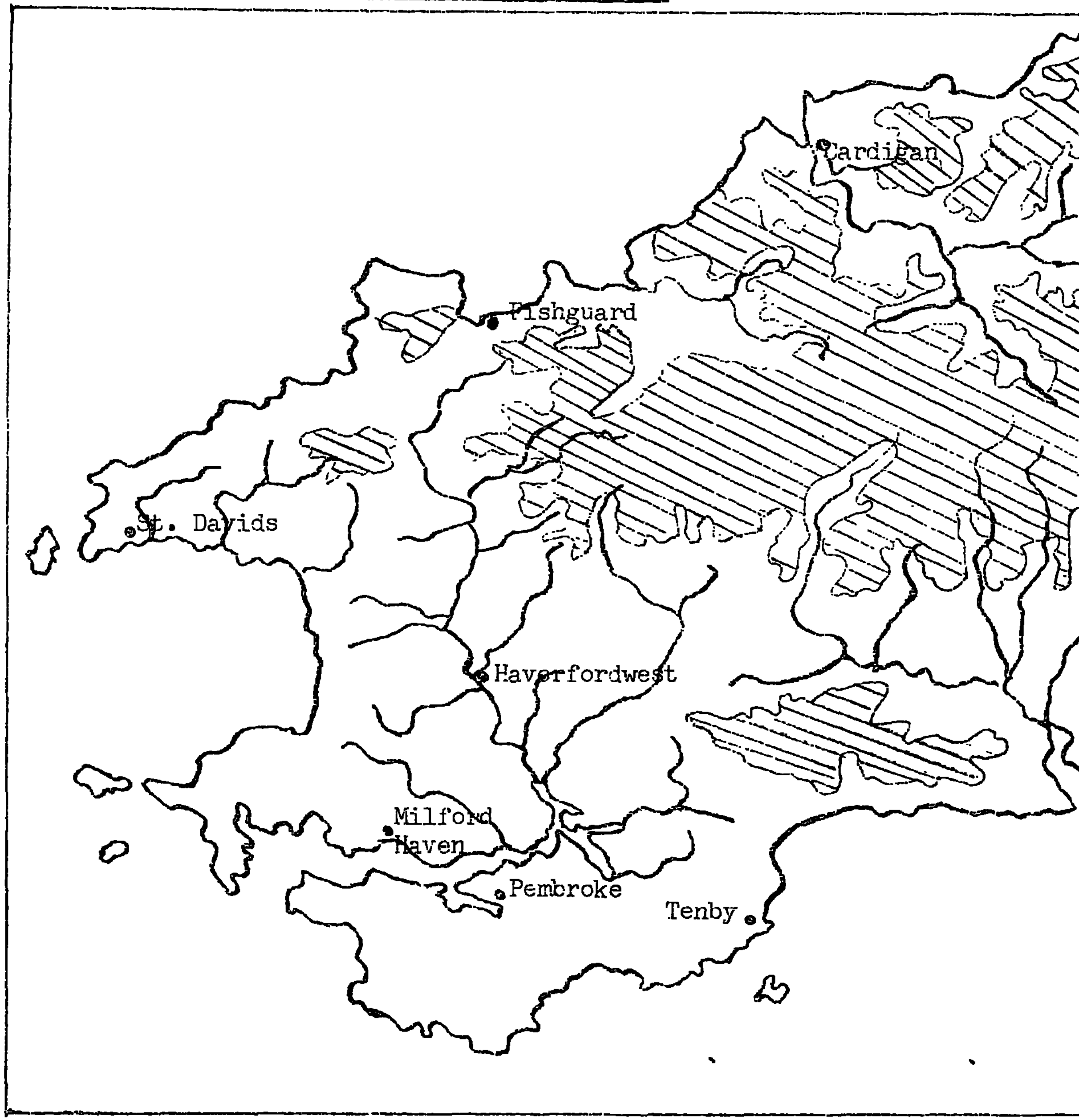
TOPOGRAPHY OF PEMBROKESHIRE

FIGURE 1

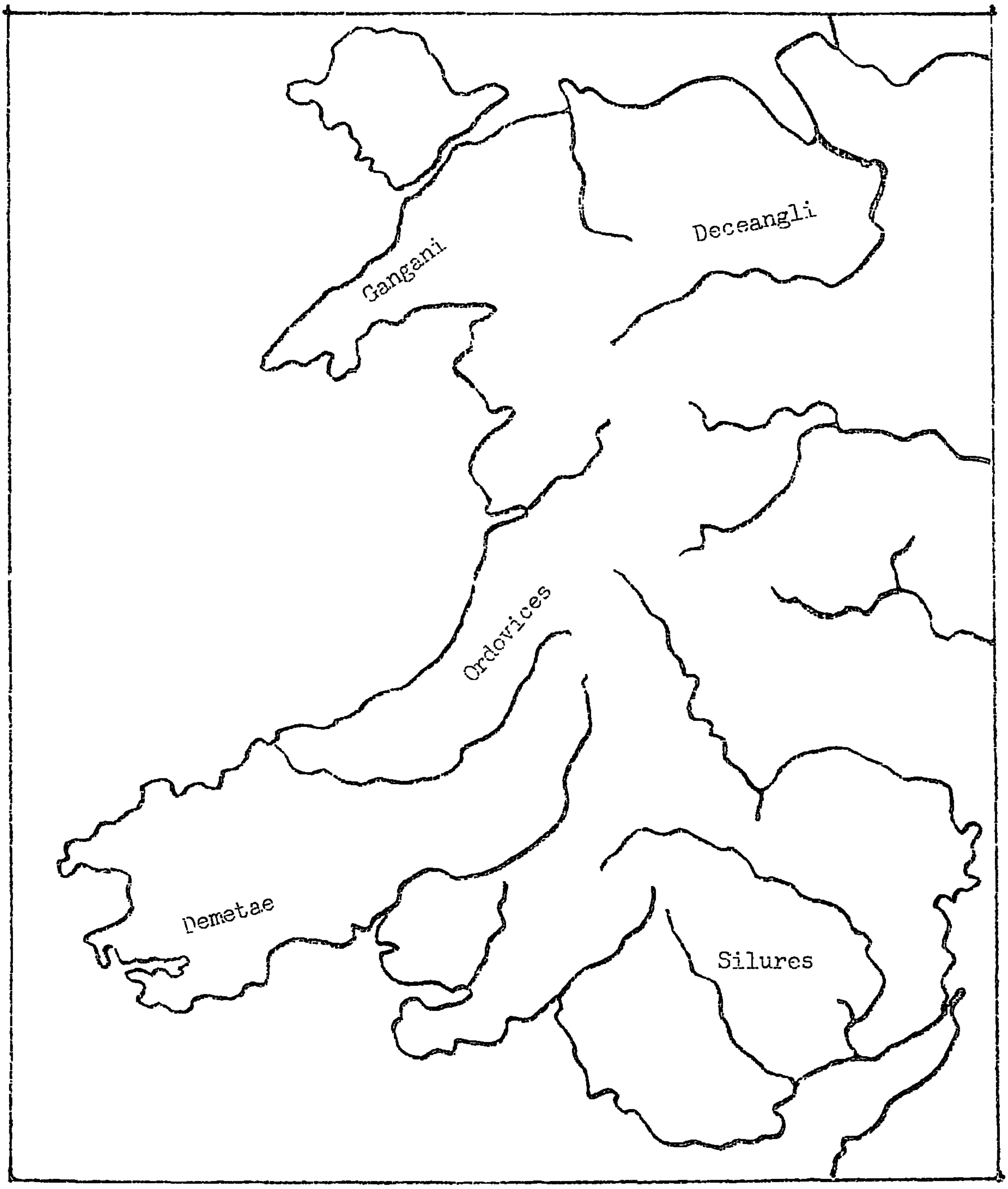


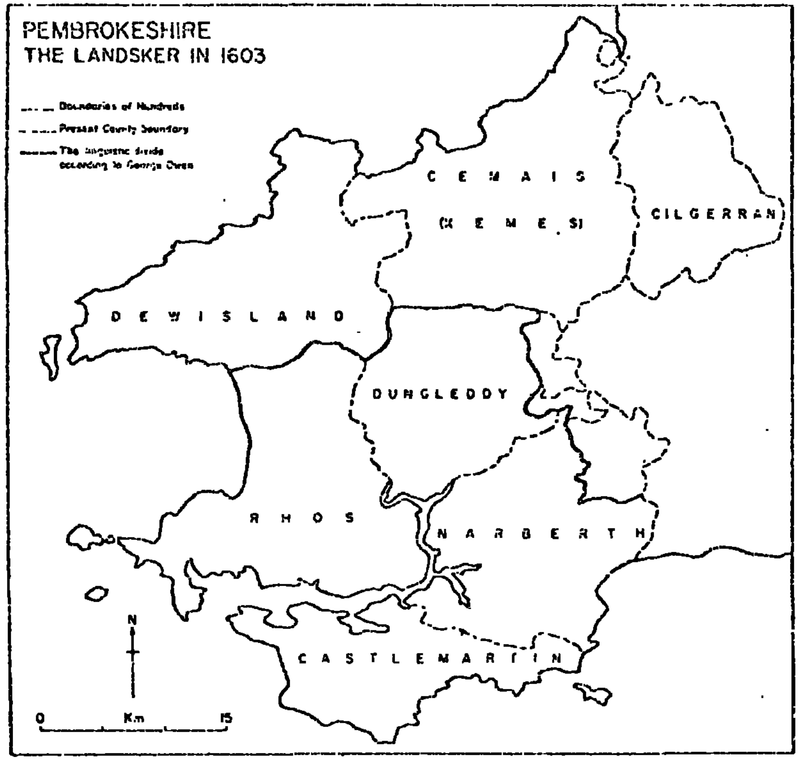
KEY

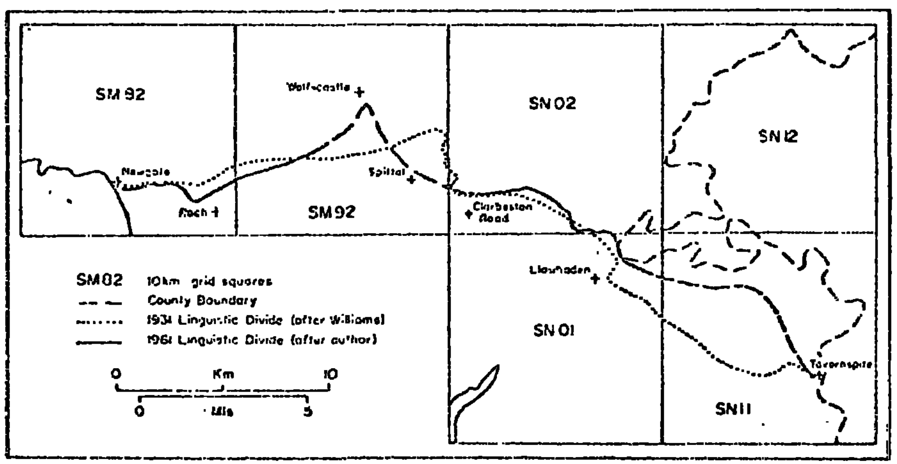
Land over 400 ft.

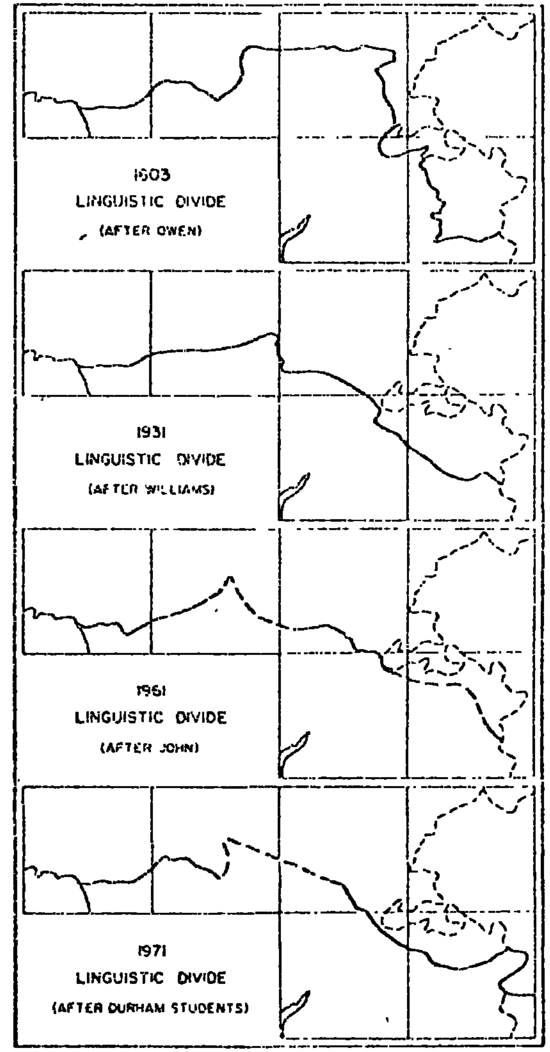
FIGURE 2

IRON AGE TRIBES IN WALES





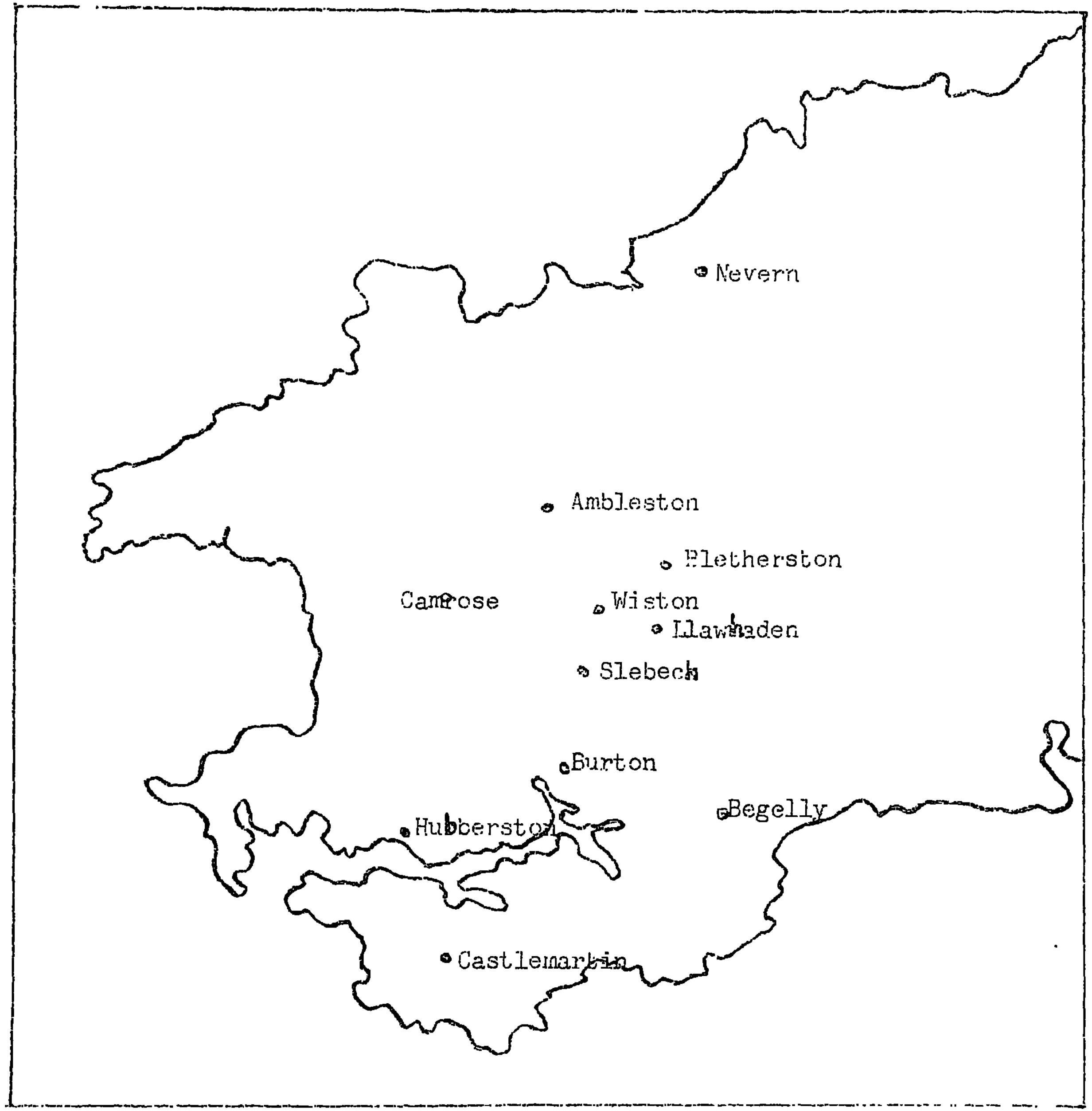




After John 1972

FIGURE 4

PARISHES CONSIDERED IN REGISTER STUDY



LOCATIONS OF SCHOOLS VISITED DURING DERMATOGLYPHICS SURVEY

FIGURE 5

Figures in round brackets refer to number of marriages for the period.
Figures in square brackets refer to total population of parish.

		1750-1780	1780-1810	1810-1840	1840-1870	1870-1900	1900-1930
North Pembrokeshire							
Nevern	1	78.72 (94)	-	58.66(254)	-	-	-
	2	95.74 [1,283]	-	80.71 [1,558]	-	-	-
	3	100.00	-	98.82	-	-	-
Ambleston	1	34.12 (85)	34.12 (85)	66.02(103)	56.82 (44)	77.78 (18)	-
	2	65.88	65.88	85.44	72.73	88.88	-
	3	94.12 [421]	94.12 [421]	96.12 [574]	81.82 [541]	88.88 [443]	-
Bletherston	1	31.91 (47)	35.00 (60)	48.84 (43)	79.16 (48)	-	-
	2	70.21	61.66	72.09	95.83	-	-
	3	78.72 [235]	91.66 [235]	88.37 [300]	95.83 [267]	-	-
South Pembrokeshire							
Burton	1	63.01 (73)	52.29(108)	82.29 (96)	60.00 (30)	42.55 (94)	-
	2	83.56	77.98	87.50	86.67	78.78	-
	3	97.26 [457]	94.50 [457]	96.88 [694]	96.67 [909]	90.43 [1,027]	
Begelly	1	57.14 (28)	63.19(144)	65.42 (88)	63.72(215)	61.62 (99)	34.33(67)
	2	82.14 [354]	87.50	85.12	85.12	80.81	53.73 [443]
	3	96.43	99.31 [354]	96.81 [526]	97.67 [535]	94.95 [439]	80.60
Slebech	1	54.54 (55)	60.53 (76)	-	-	-	-
	2	90.90 [288]	77.63 [288]	-	-	-	-
	3	98.18	100.00	-	-	-	-
Hubberston	1	54.74 (95)	54.88(164)	54.77(199)	67.53(231)	55.78(147)	68.69(99)
	2	57.89	57.82	69.35	77.06	65.99	86.87
	3	77.89 [641]	70.12 [641]	72.36 [1,013]	84.85 [1458]	73.47 [1517]	90.91
Castlemartin	1	-	68.12 (69)	72.41 (87)	71.08 (83)	62.34 (77)	53.73 (67)
	2	-	81.16	80.46	87.95	70.13	71.64 [267]
	3	- (338)	100.00 [338]	100.00 [487]	98.80 [381]	90.91 [381]	92.54

Category 1. = % marriages within parish.
Category 2. = % marriages within parish + marriage with a neighbouring parish.
Category 3. = % marriages within categories 1 + 2 + marriage within N or S.Pembrokeshire.

% MARRIAGES ACROSS THE LANDSKER

(Figures in brackets represent total number of marriages)

	1750-1780	1780-1810	1810-1840	1840-1870	1870-1900	1900-1930
North Pembrokeshire						
Nevern	0 (94)	-	0 (254)	-	-	-
Ambleston	-	3.53 (85)	0.97 (103)	9.09 (44)	5.55 (18)	-
Bletherston	6.38 (47)	5.00 (60)	6.98 (43)	0 (48)	-	-
South Pembrokeshire						
Slebech	0 (55)	0 (76)	-	-	-	-
Burton	0 (73)	3.67 (109)	0 (96)	0 (30)	0 (94)	-
Begelly	0 (28)	0 (144)	0.53 (188)	0 (215)	0 (99)	0 (67)
Hubberston	0 (95)	0.61 (164)	1.51 (199)	2.60 (231)	0 (147)	0 (99)
Castlemartin	-	0 (69)	0 (87)	0 (83)	0 (77)	1.49 (67)

TABLE 11.3 PERCENTAGE WELSH AND ENGLISH (OR NON-WELSH) SURNAMES (Non-Welsh include Scots and Irish)

	1750-1780		1780-1810		1810-1840		1840-1870		1870-1900		1900-1930	
	Welsh	English	Welsh	English	Welsh	English	Welsh	English	Welsh	English	Welsh	English
N. Pembrokeshire												
Nevern	86.17	13.83	92.90	7.10	92.90	7.10	-	-	-	-	-	-
	94.68	5.32	89.76	10.24	89.76	10.24	-	-	-	-	-	-
Ambleston	-	-	92.94	7.06	89.32	10.68	84.09	15.90	77.78	22.22	-	-
	-	-	89.41	10.59	87.38	12.62	90.91	9.09	72.22	27.78	-	-
Eletherston	92.86	7.14	95.00	5.00	83.72	16.28	83.33	16.67	-	-	-	-
	92.98	17.02	98.33	1.67	88.37	11.63	93.75	6.25	-	-	-	-
Landsker												
Camrose	78.13	21.88	76.87	23.13	83.17	16.83	-	-	-	-	-	-
	76.04	23.96	83.58	16.42	73.76	26.24	-	-	-	-	-	-
Llawhaden	-	-	-	-	86.13	13.87	87.72	12.28	83.78	16.22	-	-
	-	-	-	-	90.51	9.49	88.60	11.40	78.38	21.62	-	-
Wiston	68.49	31.51	93.91	6.09	82.95	17.04	83.70	16.30	76.00	24.00	66.00	34.00
	83.56	16.44	79.13	20.87	84.66	15.34	71.74	28.26	80.00	20.00	76.00	24.00
S. Pembrokeshire												
Slebech	74.55	25.45	82.89	17.11	-	-	-	-	-	-	-	-
	74.55	25.45	84.21	15.79	-	-	-	-	-	-	-	-
Burton	65.75	34.25	57.80	42.20	76.04	23.96	86.66	13.34	68.10	31.90	-	-
	65.75	34.25	66.97	33.03	72.92	27.05	56.66	43.34	68.15	30.85	-	-
Begelly	64.29	35.71	75.00	25.00	73.94	26.06	70.23	29.77	61.62	38.38	64.18	35.82
	64.29	35.71	77.00	23.00	72.34	27.66	59.53	40.47	73.74	26.26	65.67	34.33
Hubberston	44.21	55.79	42.68	57.32	45.23	54.77	47.19	52.81	27.89	72.11	31.31	68.69
	49.47	50.53	56.10	43.90	64.82	35.18	64.50	35.50	57.14	42.86	46.46	53.54
Castlemartin	-	-	62.32	37.68	71.26	28.74	66.26	33.74	57.14	42.86	62.69	37.31
	-	-	57.97	42.03	72.41	27.50	71.08	28.92	70.13	29.87	65.67	34.33

CONTRIBUTION OF EACH PARISH TO OVERALL SAMPLES FOR NORTH, SOUTH AND LANDSKER   TABLE 1.4

(Expressed as percentages)

Parish	Dermatoglyphic Data								Serology Data		
	Child	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Census 1971	Donor	Father	Mother
North Pembrokeshire											
St. Dogmaels Rural	5.7	4.3	3.5	3.4	2.6	3.4	3.5	974	3.2	2.9	2.5
Moylegrove	0.5	1.0	0.2	0.9	1.2	0.7	0.8	173	0.4	0.7	0.7
Monington	-	-	-	0.3	-	-	-	26	-	0.1	0.1
Bayvil	0.1	0.2	0.2	0.3	0.1	0.3	0.1	49	-	-	-
Llantoed	0.1	-	-	-	0.1	-	0.1	86	0.2	0.3	-
Bridell	-	0.1	0.1	-	0.1	-	-	179	0.1	0.1	-
Cilgerran	0.4	0.5	0.4	0.6	0.4	0.8	0.9	722	0.4	0.4	0.5
Manordeifi	1.6	1.0	1.5	0.7	0.9	2.1	0.3	385	0.9	1.1	1.0
Eglwyswrw	0.5	0.7	0.7	1.3	1.2	0.2	0.4	291	0.5	0.5	0.7
Llanfair-Nant-Gwyn	0.1	-	0.1	0.3	-	0.1	0.1	248	-	-	-
Castellan	0.1	0.2	0.2	0.1	0.1	0.1	0.4	129	0.1	-	0.1
Llanfihangel Penbedw	0.3	0.1	0.3	0.3	0.3	0.1	0.3	202	-	-	0.1
Capel Colman	-	0.2	0.3	0.1	0.4	0.1	0.3	171	-	-	-
Nevern	1.2	1.6	1.3	1.1	0.7	1.6	0.8	548	0.7	1.1	1.0
Meline	0.2	0.8	0.4	0.4	0.4	0.4	0.3	181	0.1	-	0.1
Eglwyswen	0.2	0.3	0.6	1.0	0.5	0.4	0.5	151	0.1	-	0.1
Penrydd	-	-	-	-	-	-	-	80	-	-	-
Clydey	0.3	0.9	0.8	0.9	0.5	0.7	1.0	599	-	-	-
West Cilrhedyn	0.3	0.3	0.2	0.3	0.1	0.5	0.6	82	-	-	-
Mynachlog-ddu	0.6	0.2	0.7	1.4	0.9	0.8	0.8	232	0.3	0.7	0.4
Llanfyrnach	1.0	2.1	1.5	1.7	1.9	1.6	1.7	758	-	-	-
Newport	2.2	2.1	2.4	2.8	1.7	2.0	1.2	1,062	0.7	0.5	0.8
Llaychllwyddog	-	0.2	0.2	0.1	0.5	0.5	0.4	76	0.2	0.3	0.1
Pontfaen	-	0.2	-	0.3	0.1	-	-	17	-	0.1	0.1
Morvil	-	-	0.2	0.1	0.1	0.1	0.1	62	0.1	-	0.1
Maenclochog	0.5	0.6	0.7	1.6	1.1	0.5	1.0	352	0.7	0.7	0.5

TABLE 14(CONTD.)

Parish	Dermatoglyphic Data								Serology Data		
	Child	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Census 1971	Donor	Father	Mother
Llandeilo-Llwydorth	-	-	-	-	-	-	0.1	70	-	-	-
Llangolman	0.4	0.3	0.6	0.4	0.9	0.8	0.9	183	0.2	0.3	0.4
Dinas	0.9	1.5	0.9	1.3	1.5	0.5	2.2	520	0.2	0.1	0.1
Llanllawer	-	-	-	-	-	-	-	32	0.1	-	-
Llanychaer	0.1	0.1	0.2	0.1	0.3	0.5	0.1	102	-	-	-
Puncheston	0.2	1.2	0.3	0.6	0.5	0.3	0.3	178	-	0.3	0.1
Henry's Moat	0.3	0.2	0.1	0.3	0.1	-	-	135	0.3	0.1	0.3
Vorlan	-	-	-	-	-	-	-	20	-	-	-
Llanycefn	0.7	0.9	0.4	1.4	2.0	0.9	0.4	167	-	0.3	0.4
Llandissilio	1.0	1.3	0.7	0.9	0.7	1.1	0.5	344	0.4	0.4	0.4
Bletterstone	-	0.3	0.2	0.7	0.3	-	0.4	94	-	0.3	0.1
New Moat	0.1	0.1	-	0.1	0.5	0.1	-	132	0.3	0.3	0.3
Llys-y-Fran	-	-	-	-	-	-	-	66	0.1	0.3	0.3
Ambleston	0.6	0.7	0.7	1.0	0.5	0.3	0.4	299	0.3	0.3	0.3
Castlebythe	-	0.1	-	0.3	-	0.1	-	85	-	0.1	-
Little Newcastle	-	0.3	0.2	0.4	0.3	0.1	0.3	124	0.5	0.4	0.8
Llanfair-nant-y-Gôf	-	0.1	-	0.1	-	0.1	-	318	-	-	-
Llanstinan	0.1	0.2	0.2	0.1	0.3	-	-	246	0.1	-	-
Fishguard South	0.4	0.2	0.3	0.6	1.5	1.7	0.4	365	0.1	0.1	-
Fishguard and Goodwick	4.5	5.7	5.1	4.4	4.8	5.4	4.9	4,937	5.2	4.5	3.8
Llanwnda	0.6	0.3	1.0	0.3	0.7	0.4	0.3	276	-	-	-
St. Nicholas	0.5	-	0.1	0.3	0.4	0.4	0.8	122	0.2	0.3	0.3
Manorowen	0.8	0.8	0.4	0.6	0.4	0.1	0.8	95	0.2	0.4	0.1
Jordanston	0.2	0.1	0.6	0.1	0.1	0.3	0.1	123	0.2	-	0.1
Granston	0.2	0.3	0.1	0.1	-	-	-	81	-	-	-
Mathry	0.6	1.0	1.5	1.1	1.2	1.3	2.6	445	0.7	0.8	1.0
Letterston	1.1	0.5	0.8	0.9	0.5	1.2	1.3	849	1.4	2.4	1.5
St. Dogwells	0.2	0.2	0.2	0.3	0.1	0.3	0.1	278	0.2	0.1	0.4

TABLE 1.4(CONTD.)

Parish	Dermatoglyphic Data								Serology Data		
	Child	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Census 1971	Donor	Father	Mother
Spittal	0.4	0.3	0.9	0.4	0.7	1.1	1.0	267	0.8	0.5	0.8
Walton East	-	-	0.2	-	-	0.1	-	125	0.4	0.4	0.1
Clarbeston	-	-	-	0.1	0.3	-	0.1	77	-	-	0.1
Treffgarne	0.3	0.1	0.2	0.1	-	0.1	0.3	103	-	0.3	0.1
Hayscastle	0.5	0.3	1.0	0.4	0.9	0.9	1.7	289	0.4	0.5	1.3
St. Lawrence	0.2	-	-	-	-	0.1	-	103	0.1	0.1	0.1
St. Edrins	-	0.1	-	-	-	-	-	38	-	-	-
Llanreithan	0.2	-	-	-	-	-	0.1	31	-	-	-
Llanrian	2.1	3.7	2.2	3.5	2.8	3.2	3.1	800	0.7	1.2	0.5
Llanhowell	-	0.1	0.1	-	0.3	0.3	-	49	0.1	-	0.5
St. Davids	3.7	3.4	3.5	3.8	3.8	3.4	2.6	1664	3.2	3.2	2.8
Whitchurch & St.Elvis	1.4	1.3	1.4	0.6	1.7	1.4	1.3	831	1.0	0.9	0.5
Llandeloy	0.5	0.1	0.7	0.3	0.4	0.9	0.4	171	-	0.4	0.1
Brawdy	0.4	0.7	0.4	0.4	0.7	0.5	0.5	417	0.3	-	0.3
Llanfallteg West	0.8	0.9	0.9	0.7	0.3	0.1	0.5	33	0.8	0.9	0.9
Llangan West	-	-	-	-	-	0.1	-	12	-	-	-
	42.0								27.2		
Landsker Parishes											
Roch	1.3	1.3	0.7	1.1	0.5	0.7	0.4	504	-	0.1	-
Camrose	1.6	2.0	1.8	1.4	1.5	1.3	1.0	860	0.3	0.8	0.3
Rudbaxton	0.2	0.5	0.3	0.4	0.4	0.3	0.1	502	0.4	1.3	0.5
Wiston	0.6	1.2	1.3	1.6	1.1	1.1	1.6	554	0.4	1.3	0.5
Llawhaden	0.8	1.2	1.0	0.7	0.5	0.9	0.5	371	1.0	1.5	0.8
Grandre	-	-	-	-	-	-	-	92	-	-	-
Llandewi Velfrey	0.5	1.5	0.6	1.7	1.6	0.7	1.0	349	0.2	0.1	0.4
Lampeter Velfrey	2.2	3.0	3.3	2.1	2.0	2.2	1.7	706	0.5	0.4	0.4
	7.2								2.8		

TABLE 1.4(CONTD.)

Parish	Dermatoglyphic Data								Serology Data		
	Child	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Census 1971	Donor	Father	Mother
South Pembrokeshire											
North Prendergast	0.8	0.5	0.4	0.1	0.3	0.4	0.4	485	0.1	0.1	0.1
Uzmaston	-	0.3	0.2	0.1	0.1	0.3	0.3	422	0.1	-	0.1
Slebech	0.1	0.1	0.1	0.7	0.3	0.1	0.3	189	-	-	0.1
Robeston Walthen	-	0.1	0.1	-	-	0.3	0.3	174	0.3	0.3	0.3
Narberth (N + S)	2.7	1.7	2.1	2.1	1.7	1.7	2.3	1683	3.3	2.6	2.3
Crinow	-	-	-	0.1	-	-	-	119	-	-	-
Mounton	-	-	-	-	-	-	-	12	-	-	-
Newton North	0.1	-	-	-	-	-	-	62	-	-	-
Minwear	-	0.1	-	0.1	0.3	0.1	-	40	-	-	-
Martletwy	0.3	1.0	1.2	1.4	1.2	1.8	0.9	219	0.7	1.2	0.9
Boulston	-	-	-	-	0.1	-	-	72	-	-	-
Haroldston St.Issells	0.4	-	0.1	0.1	0.1	-	-	1484	-	-	-
Haverfordwest	7.5	4.7	3.0	5.0	4.7	5.0	3.5	9104	12.9	8.1	11.1
Hamlet of St. Martins	2.3	0.9	0.7	0.4	0.3	0.1	0.6	452	-	-	-
Hamlet of St. Thomas	2.4	0.9	0.7	0.6	0.5	0.5	0.1	287	-	-	-
Lambston	0.1	0.1	0.2	0.1	-	0.4	0.4	155	0.3	0.1	0.3
Nolton	0.3	0.5	0.2	1.0	0.9	0.4	0.3	131	-	0.3	0.1
Haroldston West	0.1	0.1	-	-	-	-	-	123	0.2	0.3	0.3
Walton West	0.1	0.5	0.7	0.9	0.8	0.8	0.6	565	0.3	0.4	0.3
Walwyn's Castle	-	0.1	0.3	0.6	0.4	0.8	0.9	165	0.2	0.5	0.3
Steynton	0.4	0.6	0.7	0.3	0.4	0.3	0.4	416	0.4	0.1	0.4
Johnston	0.4	0.6	0.6	0.1	0.8	0.3	0.5	1538	0.4	0.7	0.7
Freystrop	0.1	0.3	0.3	0.7	0.3	0.3	0.5	362	-	0.3	0.3
Llangwm	0.3	0.9	0.2	0.9	0.8	0.7	-	1091	0.2	0.3	0.1
Coedcanlas	-	-	-	-	-	-	-	48	-	0.1	-
Lawrenny	-	0.1	-	-	0.8	0.5	0.5	106	0.3	0.3	0.4
Yerbeston	-	-	-	-	-	-	-	48	-	-	-

TABLE 1.4 (CONTD.)

Parish	Dermatoglyphic Data								Serology Data		
	Child	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Census 1971	Donor	Father	Mother
Loveston	-	0.1	0.1	-	-	0.1	0.1	59	-	0.3	-
Reynalton	-	-	0.1	0.1	-	0.1	0.3	88	0.2	0.3	0.3
Begelly	0.9	0.6	0.3	0.6	0.9	0.3	0.4	458	0.5	0.7	0.9
St. Issells	1.7	1.2	2.0	2.1	1.7	1.6	2.2	3031	1.9	2.0	3.0
Ludchurch	0.2	0.5	0.2	1.3	0.8	0.3	0.4	156	0.4	0.8	0.4
Amroth	0.6	0.6	1.3	1.3	0.7	1.1	0.6	616	0.8	1.2	1.0
Crunwere	0.3	0.6	0.2	0.6	0.8	0.7	0.8	137	-	-	-
East Williamston	0.1	0.2	0.1	0.3	-	0.4	0.1	377	0.1	0.4	0.1
Jeffreston	0.3	0.2	-	0.6	0.7	0.4	0.9	339	0.4	0.3	0.3
Carew	0.1	1.2	0.1	0.7	0.5	0.5	0.4	681	0.9	0.5	0.4
Upton	-	-	-	-	-	-	-	4	-	-	-
Burton	0.3	0.5	0.2	0.4	0.7	0.7	0.3	606	0.4	0.1	0.8
Cosheston	0.1	0.2	0.3	0.3	0.7	0.4	0.3	406	-	0.4	0.7
Rosemarket	0.2	-	0.1	0.4	0.5	-	0.4	427	0.8	0.6	0.9
Llanstadwell	0.4	0.5	0.7	0.1	0.4	0.1	-	850	0.4	0.2	0.1
Neyland	0.9	1.2	1.3	1.4	1.3	1.1	1.9	2637	2.4	2.1	3.4
Milford Haven	4.2	5.2	5.8	4.7	5.2	5.0	5.5	13751	12.7	9.4	12.6
Hubberston	0.8	1.2	0.6	0.7	0.8	0.3	0.3	105	1.3	0.8	1.6
Robeston West	-	-	-	0.1	-	-	0.3	91	0.1	-	0.1
Herbranston	0.1	0.2	-	0.1	0.4	0.1	0.3	271	0.2	0.4	0.1
Hasquard	0.1	-	0.1	-	-	-	-	118	-	-	0.1
Talbenny	0.2	-	0.2	0.1	0.1	0.3	0.1	141	-	-	0.1
St. Brides	0.1	0.1	0.2	0.1	-	0.1	0.5	118	-	-	0.1
Marloes	0.1	-	0.7	0.4	0.3	0.7	0.5	292	-	0.5	0.3
St. Ishmaels	0.1	0.7	0.4	0.3	0.5	0.8	1.3	416	0.2	0.1	0.3
Dale	-	-	0.3	0.3	0.4	0.3	0.6	346	0.1	0.3	0.1
Angle	0.3	0.3	0.4	0.4	0.5	0.3	1.3	286	0.2	0.4	0.5
Pwllcrochan	-	-	-	0.1	-	-	0.1	296	0.1	0.1	-

TABLE 1.4 (CONTD.)

Parish	Dermatoglyphic Data								Serology Data		
	Child	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Census 1971	Donor	Father	Mother
Rhoscrowther	-	0.2	0.4	0.1	-	0.4	0.1	149	-	0.3	-
Hundleton	-	0.2	0.7	0.7	0.1	0.7	0.4	541	0.2	-	0.1
Pembroke	11.0	8.9	10.6	6.0	7.7	9.7	9.6	14197	15.2	12.6	13.0
Nash	-	-	-	-	-	-	-	54	-	-	-
Lamphey	1.2	0.6	0.7	0.4	0.9	0.9	0.9	760	0.2	0.3	0.5
Hodgeston	-	-	0.1	-	0.1	0.3	-	36	-	-	-
St. Florence	0.1	0.1	0.4	-	0.3	0.8	0.3	510	0.3	0.5	0.3
Redberth	0.1	-	0.1	-	-	0.1	0.4	66	0.1	-	0.1
Manorbier	0.9	0.8	0.6	0.7	0.8	0.5	0.3	1168	0.2	0.9	0.5
Gumfreston	-	0.1	-	-	-	-	-	70	-	-	0.1
Penally	0.3	0.1	0.2	0.1	0.3	0.7	0.3	1080	0.4	0.7	0.5
St. Mary-out-Liberty	0.7	0.6	0.4	0.3	0.3	0.1	0.3	396	0.1	-	-
Tenby	1.9	1.3	2.5	1.6	2.0	2.1	2.1	4994	8.1	9.1	5.7
Stackpole Elidor	0.3	0.9	0.3	0.7	0.3	0.1	0.5	186	0.1	0.1	0.1
St. Petrox	0.2	0.1	-	-	-	-	-	65	-	-	-
Bosherston	0.2	-	0.1	-	0.3	-	0.3	73	-	-	-
St. Twynnells	0.1	-	-	-	-	0.1	-	87	-	-	-
Castlemartin	0.3	0.6	0.2	0.1	0.4	0.1	0.3	155	0.4	-	0.3
	50.8								70.0		

Total population of Pembrokeshire

From 1971 Census . 98,968
% Resident in N. Pembrokeshire : 23.727
% Resident in Landsker Parishes = 3.581
% Resident in S. Pembrokeshire = 72.700

TABLE 1.5

LANGUAGE ABILITY

	Child	Mother	Father	Father's Father	Father's Mother	Mother's Father	Mother's Mother	Welsh spoken in home
Child's Birth Place in North Pembrokeshire								
English %	18.5	21.4	20.0	23.0	21.7	21.2	20.7	No .397
English/Welsh %	81.5	78.6	80.0	77.0	78.3	78.8	79.3	Yes .603
N =	406	406	406	405	406	406	406	406
Child's Birth Place in South Pembrokeshire								
English %	86.7	86.9	88.1	81.5	80.3	83.3	81.9	No 95.4
English/Welsh %	13.3	13.1	11.9	18.4	19.7	16.7	18.1	Yes 4.6
N =	549	549	548	549	548	546	547	549

TABLE 1.6

SURNAME ORIGINS

Dermatoglyphics Survey

	Frequencies						
	Welsh	Norman	Flemish	Viking	English	Scottish	Irish
North Pembrokeshire	.809	.007	.005	.007	.153	.002	.015
South Pembrokeshire	.547	.019	.015	.006	.387	.006	.020

N.B. These frequencies were calculated using the surnames of the individuals who participated in the surveys. Very similar frequencies were found using the parents' and grandparents' surnames, therefore these have not been included.

APPENDIX

List of Welsh Surnames

(*Characteristic of South Wales)

Adda	Griffiths	Morgan
Anwyl	Gronow	Morris
Adams	Gwatkin	Onions
Bayham	Gwilt	Owen
Bevan	Gwilym	Prosser
Beddoe	Gwyn	Probyn
Bellis	*Harries	Parry
*Beynon	*Hopkin	*Phillips
Bithel	*Howell	*Perkins
Blythin	Hughes	Preece
Bowen	Humphries	Price
Breese	Idris	Prichard
Cadarn	Ithell	Probart
Caddell	*James	Protheroe
Cadwallader	Jenkins	Prytherch
Craddock	*John	Pugh
David	Jones	*Rees
Davies	Joseph	Richards
*Deakin	Kenwyn	Roberts
Dilwyn	Kyffin	Rogers
*Edmunds	Lewis	Rowlands
Edwards	Leyshon	Stephens
Elias	*Llewellyn	Thomas
Ellis	Lloyd	Treharne
Evans	Llywarch	Trevethan
Eynon	Loughor	Tudor
Foulk	Machen	Vaughan
Francis	*Maddocks	*Walters
George	Mainwaring	*Watkins
Gethin	Mathias	Williams
Glyn	Meridith	Wynn
Gough	Meyrick	Yorath

After Guppy (1890)
Watkin (1956)

TABLE 1.8

DERMATOGLYPHIC SURVEY

Schools visited during 1976:

Headteacher	School
Mr. C. D. Davies	County Secondary School, Queensway, Haverfordwest
Mr. C. Nelson	Pembroke School, Bush, Pembroke
Mr. J. Glyn Owen	County Secondary School, St. Davids
Mr. E. Lloyd Williams	County Secondary School, Heol Dyfed, Fishguard
Mr. L. G. Hill	Greenhill County Secondary, Heywood Lane, Tenby
Mr. J. G. M. Ladd	Presew County Secondary School, Crynmych
Mr. J. R. Northeast	Central Secondary School, Prioryville, Milford Haven
Mr. W. G. Thomas	Haverfordwest Grammar School for Boys, Scarrowscant
Mr. K. J. C. Phelps	County Secondary School, Narberth

Schools visited during 1977:

Mr. B. Jones	Wolfscastle County Primary, Wolfscastle
Mr. G. Bancroft	The Grammar School, Whitland
Mr. W. G. Thomas	Newcastle Emlyn V.C.P. School, Newcastle Emlyn
Mr. I. H. Perkins	Roch County Primary School, Roch
Mr. Morgan	Letterston V.C. School, St. Davids Rd., Letterston
Mr. Evans	Goodwick County Primary, Mill Street, Goodwick
Mr. Beynon	Fishguard J.M. School, West Street, Fishguard
Mr. Jones	Solva County Primary, Solva
Mr. A. Ifans	Puncheston County Primary, Puncheston
Mr. Rees	Newport County Primary, Lwr. St. Mary St., Newport
Mr. G. Francis	Narberth County Primary, Narberth

Mr. J. J. Roberts	Brynconin County Primary, Llandysilio, Clyderwen
Mr. P. J. Williams	Tavernspite County Primary School, Tavernspite
Miss P. Thomas	Grove Junior School, Orange Way, Pembroke
Mr. K. A. Davies	Lamphey County Primary School, Lamphey, Pembroke
Mr. J. J. Owens	Barn Street County Primary School, Jury Lane, Haverfordwest
Mr. F. L. Childe	Stackpole V.C. School, Stackpole
Mr. Thomas	Cardigan Secondary School, Cardigan

ABBREVIATIONS USED IN DERMATOGLYPHICS TABLES

A = English in South Pembrokeshire

B = English in North Pembrokeshire

C = Welsh in South Pembrokeshire

D = Welsh in North Pembrokeshire

E = English in North/English in South

F = Welsh in North/Welsh in South

G = English in South/Welsh in South

H = English in North/Welsh in North

I = Welsh in North/English in South

J = Welsh in South/English in North

TABLE 2.1

UNILATERAL FINGER RIDGE COUNTS
Digit Rankings

	Males	Females
Raw Data	R1 > R4 > R5 > R2 > R3 L1 > L4 > L5 > L3 > L2	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2
Single Parameters		
BP North Pembs.	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2	R1 > R4 > R2 > R5 > R3 L4 > L1 > L5 > L3 > L2
South Pembs.	R1 > R4 > R5 > R2 > R3 L1 > L4 > L5 > L3 > L2	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2
PBP North Pembs.	R1 > R4 > R5 > R2 > R3 L1 > L4 > L5 > L3 > L2	R1 > R4 > R2 > R5 > R3 L1 > L4 > L5 > L3 > L2
South Pembs.	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2
DW English	R1 > R4 > R5 > R3 > R2 L1 > L4 > L5 > L3 > L2	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2
Welsh	R1 > R4 > R5 > R2 > R3 L1 > L4 > L5 > L3 > L2	R1 > R4 > R2 > R5 > R3 L4 > L1 > L5 > L3 > L2
Dual Parameters		
English in South	R1 > R4 > R5 > R3 > R2 L4 > L1 > L5 > L3 > L2	R1 > R4 > R5 > R2 > R3 L1 > L4 > L5 > L3 > L2
English in North	R1 > R4 > R5 > R3 > R2 L1 > L4 > L5 > L2 > L3	R4 > R1 > R2 > R5 > R3 L4 > L1 > L3 > L5 > L2
Welsh in South	R1 > R4 > R5 > R2 > R3 L1 > L4 > L5 > L3 > L2	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L2 > L3
Welsh in North	R1 > R4 > R5 > R2 > R3 L4 > L1 > L5 > L3 > L2	R1 > R4 > R2 > R5 > R3 L1 > L4 > L5 > L3 > L2

TABLE 2.2

FINGER RIDGE COUNTS

Males	Mean	S.D.	g^1	g^2	Females	Mean	S.D.	g^1	g^2
RT1	18.65	5.34	-0.499	0.720		16.87	5.07	-0.453	0.042
RT2	12.49	6.41	-0.134	-0.792		12.45	5.87	-0.176	-0.425
RT3	11.98	5.32	-0.015	-0.319		11.57	5.03	-0.141	-0.485
RT4	15.50	5.66	-0.361	-0.135		14.75	5.83	-0.276	-0.207
RT5	13.48	4.91	-0.239	-0.610		12.51	5.02	-0.092	-0.638
LT1	16.31	5.24	-0.259	0.060		15.10	4.86	-0.212	-0.284
LT2	11.81	6.21	-0.069	-0.935		11.45	5.93	-0.072	-0.863
LT3	12.70	5.54	-0.182	-0.448		12.14	5.34	-0.217	-0.443
LT4	16.07	5.66	-0.163	-0.016		15.34	5.86	-0.199	-0.092
LT5	13.82	4.80	-0.334	-0.191		13.14	4.98	-0.260	-0.465
FR1	24.37	11.59	0.427	-0.377		20.48	10.51	0.459	-0.251
FR2	14.78	11.59	0.472	-0.827		14.18	11.19	0.488	-0.777
FR3	13.55	9.79	1.029	1.045		12.04	8.59	1.151	1.803
FR4	21.05	11.90	0.302	-0.751		19.00	11.19	0.486	-0.243
FR5	15.24	7.75	0.698	0.340		13.16	6.92	0.527	0.453
FL1	19.72	10.82	0.588	-0.075		17.52	9.87	0.573	0.168
FL2	14.17	11.25	0.572	-0.706		13.26	10.87	0.681	-0.387
FL3	14.12	10.14	1.078	1.186		12.43	9.46	0.941	0.901
FL4	19.86	11.20	0.646	-0.011		18.47	11.35	0.511	-0.252
FL5	14.72	6.88	0.860	1.920		13.61	7.11	0.522	1.016
RFRC	73.95	20.32	-0.097	-0.307		70.86	19.42	-0.139	-0.221
LFRC	72.25	20.74	-0.111	-0.322		69.75	19.83	-0.246	-0.280
TFRC	148.35	37.99	-0.060	-0.324		143.04	35.53	-0.174	-0.076
RFAC	89.10	42.90	0.471	-0.261		78.90	39.97	0.523	0.039
LFAC	82.43	40.40	0.543	0.036		75.02	39.62	0.454	-0.086
TFAC	171.97	81.35	0.494	-0.113		153.64	78.09	0.465	-0.073

N = 712 N = 723

N.B. g^1 = Skew g^2 = Kurtosis

TABLE 2.3

FINGER RIDGE COUNTS

T-test Probabilities

Males	BP	PBP	DW	Females	BP	PBP	DW
RT1	.506	.866	.176		.010	.110	.201
RT2	.640	.673	.293		.562	.807	.404
RT3	.213	.586	.140		.956	.443	.062
RT4	.259	.757	.910		.720	.129	.916
RT5	.270	.548	.647		.091	.032	.858
LT1	.151	.201	.620		.423	.759	.786
LT2	.771	.519	.804		.769	.384	.407
LT3	.725	.916	.678		.917	.879	.099
LT4	.024	.541	.573		.135	.020	.888
LT5	.380	.714	.724		.622	.496	.753
FR1	.309	.687	.402		.028	.016	.190
FR2	.408	.557	.552		.972	.536	.997
FR3	.219	.727	.360		.391	.048	.156
FR4	.164	.759	.838		.257	.041	.232
FR5	.234	.546	.562		.126	.084	.399
FL1	.157	.345	.641		.617	.562	.853
FL2	.282	.421	.361		.498	.635	.381
FL3	.861	.937	.414		.873	.711	.322
FL4	.055	.737	.737		.346	.086	.918
FL5	.900	.870	.441		.635	.365	.930
RFRC	.519	.880	.764		.495	.431	.751
LFRC	.265	.617	.663		.338	.192	.168
RFRC	.682	.385	.636		.304	.171	.373
RFAC	.176	.913	.912		.147	.034	.754
LFAC	.191	.538	.777		.474	.255	.587
TFAC	.181	.723	.770		.251	.081	.656

TABLE 2.4

FINGER RIDGE COUNTS

MANN-WHITNEY PROBABILITIES

Males	BP	PBP	DW	Females	BP	PBP	DW
RT1	0.809	0.333	0.134	RT1	0.027	0.107	0.322
RT2	0.619	0.705	0.377	RT2	0.508	0.869	0.399
RT3	0.129	0.525	0.131	RT3	0.941	0.496	0.064
RT4	0.356	0.855	0.948	RT4	0.619	0.132	0.904
RT5	0.271	0.675	0.832	RT5	0.083	0.039	0.751
LT1	0.163	0.289	0.753	LT1	0.349	0.652	0.770
LT2	0.177	0.681	0.809	LT2	0.684	0.340	0.417
LT3	0.623	0.896	0.642	LT3	0.964	0.938	0.081
LT4	0.019	0.489	0.395	LT4	0.146	0.020	0.457
LT5	0.173	0.414	0.827	LT5	0.626	0.581	0.889
FR1	0.477	0.848	0.413	FR1	0.054	0.058	0.188
FR2	0.435	0.584	0.522	FR2	0.859	0.678	0.890
FR3	0.141	0.881	0.213	FR3	0.736	0.188	0.093
FR4	0.187	0.838	0.789	FR4	0.303	0.043	0.399
FR5	0.218	0.459	0.643	FR5	0.136	0.061	0.267
FL1	0.175	0.359	0.561	FL1	0.636	0.789	0.490
FL2	0.364	0.498	0.495	FL2	0.435	0.516	0.528
FL3	0.991	0.558	0.917	FL3	0.931	0.687	0.404
FL4	0.037	0.660	0.627	FL4	0.373	0.058	0.811
FL5	0.380	0.848	0.745	FL5	0.611	0.273	0.807
RFRC	0.536	0.900	0.851	RFRC	0.616	0.633	0.211
LFRC	0.259	0.875	0.719	LFRC	0.268	0.166	0.379
TFRC	0.571	0.347	0.574	TFRC	0.279	0.166	0.734
RFAC	0.151	0.899	0.985	RFAC	0.224	0.049	0.547
LFAC	0.167	0.556	0.991	LFAC	0.563	0.236	0.647
RFAC	0.167	0.782	0.876	RFAC	0.325	0.089	0.294

TABLE 2.5

MALES

FINGER RIDGE COUNTS

(1) t-TEST PROBABILITIES &
(2) Mann-Whitney U

	E		F		G		H		I		J	
	1	2	1	2	1	2	1	2	1	2	1	2
RT1	.273	.444	.920	.659	.294	.218	.588	.852	.338	.391	.623	.934
RT2	.995	.967	.711	.658	.608	.682	.591	.608	.396	.414	.737	.787
RT3	.627	.472	.072	.053	.041	.077	.498	.502	.743	.983	.080	.052
RT4	.606	.749	.277	.308	.746	.653	.936	.976	.476	.623	.484	.536
RT5	.161	.233	.641	.521	.612	.697	.397	.563	.343	.388	.266	.313
LT1	.125	.278	.520	.393	.510	.776	.428	.642	.206	.244	.238	.287
LT2	.124	.130	.644	.546	.345	.248	.242	.191	.619	.570	.363	.303
LT3	.728	.774	.431	.366	.346	.335	.818	.828	.869	.964	.807	.739
LT4	.316	.366	.069	.057	.910	.755	.866	.592	.069	.038	.353	.533
LT5	.503	.495	.440	.262	.625	.783	.667	.979	.782	.342	.384	.437
FR1	.164	.117	.746	.941	.464	.438	.498	.297	.314	.473	.355	.282
FR2	.692	.572	.470	.563	.966	.926	.960	.830	.479	.520	.700	.527
FR3	.341	.283	.185	.089	.247	.083	.406	.268	.909	.962	.108	.027
FR4	.164	.250	.285	.244	.621	.593	.281	.369	.582	.611	.088	.127
FR5	.025	.053	.742	.615	.779	.703	.051	.155	.557	.454	.032	.073
FL1	.075	.052	.402	.521	.980	.996	.256	.146	.438	.493	.084	.042
FL2	.128	.102	.794	.893	.291	.313	.514	.394	.204	.330	.398	.323
FL3	.886	.997	.862	.762	.948	.480	.990	.809	.815	.735	.926	.645
FL4	.128	.172	.209	.154	.724	.675	.599	.789	.135	.080	.177	.235
FL5	.163	.279	.817	.559	.743	.680	.074	.551	.551	.833	.144	.180
RFRC	.813	.741	.444	.496	.701	.833	.991	.935	.724	.698	.635	.625
LFRC	.307	.263	.609	.689	.491	.418	.811	.770	.235	.206	.581	.524
TFRC	.821	.690	.729	.716	.946	.910	.964	.784	.784	.625	.796	.726
RFAC	.125	.117	.370	.296	.930	.781	.315	.282	.445	.479	.117	.083
LFAC	.107	.183	.480	.387	.796	.990	.359	.401	.343	.341	.177	.128
TFAC	.109	.134	.430	.361	.912	.935	.330	.337	.384	.414	.142	.104

FEMALES — FINGER RIDGE COUNTS — DUAL PARTITION

(1) t-Test and (2) Mann-Whitney U Probabilities

	E		F		G		H		I		J	
	1	2	1	2	1	2	1	2	1	2	1	2
RT1	.077	.134	.025	.061	.322	.525	.315	.443	.229	.249	.018	.052
RT2	.067	.069	.446	.450	.083	.073	.259	.229	.274	.242	.569	.514
RT3	.142	.139	.649	.699	.810	.728	.044	.038	.490	.442	.096	.079
RT4	.179	.105	.248	.114	.351	.155	.158	.100	.837	.899	.550	.636
RT5	.742	.673	.044	.040	.521	.589	.219	.183	.169	.121	.906	.999
LT1	.557	.716	.216	.300	.649	.903	.259	.275	.490	.251	.768	.692
LT2	.028	.044	.108	.103	.256	.258	.010	.014	.706	.639	.158	.177
LT3	.047	.079	.560	.524	.867	.727	.011	.011	.456	.353	.041	.038
LT4	.195	.127	.006	.006	.057	.046	.071	.045	.498	.495	.995	.917
LT5	.552	.616	.409	.374	.682	.481	.415	.465	.661	.768	.788	.938
FR1	.988	.655	.005	.025	.077	.189	.546	.894	.353	.440	.230	.151
FR2	.020	.037	.174	.355	.178	.389	.022	.033	.927	.965	.233	.179
FR3	.104	.052	.122	.333	.933	.799	.005	.005	.139	.218	.129	.037
FR4	.238	.209	.090	.089	.826	.707	.031	.034	.163	.239	.286	.294
FR5	.378	.540	.044	.077	.488	.710	.085	.125	.162	.125	.775	.730
FL1	.165	.273	.148	.279	.249	.589	.116	.133	.835	.592	.568	.443
FL2	.013	.023	.030	.032	.200	.208	.002	.004	.444	.443	.106	.137
FL3	.061	.083	.233	.313	.519	.625	.019	.030	.641	.700	.142	.118
FL4	.131	.088	.035	.032	.131	.077	.063	.063	.625	.706	.577	.598
FL5	.204	.286	.243	.258	.328	.449	.219	.183	.813	.646	.653	.581
RFRC	.334	.248	.089	.133	.101	.135	.331	.290	.974	.997	.865	.942
LFRC	.036	.080	.043	.040	.423	.579	.005	.006	.245	.176	.117	.150
TFRC	.034	.056	.033	.040	.300	.372	.006	.008	.284	.225	.184	.225
RFAC	.141	.137	.015	.038	.239	.390	.022	.033	.239	.267	.535	.464
LFAC	.028	.033	.038	.067	.157	.334	.009	.008	.564	.544	.234	.171
TFAC	.062	.066	.018	.039	.166	.283	.013	.017	.371	.353	.384	.304

TABLE 2.7

FINGER PATTERN FREQUENCIES

Males	RP1	RP2	RP3	RP4	RP5	LP1	LP2	LP3	LP4	LP5
True Arch	0.013	0.075	0.066	0.024	0.014	0.039	0.071	0.059	0.030	0.013
Tented Arch	-	0.042	0.008	0.003	0.001	-	0.030	0.013	-	0.001
Ulner Loop	0.587	0.292	0.720	0.498	0.795	0.657	0.354	0.730	0.644	0.880
Radial Loop	-	0.240	0.014	0.006	0.001	0.001	0.233	0.027	0.003	-
Whorl	0.190	0.159	0.113	0.329	0.087	0.076	0.148	0.081	0.205	0.034
Double Loop	0.198	0.123	0.058	0.059	0.052	0.223	0.126	0.074	0.059	0.048
Ulnar C.P. Loop	0.011	0.008	0.010	0.080	0.046	0.001	0.007	0.014	0.058	0.024
Radial C.P. Loop	0.001	0.054	0.001	0.004	0.003	0.001	0.031	0.003	0.001	-
Amalgamated Patterns										
Arch	0.013	0.118	0.075	0.027	0.016	0.039	0.100	0.072	0.030	0.014
Loop	0.587	0.538	0.734	0.504	0.796	0.659	0.587	0.757	0.646	0.880
Whorl	0.400	0.344	0.191	0.469	0.188	0.302	0.313	0.171	0.324	0.106

N = 712

TABLE 2.7 (CONTD.)

FINGER PATTERN FREQUENCIES (CONTD.)

Females	RP1	RP2	RP3	RP4	RP5	LP1	LP2	LP3	LP4	LP5
True Arch	0.035	0.108	0.077	0.029	0.031	0.058	0.105	0.107	0.054	0.045
Tented Arch	-	0.027	0.008	-	-	-	0.020	0.017	0.003	-
Ulnar Loop	0.650	0.405	0.789	C.571	0.851	0.670	0.354	0.718	0.610	0.846
Radial Loop	-	0.151	0.011	0.011	0.006	-	0.219	0.015	0.004	0.001
Whorl	0.130	0.164	0.054	0.267	0.053	0.070	0.139	0.074	0.209	0.045
Double Loop	0.169	0.101	0.046	0.029	0.028	0.197	0.111	0.063	0.042	0.032
Ulnar C.P. Loop	0.015	0.004	0.011	0.089	0.032	0.001	0.010	0.006	0.078	0.032
Radial C.P. Loop	-	0.041	0.003	0.003	-	0.003	0.041	0.010	-	-
Amalgamated Patterns										
Arch	0.035	0.134	0.085	0.029	0.031	0.058	0.125	0.124	0.057	0.045
Loop	0.650	0.556	0.801	0.582	0.856	0.670	0.574	0.733	0.615	0.847
Whorl	0.315	0.310	0.114	0.389	0.113	0.272	0.301	0.143	0.328	0.108
X^2	0.0002	0.3144	0.0003	0.0083	0.0001	0.1459	0.3493	0.0029	0.0350	0.0029
M-W	0.000	0.119	0.001	0.001	0.000	0.116	0.404	0.003	0.545	0.176

N = 723

TABLE 2.8

MALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY CHILD'S BIRTH PLACE

Right hand	RP1		RP2		RP3		RP4		RP5	
	N	S	N	S	N	S	N	S	N	S
True arch	0.015	0.018	0.080	0.089	0.064	0.070	0.030	0.028	0.010	0.021
Tented arch	-	-	0.035	0.039	-	0.004	-	-	0.005	-
Ulnar loop	0.590	0.625	0.275	0.316	0.718	0.739	0.460	0.530	0.757	0.796
Radial loop	-	-	0.240	0.245	0.020	0.011	0.010	0.007	-	0.004
Whorl	0.200	0.170	0.180	0.128	0.114	0.099	0.355	0.299	0.109	0.077
Double loop	0.190	0.170	0.110	0.131	0.054	0.060	0.045	0.050	0.054	0.049
C.P. ulnar	0.005	0.014	0.010	0.011	0.015	0.014	0.090	0.085	0.050	0.049
C.P. radial	-	0.004	0.070	0.043	0.015	0.004	0.010	-	0.005	0.004
(P)	0.729		0.657		0.812		0.505		0.715	
Amalgamated Patterns										
Arch	0.015	0.018	0.115	0.128	0.064	0.074	0.030	0.028	0.015	0.021
Loop	0.590	0.625	0.515	0.560	0.738	0.750	0.470	0.537	0.767	0.799
Whorl	0.395	0.357	0.370	0.312	0.198	0.176	0.500	0.435	0.218	0.180
N =	200	283	200	282	202	284	200	281	202	284
X^2	0.748		1.765		0.487		2.148		0.051	
(P)	0.688		0.414		0.784		0.342		0.525	
M-W/P	0.205		0.272		0.594		0.457		0.304	

TABLE 28 (CONTD.)

MALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY CHILD'S BIRTH PLACE (CONTD.)

Left hand	LP1		LP2		LP3		LP4		LP5	
	N	S	N	S	N	S	N	S	N	S
True arch	0.050	0.039	0.075	0.078	0.079	0.060	0.050	0.018	0.020	0.014
Tented arch	-	-	0.020	0.032	0.010	0.007	-	-	0.005	-
Ulnar loop	0.619	0.686	0.285	0.387	0.678	0.752	0.574	0.706	0.871	0.866
Radial loop	-	-	0.265	0.191	0.035	0.021	0.005	0.004	-	-
Whorl	0.069	0.060	0.180	0.145	0.084	0.074	0.243	0.160	0.035	0.035
Double loop	0.257	0.212	0.140	0.121	0.084	0.074	0.069	0.046	0.040	0.057
C.P. ulnar	0.005	-	0.010	0.004	0.025	0.011	0.054	0.067	0.030	0.028
C.P. radial	-	0.004	0.025	0.043	0.005	-	0.005	-	-	-
(P)	0.489		0.188		0.600		0.029		0.802	
Amalgamated Patterns										
Arch	0.050	0.039	0.095	0.110	0.089	0.067	0.050	0.018	0.025	0.014
Loop	0.618	0.686	0.550	0.578	0.713	0.773	0.579	0.709	0.871	0.866
Whorl	0.332	0.275	0.355	0.312	0.198	0.160	0.371	0.273	0.104	0.120
N =	202	283	200	282	202	282	202	282	202	283
X^2	2.344		1.068		2.288		10.488		0.992	
(P)	0.309		0.586		0.319		0.005		0.609	
M-W/P	0.159		0.061		0.435		0.482		0.258	

TABLE 2.9

MALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY PARENTS' BIRTH PLACE

Right hand	RP1		RP2		RP3		RP4		RP5	
	W	E	W	E	W	E	W	E	W	E
True arch	0.022	0.009	0.096	0.063	0.119	0.027	0.052	0.018	0.022	-
Tented arch	-	-	0.007	0.054	-	-	-	-	0.007	-
Ulnar loop	0.575	0.634	0.281	0.313	0.659	0.821	0.444	0.576	0.785	0.830
Radial loop	-	-	0.200	0.196	0.015	0.009	0.015	-	-	-
Whorl	0.201	0.152	0.185	0.161	0.104	0.107	0.326	0.294	0.089	0.063
Double loop	0.194	0.179	0.141	0.170	0.059	0.036	0.074	0.046	0.067	0.054
C.P. ulnar	0.007	0.018	0.015	0.009	0.022	-	0.074	0.064	0.030	0.045
C.P. radial	-	0.009	0.074	0.036	0.022	-	0.015	-	-	0.009
(P)	0.594		0.335		0.022		0.219		0.448	
<u>Amalgamated Patterns</u>										
Arch	0.022	0.009	0.104	0.116	0.119	0.027	0.052	0.018	0.030	0.000
Loop	0.575	0.634	0.481	0.509	0.674	0.830	0.459	0.578	0.785	0.830
Whorl	0.403	0.357	0.415	0.375	0.207	0.143	0.489	0.404	0.185	0.170
N =	134	112	135	112	135	112	135	109	135	112
X^2	1.372		0.424		10.135		4.466		3.557	
(P)	0.504		0.809		0.006		0.107		0.169	
M-W/P	0.560		0.520		0.779		0.496		0.858	

TABLE 2.9(CONTD.)

MALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY PARENTS' BIRTH PLACE (CONTD.)

Left hand	LP1		LP2		LP3		LP4		LP5	
	W	E	W	E	W	E	W	E	W	E
True arch	0.059	0.018	0.097	0.045	0.104	0.036	0.067	-	0.022	0.009
Tented arch	-	-	0.015	0.072	0.000	0.009	-	-	0.007	-
Ulnar loop	0.607	0.694	0.321	0.351	0.652	0.764	0.556	0.739	0.867	0.892
Radial loop	-	-	0.216	0.225	0.037	0.018	-	-	-	-
Whorl	0.074	0.063	0.157	0.117	0.074	0.082	0.207	0.144	0.037	0.027
Double loop	0.259	0.225	0.149	0.117	0.104	0.064	0.089	0.036	0.037	0.054
C.P. ulnar	-	-	0.007	0.009	0.022	0.018	0.074	0.081	0.030	0.018
C.P. radial	-	-	0.034	0.063	0.007	0.009	0.007	0.000	-	-
(P)	0.302		0.234		0.328		0.009		0.786	
Amalgamated Patterns										
Arch	0.050	0.018	0.112	0.117	0.104	0.045	0.067	0.000	0.030	0.009
Loop	0.607	0.694	0.537	0.577	0.689	0.782	0.555	0.739	0.867	0.892
Whorl	0.334	0.288	0.351	0.306	0.207	0.173	0.378	0.261	0.103	0.099
N =	135	111	134	111	135	110	135	111	135	111
X^2	3.645		0.5455		3.748		13.146		1.331	
(P)	0.162		0.761		0.154		0.001		0.514	
M-W/P	0.810		0.450		0.794		0.280		0.739	

TABLE 2.10

MALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY ANCESTRY

Right hand	RP1		RP2		RP3		RP4		RP5	
	E	W	E	W	E	W	E	W	E	W
True arch	0.004	0.018	0.071	0.078	0.059	0.070	0.019	0.028	0.011	0.016
Tented arch	-	-	0.056	0.034	0.015	0.005	0.004	0.002	-	0.002
Ulnar loop	0.597	0.579	0.272	0.305	0.703	0.732	0.494	0.500	0.799	0.793
Radial loop	-	-	0.254	0.239	0.022	0.009	0.004	0.007	-	0.002
Whorl	0.168	0.204	0.157	0.161	0.108	0.114	0.351	0.314	0.086	0.086
Double loop	0.220	0.185	0.123	0.124	0.074	0.048	0.053	0.060	0.052	0.052
C.P. ulnar	0.011	0.011	0.015	0.005	0.007	0.014	0.072	0.085	0.052	0.043
C.P. radial	0.000	0.002	0.052	0.055	0.011	0.009	0.004	0.005	-	0.005
(P)	0.347		0.684		0.388		0.953		0.885	
<u>Amalgamated Patterns</u>										
Arch	0.004	0.018	0.127	0.112	0.074	0.075	0.023	0.030	0.011	0.018
Loop	0.597	0.579	0.526	0.544	0.725	0.741	0.498	0.507	0.799	0.796
Whorl	0.399	0.403	0.347	0.344	0.201	0.184	0.479	0.463	0.190	0.186
N =	268	437	268	436	269	440	265	436	269	440
X^2	2.862		0.394		0.302		0.427		0.544	
(P)	0.239		0.821		0.860		0.808		0.762	
M-W/P	0.891		0.805		0.644		0.642		0.776	

MALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY ANCESTRY (CONTD.)

Left hand	LP1		LP2		LP3		LP4		LP5	
	E	W	E	W	E	W	E	W	E	W
True arch	0.022	0.050	0.068	0.073	0.060	0.059	0.023	0.034	0.007	0.016
Tented arch	-	-	0.034	0.027	0.015	0.011	-	-	-	0.002
Ulnar loop	0.664	0.651	0.360	0.349	0.757	0.715	0.669	0.629	0.873	0.884
Radial loop	-	0.002	0.242	0.226	0.026	0.025	0.004	0.002	-	-
Whorl	0.060	0.087	0.140	0.153	0.067	0.089	0.195	0.212	0.030	0.036
Double loop	0.250	0.207	0.121	0.130	0.052	0.087	0.060	0.059	0.056	0.043
C.P. ulnar	0.004	-	0.011	0.005	0.022	0.009	0.049	0.062	0.034	0.018
C.P. radial	-	0.002	0.023	0.037	-	0.005	-	0.002	-	-
(P)	0.170		0.894		0.380		0.858		0.550	
Amalgamated Patterns										
Arch	0.022	0.050	0.102	0.100	0.075	0.071	0.023	0.034	0.007	0.018
Loop	0.664	0.654	0.602	0.575	0.783	0.740	0.673	0.631	0.873	0.884
Whorl	0.314	0.296	0.296	0.325	0.142	0.189	0.304	0.335	0.120	0.098
N =	268	439	264	438	267	438	266	439	267	439
X^2	3.422		0.644		2.597		1.672		2.123	
(P)	0.181		0.725		0.273		0.433		0.346	
M-W/P	0.333		0.765		0.161		0.635		0.218	

TABLE 2.11

FEMALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY CHILD'S BIRTH PLACE

Right Hand	RP1		RP2		RP3		RP4		RP5	
	N	S	N	S	N	S	N	S	N	S
True Arch	0.054	0.031	0.113	0.100	0.069	0.050	0.054	0.011	0.039	0.031
Tented Arch	-	-	0.010	0.027	0.015	0.004	-	-	-	-
Ulnar Loop	0.621	0.632	0.448	0.402	0.799	0.808	0.549	0.553	0.862	0.847
Radial Loop	-	-	0.133	0.151	-	0.015	0.005	0.004	0.005	0.004
Whorl	0.138	0.149	0.177	0.151	0.064	0.062	0.279	0.271	0.049	0.057
Double Loop	0.167	0.169	0.064	0.139	0.039	0.054	0.020	0.042	0.030	0.031
C.P. Ulnar	0.020	0.019	0.005	0.004	0.005	0.008	0.088	0.118	0.015	0.031
C.P. Radial	-	-	0.049	0.027	0.010	-	0.005	-	-	-
(P)	0.795		0.146		0.282		0.088		0.891	
Amalgamated Patterns										
Arch	0.054	0.031	0.123	0.127	0.083	0.054	0.054	0.011	0.039	0.031
Loop	0.621	0.632	0.561	0.553	0.799	0.823	0.554	0.587	0.867	0.850
Whorl	0.325	0.337	0.296	0.320	0.118	0.123	0.392	0.432	0.094	0.119
N =	203	261	203	259	204	260	204	262	203	261
X^2	1.619		0.416		1.597		7.313		0.962	
(P)	0.445		0.812		0.450		0.026		0.618	
M-W/P	0.551		0.584		0.346		0.181		0.277	

TABLE 2.11(CONTD.)

FEMALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY CHILD'S BIRTH PLACE (CONTD.)

Left Hand	LP1		LP2		LP3		LP4		LP5	
	N	S	N	S	N	S	N	S	N	S
True Arch	0.060	0.057	0.116	0.092	0.119	0.087	0.074	0.034	0.059	0.030
Tented Arch	-	-	0.020	0.023	0.005	0.019	0.005	0.004	-	-
Ulnar Loop	0.647	0.653	0.357	0.336	0.703	0.740	0.554	0.626	0.817	0.860
Radial Loop	-	-	0.226	0.221	0.025	0.015	0.005	0.004	-	-
Whorl	0.075	0.083	0.146	0.160	0.089	0.060	0.238	0.211	0.050	0.038
Double Loop	0.209	0.204	0.090	0.118	0.054	0.079	0.035	0.049	0.030	0.042
C.P. Ulnar	0.005	-	0.010	0.015	0.005	-	0.089	0.072	0.045	0.030
C.P. Radial	0.005	0.004	0.035	0.034	-	-	-	-	-	-
(P)	0.913		0.957		0.294		0.418		0.412	
Amalgamated Patterns										
Arch	0.060	0.057	0.136	0.115	0.124	0.105	0.079	0.038	0.059	0.030
Loop	0.647	0.653	0.583	0.557	0.728	0.755	0.559	0.630	0.817	0.860
Whorl	0.293	0.290	0.281	0.328	0.148	0.140	0.362	0.332	0.124	0.110
N =	201	265	199	262	202	265	202	265	202	264
X^2	0.029		1.347		0.507		4.786		2.701	
(P)	0.986		0.510		0.776		0.091		0.259	
M-W/P	0.902		0.327		0.854		0.991		0.717	

TABLE 2.12

FEMALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY PARENTS' BIRTH PLACE

	RP1		RP2		RP3		RP4		RP5	
Right hand	N	S	N	S	N	S	N	S	N	S
True Arch	0.070	0.009	0.123	0.100	0.096	0.046	0.079	-	0.044	0.028
Tented Arch	-	-	-	0.018	0.018	-	-	-	-	-
Ulnar Loop	0.623	0.642	0.482	0.318	0.789	0.780	0.535	0.573	0.876	0.853
Radial Loop	-	-	0.132	0.209	-	0.018	0.009	-	-	0.009
Whorl	0.123	0.128	0.167	0.209	0.044	0.064	0.263	0.300	0.035	0.046
Double Loop	0.167	0.202	0.053	0.118	0.044	0.092	0.026	0.045	0.044	0.046
C.P. Ulnar	0.018	0.018	-	0.009	-	-	0.079	0.082	-	0.018
C.P. Radial	-	-	0.044	0.018	0.009	-	0.009	-	-	-
Amalgamated Patterns										
Arch	.070	.009	.123	.118	.115	.046	.079	.000	.044	.028
Loop	.623	.642	.614	.527	.789	.798	.544	.573	.876	.862
Whorl	.307	.349	.263	.355	.096	.156	.377	.427	.080	.110
N =	114	109	114	110	114	109	114	110	113	109
X^2	5.465		2.265		4.782		9.117		0.986	
(P)	0.065		0.322		0.092		0.011		0.611	
M-W/P	0.216		0.222		0.037		0.158		0.247	

TABLE 2.12 (CONTD.)

FEMALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY PARENTS' BIRTH PLACE (CONTD.)

Left hand	RP1		RP2		RP3		RP4		RP5	
	N	S	N	S	N	S	N	S	N	S
True Arch	0.070	0.045	0.134	0.119	0.140	0.091	0.088	0.036	0.070	0.018
Tented Arch	-	-	-	0.018	0.009	0.009	0.009	-	-	-
Ulnar Loop	0.658	0.673	0.384	0.294	0.702	0.764	0.561	0.600	0.807	0.881
Radial Loop	-	-	0.214	0.275	0.026	0.009	0.009	0.009	-	-
Whorl	0.044	0.082	0.161	0.119	0.079	0.027	0.246	0.236	0.053	0.037
Double Loop	0.219	0.191	0.054	0.128	0.044	0.100	0.036	0.055	0.035	0.055
C.P. Ulnar	-	-	0.018	0.018	-	-	0.053	0.064	0.035	0.009
C.P. Radial	0.009	0.009	0.036	0.028	-	-	-	-	-	-
<u>Amalgamated Patterns</u>										
Arch	0.070	0.045	0.134	0.138	0.149	0.100	0.096	0.036	0.070	0.018
Loop	0.658	0.673	0.598	0.569	0.728	0.773	0.570	0.609	0.807	0.881
Whorl	0.272	0.282	0.268	0.293	0.123	0.127	0.334	0.355	0.123	0.101
N =	114	110	112	109	114	110	114	110	114	109
X^2	0.628		0.2176		1.238		3.240		3.935	
(P)	0.731		0.897		0.538		0.198		0.140	
M-W(P)	0.671		0.776		0.424		0.378		0.608	

TABLE 2.13

FEMALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY ANCESTRY

Right hand	RP1		RP2		RP3		RP4		RP5	
	E	W	E	W	E	W	E	W	E	W
True arch	0.021	0.044	0.095	0.116	0.074	0.075	0.018	0.037	0.011	0.044
Tented arch	-	-	0.018	0.032	0.004	0.012	-	-	-	-
Ulnar loop	0.698	0.620	0.418	0.396	0.792	0.788	0.557	0.581	0.858	0.846
Radial loop	-	-	0.160	0.146	0.011	0.012	0.004	0.016	0.004	0.007
Whorl	0.128	0.131	0.174	0.157	0.064	0.048	0.309	0.240	0.057	0.051
Double loop	0.139	0.189	0.085	0.111	0.035	0.053	0.028	L.030	0.021	0.032
C.P. Ulnar	0.014	0.016	-	0.007	0.021	0.005	0.085	0.092	0.050	0.021
C.P. Radial	-	-	0.050	0.035	-	0.005	-	0.005	-	-
(P)	0.157		0.454		0.269		0.164		0.038	
Amalgamated Patterns										
Arch	0.021	0.044	0.113	0.148	0.078	0.090	0.018	0.037	0.011	0.044
Loop	0.698	0.620	0.578	0.542	0.880	0.800	0.560	0.597	0.862	0.853
Whorl	0.281	0.336	0.309	0.310	0.122	0.110	0.422	0.366	0.128	0.103
Number =	281	434	282	432	283	434	282	434	282	435
X^2	5.692		1.933		0.4337		3.887		6.990	
(P)	0.058		0.361		0.805		0.143		0.030	
M-W/P	0.303		0.696		0.578		0.097		0.037	

TABLE 2.13 (CONTD.)

FEMALES - FINGER PATTERN FREQUENCIES - SUBDIVISION BY ANCESTRY (CONTD.)

Left hand	RP1		RP2		RP3		RP4		RP5	
	E	W	E	W	E	W	E	W	E	W
True arch	0.053	0.062	0.105	0.105	0.119	0.099	0.049	0.058	0.035	0.051
Tented arch	-	-	0.025	0.016	0.021	0.014	0.004	0.002	0.0	0.0
Ulnar loop	0.660	0.677	0.330	0.371	0.695	0.733	0.625	0.601	0.870	0.829
Radial loop	-	-	0.209	0.226	0.014	0.016	-	0.007	0.004	-
Whorl	0.084	0.060	0.163	0.124	0.095	0.060	0.214	0.205	0.042	0.046
Double loop	0.204	0.194	0.124	0.103	0.049	0.071	0.028	0.051	0.025	0.037
C.P. Ulnar	-	0.002	-	0.016	0.004	0.007	0.081	0.076	0.025	0.037
C.P. Radial	-	0.005	0.043	0.040	0.004	0.000	-	-	-	-
(P)	0.568		0.259		0.358		0.588		0.481	
Amalgamated Patterns										
Arch	0.052	0.062	0.131	0.121	0.140	0.113	0.053	0.060	0.035	0.051
Loop	0.660	0.677	0.539	0.597	0.709	0.749	0.625	0.608	0.874	0.829
Whorl	0.288	0.261	0.330	0.282	0.151	0.138	0.323	0.332	0.091	0.120
N =	285	434	482	429	285	435	285	434	285	434
X^2	0.826		2.412		1.659		0.276		2.634	
(P)	0.662		0.299		0.436		0.871		0.269	
M-W/P	0.353		0.449		0.716		0.924		0.626	

DIGITAL PATTERN DOMINANCE IN SINGLE PARAMETER SUBSETS

TABLE 2.14

		Males							Females							
		BP	PBP	DW		BP	PBP	DW		BP	PBP	DW		BP	PBP	DW
RP1	Arch	S	N	W	LP1	N	N	W	RP1	N	N	W	LP1	N	N	W
	Loop	S	S	E		S	S	W		S	S	E		S	S	E
	Whorl	N	N	W		N	N	E		S	S	W		N	S	E
RP2	Arch	S	S	E	LP2	S	S	E	RP2	S	N	E	LP2	N	S	E
	Loop	S	S	W		S	S	E		N	N	W		N	N	E
	Whorl	N	N	E		N	N	W		S	S	E		S	S	W
RP3	Arch	S	N	W	LP3	N	N	E	RP3	N	N	W	LP3	N	N	E
	Loop	S	S	W		S	S	E		S	S	W		S	S	E
	Whorl	N	N	E		N	N	W		S	N	E		N	S	W
RP4	Arch	N	N	W	LP4	N	N	W	RP4	N	N	W	LP4	N	N	W
	Loop	S	S	E		S	S	E		S	S	W		S	S	E
	Whorl	N	N	W		N	N	W		S	S	E		N	S	W
RP5	Arch	S	N	W	LP5	N	N	W	RP5	N	N	W	LP5	N	N	W
	Loop	S	S	E		N	S	W		N	N	E		S	S	W
	Whorl	N	N	E		S	N	E		S	S	E		N	N	E

TABLE 2.15

FINGER PATTERN FREQUENCIES FOR ENGLISH IN SOUTH PEMBS. (A)

Males (N=124)	RP1	RP2	RP3	RP4	RP5	LP1	LP2	LP3	LP4	LP5
True arch	0.008	0.081	0.056	0.035	0.016	0.016	0.089	0.056	0.024	0.016
Tented arch	-	0.040	0.008	-	-	-	0.024	-	-	-
Ulnar loop	0.637	0.298	0.734	0.508	0.790	0.718	0.382	0.782	0.707	0.847
Radial loop	-	0.258	0.016	0.008	-	-	0.228	0.024	-	-
Whorl	0.121	0.121	0.065	0.311	0.089	0.032	0.122	0.056	0.130	0.024
Double loop	0.218	0.145	0.105	0.066	0.048	0.234	0.130	0.065	0.073	0.065
C.P. ulnar	0.016	0.024	0.008	0.082	0.056	-	0.008	0.016	0.065	0.048
C.P. radial	-	0.032	0.008	-	-	-	0.016	-	-	-
Amalgamated Patterns										
Arch	0.008	0.121	0.065	0.025	0.016	0.016	0.114	0.056	0.024	0.016
Loop	0.637	0.556	0.750	0.516	0.790	0.718	0.610	0.806	0.707	0.847
Whorl	0.355	0.323	0.185	0.459	0.194	0.266	0.276	0.138	0.269	0.137
Females (N=122)										
True arch	0.041	0.083	0.041	0.016	0.008	0.073	0.098	0.105	0.048	0.032
Tented arch	-	0.017	0.008	-	-	-	0.033	0.032	0.008	-
Ulnar loop	0.653	0.479	0.820	0.525	0.909	0.661	0.336	0.726	0.613	0.903
Radial loop	-	0.157	0.016	-	-	-	0.238	0.016	-	-
Whorl	0.140	0.140	0.074	0.328	0.041	0.089	0.172	0.073	0.250	0.024
Double loop	0.140	0.099	0.033	0.025	0.017	0.177	0.098	0.048	0.024	0.032
C.P. ulnar	0.025	-	0.008	0.107	0.025	-	-	-	0.056	0.008
C.P. radial	-	0.017	-	-	-	-	0.025	-	-	-
Amalgamated Patterns										
Arch	0.041	0.099	0.049	0.016	0.008	0.073	0.131	0.137	0.056	0.032
Loop	0.653	0.636	0.836	0.525	0.909	0.661	0.574	0.742	0.613	0.903
Whorl	0.306	0.265	0.115	0.459	0.083	0.266	0.295	0.121	0.331	0.065

TABLE 2.16

FINGER PATTERN FREQUENCIES FOR ENGLISH IN NORTH PEMBS. (B)

Males (N=33)	RP1	RP2	RP3	RP4	RP5	LP1	LP2	LP3	LP4	LP5
True arch	0.000	-	-	-	-	-	-	0.030	-	-
Tented arch	-	0.094	-	-	-	-	0.063	-	-	-
Ulnar loop	0.515	0.344	0.788	0.455	0.727	0.606	0.313	0.758	0.636	0.788
Radial loop	-	0.156	0.030	0.000	-	-	0.188	0.030	0.030	0.000
Whorl	0.212	0.250	0.121	0.424	0.152	0.091	0.188	0.061	0.333	0.121
Double loop	0.273	0.094	0.061	0.030	0.030	0.273	0.219	0.030	-	0.030
Ulnar C.P.	-	0.031	-	0.091	0.091	0.030	-	0.091	-	0.061
Radial C.P.	-	0.031	-	-	-	-	0.031	-	-	-
Amalgamated Patterns										
Arch	0.000	0.094	0.000	0.000	0.000	0.000	0.063	0.030	0.000	0.000
Loop	0.515	0.500	0.818	0.455	0.727	0.606	0.500	0.788	0.667	0.788
Whorl	0.485	0.406	0.182	0.545	0.273	0.394	0.437	0.182	0.333	0.212
Females (N=40)										
True Arch	-	0.025	0.025	-	-	0.026	0.050	0.100	0.025	-
Tented arch	-	0.025	-	-	-	-	0.025	0.025	-	-
Ulnar loop	0.650	0.350	0.775	0.525	0.850	0.564	0.250	0.625	0.575	0.850
Radial loop	-	0.175	-	-	-	-	0.225	0.025	-	-
Whorl	0.175	0.250	0.125	0.375	0.075	0.103	0.225	0.175	0.250	0.050
Double loop	0.175	0.075	0.050	0.025	0.025	0.308	0.200	0.050	0.025	0.025
C.P. ulnar	-	-	0.025	0.075	0.050	-	-	-	0.125	0.075
C.P. radial	-	0.100	-	-	-	-	0.025	-	-	-
Amalgamated Patterns										
Arch	0.000	0.050	0.025	0.000	0.000	0.026	0.075	0.125	0.025	0.000
Loop	0.650	0.525	0.775	0.525	0.850	0.564	0.475	0.650	0.575	0.850
Whorl	0.350	0.425	0.200	0.475	0.150	0.410	0.450	0.225	0.400	0.150

TABLE 2.17

FINGER PATTERN FREQUENCIES FOR WELSH IN SOUTH PEMBS. (C)

Males (N=160)	RP1	RP2	RP3	RP4	RP5	LP1	LP2	LP3	LP4	LP5
True arch	0.025	0.095	0.081	0.031	0.025	0.057	0.069	0.063	0.013	0.013
Tented arch	-	0.038	-	-	-	-	0.038	0.013	-	-
Ulnar loop	0.616	0.329	0.744	0.547	0.800	0.660	0.390	0.728	0.704	0.881
Radial loop	-	0.234	0.006	0.006	0.006	-	0.164	0.019	0.006	0.000
Whorl	0.208	0.133	0.125	0.289	0.069	0.082	0.164	0.089	0.182	0.044
Double loop	0.132	0.120	0.025	0.038	0.050	0.195	0.113	0.082	0.025	0.050
C.P. ulnar	0.013	-	0.019	0.088	0.044	-	-	0.006	0.069	0.013
C.P. radial	0.006	0.051	-	-	0.006	0.006	0.063	-	-	-
<u>Amalgamated Patterns</u>										
Arch	0.025	0.133	0.081	0.031	0.025	0.057	0.107	0.076	0.013	0.013
Loop	0.616	0.563	0.750	0.553	0.806	0.660	0.553	0.747	0.710	0.880
Whorl	0.350	0.304	0.169	0.416	0.169	0.283	0.340	0.177	0.277	0.107
<u>Females (N=138)</u>										
True arch	0.021	0.116	0.058	0.007	0.050	0.046	0.086	0.071	0.021	0.029
Tented arch	-	0.036	-	-	-	-	0.014	0.007	-	-
Ulnar loop	0.614	0.333	0.797	0.579	0.793	0.645	0.336	0.752	0.638	0.821
Radial loop	-	0.145	0.014	0.007	0.007	-	0.207	0.014	0.007	-
Whorl	0.157	0.152	0.051	0.221	0.071	0.078	0.150	0.050	0.177	0.050
Double loop	0.193	0.174	0.072	0.057	0.043	0.227	0.136	0.106	0.071	0.050
C.P. ulnar	0.014	0.007	0.007	0.129	0.036	-	0.029	-	0.085	0.050
C.P. radial	-	0.036	-	-	-	0.007	0.043	-	-	-
<u>Amalgamated Patterns</u>										
Arch	0.021	0.152	0.058	0.007	0.050	0.043	0.100	0.078	0.021	0.029
Loop	0.614	0.478	0.812	0.586	0.800	0.645	0.543	0.766	0.645	0.821
Whorl	0.365	0.370	0.130	0.407	0.150	0.312	0.357	0.156	0.334	0.150

TABLE 2.18

FINGER PATTERN FREQUENCIES FOR WELSH IN NORTH PEMBS. (D)

Males (N=167)	RP1	RP2	RP3	RP4	RP5	LP1	LP2	LP3	LP4	LP5
True arch	0.018	0.096	0.077	0.036	0.012	0.060	0.090	0.089	0.060	0.024
Tented arch	-	0.024	-	-	0.006	-	0.012	0.012	-	0.006
Ulnar loop	0.602	0.263	0.702	0.458	0.774	0.619	0.281	0.667	0.560	0.887
Radial loop	-	0.251	0.018	0.012	-	-	0.275	0.030	-	-
Whorl	0.199	0.168	0.113	0.343	0.101	0.065	0.180	0.089	0.226	0.018
Double loop	0.175	0.114	L.054	0.048	0.060	0.256	0.126	0.095	0.083	0.042
C.P. ulnar	0.006	0.006	0.018	0.090	0.042	-	0.012	0.012	0.065	0.024
C.P. radial	-	0.078	0.018	0.012	0.006	-	0.024	0.006	0.006	-
Amalgamated Patterns										
Arch	0.018	0.120	0.077	0.036	0.018	0.060	0.102	0.101	0.060	0.030
Loop	0.602	0.515	0.720	0.470	0.774	0.619	0.557	0.696	0.560	0.887
Whorl	0.380	0.365	0.203	0.494	0.208	0.321	0.341	0.203	0.380	0.083
Females (N=164)										
True arch	0.067	0.135	0.079	0.067	0.049	0.068	0.132	0.123	0.086	0.074
Tented arch	-	0.006	0.018	-	-	-	0.019	-	0.006	-
Ulnar loop	0.613	0.472	0.805	0.555	0.865	0.667	0.384	0.722	0.549	0.809
Radial loop	-	0.123	-	0.006	0.006	-	0.226	0.025	0.006	-
Whorl	0.129	0.160	0.049	0.256	0.043	0.068	0.126	0.068	0.235	0.049
Double loop	0.166	0.061	0.037	0.018	0.031	0.185	0.063	0.056	0.037	0.031
C.P. ulnar	0.025	0.006	-	0.091	0.006	0.006	0.013	0.006	0.080	0.037
C.P. radial	-	0.037	0.012	0.006	-	0.006	0.038	-	-	-
Amalgamated Patterns										
Arch	0.067	0.141	0.097	0.067	0.049	0.068	0.151	0.123	0.092	0.074
Loop	0.613	0.595	0.805	0.561	0.871	0.667	0.610	0.747	0.556	0.809
Whorl	0.320	0.264	0.098	0.372	0.080	0.265	0.239	0.130	0.352	0.117

TABLE 2.19

FINGER PATTERN FREQUENCIES - X_2^2 and (P) (USING AMALGAMATED PATTERNS)

Males	E		F		G		H		I		J	
	X_2^2	(P)	X_2^2	(P)	X_2^2	(P)	X_2^2	(P)	X_2^2	(P)	X_2^2	(P)
RP1	2.053	0.358	0.312	0.855	1.202	0.548	1.722	0.423	0.771	0.680	2.445	0.295
RP2	0.836	0.658	1.378	0.502	0.162	0.922	0.290	0.865	0.604	0.738	1.386	0.500
RP3	2.289	0.318	0.613	0.736	0.375	0.829	2.972	0.226	0.354	0.838	2.876	0.238
RP4	1.415	0.492	2.273	0.321	0.597	0.742	1.352	0.509	0.791	0.674	2.598	0.273
RP5	1.443	0.486	0.984	0.611	0.522	0.770	1.190	0.552	0.115	0.944	2.626	0.269
LP1	2.454	0.293	0.628	0.730	3.343	0.188	2.407	0.300	5.052	0.080	3.105	0.212
LP2	3.297	0.192	0.023	0.989	1.298	0.523	1.289	0.525	1.388	0.500	1.385	0.500
LP3	0.717	0.699	1.141	0.565	1.412	0.494	1.931	0.381	4.640	0.098	0.899	0.638
LP4	1.257	0.534	10.541	0.005	0.565	0.754	2.681	0.262	7.159	0.028	0.796	0.672
LP5	1.600	0.449	1.610	0.447	0.682	0.711	5.672	0.059	2.628	0.268	3.106	0.212
	n=124 (A)	n=33 (B)	n=168 (D)	n=160 (C)	n=124 (A)	n=168 (C)	n=33 (B)	n=168 (D)	n=168 (D)	n=124 (A)	n=160 (C)	n=33 (B)
Females												
RP1	1.839	0.399	9.912	0.142	1.649	0.348	2.863	0.239	1.054	0.591	0.939	0.626
RP2	3.994	0.136	4.623	0.099	6.563	0.038	5.260	0.072	1.184	0.553	2.894	0.235
RP3	2.156	0.340	2.202	0.333	0.269	0.874	4.936	0.085	2.409	0.300	1.746	0.418
RP4	0.672	0.715	y.194	0.027	1.331	0.514	3.628	0.163	5.419	0.066	0.825	0.662
RP5	1.820	0.403	3.768	0.152	7.076	0.029	3.673	0.159	3.770	0.152	2.096	0.351
LP1	3.555	0.169	1.486	0.476	1.555	0.459	3.698	0.157	0.025	0.988	1.430	0.489
LP2	3.513	0.173	5.632	0.060	1.429	0.489	7.415	0.025	1.168	0.558	1.187	0.552
LP3	2.625	0.269	1.928	0.381	2.811	0.245	2.379	0.304	0.145	0.930	2.210	0.331
LP4	1.104	0.576	7.548	0.023	2.275	0.321	2.078	0.354	1.683	0.431	0.663	0.718
LP5	3.976	0.137	3.557	0.169	4.916	0.086	3.308	0.191	5.007	0.082	1.174	0.556
	n=124 (A)	n=40 (B)	n=162 (D)	n=140 (C)	n=124 (A)	n=140 (C)	n=40 (B)	n=162 (D)	n=162 (D)	n=124 (A)	n=140 (C)	n=40 (B)

TABLE 2.20

FINGER PATTERN INTENSITIES (TRIRADII FREQUENCIES)

Males - Child's Birthplace (BP)

	0		1		2			0		1		2	
	N	S	N	S	N	S		N	S	N	S	N	S
R1	.015	.018	.590	.625	.395	.357	L1	.050	.039	.619	.686	.332	.276
R2	.080	.089	.550	.599	.370	.312	L2	.075	.078	.570	.610	.355	.312
R3	.064	.070	.738	.754	.198	.176	L3	.079	.060	.723	.780	.198	.160
R4	.030	.028	.470	.537	.500	.434	L4	.050	.018	.579	.707	.371	.273
R5	.010	.021	.772	.799	.218	.180	L5	.020	.014	.876	.866	.202	.283

Parents' Common Birthplace

	W	E	W	E	W	E		W	E	W	E	W	E
R1	.022	.009	.575	.634	.403	.357	L1	.059	.018	.607	.694	.333	.282
R2	.096	.063	.488	.563	.415	.375	L2	.097	.045	.552	.649	.351	.306
R3	.119	.027	.674	.830	.207	.143	L3	.104	.036	.689	.791	.207	.173
R4	.052	.018	.459	.578	.489	.404	L4	.067	-	.556	.739	.378	.261
R5	.022	-	.792	.830	.185	.170	L5	.022	.009	.874	.892	.106	.099

Ancestry

	E	W	E	W	E	W		E	W	E	W	E	W
R1	.004	.018	.597	.579	.399	.403	L1	.022	.050	.664	.654	.313	.296
R2	.071	.078	.582	.578	.347	.344	L2	.068	.073	.636	.602	.295	.324
R3	.059	.070	.740	.746	.201	.184	L3	.060	.059	.798	.751	.142	.189
R4	.019	.028	.502	.509	.477	.463	L4	.023	.034	.673	.631	.305	.335
R5	.011	.016	.799	.797	.190	.186	L5	.007	.016	.873	.886	.120	.098

TABLE 220 (CONTD.)

FINGER PATTERN INTENSITIES (TRIRADII FREQUENCIES) (CONTD.)

Females - Child's Birthplace (BP)

	0		1		2			0		1		2	
	N	S	N	S	N	S		N	S	N	S	N	S
R1	.054	.031	.621	.632	.325	.337	L1	.060	.057	.647	.653	.294	.291
R2	.113	.100	.571	.579	.296	.320	L2	.116	.092	.603	.590	.281	.328
R3	.069	.050	.814	.827	.118	.123	L3	.119	.087	.733	.774	.149	.140
R4	.054	.011	.554	.587	.392	.431	L4	.074	.034	.564	.634	.361	.332
R5	.039	.031	.867	.851	.094	.119	L5	.059	.030	.817	.860	.124	.110

Parents' Common Birthplace (PBP)

	N	S	N	S	N	S		N	S	N	S	N	S
R1	.070	.009	.623	.642	.307	.349	L1	.070	.045	.658	.673	.272	.282
R2	.123	.100	.614	.545	.263	.355	L2	.134	.119	.598	.587	.268	.294
R3	.096	.046	.807	.798	.096	.156	L3	.140	.091	.737	.782	.123	.127
R4	.079	-	.544	.573	.377	.427	L4	.088	.036	.579	.609	.333	.355
R5	.044	.028	.876	.862	.080	.110	L5	.070	.018	.807	.881	.123	.101

Ancestry

	E	W	E	W	E	W		E	W	E	W	E	W
R1	.021	.044	.698	.620	.281	.336	L1	.053	.062	.660	.679	.288	.260
R2	.095	.116	.596	.574	.309	.310	L2	.105	.105	.564	.613	.330	.282
R3	.074	.078	.804	.812	.120	.111	L3	.119	.099	.730	.763	.151	.138
R4	.018	.037	.560	.597	.422	.366	L4	.049	.058	.629	.610	.323	.332
R5	.011	.044	.862	.853	.128	.103	L5	.035	.051	.874	.829	.091	.120

TABLE 2.21

FINGER PATTERN TRIRADII

SINGLE PARAMETERS

	BP		PBP		DW		BP		PBP		DW	
	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W
Males							Females					
R1	.688	.388	.504	.560	.239	.891	.445	.551	.065	.216	.058	.303
R2	.414	.169	.418	.806	.942	.915	.805	.417	.328	.154	.680	.891
R3	.814	.529	.006	.779	.758	.474	.693	.485	.168	.064	.914	.738
R4	.342	.199	.107	.496	.735	.627	.026	.181	.011	.158	.143	.097
R5	.388	.216	.262	.954	.870	.821	.618	.277	.611	.247	.030	.037
L1	.310	.296	.162	.810	.181	.333	.986	.902	.731	.671	.662	.353
L2	.612	.357	.170	.831	.673	.834	.462	.292	.889	.632	.370	.346
L3	.346	.613	.083	.698	.270	.174	.476	.632	.512	.414	.568	.858
L4	.005	.115	.001	.280	.433	.635	.090	.976	.284	.424	.837	.941
L5	.772	.500	.709	.859	.424	.246	.259	.717	.140	.608	.268	.626

TABLE 2.22

FINGER PATTERN TRIRADII

MALES

	0	1	2		0	1	2	
English in North Pembs.								N = 33
R1	0.000	0.515	0.485	L1	-	0.606	0.394	
R2	-	0.594	0.406	L2	-	0.563	0.437	
R3	-	0.818	0.182	L3	0.030	0.788	0.182	
R4	-	0.455	0.545	L4	-	0.667	0.333	
R5	-	0.727	0.273	L5	-	0.788	0.212	
English in South Pembs.								N = 124
R1	0.008	0.637	0.355	L1	0.016	0.718	0.266	
R2	0.081	0.596	0.323	L2	0.089	0.634	0.277	
R3	0.056	0.758	0.186	L3	0.056	0.806	0.138	
R4	0.025	0.516	0.459	L4	0.024	0.707	0.269	
R5	0.016	0.790	0.194	L5	0.016	0.847	0.137	
Welsh in North Pembs.								N = 167
R1	0.018	0.602	0.380	L1	0.060	0.619	0.321	
R2	0.096	0.539	0.365	L2	0.090	0.569	0.341	
R3	0.077	0.720	0.203	L3	0.089	0.708	0.203	
R4	0.036	0.470	0.494	L4	0.060	0.560	0.380	
R5	0.012	0.780	0.208	L5	0.024	0.895	0.083	
Welsh in South Pembs.								N = 160
R1	0.025	0.616	0.359	L1	0.057	0.660	0.283	
R2	0.095	0.601	0.304	L2	0.069	0.591	0.340	
R3	0.081	0.750	0.169	L3	0.063	0.760	0.177	
R4	0.031	0.553	0.416	L4	0.013	0.711	0.276	
R5	0.025	0.806	0.169	L5	0.013	0.881	0.106	

FINGER PATTERN TRIRADII (CONTD.)

FEMALES

English in North Pembs.

	0	1	2		0	1	2
R1	0.000	0.650	0.360	L1	0.026	0.564	0.410
R2	0.025	0.550	0.425	L2	0.050	0.500	0.450
R3	0.025	0.775	0.200	L3	0.100	0.675	0.225
R4	0.000	0.525	0.475	L4	0.025	0.575	0.400
R5	0.000	0.850	0.150	L5	0.000	0.850	0.150

N = 40

English in South Pembs.

	0	1	2		0	1	2
R1	0.041	0.653	0.306	L1	0.073	0.661	0.265
R2	0.083	0.653	0.264	L2	0.098	0.607	0.295
R3	0.041	0.844	0.115	L3	0.105	0.774	0.121
R4	0.016	0.525	0.459	L4	0.048	0.621	0.331
R5	0.008	0.909	0.083	L5	0.032	0.903	0.065

N = 122

Welsh in North Pembs.

	0	1	2		0	1	2
R1	0.067	0.614	0.319	L1	0.068	0.667	0.265
R2	0.135	0.601	0.264	L2	0.132	0.629	0.239
R3	0.079	0.823	0.098	L3	0.123	0.747	0.130
R4	0.067	0.561	0.372	L4	0.086	0.562	0.352
R5	0.049	0.879	0.082	L5	0.074	0.809	0.117

N = 164

Welsh in South Pembs.

	0	1	2		0	1	2
R1	0.021	0.614	0.365	L1	0.043	0.645	0.312
R2	0.116	0.514	0.370	L2	0.086	0.557	0.357
R3	0.058	0.812	0.130	L3	0.071	0.773	0.156
R4	0.007	0.586	0.407	L4	0.021	0.645	0.334
R5	0.050	0.800	0.150	L5	0.029	0.821	0.150

N = 138

TABLE 2.23(CONTD.)

FINGER PATTERN TRIRADII (CONTD.)

DUAL PARAMETERS

	E		F		G		H		I		J	
	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W	$X^2/(P)$	M-W
Males												
R1	.358	.162	.855	.646	.548	.899	.423	.225	.680	.756	.295	.141
R2	.212	.109	.480	.339	.887	.734	.189	.226	.613	.566	.142	.066
R3	.370	.609	.736	.489	.695	.490	.226	.614	.705	.983	.238	.334
R4	.495	.373	.321	.198	.742	.432	.509	.526	.674	.676	.273	.156
R5	.486	.267	.468	.271	.770	.512	.602	.363	.914	.713	.269	.117
L1	.293	.130	.730	.527	.186	.816	.300	.248	.080	.690	.212	.116
L2	.074	.021	.777	.830	.482	.288	.168	.075	.483	.400	.227	.091
L3	.699	.410	.528	.965	.622	.523	.471	.743	.159	.521	.760	.701
L4	.534	.425	.005	.201	.754	.874	.262	.934	.028	.196	.672	.459
L5	.449	.230	.590	.343	.711	.516	.064	.019	.313	.132	.212	.080
Females												
R1	.399	.418	.142	.196	.438	.248	.239	.390	.591	.926	.626	.997
R2	.105	.035	.143	.046	.079	.178	.041	.014	.371	.512	.222	.332
R3	.369	.166	.543	.211	.746	.880	.114	.038	.394	.262	.418	.234
R4	.715	.789	.027	.223	.514	.457	.163	.123	.067	.062	.662	.422
R5	.403	.254	.152	.122	.029	.654	.159	.063	.152	.210	.351	.547
L1	.169	.034	.476	.263	.459	.277	.157	.030	.988	.961	.489	.146
L2	.168	.095	.060	.046	.562	.447	.020	.013	.461	.247	.495	.241
L3	.267	.222	.281	.167	.483	.239	.310	.189	.851	.869	.448	.614
L4	.634	.265	.036	.659	.474	.730	.397	.351	.374	.930	.718	.472
L5	.137	.048	.169	.118	.086	.045	.191	.164	.082	.780	.556	.721

MALES - FINGER PATTERN INTENSITY INDICES - SINGLE PARAMETERS

		BP		FBP		DW	
		N	S	N	S	E	W
P1R	Mean	6.598	6.312	6.373	6.460	6.5019	6.464
	S.D.	2.077	2.032	2.054	1.981	1.915	2.039
	t-test/P	.133		.740		.809	
	M-W/P	.079		.661		.870	
P1L	Mean	6.1194	5.982	6.082	6.009	6.135	6.005
	S.D.	1.935	1.900	2.120	1.553	1.995	1.779
	t-test/P	.438		.758		.382	
	M-W/P	.760		.380		.623	
P1T	Mean	12.729	12.300	12.463	12.477	12.629	12.495
	S.D.	3.726	3.625	3.954	3.225	3.491	3.597
	t-test/P	.208		.975		.631	
	M-W/P	.124		.538		.668	

		A	B	C	D
P1R	Mean	6.382	7.059	6.258	6.504
	S.D.	1.910	2.131	2.126	2.059
P1L	Mean	6.008	.6706	5.962	6.000
	S.D.	2.038	2.168	1.791	1.869
P1T	Mean	12.382	13.878	12.235	12.515
	S.D.	3.538	3.635	3.702	3.720

		E	F	G	H	I	J
P1R	(t-test/P	.077	.292	.612	.119	.612	.035
	(M-W/P	.090	.156	.506	.237	.450	.040
P1L	(t-test/P	.083	.852	.840	.040	.972	.027
	(M-W/P	.088	.410	.999	.223	.413	.080
P1T	(t-test/P	.049	.500	.738	.055	.759	.021
	(M-W/P	.050	.308	.709	.121	.507	.036

TABLE 2.25

FINGER PATTERN INTENSITY INDICES - SINGLE PARAMETERS - FEMALES

	BP		PBP		DW	
	N	S	N	S	E	W
P1R Mean	5.900	6.440	5.717	6.796	6.247	6.000
S.D.	1.900	4.298	1.948	6.176	4.094	2.021
T-test (P)	.072		.085		.349	
M-W/P	.308		.098		.795	
P1L Mean	5.930	5.958	5.673	5.927	5.901	5.863
S.D.	2.266	2.008	2.181	1.957	2.057	2.125
T-test (P)	.889		.363		.811	
M-W/P	.798		.737		.604	
P1T Mean	11.824	12.401	11.366	12.748	12.144	11.854
S.D.	3.903	5.198	3.955	6.683	5.034	3.865
T-test (P)	.177		.066		.415	
M-W/P	.818		.271		.639	

DUAL PARAMETERS

		A	B	C	D
P1R	Means	6.550	6.550	6.345	5.739
	S.D.	5.898	1.663	2.125	1.925
P1L	Means	5.847	6.625	5.058	5.758
	S.D.	2.175	2.108	1.849	2.277
P1T	Means	12.400	13.175	12.402	11.484
	S.D.	6.519	3.358	3.697	3.966

		E	F	G	H	I	J
	(T-test/P	1.00	.010	.719	.015	.149	.575
	(M-W/P	.130	.068	.492	.028	.289	.369
P1L	(T-test/P	.049	.209	.397	.030	.739	.099
	(M-W/P	.019	.369	.477	.020	.908	.080
P1T	(T-test/P	.473	.042	.998	.014	.175	.237
	(M-W/P	.055	.259	.659	.019	.548	.139

TABLE 2.26

PALMAR RIDGE COUNTS

Males	Mean	S.D.	g^1	g^2	Females	Mean	S.D.	g^1	g^2
RAB	40.41	5.84	0.232	0.635	RAB	39.85	5.51	0.122	0.932
RBC	26.30	8.25	-1.349	2.966	RBC	25.61	8.91	-1.286	2.179
RCD	35.34	10.05	-2.041	5.107	RCD	34.65	11.06	-1.812	0.702
LAB	41.73	6.03	0.415	0.620	LAB	41.50	5.45	0.305	0.619
LBC	25.58	8.51	-1.380	2.620	LBC	24.73	9.71	-1.308	1.427
LCD	33.93	10.88	-1.747	3.429	LCD	33.09	12.46	-1.618	2.118
RP TOT	104.42	12.83	-0.233	0.382	RP TOT	103.19	13.67	0.403	-0.182
LP TOT	103.94	14.23	-0.156	0.431	LP TOT	103.49	14.22	-0.321	0.489
TPRC	202.37	25.69	-0.188	0.215	TPRC	206.58	26.88	-0.247	0.404

TABLE 2.27

PALMAR RIDGE COUNTS - SINGLE PARTITION

t-TEST PROBABILITIES

Single Parameters

Males	BP	PBP	DW	Females	BP	PBP	DW
RAB	0.899	0.894	0.758	RAB	0.182	0.433	0.915
RBC	0.617	0.737	0.242	RBC	0.766	0.895	0.569
RCD	0.779	0.312	0.710	RCD	0.832	0.640	0.020
LAB	0.969	0.692	0.425	LAB	0.347	0.856	0.602
LBC	0.905	0.785	0.485	LBC	0.361	0.763	0.258
LCD	0.838	0.975	0.917	LCD	0.160	0.416	0.247
RPTOT	0.596	0.872	0.514	RPTOT	0.196	0.682	0.538
LPTOT	0.860	0.956	0.470	LPTOT	0.645	0.714	0.635
TPRC	0.772	0.759	0.500	TPRC	0.419	0.996	0.557

Dual Parameters

Males	E*	F	G	H*	I	J*	Females E*	F	G	H*	I	J*
RAB	0.082	0.451	0.470	0.055	0.953	0.154	0.109	0.205	0.148	0.051	0.741	0.010
RBC	0.184	0.410	0.736	0.038	0.260	0.126	0.863	0.615	0.437	0.678	0.719	0.518
RCD	0.810	0.661	0.831	0.703	0.854	0.910	0.655	0.809	0.398	0.967	0.473	0.854
LAB	0.562	0.903	0.759	0.382	0.668	0.432	0.361	0.260	0.142	0.149	0.588	0.054
LBC	0.005	0.223	0.366	0.003	0.811	0.021	0.158	0.706	0.896	0.326	0.589	0.197
LCD	0.039	0.463	0.543	0.034	0.931	0.090	0.033	0.325	0.520	0.033	0.789	0.006
RPTOT	0.043	0.882	0.883	0.019	0.773	0.027	0.624	0.139	0.330	0.786	0.708	0.237
LPTOT	0.026	0.237	0.636	0.006	0.537	0.043	0.588	0.411	0.622	0.482	0.806	0.908
TPRC	0.020	0.504	0.773	0.008	0.744	0.024	0.870	0.253	0.446	0.722	0.791	0.624

* Comparison involved subset EN

TABLE 2.28

PALMAR RIDGE COUNTS

MANN-WHITNEY PROBABILITIES

Single Parameters

Males	BP	PBP	DW	Females	BP	PBP	DW
RAB	0.836	0.893	0.609	RAB	0.115	0.344	0.012
RBC	0.673	0.462	0.177	RBC	0.891	0.562	0.658
RCD	0.309	0.156	0.649	RCD	0.458	0.698	0.768
LAB	0.956	0.586	0.348	LAB	0.559	0.946	0.113
LBC	0.813	0.461	0.499	LBC	0.690	0.962	0.464
LCD	0.998	0.837	0.628	LCD	0.676	0.670	0.964
RPTOT	0.613	0.886	0.513	RPTOT	0.093	0.751	0.294
LPTOT	0.979	0.885	0.453	LPTOT	0.545	0.677	0.482
TPRC	0.726	0.754	0.516	TPRC	0.247	0.891	0.426

~~Dual Parameters~~

Males	E*	F	G	H*	I	J*	Females E*	F	G	H*	I	J*
RAB	0.163	0.424	0.733	0.173	0.736	0.198	0.085	0.141	0.136	0.085	0.970	0.011
RBC	0.025	0.252	0.796	0.002	0.183	0.014	0.699	0.802	0.952	0.586	0.811	0.839
RCD	0.912	0.258	0.620	0.806	0.626	0.593	0.759	0.504	0.881	0.962	0.606	0.669
LAB	0.340	0.872	0.827	0.257	0.743	0.291	0.281	0.535	0.230	0.086	0.467	0.041
LBC	0.004	0.094	0.251	0.002	0.730	0.025	0.720	0.459	0.575	0.664	0.936	0.865
LCD	0.085	0.480	0.763	0.057	0.669	0.104	0.104	0.864	0.962	0.094	0.909	0.178
RPTOT	0.020	0.758	0.943	0.008	0.769	0.018	0.555	0.067	0.289	0.901	0.509	0.156
LPTOT	0.012	0.246	0.560	0.003	0.650	0.018	0.902	0.384	0.629	0.799	0.807	0.800
TPRC	0.010	0.467	0.640	0.004	0.799	0.013	0.855	0.164	0.417	0.806	0.628	0.433

*Comparison involved subset EN.

TABLE 2.29

PALMAR PATTERN FREQUENCIES

	No. of Patterns					No. of Patterns			
Males (N=712)	0	1	2	Mean	Females (N=723)	0	1	2	Mean
PTR	.959	.041	-	0.041		.942	.057	0.001	0.060
RTR	.951	.049	-	0.049		.947	.053	-	0.053
P2R	.931	.069	-	0.069		.968	.032	-	0.032
C2R	.999	.001	-	0.001		1.0	-	-	-
P3R	.459	.541	-	0.540		.485	.515	-	0.515
P3TR	.907	.093	-	0.093		.913	.087	-	0.087
C3R	.994	.006	-	0.006		.999	.001	-	0.001
P4R	.591	.397	.011	0.420		.584	.414	.003	0.419
C4R	.992	.008	-	0.008		.999	.001	-	0.001
U4R	.997	.003	-	0.003		1.0	-	-	-
PHR	.869	.131	-	0.131		.888	.109	.003	0.115
CHR	.764	.235	.001	0.237		.743	.249	.008	0.266
RHR	.966	.034	-	0.034		.963	.037	-	0.037
UHTR	.999	.001	-	0.001		.997	.003	-	0.003
CHTR	.999	.001	-	0.001		1.0	-	-	-
PTL	.886	.110	.004	0.118		.896	.104	-	0.104
RTL	.912	.087	.001	0.090		.925	.075	-	0.075
P2L	.962	.038	-	0.038		.982	.018	-	0.018
C2L	.999	.001	-	0.001		1.0	-	-	-
P3L	.719	.279	.001	0.282		.729	.271	-	0.271
P3TL	.855	.145	-	0.145		.884	.116	-	0.116
C3L	1.0	-	-	-		.999	.001	-	0.001
P4L	.392	.566	.042	0.650		.383	.588	.029	0.646
C4L	.985	.015	-	0.015		.982	.018	-	0.018
U4L	.993	.007	-	0.007		.996	.004	-	0.004
PHL	.865	.131	.004	0.139		.880	.116	.004	0.125
CHL	.758	.239	.003	0.244		.723	.272	.004	0.281
RHL	.987	.013	-	0.013		.986	.014	-	0.014
UHTL	.999	.001	-	0.001		1.0	-	-	-
CHTL	.999	.001	-	0.001		1.0	-	-	-

PALMAR PATTERN FREQUENCIES - SINGLE PARAMETERS

Males	BP		FBP		DW	
	X_2^2	(P)	X_2^2	(P)	X_2^2	(P)
PTR	0.001	0.979	0.091	0.762	0.040	0.841
RTR	1.536	1.215	0.016	0.899	0.640	0.424
P2R	0.425	0.514	0.016	0.899	3.785	0.052
C2R	(0.029)	(0.864)	(0.009)	(0.925)	(0.062)	(0.803)
P3R	1.165	0.075	1.358	0.244	0.318	0.573
P3TR	0.200	0.655	0.000	0.992	0.446	0.504
C3R	(0.088)	(0.766)	(0.337)	(0.562)	(1.102)	(0.294)
P4R	9.778	0.008	0.833	0.659	0.638	0.727
C4R	(0.027)	(0.869)	0.101	0.751	(0.427)	(0.513)
U4R	(0.029)	(0.864)	-	-	(0.142)	(0.707)
PHR	0.567	0.451	(0.019)	(0.889)	0.393	0.531
CHR	2.345	0.310	2.918	0.088	14.789	0.001
RHR	(0.453)	(0.501)	(1.663)	(0.197)	0.465	0.493
UHTR	-	-	-	-	(0.062)	(0.803)
CHTR	(0.029)	(0.864)	(0.009)	(0.925)	-	-
PTL	2.908	0.234	2.538	0.281	1.078	0.583
RTL	4.142	0.126	0.990	0.610	1.519	0.468
P2L	0.008	0.931	0.844	0.358	5.414	0.020
C2L	(0.029)	(0.864)	(0.009)	(0.925)	(0.062)	(0.803)
P3L	0.115	0.735	0.012	0.911	1.508	0.475
P3TL	0.393	0.531	0.929	0.335	0.001	0.975
C3L	-	-	-	-	-	-
P4L	4.689	0.096	1.642	0.440	1.075	0.584
C4L	(0.016)	(0.899)	(0.034)	(0.856)	(0.043)	(0.835)
U4L	(0.278)	(0.598)	(0.009)	(0.925)	(0.133)	(0.715)
PHL	1.772	0.412	1.645	0.439	1.496	0.473
CHL	1.574	0.455	1.135	0.287	15.026	0.001
RHL	(0.000)	(0.996)	(1.008)	(0.315)	(0.004)	(0.950)
UHTL	(0.029)	(0.864)	-	-	(0.062)	(0.803)
RHTL	(0.029)	(0.864)	(0.009)	(0.925)	-	-

N.B. Figures in brackets refer to patterns present in very low frequencies.

TABLE 2.31

PALMAR PATTERNS - MALES

	X^2 (P)			Mann-Whitney Probabilities		
	BP	PBP	DW	BP	PBP	DW
PTR	0.979	0.762	0.841	0.809	0.994	0.692
RTR	0.215	0.899	0.426	0.151	0.699	0.328
P2R	0.514	0.899	0.052	0.410	0.895	0.036
C2R	(0.864)	(0.925)	(0.803)	(0.236)	(0.362)	(0.435)
P3R	0.075	0.244	0.573	0.062	0.197	0.521
P3TR	0.655	0.992	0.504	0.548	0.827	0.424
C3R	(0.766)	(0.562)	(0.294)	0.772	(0.895)	(0.117)
P4R	0.008	0.659	0.727	0.083	0.891	0.678
C4R	(0.869)	(0.751)	(0.513)	(0.731)	0.411	(0.282)
U4R	(0.864)	-	(0.707)	(0.236)	-	(0.269)
PHR	0.451	0.889	0.531	0.373	0.736	0.459
CHR	0.310	0.088	0.001	0.174	0.063	0.000
RHR	0.501	0.197	0.495	0.348	0.095	0.371
UHTR	-	-	(0.803)	-	-	0.435
CHTR	(0.864)	-	-	(0.236)	-	-
PTL	0.234	0.281	0.583	0.230	0.447	0.733
RTL	0.126	0.609	0.468	0.150	0.868	0.400
P2L	0.931	0.358	0.020	0.885	0.229	0.011
C2L	(0.864)	(0.925)	(0.803)	(0.399)	(0.272)	(0.200)
P3L	0.735	0.911	0.470	0.659	0.977	0.380
P3TL	0.531	0.335	0.975	0.488	0.252	0.938
C3L	-	-	-	-	-	-
P4L	0.096	0.440	0.584	0.956	0.201	0.413
C4L	(0.899)	(0.855)	(0.835)	(0.814)	(0.550)	(0.916)
U4L	(0.598)	(0.925)	(0.715)	0.326	(0.272)	(0.408)
PHL	0.412	0.439	0.473	0.727	0.668	0.399
CHL	0.455	0.287	0.001	0.311	0.222	0.000
RHL	0.996	0.315	0.950	0.673	0.113	0.777
UHTL	(0.864)	-	(0.803)	(0.236)	-	(0.435)
CHTL	(0.864)	(0.925)	-	(0.236)	(0.362)	-

TABLE 2.32

PALMAR PATTERN FREQUENCIES - FEMALES

	BP		PBP		DW	
	X^2	(P)	X^2	(P)	X^2	(P)
PTR	1.109	0.292	0.684	3.105	3.105	0.212
RTR	0.248	0.619	0.145	0.703	4.860	0.028
P2R	(0.104)	(0.747)	(0.145)	(0.703)	(2.173)	(0.140)
C2R	-	-	-	-	-	-
P3R	0.000	0.991	1.572	0.210	0.010	0.921
P3TR	0.491	0.484	0.183	0.669	0.931	0.335
C3R	(0.017)	(0.896)	-	-	(0.046)	(0.831)
P4R	0.171	0.679	0.519	0.471	1.819	0.403
C4R	(0.017)	(0.896)	-	-	0.046	0.831
U4R	-	-	-	-	-	-
PHR	1.288	0.525	0.010	0.920	0.549	0.760
CHR	5.267	0.072	2.398	0.301	2.239	0.327
RHR	(0.130)	(0.718)	(0.169)	(0.681)	0.224	0.636
UHTR	(0.017)	(0.896)	-	-	(0.178)	(0.673)
CHTR	-	-	-	-	-	-
PTL	0.002	0.968	0.019	0.892	0.001	0.967
RTL	0.401	0.527	1.302	0.254	0.109	0.742
P2L	(0.031)	(0.861)	(1.434)	(0.231)	(0.042)	(0.838)
C2L	-	-	-	-	-	-
P3L	0.113	0.737	0.577	0.447	0.027	0.869
P3TL	0.017	0.895	0.012	0.912	0.004	0.949
C3L	-	-	-	-	(0.046)	0.831
P4L	0.042	0.979	0.649	0.723	0.101	0.951
C4L	(0.300)	(0.584)	(0.541)	(0.462)	(1.821)	(0.177)
U4L	(0.280)	(0.597)	(0.000)	(0.986)	(0.660)	(0.417)
PHL	0.340	0.844	0.098	0.952	0.052	0.974
CHL	2.758	0.252	1.193	0.551	1.011	0.603
RHL	(0.122)	(0.727)	(0.220)	(0.639)	(0.126)	(0.723)
UHTL	-	-	-	-	-	-
CHTL	-	-	-	-	-	-

TABLE 2.33

PALMAR PATTERNS - FEMALES

Females	X^2 (P)			M-W (P)		
	BP	PBP	DW	BP	PBP	DW
PTR	0.292	0.408	0.212	0.212	0.262	0.151
RTR	0.619	0.703	0.028	0.486	0.482	0.018
P2R	0.747	0.703	0.140	0.551	0.482	0.091
C2R	-	-	-	-	-	-
P3R	0.991	0.210	0.921	0.916	0.166	0.861
P3TR	0.484	0.669	0.335	0.386	0.497	0.272
C3R	(0.896)	-	(0.881)	(0.254)	-	-
P4R	0.679	0.471	0.403	0.612	0.393	0.407
C4R	(0.896)	-	(0.831)	(0.380)	-	(0.218)
U4R	-	-	-	-	-	-
PHR	0.525	0.920	0.760	0.559	0.920	0.474
CHR	0.072	0.301	0.327	0.760	0.708	0.139
RHR	0.718	0.681	0.636	0.551	0.441	0.501
UHTR	(0.896)	-	(0.673)	(0.254)	-	(0.762)
CHTR	-	-	-	-	-	-
PTL	0.968	0.892	0.967	0.918	0.930	0.934
RTL	0.527	0.254	0.742	0.424	0.160	0.636
P2L	0.861	0.231	0.838	0.895	0.108	0.935
C2L	-	-	-	-	-	-
P3L	0.737	0.447	0.869	0.660	0.365	0.802
P3TL	0.896	0.912	0.949	0.988	0.938	0.855
C3L	-	-	(0.831)	-	-	-
P4L	0.979	0.723	0.951	0.918	0.947	0.880
C4L	(0.584)	(0.462)	(0.177)	(0.385)	(0.149	(0.102)
U4L	(0.597)	(0.986)	(0.417)	0.853	(0.309)	(0.161)
RHL	0.844	0.952	0.974	0.614	(0.761)	(0.919)
CHL	0.252	0.551	0.603	0.117	0.540	0.881
RHL	0.727	0.639	0.723	0.464	0.971	0.497
UHTL	-	-	-	-	-	-
CHTL	-	-	-	-	-	-

TABLE 2.34

PALMAR PATTERN FREQUENCIES - MALES

	BP						PBP						DW					
	0		1		2		0		1		2		0		1		2	
	N	S	N	S	N	S	W	E	W	E	W	E	E	W	E	W	E	W
PTR	.955	.951	.045	.049	-	-	.956	.955	.044	.045	-	-	.955	.961	.045	.039	-	-
RTR	.960	.930	.040	.070	-	-	.941	.929	.059	.071	-	-	.941	.957	.059	.043	-	-
P2R	.936	.915	.064	.085	-	-	.933	.938	.067	.063	-	-	.907	.948	.093	.052	-	-
C2R	.995	1.0	.005	-	-	-	.933	1.0	.007	-	-	-	1.0	.988	-	.002	-	-
P3R	.530	.444	.470	.556	-	-	.511	.429	.489	.571	-	-	.442	.467	.558	.533	-	-
P3TR	.911	.894	.089	.106	-	-	.919	.911	.081	.089	-	-	.918	.900	.082	.100	-	-
C3R	.995	.993	.005	.007	-	-	.993	.991	.007	.009	-	-	1.0	.991	-	.009	-	-
P4R	.535	.602	.436	.398	.030	-	.548	.554	.444	.446	.007	-	.599	.585	.394	.401	.007	.014
C4R	.990	.993	.010	.009	-	-	.978	.991	.022	.009	-	-	.996	.989	.004	.011	-	-
U4R	.995	1.0	.005	-	-	-	1.0	1.0	-	-	-	-	1.0	.995	-	.005	-	-
PHR	.856	.884	.144	.116	-	-	.889	.875	.111	.125	-	-	.881	.862	.119	.138	-	-
CHR	.792	.739	.208	.257	-	.004	.822	.723	.178	.277	-	-	.685	.810	.312	.188	-	.002
RHR	.960	.975	.040	.025	-	-	.956	.991	.044	.009	-	-	.974	.961	.026	.039	-	-
UHTR	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	.998	-	.002	-	-
CHTR	.995	1.0	.005	-	-	-	.993	1.0	.007	-	-	-	1.0	1.0	-	-	-	-
PTL	.901	.866	.099	.123	-	.011	.904	.875	.096	.107	-	.018	.881	.889	.112	.109	.007	.002
RTL	.936	.898	.059	.102	.005	-	.926	.920	.067	.080	.007	-	.900	.918	.100	.079	-	.002
P2L	.960	.958	.040	.042	-	-	.963	.929	.037	.071	-	-	.941	.977	.059	.023	-	-
C2L	1.0	.996	-	.004	-	-	1.0	.991	-	.009	-	-	.996	1.0	.004	-	-	-
P3L	.718	.736	.282	.264	-	-	.704	.705	.296	.295	-	-	.699	.730	.301	.268	-	.002
P3TL	.876	.852	.124	.148	-	-	.881	.830	.119	.170	-	-	.855	.857	.145	.143	-	-
C3L	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-
P4L	.391	.353	.535	.602	.074	.035	.385	.464	.556	.491	.059	.045	.405	.381	.561	.571	.033	.048
C4L	.985	.982	.015	.018	-	-	.970	.982	.030	.018	-	-	.985	.984	.015	.016	-	-
U4L	.995	.986	.005	.014	-	-	1.0	.991	-	.009	-	-	.996	.991	.004	.009	-	-
PHL	.861	.873	.139	.120	-	.007	.874	.893	.126	.098	-	.009	.851	.873	.141	.125	.007	.002
CHL	.792	.765	.208	.243	-	.004	.822	.759	.178	.241	-	-	.684	.803	.309	.197	.007	-
RHL	.985	.989	.015	.011	-	-	.978	1.0	.022	-	-	-	.989	.986	.011	.014	-	-
UHTL	.995	1.0	.005	-	-	-	1.0	-	-	-	-	-	1.0	.998	-	.002	-	-
CHTL	.995	1.0	.005	-	-	-	.993	1.0	.007	-	-	-	1.0	1.0	-	-	-	-

TABLE 2.35

PALMAR PATTERN FREQUENCIES - FEMALES

	BP						PBP						DW					
	0		1		2		0		1		2		0		1		2	
	N	S	N	S	N	S	W	E	W	E	W	E	E	W	E	W	E	W
PTR	.956	.928	.044	.072	-	-	.930	.964	.070	.036	-	-	.927	.952	.070	.048	.003	-
RTR	.951	.936	.049	.064	-	-	.965	.945	.035	.055	-	-	.923	.963	.077	.037	-	-
P2R	.975	.966	.025	.034	-	-	.965	.945	.035	.055	-	-	.955	.977	.045	.023	-	-
C2R	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-
P3R	.471	.475	.529	.525	-	-	.474	.382	.526	.618	-	-	.490	.483	.510	.517	-	-
P3TR	.902	.925	.098	.075	-	-	.912	.936	.088	.064	-	-	.899	.922	.101	.078	-	-
C3R	.995	1.0	.005	-	-	-	1.0	1.0	-	-	-	-	1.0	.998	-	.002	-	-
P4R	.554	.577	.446	.423	-	-	.553	.609	.447	.391	-	-	.601	.572	.399	.423	-	.005
C4R	1.0	.996	-	.004	-	-	1.0	1.0	-	-	-	-	.997	1.0	.003	-	-	-
U4R	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-
PHR	.873	.891	.127	.106	-	.004	.877	.873	.123	.127	-	-	.878	.895	.119	.103	.003	.002
CHR	.706	.713	.275	.287	.020	-	.702	.673	.281	.327	.018	-	.713	.762	.276	.231	.010	.007
RHR	.966	.955	.034	.045	-	-	.974	.955	.026	.045	-	-	.969	.959	.031	.041	-	-
UHTR	.995	1.0	.005	-	-	-	1.0	1.0	-	-	-	-	.997	.998	.003	.002	-	-
CHTR	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-
PTL	.882	.879	.118	.121	-	-	.904	.900	.096	.100	-	-	.895	.897	.105	.103	-	-
RTL	.926	.906	.074	.094	-	-	.956	.909	.044	.091	-	-	.920	.929	.080	.071	-	-
P2L	.975	.977	.025	.023	-	-	.956	.991	.044	.009	-	-	.983	.982	.017	.018	-	-
C2L	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-
P3L	.735	.717	.265	.283	-	-	.737	.682	.263	.318	-	-	.724	.732	.276	.268	-	-
P3TL	.887	.887	.113	.113	-	-	.851	.855	.149	.145	-	-	.881	.886	.119	.114	-	-
C3L	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	.997	1.0	.003	-	-	-
P4L	.382	.389	.593	.585	.025	.026	.430	.436	.544	.518	.026	.045	.381	.384	.587	.588	.031	.027
C4L	.985	.974	.015	.026	-	-	1.0	.982	-	.018	-	-	.972	.989	.028	.011	-	-
U4L	.995	.996	.005	.004	-	-	1.0	.991	-	.009	-	-	1.0	.993	-	.007	-	-
PHL	.887	.872	.108	.125	.005	.004	.895	.882	.096	.109	.009	.009	.881	.879	.115	.117	.003	.005
CHL	.667	.732	.324	.264	.010	.004	.702	.736	.289	.264	.009	-	.727	.721	.266	.277	.007	.002
RHL	.980	.989	.020	.011	-	-	.982	.982	.018	.018	-	-	.983	.989	.017	.011	-	-
UHTL	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-
CHTL	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-	1.0	1.0	-	-	-	-

TABLE 2.36

PALMAR PATTERN FREQUENCIES - DUAL PARAMETERS - MALES

	A			B			C			D		
	0	1	2	0	1	2	0	1	2	0	1	2
PTR	.944	.056	-	.939	.061	-	.956	.044	-	.958	.042	-
RTR	.903	.097	-	.970	.030	-	.950	.050	-	.958	.042	-
P2R	.895	.105	-	.879	.121	-	.931	.069	-	.952	.048	-
P3R	.444	.556	-	.485	.515	-	.444	.556	-	.536	.468	-
P3TR	.927	.073	-	.848	.152	-	.869	.131	-	.923	.077	-
P4R	.597	.403	-	.545	.455	-	.606	.394	-	.530	.435	.036
PHR	.887	.113	-	.848	.152	-	.881	.119	-	.857	.143	-
CHR	.702	.298	-	.667	.333	-	.769	.225	.006	.815	.185	-
RHR	.976	.024	-	.970	.030	-	.975	.025	-	.958	.042	-
PTL	.839	.145	.016	.909	.091	-	.888	.106	.006	.899	.101	-
RTL	.847	.153	-	.970	.030	-	.938	.063	-	.929	.065	.006
P2L	.935	.065	-	.909	.091	-	.975	.025	-	.976	.024	-
P3L	.710	.290	-	.697	.303	-	.756	.244	-	.720	.280	-
P3TL	.847	.153	-	.909	.091	-	.856	.144	-	.875	.125	-
P4L	.387	.581	.032	.333	.576	.091	.344	.619	.038	.399	.530	.071
PHR	.855	.137	.008	.818	.182	-	.888	.106	.006	.869	.131	-
CHR	.718	.274	.008	.636	.364	-	.781	.219	-	.821	.179	-
RHR	.984	.016	-	1.0	-	-	.994	.006	-	-	.018	-

N.B. All patterns with very low frequencies have been excluded.

TABLE 2.37

PALMAR PATTERN FREQUENCIES - DUAL PARAMETERS - FEMALES

	A			B			C			D		
	0	1	2	0	1	2	0	1	2	0	1	2
PTR	.903	.097	-	.950	.050	-	.950	.050	-	.957	.043	-
RTR	.911	.089	-	.925	.075	-	.957	.043	-	.957	.043	-
P2R	.944	.056	-	.975	.025	-	.986	.014	-	.976	.024	-
P3R	.476	.524	-	.525	.475	-	.475	.525	-	.457	.543	-
P3TR	.895	.105	-	.925	.075	-	.950	.050	-	.896	.104	-
P4R	.589	.411	-	.525	.475	-	.567	.433	-	.561	.439	-
PHR	.887	.113	-	.825	.175	-	.894	.099	.007	.884	.116	-
CHR	.661	.339	-	.675	.275	.050	.759	.241	-	.713	.274	.012
RHR	.968	.032	-	.975	.025	-	.943	.057	-	.963	.037	-
PTL	.887	.113	-	.800	.200	-	.872	.128	-	.902	.098	-
RTL	.911	.089	-	.875	.125	-	.901	.099	-	.939	.061	-
P2L	.968	.032	-	.975	.025	-	.986	.014	-	.976	.024	-
P3L	.726	.274	-	.725	.275	-	.709	.291	-	.738	.262	-
P3TL	.855	.145	-	.950	.275	-	.915	.085	-	.872	.128	-
P4L	.395	.581	.024	.325	.650	.025	.383	.589	.028	.396	.579	.024
PHL	.871	.129	-	.900	.075	.025	.872	.121	.007	.884	.116	-
CHL	.750	.242	.008	.700	.275	.025	.716	.284	-	.659	.335	.006
RHL	.976	.024	-	1.0	-	-	1.0	-	-	.976	.024	-

N.B. Patterns with low frequencies not included.

TABLE 2.38

PALMAR PATTERNS X^2 - MALES

	E		F		G		H		I		J	
	X^2	(P)	X^2	(P)	X^2	(P)	X^2	(P)	X^2	(P)	X^2	(P)
PTR	.109	.741	.032	.857	.046	.831	.000	.984	.095	.759	.001	.972
RTR	.767	.381	.009	.923	1.675	.196	.033	.856	2.713	.099	.001	.972
P2R	(.002)	(.963)	(.339)	(.560)	(.756)	(.385)	(1.512)	(.219)	(2.69)	(.101)	(.446)	(.504)
C2R	-	-	.001	.981	-	-	(.826)	(.363)	(.023)	(.879)	-	-
P3R	.051	.821	2.418	.120	.014	.907	.119	.731	2.070	.150	.058	.810
P3TR	1.146	.285	2.013	.156	1.962	.161	1.061	.303	.005	.944	.001	.976
C3R	-	-	(.002)	(.966)	(.285)	(.593)	(.826)	(.363)	(.023)	(.879)	(.089)	(.765)
P4R	.111	.739	6.888	.032	.002	.968	1.217	.544	5.168	.076	.205	.650
C4R	.509	.476	(.002)	(.966)	(.285)	(.593)	(.108)	(.742)	(.070)	.791	(.768)	(.381)
U4R	-	-	(.001)	(.981)	-	-	(.826)	(.363)	(.023)	(.879)	-	-
PHR	.092	.761	.233	.629	.001	.973	.020	.887	.332	.565	.053	.818
CHR	.031	.861	1.933	.380	2.665	.264	2.850	.091	4.560	.033	1.904	.386
RHR	.179	.672	.282	.595	.117	.732	.033	.856	.236	.627	.182	.669
UHTR	-	-	-	-	-	-	-	-	-	-	-	-
CHTR	-	-	-	-	-	-	-	-	-	-	-	-
PTL	1.257	.533	1.082	.582	1.696	.428	.019	.891	4.156	.125	.283	.868
RTL	2.523	.112	.971	.616	5.321	.021	.819	.664	6.619	.037	.099	.754
P2L	.021	.885	.083	.773	1.808	.179	(1.968)	(.161)	(2.056)	(.152)	(1.776)	(0.183)
C2L	.509	.476	-	-	.016	.898	-	-	(.023)	(.879)	-	-
P3L	.005	.942	.379	.538	.558	.455	.004	.952	.004	.947	.243	.622
P3TL	.402	.526	.113	.737	.003	.957	.067	.796	.272	.602	.280	.596
C3L	-	-	-	-	-	-	-	-	-	-	-	-
P4L	2.212	.331	3.519	.172	.585	.746	.554	.758	2.356	.308	1.765	.414
C4L	(.019)	(.889)	(.124)	(.725)	.083	.773	(.000)	(.881)	(.118)	(.731)	(.000)	(.984)
U4L	(.509)	(.476)	(.305)	(.581)	.063	.802	(.826)	(.354)	(.251)	(.616)	(.000)	(.984)
PHL	.663	.718	1.502	.471	.673	.714	.247	.620	1.392	.499	1.667	.435
CHL	1.224	.542	.599	.439	2.548	.280	4.650	.031	5.318	.070	2.381	.123
RHL	.019	.889	(.206)	(.650)	.050	.824	(.000)	(.991)	(.118)	(.731)	(.768)	(.381)
UHTL	-	-	(.001)	(.981)	-	-	(.826)	(.363)	(.023)	(.879)	-	-
CHTL	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 2.39

PALMAR PATTERNS X^2 - FEMALES

	E		F		G		H		I		J	
	X^2	(P)	X^2	(P)	X^2	(P)	X^2	(P)	X^2	(P)	X^2	(P)
PTR	.854	.522	.000	.989	1.551	.213	.052	.820	2.532	.112	.162	.687
RTR	.003	.956	.078	.781	1.636	.201	.194	.660	1.823	.176	.177	.674
P2R	.145	.703	.051	.821	2.200	.120	.300	.584	1.199	.273	.052	.819
C2R	-	-	-	-	-	-	-	-	-	-	-	-
P3R	.129	.719	.039	.844	.013	.910	.351	.554	.037	.848	.142	.706
P3TR	.061	.805	2.351	.125	2.144	.143	.063	.803	.026	.871	.052	.820
C3R	-	-	(.006)	(.940)	-	-	(.589)	(.443)	.020	.888	-	-
P4R	.275	.600	.000	.997	.051	.821	.054	.816	.123	.726	.088	.769
C4R	(.358)	(.550)	-	-	(.004)	(.949)	-	-	(.020)	(.888)	-	-
U4R	-	-	-	-	-	-	-	-	-	-	-	-
PHR	.562	.453	1.363	.506	.998	.607	.550	.459	.012	.913	1.990	.370
CHR	6.588	.037	2.256	.323	2.613	.106	.411	.300	2.757	.252	7.490	.024
RHR	.088	.767	.318	.573	.436	.509	.015	.902	.016	.899	.162	.687
UHTR	-	-	.006	.940	-	-	(.589)	(.443)	(.020)	(.888)	-	-
CHTR	-	-	-	-	-	-	-	-	-	-	-	-
PTL	1.287	.255	.423	.516	.032	.858	2.339	.126	.052	.820	.803	.370
RTL	.134	.714	1.052	.305	.007	.934	1.109	.292	.446	.505	.031	.860
P2L	.088	.767	.051	.821	.328	.567	.300	.584	.002	.968	.052	.819
C2L	-	-	-	-	-	-	-	-	-	-	-	-
P3L	.038	.846	.184	.668	.027	.871	.001	.972	.009	.926	.000	.997
P3TL	1.746	.186	1.038	.308	1.810	.179	1.256	.263	.061	.805	.159	.690
C3L	-	-	-	-	-	-	-	-	-	-	-	-
P4L	.638	.727	.092	.955	.076	.962	.700	.705	.001	.999	.491	.783
C4L	(.001)	(.972)	(.124)	(.725)	(.884)	(.347)	(.017)	(.897)	(1.319)	(.251)	(.052)	(.819)
U4L	-	-	(.365)	(.546)	(004)	(.949)	(.589)	(.443)	(.020)	(.888)	(.455)	(.500)
PHL	3.891	.143	1.189	.552	.918	.632	4.607	.099	.023	.875	1.517	.468
CHL	.946	.623	1.879	.391	1.675	.433	1.617	.446	2.974	.226	8.545	.170
RHL	.099	.753	1.855	.173	1.627	.202	.131	.718	.141	.707	-	-
UHTL	-	-	-	-	-	-	-	-	-	-	-	-
CHTL	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 2.40.

FINGER TRIRADII FREQUENCIES

	0	1	2		0	1	2
Males				Females			
R1	.013	.587	.400	R1	.035	.650	.315
R2	.075	.581	.344	R2	.108	.583	.310
R3	.066	.743	.191	R3	.077	.809	.114
R4	.024	.506	.469	R4	.029	.582	.388
R5	.014	.797	.188	R5	.031	.856	.113
L1	.039	.659	.302	L1	.058	.670	.271
L2	.071	.616	.313	L2	.105	.594	.301
L3	.059	.769	.171	L3	.107	.750	.143
L4	.030	.646	.324	L4	.054	.618	.328
L5	.013	.881	.106	L5	.045	.847	.108

N = 712 N = 723

PALMAR TRIRADII FREQUENCIES

	0	1	2	3		0	1	2	3
Males					Females				
TR	.417	.583	-	-	TR	.450	.550	-	-
T1R	.597	.383	.002	-	T1R	.567	.418	.015	-
T2R	.903	.096	.001	-	T2R	.920	.080	-	-
TBR	.716	.282	.001	-	TBR	.676	.320	.004	-
TRR	.997	.001	-	-	TRR	.999	.001	-	-
TUR	.996	.004	-	-	TUR	.997	.003	-	-
TEFR	.938	.037	.025	-	TEFR	.931	.035	.033	.001
TL	.421	.577	.001	-	TL	.476	.521	.003	-
T1L	.541	.430	.029	-	T1L	.508	.473	.019	-
T2L	.937	.063	-	-	T2L	.914	.086	-	-
TBL	.742	.255	.003	-	TBL	.694	.304	.001	-
TRL	.999	.001	-	-	TRL	1.000	-	-	-
TUL	.999	.001	-	-	TUL	1.000	-	-	-
TEFL	.871	.059	.065	.006	TEFL	.889	.055	.055	-

N = 712 N = 723

DIGITAL TRIRADII FREQUENCIES

	3	4	5	6	7	8		3	4	5	6	7	8
Males							Females						
TDR	.037	.802	.136	.017	.003	.001	TDR	.052	.837	.098	.010	.001	.000
TDL	.044	.781	.152	.020	.000	.001	TDL	.078	.786	.122	.013	.001	.000

N = 712 N = 723

TABLE 2.41

U-Test(P) + Chi^2 Test - Associated Probabilities
Palmar Triraddii

Single Partition

Variables	BP		PBP		DW		BP		PBP		DW	
	X^2(P)	U-test/P	X^2/(P)	U-test/P	X^2(P)	U-test/P	X^2(P)	U-test/P	X^2(P)	U-test/P	X^2(P)	U-test/P
Males							Females					
TEFR	.659	.363	.821	.694	.100	.182	.552	.500	.918	.835	.068	.101
TR	.357	.311	.377	.311	.325	.288	.997	.928	.983	.911	.547	.498
T1R	.403	.349	.407	.561	.500	.683	.690	.501	.995	.917	.206	.533
T2R	.865	.746	.814	.646	.274	.422	.888	.754	.380	.265	.474	.392
TBR	.480	.343	.470	.386	.004	.002	.518	.999	.279	.266	.275	.160
TDR	.176	.575	.489	.254	.284	.827	.635	.521	.521	.437	.368	.621
TEFL	.383	.412	.538	.482	.816	.582	.574	.687	.937	.764	.996	.932
TL	.802	.782	.593	.508	.099	.069	.560	.304	.415	.344	.076	.104
T1L	.377	.212	.668	.428	.321	.278	.716	.426	.809	.642	.324	.368
T2L	.414	.317	.933	.848	.886	.988	.467	.373	.429	.313	.411	.339
TBL	.523	.397	.442	.357	.001	.001	.219	.155	.590	.667	.522	.463
TDL	.887	.767	.763	.584	.479	.586	.476	.918	.584	.411	.745	1.000

DUAL PARAMETERS PALMAR TRIRADII TABLE 2.42

	E		F		G		H		I		J	
	X^2	M-W	X^2	M-W	X^2	M-W	X^2	M-W	X^2	M-W	X^2	M-W
Males												
TEFR	.529	.337	.313	.736	.009	.038	.966	.975	.141	.817	.741	.817
TR	.531	.411	.166	.135	.538	.461	.290	.213	.593	.698	.847	.698
T1R	.190	.548	.273	.117	.567	.288	.223	.398	.865	.992	.183	.992
T2R	.929	.681	.967	.821	.906	.931	.974	.732	.942	.631	.872	.631
TBR	.813	.657	.471	.427	.499	.405	.198	.133	.142	.321	.503	.321
TDR	.431	.184	.154	.217	.593	.478	.083	.077	.236	.327	.566	.327
TEFL	.494	.199	.927	.884	.366	.106	.937	.627	.227	.687	.888	.687
TL	.535	.415	.397	.339	.517	.444	.469	.361	.999	.723	.870	.723
T1L	.804	.601	.143	.120	.153	.561	.542	.273	.496	.884	.667	.884
T2L	.471	.278	.562	.418	.790	.599	.539	.335	.997	.124	.252	.124
TBL	.731	.616	.820	.717	.120	.064	.074	.044	.058	.078	.123	.078
TDL	.785	.718	.868	.650	.580	.448	.570	.551	.815	.395	.299	.395
Females												
TEFR	.856	.579	.903	.886	.243	.140	.654	.724	.148	.157	.793	.659
TR	.111	.076	.491	.422	.977	.925	.036	.023	.576	.498	.119	.083
T1R	.801	.669	.547	.477	.480	.745	.434	.255	.510	.297	.527	.517
T2R	.805	.581	.317	.220	.143	.090	.915	.832	.721	.575	.820	.537
TBR	.200	.978	.786	.695	.366	.302	.126	.669	.571	.491	.158	.503
TDR	.287	.275	.378	.093	.206	.080	.519	.323	.434	.896	.768	.940
TEFL	.238	.184	.457	.243	.744	.589	.185	.069	.539	.561	.540	.344
TL	.601	.470	.634	.554	.099	.048	.011	.014	.023	.009	.034	.040
T1L	.881	.739	.974	.885	.029	.023	.396	.245	.039	.026	.352	.218
T2L	.261	.145	.126	.085	.446	.323	.129	.071	.629	.502	.578	.344
TBL	.943	.790	.161	.077	.580	.492	.602	.348	.453	.314	.997	.841
TDL	.498	.604	.270	.863	.234	.865	.696	.571	.574	.964	.357	.706

TABLE 2.43

PALMAR PATTERN INTENSITY INDICES - MALES

Single Parameters

		BP		PBP		DW	
		N	S	N	S	E	W
RPPI	Mean	5.605	5.680	5.575	5.718	5.718	5.583
	S.D.	.935	.955	.844	1.059	.935	.889
	t-Test/P	.394		.231		.056	
	M-W/P	.671		.286		.030	
LPPI	Mean	4.722	5.833	5.699	5.782	5.902	5.694
	S.D.	.912	1.167	.937	1.302	1.230	.939
	t-Test/P	.246		.579		.019	
	M-W/P	.641		.998		.027	
TPPI	Mean	11.354	11.516	11.278	11.509	11.626	11.292
	S.D.	1.51	1.91	1.578	2.233	1.944	1.556
	t-Test/P	.300		.363		.018	
	M-W/P	.657		.645		.009	

Dual Parameters

		A	B	C	D
RPPI	Mean	4.742	5.879	5.631	5.560
	S.D.	1.096	.781	.829	.950

		A	B	C	D
LPPI	Mean	6.025	5.909	5.686	5.689
	S.D.	1.351	.947	.982	.904

		A	B	C	D
TPPI	Mean	11.771	11.789	11.321	11.281
	S.D.	2.230	1.269	1.600	1.537

		E	F	G	H	I	J
RPPI	T-test/P	.418	.473	.350	.072	.133	.116
	M-W/P	.119	.429	.663	.014	.260	.042
LPPI	T-test/P	.576	.973	.020	.207	.018	.233
	M-W/P	.981	.782	.044	.224	.072	.168
TPPI	T-test/P	.954	.818	.061	.077	.038	.117
	M-W/P	.269	.827	.108	.020	.069	.022

TABLE 2.44

PALMAR PATTERN INTENSITY INDICES - FEMALES

Single Parameters

		BP		PBP		DW	
		N	S	N	S	E	W
RPPI	Mean	5.662	5.635	5.649	5.682	5.671	5.528
	S.D.	.859	.951	.841	1.108	1.056	.793
	t-Test/P	.753		.804		.051	
	M-W/P	.731		.643		.044	
LPPI	Mean	5.772	4.717	5.681	5.722	5.710	5.673
	S.D.	.918	1.021	.869	.984	.983	.931
	t-Test/P	.543		.744		.608	
	M-W/P	.501		.825		.765	
TPPI	Mean	11.436	11.355	11.336	11.417	11.371	11.205
	S.D.	1.519	1.722	1.437	1.804	1.747	1.493
	t-Test/P	.601		.715		.190	
	M-W/P	.543		.787		.286	

Dual Parameters

		A	B	C	D		A	B	C	D		A	B	C	D
RPPI	Mean	5.764	5.750	5.521	5.640	LPPI	5.730	5.875	5.705	5.747	TPPI	11.488	11.625	11.239	11.389
	S.D.	1.079	.954	.809	.835		1.037	1.017	1.010	.894		1.835	1.675	1.615	1.480

		E	F	G	H	I	J
RPPI	t-Test/P	.941	.211	.042	.470	.274	.122
	M-W/P	.918	.208	.021	.489	.227	.150
LPPI	t-Test/P	.440	.703	.847	.431	.880	.351
	M-W/P	.477	.695	.983	.610	.691	.464
TPPI	t-Test/P	.676	.403	.247	.380	.628	.189
	M-W/P	.635	.399	.291	.444	.729	.226

TABLE 2.45

DISCRIMINANT FUNCTION ANALYSIS - CHILD'S BIRTH PLACE - MALES

REDUCED MATRIX

Groups North Pembs., n = 192, South Pembs., n = 274
Total = 466

Standardised Discriminant Function Coefficients

Function 1

RFR3	0.49449
LFU1	0.42627
LFR3	-0.82762
LFU4	0.82519
LFU5	-0.57497
LPP1	-0.28584

Eigenvalue 0.05161

Canonical Correlation 0.222

Explained variance on one function = 0.04928

Df = 6, 459

F-value = 3.94829

D^2 = 0.21306
Sigp 0.05

% correctly classified cases = 58.58%

Distance between group centroids = 0.450 S.D.U.

(S.D.U. = Standard Deviation Units)

FULL MATRIX

Groups North Pembs., n = 192, South Pembs., n = 274
Total = 466

Standardised Discriminant Function Coefficient

Function 1

RFR3	0.35028
RFU5	0.24925
LFU1	0.30055
LFR3	-0.59441
LFU4	0.57920
LFU5	-0.49093
P4R	0.35773
CHR	-0.21130
PTL	-0.28744
P3L	0.17009
PHL	0.65112
T1R	0.25527
TL	-0.07204
T1L	-1.46760
T2L	-0.36314

Eigenvalue = 0.09310
Canonical correlation 0.292
Explained variance on one function = 0.08526
Df = 15, 450
F-Value = 2.79314
D^2 = 0.38352
Sigp = .005

% correctly classified cases = 60.52%

Distance between group centroids = 0.592 S.D.U.

TABLE 2.46

DISCRIMINANT FUNCTION ANALYSIS - PARENTS' BIRTH PLACE - MALES

REDUCED MATRIX

Groups N.Pembs., n=131, S.Pembs.,n=105, Total = 286

Standardised Discriminant Function Coefficients

	Function 1
RFR3	0.64929
LFR1	-0.28760
LFR2	-0.31161
LFU2	-0.36951
LFR4	0.55756
LFU4	-0.62382
RCD	0.50158
LBC	-0.40155
RPP1	0.29548

Eigenvalue = 0.09492

Canonical correlation = 0.294

Explained variance on one function = 0.08644

Df = 9, 226

D^2 = 0.38280

Sig = .025

% Correctly classified cases = 60.17%

Distance between group centroids = 0.591 S.D.U.

FULL MATRIX

Groups N.Pembs.,n=131, S.Pembs.,n=105, Total = 236

Standardised Discriminant Function Coefficients

	Function 1
LFU1	0.28465
LFR4	-0.59152
LFU4	0.56441
LFU5	-0.23931
RCD	-0.43122
LCD	0.29552
CHR	-1.17697
PHR	-0.31794
RTL	-1.22553
PTL	-2.48606
P2L	-0.55737
P3TL	-0.22998
T1R	0.21950
TBR	1.08602
TEFL	3.38047
T1L	-0.34412

Eigenvalue = 0.21549

Canonical coefficient = 0.421

Explained variance on one function = 0.17724

Df = 17, 218

F-Value = 2.76332

D^2 = 0.86914

Sig = .005

% correctly classified cases = 66.95%

Distance between group centroids = 0.845 S.D.U.

TABLE 2.47

DISCRIMINANT FUNCTION ANALYSIS - ANCESTRY - MALES

REDUCED MATRIX

Groups English n = 256, Welsh n = 419 Total = 675

Standardised Discriminant Function Coefficients

	Function 1
RFR1	0.30640
RFU1	0.26494
RFU2	0.47558
RFR3	-0.45990
RFU3	-0.59873
LFR2	0.27625
LFU3	0.65533
LFU4	0.41537
LFR5	-0.26624
P1L	-0.64765
LPP1	-0.55243

Eigenvalue = 0.04766

Canonical correlation 0.213

Explained variance on one function = 0.04537

Df = 11, 663

F-value = 2.87272

D^2 = 0.20216

Sig = 0.01

% correctly classified cases = 60.44%

Distance between group centroids = 0.439 S.D.U.

FULL MATRIX

Groups English n = 256, Welsh n = 419 Total = 675

Standardised Discriminant Function Coefficients

	Function 1
RFR1	0.29224
RFU2	0.40908
RFR3	-0.32592
RFU3	-0.47975
LFR2	0.23976
LFU3	0.47549
LFU4	0.34069
LFR5	-0.21868
RBC	0.23005
RCD	-0.29242
P1L	-0.45946
P3TR	0.14245
CHR	-0.23851
PHR	0.17221
P2L	-0.36791
T1R	-0.24893
TL	-0.31023
TBL	-0.42789

Eigenvalue = 0.8827

Canonical correlation = 0.285

Explained variance on one function = 0.08123

Df = 18, 656

F-value = 3.21685

D^2 = 0.37439

Sig = .005

% correctly classified cases = 64.30%

Distance between group centroids = 0.587 S.D.U.

TABLE 2.48

DISCRIMINANT FUNCTION ANALYSIS - CHILD'S BIRTH PLACE - FEMALES

REDUCED MATRIX

Groups N.Pembs. n = 195, S.Pembs. n = 248, Total = 443

Standardised Discriminant Function Coefficients

	Function 1
RFR1	0.98458
RFR2	-0.37791
LFR1	-0.64753
LFU3	-0.28686
LFR4	0.38812
RAB	0.36560
RCD	0.25327
LCD	-0.54704
P1R	0.20818

Eigenvalue = 0.06840

Canonical correlation = 0.253

Explained variation on one function = 0.0640

Df = 9, 433

F-value = 3.2909

D^2 = 0.27761

Significance = .05

% correctly classified cases = 60.95%

Distance between group centroids = 0.50915 S.D.U.

FULL MATRIX

Groups N.Pembs. n = 195, S.Pembs. n = 248, Total = 443

Standardised Discriminant Function Coefficients

	Function 1
RFR1	0.83308
RFR2	-0.34958
LFR1	-0.58611
LFU3	-0.25899
LFR4	0.38948
RAB	0.32703
RCD	0.39626
LCD	-0.66129
P1R	0.21684
P2R	0.31770
P2L	-0.24017
CHL	-0.29855
T1R	-0.18239
TDR	-0.43211
TDL	0.37709

Eigenvalue = 0.09639

Canonical correlation = 0.297

Explained variance on one function = 0.0882

Df = 15,427

F-value = 2.74391

D^2 = 0.39123

Sig = 0.005

% correctly classified cases = 62.75%

Distance between group centroids = 0.59663 S.D.U.

TABLE 2.49

DISCRIMINANT FUNCTION ANALYSIS - PARENTS' BIRTH PLACE - FEMALES

REDUCED MATRIX

Groups N.Pembs. n = 108, S.Pembs. n = 104, n = 104

Standardised Discriminant Function Coefficients

	Function 1
RFR1	-0.75396
RFU3	-0.53334
RFR4	-0.38331
LFR1	0.32041
LFR2	0.44054
LFR3	0.39223
LFU3	0.47143
LFR4	-0.39643
RCD	-0.27574
LCD	0.39084

Eigenvalue = 0.15108

Canonical coefficient = 0.362

Explained variance on one function = 0.13104

Df = 10, 201

F-value = 3.0367

D^2 = 0.60485

Significance = 0.025

% correctly classified cases = 64.15%

Distance between group centroids = 0.72299 S.D.U.

FULL MATRIX

Groups N.Pembs. n = 108, S.Pembs. n = 104, Total = 212

Standardised Discriminant Function Coefficients

	Function 1
RFR1	0.26345
RFR2	-0.27676
RFR3	0.23677
RFR4	0.23278
LFR2	-0.20407
LFR3	-0.36997
LFR4	0.44538
RAB	0.27378
RCD	0.19363
LCD	-0.58227
P1R	0.16610
RTR	0.44845
PTR	-0.71041
P2R	0.23495
RTL	0.22497
P2L	-0.43001
CHL	-0.16256
TDL	0.49153

Eigenvalue = 0.27736
Canonical correlation = 0.446
Explained variance on one function = 0.19892
Df = 18, 193
F-value = 2.97392
D^2 = 1.11087
Sig. = .005

% correctly classified cases = 67.45%

Distance between group centroids = 0.92993 S.D.U.

DISCRIMINANT FUNCTION ANALYSIS - ANCESTRY - FEMALES

REDUCED MATRIX

Groups English, n = 269 Welsh n = 409, Total = 678

Standardised Discriminant Function Coefficients

	Function 1
RFU1	0.66819
RFR2	0.26874
RFU2	0.42788
RFR3	-0.70644
RFU3	-0.26307
RFU4	-0.37940
LFU1	-0.34681
LFU2	-0.32137
LFR4	0.30690
LFU4	0.42745
RAB	0.46056
RBC	-0.19748
P1R	-0.24832
RPP1	0.31290

Eigenvalue = 0.05475

Canonical correlation = 0.228

Explained variance on one function = 0.0520

Df = 14, 663

F-value = 2.5930

D^2 = 0.22844

Sig. = .005

% correctly classified cases = 59.14%

Distance between group centroids = 0.46537

FULL MATRIX

Groups English n = 269, Welsh n = 409, Total = 678

Standardised Discriminant Function Coefficients

	Function 1
RFU1	0.54181
RFR2	0.21811
RFU2	0.34193
RFR3	-0.41039
RFU4	-0.28765
LFU1	-0.32873
LFU2	-0.23471
LFU4	0.25850
RAB	0.39596
RCD	-0.30155
P1R	-0.20426
RTR	-0.29420
P2R	-0.19981
P3R	0.34714
P4R	0.17890
PHR	-0.24179
CHL	0.73521
PHL	0.37648
TR	0.35099
TBR	-0.20544
TL	-0.63405
T1L	-0.31757
TBL	-0.66205

Eigenvalue = 0.08678
Canonical correlation = 0.283
Explained variance on one function = 0.0801
Df = 23, 654
F-value = 2.4676
D^2 = 0.36207 Sig. = .005

% correctly classified cases = 61.50%
Distance between group centroids = 0.57719 SDU

TABLE 2.51

DISCRIMINANT FUNCTION ANALYSIS - MALES

CHILD'S BIRTH PLACE (3 LOCATIONS)

Groups North n = 192, S.W. n = 151 S.E. n = 123, Total = 466 Full Matrix

Standardised Discriminant Function Coefficients

	Function 1	Function 2
RFR1	0.32105	-0.32160
RFU1	-0.28533	0.18794
RFR3	-0.42778	-0.10886
RFU4	-0.52585	0.42337
LFU1	-0.09646	-0.36598
LFR3	0.69600	0.26753
LFU4	-0.00885	-0.89445
LFU5	0.19562	0.45809
LCD	-0.22512	0.20286
P3R	0.35845	0.19254
P3TR	-0.01820	0.30551
CHR	0.26920	0.07198
RTL	0.33674	-0.05772
TR	-0.14821	0.48538
T1L	0.34915	0.17922
Eigenvalue	0.09854	0.05998
Canonical correlation	0.300	0.238
Explained variance on 2 functions		0.1466

Df = 15, 447

F-Value Matrix

	Group 1 (N)	Group 2 (S.W.)
Group 2 (SW)	2.76649	
D^2	0.7016	
Group 3 (SE)	1.79573	2.54256
D^2	0.3787	0.5979

% correctly classified cases = 44.42%

TABLE 2.52

DISCRIMINANT FUNCTION ANALYSIS - FEMALES
CHILD'S BIRTH PLACE (3 LOCATIONS)

Groups North n = 195, S.W. n = 132, S.E. n = 116, Total = 443 Full Matrix

Standardised Discriminant Function Coefficient

	Function 1	Function 2
RFR1	-0.36174	0.99601
RFU1	-0.38034	-0.30675
RFR2	0.28267	-0.23910
RFU3	0.22770	0.31604
RFU5	-0.45929	-0.21338
LFR1	0.51329	-0.35176
LFR4	0.39240	0.19640
LFU4	0.51489	0.07398
RAB	-0.32308	0.22331
LCD	0.35790	-0.26253
PHR	0.41205	0.08503
P3L	0.14279	0.27575
CHL	0.17676	-0.22108
PHL	-0.26718	0.00137
T1L	-0.20663	-0.29616
Eigenvalue	0.11602	0.05752
Canonical correlation	0.322	0.233

Explained variance on 2 functions = 0.1580

Df = 15, 427

% correctly classified cases = 47.63

F-Matrix

	Group 1 (N)	Group 2 (SW)
Group 2 (SW)	2.96151	
D^2	0.5937	
Group 3 (SE)	1.64071	2.84127
D^2	1.3569	0.7385

DISCRIMINANT FUNCTION ANALYSIS - DUAL PARAMETERS - MALES

	REDUCED MATRIX				FULL MATRIX		
	Groups A=119 B=34 C=186 D=155 Total=494				Groups A=119 B=34 C=186 D=155 Total=494		
	Standardised Discriminant Function Coefficients				Standardised Discriminant Function Coefficients		
	Function 1	Function 2	Function 3		Function 1	Function 2	Function 3
RFU1	0.30619	-0.28246	-0.13275	RFU1	0.23603	-0.27412	0.16276
RFU2	0.39378	-0.01154	-0.01826	RFU2	0.30982	-0.09040	0.11373
RFR3	-0.41694	-0.41405	-0.85280	RFR3	-0.38917	-0.55358	-0.23439
RFU5	-0.29846	-0.32201	0.07403	RFU5	-0.28064	-0.22338	0.15870
LFR2	0.13621	-0.01309	0.60191	LFR2	0.09976	0.27244	0.34746
LFR3	-0.12444	0.90128	0.04867	LFR3	-0.13681	0.44176	-0.53203
LFU3	0.28858	0.28433	0.31667	LFU3	0.33199	0.32421	0.05466
LFU4	0.56473	-0.54405	-0.33953	LFU4	0.41667	-0.47730	0.23942
LFU5	-0.25533	-0.30424	0.21385	LFU5	-0.19319	0.25857	-0.12049
RCD	-0.23943	-0.11124	0.35730	LBC	0.39560	0.02503	-0.33044
LBC	0.53169	0.32581	-0.50673	P1L	-0.40760	-0.04961	0.05025
P1L	-0.49369	-0.35133	0.04232	LPP1	-0.43986	-0.41270	-0.32693
RPP1	0.31605	-0.47494	0.54567	P2R	-0.59542	-0.12447	0.15377
LPP1	-0.64956	0.63336	-0.74826	P3R	-0.79323	-0.04153	0.66072
				P3TR	-0.52686	0.01112	0.69689
				P4R	-0.73609	-0.46969	0.73686
				CHR	-0.19710	0.12682	-0.09532
				RTL	0.22994	-0.11606	-0.44976
				PTL	-0.00905	0.52383	0.18787
				T1R	0.06130	-0.38621	-0.35907
				TDR	0.83296	0.36537	-0.32101
				TL	0.42391	0.39024	-0.12049
				T1L	0.19485	0.72197	0.05772

TABLE 2.53 (CONTD.)

DISCRIMINANT FUNCTION ANALYSIS - DUAL PARAMETERS - MALES

Eigen Value	0.1022	0.04649	0.03562
Canonical correlation	0.305	0.211	0.185
Explained variance on 3 functions	= 0.17238		
Df	= 14, 477		
F-Matrix	Group 1(EN)	Group 2(ES)	Group 3(WN)
Group 2(ES)			
F-value	1.81202		
D^2	3.1952		
Group 3(WN)			
F-value	2.90563	2.58411	
D^2	3.2779	0.83293	
Group 4(WS)			
F-value	2.30450	1.59811	1.54001
D^2	3.1198	0.61814	0.38110

% cases correctly classified = 36.44%

Eigen Value	0.14709	0.8013	0.06828
Canonical correlation	0.358	0.272	0.253
Explained variance on 3 functions	= 0.2662		
Df	= 23, 468		
F-Matrix	Group 1(EN)	Group 2(ES)	Group 3(WN)
Group 2(ES)			
F-value	1.89505		
D^2	5.5958		
Group 3(WN)			
F-value	2.77565	1.98298	
D^2	5.2437	1.0703	
Group 4(WS)			
F-value	2.35182	1.54570	1.75072
D^2	5.3316	1.0012	0.7255

% cases correctly classified = 42.91%

TABLE 2.54

DISCRIMINANT FUNCTION ANALYSIS - DUAL PARAMETERS - FEMALES

	REDUCED MATRIX				FULL MATRIX		
	Groups A=116 B=39 C=132 D=198 Total=485				Groups A=116 B=39 C=132 D=198 Total=485		
	Standardised Discriminant Function Coefficients				Standardised Discriminant Function Coefficients		
	Function 1	Function 2	Function 3		Function 1	Function 2	Function 3
RFR1	-1.06898	0.12488	0.29446	RFR1	-0.24904	0.82970	-0.55795
RFU2	-0.06581	-0.73117	-0.33348	RFU2	-0.40906	-0.02042	0.47766
RFR3	0.45191	0.25448	0.15204	RFR3	0.32420	-0.37693	0.01192
RFR4	-0.21037	-0.60434	0.18839	RFU4	0.39973	0.06818	-0.17686
RFU4	0.11799	0.46971	0.06814	RFR5	0.32085	-0.00977	-0.50536
RFR5	-0.02473	0.58568	0.52808	RFU5	-0.29297	0.27272	0.09411
RFU5	-0.32009	-0.32347	-0.03758	LFR1	0.06043	-0.36056	0.49268
LFR1	0.54229	-0.25701	-0.26551	LFU2	-0.23499	-0.28021	-0.29073
LFU2	0.12352	-0.09229	0.71247	LFR4	-0.78441	0.14991	-0.15757
RAB	-0.49276	0.05603	-0.06028	RAB	-0.03852	0.42171	-0.15088
LCD	0.48185	-0.15277	0.02416	LCD	-0.05785	-0.41246	0.24530
P1L	0.20846	-0.43187	-0.73398	P1R	-0.10692	0.08768	-1.20257
P1T	0.10631	0.47279	0.46349	P1T	0.31195	-0.33232	1.12653
				RPP1	0.19506	-0.16651	0.09250
				P3TR	0.26059	0.03696	-0.01706
				P3TL	0.18049	0.22577	0.00722
				TEFR	0.16930	0.12903	-0.30805
				TEFL	-0.37243	-0.23028	-0.01546
				TL	-0.52455	-0.49008	-0.42785
				T1L	-0.67111	-0.15080	0.01931

TABLE 3.54 (CONTD.)

Eigen Value	0.08248	0.05638	0.03681
Canonical coefficients	0.276	0.231	0.188
Explained variance on 3 functions	= 0.1649		
Df	= 13, 469		

F-Matrix

	Group 1(EN)	Group 2(ES)	Group 3(WN)
Group 2(ES)			
F-value	2.36503		
D^2	3.3314		
Group 3(WN)			
F-value	2.10903	1.61044	
D^2	1.7405	0.44682	
Group 4(WS)			
F-value	2.89303	2.27305	1.94959
D^2	3.58116	0.94599	0.47535

% cases correctly classified = 38.35

Eigen Value	0.14139	0.10429	0.06464
Canonical coefficients	0.352	0.307	0.246
Explained variance on 3 functions	= 0.2786		
Df	= 20, 462		

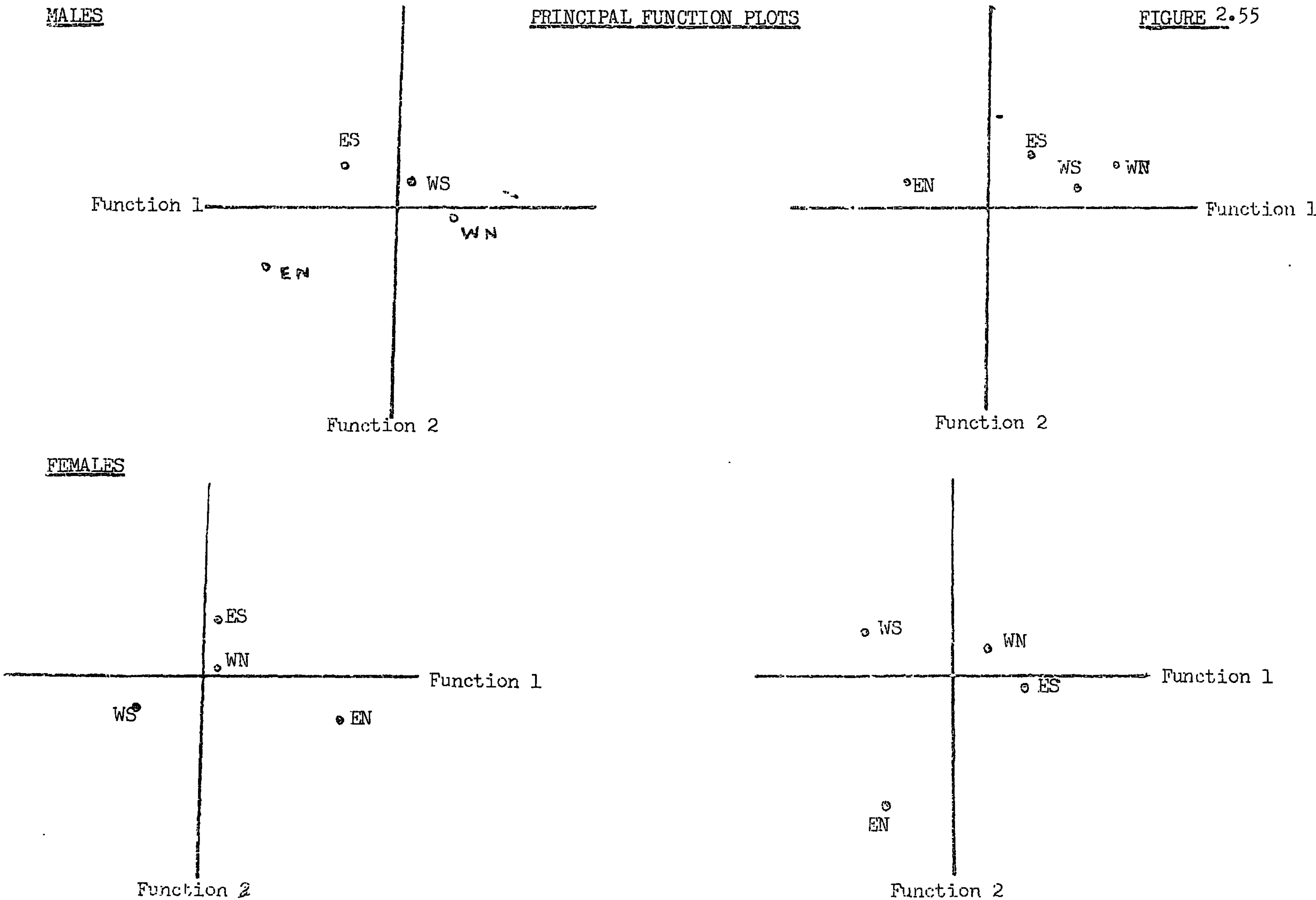
F-Matrix

	Group 1(EN)	Group 2(ES)	Group 3(WN)
Group 2(ES)			
F-value	2.44689		
D^2	5.4859		
Group 3(WN)			
F-value	2.53112	1.62721	
D^2	3.3246	0.71858	
Group 4(WS)			
F-value	2.35916	2.98054	2.55769
D^2	4.648	1.9743	0.99259

% cases correctly classified = 41.86

PRINCIPAL FUNCTION PLOTS

FIGURE 2.55



Reduced Matrix

Complete Matrix

TABLE 3.1

SUBDIVISION BY SEX

		Medial Aspect of Arm						Forehead			
		Mean	s.d.	T-test	Mann-Whitney			Mean	s.d.	T-test	Mann-Whitney
601	M F	33,99 34.76	4,22 4,66	0.008	0,003	601	M F	33,75 33.13	5,06 4.55	0.197	0,058
602	M F	40,78 41,66	4.59 4.75	0,002	0.000	602	M F	38.40 38,80	4.71 4.72	0.142	0,063
603	M F	42.27 43.04	4.46 4.57	0,006	0,001	603	M F	39.96 40.14	4.79 4.65	0.520	0.366
604	M F	42.01 42,73	4.49 4,64	0,010	0,004	604	M F	40.12 40.29	4.73 4.67	0.544	0.134
605	M F	[illegible] 40,51	[illegible] 4.41	0.011	0,004	605	M F	38,29 38.52	4,32 4.52	0,385	0.369
606	M F	44.29 44.94	4.16 4.59	0.016	0,001	606	M F	42.62 42.78	4.25 4.69	0.551	0.330
607	M F	54.63 55,05	[illegible] 5.17	[illegible]	0,001	607	M F	54.32 54.81	4.46 4,69	0,082	0,025
608	M F	[illegible] [illegible]	3,45 [illegible]	[illegible]	0.035	608	M F	61.92 62,14	4.43 4.86	0.460	0.128
609	M F	[illegible] [illegible]	[illegible] [illegible]	[illegible]	0.337	609	M F	63.62 63.73	4.05 4.73	0.683	0,338

[illegible] 533
[illegible] 529

TABLE 3.2

SUBDIVISION BY AGE - MALES

Filter		Medial Aspect of Arm Mean	s.d.	T-test	Mann-Whitney	Filter		Forehead Mean	s.d.	T-test	Mann-Whitney
601	1	34.20	4.14	0.379	0.407	601	1	34.34	6.445	0.000	0.000
	2	33.86	4.26				2	31.96	4.064		
602	1	40.53	5.13	0.426	0.533	602	1	39.52	5.252	0.000	0.000
	2	40.89	4.34				2	37.87	4.36		
603	1	42.43	4.99	0.578	0.318	603	1	41.58	5.29	0.000	0.000
	2	42.18	4.21				2	39.15	4.34		
604	1	42.56	5.20	0.065	0.014	604	1	41.79	5.29	0.000	0.000
	2	41.72	4.09				2	39.32	4.25		
605	1	40.70	4.27	0.006	0.004	605	1	39.81	4.10	0.000	0.000
	2	39.66	3.95				2	37.54	4.24		
606	1	45.11	4.24	0.001	0.001	606	1	44.21	3.86	0.000	0.000
	2	43.87	4.07				2	41.83	4.24		
607	1	55.02	4.43	0.141	0.033	607	1	55.58	4.89	0.000	0.000
	2	54.44	3.81				2	53.70	4.13		
608	1	61.56	3.94	0.050	0.000	608	1	63.28	5.14	0.000	0.000
	2	60.88	3.16				2	61.27	3.91		
609	1	63.54	4.27	0.002	0.000	609	1	65.28	3.95	0.000	0.000
	2	62.37	3.07				2	62.83	3.89		

Age Group 1 = 7-11 yrs.
Age Group 2 = 12-18 yrs.

TABLE 3.3

SUBDIVISION BY AGE - FEMALES

Filter		Medial Aspect of Arm				Filter		Forehead			
		Mean	s.d.	T-test	Mann-Whitney			Mean	s.d.	T-test	Mann-Whitney
601	1	33.93	5.24	0.037	0.027	601	1	33.56	5.37	0.223	0.058
	2	34.96	4.40				2	32.96	4.21		
602	1	40.47	5.50	0.002	0.000	602	1	39.13	5.62	0.429	0.138
	2	42.08	4.37				2	38.71	4.35		
603	1	42.56	5.51	0.200	0.220	603	1	41.06	5.78	0.017	0.000
	2	43.20	4.17				2	39.80	4.11		
604	1	42.39	5.65	0.373	0.702	604	1	41.22	5.67	0.015	0.000
	2	42.85	4.20				2	39.95	4.19		
605	1	40.52	5.21	0.685	0.822	605	1	39.62	5.51	0.003	0.000
	2	40.70	4.10				2	38.13	4.02		
606	1	44.70	5.48	0.504	0.969	606	1	44.02	5.74	0.001	0.000
	2	45.04	4.22				2	42.33	4.15		
607	1	55.06	6.53	0.989	0.381	607	1	55.97	6.34	0.005	0.000
	2	55.05	4.59				2	54.38	3.82		
608	1	61.52	6.14	0.641	0.129	608	1	63.11	6.68	0.030	0.000
	2	61.27	3.73				2	61.83	3.81		
609	1	63.02	6.18	0.652	0.010	609	1	64.82	6.65	0.008	0.000
	2	62.78	3.11				2	63.26	3.46		

Age Group 1 = 7-11 yrs.
Age Group 2 = 12-18 yrs.

TABLE 3.4

SUBDIVISION BY BIRTH PLACE - MALES

Filter [illegible]		Age 7-11 yrs.						Age 11-18 yrs.			
		Mean	s.d.	T-test	Mann-Whitney			Mean	s.d.	T-test	Mann-Whitney
601	N	35.66	4.13	0.001	0.004	601	N	33.47	4.35	0.414	0.488
	S	33.19	3.99				S	33.92	4.27		
602	N	41.84	6.75	0.064	0.003	602	N	40.51	4.73	0.298	0.288
	S	39.84	4.07				S	41.12	4.19		
603	N	43.70	5.91	0.030	0.004	603	N	41.79	4.02	0.359	0.402
	S	41.55	4.39				S	42.30	4.48		
604	N	43.70	6.93	0.099	0.003	604	N	41.76	3.74	0.793	0.904
	S	41.88	4.11				S	41.61	4.41		
605	N	42.80	3.26	0.000	0.000	605	N	39.81	3.81	0.834	0.986
	S	39.53	4.17				S	39.59	4.22		
606	N	47.22	4.21	0.000	0.000	606	N	43.82	3.54	0.602	0.767
	S	43.89	3.70				S	44.69	4.58		
607	N	55.98	5.54	0.058	0.004	607	N	54.35	3.40	0.447	0.389
	S	54.24	3.91				S	54.71	3.39		
608	N	62.66	4.78	0.027	0.000	608	N	60.73	3.08	0.604	0.768
	S	60.93	3.10				S	60.94	3.19		
609	N	64.46	6.42	0.105	0.000	609	N	62.19	2.95	0.948	0.989
	S	62.86	2.91				S	62.17	3.13		

(N n = 50, S n = 75) (N n = 98, S n = 150)

TABLE 3.4

SUBDIVISION BY BIRTH PLACE - MALES

Filter Forehead		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
601	N	37.26	9.39	0.003	0.000	601	N	32.45	3.92	0.109	0.125
	S	32.82	4.33				S	31.59	4.25		
602	N	41.14	6.66	0.015	0.001	602	N	37.79	3.69	0.773	0.769
	S	38.43	4.82				S	37.94	4.67		
603	N	43.26	6.99	0.009	0.001	603	N	38.69	3.92	0.199	0.343
	S	40.32	4.15				S	39.41	4.53		
604	N	44.34	7.12	0.001	0.000	604	N	39.42	4.12	0.652	0.669
	S	40.36	4.05				S	39.17	4.50		
605	N	42.36	3.66	0.000	0.000	605	N	37.71	3.78	0.404	0.482
	S	38.59	4.11				S	37.26	4.73		
606	N	46.08	3.60	0.000	0.000	606	N	42.10	3.96	0.358	0.249
	S	43.25	3.88				S	41.58	4.61		
607	N	56.76	6.99	0.121	0.002	607	N	54.08	3.38	0.451	0.607
	S	55.05	3.92				S	53.70	4.55		
608	N	64.26	7.15	0.162	0.002	608	N	61.54	3.60	0.235	0.165
	S	62.72	3.51				S	60.92	4.26		
609	N	66.92	4.81	0.001	0.000	609	N	62.77	3.65	0.980	0.984
	S	64.28	3.45				S	62.78	4.19		

(N n = 50, S n =75) (N n = 98, S n =150)

TABLE 3.5

SUBDIVISION BY BIRTH PLACE - FEMALES

Filter Arm		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
601	N	35.34	4.31	0.027	0.058	601	N	35.63	4.45	0.042	0.026
	S	32.64	6.71				S	34.50	4.39		
602	N	41.58	4.31	0.108	0.377	602	N	42.25	4.43	0.811	0.605
	S	39.47	7.49				S	42.11	4.35		
603	N	43.87	4.23	0.067	0.205	603	N	43.33	3.94	0.710	0.354
	S	41.51	7.33				S	43.13	4.48		
604	N	43.58	4.23	0.057	0.213	604	N	43.11	3.91	0.426	0.145
	S	41.06	7.58				S	42.68	4.53		
605	N	41.87	3.52	0.039	0.102	605	N	40.52	3.85	0.485	0.846
	S	39.32	7.34				S	40.89	4.44		
606	N	45.95	3.39	0.070	0.136	606	N	45.20	3.97	0.778	0.451
	S	43.68	7.55				S	45.05	4.43		
607	N	56.24	3.11	0.200	0.479	607	N	55.19	3.77	0.633	0.939
	S	54.23	8.93				S	54.91	5.31		
608	N	62.42	3.09	0.155	0.487	608	N	61.05	3.97	0.236	0.350
	S	60.28	9.61				S	61.60	3.60		
609	N	64.00	3.36	0.161	0.748	609	N	52.70	2.76	0.479	0.407
	S	61.83	9.80				S	62.97	3.58		

(N n = 38, S n = 47)

(N n = 110, S n = 157)

TABLE 3.5

SUBDIVISION BY BIRTH PLACE - FEMALES

Filter Forehead		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
601	N	34.50	4.24	0.167	0.546	601	N	33.68	3.57	0.011	0.014
	S	32.83	6.78				S	32.46	4.20		
602	N	40.45	3.78	0.104	0.226	602	N	38.78	4.11	0.991	0.879
	S	38.40	7.38				S	38.78	4.37		
603	N	42.82	3.81	0.035	0.085	603	N	40.23	3.76	0.215	0.288
	S	40.02	7.86				S	39.60	4.17		
604	N	42.84	3.48	0.044	0.124	604	N	40.26	3.86	0.294	0.309
	S	40.28	7.65				S	39.71	4.47		
605	N	41.66	3.87	0.015	0.034	605	N	38.29	3.97	0.641	0.741
	S	38.53	7.47				S	38.06	4.09		
606	N	45.58	3.42	0.048	0.078	606	N	42.28	4.39	0.701	0.752
	S	43.02	7.84				S	42.47	3.83		
607	N	57.56	3.23	0.109	0.301	607	N	54.54	3.81	0.778	0.752
	S	55.08	9.29				S	54.41	3.52		
608	N	64.74	3.73	0.096	0.155	608	N	61.42	3.21	0.211	0.048
	S	62.04	10.12				S	62.00	4.27		
609	N	65.97	3.21	0.199	0.873	609	N	63.04	3.74	0.718	0.967
	S	63.89	10.39				S	63.19	3.26		

(N n = 38, S n = 47) (N n = 110, S n = 157)

TABLE 3.6

SUBDIVISION BY PARENTS' BIRTH PLACE - MALES

Filter		Age 7-11 yrs.						Age 11-18 yrs.			
		Mean	s.d.	T-test	Mann-Whitney			Mean	s.d.	T-test	Mann-Whitney
Arm											
601	N	35.656	4.43	.049	.100	601	N	33.738	4.72	.583	.349
	S	33.763	3.48				S	33.289	4.12		
602	N	41.313	8.01	.250	.028	602	N	40.934	5.17	.977	.911
	S	39.632	3.68				S	40.911	3.83		
603	N	43.125	7.07	.447	.149	603	N	42.295	4.50	.923	.859
	S	42.079	3.35				S	42.375	4.43		
604	N	43.125	8.36	.554	.063	604	N	42.033	4.30	.462	.458
	S	42.184	3.36				S	41.446	4.29		
605	N	42.813	3.76	.003	.008	605	N	39.803	4.21	.225	.235
	S	40.211	3.40				S	38.911	3.64		
606	N	47.344	4.95	.004	.007	606	N	44.115	3.80	.676	.353
	S	44.290	3.02				S	43.804	4.23		
607	N	55.063	6.88	.838	.222	607	N	54.787	3.85	.308	.246
	S	54.790	3.25				S	54.089	3.49		
608	N	62.281	7.89	.494	.021	608	N	61.000	3.19	.976	.697
	S	61.526	2.81				S	61.018	3.14		
609	N	63.719	7.87	.889	.150	609	N	62.803	2.91	.152	.189
	S	63.921	2.31				S	62.000	3.11		

(N n = 32, S n = 38)   (N n = 61, S n = 56)

TABLE 3.6 (CONTD.)

SUBDIVISION BY PARENTS' BIRTH PLACE - MALES

(Forehead)

Filter		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
Forehead											
601	N	38.750	11.23	.013	.001	601	N	32.066	4.14	.034	.026
	S	33.290	4.01				S	30.482	3.79		
602	N	41.031	8.20	.167	.008	602	N	37.377	4.40	.916	.850
	S	38.763	4.38				S	37.286	4.93		
603	N	43.656	8.32	.074	.000	603	N	38.525	4.500	.058	.649
	S	40.737	3.74				S	38.482	4.16		
604	N	45.469	8.27	.005	.001	604	N	39.623	4.88	.101	.110
	S	40.816	3.46				S	38.268	3.87		
605	N	42.844	4.07	.000	.000	605	N	37.689	4.28	.142	.234
	S	39.105	3.11				S	36.500	4.42		
606	N	46.344	3.56	.005	.004	606	N	42.148	4.60	.024	.011
	S	43.816	3.62				S	40.375	3.68		
607	N	56.500	8.42	.580	.035	607	N	54.161	3.87	.259	.412
	S	55.642	2.82				S	53.269	4.67		
608	N	63.935	8.80	.576	.020	608	N	61.246	3.89	.743	.380
	S	63.026	2.65				S	61.000	4.20		
609	N	67.781	5.19	.007	.003	609	N	62.754	4.90	.759	.395
	S	65.000	2.22				S	62.518	4.41		

(N n = 32, S n = 38) (N n = 61, S n = 56)

TABLE 3.7

SUBDIVISION BY PARENTS' BIRTH PLACE - FEMALES

Filter		Age 7-11 yrs.						Age 11-18 yrs.			
		Mean	s.d.	T-test	Mann-Whitney			Mean	s.d.	T-test	Mann-Whitney
Arm											
601	N	35.074	4.10	.460	.385	601	N	35.424	4.82	.160	.068
	S	34.143	4.53				S	34.304	4.15		
602	N	41.333	4.23	.463	.817	602	N	42.271	4.80	.894	.855
	S	40.489	4.17				S	42.159	4.65		
603	N	43.778	3.57	.213	.403	603	N	43.339	4.56	.660	.359
	S	42.381	4.08				S	42.986	4.49		
604	N	43.889	4.13	.131	.264	604	N	42.932	4.41	.649	.366
	S	42.095	3.85				S	42.551	4.95		
605	N	42.148	3.46	.039	.079	605	N	40.672	4.47	.560	.292
	S	40.095	3.13				S	40.203	4.55		
606	N	45.630	3.29	.306	.388	606	N	45.517	4.35	.252	.155
	S	44.762	2.23				S	44.623	4.38		
607	N	56.370	3.11	.214	.345	607	N	54.828	4.56	.637	.598
	S	55.278	3.05				S	54.406	5.35		
608	N	62.704	3.17	.295	.713	608	N	60.707	4.69	.698	.981
	S	61.905	2.02				S	61.000	3.79		
609	N	64.630	3.41	.137	.298	609	N	52.983	3.22	.254	.551
	S	63.429	2.04				S	62.290	3.53		

(N n = 27, S n = 21) (N n =58, S n = 69)

TABLE 3.7 (CONTD.)

SUBDIVISION BY PARENTS' BIRTH PLACE - FEMALES

Filter		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
Forehead											
601	N	34.889	4.18	.237	.147	601	N	34.085	3.91	.041	.063
	S	33.429	4.19				S	32.565	4.33		
602	N	40.667	3.84	.291	.179	602	N	38.881	4.538	.596	.706
	S	39.381	4.49				S	38.449	4.635		
603	N	43.074	3.68	.190	.122	603	N	40.661	3.76	.037	.066
	S	41.524	4.40				S	39.159	4.24		
604	N	43.519	3.63	.095	.075	604	N	40.153	4.27	.399	.530
	S	41.619	4.07				S	39.507	4.32		
605	N	42.148	3.87	.202	.199	605	N	38.379	4.04	.185	.123
	S	40.714	3.73				S	37.435	3.94		
606	N	46.000	3.72	.647	.518	606	N	42.052	4.28	.584	.785
	S	45.524	3.31				S	42.464	4.16		
607	N	58.185	3.45	.255	.379	607	N	54.431	3.98	.696	.575
	S	57.143	3.59				S	54.174	3.42		
608	N	65.148	3.82	.212	.097	608	N	51.086	4.99	.387	.407
	S	63.905	2.70				S	61.783	4.05		
609	N	66.630	3.04	.988	.958	609	N	63.293	4.38	.323	.208
	S	66.619	1.88				S	62.609	3.15		

(N n = 27, S n = 21) (N n = 58, S n =69)

TABLE 3.8

DIVISION BY ANCESTRY - MALES

Filter		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
Arm											
601	E	34.088	3.91	.790	.993	601	E	33.859	4.53	.997	.629
	W	34.268	4.27				W	33.861	4.07		
602	E	40.088	4.50	.429	.319	602	E	40.537	4.50	.192	.171
	W	40.750	3.43				W	41.144	4.21		
603	E	42.368	4.66	,907	.813	603	E	41.792	4.37	.136	.072
	W	4.2464	3.18				W	42.466	4.08		
604	E	42.228	4.64	.546	.550	604	E	41.322	3.88	.115	.059
	W	42.741	5.48				W	42.014	4.22		
605	E	40.368	4.35	.468	.552	605	E	39.544	4.21	.635	.484
	W	40.875	4.24				W	39.745	3.75		
606	E	44.474	4.34	.159	.428	606	E	43.866	4.56	.958	.380
	W	45.446	4.17				W	43.889	3.69		
607	E	54.597	4.14	.373	.203	607	E	54.040	4.02	.094	.024
	W	55.241	4.57				W	54.726	3.64		
608	E	60.930	4.08	.138	.085	608	E	60.356	3.00	.008	.007
	W	61.884	3.85				W	61.260	3.23		
609	E	63.228	3.21	.440	.131	609	E	62.034	3.04	.083	.087
	W	63.705	4.73				W	52.606	3.08		

(E n = 57, W n = 112) (E n = 149, W n = 208)

DIVISION BY ANCESTRY - MALES

Filter		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
Forehead											
601	E	33.429	4.23	.088	.142	601	E	31.893	4.11	.806	.966
	W	34.955	7.27				W	32.000	4.04		
602	E	39.035	4.14	.344	.259	602	E	37.356	4.16	.060	.074
	W	39.768	5.74				W	38.236	4.47		
603	E	41.000	3.83	.247	.091	603	E	38.765	4.37	.152	.187
	W	41.875	5.90				W	39.433	4.31		
604	E	40.860	3.97	.065	.250	604	E	38.772	3.98	.040	.062
	W	42.270	5.79				W	39.707	4.40		
605	E	38.719	3.73	.013	.018	605	E	37.094	3.77	.079	.089
	W	40.366	4.19				W	37.870	4.53		
606	E	43.386	3.67	.046	.121	606	E	41.745	4.07	.735	.483
	W	44.634	3.88				W	41.899	4.36		
607	E	55.386	3.70	.680	.377	607	E	53.329	4.02	.147	.103
	W	55.679	5.41				W	53.971	4.19		
608	E	62.860	4.49	.446	.303	608	E	60.899	3.69	.134	.104
	W	63.500	5.45				W	61.529	4.06		
609	E	64.544	2.82	.049	.053	609	E	62.642	3.92	.431	.317
	W	65.652	4.37				W	62.971	3.87		

(E n = 57, W n = 112) (E n = 149, W n = 208)

TABLE 3.9

DIVISION BY ANCESTRY - FEMALES

Filter		Age 7-11 yrs. Mean	s.d.	T-test	Mann-Whitney			Age 11-18 yrs. Mean	s.d.	T-test	Mann-Whitney
Arm											
601	E	32.638	6.50	.072	.088	601	E	34.732	4.21	.380	.246
	W	34.557	4.42				W	35.131	4.54		
602	E	38.979	7.49	.063	.042	602	E	41.994	4.02	.739	.472
	W	41.196	4.06				W	42.144	4.63		
603	E	40.851	7.60	.036	.043	603	E	43.055	3.82	.545	.377
	W	43.381	3.93				W	43.317	4.42		
604	E	40.532	7.55	.023	.026	604	E	42.735	4.14	.643	.430
	W	43.289	4.23				W	42.937	4.25		
605	E	38.787	7.05	.023	.041	605	E	40.447	3.96	.273	.139
	W	41.361	3.81				W	40.914	4.20		
606	E	43.021	7.80	.042	.059	606	E	44.938	4.01	.689	.652
	W	45.516	3.67				W	45.114	4.37		
607	E	52.894	10.01	.037	.053	607	E	55.193	4.06	.598	.699
	W	56.103	3.48				W	54.941	4.95		
608	E	59.979	9.83	.124	.173	608	E	61.466	3.35	.358	.745
	W	62.268	2.85				W	61.119	3.98		
609	E	61.404	9.83	.108	.100	609	E	62.584	3.15	.300	.569
	W	63.804	2.95				W	62.918	3.08		

(E n = 47, W n = 97) (E n = 164, W n = 222)

TABLE 3.9(CONTD.)

DIVISION BY ANCESTRY - FEMALES

Filter		Age 7-11 yrs.						Age 11-18 yrs.			
		Mean	s.d.	T-test	Mann-Whitney			Mean	s.d.	T-test	Mann-Whitney
Forehead											
601	E	32.192	6.21	.052	.104	601	E	31.982	4.25	.000	.000
	W	34.227	4.81				W	33.676	4.03		
602	E	37.511	7.28	.042	.055	602	E	37.883	4.28	.001	.002
	W	39.907	4.45				W	39.324	4.31		
603	E	39.234	7.34	.023	.022	603	E	39.184	4.23	.011	.019
	W	41.948	4.63				W	40.258	3.96		
604	E	39.489	7.23	.028	.015	604	E	39.549	4.24	.102	.124
	W	42.072	4.55				W	40.258	4.14		
605	E	37.851	7.12	.023	.014	605	E	37.801	4.12	.170	.104
	W	40.474	4.31				W	38.373	3.93		
606	E	41.894	7.46	.009	.001	606	E	41.745	3.99	.018	.010
	W	45.052	4.37				W	42.759	4.23		
607	E	53.723	9.38	.022	.018	607	E	54.050	3.60	.146	.053
	W	57.072	3.75				W	54.627	3.97		
608	E	61.277	10.17	.080	.038	608	E	61.485	3.62	.134	.094
	W	64.010	3.81				W	62.077	3.93		
609	E	62.340	10.11	.019	.000	609	E	62.882	3.34	.070	.102
	W	66.021	3.53				W	63.532	3.52		

(E n = 47, W n = 97)   (E n = 164, W n = 222)

TABLE 3.10

AGE GROUP 1 - MALES

Filter		Welsh in N (n = 45)/ English in S (n = 27)					English in S (n = 27)/ Welsh in S (n = 48)					Welsh in N (n = 45)/ Welsh in S (n = 48)			
		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W
Arm															
601	W E	35.78 33.19	4.34 4.28	0.016	0.043	E W	33.19 33.19	4.28 3.87	0.998	0.877	N S	35.78 33.19	4.34 3.87	0.003	0.006
602		41.96 39.37	7.10 4.40	0.061	0.011		39.37 40.10	4.40 3.90	0.458	0.602		41.96 40.10	7.11 3.90	0.120	0.008
603		43.73 41.33	6.18 4.41	0.082	0.023		41.33 41.67	4.41 4.41	0.755	0.786		43.73 41.67	6.18 4.42	0.069	0.010
604		43.73 41.33	7.30 4.71	0.095	0.014		41.33 42.19	4.71 3.75	0.391	0.561		43.73 42.19	7.30 3.75	0.208	0.009
605		42.91 39.74	3.35 4.33	0.001	0.004		39.74 39.42	4.33 4.13	0.749	0.698		42.91 39.42	3.35 4.13	0.000	0.000
606		47.22 43.48	4.37 4.12	0.001	0.002		43.48 44.13	4.12 3.47	0.473	0.665		47.22 44.13	4.37 3.47	0.000	0.001
607		56.07 53.89	5.63 4.19	0.087	0.016		53.89 54.44	4.19 3.77	0.563	0.649		56.07 54.44	5.63 3.77	0.108	0.009
608		62.51 60.30	4.99 3.41	0.029	0.001		60.30 61.29	3.41 2.89	0.184	0.257		62.51 61.29	4.99 2.89	0.157	0.010
609		64.24 62.30	6.71 3.27	0.104	0.001		62.30 63.19	3.27 2.67	0.205	0.286		64.24 63.19	6.71 2.67	0.328	0.004

TABLE 3.10 (CONTD.)

AGE GROUP 1 - MALES

Filter	Welsh in N (n = 45)/ English in S (n = 27)				English in S (n = 27)/ Welsh in S (n = 48)				Welsh in N (n = 45)/ Welsh in S (n = 48)			
	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W
Forehead												
601	37.58 32.58	9.85 4.75	0.005	0.002	32.58 32.96	4.75 4.13	0.720	0.995	37.58 32.96	9.85 4.13	0.005	0.000
602	41.13 37.52	7.02 4.70	0.011	0.001	37.52 38.94	4.70 4.86	0.223	0.239	41.13 38.93	7.02 4.86	0.085	0.010
603	43.51 40.41	7.29 4.08	0.024	0.000	40.41 40.27	4.08 4.24	0.892	0.912	43.51 40.27	7.29 4.24	0.011	0.000
604	44.58 39.96	7.45 4.54	0.002	0.002	39.96 40.58	4.54 3.78	0.528	0.698	44.58 40.58	7.45 3.78	0.002	0.001
605	42.44 38.48	3.83 4.54	0.000	0.000	38.48 38.65	4.54 3.90	0.869	0.996	42.44 38.65	3.83 3.90	0.000	0.000
606	46.09 42.96	3.77 4.23	0.002	0.002	42.96 43.42	4.23 3.70	0.630	0.885	46.09 43.42	3.77 3.70	0.001	0.000
607	56.56 55.19	7.34 4.38	0.324	0.078	55.19 54.98	4.38 3.69	0.829	0.764	56.56 54.98	7.34 3.69	0.200	0,008
608	64.13 62.70	7.51 3.43	0.275	0.016	62.70 62.73	3.43 3.59	0.976	0.735	64.13 62.73	7.51 3.59	0.259	0.017
609	67.04 64.04	5.05 3.37	0.003	0.006	64.04 64.42	3.39 3.52	0.651	0.395	67.04 64.42	5.05 3.52	0.005	0.007

TABLE 3.11

AGE GROUP 2 - MALES

Filter		Welsh in N (n = 73)/ English in S (n = 60)					English in S (n = 60)/ Welsh in S (n = 90)					Welsh in N (n = 73)/ Welsh in S (n = 90)			
		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W
Arm															
601	W E	33.47 34.02	4.31 4.57	0.477	0.600	E W	34.02 33.87	4.57 4.07	0.834	0.819	N S	33.47 33.87	4.31 4.07	0.544	0.638
602		40.52 40.82	4.79 4.58	0.718	0.712		40.82 41.80	4.58 3.92	0.490	0.448		40.52 41.30	4.79 3.92	0.255	0.257
603		41.93 41.97	3.96 4.70	0.963	0.879		41.97 42.52	4.70 4.35	0.459	0.346		41.93 42.52	3.96 4.35	0.371	0.333
604		41.95 41.20	3.83 4.19	0.287	0.263		41.20 41.89	4.19 4.55	0.350	0.216		41.96 41.89	3.83 4.55	0.933	0.868
605		39.67 39.88	3.72 4.78	0.779	0.680		39.88 39.40	4.78 3.82	0.494	0.527		39.67 39.40	3.72 3.82	0.649	0.656
606		43.90 44.60	3.60 5.02	0.409	0.728		44.60 43.74	5.62 3.73	0.303	0.524		43.90 43.74	3.60 3.73	0.783	0.784
607		54.47 54.75	3.54 4.15	0.670	0.966		54.75 54.69	4.15 3.73	0.925	0.627		54.47 54.69	3.54 3.73	0.698	0.600
608		60.89 60.63	3.13 3.15	0.639	0.475		60.63 61.16	3.15 3.22	0.328	0.388		60.89 61.16	3.13 3.22	0.597	0.871
609		62.38 62.03	2.94 3.25	0.518	0.601		62.03 62.26	3.25 3.07	0.674	0.737		62.38 62.26	2.94 3.07	0.787	0.848

TABLE 3.11(CONTD.)

AGE GROUP 2 - MALES

Filter	Welsh in N (n = 73)/ English in S (n = 60)				English in S (n = 60)/ Welsh in S (n = 90)				Welsh in N (n = 73)/ Welsh in S (n = 90)			
	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W
Forehead												
601	32.44	4.18	0.216	0.263	31.50	4.52	0.839	0.913	32.44	4.18	0.225	0.164
	31.50	4.52			31.64	4.10			31.64	4.10		
602	38.00	3.89	0.329	0.370	37.32	4.13	0.183	0.225	38.00	3.89	0.610	0.695
	37.32	4.13			38.36	4.98			38.36	4.98		
603	38.82	4.34	0.903	0.892	38.92	4.63	0.274	0.417	38.82	4.34	0.185	0.428
	38.92	4.63			39.74	4.45			39.74	4.45		
604	39.88	4.49	0.150	0.149	38.75	4.44	0.348	0.334	39.88	4.49	0.555	0.585
	38.75	4.44			39.46	4.54			39.46	4.54		
605	38.08	3.93	0.188	0.211	37.15	4.17	0.817	0.822	38.08	3.93	0.304	0.808
	37.15	4.19			37.33	5.10			37.33	5.10		
606	42.30	4.15	0.786	0.539	42.10	4.36	0.260	0.297	42.30	4.15	0.113	0.064
	42.10	4.36			41.23	4.76			41.23	4.76		
607	54.32	3.51	0.319	0.194	53.67	3.97	0.942	0.552	54.32	3.51	0.372	0.683
	53.67	3.97			53.72	4.93			53.72	4.93		
608	61.59	3.88	0.240	0.156	60.77	4.15	0.720	0.780	61.59	3.88	0.387	0.217
	60.77	4.15			61.02	4.35			61.02	4.35		
609	62.75	3.67	0.871	0.716	62.64	4.07	0.752	0.626	62.75	3.67	0.858	0.867
	62.64	4.07			62.87	4.28			62.87	4.28		

TABLE 3.12

AGE GROUP 1 - FEMALES

Filter		Welsh in N (n = 31)/ English in S (n = 17)					Welsh in S (n = 30)/ English in S (n = 17)					Welsh in N (n = 31)/ Welsh in S (n = 30)			
		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W
Arm															
601	W	35.42	4.57	0.077	0.078	E	30.94	9.30	0.282	0.425	N	35.42	4.57	0.126	0.197
	E	30.94	9.30			W	33.60	4.58			S	33.60	4.58		
602		41.58	4.36	0.130	0.150		37.18	11.00	0.211	0.271		41.58	4.36	0.459	0.811
		37.18	11.00				40.77	4.17				40.77	4.17		
603		43.90	4.35	0.129	0.150		39.41	11.23	0.254	0.362		43.90	4.35	0.236	0.553
		39.41	11.23				42.70	3.42				42.70	3.43		
604		43.74	4.40	0.082	0.093		38.47	11.39	0.170	0.281		43.74	4.40	0.249	0.460
		38.47	11.39				42.53	3.66				42.53	3.66		
605		41.84	3.75	0.068	0.064		36.65	10.68	0.136	0.169		41.83	3.75	0.315	0.434
		36.65	10.68				40.83	4.00				40.83	4.00		
606		45.94	3.70	0.142	0.135		41.47	11.67	0.248	0.256		45.94	3.70	0.268	0.472
		41.47	11.67				44.93	3.28				44.93	3.28		
607		56.35	3.16	0.243	0.328		52.12	14.26	0.317	0.518		56.35	3.16	0.438	0.667
		52.12	14.26				55.73	3.06				55.73	3.06		
608		62.52	3.28	0.240	0.761		57.82	15.70	0.331	0.694		62.52	3.27	0.242	0.452
		57.82	15.70				61.67	2.25				61.69	2.25		
609		63.90	3.53	0.232	0.688		59.06	15.90	0.280	0.661		63.90	3.53	0.516	0.804
		59.06	15.90				63.40	2.40				63.40	2.40		

TABLE 3.12(CONTD.)

AGE GROUP 1 - FEMALES

Filter	Welsh in N (n = 31)/ English in S (n = 17)				Welsh in S (n = 30)/ English in S (n = 17)				Welsh in N (n = 31)/ Welsh in S (n = 30)			
	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W
Forehead												
601	34.35 30.53	4.62 8.73	0.107	0.209	30.53 34.13	8.73 4.99	0.132	0.123	34.35 34.13	4.62 4.99	0.858	0.701
602	40.29 36.06	4.04 9.95	0.110	0.057	36.06 39.73	9.95 5.17	0.171	0.126	40.29 39.73	4.04 5.17	0.640	0.965
603	42.81 36.88	4.13 10.67	0.040	0.013	36.88 41.88	10.66 5.12	0.089	0.076	42.81 41.80	4.13 5.12	0.401	0.572
604	42.90 37.41	3.73 10.38	0.049	0.015	37.41 41.96	10.37 5.10	0.110	0.062	42.90 41.90	3.73 5.09	0.323	0.675
605	41.42 35.94	3.98 10.33	0.049	0.024	35.94 40.00	10.33 4.85	0.142	0.149	41.42 40.00	3.98 4.85	0.216	0.321
606	45.68 39.65	3.55 10.86	0.039	0.002	39.65 44.93	10.86 4.69	0.071	0.017	45.68 44.93	3.55 4.69	0.136	0.648
607	57.61 51.53	3.25 13.94	0.094	0.039	51.53 57.10	13.94 4.27	0.126	0.072	57.61 57.10	3.25 4.27	0.599	0.856
608	64.61 58.94	4.06 15.77	0.163	0.075	58.94 63.80	15.77 4.06	0.229	0.148	64.61 63.80	4.06 4.06	0.438	0.622
609	66.06 60.65	3.37 16.21	0.191	0.329	60.65 65.73	16.21 4.05	0.221	0.160	66.66 65.73	3.37 4.05	0.769	0.777

TABLE 3.13

AGE GROUP 2 - FEMALES

Filter		Welsh in N (n = 84)/ English in S (n = 67)					Welsh in S (n = 90)/ English in S (n = 67)					Welsh in N (n = 84)/ Welsh in S (n = 90)			
		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W		Mean	s.d.	T-test	M-W
Arm															
601	W	35.88	4.70	0.010	0.003	E	33.92	4.37	0.156	0.105	N	35.88	4.70	0.170	0.136
	E	33.93	4.38			W	34.93	4.37			S	34.93	4.38		
602		42.29	4.58	0.253	0.154		41.45	4.26	0.105	0.133		42.30	4.58	0.657	0.869
		41.46	4.26				42.60	4.38				42.60	4.38		
603		43.33	4.25	0.170	0.067		42.36	4.31	0.067	0.122		43.33	4.25	0.588	0.874
		42.36	4.31				43.69	4.55				43.70	4.55		
604		43.17	4.20	0.168	0.044		42.14	4.89	0.196	0.153		43.17	4.20	0.905	0.414
		42.14	4.89				43.09	4.22				43.09	4.22		
605		40.81	4.08	0.387	0.155		40.20	4.48	0.094	0.111		40.81	4.08	0.356	0.680
		40.20	4.48				41.40	4.36				41.40	4.36		
606		45.51	4.10	0.212	0.121		44.64	4.34	0.317	0.582		45.51	4.10	0.824	0.349
		44.64	4.34				45.36	4.50				45.36	4.50		
607		55.27	4.05	0.501	0.512		54.77	4.86	0.783	0.459		55.27	4.05	0.734	0.860
		54.77	4.86				55.01	5.64				55.01	5.64		
608		60.92	4.26	0.476	0.866		61.38	3.48	0.503	0.345		60.92	4.26	0.161	0.177
		61.38	3.48				61.77	3.69				61.77	3.69		
609		62.78	2.70	0.776	0.861		62.64	3.42	0.313	0.496		62.78	2.70	0.369	0.375
		62.53	3.42				63.22	3.67				63.22	3.69		

TABLE 3.10 (CONTD.)

AGE GROUP 2 - FEMALES

Filter	Welsh in N (n = 84)/ English in S (n = 67)				Welsh in S (n = 90)/ English in S (n = 67)				Welsh in N (n = 84)/ Welsh in S (n = 90)			
	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W	Mean	s.d.	T-test	M-W
Forehead												
601	34.06 31.21	3.60 4.36	0.000	0.000	31.21 33.40	4.36 3.82	0.001	0.002	34.06 33.40	3.60 3.83	0.244	0.215
602	38.95 37.23	4.39 4.66	0.021	0.026	37.23 39.91	4.66 3.79	0.000	0.000	38.95 39.91	4.39 3.79	0.124	0.181
603	40.55 38.71	3.86 4.67	0.009	0.021	38.71 40.27	4.67 3.64	0.026	0.055	40.55 40.27	3.86 3.64	0.627	0.541
604	40.37 39.00	3.93 4.98	0.070	0.074	39.00 40.24	4.98 3.99	0.089	0.087	40.37 40.24	3.92 3.99	0.825	0.885
605	38.33 37.35	3.83 4.45	0.152	0.135	37.35 38.58	4.45 3.73	0.062	0.064	38.33 38.53	3.83 3.73	0.654	0.658
606	42.53 41.70	4.63 4.09	0.253	0.175	41.70 43.04	4.09 3.55	0.030	0.038	42.53 43.04	4.63 3.55	0.413	0.513
607	54.72 53.86	3.97 3.30	0.160	0.095	53.86 54.82	3.29 3.64	0.094	0.044	54.72 54.82	3.97 3.64	0.867	0.856
608	61.46 61.71	3.39 3.74	0.665	0.515	61.71 62.21	3.74 4.64	0.472	0.251	61.46 62.21	3.39 4.64	0.227	0.065
609	63.25 62.88	3.86 3.11	0.523	0.361	62.88 63.43	3.11 3.37	0.303	0.571	63.25 63.43	3.86 3.37	0.763	0.852

TABLE 3.14

REGIONAL VARIATION

All Readings for Medial Aspect of the Arm

MALES

Locality	No.	Age	Filter			Author
			601	605	609	
North Pembrokeshire	148	7-18	34.20	40.78	62.93	Present study
South Pembrokeshire	225	7-18	33.68	39.57	62.38	Present study
Merthyr Tydfil	84	Children	32.77	38.71	62.80	Smith et al (1973)
Carnew (Eire)	105	All ages	34.86	39.37	64.40	Sunderland et al (1973)
Ballinlough (Eire)	105	All ages	35.40	40.94	65.31	Sunderland et al (1973)
N. Northumberland	93	15-16	34.17	43.81	68.63	Hulse (1973)
S.E. Northumberland	55	15-16	33.02	42.09	66.82	Hulse (1973)
Cumberland	99	Children	35.78	41.80	66.46	Smith et al (1973)
Isle of Man	90	Children	36.62	41.94	65.91	Smith et al (1973)

TABLE 3.15

REGIONAL VARIATION (CONTD.)

FEMALES

Locality	No.	Age	Filter			Author
			601	605	609	
North Pembrokeshire	148	7-18	35.56	40.86	63.05	Present study
South Pembrokeshire	204	7-18	34.07	40.52	62.71	Present study
Merthyr Tydfil	98	Children	33.23	38.66	63.46	Smith et al (1973)
Carnew	162	All ages	37.23	42.12	64.64	Sunderland et al (1973)
Ballinlough	127	All ages	36.19	41.90	65.13	Sunderland et al (1973)
N. Northumberland	104	15-16	36.45	44.79	68.93	Hulse (1973)
S.E. Northumberland	51	15-16	35.61	43.88	68.28	Hulse (1973)
Cumberland	153	Children	36.94	42.35	66.96	Smith et al (1973)
Isle of Man	73	Children	36.75	41.79	67.01	Smith et al (1973)

ABBREVIATIONS USED IN SEROLOGY TABLES

1. Using two birth locations:-

A	=	Welsh in North	Welsh in South
B	=	Welsh in North	English in South
C	=	Welsh in South	English in South

2. Using three birth locations:-

D	=	Welsh in North	Welsh in S.W.
E	=	Welsh in North	Welsh in S.E.
F	=	Welsh in North	English in S.W.
G	=	Welsh in North	English in S.E.
H	=	Welsh in S.W.	Welsh in S.E.
I	=	Welsh in S.W.	English in S.E.
J	=	Welsh in S.E.	English in S.E.
K	=	Welsh in S.E.	English in S.W.
L	=	English in S.W.	English in S.E.
M	=	Welsh in S.W.	English in S.W.

TABLE 4.1

ABO BLOOD GROUPS

	BP (2 Groups)				BP (3 Groups)					
	North Pembs.		S. Pembs.		North Pembs.		S.W. Pembs.		S.E. Pembs.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
Blood Group										
O	106	.426	.280	.440	106	.426	133	.428	147	.452
A	109	.438	.262	.412	109	.438	132	.424	130	.400
B	29	.116	69	.108	29	.116	36	.116	33	.102
AB	5	.020	25	.039	5	.020	10	.032	15	.046
Total	249	1.000	636	1.000	249	1.000	311	1.000	325	1.000
Gene Freqs.										
p	.277		.259		.277		.269		.250	
q	.071		.077		.071		.077		.077	
r	.652		.664		.652		.654		.673	
	X^2 showed non-significant differences between subsets									

PBP (2 groups)	North Pembs.		South Pembs.			English		Welsh	
Blood Group	No.	Freq.	No.	Freq.	Ancestry	No.	Freq.	No.	Freq.
O	67	.406	168	.471	(Surname)	144	.442	249	.448
A	75	.455	139	.389		139	.426	220	.396
B	18	.109	40	.112		30	.092	71	.128
AB	5	.030	10	.028		13	.040	16	.029
Total	165	1.000	357	1.000		326	1.000	556	1.000
Gene Freqs.									
p	.291		.241			.267		.250	
q	.072		.073			.068		.082	
r	.637		.686			.665		.668	

X^2 showed non-significant differences between subsets

ABO BLOOD GROUPS - DUAL PARAMETERS

Blood Group	Welsh in North		Welsh in South		English in South	
	No.	Freq.	No.	Freq.	No.	Freq.
O	86	42.2	145	45.0	123	43.9
A	89	43.6	124	38.5	119	42.5
B	24	11.8	42	13.0	25	8.9
AB	3	2.5	11	3.4	13	4.6
Total	204	1.000	322	1.000	280	1.000
Gene Frequencies						
p	.277		.243		.267	
q	.074		.086		.070	
r	.649		.671		.663	
	X^2 tests showed non-significant differences between subsets					

Using three birth locations	Welsh in North		Welsh in S.W.		Welsh in S.E.		English in S.W.		English in S.W.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
Blood Group										
O	86	42.2	71	44.4	74	45.7	55	40.7	68	46.9
A	89	43.6	63	39.4	61	37.7	61	45.3	58	40.0
B	24	11.8	22	13.8	20	12.3	13	9.6	12	8.3
AB	5	2.5	4	2.5	7	4.3	6	4.4	7	4.8
Total	204	1.000	160	1.000	162	1.000	135	1.000	145	1.000
Gene Frequencies										
p	.277		.249		.237		.289		.247	
q	.074		.085		.087		.073		.068	
r	.649		.666		.676		.638		.685	
	X^2 tests showed non-significant differences between subsets									

TABLE 4.3

RHESUS SYSTEM -- SINGLE PARAMETERS

Gene Complex	BP	North Pembs.		South Pembs.		PBP	North Pembs.		South Pembs.	
		No.	Freq.	No.	Freq.		No.	Freq.	No.	Freq.
CcDEe		61	.271	66	.141		40	.267	36	.135
CcDee		81	.360	164	.350		58	.387	97	.365
CCDee		28	.124	71	.151		17	.113	40	.150
ccDEE		3	.013	10	.021		2	.013	5	.019
ccDEe		7	.031	49	.104		6	.040	29	.109
CcDEE		3	.013	7	.015		2	.013	4	.015
ccDee		8	.036	3	.006		3	.020	4	.015
ccdee		32	.142	93	.198		21	.140	50	.188
ccdEe		1	.004	4	.009		1	.007	1	.004
Ccdee		1	.004	2	.004		-	-	-	-
Total		225	1.000	469	1.000		150	1.000	266	1.000

$X^2 = 35.797$, sig. .001 $X^2 = 17.363$, sig. .027

Gene Complex	BP (3 locations) North		South-West		South-East		Ancestry English		Welsh	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
CcDEe	61	.271	22	.143	44	.140	34	.138	90	.201
CcDee	81	.360	63	.409	101	.321	85	.346	166	.371
CCDee	28	.124	24	.156	47	.149	37	.150	56	.125
ccDEE	3	.013	-	-	10	.032	6	.024	6	.013
ccDEe	7	.031	16	.104	33	.105	20	.081	35	.078
CcDEE	3	.013	-	-	7	.022	3	.012	6	.013
ccDee	8	.036	2	.013	1	.003	2	.008	10	.022
ccdee	32	.142	24	.156	69	.219	56	.228	74	.165
ccdEe	1	.004	2	.013	2	.006	3	.012	2	.004
Ccdee	1	.004	1	.006	1	.003	-	-	3	.007
Total	225	1.000	154	1.000	315	1.000	246	1.000	448	1.000

$X^2 = 52.0560$, sig. .001 $X^2 = 13.802$, sig. 0.129

TABLE 4.4

RHESUS SYSTEM -- DUAL PARAMETERS

Gene Complex	Welsh in North Pembs.		Welsh in South Pembs.		English in South Pembs.	
	No.	Freq.	No.	Freq.	No.	Freq.
CcDEe	50	.272	35	.147	22	.107
CcDee	68	.370	87	.366	73	.356
CCDee	22	.120	33	.139	32	.156
ccDEE	3	.016	3	.013	6	.029
ccDEe	6	.033	27	.113	19	.093
CcDEE	2	.011	4	.017	2	.010
ccDee	7	.038	3	.013	0	-
ccdee	25	.136	42	.176	49	.239
ccdEe	0	-	2	.008	2	.010
Ccdee	1	.005	2	.008	0	-
Total	184	1.000	238	1.000	205	1.000

A X^2 = 22.918, sig. .006 B X^2 = 37.437 sig. .001 C X^2 = 10.401, sig. .319

Gene complex	Welsh in North		Welsh in S.W.		Welsh in S.E.		English in S.W.		English in S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
CcDEe	50	.272	8	.101	27	.170	9	.136	13	.094
CcDee	68	.370	34	.430	53	.333	27	.409	46	.331
CCDee	22	.120	13	.165	20	.126	11	.167	21	.151
ccDEE	3	.016	-	-	3	.019	-	-	6	.043
CcDEe	6	.033	9	.114	18	.113	6	.091	13	.094
CcDEE	2	.011	-	-	4	.025	-	-	2	.014
ccDee	7	.038	2	.025	1	.006	-	-	-	-
ccdee	25	.136	10	.127	32	.201	13	.197	36	.259
ccdEe	0	-	2	.025	-	-	-	-	2	.014
Ccdee	1	.005	1	.013	1	.006	-	-	-	-
Total	184	1.000	79	1.000	159	1.000	66	1.000	139	1.000

D X^2 22.540, sig. .007
E X^2 19.131, sig. .014
F X^2 14.084, sig. .080
G X^2 35.991, sig. .001
H X^2 14.560 sig. [illegible]

I X^2 15.993, sig. .067
J X^2 10.834, sig. .287
K X^2 5.602, sig. .692
L X^2 7.074, sig. .421
M X^2 [illegible]

TABLE 4.5

RHESUS SYSTEM GENE FREQUENCIES

	Gene Complexes							
	cde	cDE	Cde	cdE	cDe	CDE	CdE	cDe
Birth Locations (2)								
North Pembrokeshire	.333	.173	.006	.006	.442	-	-	.040
South Pembrokeshire	.425	.152	.005	.011	.401	-	-	.006
Birth Locations (3)								
North Pembrokeshire	.333	.173	.006	.006	.442	-	-	.040
S.W. Pembrokeshire	.418	.114	.007	.016	.428	-	-	.017
S.E. Pembrokeshire	.426	.173	.004	.007	.388	-	-	.003
Ancestry								
English	.441	.165	-	.014	.398	-	-	.009
Welsh	.414	.139	.008	.005	.413	-	-	.026

TABLE 4.6

M & N BLOOD GROUPS - SINGLE PARAMETERS

Phenotype	BP (Two Groups)				BP (Three Groups)					
	North Pembs.		South Pembs.		North		S.W.		S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
MM	73	.331	142	.329	73	.331	51	.432	8	.284
MN	104	.470	163	.378	104	.470	39	.330	126	.403
NN	44	.199	126	.292	44	.199	28	.238	98	.313
Total	221	1.000	431	1.000	221	1.000	118	1.000	313	1.000
Gene Freqs.										
M	.566		.518		.566		.597		.485	
N	.434		.482		.434		.403		.515	

Phenotype	PBP				Ancestry			
	North Pembs.		South Pembs.		English		Welsh	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
MM	41	.291	82	.326	70	.308	140	.332
MN	72	.511	93	.373	88	.387	180	.427
NN	28	.198	74	.298	69	.305	101	.241
Total	141	1.000	249	1.000	227	1.000	421	1.000
Gene Freqs.								
M	.546		.516		.502		.546	
N	.454		.484		.498		.454	

TABLE 4.6 (CONTD.)

M & N BLOOD GROUPS - DUAL PARAMETERS

2 locations	Welsh in North		Welsh in South		English in South	
	No.	Freq.	No.	Freq.	No.	Freq.
Phenotype						
MM	58	.317	74	.344	59	.307
MN	84	.459	87	.405	70	.365
NN	41	.224	54	.251	63	.328
Total	141	1.000	215	1.000	192	1.000
Gene Frequencies						
M	.546		.546		.489	
N	.454		.454		.511	

3 locations	Welsh in North		Welsh in S.W.		Welsh in S.E.		English in S.W.		English in S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
Phenotype										
MM	58	.317	29	.483	45	.290	19	.373	40	.284
MN	84	.459	16	.267	71	.458	20	.392	50	.355
NN	41	.224	15	.250	39	.252	12	.235	51	.361
Total	141	1.000	60	1.000	155	1.000	51	1.000	141	1.000
Gene Frequencies										
M	.546		.617		.519		.519		.461	
N	.454		.383		.481		.481		.539	

TABLE 4.7

MNSs BLOOD GROUPS (SINGLE PARAMETERS)
(tested with three antisera Anti-M, Anti-N and Anti-S)

Phenotype	BP (2 Groups)				BP (3 Groups)					
	North Pembs.		South Pembs.		N		S.W.		S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
MMS	51	.231	103	.239	51	.231	34	.331	62	.198
MMss	22	.100	39	.090	22	.100	12	.102	27	.086
MNS	61	.276	91	.211	61	.276	21	.178	72	.230
MNss	43	.195	72	.167	43	.195	18	.153	54	.173
NNS	11	.050	53	.123	11	.050	12	.102	41	.131
NNss	33	.149	73	.169	33	.149	16	.136	57	.182
Total	221	1.000	431	1.000	221	1.000	118	1.000	313	1.000
Gene Frequencies										
MS	.2641		.2407		.2641		.2920		.2144	
Ms	.3019		.2773		.3019		.3050		.2706	
NS	.0696		.1067		.0696		.0827		.1169	
Ns	.3644		.3753		.3644		.3203		.3981	

X^2 = 11.716, sig. .039 X^2 = 23.417, sig. .0244

TABLE 4.7(CONTD.)

MNSs BLOOD GROUPS (SINGLE PARAMETERS)

Phenotype	PBP				Ancestry			
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
MMS	28	.199	61	.245	47	.207	105	.249
MMss	13	.092	21	.084	23	.101	35	.083
MNS	42	.298	52	.209	43	.189	107	.254
MNss	30	.213	41	.165	45	.198	73	.173
NNS	5	.035	27	.108	32	.141	81	.074
NNss	23	.163	47	.189	37	.163	70	.166
Total	141	1.000	249	1.000	227	1.000	421	1.000
Gene Frequencies								
MS	.2539		.2490		.2021		.2730	
Ms	.2921		.2670		.2999		.2730	
NS	.0620		.0893		.1182		.0772	
Ns	.3920		.3947		.3798		.3768	

X^2 = 11.190, sig. .048 X^2 = 11.8635 sig. .037

TABLE 4.8

MNSs BLOOD GROUPS - DUAL PARAMETERS

Phenotype	Welsh in North		Welsh in South		English in South	
	No.	Freq.	No.	Freq.	No.	Freq.
MMS	41	.224	57	.265	39	.203
MMss	17	.93	17	.79	20	.104
MNs	53	.290	50	.233	36	.188
MNss	31	.169	37	.172	34	.177
NNS	11	.060	18	.84	31	.161
NNss	30	.164	36	.167	32	.167
Total	183	1.000	215	1.000	192	1.000
Gene Frequencies						
MS	.2638		.2783		.1956	
Ms	.2821		.2677		.2934	
NS	.0835		.0837		.1363	
Ns	.3705		.3788		.3747	

X^2 Test A X^2 3.622, sig. B X^2 14.123, sig. .028 C X^2 8.508, sig. 203

TABLE 4.8 (CONTD.)

MNSs BLOOD GROUPS - DUAL PARAMETERS

Using three birth locations	Welsh in North		Welsh in S.W.		Welsh in S.E.		English in S.W.		English in S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
Phenotype										
MMS	41	22.4	24	40.1	33	21.2	14	27.5	25	17.7
MMss	17	9.3	5	8.3	12	7.7	5	9.8	15	10.6
MNS	53	29.0	8	13.3	42	27.11	10	19.6	26	18.4
MNss	31	16.9	8	13.3	29	18.7	10	19.6	24	17.0
NNS	11	6.0	8	13.3	10	6.5	3	5.9	28	19.9
NNss	30	16.4	7	11.7	29	18.7	9	17.6	23	16.5
Total	183	1.000	60	1.000	155	1.000	51	1.000	141	1.000
Gene Frequencies										
MS	.2638		.3319		.2556		.2517		.1715	
Ms	.2821		.2851		.2634		.2673		.2895	
NS	.0835		.0909		.0729		.0626		.1645	
Ns	.3705		.2921		.4081		.4184		.3745	

X^2 Test

D X^2 13.780, sig. .017
E X^2 .8876, sig. .971
F X^2 1.940, sig. .857
G X^2 17.612, sig. .004
H X^2 14.176, sig. .015

I X^2 12.574, sig. .050
J X^2 14.301, sig. .026
K X^2 2.235, sig. .897
L X^2 6.799, sig. .236
M X^2 4.901, sig. .425

TABLE 4.9

P_1 BLOOD GROUP - SINGLE PARAMETERS

	BP (2 locations)								FBP							
	North Pembs.				South Pembs.				North				South			
	P_1 +ve		P_1 -ve		P_1 +ve		P_1 -ve		P_1 +ve		P_1 -ve		P_1 +ve		P_1 -ve	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
	156	.632	91	.368	308	.555	247	.445	105	.640	59	.360	169	.554	136	.446
Total	247				555				164				305			
Gene frequencies																
P_1	.3931				.3329				.4002				.3323			
$P_2 + P$	.6069				.6671				.5998				.6677			

X^2 7.151 Sig. .1281

Ancestry	English				Welsh			
	P_1 +ve		P_1 -ve		P_1 +ve		P_1 -ve	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
	169	.595	115	.405	293	.571	220	.429
Total	284						513	
Gene Frequencies								
P_1	.3637				.3452			
$P_2 + p$	.6363				.6548			

X^2 2.897 Sig. .5752

P_1 BLOOD GROUP - SINGLE PARAMETERS

BP (3 locations)	North				South-west				South-east			
	P_1+ve		P_1-ve		P_1+ve		P_1-ve		P_1+ve		P_1-ve	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
	156	.632	91	.368	261	.610	90	.390	167	.515	157	.485
Total	247				351				324			
Gene Freqs.												
P_1	.3931				.4936				.3915			
P_2 + p	.6069				.5064				.6085			

X^2 = 18.1589 Sig. = .0201

TABLE 4.10

P_1 BLOOD GROUP SYSTEM - DUAL PARAMETERS

	Welsh in North Pembs.		English in South		Welsh in South	
	No.	Freq.	No.	Freq.	No.	Freq.
P_1+ve	126	.621	141	.585	149	.527
P_1-ve	77	.579	100	.415	134	.473
Total	203	1.000	241	1.000	283	1.000
Gene Freqs.						
P_1	.3841		.3558		.3119	
P_2 + p	.6159		.6442		.6881	

A X^2 6.5469, sig. 0.1619 B X^2 1.8409, sig. 0.7650 C X^2 3.7180, sig. 0.4455

	Welsh in North		Welsh in S.W.		Welsh in S.E.		English in S.W.		English in S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
P_1+ve	126	.621	67	.549	82	.509	64	.667	77	.531
P_1-ve	77	.379	55	.451	79	.491	32	.333	68	.469
Total	203	1.000	122	1.000	161	1.000	96	1.000	145	1.000
Gene Freqs.										
P_1	.3841		.3286		.2995		.4226		.3152	
P_2 + p	.6159		.6714		.7005		.5774		.6848	

D X^2 5.9698, sig. .2014 H X^2 4.1740, sig. .3830 K X^2 7.5386, sig. .1100
E X^2 5.0702, sig. .2802 I X^2 5.811, sig. .2129 L X^2 6.7088, sig. .1521
F X^2 1.3566, sig. .8517 J X^2 0.6098, sig. .9620 M X^2 5.6072, sig. .2305
G X^2 5.0702, sig. .2802

TABLE 4.11

PHOSPHOGLUCOMUTASE (PGM^1)

Phenotypes	BP (2 Locations)				PBP			
	North Pembs.		South Pembs.		North Pembs.		South Pembs.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
1-1	190	.782	404	.671	122	.758	285	.687
2-1	44	.181	179	.297	32	.190	94	.275
2-2	9	.037	19	.032	7	.043	13	.038
Total	243	1.000	602	1.000	161	1.000	342	1.000
	X^2 12.048, sig. .0024				X^2 3.3822, sig. 0.1843			
Gene Frequencies								
PGM^1_1	.872		.819		.857		.824	
PGM^1_2	.128		.181		.143		.176	

Phenotypes	BP (3 locations)						Ancestry			
	North		South-west		South-east		English		Welsh	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
1-1	190	.782	203	.695	201	.648	218	.717	373	.695
2-1	44	.181	82	.281	97	.313	77	.253	144	.268
2-2	9	.037	7	.024	12	.039	9	.030	20	.037
Total	243	1.000	292	1.000	310	1.000	304	1.000	537	1.000
	X^2 14.089, sig. .007						X^2 0.6316, sig. .7292			
Gene Frequencies										
PGM^1_1	.872		.835		.804		.843		.829	
PGM^1_2	.128		.155		.196		.157		.171	

TABLE 4.12

PHOSPHOGLUCOMUTASE - DUAL PARAMETERS

Phenotype	Welsh in North No.	Welsh in North Freq.	Welsh in South No.	Welsh in South Freq.	English in South No.	English in South Freq.
1-1	151	.759	199	.646	183	.701
2-1	39	.196	99	.321	70	.268
2-2	9	.045	10	.032	8	.031
Total	199	1.000	308	1.000	261	1.000
Gene Frequencies						
PGM^1	.857		.806		.835	
PGM^2	.143		.194		.165	

A X^2 9.7387, sig. .0077 B X^2 3.6510 sig. .1611 C X^2 2.0001, sig. .3679

Phenotype	Welsh in North No.	Welsh in North Freq.	Welsh in S.W. No.	Welsh in S.W. Freq.	Welsh in S.E. No.	Welsh in S.E. Freq.	English in S.W. No.	English in S.W. Freq.	English in S.E. No.	English in S.E. Freq.
1-1	151	.759	100	.658	99	.635	90	.726	93	.679
2-1	39	.196	48	.316	51	.327	31	.250	39	.285
2-2	9	.045	4	.026	6	.038	3	.024	5	.036
Total	199	1.000	152	1.000	156	1.000	124	1.000	137	1.000
Gene Frequencies										
PGM^1	.857		.816		.798		.851		.816	
PGM^2	.143		.184		.202		.149		.184	

D X^2 7.0496, sig. .0295
E X^2 7.924, sig. .0190
F X^2 2.0498, sig. .3588
G X^2 3.6123, sig. .1643
H X^2 0.4441, sig. .8009

I X^2 0.5189, sig. .7715
J X^2 0.6491, sig. .7229
K X^2 2.6845, sig. .2613
L X^2 0.8180, sig. .6643
M X^2 1.5023, sig. p4718

TABLE 4.13

ACID PHOSPHATASE

Phenotypes	BP (2 locations)				PBP			
	North Pembs.		South Pembs.		North Pembs.		South Pembs.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
A	23	.095	89	.145	14	.086	49	.142
BA	122	.303	291	.303	46	.284	103	.299
B	74	.500	186	.475	88	.543	165	.478
CB	22	.090	45	.073	13	.080	27	.078
CA	3	.012	2	.003	1	.006	1	.003
Total	244	1.000	613	1.000	162	1.000	345	1.000
	X^2 6.7622, sig. .1490				X^2 4.0603, sig. .3979			
Gene Frequencies								
p^a	.253		.297		.231		.293	
p^b	.697		.665		.725		.666	
p^c	.046		.038		.043		.041	

TABLE 4.13 (CONTD.)

ACID PHOSPHATASE

Phenotypes	BP (3 Locations)						Ancestry			
	North Pembs.		S.W. Pembs.		S.E. Pembs.		English		Welsh	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
A	23	.095	44	.145	45	.145	39	.126	74	.136
BA	122	.303	143	.314	91	.294	101	.326	149	.273
B	74	.500	95	.472	148	.477	140	.452	277	.510
CB	22	.090	20	.066	25	.081	29	.004	40	.074
CA	3	.012	1	.003	1	.003	1	.003	4	.007
Total	244	1.000	304	1.000	310	1.000	310	1.000	543	1.000
	X^2 7.3935, sig. .4948						X^2 5.004, sig. 2869			
Gene Frequencies										
p^a	.253		.304		.294		.336		.273	
p^b	.697		.662		.664		.662		.684	
p^c	.047		.035		.042		.049		.045	

TABLE 4.14

ACID PHOSPHATASE - DUAL PARAMETERS

Phenotype	Welsh in North		Welsh in South		English in South	
	No.	Freq.	No.	Freq.	No.	Freq.
A	19	.095	50	.160	34	.128
BA	101	.505	161	.514	116	.436
B	58	.290	81	.259	90	.338
CB	20	.100	19	.061	26	.098
CA	2	.010	2	.006	0	-
Total	200	1.000	313	1.000	266	1.000

Gene Frequencies

	Welsh in North	Welsh in South	English in South
p^a	.245	.293	.297
p^b	.700	.673	.654
p^c	.055	.034	.049

A = X^2 6.9455, sig. .1388 B = X^2 5.7514, sig. .2185 C = X^2 10.1725, sig. .0376

TABLE 4.14 (CONTD.)

ACID PHOSPHATASE - DUAL PARAMETERS (CONTD.)

Phenotype	Welsh in North		Welsh in S.W.		Welsh in S.E.		English in S.W.		English in S.E.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
A	19	.095	25	.160	25	.159	16	.122	18	.133
BA	101	.505	72	.462	89	.567	63	.481	53	.393
B	58	.290	48	.308	33	.210	42	.321	48	.356
CB	20	.100	10	.064	9	.057	10	.076	16	.119
CA	2	.010	1	.006	1	.006	-	-	-	-
Total	200	1.000	156	1.000	157	1.000	131	1.000	135	1.000
Gene Frequencies										
p^a	.245		.317		.267		.283		.310	
p^b	.700		.648		.700		.679		.630	
p^c	.055		.035		.033		.038		.060	

D = X^2 4.9266, sig. .2949
E = X^2 7.8851, sig. .096
F = X^2 2.6885, sig. .6112
G = X^2 5.9894, sig. .1999
H = X^2 4.622, sig. .8283

I = X^2 4.9223, sig. .2954
J = X^2 14.4284, sig. .006
K = X^2 6.2594, sig. .1806
L = X^2 2.7048, sig. .4394
M = X^2 1.8117, sig. 7703

TABLE 4.15

SERUM HAPTOGLOBINS - SINGLE PARAMETERS

Phenotypes	BP (Two Groups)				BP (Three Groups)					
	North Pembs.		South Pembs.		North		South-west		South-east	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
1-1	36	.142	89	.161	36	.142	26	.113	63	.195
2-1	126	.510	284	.513	126	.510	126	.545	158	.489
2-2	86	.348	181	.327	86	.348	79	.342	102	.316
Total	247	1.000	554	1.000	247	1.000	231	1.000	323	1.000
	X^2 .6345, sig. .7282				X^2 7.6659, sig. .1046					
Gene Frequencies										
Hp^1	.397		.418		.397		.386		.440	
Hp^2	.603		.582		.603		.614		.560	

Phenotypes	PBP (Two Groups)				Ancestry			
	North		South		Welsh		English	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
1-1	24	.146	47	.155	71	.139	52	.183
2-1	83	.506	153	.503	255	.498	147	.518
2-2	57	.348	104	.342	186	.363	85	.299
Total	164	1.000	304	1.000	512	1.000	284	1.000
	X^2 .0588, sig. .9710				X^2 4.6684, sig. .0969			
Gene Frequencies								
Hp^1	.399		.407		.388		.442	
Hp^2	.601		.593		.612		.558	

TABLE 4.16

SERUM HAPTOGLOBINS - DUAL PARAMETERS

Phenotypes	Welsh in North Pembs.		English in South Pembs.		Welsh in South Pembs.	
	No.	Freq.	No.	Freq.	No.	Freq.
1-1	29	.143	44	.183	39	.138
2-1	101	.498	125	.519	140	.496
2-2	73	.360	72	.298	103	.366
Total	203	1.000	241	1.000	282	1.000
Gene Frequencies	A X^2 .0281, sig.986		B X^2 2.4031, sig.3007		C X^2 3.4487, sig.1783	
Hp^1	.392		.442		.386	
Hp^2	.608		.558		.614	

Phenotypes	Welsh in N.Pembs.		English in SW Pembs.		Welsh in SW Pembs.		English in SE Pembs.		Welsh in SE Pembs.	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
1-1	29	.143	14	.146	11	.090	30	.207	28	.175
2-1	101	.498	56	.583	60	.492	69	.476	80	.500
2-2	73	.360	26	.271	51	.418	46	.317	52	.325
Total	203	1.000	96	1.000	122	1.000	145	1.000	160	1.000
Gene Frequencies										
Hp^1	.392		.438		.336		.445		.425	
Hp^2	.608		.562		.664		.555		.575	

D	X^2	2.4060, sig. .3003	G	X^2	2.5713, sig. .2765	J	X^2	.5119, sig. .7742
E	X^2	2.5713, sig. .2765	H	X^2	5.2519, sig. .0724	K	X^2	1.6732, sig. .4332
F	X^2	2.4690, sig. .2910	I	X^2	7.7669, sig. .0206	L	X^2	2.8822, sig. .2367
						M	X^2	5.5935, sig. .0610

TABLE 4.17

ABO BLOOD GROUPS

Locality	No.	Gene Frequencies			Author
		p	q	r	
Co. Leix (Eire)	61	.060	.110	.830	Tills (1975)
Iceland	878	.142	.068	.790	Donoyani et al (1950)
Eire		.170	.070	.760	Teesdale & Tills (1970)
Carnew (Eire)	175	.189	.077	.734	Sunderland et al (1973)
Co. Wicklow (Eire)	58	.190	.060	.750	Tills (1975)
Ulster	29,143	.199	.063	.738	Kopec (1970)
Co. Waterford(Eire)	65	.200	.040	.760	Tills (1975)
Co. Kilkenny (Eire)	41	.210	.040	.740	Tills (1975)
S.W. Scotland	612	.226	.085	.689	Kopec (1970)
Co. Wexford (Eire)	54	.23	.10	.67	Tills (1975)
Carmarthenshire,E.	1,249	.23	.07	.70	Watkin (1965)
Wales (excluding S.W. peninsula) area 13	7,062	.232	.072	.697	Kopec (1970)
North Wales	2,550	.244	.064	.692	Fraser Roberts (1942)
N.Pembs. & Lower Teife Valley	876	.245	.077	.679	Watkin (1960)
South-east Carn.	469	.249	.078	.673	Garlick & Pantin (1957)
Pembrokeshire (Area 38)	2,621	.250	.066	.685	Kopec (1970)
South-East Pembs.	325	.250	.077	.673	Present study
Carmarthenshire,W.	599	.259	.052	.689	Watkin (1960)
Pembrokeshire (whole county)	885	.265	.075	.660	Present study
Isle of Man	809	.266	.051	.683	Mitchell (1974)
Belgium	2,000	.267	.051	.682	Otto-Servais et al (1959)
South-west Pembs.	311	.269	.077	.654	Present study
North Pembs.	249	.277	.071	.652	Present study
'Little England' N.W.	505	.279	.074	.647	Watkin (1960)
'Little England' S.E.	431	.339	.083	.578	Watkin (1960)

TABLE 4.18

RHESUS SYSTEM

Gene Frequencies

Locality	No.	D	d	Author
South-east Pembrokeshire	325	.519	.481	Present study
S.W. Scotland	786	.547	.453	Mitchell et al (1976)
Isle of Man	625	.552	.448	Mitchell (1974)
Eire	295	.553	.447	Palsson (1970)
England	355,221	.571	.429	Kopec (1970)
Co. Wexford	4,928	.573	.427	Dawson (1964)
Scotland	45,906	.579	.421	Kopec (1970)
Belgium	3,935	.580	.420	Moureau (1952)
Co. Carlow	2,517	.580	.420	Dawson (1964)
Pembs. (Overall)	694	.582	.418	Present study
Co. Leix	2,645	.584	.416	Dawson (1964)
Glamorgan	1,061	.587	.413	Drummond (1969)
Ulster	56,316	.589	.411	Kopec (1970)
Wales	15,484	.594	.406	Kopec (1970)
North Pembrokeshire	249	.594	.404	Present study
Co. Wicklow	3,198	.596	.404	Dawson (1964)
Co. Waterford	3,431	.600	.400	Dawson (1964)
Iceland	205	.605	.395	Donegani et al (1950)
Co. Cork	3,367	.610	.390	Dawson (1964)
S.E. Carmarthen	422	.623	.377	Garlick & Pantin (1957)
S.W. Pembrokeshire	311	.634	.366	Present study

TABLE 4.19

RHESUS SYSTEM

Gene Frequencies

Locality	No.	cde	CDE	Cde	cdE	CDe	cDe	Author
North Pembrokeshire	225	.333	.173	.006	.006	.442	.060	Present study
Belgium	265	.344	.137	.010	-	.462	.043	Leguebe (1966)
Co. Wicklow	58	.345	.132	-	-	.36	-	Tills (1975)
Carnew	175	.352	.136	-	-	.455	.028	Sunderland et al (1973)
S.E. Carmarthen	422	.360	.178	.003	.006	.410	.036	Carlick & Parlin (1957)
Pembs. (overall)	694	.392	.153	.006	.010	.419	.027	Present study
England	154	.395	.167	.007	.015	.408	.009	Race et al (1944)
Eire	295	.402	.159	.023	.007	.359	.051	Palsson et al (1970)
S.W. Pembrokeshire	154	.418	.114	.007	.016	.428	.017	Present study
Iceland	295	.422	.144	.088	-	.313	.034	Palsson et al (1970)
S.E. Pembrokeshire	315	.426	.173	.004	.007	.388	.003	Present study
Ulster	200	.441	.104	.006	.006	.402	.035	Huth (1953)
Co. Wexford	54	.47	.13	-	-	.36	-	Tills (1975)
Scotland Highlands	100	.475	.154	.012	.025	.310	.025	Brown, E. (1965)
Co. Waterford	66	.48	.15	-	-	.35	-	Brown, E. (1965)
Co. Carlow	52	.54	.10	-	-	.32	.02	Brown, E. (1965)

TABLE 4.20

MN SYSTEM

Gene Frequencies

Locality	No.	M	N	Author
S.E. Pembrokeshire	313	.483	.517	Present study
Netherlands	200	.522	.478	Loghem & Berkhout (1948)
England	422	.524	.476	Taylor & Prior (1938)
Carnew (Eire)	175	.529	.471	Sunderland et al (1973)
Co. Waterford (Eire)	66	.53	.47	Tills (1975)
Pembrokeshire (overall)	652	.535	.465	Present study
Eire (Cork and Kerry)	304	.549	.451	Casey et al (1962)
Ulster (Belfast)	202	.550	.450	Macafee (1964)
Co. Carlow	52	.560	.440	Tills (1975)
North Pembrokeshire	221	.566	.434	Present study
Iceland	747	.570	.430	Donegani (1950)
S.E. Carmarthenshire	468	.575	.425	Garlick & Pantin (1957)
Scottish Highlands	100	.580	.421	Brown, E. (1965)
Iceland	2,029	.581	.419	Bjarrasson (1968)
Wales	192	.583	.417	Boyd and Boyd (1937)
Scotland (Glasgow)	456	.590	.410	Malta (1937)
Co. Kilkenny (Eire)	41	.590	.410	Tills (1975)
S.W. Pembrokeshire	118	.599	.401	Present study
Co. Leix (Eire)	61	.60	.40	Tills (1975)
Co. Wicklow (Eire)	58	.62	.38	Tills (1975)
Co. Wexford (Eire)	53	.64	.36	Tills (1975)

TABLE 4.21

MNSs SYSTEM

Gene Frequencies

Locality	No.	MS	Ms	NS	Ns	Author
Netherlands	89	.184	.344	.089	.382	Meier & Nijenhuis (1961)
Carnew	175	.193	.336	.055	.416	Sunderland et al (1973)
Ulster	106	.196	.408	.041	.355	Ikin et al (1952)
Co. Waterford	66	.21	.32	.07	.40	Tills (1975)
S.E. Carmarthen	468	.213	.362	.083	.341	Garlick & Pantin (1957)
S.E. Pembrokeshire	313	.214	.271	.117	.398	Present study
Wales	116	.223	.321	.114	.343	Ikin et al (1952)
Iceland	135	.225	.449	.055	.270	Palssen & Walter (1967)
Norway	260	.232	.332	.054	.382	Mohr (1966)
England	1,166	.240	.298	.056	.406	Ikin et al (1952)
Scotland	527	.246	.293	.050	.411	Ikin et al (1952)
Pembrokeshire(overall)	652	.257	.293	.089	.361	Present study
Netherlands	347	.258	.289	.069	.384	Nijenhuis (1961)
North Pembrokeshire	221	.264	.302	.070	.364	Present study
Eire	295	.265	.353	.062	.320	Palssen et al (1970)
Co. Wicklow	58	.275	.346	.027	.40	Sunderland et al (1973)
S.W. Pembrokeshire	118	.292	.305	.083	.320	Present study
Scottish Highlands	100	.309	.271	.089	.332	Brown, E. (1965)
Co. Wexford	53	.32	.32	-	.36	Tills (1975)

TABLE 4.22

P SYSTEM

Gene Frequencies

Locality	No.	P_1	$P_2 + P$	Author
Eire	295	.259	.741	Palsson et al (1970)
Co. Tipperary	55	.38	.62	Tills (1975)
South-east Pembrokeshire	324	.392	.608	Present study
North Pembrokeshire	417	.393	.607	Present study
Iceland	2,058	.403	.597	Bjarnason et al(1968)
Pembrokeshire(Overall)	804	.426	.574	Present study
Ulster	319	.446	.554	Teesdale & Tills(1970)
Co. Wicklow	58	.475	.525	Sunderland et al(1973)
Wales	116	.483	.517	Ikin et al (1954)
Iceland	135	.484	.516	Palsson & Walter (1967)
Eire	1,540	.489	.511	Teesdale & Tills (1970)
Carnew	175	.493	.507	Sunderland et al (1973)
South-west Pembrokeshire	351	.494	.506	Present study
Scotland	527	.505	.495	Ikin et al (1954)
England	1,166	.516	.484	Ikin et al (1954)
Ulster	106	.534	.466	Ikin et al (1954)
Netherlands	845	.538	.461	Nijenhuis (1961)

TABLE 4.23

DUFFY SYSTEM

Gene Frequencies

Locality	No.	Fy^a	Fy^b + Fy	Author
Eire	295(Males)	.304	.696	Palsson et al (1970)
Scottish Highlands	100	.360	.640	Brown, E. (1965)
Eire	95	.385	.615	Hackett & Dawson (1958)
Munster (Eire)	379	.400	.600	Tills (1975)
Ulster	106	.409	.591	Ikin (1954)
England	1166	.413	.589	Ikin (1954)
S.W. Pembrokeshire	231	.419	.581	Present study
Netherlands	937	.419	.581	Nijenhuis (1961)
Pembs. (overall)	800	.423	.577	Present study
North Pembrokeshire	246	.423	.577	Present study
Scotland	527	.424	.576	Ikin et al (1954)
Iceland	2055	.426	.574	Bjarnason et al (1968)
S.E. Pembrokeshire	323	.427	.573	Present study
Norway	259	.444	.556	Mohr (1966)
Leinster (Eire)	656	.45	.55	Tills (1975)
Wales	116	.451	.549	Ikin (1954)

TABLE 4.23

KELL SYSTEM

Gene Frequencies

Locality	No.	K	k	Author
S.W. Pembrokeshire	231	.035	.965	Present study
Ulster	106	.038	.962	Ikin (1954)
England	1166	.039	.961	Ikin (1954)
Denmark	1204	.041	.959	Skov et al (1970)
Pembs. (Overall)	802	.042	.958	Logharn et al (1953)
Netherlands	538	.044	.956	Teesdale & Tills (1970)
Eire	1701	.044	.956	Ikin (1954)
Wales	116	.043	.957	Ikin (1954)
North Pembs.	247	.045	.0955	PRESENT STUDY
Scotland	527	.045	.0955	Ikin (1954)
Ulster	319	.046	.954	Teesdale & Tills (1970)
South East Pembs.	324	.047	.953	Present study
Iceland	2056	.054	.946	Bjarnason et al (1968)

TABLE 4.24

PHOSPHOGLUCOMUTASE

Gene Frequencies

Locality	No.	PGM^1	PGM^2	Author
Co. Wicklow	58	.67	.33	Tills (1975)
Co. Waterford	93	.68	.32	Tills (1975)
Co. Wexford	54	.72	.28	Tills (1975)
Co. Kilkenny	43	.74	.26	Tills (1975)
Isle of Man	311	.741	.252	Mitchell (1974)
Northumberland, West	61	.746	.254	Papiha (1973)
Northumberland, S.E.	109	.761	.239	Papiha (1973)
S.W. Scotland	828	.765	.235	Kopec (1970)
England	2,115	.764	.236	Hopkinson & Harris (1966)
Carnew	175	.767	.233	Sunderland et al (1973)
Co. Carlow	52	.77	.23	Tills (1971)
Germany (Bonn)	492	.777	.223	Rittner et al (1969)
Ulster	318	.786	.214	Tills (1971)
Northumberland (North)	134	.791	.209	Papiha (1973)
Co. Leix	81	.80	.20	Tills (1971)
South-east Pembrokeshire	310	.804	.196	Present study
Iceland	129	.818	.182	Mourant & Tills(1967)
South-west Pembrokeshire	292	.835	.155	Present study
Pembrokeshire (overall)	845	.837	.163	Present study
Ulster (Armagh, Down)	105	.85	.15	Tills (1971)
Eire	106	.863	.137	Palsson (1970)
North Pembrokeshire	243	.872	.128	Present study

TABLE 4.25

ACID PHOSPHATASE

Gene Frequencies

Locality	No.	p^a	p^b	p^c	Author
Co. Wexford	54	.230	.700	.070	Tills (1975)
Co. Carlaw	52	.250	.700	.050	Tills (1975)
North Pembrokeshire	244	.257	.697	.046	Present study
Pembrokeshire (overall)	857	.283	.699	.058	Present study
Eire	295	.288	.676	.036	Palsson et al (1970)
Northumberland (W)	62	.290	.645	.065	Papiha (1973)
South-east Pembrokeshire	310	.294	.664	.042	Present study
South-west Pembrokeshire	304	.304	.662	.035	Present study
Northumberland (N)	134	.310	.638	.052	Papiha (1973)
Co. Wicklow	58	.319	.612	.069	Sunderland et al (1973)
Co. Waterford	93	.330	.640	.030	Tills (1971)
Ulster	315	.332	.632	.037	Tills (1971)
Eire	1787	.338	.616	.046	Tills (1971)
S.W. Scotland		.338	.608	.054	Renwick (1973)
Co. Leix	61	.340	.620	.040	Tills (1971)
Northumberland (S.E.)	109	.349	.624	.027	Papiha (1973)
Belgium	500	.349	.596	.055	Brocteur et al (1970)
Co. Kilkenny	41	.360	.620	.020	Tills (1971)
England	369	.362	.599	.038	Hopkinson (1966) in Bjarnason et al (1973)
Norway	210	.379	.555	.066	Berg (1971)

TABLE 4.26

ESTERASE D

Gene Frequencies

Locality	No.	ESD^1	ESD^2	Author
N.E. England	583	.876	.124	Papiha & Nahar (1977)
Eire	186	.877	.123	Welch & Lee (1974)
S.E. England	906	.885	.115	Parkin & Adams (1975)
England	399	.887	.113	Welch & Lee (1974)
Belgium	166	.894	.106	
Denmark	1,392	.896	.104	Sorennsen & Fenger (1976)
S.W. Scotland	829	.902	.098	Cartwright et al (1976)
Northumberland	128	.911	.089	Cartwright et al (1976)
South-east Pembs.	313	.914	.086	Present study
North Pembrokeshire	246	.915	.085	Present study
Pembs. (overall)	866	.917	.083	Present study
South-west Pembs.	307	.924	.076	Present study

TABLE 4.27

ADENYLATE KINASE

Gene Frequencies

Locality	No.	AK^1	AK^2	Author
Eire	114	.873	.127	Bajakzadeh (1969)
Carlaw (Eire)	175	.940	.060	Sunderland et al (1973)
Iceland	1,139	.943	.057	Tills et al (1971)
Co. Wicklow	58	.95	.05	Tills (1975)
Co. Wexford	54	.95	.05	Tills (1975)
British	1,887	.955	.045	Rapley et al (1967)
Ulster	318	.959	.041	Tills (1975)
Eire	1,786	.966	.034	Tills (1971)
Isle of Man	326	.966	.034	Mitchell (1974)
S.W. Scotland	412	.966	.034	Mitchell et al (1976)
Denmark	230	.970	.030	Lamm (1971)
Co. Leix	61	.980	.020	Tills (1975)
Co. Waterford	93	.980	.020	Tills (o975)
Co. Kilkenny	41	.980	.020	Tills (1975)
North Pembs.	244	.981	.019	Present study
Carnew	175	.983	.017	Sunderland et al (1973)
Pembrokeshire (overall)	845	.984	.016	Present study
S.W. Pembs.	302	.986	.014	Present study
S.W. Pembs.	299	.986	.014	Present study

TABLE 4.28

HAPTOGLOBINS

Gene Frequencies

Locality	No.	Hp^1	Hp^2	Author
Co. Leix	61	.330	.670	Tills (1975)
Iceland (North)	356	.340	.660	Beckmon & Johnannsson (1967)
Isle of Man	356	.350	.650	Mitchell et al (1974)
Scotland	100	.356	.644	Kamel et al (1963)
Co. Wexford	54	.370	.530	Tills (1975)
Eire	1,766	.377	.623	Tills (1971)
Eire	295	.378	.622	Palsson (1970)
Co. Waterford	65	.380	.620	Tills (1975)
South-west Pembs.	231	.386	.614	Present study
England	218	.389	.611	Allison et al (1958)
North Pembs.	247	.397	.603	Present study
S.W. Scotland	874	.399	.601	Mitchell et al (1976)
Pembrokeshire (overall)	801	.408	.592	Present study
Ulster	315	.410	.590	Tills (1971)
Iceland	402	.416	.584	Beckman & Johannsson (1967)
Belgium	610	.415	.585	Ros et al (1963)
Co. Wicklow	58	.424	.576	Sunderland et al (1973)
Iceland (West) (South)	402	.429 .436	.571 .564	Beckman & Johannsson (1967)
South-east Pembs.	323	.440	.560	Present study
Carnew	175	.450	.550	Sunderland et al (1973)
Co. Carlaw	52	.510	.490	Tills (1975)

TABLE 4.29

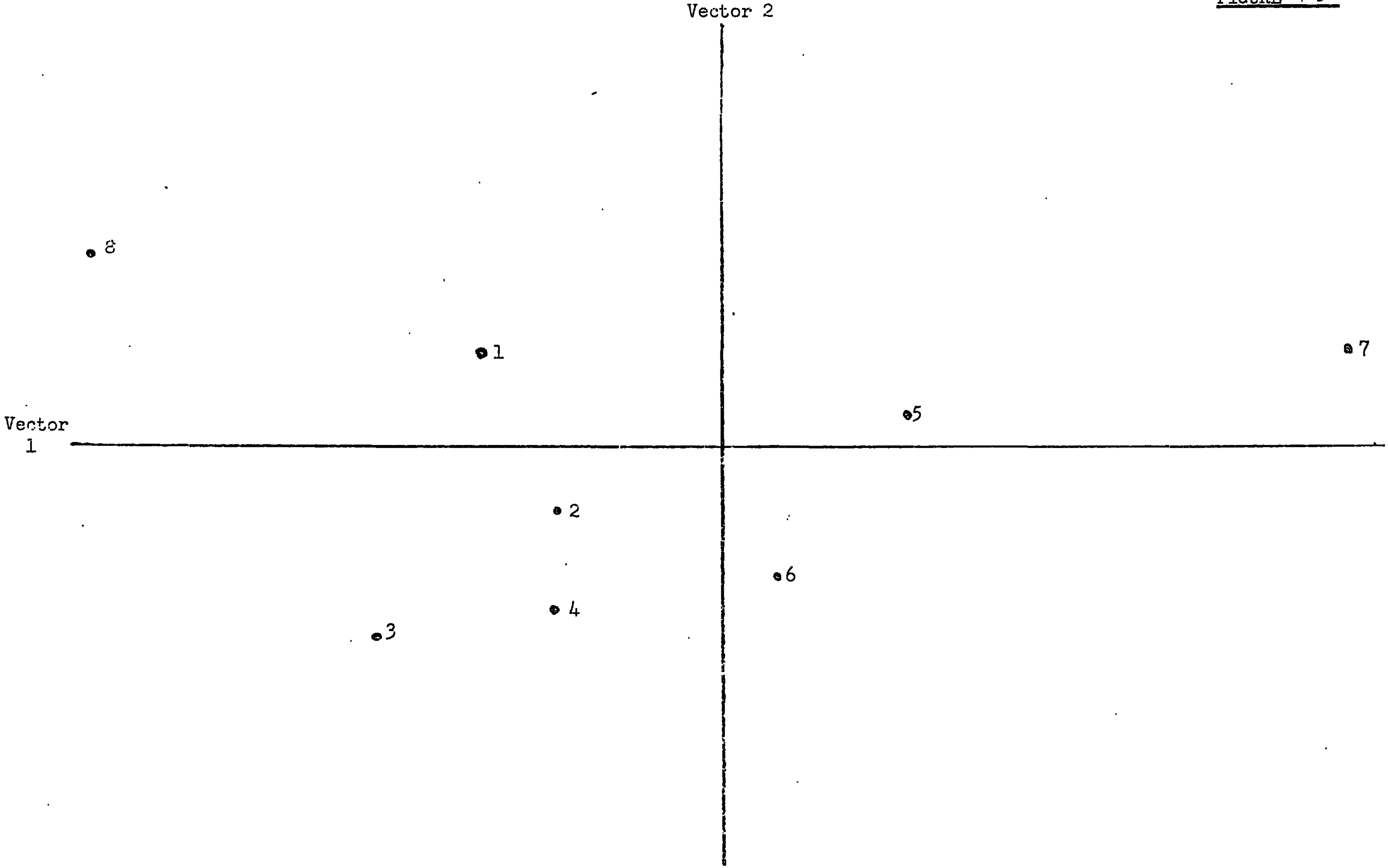
EDWARDS E^2 DISTANCES

	1 N. Pembs.	2 SW Pembs.	3 SE Pembs.	4 England	5 Eire	6 Scotland	7 Iceland	8 Flemish
1 N. Pembs.	1.000	0.00372	0.00435	0.00551	0.00422	0.00501	0.01038	0.00521
2 S.W. Pembs.	0.05576		0.00411	0.00325	0.00414	0.00397	0.01152	0.00998
3 S.E. Pembs.	0.06518	0.06165		0.00313	0.00687	0.00440	0.01300	0.00997
4 England	0.08259	0.04875	0.04702		0.00545	0.00185	0.01104	0.00839
5 Eire	0.06326	0.06216	0.10309	0.08171		0.00389	0.00479	0.01016
6 Scotland	0.07520	0.05956	0.06601	0.02774	0.05832		0.00889	0.01025
7 Iceland	0.15566	0.17285	0.19499	0.16566	0.07192	0.13333		0.01417
8 Flemish	0.07809	0.14977	0.14953	0.12580	0.15245	0.15371	0.21254	1.000

Upper triangle represents standardised E^2 values.

FIGURE 4.30

NMMS Plot of E^2 Distance Matrix



```
C
C
C     PROGRAM TO EVALUATE EDWARDS E SQUARED
C     ************************************
C
C     A. R. WOOLLEY        10.09.79
C     *************        ********
C
C
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION TITLE(20),  PA(20,10), PB(20,10), NA(20)
C
C     WRITE TITLE, READ DATA & REPRINT
C
      WRITE(6,5)
    5 FORMAT(///T20,'EDWARDS E SQUARED EVALUATION'/T20,28('*')//)
   10 FORMAT(I2)
      READ(5,2) TITLE
      READ(5,10) NSYS
    2 FORMAT(20A4)
      WRITE(6,3) TITLE
    3 FORMAT(//T20,20A4//)
      DO 20 I=1,NSYS
      READ(5,10) NA(I)
      NP=NA(I)
      DO 19 J=1,NP
      READ(5,16)  PA(I,J), PB(I,J)
   16 FORMAT(2F10.0)
   19 CONTINUE
   20 CONTINUE
C
      WRITE(6,25)
      WRITE(6,30) NSYS
   25 FORMAT(T20,'DATA REPRINT'/T20,12('*')//)
   30 FORMAT(T20,'NUMBER OF SYSTEMS = ',I2//)
C
      DO 50 I=1,NSYS
      WRITE(6,35) I, NA(I)
   35 FORMAT(T15,'SYSTEM ',I2,' WITH ',I2,' ALLELES')
      NP=NA(I)
      DO 45 J=1,NP
      WRITE(6,40) PA(I,J), PB(I,J)
   40 FORMAT(T15,2(F8.5,2X))
   45 CONTINUE
   50 CONTINUE
C
C     CALCULATE & PRINT RESULTS
C
      WRITE(6,55)
   55 FORMAT(///T20,'RESULTS OF CALCULATION'/T20,22('*')//
     1T20,'SYSTEM',T30,'E SQUARED'/T20,6('*'),T30,9('*')/)
```

```
C
      ETOT=0.0
      DO 90 I=1,NSYS
      X=0.0
      Y=0.0
      Z=0.0
      NP=NA(I)
      DO 70 J=1,NP
      X=X+DSQRT(PA(I,J)*PB(I,J))
      Y=Y+DSQRT(PA(I,J)/NP)
      Z=Z+DSQRT(PB(I,J)/NP)
   70 CONTINUE
      ESYS = 8.0*(1.0 - X)/((1.0+Y)*(1.0+Z))
      ETOT =ETOT + ESYS
      WRITE(6,75) I, ESYS
   75 FORMAT(T22,I2,T31,F8.5)
   90 CONTINUE
C
C     CALCULATE CORRECTION FACTOR
C
      SJFAC = 0.0
      DO 95 I=1,NSYS
      SJFAC = SJFAC + (NA(I)-1)
   95 CONTINUE
      ECOR = ETOT/SJFAC
      WRITE(6,96)  ETOT, ECOR
   96 FORMAT(//T20,'TOTAL E SQUARED = ',F8.5//
     1T20,'STANDARDISED E SQUARED = ',F8.5//)
      STOP
      END
```

DEPARTMENT OF ANTHROPOLOGY

UNIVERSITY OF DURHAM

This questionnaire is designed to provide information on the patterns of movement within the entire region and to assess differences that may occur regarding the inherited characters within one region as to occupational and religious groups. I would be very grateful if you and your husband would complete it as accurately as possible. If you do not know the answer to a particular item please indicate 'NOT KNOWN'.

I give/do not give permission for my son/daughter to take part in the survey outlined above.

Signed ....
(Parent/Guardian)

Name of son/daughter .... Age ....

Name of any brothers and/or sisters in school(s). Please give school(s) as well ....

Name of any first cousins at the school ....

Maiden name of mother ....

Maiden name of mother's mother ....

Maiden name of father's mother ....

*Place of birth of pupil including parish if known ....

* " " " " father " " " " ....

* " " " " mother " " " " ....

* " " " " father's father " " " ....

* " " " " father's mother " " " ....

* " " " " mother's father " " " ....

* " " " " mother's mother " " " ....

*actual residence at the time of birth; not hospital.

Religious denomination of the family ....

*Occupation of the father ....mother ....

* " " " father's father ....

* " " " mother's father ....

*If deceased state prior occupation.

Answer yes or no in the appropriate rows for each of the questions at the head of each column space.

Can any of the family listed below speak			
	Welsh only	Welsh and English	English only
Pupil			
Father			
Mother			
Mother's father			
Mother's mother			
Father's father			
Father's mother			

Do you normally speak Welsh in your home?

Do you consider yourself Welsh or English?

Please leave blank any Questions you do not wish to answer. All information w[ill be] treated in strict confidence.

Cynlluniwyd y gofyniadau isod er mwyn ceisio darganfod patrymau'r symudiadau o le i le a fu ymysg y poblogaethau ym Mhenfro ac i ddarganfod a oes gwahaniaethau mewn nodweddion etifeddegol yn yr ardaloedd, ymysg yr enwadau crefyddol ac ymysg y galwedigaethau hefyd. Mawr werthfawrogwn pe baech chwi a'ch gwr (gwraig) yn ateb y gofyniadau mor llwyr ag sy'n bosibl. Os nad ellwch ateb rai gofyniadau, rhowch 'Nis gwn' gyferbyn a hwy.

Rhoddaf/Ni rhoddaf ganiatâd i'm mab/merch gymeryd rhan yn yr arolwg.

Arwyddir ....
(Mam/Tad/Ceidwad)

Enw'r plentyn ....

Enwau unrhyw frodyr neu chwiorydd mewn ysgolion ar hyn o bryd. Rhowch enwau'r ysgolion. ....

Enwau unrhyw gefnder/cyfnither yn yr ysgol ....

Enw morwynol mam ....

" mam mam ....

" mam nhad ....

* Lle ganwyd: y plentyn (enw'r plwyf os yn bosibl) ....

* " ei dad ....

* " ei fam ....

* " tad ei dad ....

* " mam ei dad ....

* " tad ei fam ....

* " mam ei fam ....

* Lle'r cartref adeg y geni (Nid yr ysbytty)

Enwad crefyddol y teulu ....

* Galwedigaeth y teulu (tad) .... (mam) ....

* " tad y tad ....

* " tad y fam ....

* (Os yw'n farw, rhowch ei alwedigaeth cyn iddo fraw.)

Atebwch 'Gall' neu 'Nis gall' i'r gofyniadau ar ben y colofnau, gan roddi'r atebion yn y rych a'r golofn briodol.

A all aelodau'r teulu a restrir siarad y canlynol

	Cymraeg yn unig	Cymraeg a Saesneg	Saesneg yn unig
Y plentyn			
Ei dad			
Ei fam			
Tad ei dad			
Mam ei dad			
Tad ei fam			
Mam ei fam			

A ydych fel arfer yn siarad Cymraeg yn eich cartref?
A feddyliwch am eich hun fel Cymro (Cymraes) neu fel Sais (Saesnes)?
Gadewch rhai gofyniadau heb ei hateb os gwell genych beidio rhoi'r manylion
Cedwir y ffeithiau a roddir yn hollol gyfrinachol.