Genetic variation in the human population of the Isle of Wight

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ABSTRACT

This work comprises the prediction, description and explanation of genetic variation between the Isle of Wight and the southern English mainland, and within the Island itself.

A review of the archaeological and historical evidence does little to support the belief that the Isle of Wight was colonised by any particularly distinct population such as the Jutes; nor does it indicate that isolation of the Island from the mainland has been complete enough to permit random differentiation between them. Social and economic differences within the Island might possibly give rise to genetic heterogeneity through differential migration or random effects. Demographic studies of the modern population confirm that genetic differences from the mainland are unlikely.

The distribution of blood groups, isoenzymes and serum proteins substantiates the prediction of no difference between Island and mainland. Within the Isle of Wight a difference in ABO frequencies is observed between long-established families and others, and this

is probably a real difference in spite of ambiguities of sampling. Genetic variation within the Island, as measured by genetic distance, reflects road distances between settlements and internal migration, rather than the total pattern of migration including immigration.

GENETIC VARIATION IN THE HUMAN POPULATION OF THE ISLE OF WIGHT

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To the memory of my father

CONTENTS

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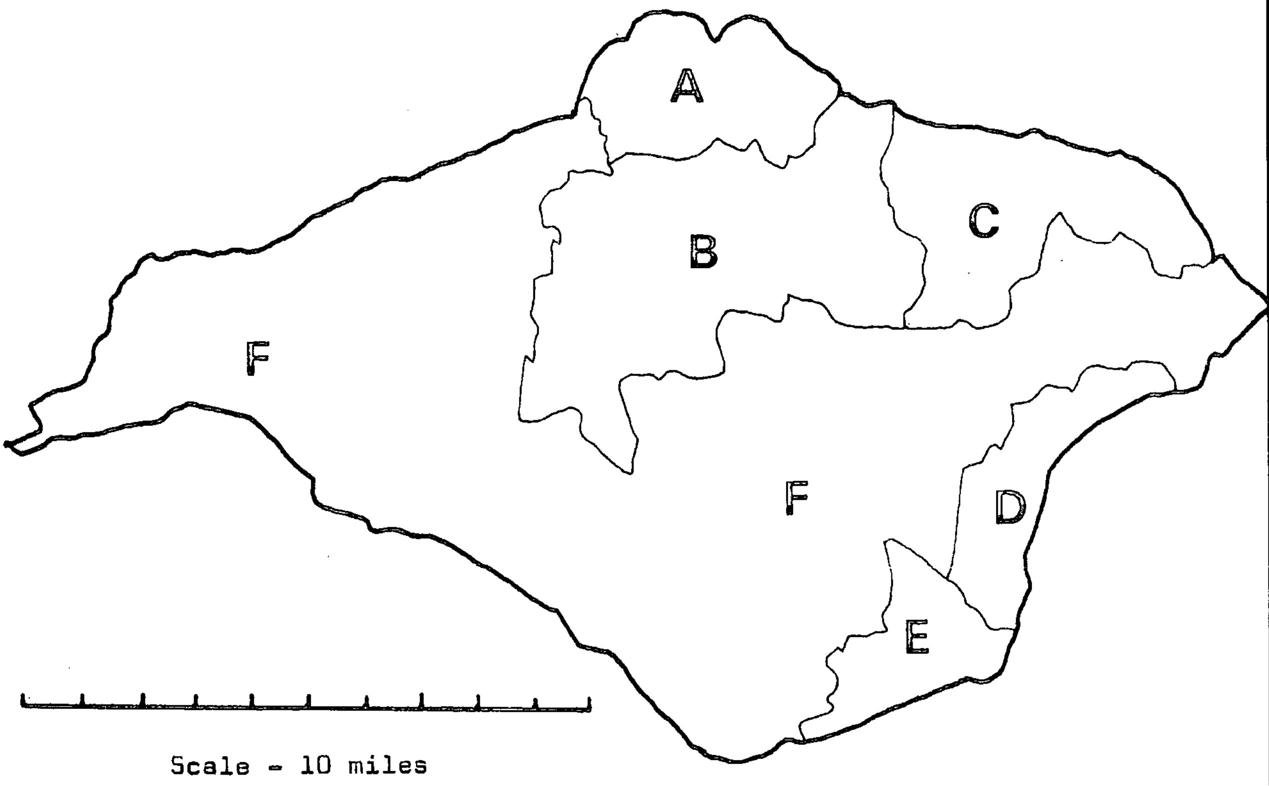
CHAPTER ONE INTRODUCTION

The Isle of Wight is situated off the centre of the south coast of England (Figure 1.1) and is separated from the mainland by the Solent and the Spithead, which form a continuous channel of sea varying in width between two and six miles. The Island is roughly diamond shaped (like an heraldic lozenge, the early authors said) and has a maximum distance from east to west of 23 miles, and from north to south of 13 miles. It has an area of 147 square miles, and at the 1971 census had a population of 109 284, whose distribution is shown in Figure 1.2.

The aim of this work is to describe and to interpret genetic variation among the living population resident on the Isle of Wight. Thus it has something of the quality of a monograph, with emphasis always on the particular place rather than on any evolutionary process and its discovery. This is an important constraint on the scope and the nature of the investigation, because the sampling and collection of data and their analysis and interpretation are bound to represent a population of a certain fixed size. In consequence, the level of resolution of the techniques available for the prediction and demonstration of micro-evolutionary change may

Figure 1.1 The Isle of Wight's position

Figure 1.2 The distribution of population on the Isle of Wight



Scale - 10 miles

KEY		Population at 1971 Census
A	Cowes UD	18 910
B	Newport MB	22 309
C	Ryde MB	23 204
D	Sandown and Shanklin UD	15 890
E	Ventnor UD	6 931
F	Isle of Wight UD	22 268

not coincide with the scale of the population which those techniques are employed to analyse. This consideration has to a large extent shaped the present work, as may be detected in the outline of the study which follows.

Chapter 2 employs mainly secondary sources to describe the history of the Isle of Wight's population from the earliest times, and seeks to predict from the details of this development whether the present-day resident population will be either different from the population of the mainland of Southern England, or heterogeneous within itself. The investigated causes of such differences are differential migration and relative isolation of the population. Unless it were operating at unprecedently high levels, local selection would be beyond the scope of the present work to detect; it has therefore not been sought.

Chapter 3 describes the methods and materials of the study of the living population, both in the field and in the laboratory.

Chapter 4 uses demographic data collected from about 1 800 living residents of the Isle of Wight to describe the structure and geographical extent of the gene pool. This focusses attention on the birthplaces of residents, their degree of endogamy and exogamy, the distances they migrate and the geographical origins of their forbears. The social structure of the population is described in relation to these and other demographic parameters, in order to measure social as well as spatial heterogeneity of the population. This chapter, as well as Chapter 2, makes some prediction about the distribution of genetic variation within the Isle of Wight and between it and the mainland.

Chapter 5 describes genetic variation observed chiefly among a sample of about 1 500 Isle of Wight blood donors. It tests for genetic differences between the present survey sample and appropriate comparative surveys of the English mainland, and looks for heterogeneity within the resident population.

Chapter 6 examines spatial variation within the Isle of Wight, and by means of migration matrices and genetic distance matrices compares observed genetic variations with that predicted on the basis of migration.

Chapter 7 is a general discussion of the work.

All that remains to be done in this chapter is to explain some conventions of nomenclature. To avoid tedious repetition "the Island" has been used throughout as a synonym for "the Isle of Wight". "The mainland" has already been used to signify England other than the Isle of Wight. "East Wight" and "West

Wight" are occasionally employed to distinguish broadly between the more rural west of the Island and the more tourist-conscious east. "Islander" and "Overner" are used here to distinguish between residents born on and off the Island; in demotic use these definitions would be more rigorous: to be born there is hardly enough. Other particular uses of the names of towns or regions are explained in their context.

CHAPTER TWO HISTORICAL BACKGROUND

I Introduction

The purpose of this chapter is to derive from the history of the Isle of Wight some predictions regarding its population's similarity to that of the English mainland. The genetic implications of such predictions can later be tested by comparing data from the Isle of Wight with appropriate mainland controls and, at a higher level of resolution, by comparing sub-samples of the present day population constructed on the basis of migrational history.

The sources of information for this endeavour are not all strictly historical since it is proposed to survey the population from the Island's earliest inhabitation, and thus great reliance must be placed on archaeological evidence as well as written history. In trying to draw a picture of the Isle of Wight population's development the author acknowledges that he is dependent upon disciplines outside his own. In view of this it seems inevitable that reliance must often be placed on the authors of secondary sources, interpretation being guided by their opinions as well as by their data. This is certainly the case in respect of archaeology where many of the primary publications belong to a period before that of modern techniques of excavation and analysis.

For convenience it has seemed appropriate to divide time into fairly discrete sections in order to isolate certain problems, and also to coincide with the documentation and interpretation of past events. Accordingly, the following periods will be dealt with in turn:

(a) Stone Age
(b) Beaker Cultures
(c) Bronze Age
(d) Iron Age
(e) Roman
(f) Dark Ages
(g) Post-Conquest
(h) Recent.

In comparing archaeological finds from the Isle of Wight with those from Southern England it must be kept in mind that the relatively much smaller Island will necessarily yield fewer finds than the mainland. This will be the case especially for anything which is numerically scarce over the whole region. Thus, for example, it cannot be argued from the lack of a Wookey Hole or Gough's Cave that the Isle of Wight was uninhabited during the Upper Palaeolithic. What is rather implied is an assumption of homogeneity with the surrounding mainland which will not be rejected except in response to positive evidence to the contrary. The effect of this will be a tendency to weaken arguments and inferences, and must lead to the expectation of rather poorer collections of artefacts and evidences than from the mainland.

In conclusion, we must accept that the information available varies both in quality and in quantity, from book to footnote and from scholarship to anecdote. It will not supply all the facts wished for, and therefore must be interpreted with caution. In particular, detailed quantitative predictions cannot be obtained from the data, and fabrication must neither be accepted from the literature, nor created anew.

II Review of Evidence

(a) Stone Age

In his introduction to the study of genetic variation in Britain, Roberts (1973) supports the general consensus that, at the broadest level, the modern population is the result of successive invasions and immigrations usually from the European mainland. He considers the Palaeolithic and Mesolithic cultures to represent the earliest inhabitants of Britain. Whilst it is possible that their genes are still in the gene pool, their influence on the subsequent genetic development of the population was probably limited by the superior economy and technology of Neolithic invaders. Whether the original inhabitants were replaced by or assimilated into the newer population the cultural evidence cannot decide. There is little to suggest inhabitation of the Isle of Wight in the Upper Palaeolithic, though a few implements occurring as surface finds have been doubtfully ascribed to this period. These have much in common with similar tools from the Wessex chalk (Grinsell, 1958).

Before 7000 or 6000 B.C. the Isle of Wight was joined to the mainland of Hampshire (Grinsell, 1958) and throughout the Mesolithic period the encroachment of the sea led to the Island's formation, and incidentally to the probable inundation of much evidence of Mesolithic inhabitation of the coasts and estuarine riverbanks. Nevertheless, many artefacts evident of Mesolithic industries have been found on the Island. In particular, H.F. Poole (1929, 1930, 1932, 1937, 1938, 1939) amassed a wealth of material which was subsequently divided into two groups. These represent firstly, river valley settlements with industries including heavy axes, large flint knives, scrapers and microliths and, secondly, settlements on the lower greensand with a predominantly microlithic flint industry which may well have persisted into the Neolithic. There are finds corresponding to the first group in the Kennet valley in Berkshire, whilst the second corresponds to the artefacts from settlements on the heathlands of Hampshire, Surrey and Sussex (Grinsell, 1958). The date of 5000 to 2500 B.C. obtained by Clifford from analysis of plant remains accompanying Poole's artefacts, is rather later than some other Mesolithic sites dated by pollen analysis to the Boreal or Pre-Boreal; the present writer would hesitate to attribute this discrepancy to insular conservatism.

The most conspicuous relics of Neolithic times are the chambered and unchambered long barrows, of which there are about 200 on the chalk of Dorset, Wiltshire, Berkshire and Hampshire. The evidence that the Isle of Wight people shared this culture is the two unchambered long barrows on East High Down and Afton Down (Grinsell and Sherwin, 1941), and the doubtful barrow adjacent to the Longstone at Mottistone (J. Hawkes, 1957).

The combined evidence from the Stone Age period suggests that the Isle of Wight population shared common cultures, and by implication a gene pool, with the inhabitants of the mainland.

(b) Beaker Cultures

It is suggested by Grinsell (1958) that the Beaker Cultures in Britain represent two numerically modest invasions of people distinctly round-headed, in contrast to the long-headed earlier Neolithic inhabitants. On the Isle of Wight, beakers have been found from burial and settlement sites at Nodgham, Freshwater, Afton Down, Gore Down, Niton Down, Bonchurch, Ryde and Nunwell Down. All these appear to be late type A "necked" beakers (Dunning, 1933), in contrast to those in the nearest counties of Kent, Sussex, Dorset, Wiltshire and Hampshire, where B i (in Wessex) and B ii (in the south-east) beakers predominate. Thus, there does seem to be some cultural difference between the Isle of Wight and the nearest mainland in this respect. Unfortunately, there are no human remains found in the Island burial sites. This being the case, and considering the late style of the beakers, an anthropologist must be cautious in inferring a distinctive genetic make-up for the Island population, when trade and stylistic change would be sufficient to account for the cultural evidence. Indeed, even in the presence of but a few skeletons, typological interpretation can impose results inherently less plausible than those produced in acknowledgement of variation within populations.

(c) Bronze Age

Grinsell (1958) reports on upwards of twenty bowl-, bell- and disc-barrows found on the chalk ridge between the Needles and Culver Cliff. These are attributed to the Early and Middle Bronze Age, though Grinsell points out that bowl-barrows, particularly, often contain beakers, and that crouched inhumation persists into the Early and even Middle Bronze Age. The barrow at Niton excavated by Dunning (1932) contained just such a crouched skeleton, with a cephalic index only slightly less than the average for Beaker Folk, but with pottery fragments assigned to the Early Bronze Age. There seems to be little in this material which distinguishes the Island from the mainland, where similar barrows occur on the chalk and occasionally on the heathlands. There are some finds from the Late Bronze Age which also point to the similarity with the mainland; in particular, the hut on Gore Down at Chale is "almost identical" with one on the South Downs at Cissbury (Dunning, 1932).

Late Bronze Age urns have been recovered from several Isle of Wight localities. Singly, they have come from cremations, as at Steephill, Brook Down and Wroxall Down. Also a large barrel urn was found near the top of a barrow at Afton Down. In addition, two extensive urnfields have been described. The one at Swanmore, containing sixty urns, was destroyed in brickfields, but the published report shows them to be like those from the Barnes urnfield. These urns have been described by Dunning (1931) as typical of the Late Bronze Age. The reminders of an older style in the urns from Afton Down, Shalcombe Down, Steephill and Brook Down, together with the lack of certain traded artefacts found in hordes on the mainland during this period, lead Dunning (1931) to infer a persistence of the Middle Bronze Age and its artefacts later than on the adjacent mainland.

(d) Iron Age

The principal Iron Age structure on the Isle of Wight is an unfinished hill-fort on Chillerton Down, the earthwork enclosing an area of 10 hectares (Dunning, 1947). This is the only Iron Age defensive work which has been recognised, and Dyer (1973) suggests that it must therefore be seen as the Island's "tribal centre", though pre-Roman Iron Age pottery and field systems are known from Ashey Down (Drewett, 1973). The Island pottery shows close parallels with that of the Southern Atrebates of Hampshire and Sussex rather than the Eastern Atrebatic ware of East Sussex or that of the Durotriges of Dorset (Cunliffe, 1974). Nonetheless, the Isle of Wight is not included by Cunliffe in the area of Atrebatic territory.

Further evidence of this period includes a find of Gallo-Belgic E coins from Sandown (Harding, 1974). This coinage was very widespread in South and East England and was in use for a considerable time, yet it appears to have been introduced immediately before Caesar's raids of 55 B.C. and 54 B.C. It is therefore not likely to signify the first century B.C. Belgic invasions, entailing prolonged warfare before settlement and unification under Cassivellaunus, which Caesar himself describes in "de bello Gallico" (Harding, 1974). If the coins are not evidence of new people they do indicate trading contact with outsiders, and in this and the Romano-British period there is some evidence to suggest that through its position at the mouth of the Solent and near Hengistburyhead, the Isle of Wight was in contact, and thus perhaps genetical contact, with sailors and merchants from abroad. Such is the case for trade with the Amorican tribes whose coins and wine jars have been found on the Island (Cunliffe, 1974). Direct export from the Island is implied in the tradition concerning the Greek (or Phoenician) tin trade (Hutchinson, 1969). The documentary evidence for this is in texts by Pliny and Diodorus. Both mention an island, "Ictis", where tin was available for sale. The description of this island as being accessible by wagon at low tide would seem to rule out the Isle of Wight at this period and support the rival tradition of St. Michael's Mount - a more plausible port of export for Cornish tin. The lack of a land bridge and the confusion of names "Ictis" and

"Vectis" led Black (1928) to reject this already well-worn tale, but it has been recently revived by Laing (1968). His distribution map of Greek coins in Britain shows a wide spread, with concentrations of finds along the Thames valley and on the south coast including the Isle of Wight. Whilst this may not be sufficient new evidence to prove the Isle of Wight's part in the tin trade it is indicative of some kind of trade and therefore contact between peoples.

In summary, it must be admitted that we cannot tell whether the cultural development apparent in the Iron Age represents a response by the Bronze Age inhabitants to settlements elsewhere or the immigration of new genes. What does seem evident is that there was a considerable amount of commercial contact with the mainland and abroad; therefore, we must avoid over-emphasis of the Island's isolation.

(e) Roman

Roman remains are abundant on the Isle of Wight, the villa at Brading which has national repute being but the most famous and most visible. In addition to some parts of the walls of Carisbrooke Castle, the relics described by Sydenham (1944, 1945) and by Sherwin (1926) include seven villas as well as pottery and coin hordes.

For the first time there is some direct historical evidence to highlight the archaeological. Suetonius relates that Vespasian, as commander of the second legion "fought thirty battles, conquered two powerful tribes, captured over twenty fortresses and annexed the Island of Vectis, which lies close to the coast of Britain." Although Vespasian's campaign in southern England was finished by A.D. 47, few of the Roman remains from the Island date earlier than the second century A.D. Notwithstanding the elapse of time before Roman influence appears, a comparison of the evidence from the Island and the mainland shows some interesting distinctions between the two.

There is a lack of towns of any size on the Island, which contrasts strongly with the presence of such large ones as Winchester, Silchester, Chichester and Canterbury on the mainland. Similarly, the evidence of military occupation is slight. There is some Roman construction at Carisbrooke Castle, but this bears no comparison with the Saxon Shore Forts, to which series Carisbrooke Castle, at some distance inland from the navigable limit of the river Medina, has been dubiously ascribed (Grinsell, 1958). There are few signs of industry on the Island, the principal one being the quarrying of limestone at Binstead. This stone was used extensively in villas on the Isle of Wight, as well as in the walls of Porchester Castle and in a Roman altar at Bitterne near Southampton. Only one pottery kiln has been found on the Isle of Wight, although there is plenty of suitable clay in the north. Likewise, there is evidence of only limited iron smelting, the single site discovered reminiscent more of a pilot project than of full-scale production.

These considerations, taken with the frequency of villas, stress the rural and agricultural nature of the Romano-British period in the Island. Nor do they necessitate a strong Roman presence, since not uncommonly were villas the centre of British estates whose local landowners had adopted Roman ways. The implications for population structure are that the Island was relatively isolated from the Roman administration and occupying forces and also from industrial trade, of which both might be associated with gene flow within Britain and beyond.

(f) The Dark Ages

The Dark Ages are perhaps the most frustrating period to evaluate; in spite of a wealth of both historical and archaeological information a satisfactory interpretation remains elusive.

It is almost a part of modern English folk-lore that southern England was colonised by Angles, Saxons and Jutes. At a local level, it is widely held in the Isle of Wight that Jutes were the settlers from whom the modern population descended. Both these beliefs were inspired principally by the writings of Bede. He completed the "Ecclesiastical History of the English Nation" in 731 A.D., and his authority is such that the unequivocal statement carries weight to this day: "Those who came over were of the three most powerful nations of Germany - Saxons, Angles and Jutes. From the Jutes are descended the people of Kent, and of the Isle of Wight, and those in the province of the West-Saxons who are to this day called Jutes, seated opposite to the Isle of Wight." We shall see below that on this topic Bede's influence probably exceeds his accuracy. Nor should this be surprising as he was writing at a distance of three hundred miles and three hundred years from the events he records, and this in an age when communications were difficult and documentation exiguous.

In fact there are some other written accounts of these invasions, including the testimony of Gildas, the Anglo-Saxon Chronicle, the Historium Brittanum, and a contemporary Latin account. The written sources have been ably collated by Hawkes (1956), on whose arguments the following synopsis rests.

The first coming of the Saxons was in 443 A.D. (but see S.C. Hawkes (1969) for an earlier date); the people concerned were mercenaries hired by the British King Vortigern, whom Rome would not help to defend his kingdom from the Picts. The second well-documented landing was made by the exiled Jutish warlord

Hengist (Beowulf, 1973) in 453. He was in command of further mercenaries, perhaps employed to defend Vortigern himself against pro-Roman dissidents who objected to the first implantation and appealed for help to Aetius, the commander-in-chief of the western Roman Empire. Following the murder of Aetius, Hengist and his men quarrelled with Vortigern and by a succession of battles took control of most of Kent, including Canterbury, and then extended this dominion to include the Isle of Wight and parts of Hampshire and Sussex.

The archaeological evidence also implicates Kent as the centre of a distinctive culture in Southern England (Loyn, 1962); and support for this distinction is added by the meticulous survey or institutions made by Jolliffe (1933). What then is the archaeological relationship between Kent and the Isle of Wight? The most important site on the Island is the cemetery at Chessel Down, which has yielded no skeletons, but a valuable collection of artefacts. The square-headed brooches are similar enough to those from Kent (Figures 3, 4 Leeds, 1957) for the argument for a shared cultural identity to be easily accepted. In his early and influential work Leeds (1913) interpreted the archaeological differences between the regions yielding these brooches and the remainder of Saxon England as directly indicative of settlement either by Jutes or by Angles and Saxons.

Any reluctance to interpret the archaeology so directly in terms of population must be increased by considering the most recent dating of these artefacts, which shows them to be sixth or seventh century (Champion, 1977), a considerable length of time after the documented invasions and conquest. If we take as a rule of thumb for interpretation the contention that the closer in date are novel artefacts to a documented invasion, the more plausibly are they evidence of new people rather than the influence of new people, then this discrepancy between the dates seriously weakens the argument for the brooches representing the presence of Jutes. Moreover, the continental work nearest in style to the Kentish grave-godds is not from Jutland or Frisia but from the Frankish dominions in the Lower Rhineland, Belgium and Northern France. This is explained by S.C. Hawkes (1969) in terms of Kent's increasing economic and political power, and indicates that the similarity between the "Jutish" kingdoms of Bede is due more to their trading with the Franks than to a homogeneity of population. An alternative explanation invoking undocumented settlement by Frankish peoples has been argued by Evison (1965), but has found little support (Hawkes, 1965; Champion, 1977).

Returning to the fifth century archaeology, there is some pottery and jewellery from Kent (but none from the Isle of Wight) which does have close parallels in Denmark and Frisia (Myres, 1969), and this material may be taken as tentative support for the documentary tradition about Hengist and the Jutes. However, it cannot tell us anything directly about the Isle of Wight population; nor, if we were to speculate that the cultural similarities between Kent and the Island are due to the movement of people from Kent rather than the influence of people in Kent, could it tell us whether the Jutish kingdom of Kent had Jutes as subjects or simply Jutes as leaders of other peoples (Loyn, 1962).

A conclusive judgement of this period has yet to be made, but on the presently available evidence it would be rash indeed to support the tradition of Jutish settlement of the Isle of Wight; we should rather acknowledge the fact that there was a good deal of trade and contact between Islanders and mainland people. If this wary judgement be thought unworthy of the optimism shown by documentary tradition and the early archaeologists, it is surely preferable to the "subordination of accuracy in observation and record ... to a grandly subjective vision of history" which Harding (1974) warns against.

Finally, mention must be made of some more documentation and of some placename evidence about the Isle of Wight. Kökeritz (1940) suggests that some Jutish influence might be observed in the place-names, but is rather vague as to the details. For this reason, and because of an intuitive unease about the subject, I have rejected the subtlety of the placename evidence. Rather more plainly, the Island has seventeen placenames with the "ing" element which is widespread in Hampshire and the adjacent mainland, and is generally taken to indicate the early phase of Anglo-Saxon settlement (Smith, 1956). Also, I have made very little of some further references in Bede and the Anglo-Saxon Chronicle to subsequent invasions of the Isle of Wight. These accounts are contradictory, unsubstantiated archaeologically and of a rather propagandist slant. The Anglo-Saxon Chronicle seems unreliable in its apparent invention of the character of Wihtgar to account for the Island's name, whilst the tale in Bede's history of the murderous evangelism of Caedwalla, who seeks to stop the Isle of Wight being the last bastion of idolatry in Britain by killing all the inhabitants, is without evidence or confirmation. The repeated, indeed the apparently redundant, slaughter attested by these sources may point to some genuine re-conquest by the Saxon and Christian culture, but the inconsistencies in the different stories detract from their conviction, and make any demographic consequences hard to evaluate.

There is a further relevant passage in the Anglo-Saxon Chronicle, which should be treated with customary caution. In 897 the Danes are reported to have landed in the Isle of Wight from six ships and to have "done much evil there". In 998 the Danes "lay in the Isle of Wight"; in 1001 "they went about just as they wanted and nothing withstood them"; in 1006 they rather characteristically "harried and burned". The last mention is of 1022 when King Knut visited the Island. Kökeritz (1940) records that there is no evidence of Danish influence in the placenames, in contrast to other regions of Danish settlement in Britain. We should perhaps conclude that the Danish presence was sporadic rather than chronic; this lessens the possibility of a systematic Danish contribution to the Island's gene-pool, but by no means categorically denies it.

(g) Post-Conquest

The term "Post-Conquest" will encompass the Isle of Wight's history from the Norman Conquest until the early 1800s. Although the number of years is not great, its nearness to our own period, as well as the vast increase in contemporary documentation, has resulted in historical treatment focussing on incident and detail, often of a political nature. It is on this detail that the description of the population's development must be based.

After the Conquest independent Lordship of the Island was given to William FitzOsborne, a retainer of the Conqueror. The Norman settlement, which is still detectable in a few present-day personal names, ushered in a phase of peaceful development. The

Abbey founded at Quarr by the Normans played a large part in fostering the development of agriculture and the woollen industry, and until its dissolution in 1536 was an exacting landlord, powerful in the Island's economy. The stable pattern of life on the Island was unthreatened until the end of the twelfth century, when fear of French invasion loomed as a cloud which would cast its shadow over the Isle of Wight for several centuries. In 1293 rumours of attack resulted in ordinances for the maintenance of lookouts and of beacons, the recruitment of local defence forces, and the restriction of export of grain and cattle. The threatened invasion was not realised until 1340, by which time Edward III had reasserted the English claim to the throne of France and the Hundred Years War had begun. This first attack was finally repelled at St. Helens, but another landing in 1377 had more serious results. The towns of Newport, Yarmouth and Newtown were burnt, the impetus of the onslaught being checked only by the Island's single castle at Carisbrooke. The lack of defenceworks exacerbated the chronic menace of the French, and documents of the Oglander family show that many of those who were able fled to the relative security of the mainland.

During the fourteenth and fifteenth centuries there were other factors which had adverse effects on the Island's population. In 1348, not for the last time in England or the Island, plague was epidemic. Whilst the wholesale decimation of population commonly alleged is almost certainly an overestimate of the damage caused in rural areas (Shrewsbury, 1970), Newport at least was severely affected; the loss of manpower combined with mistrust of contact with outsiders dealt a cruel blow to the flourishing wool and clothing industry, as is shown by the customs receipts at Southampton. The industry had recovered by the end of the century and continued to prosper with the benefit of the enclosures of the open field systems, a process which came early in the Island (Bawdon, 1967). With the breakdown of the manorial system of agriculture the land fell into fewer hands and depopulation ensued. In 1488, the Islanders petitioned parliament thus: " ... this Isle is late decayed of people by reason that many towns and vilages have been lete down, and the feldes dyked and made pasture for bestis and catalles and also many dwelling places fermes and fermeholds have of late tyme ben used to be taken into oon mannys hold and handes that of old tyme were wont be be in many severall persones holdes and handes." Parliament's response was the first anti-enclosure and depopulation Act, passed in 1488 and referring to the Isle of Wight as "desolate and not inhabited, but occupied with beasts and cattle, so that if hasty remedy is not provided, the Isle cannot long be kept and defended, but open and ready to the King's enemies, which God forbid". This was the same year as the massacre of St. Aubin, where a force of forty gentlemen and four hundred yeomen from the Island engaged in battle on the side of the Duke of Brittany. Tradition has it that after the massacre but one Islander returned to tell the tale

(Aspinall-Oglander, 1945). Whilst this may exaggerate the truth, it emphasises the plight of the Island's population at this time.

Approaching their nadir at the end of the fifteenth century, the fortunes of the Isle of Wight seem to rise during the next three hundred years. Nevertheless, there were further visitations of plague in 1583 and 1665; there was a final French raid in 1545 and the threat of the Spanish fleet in 1588. There were also fluctuations in agriculture, but through all this one is impressed with steady growth and consolidation of population and of prosperity.

It would be valuable to know how much contact there was between the common people of the mainland and the Island, other than that due to seafaring. Certainly in the 1600s the time had passed when Island gentlemen made their wills before going to London, but still communications were tenuous; in 1615 there were but two coaches on the Island, there was no passenger transport from Portsmouth to London, and letters were taken to London once or twice a month by the "coney-man" going up to market. If there is little evidence about the excursions of the Islanders onto the mainland, the opposite process has been ruefully documented. In 1625, in anticipation of the Duke of Buckingham's expedition to the Ile de Ré, 1500 Highland troops were billeted on the Isle of Wight. Postponement of the expedition extended their stay from a month to a year, a period which Sir John Oglander likened to an Egyptian thraldom owing to the troops' voracious appetites, both by day and by night. This anecdote, and its legacy of "more than seventy bastards", highlights the systematic economic and demographic influences which the proximity of the important harbours at Portsmouth and Southampton may have had on the Isle of Wight population.

Sir Richard Worsley, writing in 1781, gives a contemporary portrait of the Island which substantiates the view of rural prosperity, and emphasises the dependence on the mainland for exports and imports. The principal exports were wool in the fleece, wheat, barley, malt, salt and poultry for victualling. There was no wool processing industry, and even the grain sacks had to be imported from the mainland. The sole "manufacturing" industry was the production of salt in coastal pans. The chief ports were Newport at the navigable limit of the Medina and Cowes at its mouth.

The demographic effects of troops billeted prior to embarkation may be added to the gene flow customary at ports and the recruitment and impressment of local men to serve at sea. Perhaps, too, the presence of the busy sea traffic and bustling harbours discouraged the feeling of insularity even in those whose occupation did not directly involve them in maritime trade.

On balance, genetic isolation of the Island, even in the days before a regular passenger ferry (begun in 1805), should not be over-stressed. Certainly Worsley (1781) has no doubt that "the inhabitants cannot be supposed to differ from those of the adjacent country; the distance is too small to cause any physical variation and the constant intercourse with persons from all parts of the Kingdom, the metropolis in particular, has erased any insular pecularities that might have existed formerly". So much for isolation from the outside world, but what of isolation within the Island? There is little direct evidence, but we may assume that Newport served to connect outlying areas of the Island, which were dependent on the weekly commerce of its market. Even in the days of foot travel Newport's central position, about twelve miles from the furthest coast, would deter few from making the journey to the week's most important commercial and social event.

Population estimates for the period are few and far between. Worsley gives a 1777 figure of 18 024. R.L.P. and D.M. Jowitt (1951) supply a breakdown by religious denomination totalling 9 100 "after" 1676. Whether this includes children is not clear. A poll tax of fourpence per head of laymen over 14 years old, levied by Edward III in 1377, suggests 4 718 contributors. Including "children and beggars" Worsley converts this to 7 099. If the same conversion is applied to the 1676 figures an almost linear increase in population over the whole period is described (Figure 2.1). If the unchanged 1676 estimate is accepted as a total then a very slow recovery from the vicissitudes of the early period is implied, a perhaps more reasonable result (Figure 2.2).

Some estimate of the absolute numbers is important; although the historical narrative has done little to suggest substantial genetic isolation between the Island and the mainland, the combined catastrophes of the fourteenth and fifteenth centuries, and the wording of the 1488 Act, give a hint that a population bottleneck resulting in founder effect might have occurred. However tempting this speculation, the census figures must greatly diminish its likelihood.

(h) Recent

The nineteenth century saw the beginnings of that shift in the economy of the Isle of Wight which has led to its present position as an important tourist resort. Though initially the nature and response to its attractions were rather different from today, the development from the 1800s to the present day may be treated as a single process.

Figure 2.1 Isle of Wight population 1377 - 1777: possible increase

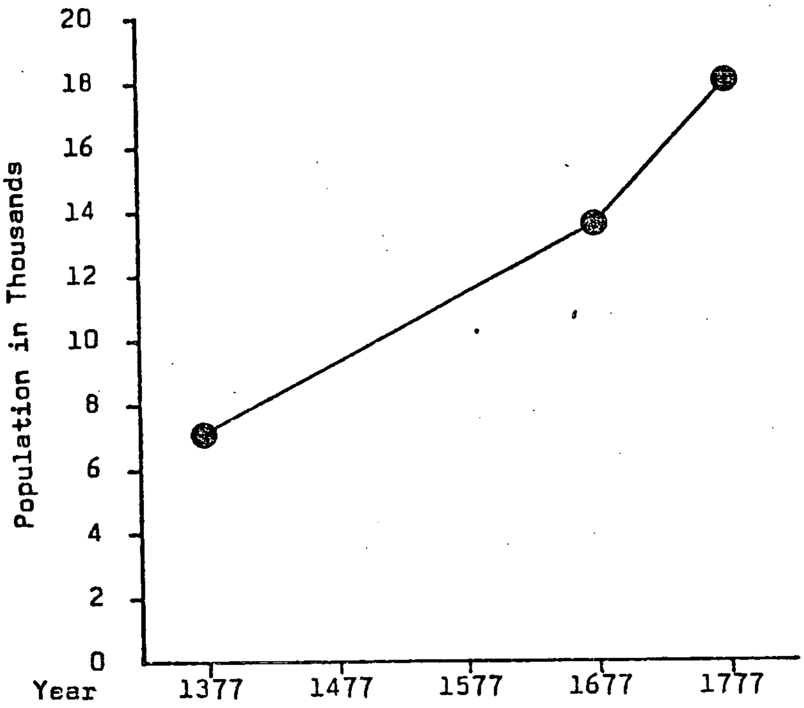
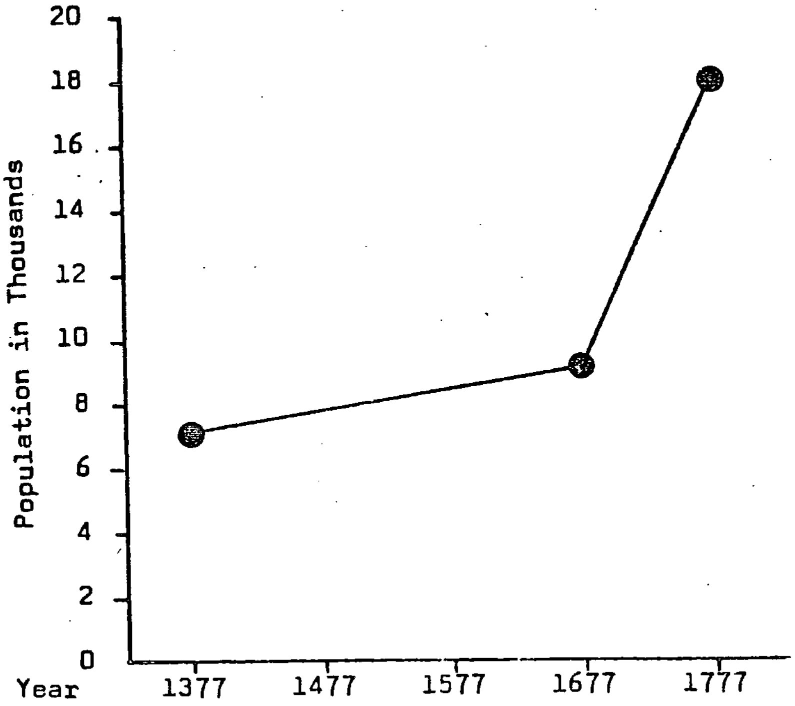


Figure 2.2 Isle of Wight population 1377 - 1777: a second possibility

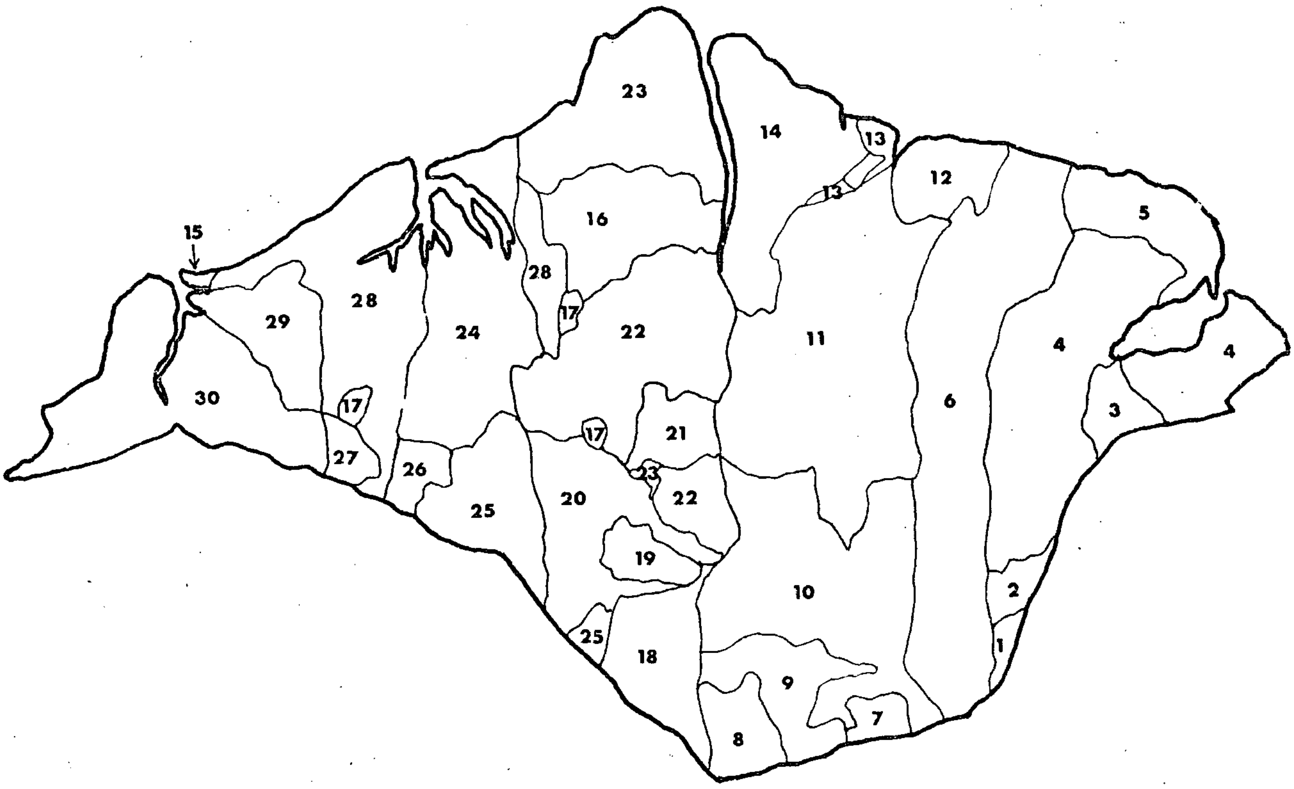


The appreciation of natural beauty fostered by the Romantic movement made the Island both a desirable place of residence and a holiday venue for the leisured classes. The extraordinarily mild climate, the clean air and the quick-witted entrepreneurs made it no less fashionable a health resort. When Queen Victoria bought the Osborne Estate at East Cowes in 1845 these developments had long been in progress, but the royal seal of approval consolidated the trend and ensured its continuation.

The distribution of new residents and hotels by no means reflected the previous importance of the Island's towns. In the east, for example, Newchurch and Brading lost their traditional pre-eminence in the region as they were outstripped in size by Ryde, Ventnor, Shanklin and Sandown. A map of Isle of Wight parishes, dated 1817, shows Newchurch to be the principal settlement in a large parish reaching from the north coast to the south (Figure 2.3). In response to the events described Ryde and Ventnor became parishes by the Newchurch Parish Act of 1866, with Ryde attaining Borough status in 1868 (Bawdon, 1967).

The Victoria County History (1912) provides census figures for the Isle of Wight parishes which substantiate the impression given above. These are shown in Tables 2.1 and 2.2. It is

Figure 2.3 Isle of Wight Parishes in 1817



KEY

1	Bonchurch	16	Newport
2	Shanklin	17	St. Nicholas
3	Yaverland	18	Chale
4	Brading	19	Kingston
5	St. Helens	20	Shorwell
6	Newchurch	21	Gatcombe
7	St. Lawrence	22	Carisbrooke
8	Niton	23	Northwood
9	Whitwell	24	Calbourne
10	Godshill	25	Brighstone
11	Arreton	26	Mottistone
12	Binstead	27	Brook
13	Wootton	28	Shalfleet
14	Whippingham	29	Thorley
15	Yarmouth	30	Freshwater

Table 2.1 Population of East Wight Parishes

Date	Arreton	Binstead	Bonchurch	Brading
1801	1 374	180	69	1 529
1811	1 481	211	88	1 818
1821	1 757	255	122	2 023
1831	1 864	258	146	2 227
1841	1 964	278	302	2 701
1851	1 902	317	523	3 046
1861	1 880	486	564	3 709
1871	1 910	748	641	5 648
1881	1 920	813	670	7 952
1891	1 903	961	668	8 994
1901	1 935	851	539	9 791

Date	Godshill	Newchurch	Wootton	Niton
1801	1 079	2 039	38	288
1811	1 135	2 847	52	370
1821	1 214	3 945	56	443
1831	1 305	4 928	55	573
1841	1 435	8 370	51	613
1851	1 316	11 539	58	684
1861	1 215	14 008	79	700
1871	1 197	18 402	82	732
1881	1 302	19 912	108	801
1891	1 480	19 890	106	931
1901	1 219	19 321	134	884

Table 2.1 continued

Date	St. Helens	St. Lawrence	Shanklin	Whippingham
1801	550	76	105	1 089
1811	658	101	138	1 619
1821	804	96	155	2 068
1831	953	78	255	2 229
1841	1 373	114	462	2 518
1851	1 948	111	355	3 100
1861	2 586	85	479	3 915
1871	3 412	135	1 432	3 730
1881	4 343	249	1 780	4 528
1891	4 611	318	2 361	5 236
1901	4 866	361	2 621	5 585

Date	Whitwell	Yaverland
1801	405	90
1811	397	100
1821	488	92
1831	556	96
1841	660	80
1851	637	78
1861	570	69
1871	666	118
1881	706	153
1891	653	94
1901	633	131

Table 2.2 Population of West Wight Parishes

Date	Brighstone	Brook	Calbourne	Carisbrooke
1801	448	83	695	2 353
1811	610	102	690	2 811
1821	686	123	767	4 670
1831	641	125	844	4 713
1841	710	150	750	5 613
1851	695	157	781	7 630
1861	630	156	728	7 517
1871	614	183	644	8 198
1881	530	195	693	8 304
1891	543	183	677	8 875
1901	506	172	599	10 354

Date	Chale	Freshwater	Gatcombe	Kingston
1801	391	605	222	37
1811	406	669	239	47
1831	473	876	247	68
1831	544	1 184	263	83
1841	610	1 299	306	73
1851	629	1 393	260	65
1861	584	1 678	201	68
1871	652	2 638	240	66
1881	681	2 809	228	69
1891	607	3 442	224	73
1901	543	4 634	194	67

Table 2.2 continued

Date	Mottistone	Newport	Northwood	St. Nicholas
1801	159	3 585	2 771	248
1811	146	3 855	3 325	233
1821	149	4 059	3 579	281
1831	142	4 081	4 491	317
1841	176	3 858	5 147	275
1851	143	3 994	6 049	265
1861	160	3 819	6 534	265
1871	140	3 556	7 374	273
1881	143	3 237	8 484	351
1891	128	3 058	9 468	441
1901	122	2 684	10 649	439

Date	Shalfleet	Shorwell	Thorley	Yarmouth
1801	626	492	128	343
1811	709	516	138	427
1821	878	576	132	564
1831	1 049	699	146	586
1841	1 218	714	163	567
1851	1 245	678	154	572
1861	1 196	612	143	726
1871	1 195	633	154	806
1881	1 050	646	189	787
1891	1 101	566	177	903
1901	986	521	129	948

noteworthy that population increase was much greater in the east of the Island than in the west and also that growth was largely confined to the new "tourist resorts". The exception to this is the parish of Carisbrooke, whose population increase may be due in part to the commercial activity in Newport caused by the rapid development of other towns. Figures 2.4 and 2.5 depict linearly the size increase of parish populations from 1801 to 1901. The slope of the lines represents the parish growth rate, and these Figures show the disproportionate expansion of population in "tourist" parishes, as well as the greater development in East Wight than in West Wight.

Associated as both an effect and a cause of the population increase was the improvement in communications in the nineteenth century. The first regular passenger ferry service began in 1805, a sailing boat plying between Ryde and Portsmouth. This was superceded by a steam ferry in 1825, and soon a rivalry (not yet altogether extinct) developed between this route and an alternative one from Southampton and Cowes. A direct rail link between London and Southampton began in 1840, a competitor from London to Portsmouth following in 1847. Just as the mainland railways and ferries facilitated access to the Island, so the Isle of Wight railways eased communications within it. Persistent wrangling between the rival companies ensured that the rail network was slow to develop, but throughout the second half of the century lines continued

Figure 2.4 Growth of East Wight Parishes 1801 - 1901

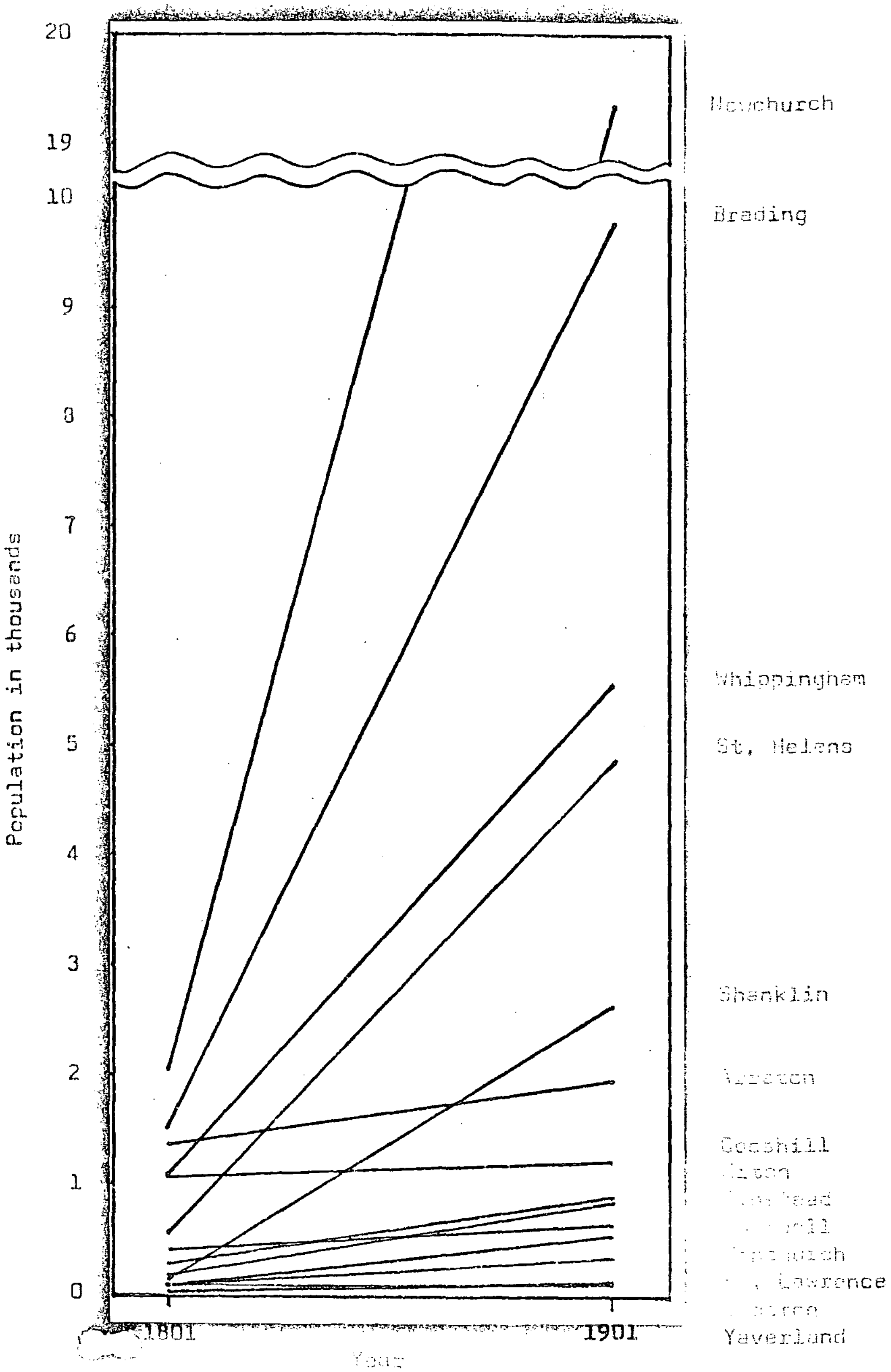
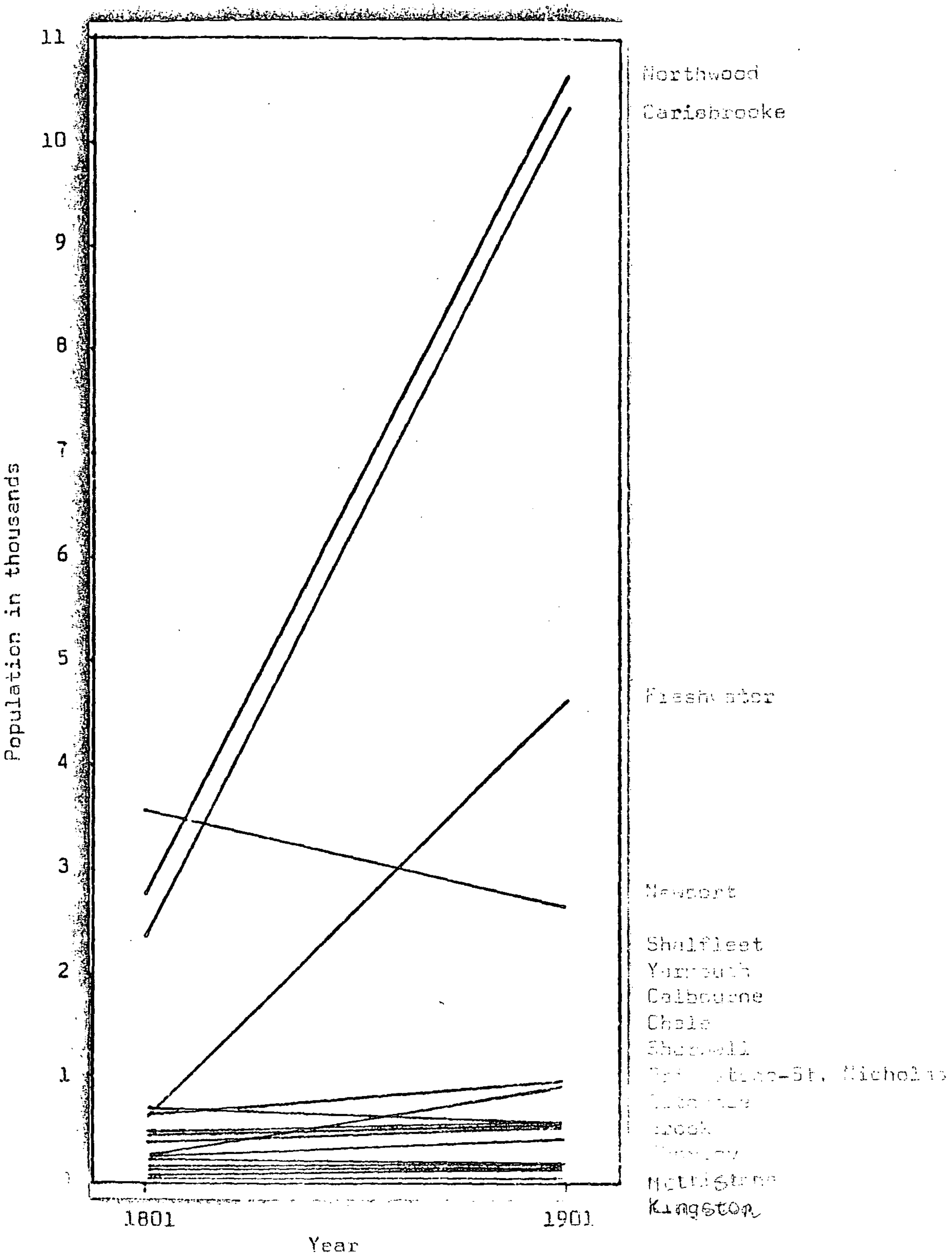


Figure 2.5 Growth of West Wight Parishes 1801 - 1901



to be opened, reaching their greatest extent by 1900 (Figure 2.6 and Table 2.3). During the twentieth century the railways have suffered competition from bus services and private cars, so that at present the only remaining link is between Ryde Pier Head and Shanklin.

It is difficult to tell whether the Island railways were an effect or a cause of growth of the towns they served. On commercial grounds one would imagine that the towns thus connected were already large or growing. This seems to be borne out by the growth of Freshwater parish after the opening of the Newport-Freshwater line, which does not seem to have changed much from the prevailing rate (Figure 2.7). On the other hand the increase in size of Sandown (the only holiday resort in Brading parish) seems to have been accelerated by the opening of the Ryde-Shanklin railway (Figure 2.8) on which line it was an intermediate halt.

It is clear from Figure 2.6 that the network of rail communication in East Wight was much more extensive than that in West Wight. Many of the rural parishes where there had been little population growth remained without a system of public transport.

The population of the Isle of Wight continued to increase until just after the First World War (Table 2.4, Figure 2.9), declined during the 1920s and 1930s and rose again after the

Figure 2.6 Isle of Wight Railways' maximum extent, 1900

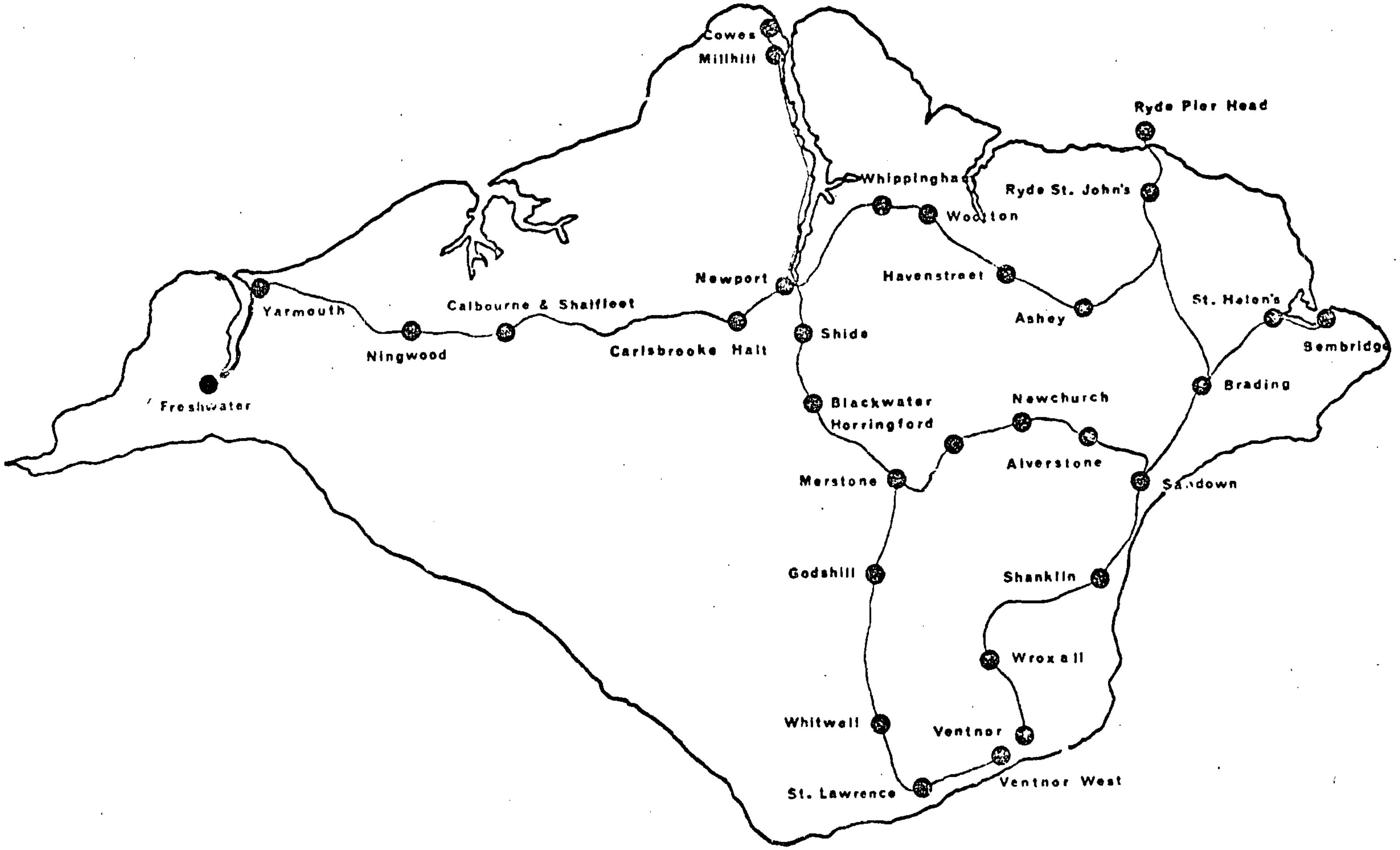


Table 2.3 Isle of Wight Railways:
Opening of principal lines

Section	Opening Date
Cowes - Newport	1862
Ryde - Shanklin	1864
Shanklin - Ventnor	1866
Sandown - Shide	1875
Ryde - Newport	1875
Ryde St. John's - Ryde Pier Head	1880
Brading - Bembridge	1882
Newport - Freshwater	1889
Merstone - St. Lawrence	1897
St. Lawrence - Ventnor	1900

Figure 2.7 The Growth of Freshwater parish 1811 - 1901

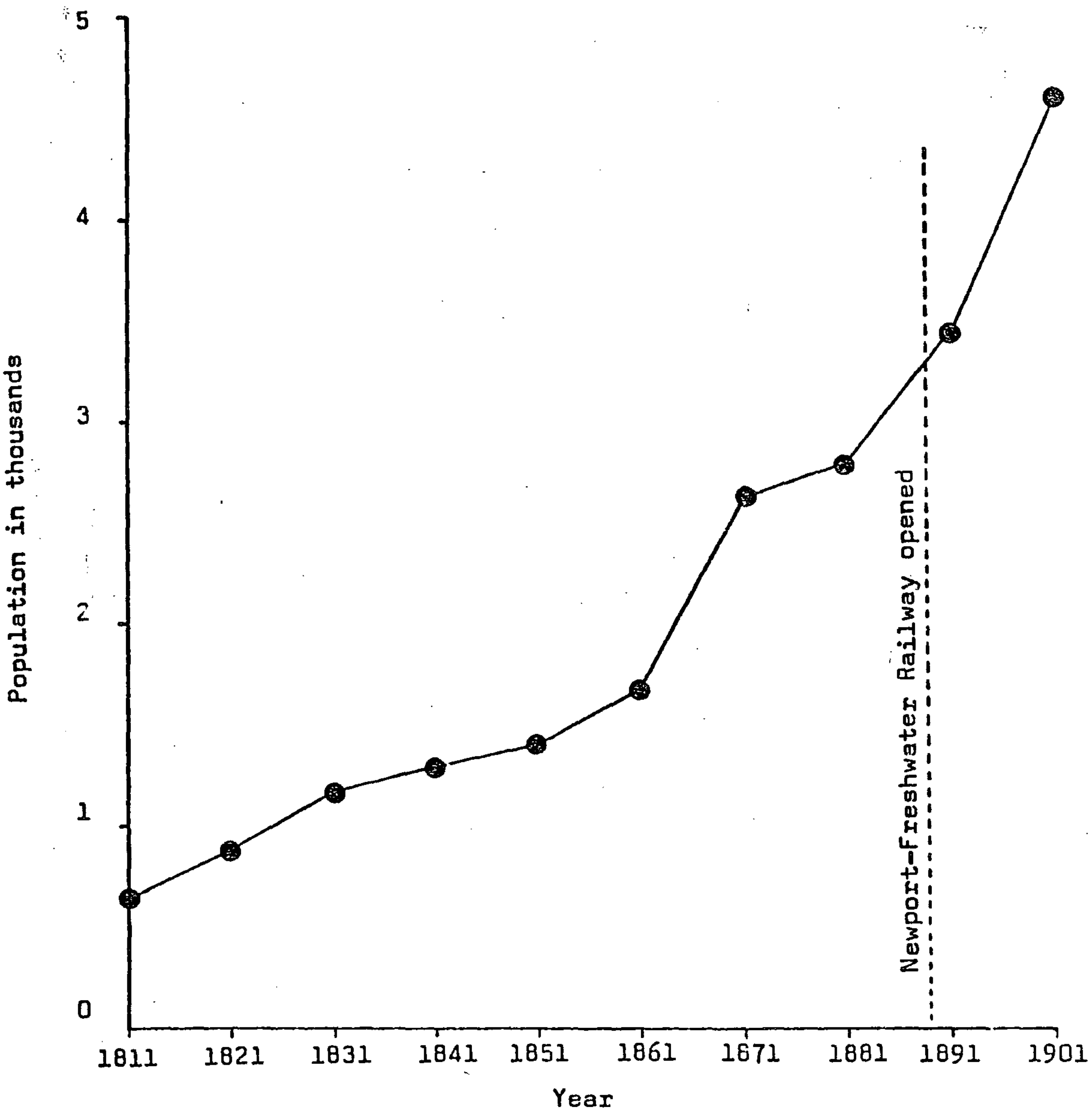


Figure 2.8 Growth of Brading parish
1801 - 1901

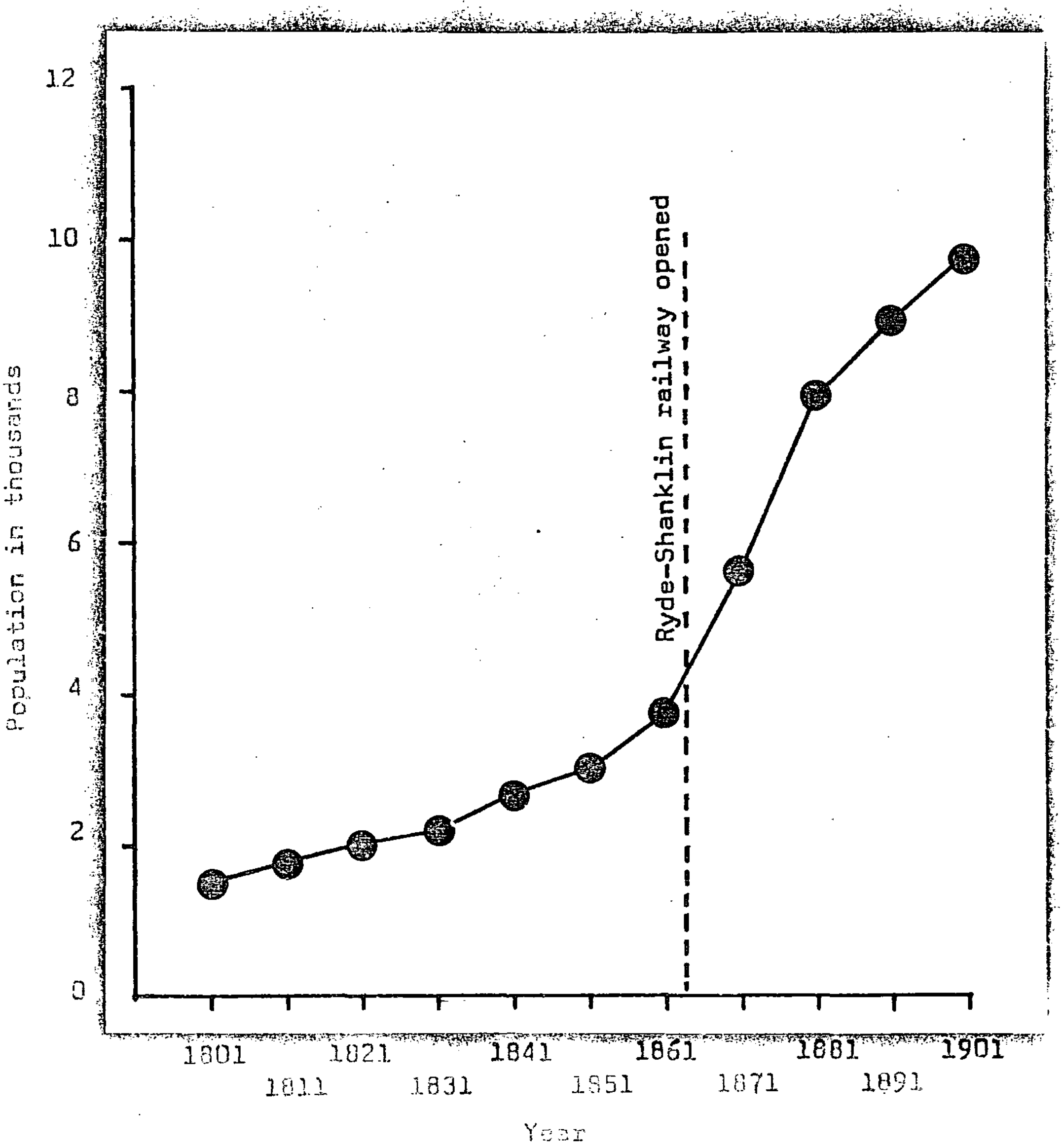


Table 2.4 Isle of Wight Population
1801 - 1971

Year	Population	Change
1801	22 097	
1811	25 938	+ 3 841
1821	31 616	+ 5 678
1831	35 431	+ 3 815
1841	42 550	+ 7 119
1851	50 324	+ 7 774
1861	55 362	+ 5 038
1871	66 219	+ 10 857
1881	73 633	+ 7 414
1891	78 672	+ 5 039
1901	83 418	+ 3 746
1911	88 186	+ 5 768
1921	94 666	+ 6 480
1931	88 454	- 6 212
1939	85 800	- 2 654
1951	95 625	+ 9 825
1961	95 752	+ 127
1971	109 512	+ 13 760

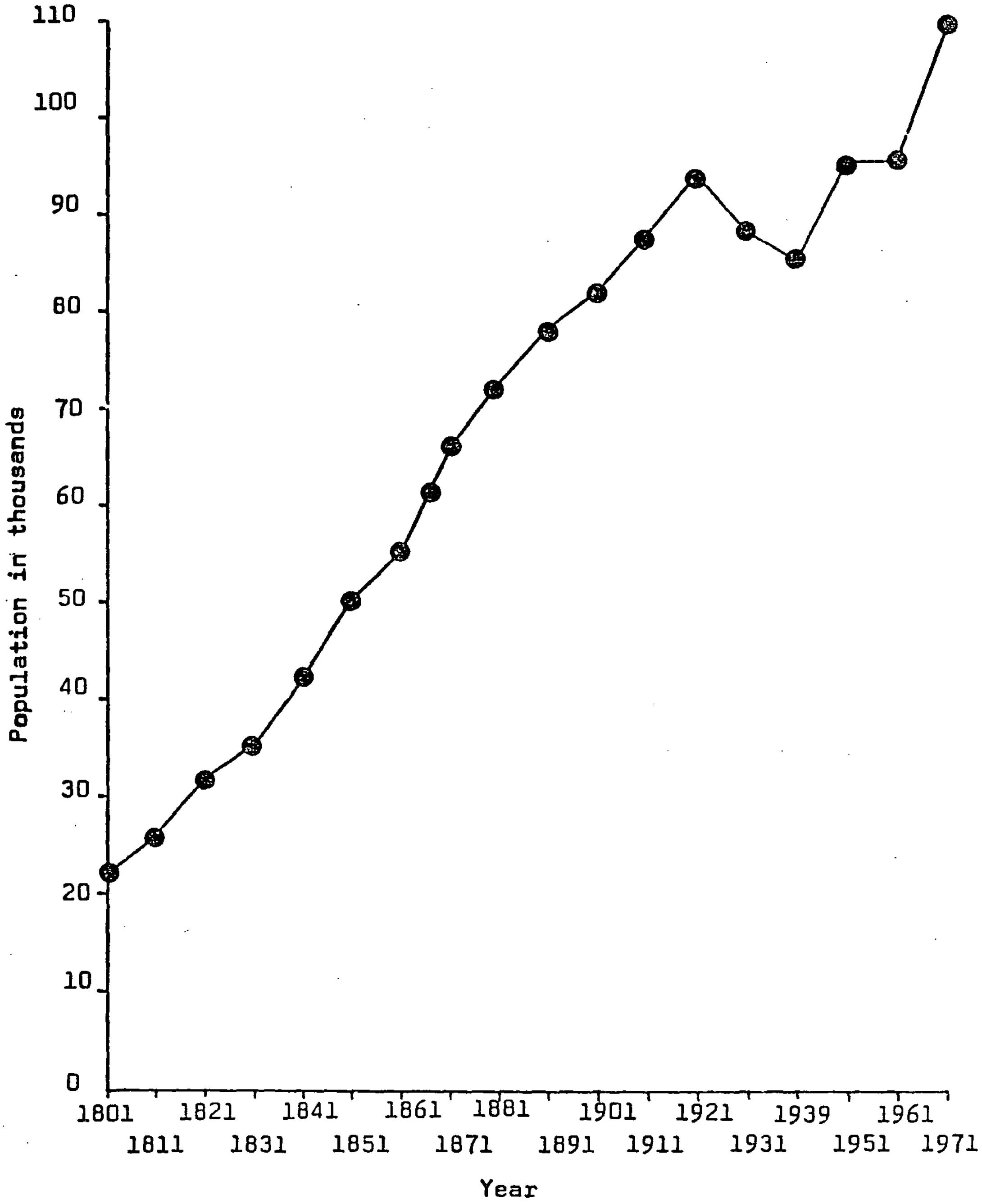
Figures taken from

Victoria County History of
Hampshire and the Isle of Wight
(1912) edited by W. Page

and from

O.P.C.S. Census 1971 Report
for the County of Isle of Wight
(1975): H.M.S.O.

Figure 2.9 Growth of Isle of Wight population, 1801 - 1971



Second World War. The reduction of population between the Wars may be explicable in terms of the Island's economy. During Britain's economic depression fewer people could afford to retire permanently to the Island and fewer could afford holidays. Island residents who might have taken up the hotel trade were forced to go onto the mainland to work, since at the time there was little other industry on the Island, and agriculture was declining as a large employer of manpower.

The resurgence of tourism after the Second World War has increased the exploitation of the Island's natural resources and has led to the development of many other diversions commonly associated with the seaside holiday. A number of the present generation of hoteliers is known to the author; most were not born on the Island but moved to it specifically to run a hotel. In the hoteliers' opinion this is frequently the case. It seems probable that the trade to which the Isle of Wight owes its fame is practised for the most part by Overners for Overners.

The principal difference between tourism in the nineteenth and the twentieth centuries is one of social class. Before the First World War the people who came to visit for pleasure or for health were predominantly upper or upper-middle class. In the twentieth century, and particularly since the Second

World War, holidays have become available to working class families, and this is the market for which the Isle of Wight now caters, notwithstanding the persistence of Cowes Week. Similarly, the people of leisure who in the nineteenth century moved to the Isle of Wight to live have their modern counterpart in the working people who take up residence on the Island at retirement age. These people are, of course, unimportant genetically, except in the rare cases when their families follow them.

Since the Second World War other economies have begun to develop, and these have considerably reduced the flow of youth onto the mainland in search of work; this, combined with the immigration of retired people, had given the Island a population of high average age (Rutter et al., 1970). In particular, light manufacturing industry centred at Cowes and Newport has developed, and the traditional Medina crafts of boat-building have burgeoned into the British Hovercraft Corporation at East Cowes. Nevertheless, Ryde, Sandown, Shanklin, Ventnor and to a lesser extent Freshwater and Cowes are still very dependant on tourism for their livelihood; less directly, all Island service industries and administration are related to it.

In terms of the population's similarity with the mainland the Recent period has been important in attracting people to live on the Island for various reasons, and the improved communications which developed with tourism have made such movement ever easier and more likely. Within the Island the railways, buses and motor cars have facilitated travel so that rural isolation has diminished.

If heterogeneity of population may be expected, it is between Newport (the only large town not strongly linked with tourism) and the coastal resorts of Cowes, Ryde, Sandown, Shanklin and Ventnor, to which many mainland people have come to practise the catering trade. The impression also remains (at least among East Wight people) that in spite of recent developments the south-west of the Island still enjoys a degree of social isolation; However, the contention that this isolation be reflected in genetic differences is rather to be doubted. There are two further subjects of interest, about which the author has no data: firstly, the proportion of people moving to live on the Island as a result of enjoyable holidays visiting it and, secondly, the extent of gene flow between holidaymakers and the resident population. On the second topic a personal opinion is that gene flow is rather greater among visitors, or between seasonal migrant workers and visitors, than between either of these two groups and local residents.

III Discussion

In reviewing the whole period of human inhabitation of the Isle of Wight two main considerations can be identified: firstly, in the phase of England's development when new populations were arriving, did the Isle of Wight receive any unusual or distinctive genetic constitution?

Secondly, in the period after the Norman Conquest, has the Island been sufficiently isolated to preserve such genetic differences as were brought about in the phase of colonisation? If no such distinction existed, has the Island's isolation been complete enough for genetic differentiation to occur?

In the phase of colonisation there is no evidence that any particularly distinctive or identifiable genetic population settled on the Island. The strongest case might be made for the Jutes, but we have seen evidence enough to reject the traditional view of wholesale colonisation by these people. This relieves us of the impossible task which would have followed, that of predicting the genetic consequences of Jutish colonisation. Would the Jutish gene frequencies in the Isle of Wight be expected to be the same as those in Kent, and would those in turn be expected to represent Jutland and Frisia? With population movement involving small groups of people the founder effect, amplified by the probability of families moving together and thus minimising genetic variance, would make predictions of similarity hazardous indeed.

There remains the possibility that the Isle of Wight achieved genetic differentiation by missing some of the colonisers who went to the mainland. There seems to be no strong suggestion that this was so, even though the Iron Age and Roman evidences are rather contradictory, the one implying considerable trade and contact with the mainland, and the other indicating some degree of isolation from the mainstream of British life.

Over the whole phase of colonisation there is no archaeological evidence of the Island's distinctiveness strong enough for us to translate it into genetic inference. This is perhaps not surprising since the evidence would have to be very abundant and consistent for us to be sure that it represented population differences rather than cultural influence or cultural development in isolation (Harding, 1974). Whilst inferences of genetic difference may just remain plausible when made on the broad scale considered by Roberts (1973), much more rigour must accompany arguments about the population of a small region.

During the period after the Norman Conquest it seems impossible that isolation has been complete enough for the Isle of Wight population as a whole to have developed genetic differences from the mainland. As suggested in the review of the Recent period, it is possible, but not very likely, that genetic heterogeneity may exist within the Island, and that the people of Newport and the south-west may differ from the rest of the population.

CHAPTER THREE METHODS AND MATERIALS

I Introduction

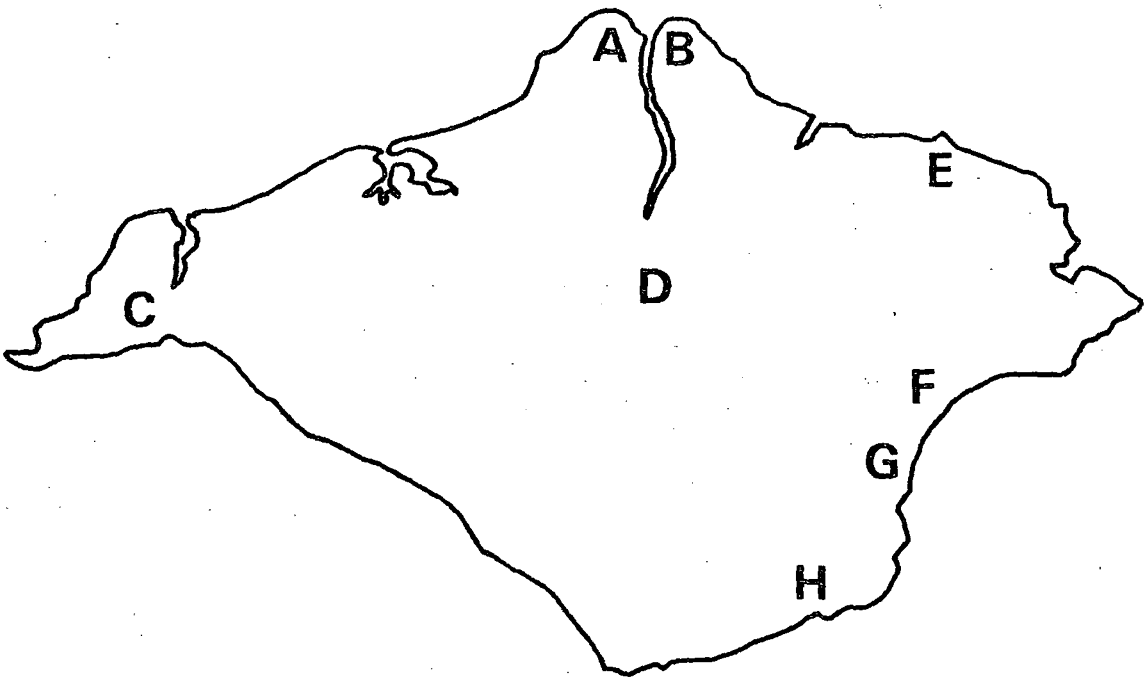
This chapter describes different aspects of the practical work carried out during the survey, and consists of three sections. First, the collection of blood samples and demographic information from blood donors and school children; second, the laboratory procedures involved in the processing of blood; and third, the statistical techniques used in analysing the results.

II Field Methods

(a) Blood Donors

Blood donor sessions are held on the Isle of Wight twice yearly, in spring and autumn, when a team from the Wessex Regional Blood Transfusion Service works on the Island for three weeks. Sessions are usually held in each of the main towns and in two factories, the larger centres being visited on several occasions. The position of the donor centres is shown in Figure 3.1.

Figure 3.1 Isle of Wight blood donor centres



KEY

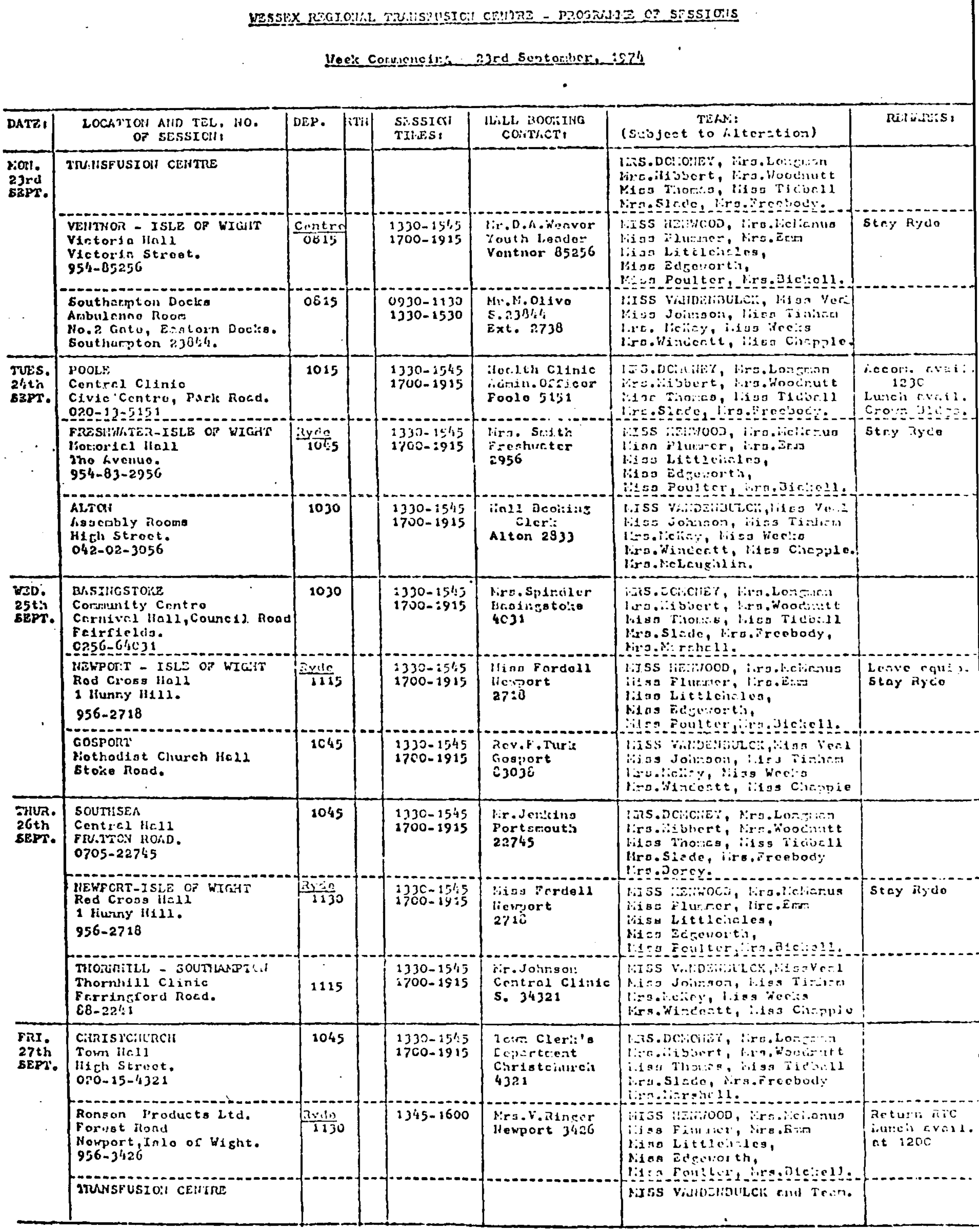
A	Cowes
B	East Cowes
C	Freshwater
D	Newport
E	Ryde
F	Sandown
G	Shanklin
H	Ventnor

Details of a typical itinerary are shown in Table 3.1. Shortly before a series of Donor Sessions is to begin, all members of the Island panel are circulated with a reminder; thus there is no preferential calling of selected genotypes from within the panel.

Blood from a day's session is shipped to the WRBTS hospital in Southampton during the evening and is analysed in their laboratories on the following day. On the day after this the side-tube blood samples were made available to me. They were packed in a polystyrene box with a "snowman" to keep them as cool as possible and either dispatched to Durham or Newcastle by British Rail Red Star Parcels or taken by car direct from the WRBTS in Southampton to the Anthropology Department in Durham. The former method, capricious but never disastrous, was the more frequently employed since the latter method was possible only after the last session of a field trip.

As well as collecting blood from Southampton, it was possible to visit the donor sessions and interview the blood donors while they rested after giving blood. Appendix I shows the form used for collecting information. The donors responded very well to this approach, only three refusing to be interviewed. Their general interest and helpfulness was in large part due to the attitude of the WRBTS teams towards this

Table 3.1 Isle of Wight blood donor sessions:
a typical itinerary



WESSEX REGIONAL TRANSFUSION CENTRE - PROGRAMME OF SESSIONS

Week Commencing 23rd September, 1974

DATE:	LOCATION AND TEL. NO. OF SESSION:	DEP.	RTN	SESSION TIMES:	HALL BOOKING CONTACT:	TEAM: (Subject to Alteration)	REMARKS:
MON. 23rd SEPT.	TRANSFUSION CENTRE					MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidball Mrs.Slade, Mrs.Freebody.	
	VENTNOR - ISLE OF WIGHT Victoria Hall Victoria Street. 954-85256	Centre 0815		1330-1545 1700-1915	Mr.D.A.Weavor Youth Leader Ventnor 85256	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Miss Edgeworth, Miss Poulter, Mrs.Bickell.	Stay Ryde
	Southampton Docks Ambulance Room No.2 Gate, Eastern Docks. Southampton 23844.	0815		0930-1130 1330-1530	Mr.M.Olive S.23844 Ext. 2738	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs. McKay, Miss Weeks Mrs.Windeatt, Miss Chapple.	
TUES. 24th SEPT.	POOLE Central Clinic Civic Centre, Park Road. 020-13-5151	1015		1330-1545 1700-1915	Health Clinic Admin.Officer Poole 5151	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidball Mrs.Slade, Mrs.Freebody.	Accom. avail. 1230 Lunch avail. Crown Bldgs.
	FRESHWATER-ISLE OF WIGHT Memorial Hall The Avenue. 954-83-2956	Ryde 1045		1330-1545 1700-1915	Mrs. Smith Freshwater 2956	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Miss Edgeworth, Miss Poulter, Mrs.Bickell.	Stay Ryde
	ALTON Assembly Rooms High Street. 042-02-3056	1030		1330-1545 1700-1915	Hall Booking Clerk Alton 2833	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Miss Weeks Mrs.Windeatt, Miss Chapple. Mrs.McLaughlin.	
WED. 25th SEPT.	BASINGSTOKE Community Centre Carnival Hall, Council Road Fairfields. 0256-64031	1030		1330-1545 1700-1915	Mrs.Spindler Basingstoke 4031	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidball Mrs.Slade, Mrs.Freebody, Mrs.Marshall.	
	NEWPORT - ISLE OF WIGHT Red Cross Hall 1 Hunny Hill. 956-2718	Ryde 1115		1330-1545 1700-1915	Miss Fordell Newport 2718	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Miss Edgeworth, Miss Poulter, Mrs.Bickell.	Leave equip. Stay Ryde
	GOSPORT Methodist Church Hall Stoke Road.	1045		1330-1545 1700-1915	Rev.F.Turk Gosport 83038	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Miss Weeks Mrs.Windeatt, Miss Chapple	
THUR. 26th SEPT.	SOUTHSEA Central Hall FRATTON ROAD. 0705-22745	1045		1330-1545 1700-1915	Mr.Jenkins Portsmouth 22745	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidball Mrs.Slade, Mrs.Freebody Mrs.Dorey.	
	NEWPORT-ISLE OF WIGHT Red Cross Hall 1 Hunny Hill. 956-2718	Ryde 1130		1330-1545 1700-1915	Miss Fordell Newport 2718	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Miss Edgeworth, Miss Poulter, Mrs.Bickell.	Stay Ryde
	THORNHILL - SOUTHAMPTON Thornhill Clinic Farringford Road. 68-2241	1115		1330-1545 1700-1915	Mr.Johnson Central Clinic S. 34321	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Miss Weeks Mrs.Windeatt, Miss Chapple	
FRI. 27th SEPT.	CHRISTCHURCH Town Hall High Street. 020-15-4321	1045		1330-1545 1700-1915	Town Clerk's Department Christchurch 4321	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidball Mrs.Slade, Mrs.Freebody Mrs.Marshall.	
	Ronson Products Ltd. Forest Road Newport, Isle of Wight. 956-3426	Ryde 1130		1345-1600	Mrs.V.Ringer Newport 3426	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Miss Edgeworth, Miss Poulter, Mrs.Bickell.	Return RTC Lunch avail. at 1200
	TRANSFUSION CENTRE					MISS VANDENBULCK and Team.	

Table 3.1 continued

WESSEX REGIONAL TRANSFUSION CENTRE - PROGRAMME OF SESSIONS

Week Commencing - 30th September, 1974

DATE:	LOCATION AND TEL. NO. OF SESSION:	DEP.	RTN	SESSION TIMES:	HALL BOOKING CONTACT:	TEAM (Subject to Alteration)	REMARKS:
MON. 30th SEPT.	TRANSFUSION CENTRE					MISS VANDENBULCK and Team (?) Off Duty	
	RYDE - ISLE OF WIGHT St.John the Baptist Church Hall High Park Rd., Oakfield. 954-2863 (Vicarage next door)	Centre 0830		1330-1545 1700-1915	Mr.E.Owen Ryde 4513	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Mrs.Slade Miss Tidball, Mrs.Freebody.	Stay Ryde
	BLANDFORD Red Cross Hall Whitecliff Mill Street.	1015		1330-1545 1700-1915	Mrs.Adeley Milton Abbas 338	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Mrs.Dorey Miss Edgeworth, Miss Poulter.	L.O.
TUES. 1st OCT.	SALISBURY City Hall Fisherton Street. 0722-27676	1045		1330-1545 1700-1915	Hall Booking Clerk Salisbury 5451	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Mrs.Windeatt Mrs.Oakley, Mrs.Bickell Mrs.McLaughlin.	
	WEST COWES-ISLE OF WIGHT Northwood House Ward Avenue. 955-2401	Ryde 1100		1330-1545 1700-1915	Entertainment Department Ryde 2581	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Mrs.Slade Miss Tidball, Mrs.Freebody.	Stay Ryde
	BITTERNE - SOUTHAMPTON Methodist Church Hall Whites Road.	1230		1400-1615 1700-1915	Mr.Parnell S. 23032	MISS HENWOOD, Mrs.McManus Miss Plummer, Mrs.Emm Miss Littlehales, Miss Edgeworth, Miss Poulter, Mrs.Marshall.	If locked, at 16 Casse Ave.
WED. 2nd OCT.	British Rail Engineering Eastleigh Works Eastleigh. S. 23838, Ext.309.	1100		1300-1600	Mr.Reynolds S. 23838, Ext.309	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Mrs.Windeatt Mrs.Oakley, Mrs.Bickell.	Lunch avail. Extra Screen
	SANDOWN-ISLE OF WIGHT St.Johns Church Annexe St.Johns Crescent (junc. with Carter Street)	Ryde 1130		1330-1545 1700-1915	Rev.H.Chatfield Sandown 2195	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Mrs.Slade Miss Tidball, Mrs.Freebody.	Stay Ryde
	Dimplex Limited Millbrook Road Southampton. S.777117, Ext.8	0830		0930-1130 1400-1600	Mr.J.Pervin S.777117	MISS HENWOOD, Mrs.McManus Miss Plummer, Miss Poulter Miss Littlehales, Mrs.Emm Miss Edgeworth, Mrs.Dorey.	
THUR. 3rd OCT.	Zurich Insurance Co.Ltd. Havant Road Portsmouth. 0705-22200, Ext.58	0800		1015-1215 1400-1600	Mr.D.W.Styles Controller Portsmouth 22200, Ext.22	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.Kay, Mrs.Windeatt Mrs.Oakley, Mrs.Bickell.	
	SHANKLIN - ISLE OF WIGHT St.Pauls Church Hall Regent Street.	Ryde 1115		1330-1545 1700-1915	Mr.G.Godwin 2a St.Pauls Avenue.	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Mrs.Slade Miss Tidball, Mrs.Freebody	Stay Ryde
	GOSPORT Methodist Church Hall Stoke Road.	1045		1330-1545 1700-1915	Rev.F.Turk Gosport 83038	MISS HENWOOD, Mrs.McManus Miss Plummer, Miss Poulter Miss Littlehales, Mrs.Emm Miss Edgeworth, Mrs.Marshall.	
FRI. 4th OCT.	SOUTHSEA Central Hall Fratton Road. 0705-22745	1015		1330-1545 1700-1915	Mr.Jenkins Portsmouth 22745	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Mrs.Windeatt Mrs.Oakley, Mrs.Bickell, Mrs.McLaughlin	
	Plessey Radar Ltd. at Northwood Women's Institute Hall Northwood, West Cowes.	Ryde 0815		0945-1145 1345-1545	Mrs.J.Pardey Cowes 4141-Firm Miss Connor Cowes 4703-Hall	MRS.DONOHEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Mrs.Slade Miss Tidball, Mrs.Freebody	Ferry trans. Lunch avail. Return to R
	TRANSFUSION CENTRE					MISS HENWOOD and Team Off Duty	

Table 3.1 continued

WESSEX REGIONAL TRANSFUSION CENTRE - PROGRAMME OF SESSIONS

Week Commencing 7th October, 1974.

DATE:	LOCATION AND TEL: NO. OF SESSION:	DEP.	RTN	SESSION TIMES:	HALL BOOKING CONTACT:	TEAM:	REMARKS
MON. 7th OCT.	TRANSFUSION CENTRE					Miss HENWOOD and Team (?) Off Duty	
	RYDE - ISLE OF WIGHT All Saint's Church Hall West Street.	0830		1330-1545 1700-1915	Mrs. W. Roberts 100 Pellhurst Road.	MISS VANDENBULCK, Miss Johnson Miss Tinham, Miss Veal, Mrs. McKay, Mrs. Windeatt Mrs. Oakley, Mrs. Bickell	Leave equip. stacked at for end of [illegible] Stay Ryde.
	DUNHAM-BUSH LTD. Fitzherbert Road, Farlington, Portsmouth. 070-18-70961	0800		1000-1200 1400-1600	Mr. W. Price Cosham 70961	MRS. POMONEY, Mrs. Longman Mrs. Woodnutt, Mrs. Thomas Mrs. Slade, Mrs. Freebody Miss Tidball, Mrs. Marshall	Lunch avail.
TUES. 8th OCT.	POOLE Central Clinic Civic Centre, Park Road. 020-13-5151	1015		1330-1545 1700-1915	Health Clinic Admin. Off. Poole. 5151	MISS HENWOOD, Mrs. Dorey Mrs. McManus, Mrs. Emm Miss Littlehales, Miss Edgworth, Miss Poulter.	Accom. Avail. 12.30 Lunch avail. Crown Bldg.
	RYDE - ISLE OF WIGHT All Saint's Church Hall West Street.	Ryde 1245		1330-1545 1700-1915	Mrs.W. Roberts 100 Pellhurst Road	MISS VANDENBULCK, Miss Tinham Miss Johnson, Miss Veal, Mrs. McKay, Mrs. Windeatt Mrs. Oakley, Mrs. Bickell	Stay Ryde.
	Office of Population Censuses & Surveys Titchfield, Fareham 03294 - 42511	0830		1000-1200 1400-1600	Mrs. B. Clarke Welfare Officer Titchfield 42511 Ext.263	MRS. POMONEY, Miss Tidball Mrs. Longman, Mrs. Woodnutt Mrs. Thomas, Mrs. Slade Mrs. Freebody.	Lunch Avail.
WED. 9th OCT.	CHRISTCHURCH Town Hall, High Street, 020-15-4321	1045		1330-1545 1700-1915	Town Clerk's Dept. Christchurch 4321	MISS HENWOOD, Mrs. McManus Mrs. Emm, Miss Littlehales Miss Edgworth, Miss Poulter Mrs. McLaughlin.	
	NEWPORT - ISLE OF WIGHT Red Cross Hall, 1 Hunny Hill. 956-2718	Ryde 1115		1330-1545 1700-1915	Miss P. Fardell Newport 2718	MISS VANDENBULCK, Miss Tinham Miss Johnson, Miss Veal, Mrs. McKay, Mrs. Windeatt Mrs. Oakley, Mrs. Bickell.	Stay Ryde.
	PETERSFIELD Town Hall Heath Road, 0730-2771	1015		1330-1545 1700-1915	Mr. Stokes Petersfield 2771	MRS. POMONEY, Mrs. Marshall Mrs. Longman, Mrs. Woodnutt Mrs. Thomas, Mrs. Slade Mrs. Freebody.	
THURS 10th OCT.	COPNOR - PORTSMOUTH St. Cuthbert's Hall Hayling Avenue. 0705-25316(Mr.Shaw opp.)	1030		1330-1545 1700-1915	Mr. B. Walters P'mouth 4101	MISS HENWOOD, Mrs. Emm, Mrs. McLaughlin. Mrs. McManus Miss Littlehales, Miss Poulter Miss Edgworth.	
	EAST COWES - I.O.W. B.H.C. Social Club, Church Path, York Road, 955-3494/3342	Ryde 0900		1030-1200) Firm 1345-1500) 1515-1545) Pub 1700-1830) lic	Mr. R. Vincett Cowes 4101 Ex. 308	MISS VANDENBULCK, Miss Veal, Miss Tinham, Miss Johnson, Mrs. McKay, Mrs. Windeatt Mrs. Oakley, Mrs. Bickell	Leave Equip. Stay Ryde.
	BASINGSTOKE Community Centre, Carnival Hall, Council Rd. Fairfields 0256-64031	1030		1330-1545 1700-1915	Mrs. Spindler B'Stoke 4031	MRS. POMONEY, Mrs. Dorey, Mrs. Longman, Mrs. Woodnutt Mrs. Thomas, Mrs. Slade, Mrs. Freebody.	
FRI. 11th OCT.	Southampton College of Technology, Mountbatten Theatre, East Park Terrace, So'ton.	0830		1000-1200 1400-1600	Mr. Stanley Chief Admin. Off. So'ton 29381	MISS HENWOOD, Mrs. Marshall Mrs. McManus, Miss Poulter, Mrs. Emm, Miss Littlehales, Miss Edgworth.	
	BRITISH HOVERCRAFT CORP.LTD. BHC Social Club, Church Path, York Rd., 955-3494/3342	Ryde 0800		0900-1200 1330-1430	Mr. R. Vincett Cowes 4101 Ext. 308	MISS VANDENBULCK, Miss Veal, Miss Tinham, Miss Johnson, Mrs. McKay, Mrs. Windeatt, Mrs. Oakley, Mrs. Bickell.	Return to R.I.C.
	TRANSFUSION CENTRE					MRS. POMONEY and Team Off Duty	

research project, and with whom I enjoyed a working relationship of such value that it must be acknowledged here as well as more formally elsewhere. There are drawbacks to verbal questions as a means of collecting demographic data, however. It is probable that a written questionnaire elicits more detailed information than a few minutes of conversation. This is perhaps balanced by the fact that the response to a written questionnaire is inferior to that to a direct interview, at least on the evidence of the school children's response (which was of the order of 20%). Furthermore, in the case of the donors written communication would have been very costly. The second weakness of this method was the considerable time required to explain the nature of the survey to each donor and to obtain and record the required information. Inevitably some donors were missed at the busiest periods of a session, particularly in the earlier sessions. With practice the procedure became much swifter, to such an extent that it was possible to put additional questions to the donors at later sessions. Because the blood samples had to be collected from Southampton, it occasionally happened that a donor session was missed completely. In such a case the only demographic data obtained were those on the donor record cards at Southampton. In fact every donor's card was examined and gave information about age, sex, place of residence and marital status of women. The most complete data from interviewed donors related to:

name
date of birth
place of residence
birthplace
birthplace of parents
birthplace of grandparents
birthplace of spouse
sex
marital status
year of marriage
number of children
year of move to Isle of Wight
whether treated as new donor
whether first time ever donor

The categories "treated as new donor" and "first time ever donor" perhaps need explanation. At each session some donors do not have a permanent record card; temporary cards are made out for them and they are classified on the work-sheets as new donors. In fact a considerable proportion of these people have given blood before, either in a different town or several years before. It is not, therefore, their first ever donation.

(b) School Children

Finger-prick blood specimens were taken from 239 pupils of The High School, Sandown, Isle of Wight. The blood was taken into tubes containing isotonic saline, during one school day. In the evening the samples, in a cooled polystyrene box, were driven by car to Durham and were processed the following day.

Participation in the survey required both the permission of the parents and the willingness of the child. The return of a statement of assent signed by the parent (and appended to the demographic questionnaire) demonstrated both requirements. The demographic questionnaire is shown in Appendix II. It asked for information on the following:

name
date of birth
birthplace
birthplace of parents
birthplace of grandparents
father's date of birth
number of sibs
number of father's sibs
number of mother's sibs
father's occupation
grandfathers' occupations
mother's date of birth

Donors and school children were asked about any known blood relatives involved in the surveys.

III Laboratory Methods

(a) Blood Grouping

Red cells were grouped by three general methods, variations within each technique being employed in accordance with the instructions for use of each antiserum.

(i) Tile technique

A drop of red cell suspension was added to a drop of antiserum on a tile. The mixture was incubated at a prescribed temperature for a certain time. The tile was agitated and agglutination observed over a light-box with the naked eye.

(ii) Tube technique

One drop of red cell suspension and one drop of antiserum were mixed in a precipitin tube. After some time bovine albumin was run down the side of the tube and the mixture incubated for a further period. Red cells were pipetted onto a slide and agglutination observed microscopically. Some antisera do not require the use of albumin.

(iii) Indirect Coombs test

Equal volumes of 5% red cell suspension and antiserum were mixed in a precipitin tube and incubated for an hour. The cells were then washed four times with isotonic saline to remove excess antiserum. A drop of washed cells was mixed with a drop of anti human serum on a tile, and after ten minutes agglutination was observed macroscopically over a light-box.

Antisera were obtained from Ortho Diagnostics, Biotest, Hyland, The Blood Group Reference Laboratory, Newcastle NBTS and Lancaster Hospitals. A list of antisera used is given in Table 3.2.

(b) Controls

When resources allowed this to be done, red cell grouping was controlled by means of Ortho "Identigen" reagent red blood cells or "Biotestcell", an equivalent product. Failing this, a panel of controls was prepared using blood from members of the Anthropology Department who had been repeatedly blood-grouped in the past. In the event, this second method proved satisfactory, though its success was dependent upon the genes and goodwill of colleagues.

(c) Liquid Nitrogen Storage

During a series of blood donor sessions samples arrived at Durham faster than they could be processed. The plasma was removed from specimens and they were stored in liquid nitrogen using the glycerol and sorbitol method described in Appendix III. Recovery of these specimens was not always successful and some 250 samples were lost in this way. This was probably due

Table 3.2 Antisera used

Specificity	Source	Technique
Anti A	BGRL	Tile 18°C 10 min.
B	BGRL	Tile 18°C 10 min.
A + B	BGRL	Tile 18°C 10 min.
A_1	NBTS	Tile 4°C 10 min.
A_{hel}	Biotest	Tile 18°C 2 min.
M	Ortho	Tile 18°C 1 min.
M	BGRL	Tile 18°C 10 min.
M	NBTS	Tile 18°C 10 min.
N	Ortho	Tile 18°C 1 min.
N	BGRL	Tube 18°C 2 hr.
S	NBTS	Tube 18°C 1 hr. 20% alb.
S	BGRL	IDC 37°C 1 hr.
s	BGRL	IDC 37°C 1 hr.
c,C,D,E	Biotest	Tube 37°C 1 hr.
C,D,E	NBTS	Tube 37°C 2 hr. 30% alb.
e	NBTS	Tube 37°C 50 min. Papain
e	Ortho	Tube 37°C 20 min. AB serum
C^w	NBTS	Tube 18°C 2 hr. 20% alb.
Fy^a	NBTS	IDC 37°C 1 hr.
Fy^b	Biotest	IDC 37°C 1 hr.
K	NBTS	IDC 37°C 1 hr.
cellano	Hyland	IDC 37°C 1 hr.
cellano	Ortho	IDC 37°C 1 hr.
JK^a	Biotest	IDC 37°C 1 hr.
JK^b	Biotest	IDC 37°C 1 hr.
Kp^a	Biotest	IDC 37°C 1 hr.
Kp^b	Biotest	IDC 37°C 1 hr.
Mi^a/V^w	NBTS	Tube 18°C 1 hr. 20% alb.
P_1	Lancaster	Tile 4°C 10 min.

to inexperience in the technique rather than to the method itself, since subsequently the majority of stored samples was recovered without difficulty. When enough red cells had been recovered there was no loss of antigenic activity and blood grouping proceeded as usual. The cells were grouped immediately after recovery from the liquid nitrogen as they began to lyse much sooner than fresh blood.

(d) Electrophoresis

Horizontal starch gel electrophoresis was used to detect the serum proteins and red cell isoenzymes studied. It is not intended to give here extensive details of the methods employed in the Durham laboratory since, for 6 mm thick gels at least, they are well known, having been reported in other theses from this department (Mitchell, 1974; Sawnhey, 1975) as well as in the published literature.

(i) Serum Proteins

The serum samples were stored in a deep freeze until tested. The basic method of Smithies (1955) was used with a discontinuous system of buffers (Poulik, 1957). This method enables both Haptoglobin and Transferrin to be demonstrated on the same gel. Prior to electrophoresis one drop of 4% haemolysate solution was added to three drops of serum, and some of the mixture was introduced to the gel on a Whatman No. 3 filter paper insert. Because the blood of donors had been preserved with a solution of ACD the serum was dilute, and often extra inserts had to be used. After electrophoresis the gel was sliced longitudinally. One half was stained with benzidene after the method of Smithies (1959) to detect haemoglobin bound to the haptoglobin bands. The other half was stained with a general protein stain, 1% Amido-schwarz 10B; this allowed transferrin types to be determined.

(ii) Red Cell Isoenzymes

Haemolysates were prepared from frozen red cells by the carbontetrachloride method of Ager and Lehman (1961). They were stored deep frozen until use.

Acid Phosphatase

Variants, including the rare phenotype C, reported by Lai *et al.* (1964) were demonstrated by the method of Hopkinson *et al.* (1963). The use of Clellands Reagent instead of EDTA and 2-mercapto-ethanol to eliminate "storage" bands was tried with some success towards the end of the analysis. This modification renders the technique less obnoxious to the laboratory worker and his colleagues.

Phosphoglucomutase

This enzyme was examined by the method of Spencer *et al.* (1964). None of the rare alleles PGM_1 3-8, found by Hopkinson and Harris (1965, 1966) was detected.

Adenylate Kinase

Variants were detected by the method of Fildes and Harris (1966). The phenotypes 1-1, 2-1 and 2-2 were observed but those due to the rare alleles AK3 and AK4, described by Bowman *et al.* (1967), were not.

Esterase-D

In contrast to the techniques used to analyse the three isoenzymes mentioned above, the phenotypes of this system were demonstrated by electrophoresis using starch gels 1 mm thick and inserts of cotton thread as described by Wraxall and Culliford (1968). The enzyme bands were stained by the fluorescence method of Parkin and Adams (1975).
Gels 1 mm in thickness are suitable for the detection of other isoenzymes (Culliford and Wraxall, 1968). Towards

the end of the processing of the blood donor series 1 mm gels were used to analyse PGM and AK. It is important to stress the value of this technique in enzyme analysis. Not only does it give a very clear separation of phenotypes, but also cuts routine running costs. Compared with the 6 mm gel method, less starch is used, less staining reagents are used, and more specimens can be run on a gel.

IV Data Analysis

Most of the statistical analysis has been done by using the computer facilities of NUMAC available at the University of Durham Computer Unit. Many of the programmes used are from the Statistical Package for Social Science (2nd Edition, Nie, Hull *et al.*, 1975). This package has many advantages for the researcher whose principal interest is not computing, but who wishes for thorough and efficient data analysis; not the least of these is the strength with which this package is supported at the Durham Computer Unit. Where other special techniques have been used, such as in the calculation of gene frequencies, they will be acknowledged at the appropriate point in the text.

CHAPTER FOUR DEMOGRAPHY OF THE PRESENT DAY POPULATION

I Introduction

The historical review of the Isle of Wight presented in Chapter 2 indicated a population increasing in size and mobility up to the present day. In this chapter the modern population will be characterised in terms of its demography, and the pattern of and the relationships between the demographic variables will be explored. Immigration will be described and measured, relating movement to marriage patterns and to other social factors.

The demographic data on which this analysis is based are derived from the individual blood donors and school children who participated in the genetic surveys, and the information was obtained by interview in the former case and by questionnaire in the latter. (See Chapter 3 for details.)

Apart from some summary census statistics there is no control over the possible bias introduced to the sample by the voluntary nature of the surveys; we must assume that the sample represents the general population, even if this assumption is but a null hypothesis to be rejected if the acceptance of its unavoidable implications compels the suspension of disbelief. In this regard, any comparisons which examine some aspect of demographic variation within the present survey sample will stand on firmer footing than analyses which compare this whole sample with those derived from different regions by other researchers, simply because all the individuals in this survey have been "self-selected" (by participating) in the same way. Cause for concern may persist, however, if town-dwellers participate in blood donation, and incidentally in the survey, more readily than country folk. That such may be the case seems evident if only from the fact that blood is collected in the towns. Different levels of response between blood donors and school children have certainly been observed, and this fact as well as the differences in age and in catchment area between the two samples has suggested that the blood donors and school children usually be treated separately and compared with caution, even when the information given by both groups is apparently equivalent.

Census data also provide some control for the sampling of age. Manifestly, the choice of secondary school children and the age limits of blood donation (18 to 65 years old) constrain the samples to well within the age range of the resident population, as shown in Table 4.1. It might be suggested, I hope without unseemly opportunism, that because the population over

Table 4.1 Age Distribution of Population and Samples

Age in yrs.	Blood donor sample	Sandown school sample	Combined samples	1971 Census
0-4				.064
5-9				.070
10-14		.184	.025	.070
15-19	.029	.816	.137	.058
20-24	.137		.122	.058
25-29	.159		.142	.056
30-34	.137		.122	.049
35-39	.136		.121	.048
40-44	.099		.088	.053
45-49	.085		.076	.058
50-54	.069		.062	.061
55-59	.059		.053	.069
60-64	.051		.046	.079
65-69	.007		.006	.076
70-74				.057
75-79				.037
80-84				.022
85-89				.010
90-94				.003
≥ 95				.001
n =	1 517	239	1 756	109 510

sixty years of age is augmented on the Isle of Wight by immigration of people retired from work and past reproductive age, the exclusion of this substantial part of the population perhaps eliminates a genetical "red herring" from consideration. Such an argument only contrives to make a virtue of necessity, however, for notwithstanding the truth of the observation there are numbered among the resident over-sixties not only recent immigrants but also long-standing inhabitants now in old age. That the sampling procedure employed forces a loss of perspective must therefore be admitted, for the long-term residents could easily have been distinguished from those who came after retirement. An equally important omission is that of newborn infants and of young children up to secondary school age, for this excludes from consideration a section of the population among whom it is not implausible to suggest that genetic variation is more conspicuously associated with viability than in any other. On the other hand, there is no clear-cut evidence to suggest that the truncation of the age range which follows from sampling only school children and blood donors will introduce any appreciable bias of autosomal gene frequencies, but this will be discussed more fully below. If the discussion of age-sampling seems to be based on exclusively genetic criteria that is but a reflection of the relative importance given to genetics and to demography during the initial stages of this work, when frankly little thought was given to the distribution and interdependence of demographic variables. As variables which are themselves used to explain the variation in genetic traits, it may be hoped that they will be subject at worst to bias that is overt; as independent variables they are more vulnerable to clandestine deviations.

II Sandown School Children

(a) Introduction

The following discussion will introduce the sample of school children in more detail. The initial purpose in recruiting a small sample of children from Sandown High School was the provision of a control set of blood group information, in view of the acknowledged possibility of bias in Rhesus gene frequencies, derived from blood donors (Kopeć, 1970). For the control series to be adequate demographic information comparable to that supplied by the blood donors was considered a necessity, and this was obtained by a written questionnaire. Because the children and their parents had more time to answer the questions than did the blood donors, and because at least the middle generation was consulted instead of just the youngest, more detailed information about some things could be obtained from them. The facts which they were asked to provide relate to age, sex, birthplace and sibship size of the child and of its parents, and to birthplace only of the grandparents. In addition, the occupation of fathers and grandfathers was recorded and the implications of social class will be discussed at some length. (From the blood donors no information about occupation or sibship sizes was collected.) Details of the questionnaires are given in Chapter 3 and in Appendices I and II.

For the reasons just described the analysis of data derived from the school sample will not always have a direct counterpart in that of the donors. This effect is amplified by the fact that various manipulations of the children's data were found to be fruitless and so were pruned from the range of techniques applied to the donors'.

Again, concern about genetics is seen to have taken priority, with the demographic information being obtained only to justify the genetic. In the following paragraphs, by contrast, demography will abandon its supporting role, and will hold the stage alone.

(b) Results and Discussion about Geographical Mobility

The sample consists of 97 boys and 142 girls, whose ages at sampling in 1974 ranged from 13 to 18 years. If these children are taken to represent the generation growing up on the Isle of Wight it is of great interest to know where they were born, so that the extent of continuity of the gene pool can be established. Their places of birth located by county, both before and after the reorganisation of county boundaries which took place in 1974, were recorded. The use of the new county designations is problematical. They are of value in specifying in certain cases whether people come from an urban area when otherwise this would not be implied by the "old county" name alone, for example, "Merseyside" instead of "Lancashire", "West Midlands" instead of "Warwickshire", or "Tyne and Wear" instead of "Northumberland". They also have the less objective appeal of modernity. The drawback and consequent cause of abandonment of this method of notation was the very evident fact that the participants in the survey were unfamiliar with the "new county" designations and used "old counties" by habit. This could be observed when both town and county of birth were given. When county only was offered as a birthplace, as it often was for previous generations, it seemed more reasonable and more accurate to assume that the "old county" designation was intended. Table 4.2 shows the "old counties" of birth of the school children, and Table 4.3 shows the "new counties". Missing data and children born overseas are excluded from these tables. The proportion of British-born children whose birth occurred on the Island is 54%, a figure which immediately impresses one as very low and indicative of a highly mobile population. However, the index being considered is one for which intuition is perhaps of little use as a guide, so further judgement will be suspended until some comparative data are found.

Table 4.2 shows that among the mainland birthplaces Greater London is clearly of paramount importance, with Hampshire and Surrey

Table 4.2 School children's "old counties" of birth: proportional contributions to resident population

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Isle of Wight	.536	.341	.302	.316	.276	.298	.232
Bedfordshire	.017		.005			.010	.005
Berkshire	.017	.013	.014	.015	.010	.014	.005
Buckinghamshire	.017	.009	.009	.005	.010	.005	.005
Cambridgeshire				.010		.010	
Cheshire	.009		.023	.015		.005	.025
Cornwall	.009	.009	.005	.015	.005		
Cumberland		.009	.005		.005	.010	
Derbyshire	.004	.013	.014	.015	.026	.014	.020
Devon		.018		.015	.016	.005	.005
Dorset			.005	.005	.016	.005	.005
Durham		.018	.018	.015	.010	.019	.015
Essex	.026	.009	.032	.005	.016	.019	.010
Gloucestershire	.004			.005	.005	.019	
Hampshire	.052	.045	.059	.051	.052	.058	.064
Herefordshire		.009		.010	.005		.005
Hertfordshire	.026	.013	.009	.005		.005	.005
Huntingdonshire							
Kent	.013	.022	.023	.036	.021	.010	.025

Table 4.2 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Lancashire	.013	.040	.036	.046	.052	.034	.059
Leicestershire		.004		.005	.005	.005	
Lincolnshire	.004		.005			.005	
Greater London	.103	.179	.212	.163	.161	.192	.236
Monmouth		.004	.005		.010		
Norfolk		.004	.005	.005	.010	.010	.005
Northamptonshire		.004		.010		.010	
Northumberland		.009		.005	.005	.005	.015
Nottinghamshire		.018	.009	.010	.026	.019	.030
Oxfordshire	.009					.005	.005
Rutland				.005			
Shropshire					.005		
Somerset	.009	.004	.005	.005		.005	.005
Staffordshire	.004			.005	.005	.024	.020
Suffolk	.004	.004	.014		.010	.005	.005
Surrey	.047	.027	.032	.026	.052	.019	.025
Sussex	.009	.009	.027	.005	.010	.014	.044
Warwickshire	.030	.045	.023	.041	.042	.019	.030
Westmorland				.005			
Wiltshire	.009	.004	.018	.005	.005	.005	.010
Worcestershire	.004		.005				
Yorkshire	.013	.045	.045	.046	.036	.053	.030
Isle of Man		.004					
Channel Isles							

Table 4.2 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Antrim				.005	.005		
Armagh							
Down							
Fermanagh							
Londonderry							
Tyrone							
Carlow				.005			
Cavan							
Clare							
Cork		.004					.010
Donegal						.005	
Dublin		.009		.005	.010		.005
Galway							
Kerry							
Kildare					.005	.005	
Kilkenny							
Laois							
Leitrim				.005			
Limerick							
Longford							
Louth					.005		

Table 4.2 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Mayo							
Meath							
Monaghan							
Offally							
Roscommon							
Sligo							
Tipperary							.005
Waterford							
Westmeath			.005				
Wexford			.005			.005	
Wicklow							.005
Anglesey							
Brecknock							
Caernarvon							
Cardigan					.005	.010	.005
Carmarthen							
Denbigh					.005		
Flint							
Glamorgan		.027	.018	.015	.010	.014	.020
Merioneth							
Montgomery							

Table 4.2 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Pembrokeshire							
Radnor	.004		.005			.005	
Aberdeen							
Angus			.005	.005	.005		
Argyll							
Ayr							
Banff							
Berwick							
Bute							
Caithness							
Clackmannon							
Dumfries							
Dunbarton							
East Lothian							
Fife		.004			.005		
Inverness							
Kincardine							
Kinross							
Kirkcudbright							
Lanark		.018	.005		.005	.005	
Midlothian	.004			.010	.005		

Table 4.2 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Moray						.005	
Nairn							
Orkney							
Peebles				.005			
Perth						.005	
Renfrew							
Ross and Cromarty							
Roxburgh							
Selkirk							
Shetland							
Stirling					.005		
Sutherland							
West Lothian							
Wigtown							
N. Ireland (unspec.)							
S. Ireland (unspec.)					.005	.005	.005
Ireland (unspec.)							
Wales (unspec.)			.005	.005	.010		
Scotland (unspec.)				.010		.005	.005
n =	233	227	222	196	192	208	203
Missing data	0	9	6	37	41	21	23
Overseas	6	7	11	6	6	10	13

Table 4.3 School children's "new counties" of birth: proportional contribution to the resident population

County	Self	Father	Mother
Isle of Wight	.536	.341	.302
Avon	.004		
Bedfordshire	.017		.005
Berkshire	.017	.009	.014
Buckinghamshire	.017	.009	.009
Cambridgeshire			
Cheshire			.023
Cleveland		.009	.018
Cornwall	.009	.009	.005
Cumbria		.009	.005
Derbyshire	.004	.013	.014
Devon		.018	
Dorset	.013	.004	.014
Durham			.014
Essex	.026	.009	.032
Gloucestershire			
Hampshire	.039	.040	.050
Hereford and Worcs	.009	.009	
Hertfordshire	.026	.013	.009
Humberside	.009		.009
Kent	.013	.022	.023

Table 4.3 continued

County	Self	Father	Mother
Lancashire			.005
Leicestershire		.004	
Lincolnshire			
Greater London	.103	.179	.212
Greater Manchester	.013	.022	.018
Merseyside	.009	.018	.014
West Midlands	.034	.040	.023
Norfolk		.004	.005
Northants		.004	
Northumberland			
Nottinghamshire		.018	.009
Oxfordshire	.009	.004	
Shropshire			
Somerset	.009	.004	.005
Staffordshire			
Suffolk	.004	.004	.014
Surrey	.043	.027	.032
East Sussex	.004	.004	.005
West Sussex	.004	.004	.023
Tyne and Wear		.022	
Warwickshire		.004	.005
Wiltshire	.009	.004	.018
North Yorks		.004	

Table 4.3 continued

County	Self	Father	Mother
South Yorks	.004	.022	.014
West Yorks	.004	.013	.014
Isle of Man		.004	
Channel Isles			
Antrim			
Armagh			
Down			
Fermanagh			
Londonderry			
Tyrone			
Carlow			
Cavan			
Clare			
Cork		.004	
Donegal			
Dublin		.009	
Galway			
Kerry			
Kildare			
Kilkenny			
Laois			

Table 4.3 continued

County	Self	Father	Mother
Leitrim			
Limerick			
Longford			
Louth			
Mayo			
Meath			
Monaghan			
Offally			
Roscommon			
Sligo			
Tipperary			
Waterford			
Westmeath			.005
Wexford			.005
Wicklow			
Clwyd			
Dyfed			
North Glamorgan			.005
South Glamorgan		.013	.014
West Glamorgan		.013	
Gwent		.004	.005
Gwynedd			
Powys	.004		.005

Table 4.3 continued

County	Self	Father	Mother
Borders Region			
Central Region			
Dunfries and Galloway R.			
Fife Region		.004	
Grampian Region			
Highland Region			
Lothian Region	.002		
Orkney Islands Area			
Shetland Islands Area			
Strathclyde Region		.018	.005
Tayside Region			
Western Isles Island Area			
N. Ireland (unspec.)			
S. Ireland (unspec.)			
Ireland (unspec.)			
Wales (unspec.)			.005
Scotland (unspec.)			
n =	233	222	222
Missing data	0	10	6
Overseas	6	7	11

contributing the next two highest proportions of immigrants. The "new counties" in Table 4.3 show the order of contributions of Hampshire and Surrey to be reversed (owing to Dorset's bureaucratic annexation of Bournemouth from Hampshire). More importantly, the West Midlands emerges as a notable source of population. Another striking feature of these tables is that although the proportion of immigrants among the school children seems high, so also does the number of counties which have not contributed directly to the present generation.

Although individual counties' contributions have been included for completeness, it is rather easier to appreciate a pattern of population movement when the counties are amalgamated into "regions". For this purpose "old counties" have been grouped together in accordance with the geographical and administrative boundaries of everyday life, with some refinement derived from the genetic distributions within the British Isles observed by Kopeć (1970). To combine birthplace localities entirely according to Kopeć might have been the optimal procedure but would have required data of a resolution unobtainable in this study. Eight regions were designated. Isle of Wight, Greater London and Ireland each comprises just what its name generally implies. Wales is without Monmouthshire, Scotland includes Northumberland, and South, Midlands and North appear perhaps more arbitrary still. The South includes Bedfordshire, Berkshire, Buckinghamshire, Cornwall, Devon, Dorset, Essex, Gloucestershire, Hampshire, Herefordshire, Hertfordshire, Kent, Somerset, Surrey, Sussex, Wiltshire and the Channel Islands. The Midlands includes Cambridgeshire, Derbyshire, Huntingdonshire, Leicestershire, Lincolnshire, Monmouthshire, Norfolk, Northamptonshire, Nottinghamshire, Oxfordshire, Rutland, Shropshire, Staffordshire, Suffolk, Warwickshire and Worcestershire. The North consists of Cheshire, Cumberland, Durham, Lancashire, Westmorland, Yorkshire and the Isle of Man.

Table 4.4 shows the contributions to the Isle of Wight school populations from these birthplace regions. This presentation does not impart any new information, but it does increase the clarity with which the localised origin of the large immigrant population can be seen. The procedure seems well justified not only because the number of school children questioned was small, but also because the number of counties is large.

Greater depth can be given to these observations by comparing the county and the regional origins of the children with those of their parents and grandparents. This is not a direct demonstration of changes or differences between generations, since that would require samples of Sandown school children from one and then two generations ago, but I hope that it will show the ramifications of the ancestral roots of the present generation. Once again, although the information for individual

Table 4.4 School children's regions of birth: proportional contributions to the resident population

Region	Self	Father	Mother	F's F	F's M	M's F	M's M
Isle of Wight	.523	.318	.280	.259	.222	.259	.197
South	.251	.180	.222	.172	.180	.167	.184
London	.100	.167	.197	.134	.130	.167	.201
Midlands	.059	.092	.071	.088	.113	.109	.096
North	.033	.109	.117	.105	.084	.105	.109
Wales	.004	.025	.025	.017	.025	.025	.021
Scotland	.004	.029	.008	.029	.025	.021	.017
Ireland		.013	.008	.017	.025	.017	.025
Overseas	.025	.029	.046	.025	.025	.042	.054
Missing data	.000	.038	.025	.155	.172	.088	.096

n = 239

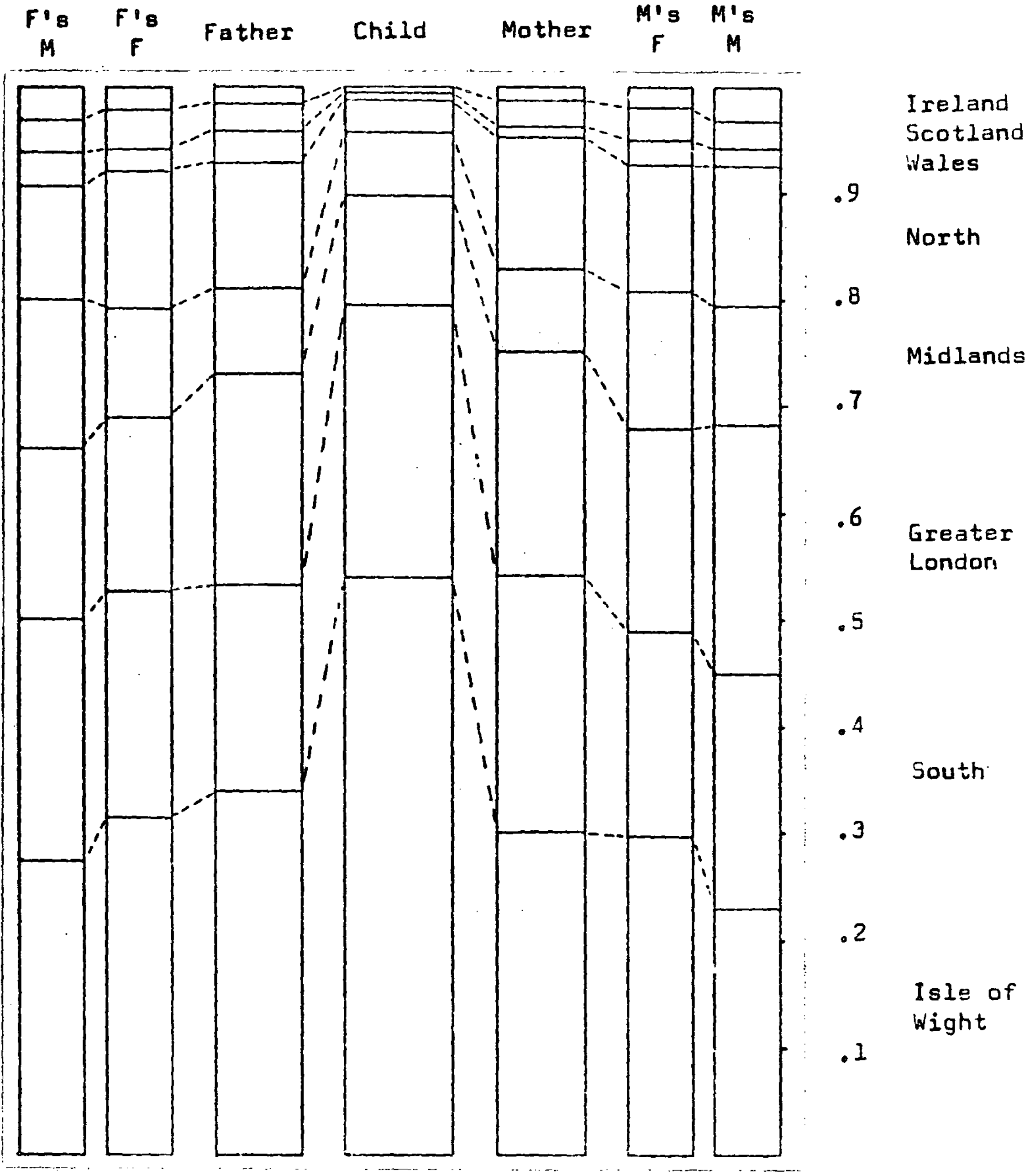
counties has been presented for completeness's sake in Table 4.2 and so far as it was available for "new counties" in Table 4.3, the pattern of change is more easily observed in Table 4.4. From this last table it can be seen that in previous generations the catchment area is wider, with more distant regions contributing proportionally more to the population. Complementary to this is the decrease in frequency of Isle of Wight-born ancestors. Another fact worth noting is that the proportion of missing data increases sharply in the parental and again in the grandparental generation. This observation will later be discussed as a possible source of bias. The cumulative frequencies shown in Table 4.5 are obtained simply by summation of the relative frequencies in Table 4.4 When cumulative frequencies which exclude missing data and overseas births are mapped out as in Figure 4.1, both the regional contributions within generations and their proportional changes between generations are easy to perceive. (As far as I know this method of presentation is due to D. Coleman.) The summary conclusion to be drawn from this figure and the Tables 4.2 to 4.4 is that the children of the present generation are still less firmly rooted on the Island than even first impressions indicated, with about a quarter only of their grandparents being born there. Greater London and the South continue to be the most important mainland sources of population, though with some increase in the proportions contributed by the more far-flung regions.

Table 4.5 School children's regions of birth: cumulative proportions

Region	Self	Father	Mother	F's F	F's M	M's F	M's M
Isle of Wight	.523	.318	.280	.259	.222	.259	.197
South	.774	.498	.502	.431	.402	.426	.381
London	.874	.665	.699	.565	.532	.593	.582
Midlands	.933	.757	.770	.653	.645	.702	.678
North	.966	.866	.887	.758	.729	.807	.787
Wales	.970	.891	.912	.775	.754	.832	.808
Scotland	.974	.920	.920	.804	.779	.853	.825
Ireland	.974	.933	.928	.821	.804	.870	.850
Overseas	.999	.962	.974	.846	.829	.912	.904
Missing data	.999	1.000	.999	1.001	1.001	1.000	1.000

n = 239

Figure 4.1 School children:
regions of birth of children and antecedents



Finally, these data may be reduced to a level where the only concern is whether or not an individual was born on or off the Isle of Wight. Concordance and discordance between generations can then be demonstrated. Table 4.6 does this for the children and their parents. The columns denote the relationship and the rows the concordance or discordance of birthplaces. The main impressions given by this table are the importance of parent-child pairs where both were born off the Island, and the small but measurable return to the Island of families where a parent was born on it but the child was not. There persists a suggestion that women have moved on to the Isle of Wight more than men; 35% of fathers were born there compared with 31% of mothers. A two by two chi square test of birthplace (Isle of Wight versus not-Isle of Wight) against sex among these parents shows this disproportion not to be statistically significant ($\chi^2=0.916$, $p>.30$).

No data for previous generations are tabulated or discussed here because of the difficulty of interpretation mentioned above in connection with county and region of birth.

At this same level of data reduction it is appropriate here to consider movement associated with marriage rather than with lifetime or generational migration. Instead of looking at concordance and discordance of birthplace of parents and offspring, we may do it for birthplaces of marriage partners

Table 4.6 School children: concordance of parent's and offspring's birthplace

	child-father	child-mother
both born on I.W.	.318	.265
parent on, child off	.032	.042
child on, parent off	.217	.274
both born off I.W.	.433	.419
n =	217	215

Table 4.7 School children: concordance of parents' birthplace

Marriage category	Number	Proportion
Endogamous	41	.193
Exogamous, husband born on I.W.	31	.146
Exogamous, wife born on I.W.	23	.108
Neither born on I.W.	117	.552

n = 212 marriages

among the children's parents. This will measure endogamy and exogamy, which are familiar and important factors in the description of breeding isolation. Marriages among the children's parents are classified in Table 4.7 as "endogamous", "endogamous with husband born on IW", "exogamous with wife born on IW" and "neither partner born on IW". This table shows that the category of marriages with neither partner born on the Island is the single largest in this sample. The overwhelming importance of marriages involving at least one partner born on the mainland is obvious: the relative frequency of endogamous marriages is 19%.

A different way of looking at the kind of data discussed above is to consider distances between localities rather than the places between which movement or marriage occurs. Distance is only one component of migration, but its units and its generality commend it above location and direction, for example. The pros and cons of such a reduction of data are familiar; the loss of information must be weighed against the clarity of the pattern revealed. In this case not only do the frequency distributions have a characteristic shape, but also the existence of similar empirically as well as theoretically derived curves will provide some basis for comparison (Cavalli-Sforza, 1962; Majumder, 1977).

Distances have been worked out from the raw migration data by measuring with a ruler from place to place on a Geographia map of the British Isles, scale nineteen miles to one inch. This method has some consequences which should be noted; firstly, the distances are "as the crow flies"; secondly, distance could not be measured unless both individual places had been identified, so there are a lot of missing data for the previous generations; and thirdly, the measurements are not very accurate and are biased. Thus, the numbers 10, 20, 30 ... etcetera miles in Tables and Figures on this topic have the connotation "within 10 miles, greater than 10 but within 20 miles, greater than 20 but within 30 miles" and so on.

If we first consider movement not specifically related to marriage, then there are two obvious kinds of measurement which deserve attention. One is the distance between an individual's birthplace and his place of residence, and the other is the distance between birthplace and parents' birthplaces. The former has the general advantage of being easier to discover, but has the disadvantage of increasing with age; the value of computing this statistic between age-groups is therefore limited. The distance between the birthplaces of parents and children can be measured from the child's birthplace to the mother's or the father's, or be expressed as the mean of these two. In each form it has the property of describing the movement during a complete generation. By analogy with the limitation imputed to birthplace-residence distance, the measure now discussed will be likely to increase with parental age; in this survey there will not be the obvious difficulty in comparing school children with blood donors, since any difference in age between the groups may be expected to be slight, and will be a real rather than an artificially contrived difference.

Table 4.8 shows in columns 1 and 2 the distribution of father-offspring (FO) and mother-offspring (MO) birthplace distances within the sample of school children. These data are plotted as histograms in Figures 4.2 and 4.3. About 40% of children were born within 10 miles of their father's birthplace and a similar figure applies for mother-offspring distances. In each case the shortest distance is clearly the mode of the distribution, which has a long tail reaching beyond 250 miles.

Direct comparison of the distribution of birthplace distances between generations is possible since movement alone is measured and is not associated with any particular locality. Columns 3-6 of Table 4.8 show the distributions of father-offspring and mother-offspring distances, taking as offspring the father and the mother of the children sampled in the survey. FFO means father's father-offspring distance, FMO means father's mother-offspring distance, and so on. Plotted

Table 4.8 School children:
distribution of parent-offspring distances

Distance in miles	FO	MO	FFO	FMO	MFO	MMO
up to 10	.438	.395	.623	.609	.579	.526
11-20	.092	.102	.087	.121	.162	.115
21-30	.037	.037	.049	.029	.010	.062
31-40	.028	.028	.011	.023	.015	.026
41-50	.009	.014	.022	.011	.015	.031
51-60	.018	.033	.005	.006	.025	.026
61-70	.041	.009	.011	.029	.020	.036
71-80	.065	.121	.055	.057	.020	.052
81-90	.018	.028	.022	.006	.005	.010
91-100	.014	.014	.016		.010	
101-110	.023	.014	.005	.006	.005	.010
111-120	.018	.005	.005	.006		.005
121-130	.009	.014	.001	.023	.020	.005
131-140	.014	.014		.006	.015	.010
141-150	.005		.005	.006	.005	.005
151-160		.004		.011		
161-170	.018	.014	.005	.011	.015	.005
171-180	.005	.033		.006	.015	.016
181-190	.037	.033	.022	.006	.010	.010
191-200	.014	.019	.005	.011		.010
201-210	.018	.009	.005	.006	.005	
211-220	.009	.009	.011			
221-230					.010	
231-240		.009	.005		.005	
241-250	.005				.005	
> 250	.064	.042	.015	.012	.025	.035
n =	217	215	183	174	197	192

Figure 4.2 School children:
distribution of father-offspring distance

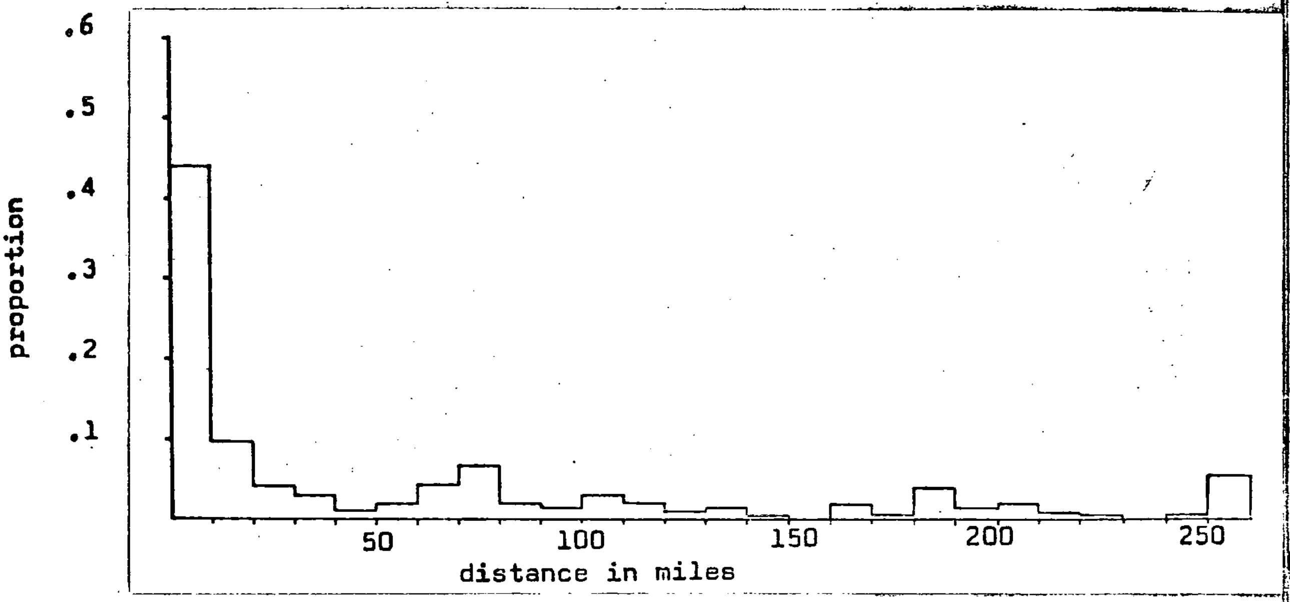
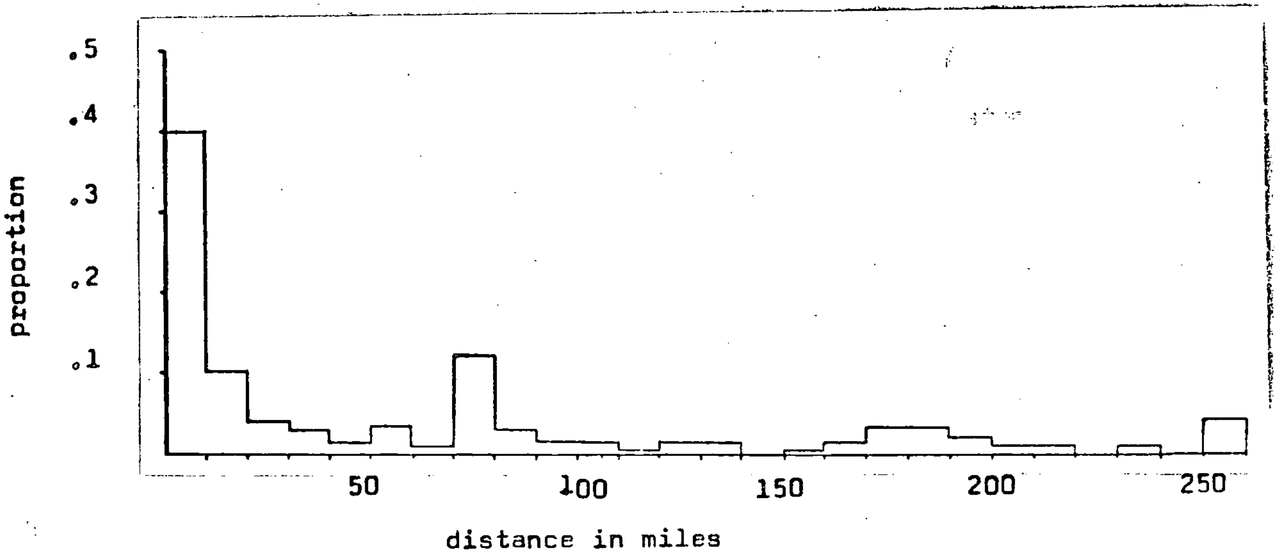


Figure 4.3 School children:
distribution of mother-offspring distance



as histograms in Figures 4.4, 4.5, 4.6 and 4.7, these data show the same shape of distribution as Figures 4.2 and 4.3. However, Table 4.8 and a comparison of the figures indicates an even more marked skew towards the origin in the earlier generations. In comparing generations we have two statistics (FO and MO representing the most recent generation, and four (FFO, FMO, MFO, and MMO,) representing the one before. A visual comparison of the generations can be made by plotting the cumulative frequency distributions for the six variables (Table 4.9) on the same graph. This is done in Figure 4.8 and it shows a quite distinct gap between the present generation and the previous one, caused by an increase in parent-offspring distances in the last generation. For curves of a similar shape and nature derived from the population of rural Oxfordshire, Jeffries et al. (1976) shun "elaborate statistical treatment", tabulating simply means, medians and quartiles. In fact, even though central limit theorem may validate the demonstration of a difference between means by use of a t-test, a comparison of means serves rather to confuse the sharpest difference between the distributions, which is in the proportion of parent-offspring pairs born within ten and within twenty miles. One way to test the statistical significance of this change in the distribution is to consider just two categories of distance, "long" and "short" (say, more than twenty miles and less than twenty miles) and to make a two by two

Figure 4.4 School children: distribution of fathers' father-offspring distance

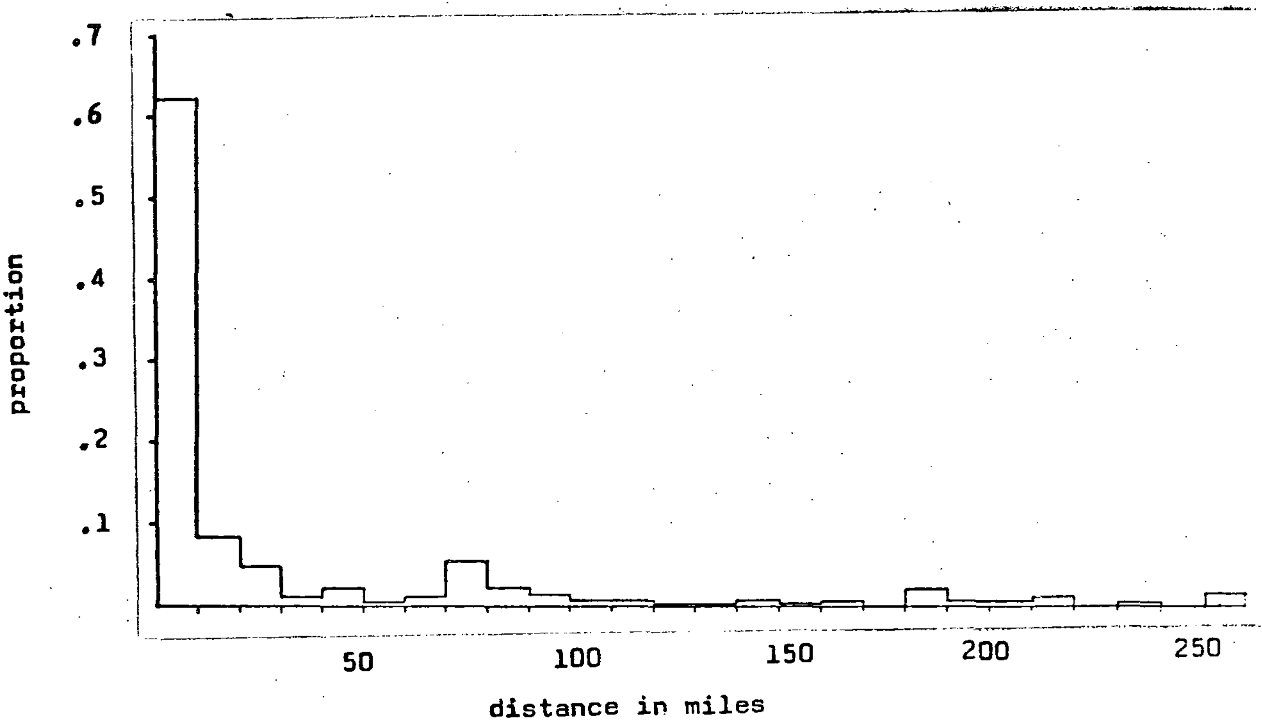


Figure 4.5 School children: distribution of mothers' father-offspring distance

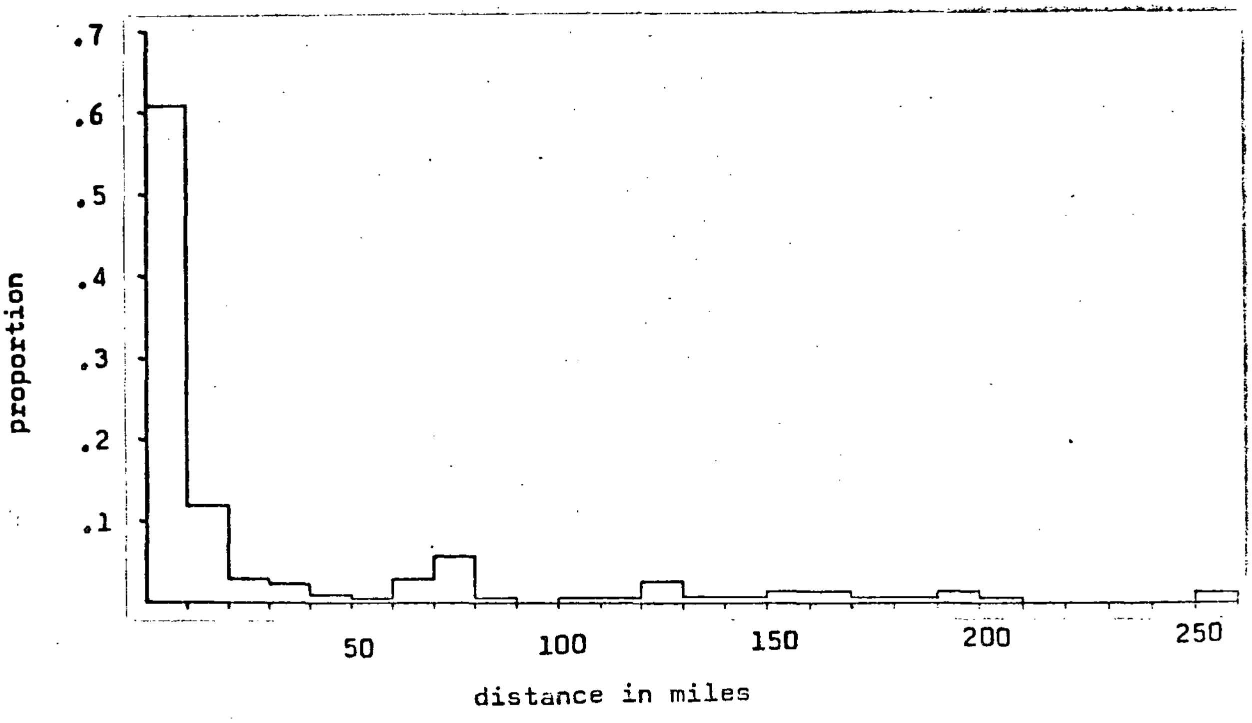


Figure 4.6 School children: distribution of mothers' father-offspring distance

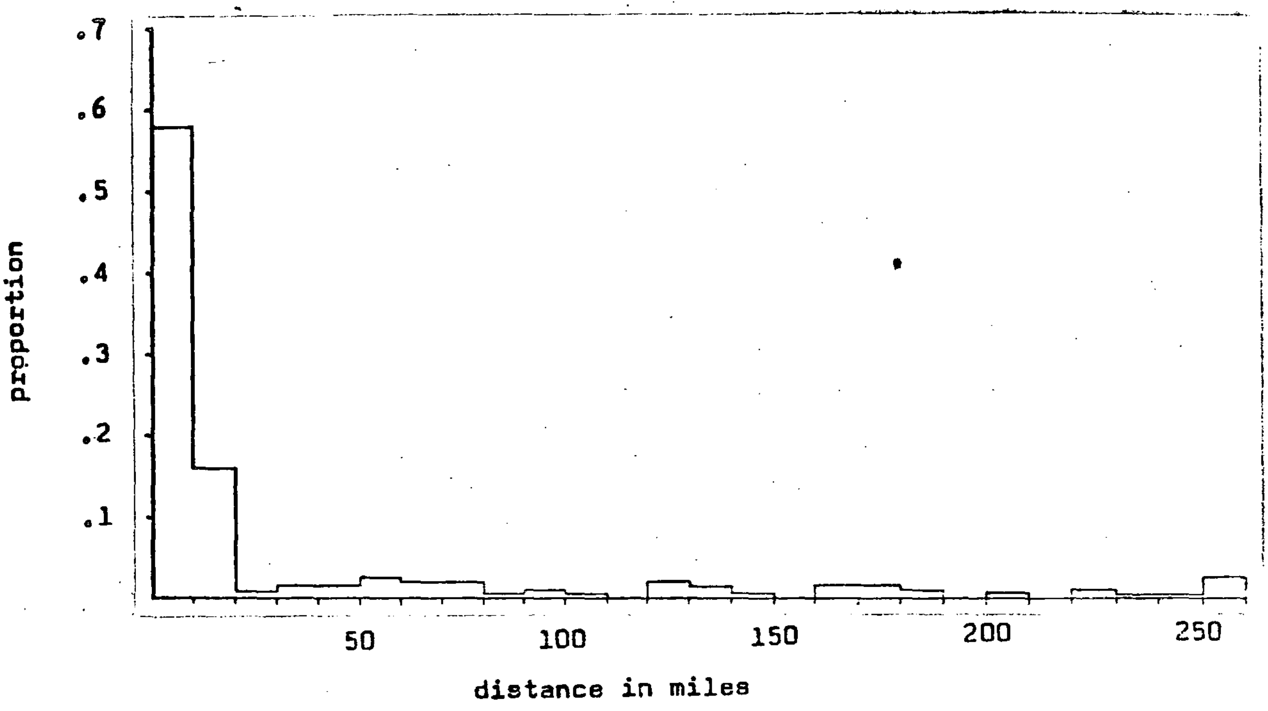


Figure 4.7 School children: distribution of mothers' mother-offspring distance

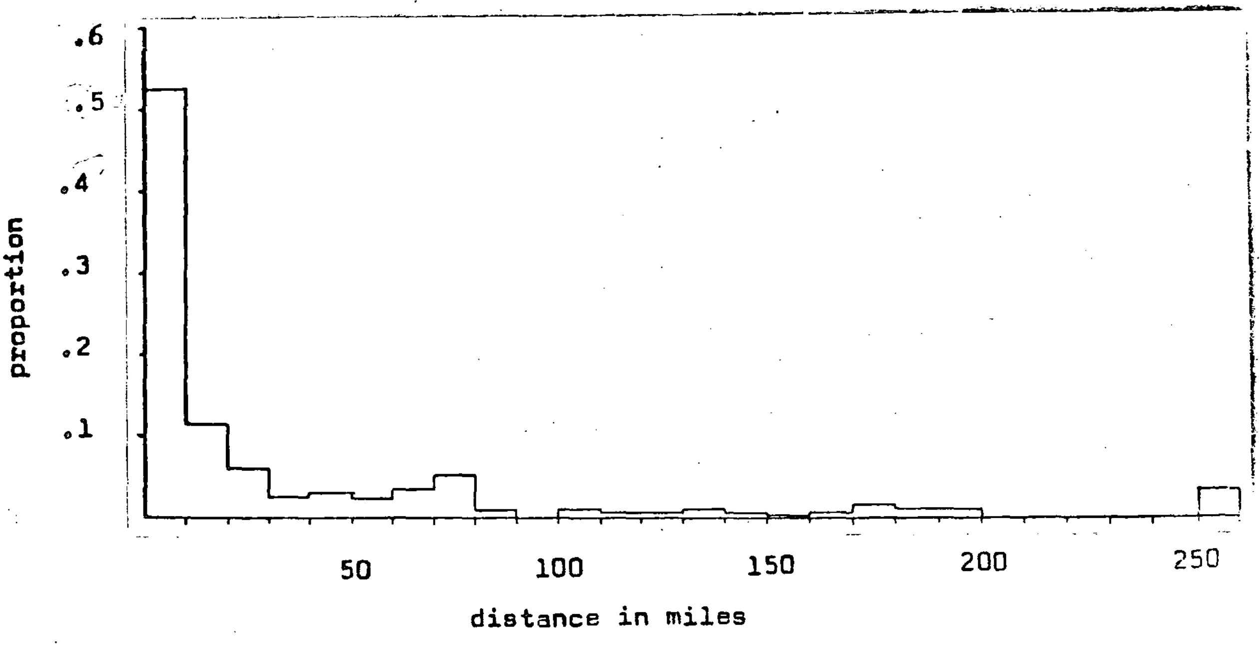


Table 4.9 School-children: parent-offspring distances, cumulative proportions

Distance in miles	F O	M O	FFO	FMO	MFO	MMO
up to 10	.438	.395	.623	.609	.579	.526
20	.530	.498	.710	.730	.741	.641
30	.567	.535	.760	.759	.751	.703
40	.594	.563	.770	.782	.766	.729
50	.604	.577	.792	.793	.782	.760
60	.622	.609	.798	.799	.802	.786
70	.664	.619	.809	.828	.827	.823
80	.728	.740	.863	.885	.848	.875
90	.747	.767	.885	.891	.853	.885
100	.760	.781	.902	.891	.863	.885
110	.783	.795	.907	.897	.868	.896
120	.802	.800	.913	.902	.868	.901
130	.811	.814	.923	.925	.888	.906
140	.825	.828	.923	.931	.904	.917
150	.829	.828	.929	.937	.909	.922
160	.829	.833	.929	.948	.909	.922
170	.848	.847	.934	.960	.924	.927
180	.853	.879	.934	.966	.939	.943
190	.889	.912	.956	.971	.949	.953
200	.903	.930	.962	.983	.949	.964
210	.922	.940	.967	.989	.954	.964
220	.931	.949	.978	.989	.954	.964
230	.931	.949	.978	.989	.964	.964
240	.931	.958	.984	.989	.970	.964
250	.935	.958	.984	.989	.975	.964
> 250	1.000	1.000	1.000	1.000	1.000	1.000
n	217	215	183	174	197	192

Figure 4.8 School children:
parent-offspring distances,
cumulative proportions

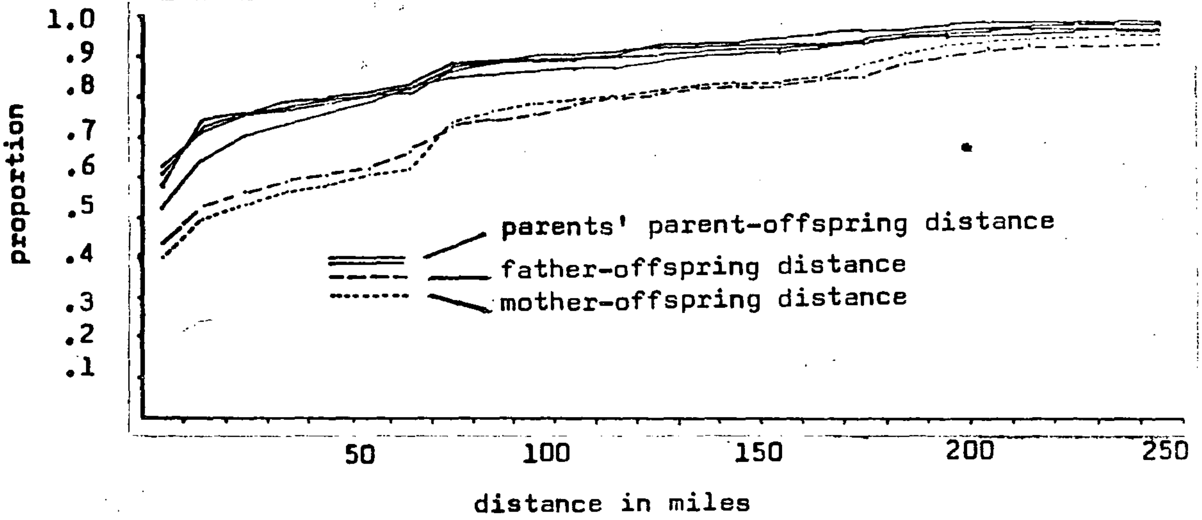
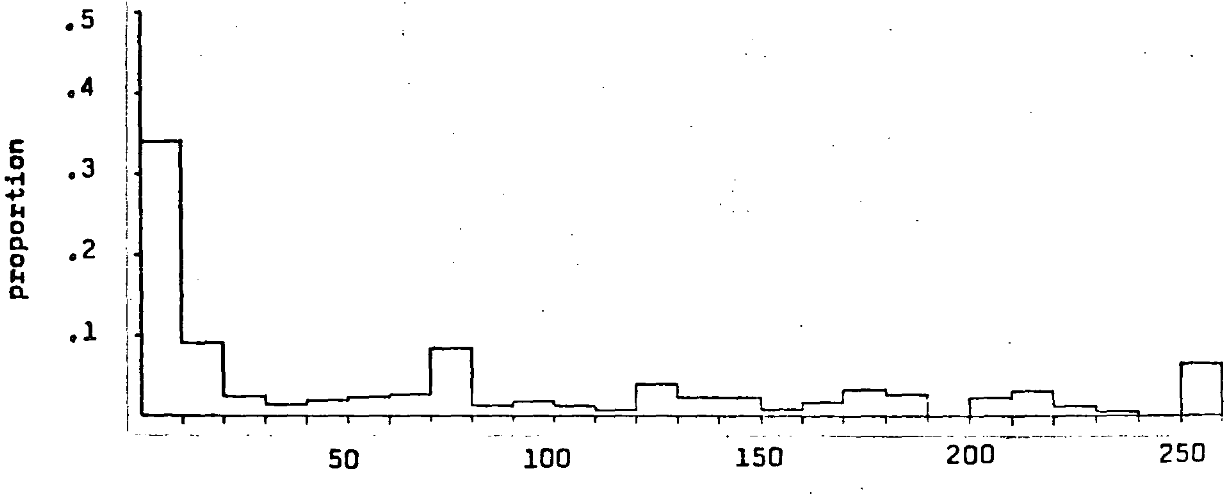


Figure 4.9 School children:
distribution of
parents' birthplace distance



contingency table of generation against distance. This is done in Table 4.10.

The distance measures considered so far, summarising movement during a lifetime and movement through a generation may be regarded as in some way proportional to the geographical and numerical size of the gene pool. An analogous measure of its extent is the distance between the birthplaces of marriage partners (here called "birthplace distance"). Such a statistic may seem more directly associated with breeding behaviour than did the two previous measures, which are due to migration from all causes. From another point of view, however, birthplace distance is more obscure; it alone cannot tell us where genes go to, only where they come from. Birthplace-residence distance describes the movement of a person; parent-offspring distance measures a movement of genes which coincides with a movement of persons (except in the case of father-offspring distance when the pregnant woman moves on her own); birthplace distance, by contrast, although describing the distances apart of localities linked by marriage, does not imply anything beyond the minimum necessary migration, which may have little to do with how far the marriage partners actually move, or where they have their children. For all this, the appeal of birthplace distance as an analogy for the size of the gene pool is considerable, though its difference in kind from the other measures should not be forgotten. Table 4.11 shows the distribution

Table 4.10 School children: parent-offspring distances of two generations

	less than 20 miles	more than 20 miles
schoolchildren's birthplace-offspring distance	222	210
parents' birthplace-offspring distance	526	217

$$\chi^2 = 43.63, \quad p < .001$$

Table 4.11 School children: distribution of parents' birthplace distances

Distance in miles	PBD	FPBD	MPBD
up to 10	.340	.527	.441
11 - 20	.090	.112	.151
21 - 30	.024	.041	.059
31 - 40	.014	.036	.016
41 - 50	.019	.036	.043
51 - 60	.024	.018	.022
61 - 70	.028	.006	.038
71 - 80	.085	.047	.054
81 - 90	.014	.018	.011
91 - 100	.019	.024	
101 - 110	.014		.016
111 - 120	.009	.006	
121 - 130	.042	.012	.016
131 - 140	.024	.012	.038
141 - 150	.024		
151 - 160	.009	.012	
161 - 170	.019	.006	.005
171 - 180	.033	.012	.005
181 - 190	.028	.012	.016
191 - 200			.016
201 - 210	.024	.012	
211 - 220	.033	.006	
221 - 230	.014		.005
231 - 240	.005	.006	
241 - 250		.006	
> 250	.060	.036	.046
n	212	169	186

of birthplace distance for the children's parents (PBD), the children's fathers' parents (FPBD), and the children's mothers' parents (MPBD). Histograms of these data are shown in Figures 4.9, 4.10 and 4.11. The cumulative frequency distributions of these variables are presented in Table 4.12 and plotted in Figure 4.12. Whilst the difference between generations is again apparent, there is heterogeneity among the grandparents.

(c) Results and Discussion about Social Class

The school children were asked to state the occupations of their fathers and grandfathers; from this information, by means of the Registrar General's Classification of Occupations (1970), the social class of each family in two generations was inferred. The distribution of social class is shown in Table 4.13. There is plainly a great similarity in social class distribution between the mothers' parents and the fathers' parents, with both these differing slightly from the distribution in the present generation. For comparison we may examine the equivalent figures published by Rutter, Tizard and Whitmore (1970). Table 4.14 shows the social class distribution among (a) their own control group of nine and ten-year-old children, (b) the Isle of Wight total population (information from schools about all school children) and (c) seven-

Figure 4.10 School children: distribution of fathers' parents' birthplace distance

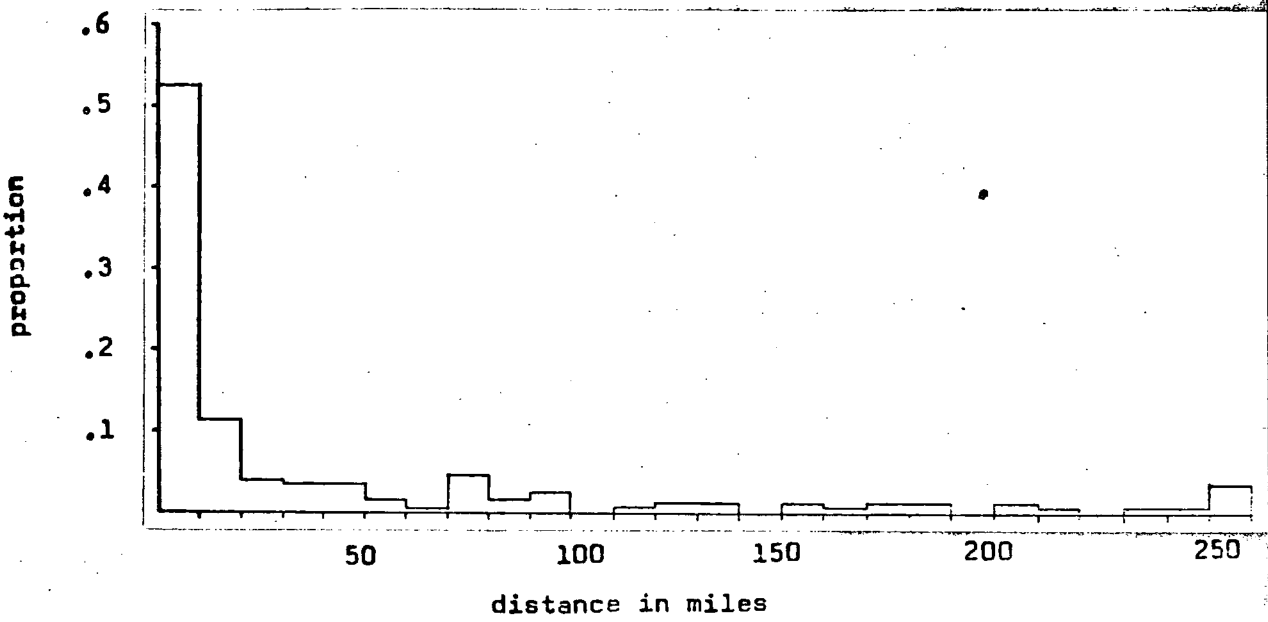


Figure 4.11 School children: distribution of mothers' parents' birthplace distance

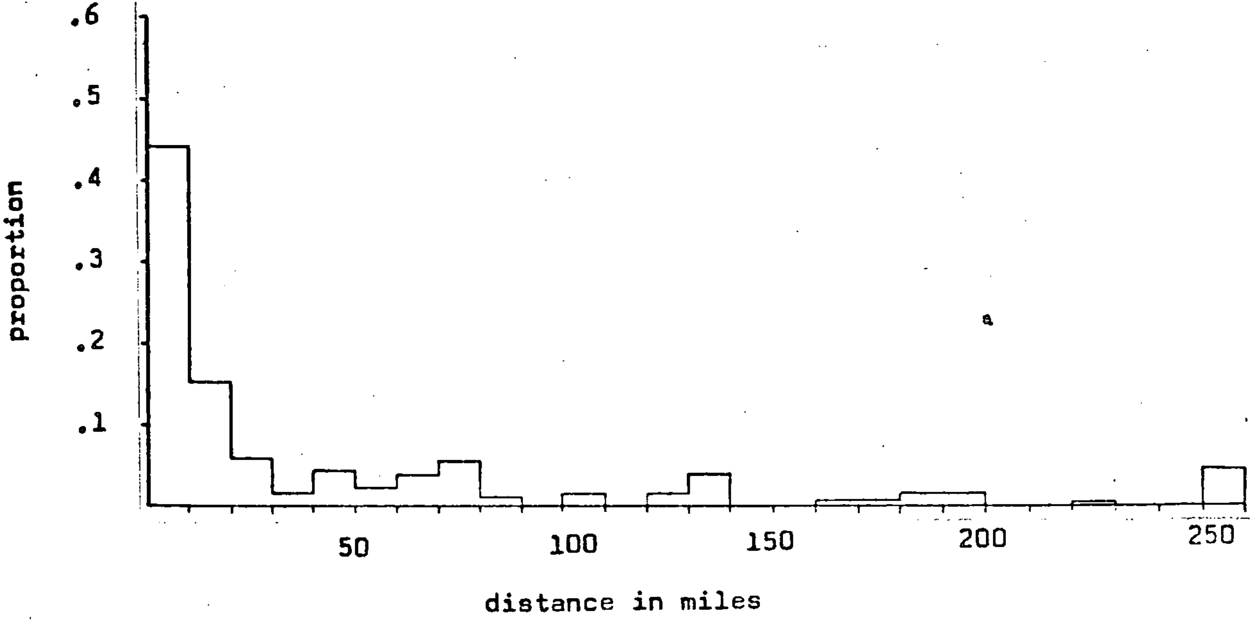


Table 4.12 School children: parents' birthplace distances, cumulative proportions

Distance in miles	Parents'	Father's parents'	Mother's parents'
up to 10	.340	.527	.441
20	.429	.639	.591
30	.453	.680	.651
40	.467	.716	.667
50	.486	.751	.710
60	.509	.769	.731
70	.538	.775	.769
80	.623	.822	.823
90	.637	.840	.833
100	.656	.864	.833
110	.670	.864	.849
120	.679	.870	.849
130	.722	.382	.866
140	.745	.893	.903
150	.769	.893	.903
160	.778	.905	.903
170	.797	.911	.909
180	.830	.923	.914
190	.858	.935	.930
200	.858	.935	.946
210	.882	.947	.946
220	.915	.953	.946
230	.929	.953	.952
240	.934	.959	.952
250	.939	.964	.952
> 250	1.000	1.000	1.000
n	212	169	186

Figure 4.12 School children:
birthplace distances in two generations,
cumulative proportions

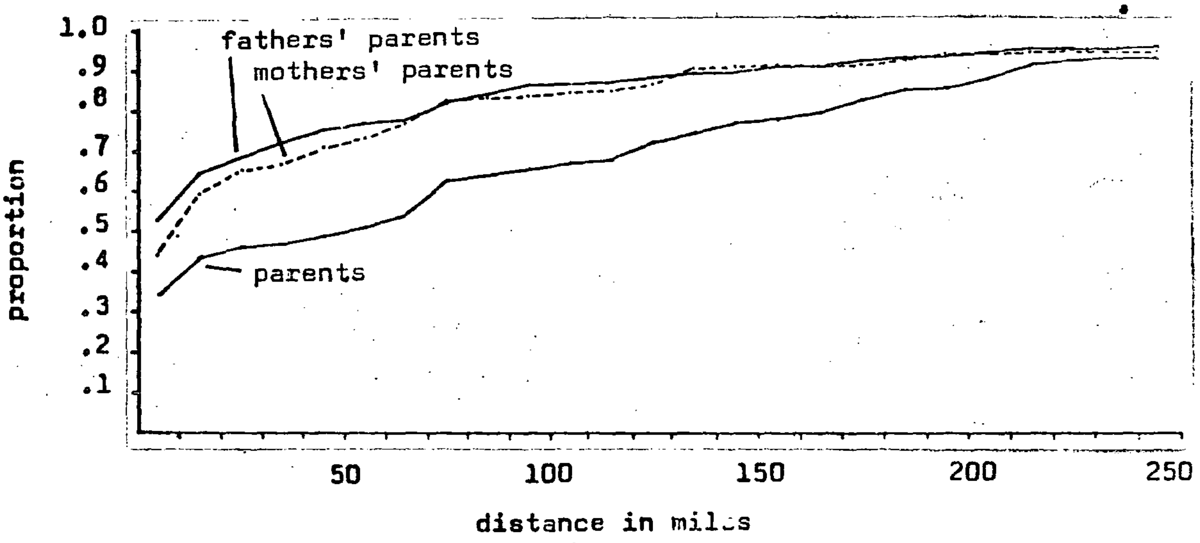


Table 4.13 School children:
distribution of social class
based on father's occupation

Social class	Children	Fathers	Mothers
I	.08	.05	.06
II	.29	.25	.25
III Non manual	.12	.11	.13
III Manual	.39	.41	.42
IV	.10	.13	.12
V	.02	.04	.02
	n = 219	n = 162	n = 162

Table 4.14 School children:
comparative distributions of
social class.
Information from Rutter, Tizard
& Whitmore (1970)

Social class	a	b	c
I and II	.19	.22	.20
III Non manual	.17	.12	.10
III Manual	.46	.41	.45
IV and V	.18	.25	.25
n =	136	3 437	14 128

year-olds sampled in the National Child Development Study. There is a consistent difference between the present survey's results and those tabulated by Rutter, Tizard and Whitmore; the present investigation finds much higher frequencies of social class I and II, at the expense of IV and V. In view of the relative homogeneity within each survey, the most plausible explanation of the discrepancy is perhaps to be found in the voluntary nature of the present investigation, which might be expected to produce a bias toward the higher social classes.

Notwithstanding this possibility of bias, it will be of interest to see if social class is associated with any other demographic parameters, and if so, whether any causation can reasonably be surmised. Put most simply, the associations sought are with either the place the family comes from, or the kind of family it is. The aspects of place to be considered are location and size, and the aspects of family are parental age, family size, migration and social class itself.

Table 4.15 shows the distribution of birthplace of the fathers divided by social class. Because of the small sample size birthplace is classified as "Isle of Wight" or "not Isle of Wight" and social class as "manual" (that is, IIIM, IV and V) or "non-manual" (that is, I, II and IIIN). Clearly, there is an association of manual occupation (low social class) with

Table 4.15 School children: father's birthplace in relation to occupation

Birthplace Occupational group	IW	Not IW
Non-manual	22	78
Manual	50	57

$\chi^2_1 = 12.866 \quad p < .001$

Table 4.16 School children: child's "ancestry" in relation to father's occupation

"Ancestry" Occupational group	IW	Not IW
Non-Manual	6	38
Manual	16	10

$\chi^2 = 15.249 \quad p = .0001$

birth on the Isle of Wight: $\chi^2=12.866$, $p<0.001$. A still larger χ^2 results from the division of population by "ancestry" of the child instead of father's birthplace, so that the categories of birth are "those children born on the Isle of Wight with both parents and at least three grandparents born there" and "those born off the Isle of Wight with neither parent born there and no more than one grandparent born there". This is shown in Table 4.16. The difference in distribution of occupations between the two groups, which is measured by the two by two table, is shown in more detail in Table 4.17, but the small number of cases in many cells prevents this table from being used for a significance test.

Contingency tables analogous to Table 4.15 have been made for the children's fathers' families and the children's mothers' families; these are Table 4.18 and Table 4.19. They test for association between father's father's job and father's father's birthplace, and mother's father's job and mother's father's birthplace. In neither of these tables is there demonstrated any association between birth on or off the Isle of Wight and occupational class.

Birthplace size is perhaps not an obvious variable to relate to social class. The reason for attempting to do so was as follows: if one could extrapolate from the association of low social class with birth on the Isle of Wight, the generalisation

Table 4.17 School children:
social class in relation
to "ancestry" of children

"Ancestry" Social class	IW	Not IW
I	0	7
II	4	25
III Non-manual	2	6
III Manual	11	7
IV	3	3
V	2	0

Table 4.18 School children:
father's father's birthplace
in relation to his occupation

Birthplace Occupational group	IW	Not IW
Non-manual	18	38
Manual	29	64

$\chi_1^2 = 0.015 \qquad p > .05$

Table 4.19 School children:
mother's father's birthplace
in relation to his occupation

Birthplace Occupational group	IW	Not IW
Non-manual	15	46
Manual	30	57

$\chi_1^2 = 1.658 \qquad p > .05$

thus produced might be a contrast in social class between the town-born and the country-born. The size of birthplace was taken as a crude indication of urban or rural provenance. In the following tables the dichotomy occurs at a population size of twenty-five thousand. There is no very good reason for this, but it gives a convenient split of the data and it draws the dividing line at the limit of settlement size on the Island.

Table 4.20 shows that there is a relationship between social class and birthplace size, but we may suspect that it is due to the confounding of birth on the Isle of Wight with size of birthplace which results from the categories of birthplace size employed. Table 4.21 is the equivalent tabulation with Isle of Wight-born fathers excluded; this time no association is demonstrated. Similarly, a lack of association is indicated by Table 4.22 and Table 4.23, which crosstabulate father's father's birthplace size with father's father's job and mother's father's birthplace size with mother's father's job.

The association of social class with age of the children's parents has been sought because it is suspected that social class may increase with age owing to the general tendancy for a man to be promoted throughout the course of his working life (Harrison, Hiorns and Küchemann, 1971). From this point of

Table 4.20 School children: father's occupation in relation to father's birthplace size

Birthplace size Occupational group	$\leq$ 25 000	$>$ 25 000
Non-manual	38	62
Manual	64	43

$\chi^2 = 8.990 \quad p < .01$

Table 4.21 School children: father's occupation in relation to father's birthplace size. Fathers born on Isle of Wight excluded

Birthplace size Occupational group	$\leq$ 25 000	$>$ 25 000
Non-manual	16	62
Manual	18	43

$\chi^2 = 1.499 \quad p > .05$

Table 4.22 School children: father's father's occupation in relation to his birthplace size

Birthplace size Occupational group	$\leq$ 25 000	$>$ 25 000
Non-manual	28	27
Manual	42	46

$\chi^2 = 0.039 \quad p > .05$

Table 4.23 School children: mother's father's occupation in relation to his birthplace size

Birthplace size Occupational group	$\leq$ 25 000	$>$ 25 000
Non-manual	25	32
Manual	34	49

$\chi^2 = 0.028 \quad p > .05$

view we might expect the parents' age at the time of the survey to be related to social class. (In the context of a survey such as this, which samples a narrowly restricted range of age among the children, the preceding sentence is equivalent to saying that social class is related to parents' age at the birth of the child, either directly or by way of parity or birth order.) The mean age (at the time of the survey in 1974) of fathers, mothers and both parents has been compared between manual and non-manual employment groups by means of a t-test in Table 4.24. There is no significant difference between the mean age of the groups when mothers or fathers or both parents are considered. The single result which approaches significance is the comparison of mothers' mean age, which is 42.5 among the manual workers and 43.9 among the non-manual ($t = -1.92$, $p = .056$); numerically there is a difference between groups in the same direction both for fathers' mean age and for parents' mean age. Mothers' mean ages at the birth of the child (tested in the survey) in the two occupational groups are compared in Table 4.25.

The pattern of age-differences between manual and non-manual workers at the time of the survey is indeed compatible with both social class advancement with age and delay of reproduction among the non-manual group. The effect of birth order among the surveyed children, however, confers much greater weight upon the former interpretation.

Table 4.24 School children:
age of parents at time of survey
compared between social classes

Parent	Social class		Mean age	S.E.	t	p
Father	Manual	(n = 104)	46.4	0.7	-1.09	.277
	Non-manual	(n = 101)	47.4	0.7		
Mother	Manual	(n = 105)	42.5	0.5	-1.92	.056
	Non-manual	(n = 102)	43.9	0.5		
Both parents	Manual	(n = 103)	44.5	0.6	-1.59	.112
	Non-manual	(n = 100)	45.7	0.5		

Table 4.25 School children:
age of parents at birth of child
compared between social classes

Parent	Social class		Mean age	S.E.	t	p
Father	Manual	(n = 104)	31.2	0.6	-0.96	.337
	Non-manual	(n = 101)	32.1	0.7		
Mother	Manual	(n = 105)	27.3	0.5	-1.80	.073
	Non-manual	(n = 102)	28.6	0.5		
Both parents	Manual	(n = 103)	29.3	0.5	-1.47	.143
	Non-manual	(n = 100)	30.4	0.5		

The relationship between social class and family size seemed to be worth examining if only because of the traditional stereotype of poor parents with little education having large families, presumably through having no knowledge of or making no use of contraceptives. As birth-control becomes more common and more commonplace, this image may be replaced by one of larger families among the higher social classes and smaller among the lower.

The present investigation is hampered by the use of school children and their sibs to represent family size, since completed family size is what should properly be used, and among children of thirteen to eighteen years of age it obviously cannot be guaranteed. The comparison of sibship size between groups based on father's occupation was made by means of a t-test. The mean sibship size of the non-manually employed, 2.793 (standard error = 0.105), did not differ from that of the manually employed, 2.954 (standard error = 0.109). These data should perhaps be asked to do no more than they have done already, which is to deprecate belief in at least the extreme versions of either of the stereotypes mentioned above. The comparison of sibship size in this generation is shown in Table 4.26. Table 4.27 shows a comparison of fathers' sibship size made between fathers' fathers' occupational groups. Not only does this tend to support the inference of equivalence of family

Table 4.26 School children:
sibship size compared between
social classes

Social class	Mean sibship	S.E.	t	p
Manual (n = 111)	2.8	0.1	-1.07	.288
Non-manual (n = 108)	2.9	0.1		

Table 4.27 School children:
father's sibship size compared
between social classes

Social class	Mean sibship	S.E.	t	p
Manual (n = 88)	3.8	0.3	1.49	.139
Non-manual (n = 59)	3.2	0.3		

size between occupational groups (and in certainly completed families), but also shows some combination of the extent of incompleteness of family size in the present generation and the decline in family size from the previous generation to the present one.

The relationship between social class and geographical mobility has been suggested by the association of birthplace and occupation demonstrated in Table 4.15. Now, by analogy with the approach to mobility made earlier in the chapter, social class is to be treated as an independent variable governing firstly, the distance between birthplaces of marriage partners, and, secondly, the distance between the birthplaces of parents and children. The general technique used is the division of the sample into manual and non-manual occupational classes and the comparison by means of a t-test of the mean distances evaluated for each group.

Table 4.28 compares the mean values of the parents' birthplace distance between categories of father's employment, of father's parents' birthplace distance between categories of father's father's employment, and of mother's parents' birthplace distance between categories of mother's father's employment. The values for the non-manual class are consistently numerically higher than those of the manual class, but the t-tests show these differences not to be statistically significant.

Table 4.28 School children:
birthplace distances compared between
social classes of husbands

Marriage partners	Social class		Mean distance in miles	S.E.	t	p
Child's parents	Manual	(n = 103)	79.8	8.8	-1.32	.188
	Non-manual	(n = 94)	97.0	9.7		
Father's parents	Manual	(n = 84)	50.2	7.8	-0.09	.927
	Non-manual	(n = 46)	51.5	12.4		
Mother's parents	Manual	(n = 75)	44.7	6.8	-1.69	.073
	Non-manual	(n = 55)	69.1	12.8		

Table 4.29 School children:
parent-offspring distances compared between
social classes (survey children as "offspring")

Parent-offspring	Social class		Mean distance in miles	S.E.	t	p
F-O	Manual	(n = 107)	65.2	8.3	-0.94	.348
	Non=manual	(n = 96)	76.9	9.3		
M-O	Manual	(n = 105)	63.8	7.4	-0.21	.834
	Non-manual	(n = 95)	66.0	7.3		
MP-O	Manual	(n = 103)	65.1	6.4	-0.62	.536
	Non-manual	(n = 91)	70.7	6.4		

Table 4.29 compares father-offspring distance, mother-offspring distance, and mid-parent-offspring distance between types of father's employment. Tables 4.30 and 4.31 make the same comparisons using respectively the fathers of the present survey children and the mothers of these children as the "offspring" for whom the distances are computed. Once again, the non-manual workers are consistently more mobile than the manual workers, but the t-tests indicate statistical significance only in the case of Table 4.31.

The final variable which deserves consideration as an associate or determinant of social class is social class itself. Just as geographical mobility has been measured among parents and children on the one hand, and among marriage partners on the other, so may social mobility be examined in terms of generational and matrimonial components. Again, because the samples are small, statistical tests can be carried out only if social class categories are reduced to "manual" and "non-manual". However, the full distribution of social class will be considered and tabulated for information and interest.

Table 4.32 examines the relationship between father's social class and father's father's social class. The χ^2 value for the two by two table is 9.005 (p=.003), clearly indicating an association between the variables, which, in view of their

Table 4.30 School children:
parent-offspring distances compared between
social classes (children's fathers as "offspring")

Parent-offspring	Social class	Mean distance in miles	S.E.	t	p
F-O	Manual (n = 88)	32.8	5.0	-1.33	.138
	Non-manual (n = 52)	48.1	10.3		
M-O	Manual (n = 82)	38.9	6.7	-0.19	.852
	Non-manual (n = 48)	41.0	9.7		
MP-O	Manual (n = 81)	35.5	4.3	-0.83	.347
	Non-manual (n = 44)	43.9	9.1		

Table 4.31 School children:
parent-offspring distances compared between
social classes (children's mothers as "offspring")

Parent-offspring	Social class	Mean distance in miles	S.E.	t	p
F-O	Manual (n = 83)	26.7	4.5	-2.79	.002
	Non-manual (n = 57)	63.9	12.5		
M-O	Manual (n = 75)	34.9	6.0	-2.02	.035
	Non-manual (n = 59)	60.2	11.0		
MP-O	Manual (n = 75)	30.5	3.6	-2.98	.001
	Non-manual (n = 55)	60.2	9.3		

Table 4.32 School children:
father's social class in relation to his father's

		Father's father's social class	
		Manual	Non-manual
Father's social class	Manual	55	21
	Non-manual	38	42

$$\chi^2_1 = 9.005 \qquad p < .01$$

Table 4.33 School children:
father's social class in relation to his father's (full matrix)

		Father's father's social class					
		I	II	IIIN	IIIM	IV	V
Father's social class	I	3	2	3	6	0	0
	II	2	17	5	18	3	2
	IIIN	0	3	7	5	3	1
	IIIM	2	13	2	30	11	2
	IV	0	4	0	7	2	0
	V	0	0	0	0	1	2

relationship in time, can be interpreted as a dependence of the son's social class upon the father's. The full matrix of social class transition derived from father's and father's father's social class is given in Table 4.33. Familial inertia of social class is indicated by the high frequencies on the principal diagonal.

The matrimonial association of social class may be examined by crosstabulating the groom's social class with the bride's. It is perhaps a point of contention whether a man's social class at marriage should be derived from his own occupation or from his father's; certainly the Registrar General's capacity for describing the social class of women suggests that the bride's social class be inferred from her father's occupation. For completeness two approaches are made here: the first is symmetrical, testing for association between groom's father's occupation and bride's father's; the second is asymmetrical, correlating groom's social class with bride's father's. These relationships are shown in Tables 4.34 and 4.35. In neither case is there a significant association between bride's and groom's social class, though this condition is more nearly approached ($\chi^2 = 3.181$, $p = .075$) when the groom's social class is defined on his father's occupation rather than his own. This suggests that any tendency toward assortative mating by social class might be based upon family

Table 4.34 School children:
father's father's social class in relation to mother's father's

		Mother's father's social class	
		Manual	Non-manual
Father's father's social class	Manual	53	32
	Non-manual	23	28

$$\chi_1^2 = 3.181 \quad .08 > p > .05$$

Table 4.35 School children:
father's social class in relation to mother's father's

		Mother's father's social class	
		Manual	Non-manual
Father's social class	Manual	48	26
	Non-manual	41	38

$$\chi_1^2 = 2.134 \quad p > .05$$

background rather than groom's achieved performance, or even upon his perceived potential.

An additional observation of interest, though of no more than anecdotal value, may be made. If in Table 4.33 the numbers of "upward moves" and "downward moves" are counted, we find that 61 families have moved up and 34 have moved down, as judged by comparing father's and son's performances. A possible equilibrium for this inequality might lie in a balance between many small increments and a few catastrophic plunges, but the figures provide no evidence of this. Clearly, the data are not explained by the hypothesis of increasing social class with age; they stand rather in defiance of it. A factor which should not be ignored, and whose consideration clouds further the already murky waters of social class, is the possibility of change through time of the distribution of all available jobs. There is some evidence that the distribution of jobs itself is tending to move towards the upper classes (Reid, 1977) and this tendency may help to explain the prevailing direction of social mobility apparent in Table 4.33.

That the investigation of social class in the whole survey is limited to such a small amount of data is a matter for regret. Internal evidence as well as a wealth of external evidence from Otmoor, Oxford city and elsewhere (for example, Harrison et al., 1970, 1971; Küchemann et al., 1974; Cartwright et al., 1978) suggests that even at the naïve level of inference from occupation, social class is an important element in the genetic structure of population in Britain. The reason that occupations were not recorded from the blood donors is simply that in the busy NBTS sessions there was not time to collect the information. In retrospect, exclusion of "occupation" rather than some other datum might well be regarded as an error of judgement.

The analysis of Isle of Wight data tends to confirm the view that the amount and extent of migration depends to some degree upon social class, and it also shows that social class itself has a familial tendency.

The association deserving most attention here, however, is felt to be the one between social class and birthplace, for this has general implications for sampling in genetical surveys. Tables 4.15, 4.16 and 4.17 demonstrate this relationship on the Isle of Wight, and Tables 4.36 and 4.37 show exactly the same phenomenon observed in a survey of blood donors resident on Anglesey (Smith, 1980). There seem to be only two obvious interpretations of data such as Tables 4.15, 4.16 and 4.17 provide: either the Isle of Wight-born tend to predominate among the lower social classes; or among the Isle of Wight-born, as among those born elsewhere, the higher social classes are more mobile. The latter alternative is undoubtedly the more plausible, but it has implications for survey sampling. In research

Table 4.36 Anglesey blood donors: man's birthplace in relation to his social class

Birthplace Social class	Anglesey	Not-Anglesey
I	3	12
II	18	24
III Non-manual	22	18
III Manual	60	46
IV	38	27
V	27	6

Kendall's tau c = -0.239

$p < .001$

Table 4.37 Anglesey blood donors: man's birthplace in relation to his occupation

Birthplace Occupation	Anglesey	Not-Anglesey
Manual	125	79
Non-manual	43	54

$\chi^2_1 = 6.982 \quad p < .01$

on the British Isles a common strategy has been to seek the "indigenous" population of various regions in order to offset the effects of twentieth century migration. Garlick and Pantin (1957) for example, are quite clear about this while Brown (1965) and Mitchell (1973) follow similar procedures deliberately but without explicit reason. The rigour with which the "indigenous" population is defined may vary: Mitchell (1973) required that both parents and at least three grandparents be born on the Isle of Man in his definition of the Manx population; Brown (1965) used the criterion that all four be born within what is now the Highland Region of Scotland; Garlick and Pantin (1957), in comparing the populations of three areas within the Black Mountain region of Carmarthenshire, limit their sample to adults born within the region and located by their area of birth within it, and to school children living in the region and located by the area of birth of both parents within it, with the further constraint that children whose parents were born in different areas within the region were excluded from the comparison. Such sampling criteria as the ones described above are designed to obviate the influence of migration in blurring the genetic boundaries and gradations between populations which are supposed to have persisted until a century or less ago. In view of the demographic tabulations made above, however, this procedure needs reconsideration. Apparently, sampling only residents who were born in or who have ancestry in a region introduces a marked social class bias into a survey. More extensive data from Anglesey have shown that associated with this social class bias there are biases of age and migratory behaviour (Smith, 1980).

Now if there is any genetic association with social class, with age or with migration, it is possible that genetic differences apparently due to geographical origin may in fact be due to other causes. The evidence for such associations is by no means unequivocal, but there are several reports bearing upon the problem.

The question of blood group variation with age has been posed a number of times. The discrepant answers provided by the ABO groups (Roberts, 1948; Buckwalter and Knowler, 1958, and Ashley and Davies, 1966 finding no variation with age, but Hart, 1944; Bennet and Walker, 1956; Jörgenson and Schwarz, 1968; Van Hoote and Kesteloot, 1972, and Williams, 1977 finding variation in different directions) indicate that the matter deserves more consideration in regard both to this and to other genetic marker systems. In fact there is no reason to expect or accept only a consistent relationship with age, for if the age-variation in genetic markers reflects difference in survival rate and longevity due to genes or genotypes, then the notably heterogeneous pattern of disease incidence will produce different effects in different localities. On top of this it has been pointed out by Williams (1977) in his collation of papers on genetic markers in diabetes mellitus that the same disease may be associated with different alleles in different populations, and this phenomenon may be more widespread.

The social class distribution of simply inherited traits has not been widely recorded, and again the evidence is contradictory. While Dawson (1964) using ABO and Rhesus groups in Ireland, and Hiorns et al. (1977) using a much wider range of genetic markers in Oxfordshire showed no association with social class, Wheatcroft (1973) found differences in PTC tasting distributions (and complex traits) among the social classes of Birmingham school children. Cartwright et al. (1978) working on blood donors in Nottingham, inferred a relationship between social class and genetic markers by computing and comparing genetic distance based on five gene loci between occupational groups. By the same method these authors further suggested a genetic component in upward social mobility. In addition to this the paper by Beardmore et al. (1980) provides strong evidence of an association between simply inherited traits and social class among Welsh new-born babies.

There has been little search for, nor is there much evidence in man of, a direct genetic component in geographical migration. However, there seems to be no more satisfactory explanation of the deficiency of acid phosphatase heterozygotes among the immigrants to the Otmoor region observed by Hiorns et al. (1977), and the authors themselves suggest the "intriguing if somewhat unlikely possibility that the phenomenon may be due to selective migration".

Although the evidence relating genetic polymorphism to age, social class and migration is equivocal, it is clearly too strong to ignore, particularly in view of the implications of these phenomena for sampling and for genetic inference.

III Blood Donors

(a) Results and Discussion

The blood donor sample comprises 1 567 people between the ages of 18 and 65 (Table 4.1 shows their age distribution) who were resident on the Isle of Wight at the time of the survey. They were asked questions about place of birth, parents' birthplaces, grandparents' birthplaces, marital status, spouse's birthplace, date of birth and date of move to the Isle of Wight if not born there, etcetera. The answers to all questions were recorded on questionnaires as shown in Appendix I. Sometimes information did not exist, sometimes it was unknown and sometimes it went unrecorded; for these reasons the number of people used in the analyses is often less than the maximum number of donors surveyed.

56% of the donors were men and 44% were women; 76% of them were married. Their genetically relevant demography will be treated in essentially the same way as that pertaining to the school children. It must be reiterated, though, that direct comparison between the sets of data should not take identity as its expectation, owing to the manifest differences between the samples. These differences extend primarily to age and catchment area, and secondarily to variables dependent upon or associated with these.

Table 4.38 shows the "old counties" of birth of the blood donors, their parents, and their grandparents. 42% of the donors were born on the Isle of Wight, compared with an unweighted mean of 31% of their parents and 31% of their grandparents. As with the school children, the contribution from individual counties to the present population is often very small, and invariably so from countries other than England. Consideration of the two previous generations, however, tempers to some extent any impression of insularity, as it did for the school children's data. The implications of such migration on to the Island recurring in each generation will be studied in Chapter 6.

Table 4.39 condenses the previous tabulation into information about regional birthplaces, where the "regions" are defined in the same way as for the school children, above. Table 4.40 shows these same data as cumulative proportions, which are then drawn as a "Coleman-diagram" in Figure 4.13. Compared with the school children, the blood donors have a still lower membership born on the Island; this difference probably reflects the comparative age-structure of the two groups and the dependence of migration upon age, rather than the differences in catchment.

When the school children were analysed, localities were further reduced to just two categories - "Isle of Wight" and "Mainland" -

Table 4.38 Blood donors' counties of birth

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Isle of Wight	.424	.307	.314	.318	.319	.316	.301
Bedfordshire	.003	.003	.001	.002	.002	.001	.001
Berkshire	.004	.005	.006	.003	.002	.005	.006
Buckinghamshire	.005	.004	.004	.001		.006	.004
Cambridgeshire	.001	.004	.002	.004	.003	.003	.003
Cheshire	.005	.007	.005	.007	.006	.004	.003
Cornwall	.003	.005	.006	.007	.006	.007	.008
Cumberland	.002	.004	.002	.004	.006	.002	.002
Derbyshire	.006	.005	.007	.004	.004	.007	.010
Devon	.009	.015	.013	.022	.024	.017	.019
Dorset	.005	.013	.013	.016	.017	.012	.012
Durham	.006	.014	.012	.015	.014	.009	.013
Essex	.021	.011	.011	.011	.010	.007	.008
Gloucestershire	.009	.012	.006	.010	.013	.004	.007
Hampshire	.067	.054	.059	.050	.039	.053	.051
Herefordshire		.002		.002	.001		
Hertfordshire	.008	.005	.004		.001	.002	.002
Huntingdonshire	.003		.001	.001			.001
Kent	.019	.024	.025	.017	.016	.020	.016
Lancashire	.025	.032	.034	.031	.030	.030	.031
Leicestershire	.002	.007	.005	.008	.006	.004	.004
Lincolnshire	.004	.004	.006	.003	.003	.003	.006

Table 4.38 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Greater London	.164	.191	.194	.134	.138	.161	.161
Monmouth	.002	.004	.008	.004	.004	.003	.005
Norfolk	.002	.007	.010	.011	.012	.017	.017
Northamptonshire	.002	.004	.002	.004	.004	.003	.005
Northumberland	.005	.007	.007	.007	.006	.006	.006
Nottinghamshire	.004	.006	.003	.005	.004	.004	.005
Oxfordshire	.005	.006	.003	.007	.007	.005	.005
Rutland				.001			
Shropshire	.003	.002	.006	.004	.003	.006	.006
Somerset	.007	.011	.010	.014	.019	.014	.013
Staffordshire	.006	.009	.015	.006	.009	.014	.013
Suffolk	.002	.004	.002	.004	.006	.003	.004
Surrey	.025	.017	.018	.016	.016	.014	.013
Sussex	.016	.015	.015	.013	.010	.009	.013
Warwickshire	.029	.021	.022	.021	.018	.021	.019
Westmorland		.001	.001			.001	.001
Wiltshire	.006	.011	.010	.010	.012	.011	.011
Worcestershire	.005	.008	.006	.006	.008	.006	.005
Yorkshire	.028	.040	.042	.041	.038	.041	.044
Isle of Man	.001	.001		.003	.002		
Channel Isles	.003	.004	.002	.005	.007	.004	.005

Table 4.38 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Antrim	.002	.004	.002	.002	.001	.001	.001
Armagh	.001	.001	.001	.001			
Down	.001	.002	.002	.002	.002	.001	.001
Fermanagh							
Londonderry			.001	.001	.001		
Tyrone	.001	.001		.001	.001		
Carlow							
Cavan							
Clare							
Cork	.002	.006	.004	.003	.002	.003	.005
Donegal							
Dublin	.002	.002	.001	.005	.003	.002	.002
Galway	.001		.001			.001	.001
Kerry		.001	.002	.001	.003	.001	.001
Kildare							
Kilkenny							
Laois							
Leitrim			.001			.001	.001
Limerick	.001	.001	.002	.002	.002	.002	.002
Longford	.001						
Louth							
Mayo						.001	.001

Table 4.38 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Meath							
Monaghan							
Offally							
Roscommon					.001		
Sligo							
Tipperary	.001	.001	.001	.001	.001		
Waterford	.004	.004	.002	.004	.004	.002	.002
Westmeath							
Wexford	.002	.002	.002	.001	.001	.002	.002
Wicklow							
Anglesey		.002	.002	.001	.001	.001	.001
Brecknock							
Caernarvon	.002	.002	.001	.002	.002	.001	.001
Cardigan							
Carmarthen	.001						
Denbigh							
Flint							.001
Glamorgan	.006	.011	.011	.004	.004	.005	.002
Merioneth						.001	
Montgomery							
Pembrokeshire	.001		.002			.003	.003
Radnor		.002		.001	.002		

Table 4.38 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Aberdeen	.001	.001	.003	.003	.002	.003	.002
Angus	.002	.001	.002	.001	.002	.001	.001
Argyll							
Ayr	.002		.001	.001			
Banff							
Berwick						.001	
Bute		.001				.001	.001
Caithness		.001	.001				
Clackmannon							
Dumfries	.002	.002	.001	.002	.002		.001
Dunbarton	.001	.001					.001
East Lothian							
Fife		.001	.002				.001
Inverness		.002	.002	.002	.002		.001
Kincardine							
Kinross							
Kirkcudbright							
Lanark	.008	.008	.006	.004	.006	.003	.003
Midlothian	.001	.002	.003	.002	.001	.002	.001
Moray	.001						
Nairn							
Orkney							
Peebles			.001			.001	.001
Perth	.001	.001		.001	.001		

Table 4.38 continued

County	Self	Father	Mother	F's F	F's M	M's F	M's M
Renfrew	.002	.003	.002	.001	.001		.001
Ross and Cromarty		.001					
Roxburgh							
Selkirk							
Shetland							
Stirling	.001	.002	.002	.001			
Sutherland							
West Lothian	.001			.001	.001	.001	.001
Wigtown							
N. Ireland (unspec.)		.001	.001	.002	.003	.002	.001
S. Ireland (unspec.)		.003	.002	.007	.010	.009	.011
Ireland (unspec.)		.004	.006	.022	.032	.027	.023
Wales (unspec.)	.001	.011	.011	.026	.022	.022	.021
Scotland (unspec.)		.008	.007	.033	.032	.033	.032
n =	1295	1228	1243	958	898	959	962
Missing data	240	293	290	569	621	561	566
Overseas	32	46	34	40	48	47	39

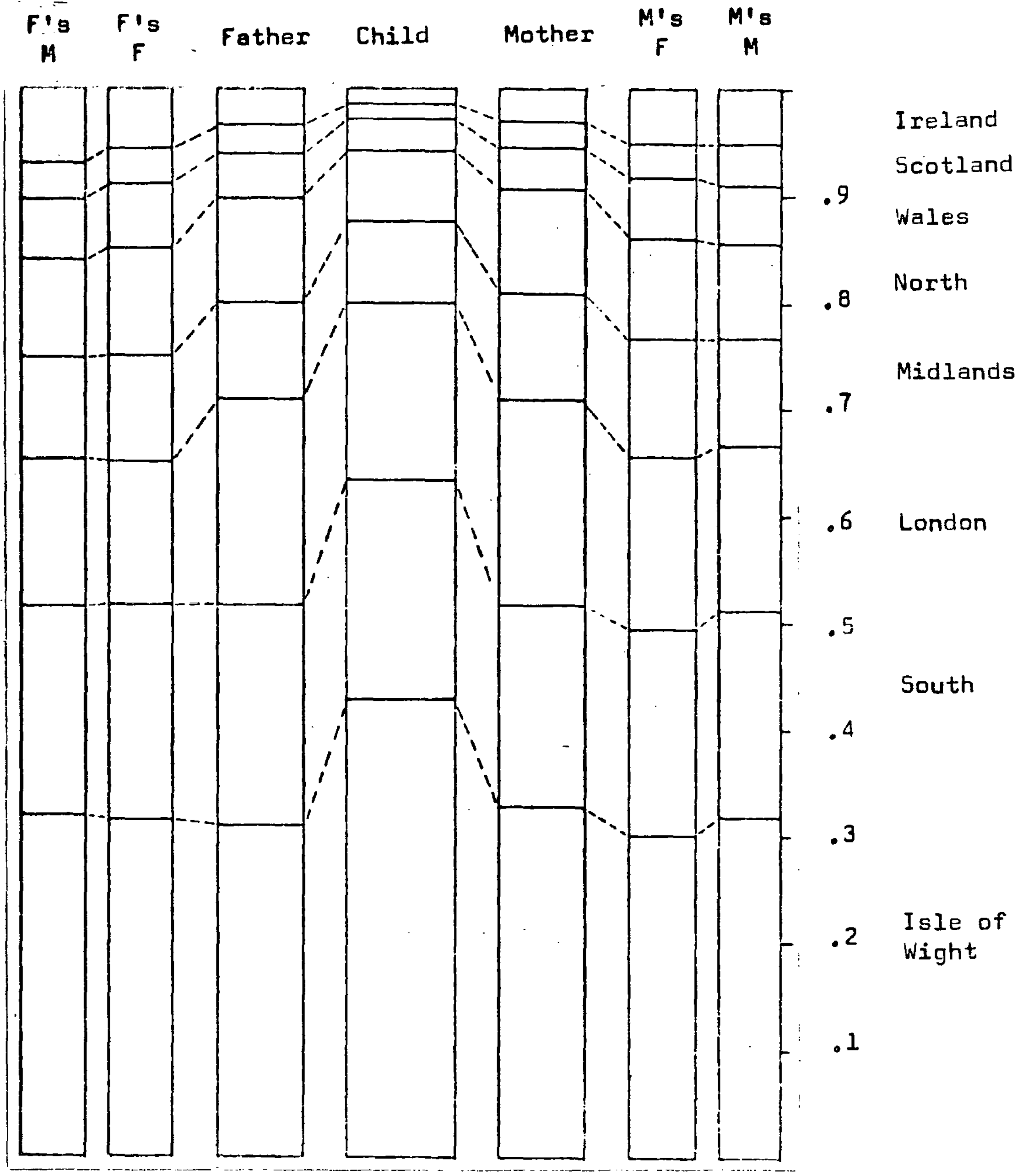
Table 4.39 Blood donors' regions of birth

	Self	Father	Mother	FF	FM	MF	MM	Spouse
Isle of Wight	.424	.307	.314	.318	.319	.317	.302	.429
South	.212	.210	.202	.199	.195	.188	.193	.203
London	.164	.191	.194	.134	.138	.162	.161	.163
Midlands	.075	.092	.098	.096	.092	.100	.109	.073
North	.068	.098	.095	.101	.096	.088	.095	.083
Wales	.026	.041	.040	.061	.057	.056	.055	.019
Scotland	.014	.028	.027	.034	.032	.033	.029	.013
Ireland	.016	.034	.031	.056	.071	.056	.056	.016
n =	1295	1228	1244	958	899	959	961	837
Overseas	32	46	33	40	48	47	39	16
Missing data	240	293	290	569	620	561	567	416 (308 single)

Table 4.40 Blood donors' regions of birth: cumulative proportions

	Self	Father	Mother	FF	FM	MF	MM	Spouse
Isle of Wight	.424	.307	.314	.318	.319	.317	.302	.429
South	.636	.517	.516	.518	.514	.505	.494	.632
London	.801	.708	.710	.651	.652	.666	.656	.796
Midlands	.876	.800	.808	.747	.744	.766	.765	.868
North	.944	.897	.903	.849	.840	.854	.860	.952
Wales	.970	.938	.943	.909	.897	.910	.915	.971
Scotland	.984	.966	.969	.944	.929	.944	.944	.984
Ireland	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
n =	1295	1228	1244	958	899	959	961	837

Figure 4.13 Blood donors:
regions of birth of donors and antecedents



and both generational and matrimonial concordances of birthplace were examined. For the blood donors only the latter will be considered. In Table 4.41 the marriages are described as endogamous, as exogamous with either the male or the female migrating, or as "migrant", where both partners were born off the Isle of Wight (Harrison and Boyce, 1972; Cartwright, 1973b). Apparently, there is a considerable deviation from random mating. This becomes clear if these data are compared with a model based on the Hardy-Weinberg equilibrium. The people involved are 700 born on the Isle of Wight and 986 born on the mainland. If the proportions by birthplace are taken to equal p and q respectively, then the expected proportions of "homozygotes" (that is, Isle of Wight/Isle of Wight and Mainland/Mainland marriages) are .17 and .34, and the expected proportion of "heterozygotes" is .49. These compare with observed figures of .25, .42 and .33.

Coleman's work on marriage in Britain (Coleman, 1977a) lends support to the view that proximity of potential mates rather than choice based on provenance is the main cause of this departure from panmixia. In the case of the Isle of Wight it seems intuitively likely that a large contribution to the deviation from random mating is made by the practice of married couples moving to the Island from the mainland. A sample of the donors was asked their year of marriage and their year of moving to the Island; 261 married donors who were born

Table 4.41 Blood donors:
concordance of marriage partners' birthplace

Marriage category	Number	Proportion
Endogamous	211	.250
Exogamous, husband born on IW	158	.187
Exogamous, wife born on IW	120	.142
Migrant (neither born on IW)	354	.420

n = 843 marriages

Table 4.42 Blood donors:
marriage type in relation to marital status at move to Isle of Wight

	Exogamous man born on IW	Exogamous woman born on IW	Migrant	Total
Married before move	5 (.033)	8 (.052)	140 (.915)	153
Married in move year	5 (.263)	4 (.211)	10 (.526)	19
Married after move	31 (.348)	27(.304)	31 (.348)	89
				261

off the Isle of Wight were questioned. 59% moved after marriage, 34% moved before marriage and 7% moved during the year of marriage. (Considering the large number of years available in which to move and to marry, this last figure probably represents a much larger proportion than a chance combination of events would lead one to expect. However, the exigencies of time and the small absolute numbers discouraged any more detailed exploration of these cases.)

Table 4.42 enumerates the categories of marriages contracted by those donors born off the Isle of Wight. This information shows that migration of married couples to the Island must indeed contribute greatly to the deviation from random mating observed from Table 4.41. Of those who married before they moved 91% married mainlanders, whereas only 35% of those who married after moving to the Island married mainlanders. The group of 19 people who moved in the year of marriage have row proportions intermediate between the clearly post- and pre-marital migrants; this suggests, conveniently though with no great force, that the group contains a mixture of individuals whose behaviour places them in either one or other of the previous categories. A final observation to be made from this table is the interesting one that nearly a tenth of the immigrant married couples have one partner who was born on the Island. Perhaps this is no different from the return rate of among all emigrants regardless of marital status or type, but the present survey discovers the phenomenon only in this particular context.

Table 4.42 has not revealed whether the migrating couples explain all the deviation from random mating. However an answer to this can be extrapolated if we modify the data of Table 4.41 in the light of Table 4.42, so as to consider just those donors who marry after moving to the Island. Of those donors in whose marriage both partners were born off the Isle of Wight, 34.8% were married after moving. Therefore, Table 4.41 can be modified by substituting for the total frequency of marriages with both partners born off the Isle of Wight, 34.8% of that number. Analogously, the numbers in the two categories of exogamous marriages can be altered, resulting in a conjectured tabulation (Table 4.43) which represents the distribution of marriage types occurring among people who were living on the Island at the latest during the year before they were married. When these data are compared to Hardy-Weinberg expectation, no deviation from random mating is detected (χ^2, H-W = 1.323, p =.250).

Such as it is, then, this evidence suggests that birth on or off the Isle of Wight affects the choice of mate only by limiting the availability of mates born elsewhere, and not by means of any preference for mates of local (or exotic) origin.

Table 4.43 Blood donors:
conjectured marriage types among those living on the Island before marriage

Marriage category	Number	Proportion
Endogamous	211	.445
Exogamous, husband born on IW	119	.251
Exogamous, wife born on IW	83	.175
Migrant	61	.128

n = 474 marriages

In order to describe the extent of the blood donors' gene pool by means of distances, three measures will be used: birthplace-residence, parent-offspring, and the distance between marriage partners' birthplaces (birthplace distance). These have been defined above in reference to the school children, and the way of working them out has also been described. As data are available for the donors, their parents and their grandparents, once again a comparison between generations will be possible. The reservations expressed over the comparability of school children's and donor's data diminish the trust to be placed in their assessment relative to each other.

The limitations of birthplace-residence distance have already been discussed. It is included here to give some information about the present generation's mobility; otherwise our knowledge of the donors' geographical mobility would stop at the previous generation. We must bear in mind, though, that the donors are heterogenous with respect to age and that since the amount of achieved migration depends to some extent on age, the variance of the birthplace-residence distribution will be related to the age-range of the people sampled. Table 4.44 shows the details of birthplace-residence distance among the donors, and Figure 4.14 plots them as a histogram. The nearest equivalent parameters in time and in concept to the birthplace-

Table 4.44 Blood donors: distribution of distances between birthplace and residence

Distance in miles	Proportion
≤ 10	.427
11 - 20	.045
21 - 30	.017
31 - 40	.010
41 - 50	.013
51 - 60	.016
61 - 70	.023
71 - 80	.190
81 - 90	.034
91 - 100	.016
101 - 110	.011
111 - 120	.015
121 - 130	.006
131 - 140	.031
141 - 140	.007
151 - 160	.008
161 - 170	.006
171 - 180	.005
181 - 190	.005
191 - 200	.007
201 - 210	.021
211 - 220	.009
221 - 230	.016
231 - 240	.002
241 - 250	.002
> 250	.058

n = 1 271

Figure 4.14 Blood donors: distribution of birthplace-residence distance

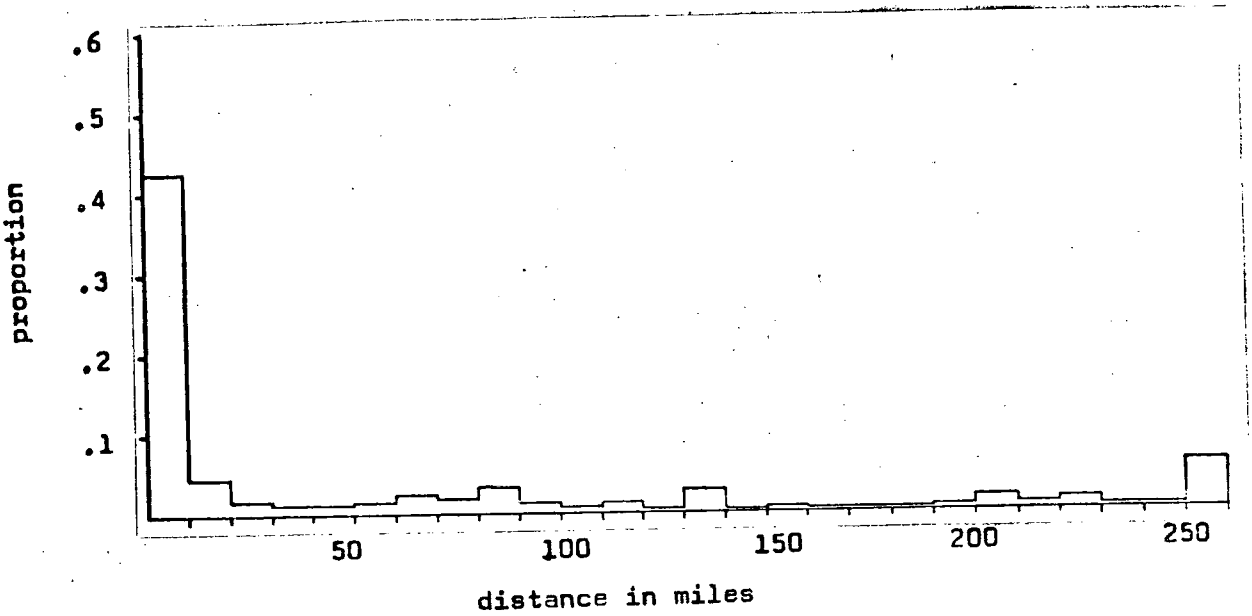
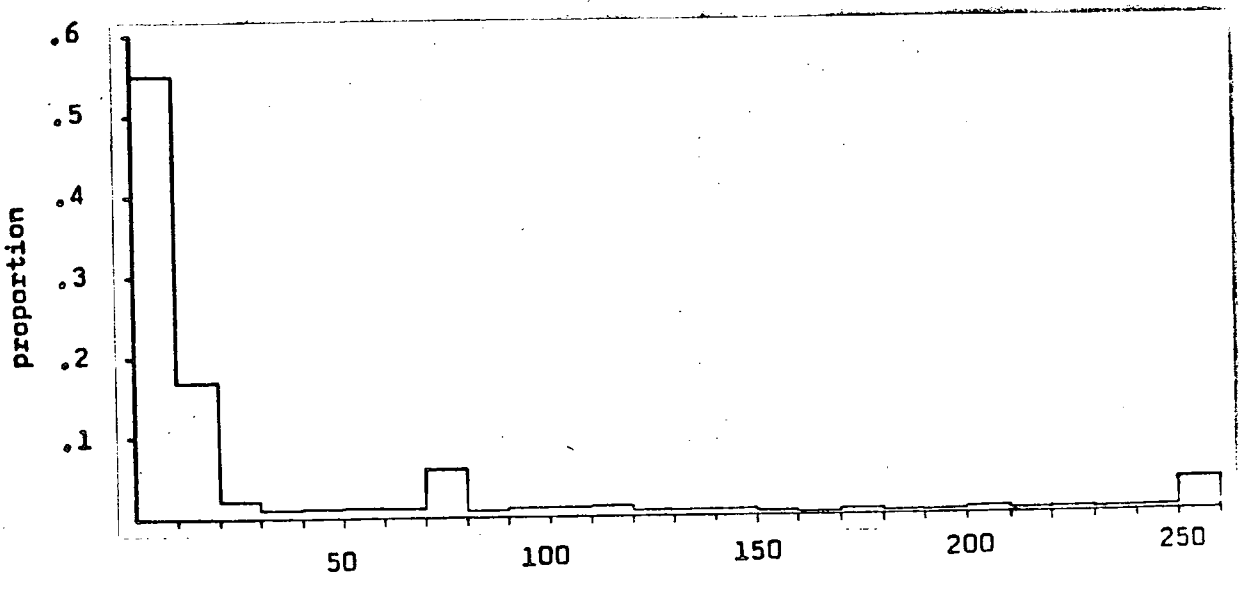


Figure 4.15 Blood donors: distribution of father-offspring distance



residence-distance of this generation are the mother-offspring and father-offspring distances computed between these donors and their parents. Too much emphasis should not be placed on a comparison between these, not only because the measures are of a rather different sort, but also on account of the possibility of secular change in mobility. Table 4.45 shows the distribution of parent-offspring distances for the present generation (MO, FO, as well as for the previous one (FFO, FMO, MFO, MMO), and these are plotted as histograms in Figures 4.15 to 4.20. Cumulative frequencies of birthplace-residence are shown in Table 4.46 and of parent-offspring distances in Table 4.47; these are plotted in Figure 4.21.

The variance of the birthplace-residence distribution is greater than that of the FO and MO curves, and its skewness is less, but it is difficult to choose between the possibility of secular change or the increased heterogeneity of movement achieved within the lifetime of the present donors as possible causes. Were one to assume that any secular change in mobility occurred throughout the entire period studied, one might deduce from the decrease in skewness and increase in variance between, say, FFO, and FO that secular change was indeed the cause. Though this interpretation is both plausible and consistent with the evidence presented, the alternative explanation cannot be falsified. The variances and skewnesses discussed above are shown in Table 4.48.

Table 4.45 Blood donors: distribution of parent-offspring distances

Distance in miles	F-O	M-O	FF-O	FM-O	MF-O	MM-O
up to 10	.549	.529	.596	.575	.551	.539
11 - 20	.168	.185	.317	.334	.350	.338
21 - 30	.020	.029	.006	.008	.010	.014
31 - 40	.010	.019	.004	.003	.010	.007
41 - 50	.011	.008	.007	.002	.004	.007
51 - 60	.013	.018	.004	.005	.009	.010
61 - 70	.011	.016	.001	.002	.001	.003
71 - 80	.060	.050	.013	.019	.021	.037
81 - 90	.007	.011	.001		.004	.001
91 - 100	.012	.010	.001	.006	.001	.003
101 - 110	.011	.009	.003	.002	.001	.003
111 - 120	.014	.008	.004	.009	.004	.004
121 - 130	.006	.004	.006	.002	.007	.004
131 - 140	.009	.009	.004		.003	.001
141 - 150	.007	.009			.003	.004
151 - 160	.005	.005		.002	.003	.003
161 - 170	.002	.008	.001	.002	.003	.001
171 - 180	.008	.010	.001	.002	.001	.001
181 - 190	.005	.007		.006	.001	.001
191 - 200	.006	.005	.001	.002		
201 - 210	.009	.008				.001
211 - 220	.006	.011	.001	.003		
221 - 230	.006	.001				
231 - 240	.004	.004	.001	.002	.001	
241 - 250	.005		.001	.002		
> 250	.039	.027	.017	.019	.006	.011
n =	1 054	1 063	678	640	702	699
Missing data	513	504	889	927	865	868

Figure 4.16 Blood donors: distribution of mother-offspring distance

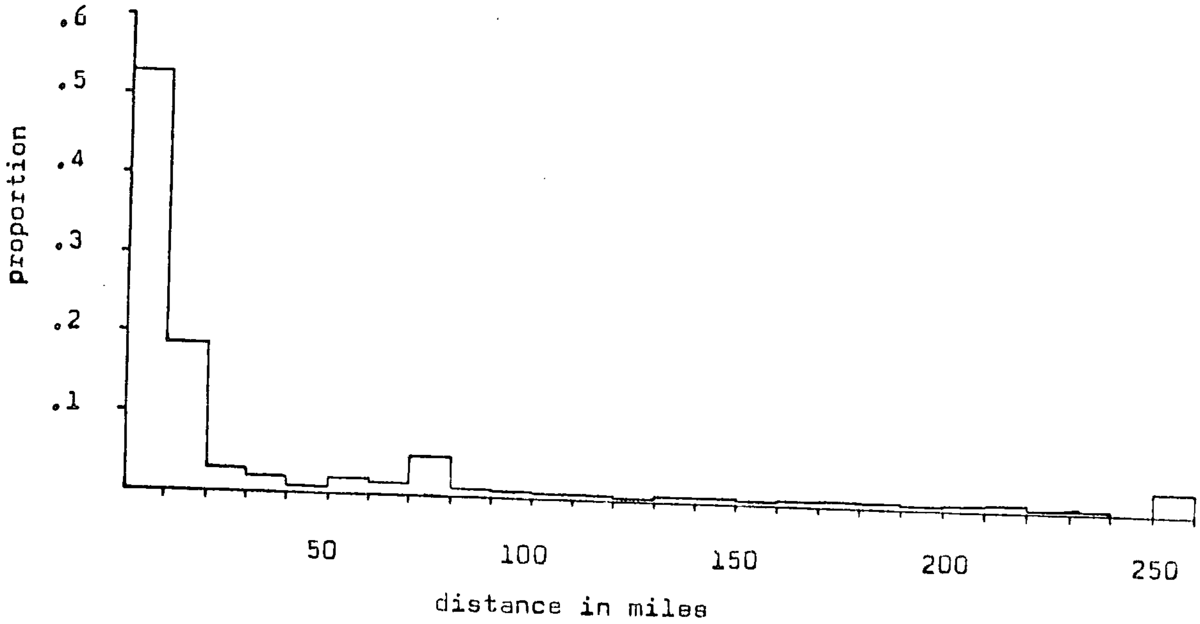


Figure 4.17 Blood donors: distribution of fathers' father-offspring distance

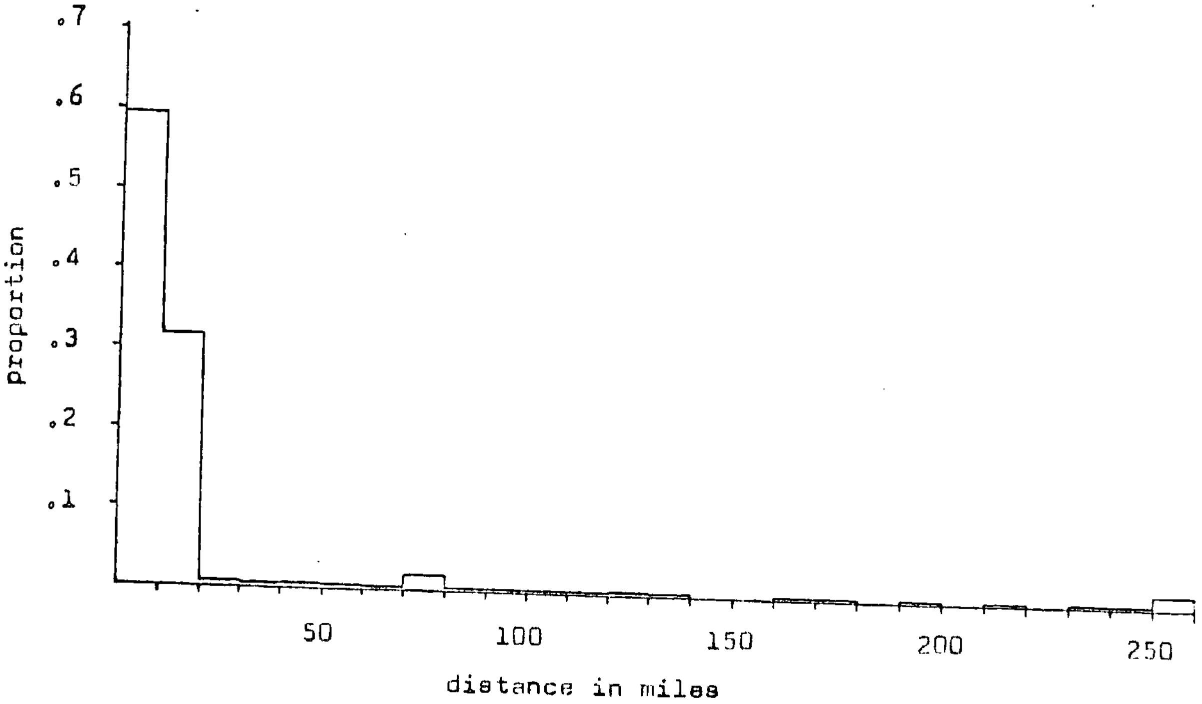


Figure 4.18 Blood donors:
distribution of fathers'
mother-offspring distance

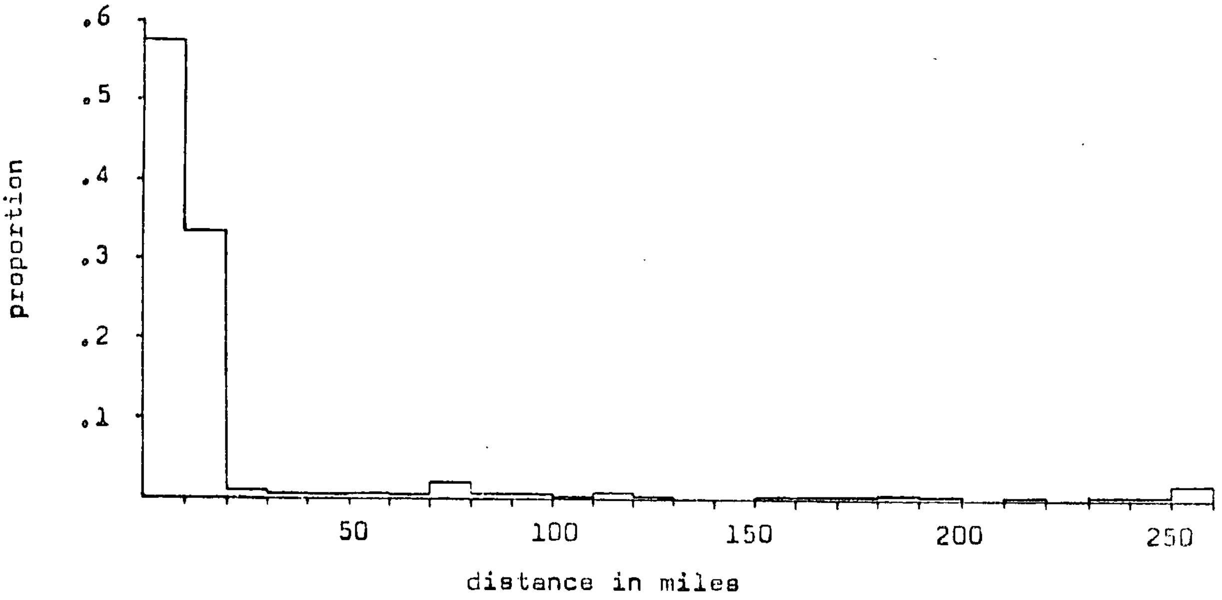


Figure 4.19 Blood donors:
distribution of mothers'
father-offspring distance

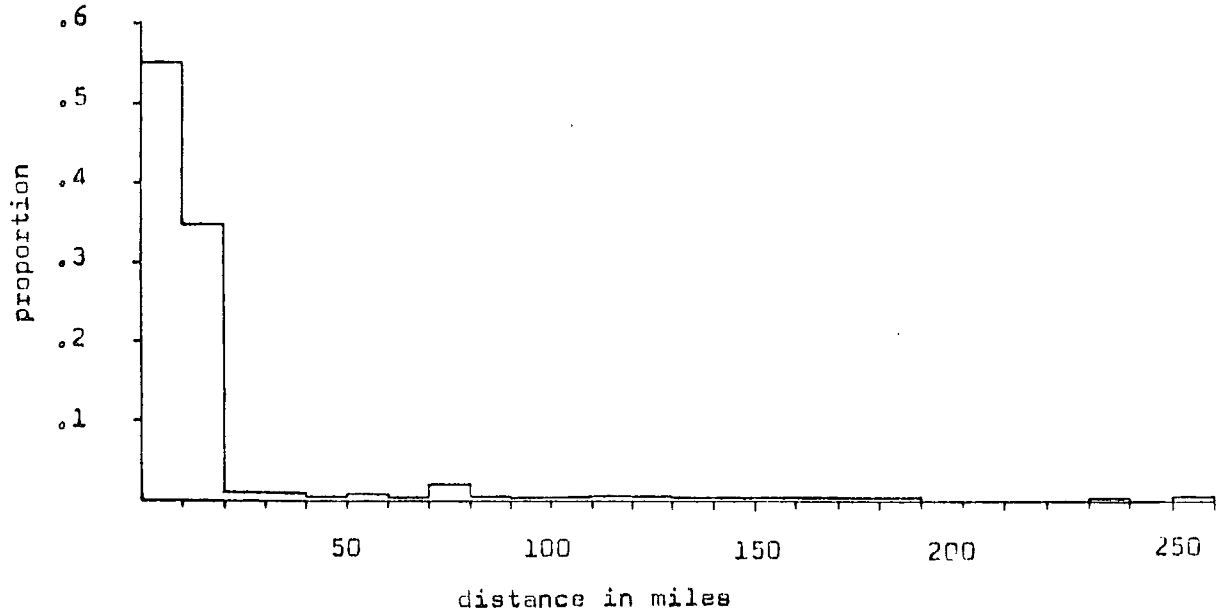


Figure 4.20 Blood donors:
distribution of mothers' mother-offspring distance

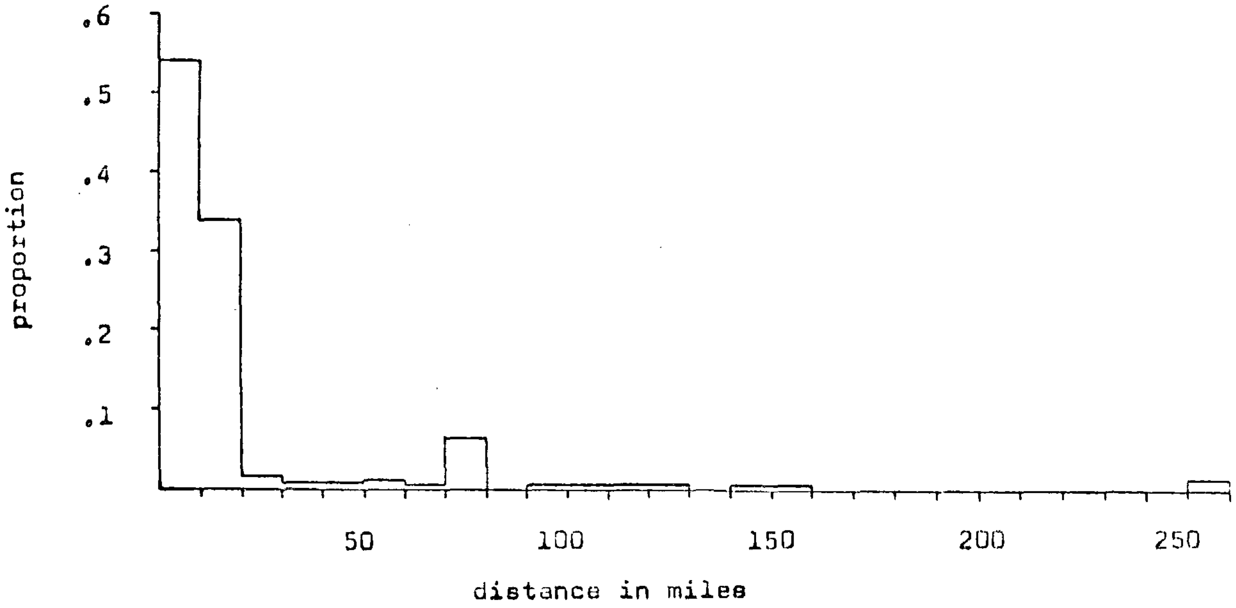


Figure 4.21 Blood donors:
parent-offspring distances, cumulative proportions

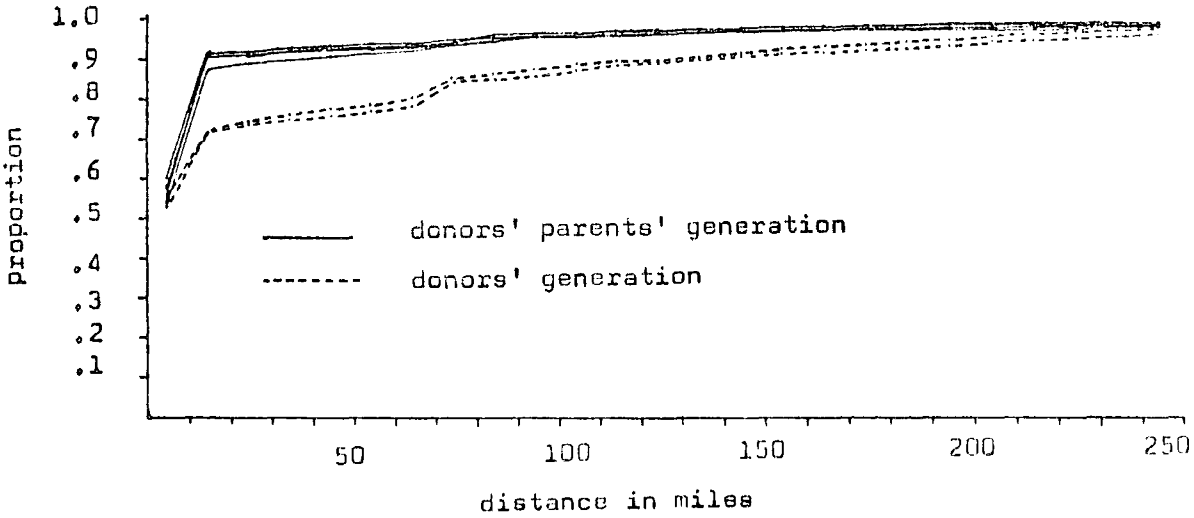


Table 4.46 Blood donors:
birthplace - residence distances,
cumulative proportions

Distance in miles	Proportion
up to 10	.427
20	.472
30	.489
40	.499
50	.512
60	.528
70	.551
80	.741
90	.775
100	.791
110	.802
120	.817
130	.823
140	.854
150	.861
160	.869
170	.875
180	.880
190	.885
200	.892
210	.913
220	.922
230	.938
240	.940
250	.942
> 250	1.000

Table 4.47 Blood donors:
parent-offspring distances,
cumulative proportions

Distance in miles	F-O	M-O	FF-O	FM-O	MF-O	MM-O
up to 10	.549	.529	.596	.575	.551	.539
20	.717	.714	.913	.909	.902	.877
30	.737	.743	.919	.917	.912	.891
40	.748	.762	.923	.920	.922	.898
50	.759	.770	.931	.922	.926	.906
60	.772	.788	.935	.927	.934	.916
70	.784	.804	.937	.928	.936	.918
80	.843	.854	.950	.947	.957	.956
90	.850	.865	.951	.947	.962	.957
100	.862	.876	.953	.953	.963	.960
110	.874	.885	.956	.955	.964	.963
120	.888	.893	.960	.964	.969	.967
130	.894	.897	.966	.966	.976	.971
140	.902	.906	.971	.966	.979	.973
150	.909	.915	.971	.966	.981	.977
160	.914	.920	.971	.967	.984	.980
170	.916	.929	.972	.969	.987	.981
180	.923	.939	.973	.970	.989	.983
190	.928	.945	.973	.977	.990	.984
200	.934	.950	.975	.978	.990	.984
210	.943	.959	.975	.978	.990	.986
220	.949	.970	.976	.981	.990	.986
230	.954	.971	.976	.981	.990	.986
240	.958	.975	.978	.983	.991	.986
250	.963	.975	.979	.984	.991	.986
> 250	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.48 Blood donors:
mean, variance and skewness of distributions of parent-offspring distance and birthplace-residence distance

Category	Mean	Variance	Skewness
BP-Res.	75.5 miles	853	2.14
F-O	48.5	622	2.8
M-O	44.9	504	2.9
FF-O	25.5	258	5.1
FM-O	25.9	250	5.1
MF-O	23.7	177	6.4
MM-O	26.5	254	6.0

Information about the birthplace distances of marriage partners is available for three generations: the donors (BD), their parents (PBD) and their grandparents (FPBD and MPBD). The distributions of these variables are shown in Table 4.49 and in Figures 4.22 to 4.25. Cumulative proportions are given in Table 4.50 and plotted on one graph in Figure 4.26. As was the case with the school children, there is an indication that mean birthplace distance has increased with the generations, notably through a decrease in the proportion of short-range marriages.

Whilst the above tabulations are intended to describe the characteristics of the Isle of Wight population as a whole, it is possible to extract from these data information about people who not only live on the Island but were born there as well. Similarly, we can find the distribution of birthplace distances among the donors with endogamous marriages. The interest of the information thus obtained is not in the shorter distances involved, since these are prescribed by the nature of the sub-sample, but rather in the fact that even on this scale the characteristic shape of the distributions of movement and distance is in large measure preserved. Table 4.51 shows the distribution of birthplace-residence distances among residents born on the Isle of Wight and the information is plotted in Figure 4.27. Table 4.52 presents the birthplace distances

Table 4.49 Blood donors:
distribution of birthplace distances

Distance in miles	Donors	Parents	Father's parents	Mother's parents
≤ 10	.345	.444	.536	.528
11- 20	.132	.196	.370	.399
21- 30	.029	.024	.008	.003
31- 40	.008	.019	.005	.006
41- 50	.018	.007	.005	.005
51- 60	.017	.016	.002	.011
61- 70	.030	.018	.003	.003
71- 80	.122	.074	.019	.017
81- 90	.024	.006	.002	
81-100	.017	.012	.005	
101-110	.016	.016	.002	
111-120	.014	.019	.008	.005
121-130	.013	.007	.002	.003
131-140	.030	.012	.005	.003
141-150	.013	.006		.002
151-160	.014	.006	.002	.005
161-170	.010	.003		
171-180	.016	.013		.002
181-190	.009	.007	.006	
191-200	.012	.004		
201-210	.016	.011		.002
211-220	.004	.011	.002	
221-230	.013	.005	.002	
231-240	.003	.002		
241-250	.007	.003	.003	
> 250	.068	.059	.013	.006
n =	765	967	617	642
missing data	494	600	950	925

Figure 4.22 Blood donors:
distribution of birthplace distance
of donors and spouses

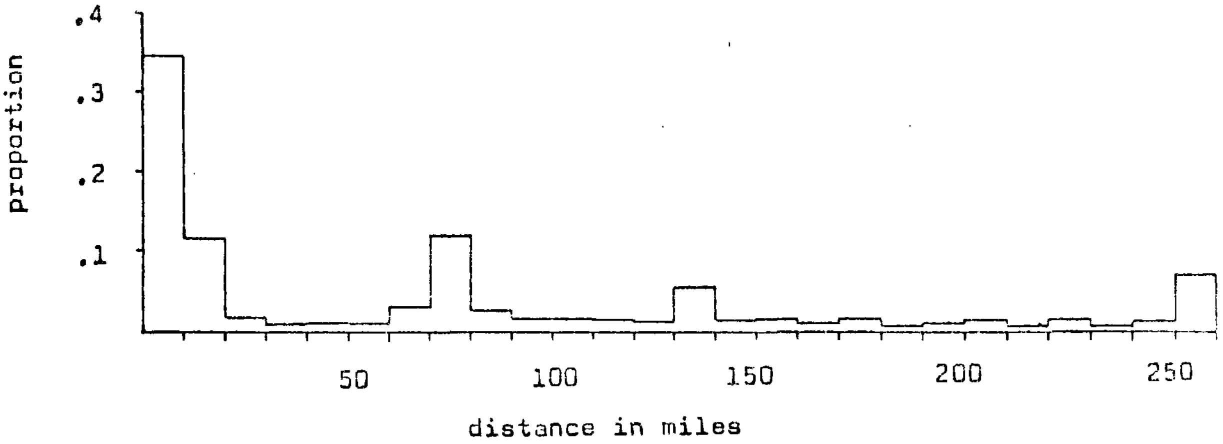


Figure 4.23 Blood donors:
distribution of parents' birthplace distance

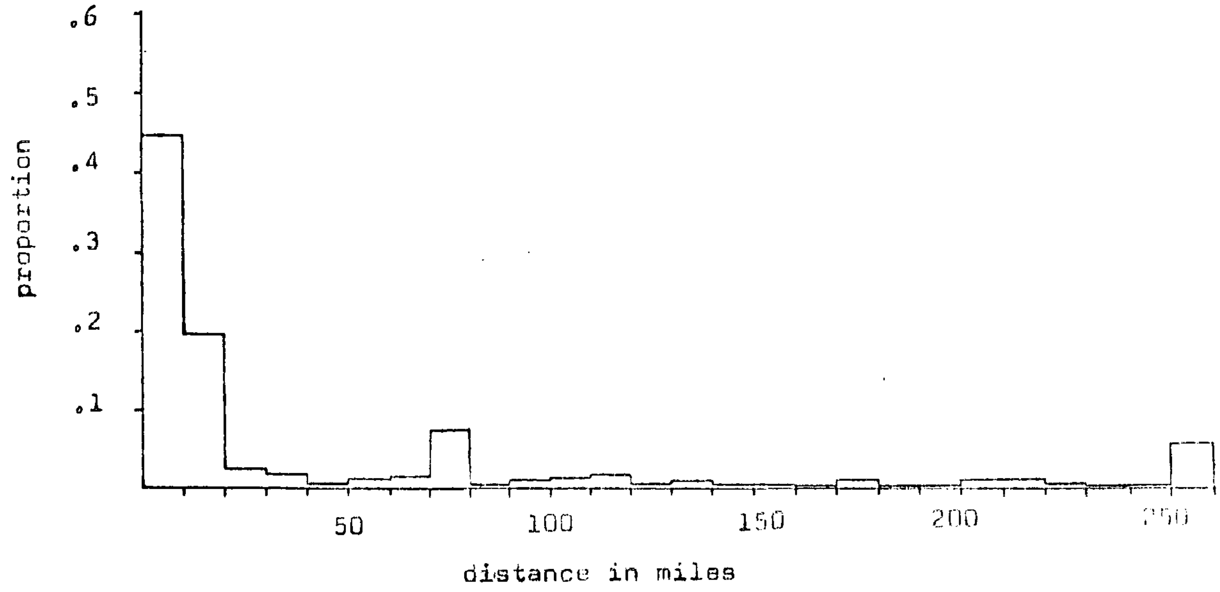


Figure 4.24 Blood donors:
distribution of fathers'
parents' birthplace distance

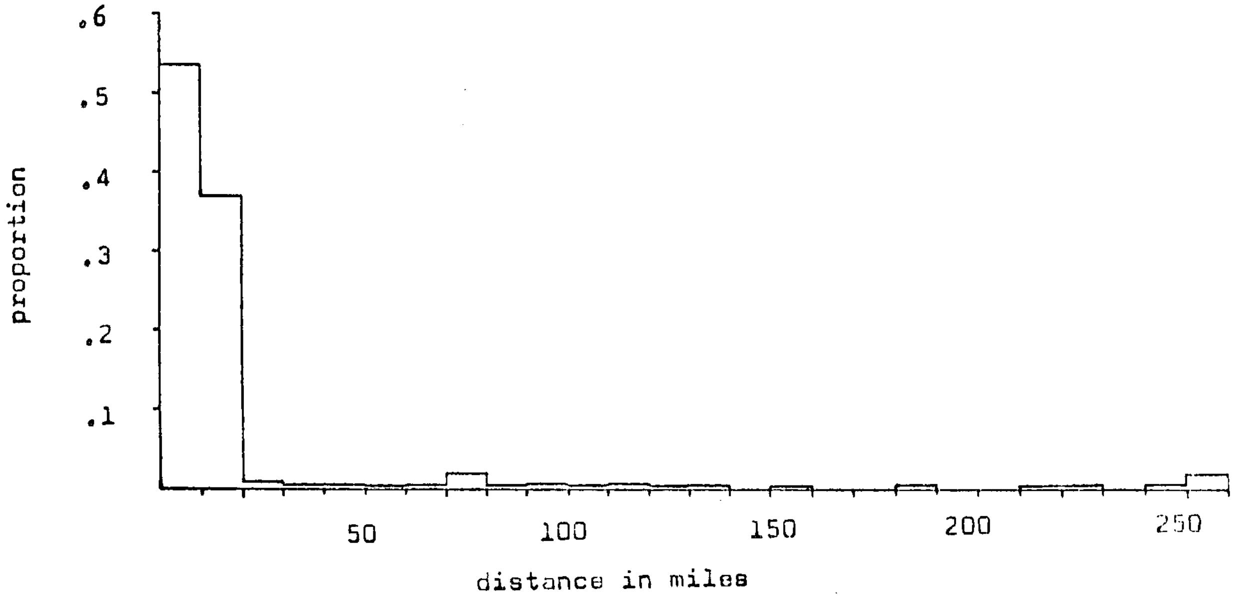


Figure 4.25 Blood donors:
distribution of mothers'
parents' birthplace distance

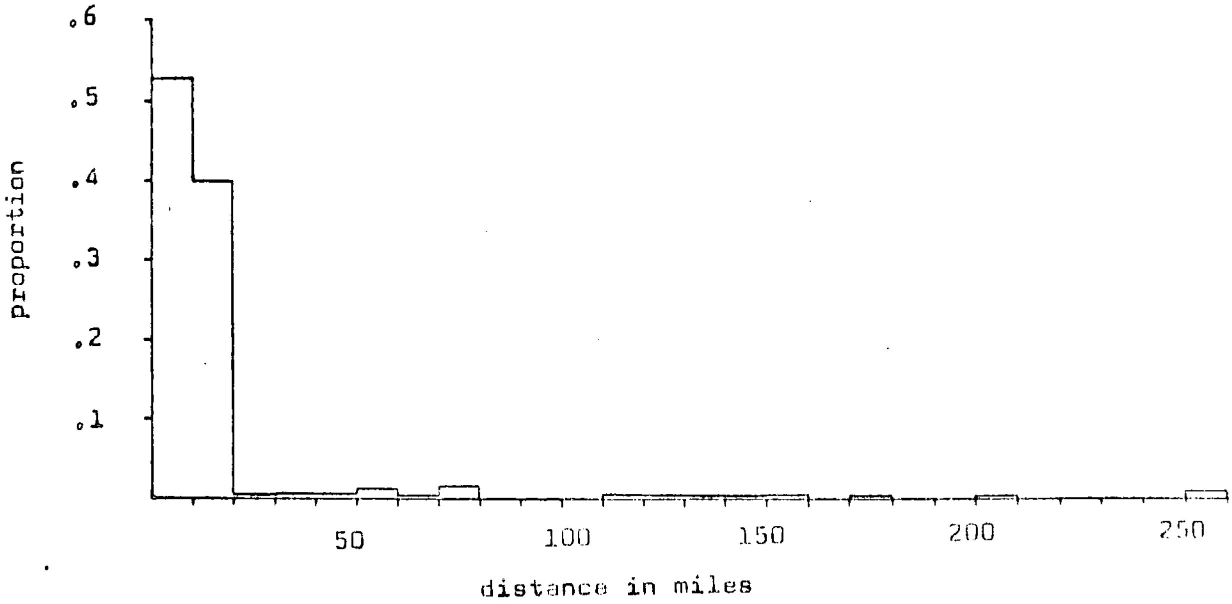


Table 4.50 Isle of Wight Blood donors: birthplace distances, cumulative proportions

Distance in miles	Donors	Parents	Father's parents	Mother's parents
up to 10	.345	.444	.536	.528
20	.477	.640	.906	.927
30	.506	.664	.914	.930
40	.514	.683	.919	.936
50	.532	.690	.924	.941
60	.549	.706	.926	.952
70	.579	.724	.929	.955
80	.701	.798	.948	.972
90	.725	.804	.950	.972
100	.742	.816	.955	.972
110	.758	.832	.957	.972
120	.772	.851	.965	.977
130	.785	.858	.967	.980
140	.815	.870	.972	.983
150	.828	.876	.972	.985
160	.842	.882	.974	.990
170	.852	.885	.974	.990
180	.868	.898	.974	.992
190	.877	.905	.980	.992
200	.889	.909	.980	.992
210	.905	.920	.980	.994
220	.909	.931	.982	.994
230	.922	.936	.984	.994
240	.925	.938	.984	.994
250	.932	.941	.987	.994
> 250	1.000	1.000	1.000	1.000

Figure 4.26 Blood donors: birthplace distances in three generations, cumulative proportions

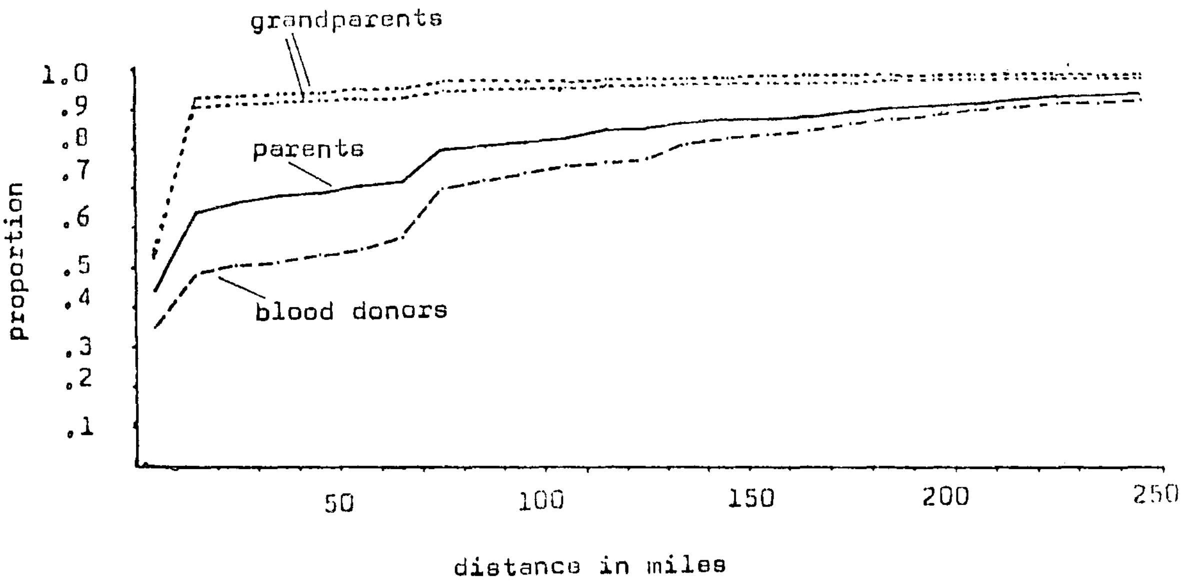


Table 4.51 Blood donors: birthplace-residence distances among those born and living on the Isle of Wight

Distance in kilometres	Donors	Spouses	Combined total
0	.478	.409	.452
1	.060	.062	.061
2	.079	.095	.085
3	.027	.034	.029
4	.020	.028	.023
5	.021	.034	.026
6	.080	.070	.077
7	.025	.025	.024
8	.026	.034	.029
9	.021	.012	.017
10	.043	.046	.044
11	.017	.031	.022
12	.026	.022	.024
13	.008	.015	.010
14	.018	.018	.019
15	.021	.019	.020
16	.002		.001
17	.013	.012	.013
18	.002	.009	.005
19	.002	.007	.003
20			
21	.002	.003	.002
22			
23			
24	.001	.007	.003
25		.003	.001
26	.004	.003	.004
27	.004	.003	.004
n =	533	325	858

Figure 4.27 Blood donors:
distribution of birthplace-residence distances among donors and spouses born and living on the Island

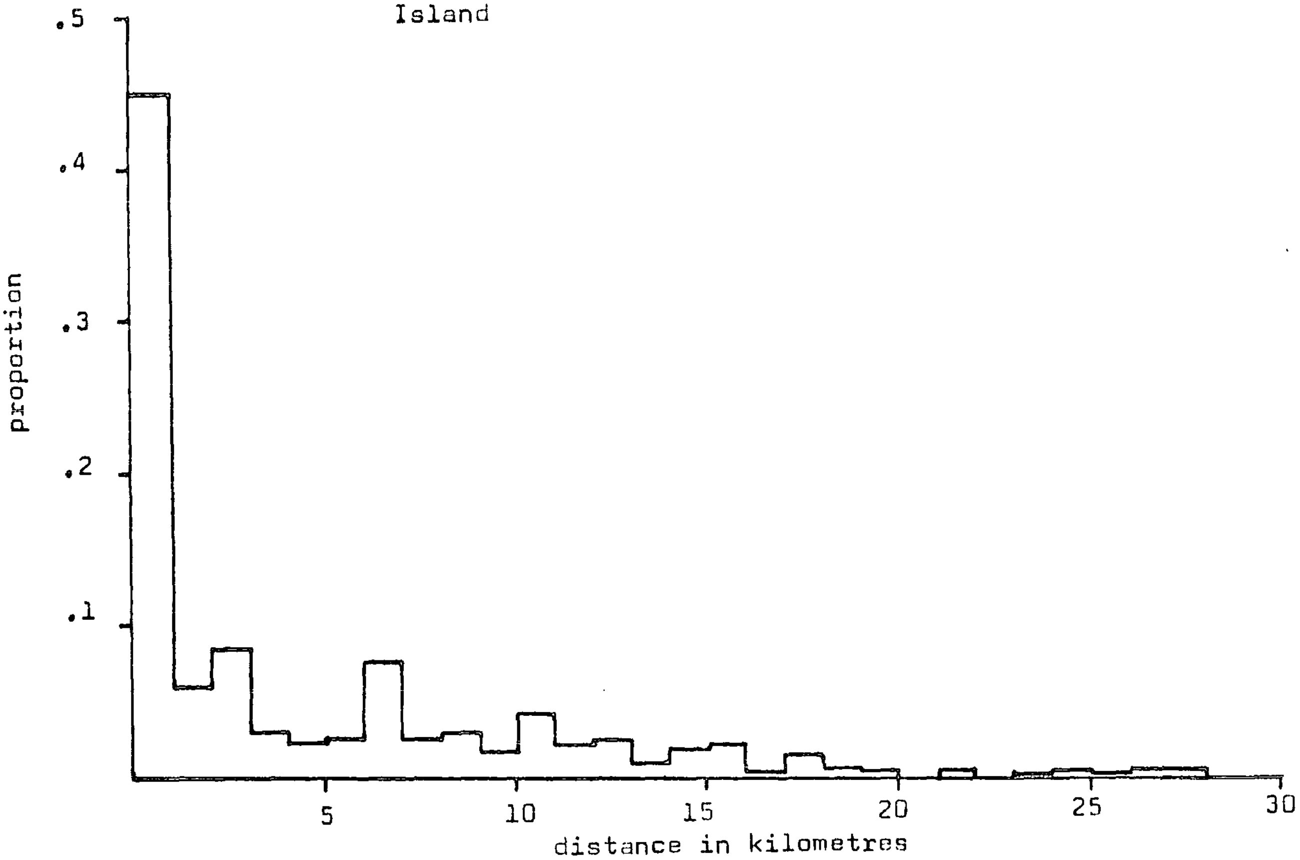


Figure 4.28 Blood donors:
distribution of birthplace-residence distances among donors and spouses born and living on the Island

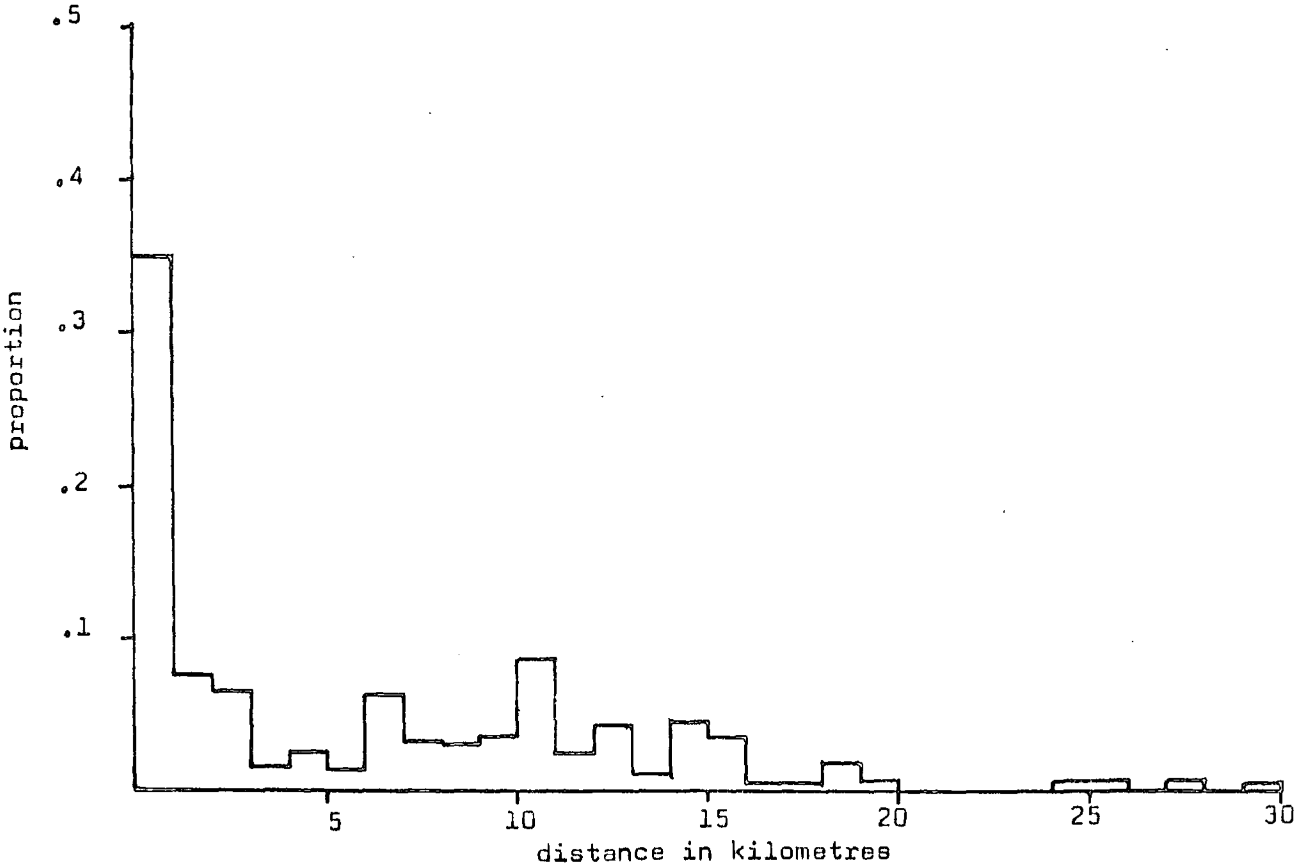


Table 4.52 Blood donors:
birthplace distances among those born and living on the Isle of Wight

Distance in kilometres	Proportion of marriages	Cumulative proportion
0	.350	.350
1	.076	.426
2	.066	.492
3	.016	.508
4	.025	.533
5	.015	.548
6	.061	.609
7	.031	.640
8	.030	.670
9	.036	.706
10	.086	.792
11	.025	.817
12	.041	.858
13	.010	.868
14	.046	.914
15	.035	.949
16	.005	.954
17	.005	.959
18	.016	.979
19	.005	.980
20		.980
21		.980
22		.980
23		.980
24	.005	.985
25	.005	.990
26		.990
27	.005	.995
28		.995
29		.995
30	.005	1.000

n = 197

of the still smaller number of donors who live on the Isle of Wight and are endogamously married. This distribution is plotted in Figure 4.28.

IV General Discussion

(a) Introduction

For all the precise description, the "measurement and the rule of three", which comprises the donors' and the school children's data, it is not clear what they mean; interpretation is possible only in the light of a context which may be provided by comparative material. Of course, some knowledge of similar work (chiefly on Otmoor, Holy Island, the Isle of Man and Hartlepool) helped to shape the present study, so it is misleading to suggest that a context is required at last to set off this work as a frame might a picture. However, it is a deficiency of the Isle of Wight study (and, in my view, of others) that the picture it presents does not sufficiently fit the frame; for the frame was there first. Inevitably, methodologies change with experience and expedience, but they also vary with what seems to be a regardless indifference to the established context; the upshot is that precise comparisons are rare, and so, in consequence, are inferences without caveat.

This theme of comparability will recur but for the moment it is enough to observe that while several studies address the same problems, few provide equivalent data.

(b) Locality of Birth

Figures 4.1, 4.13, 4.29 and 4.30 represent the regional origins of the antecedents of the following samples: the Isle of Wight school children, the Isle of Wight blood donors, W.R. Williams's (1978) sample of school children from the Welsh borders and D.A. Coleman's (1979) marriage survey of Reading. The first hindrance to comparison is the difference in regional units employed; however, this is a fairly trivial point since with reference to Coleman's or the other raw data one could compute compatible units.

A much less eluctable drawback stems precisely from the fact that the samples are from different places. How should we compare the proportion of grandparents from Wales in a sample taken on the Welsh borders with the proportion of Welsh grandparents in a sample from the Isle of Wight? Beyond the truism that children living in the Welsh borders have proportionally more Welsh grandparents than children living on the Isle of Wight, we can infer little from these figures without the

Figure 4.29 Welsh borders: regions of birth of school children and antecedents

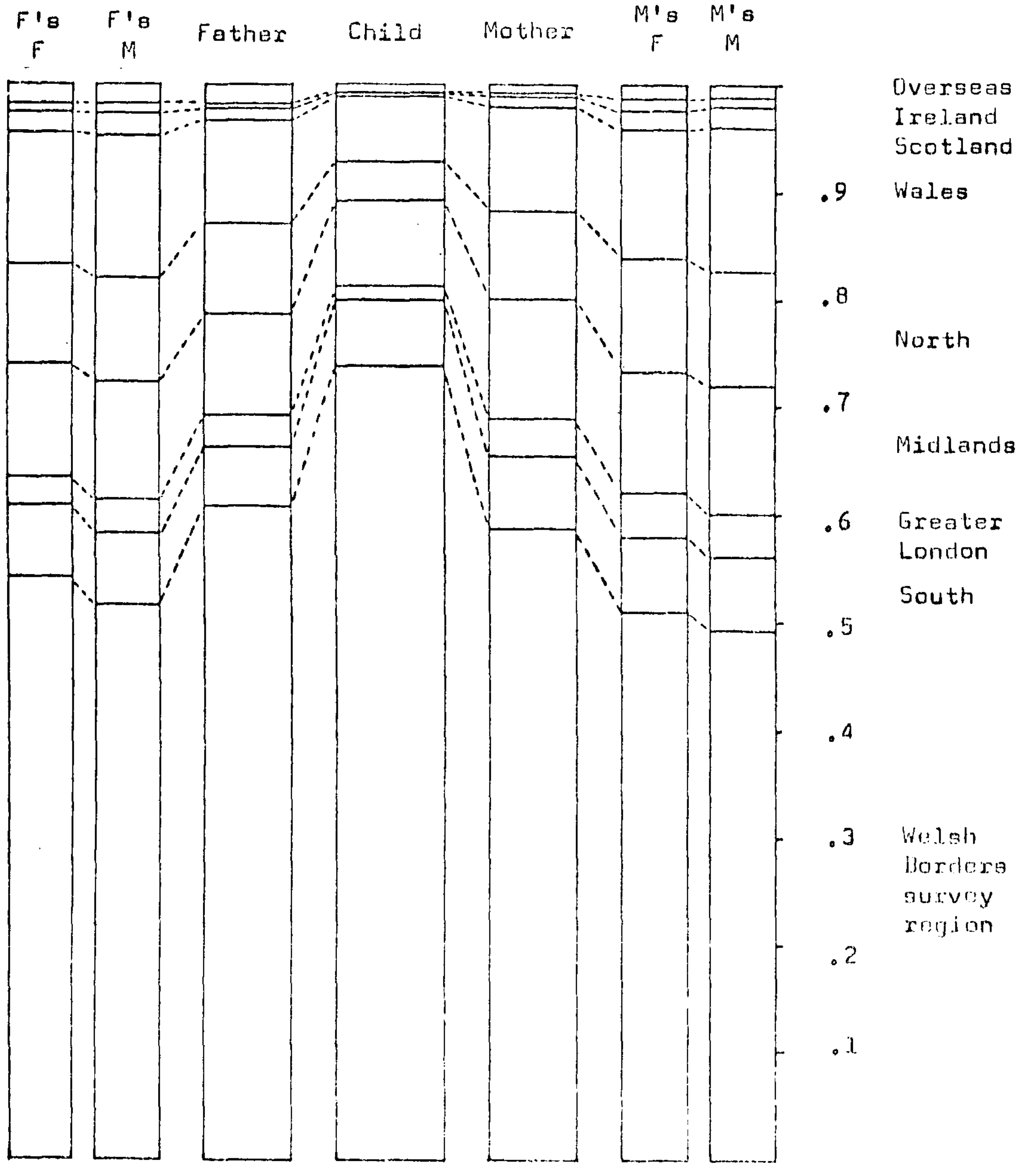
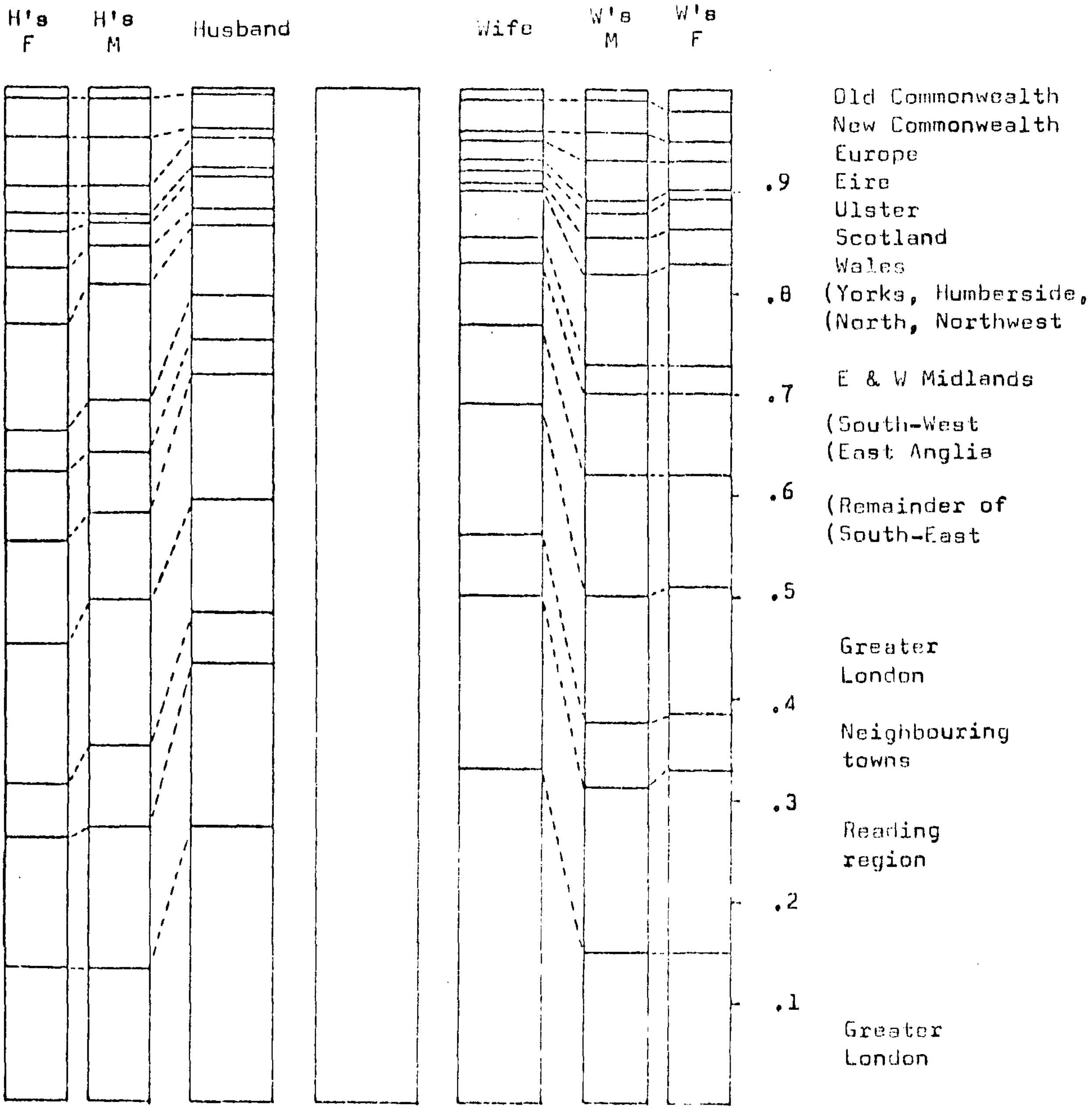


Figure 4.30 Reading marriage survey: regions of birth of spouses and parents



assumption of knowledge of an order more sophisticated than the interpretations they can themselves provide. Indeed, the truism above owes its banality to the widely-held lay belief in isolation by distance. It is just such generality which these figures lack, and consequently they cannot be used very successfully for the comparison of regional origins between surveys made in very different areas.

For demonstrating secular change within one survey region the outlook is not so bleak, as comparison between Figures 4.1 and 4.13 shows. If the differences in size of the catchment areas can be ignored, then the diagrams demonstrate the effect of age on achieved migration: of the school children 54% are born on the Isle of Wight; of the donors, 42%. This seems plausible, but can differences in catchment be dismissed so easily? By analogy with Coleman's (1977a) work on endogamy in Britain one would expect the proportion of residents born indigenously to increase with the size of the region surveyed, an opposite tendancy to the one observed here. In comparing the donors with the children, however, this analogy is not exact; although a smaller area is surveyed in the latter case the qualification as indigenous includes birth anywhere on the Isle of Wight. The effect of this is shown in Table 4.53. Whilst each sub-division of the Island has a smaller proportion of the population born in it than in the whole, this discrepancy

Table 4.53 Blood donors:
proportion of the resident population
born on or off the Island

Birthplace Place of residence	Cowes	E. Cowes	Newport	Ryde	Sandown	IW total	Outside World
Cowes	.245	.046	.119	.013	.013	.436	.554
East Cowes	.124	.168	.139	.044	.015	.490	.510
Newport	.021	.013	.368	.040	.037	.479	.521
Ryde	.024	.007	.038	.284	.024	.377	.623
Sandown	.012	.012	.048	.027	.270	.369	.631
Isle of Wight total	.057	.032	.158	.089	.089	.425	.575

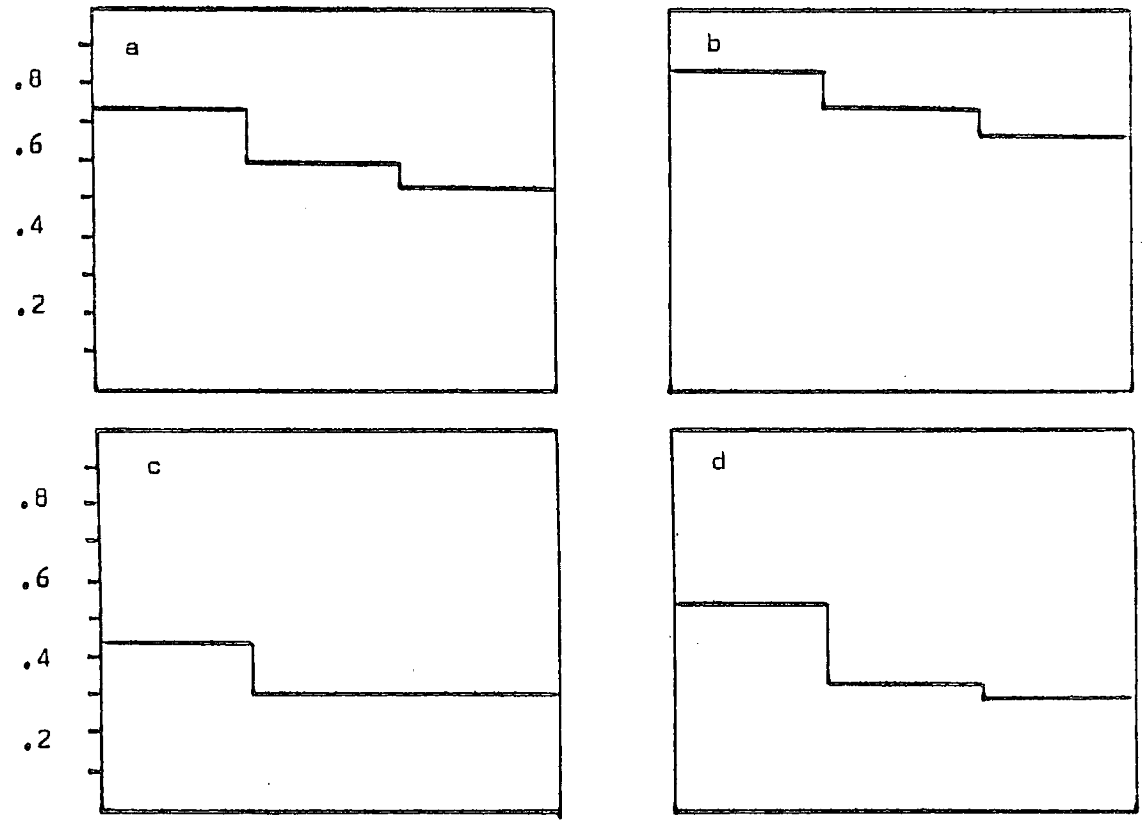
n = 1 288

disappears when the entire Island is considered as the catchment area of indigenous population for each. That such should be the case may also be inferred from the fact that the weighted mean of the "IW Total" column must provide the total proportion of indigenes for the Island. The same reasoning indicates that the proportional contributions from regions off the Island may also be compared legitimately between the donors and the children.

An additional observation, from Table 4.53, is that the regional contributions to areas themselves small and contiguous or close might usefully be compared. For example, the smaller Isle of Wight-born population and larger Greater London contingent among the populations of Ryde area and Sandown area might well be interpreted as a consequence of the tourist industry, without concern that differences in location per se were causing the observed contrasts.

Greater generality for comparing distant survey areas can be obtained by concentrating solely on the indigenous element. This approach is also likely to give access to more comparative material through being less rigorous. Beyond considering just the proportion of residents born within the survey region we may incorporate the data from these residents' antecedents. Figure 4.31 (a), (b), (c) and (d) compares this information from W.R. Williams's Welsh border sample and D.R.R. Williams's

Figure 4.31 Comparison of proportions of indigenous population and its ancestors in four regions of the British Isles



a Welsh borders
b Co. Durham, adults
c Isle of Wight, blood donors
d Isle of Wight, school children

County Durham survey (1977) with the Isle of Wight blood donors and school children. Two aspects of these figures are of interest: firstly, the maximum height the "stairs" attain (the proportion of the present generation born within the survey region) and, secondly, the steepness of the steps down to the grandparents (the population's generational mobility). Thus, for example, the Welsh border population, though containing a much greater indigenous element than the Isle of Wight donors, has apparently a longer history of detectable population movement.

There are cogent reasons why the comparisons made in Figure 4.31 are meant for the most part to illustrate a method of presentation rather than to draw conclusions. We must hesitate to match D.R.R. Williams's data against the rest owing to his much larger population catchment of approximately 186 000 (Sutherland, 1974); incompatibilities of age confound a comparison of the Welsh school children with the Isle of Wight donors; weighing the Island school children against the donors has already been done in more detail. The remaining comparison is a useful one. W.R. Williams's catchment population is the same as the Isle of Wight's (circa 100 000) and his school children are about the same age. The difference between populations thus revealed is a real one of obvious relevance to the genetic structure. However, it is appropriate here to state more fully the concern mentioned above, that ignorance of grandparents' birthplaces may be geographically biased. The proportion of these that is unknown is .13 for the Isle of Wight school children and .37 for the donors. Probably both the age of the grandparents and the nature of the questionnaires (see Chapter 3) contribute to this discrepancy. My suspicion is that given such a high level of missing data, and given that the questions were asked on the Isle of Wight, there may be a bias in recall of grandparents' birthplaces in favour of those who were born (and live to tell the tale) on the Island. Nothing in the data presented can dispel this fear, and the disposition of the donors' grandparents' birthplaces shown in Figure 4.31 might suggest this bias as plausibly as it supports any other interpretation.

Further to comment on the presentation of results, we mention that as a "shorthand" notation population samples may be described by the distribution of grandparental birthplaces (or the proportion of indigenous grandparents) alone. This statistic can be usefully employed in mapping the origins of a population sample, when the maximum amount of information needs to be condensed into a single variable (Jones, 1959; Sunderland, 1961).

To conclude this discussion of where the survey participants and their forbears are born we must consider how useful the topic is in general, and what it has revealed in the present circumstances.

Documenting these birthplaces by region has been shown to have limited value for comparative analysis, owing to the difficulties of matching geographical location, population size and age structure. I would maintain its value purely as description, however, and similarly would stand by the still more detailed presentation of birthplace by county, especially in a monograph such as the present work.

The idea of the continuity across generations of the indigenous population alone is a better general method for comparing surveys because there is no need for them to be close geographically; the constraining requirement for populations similar in size and age structure remains, however. Using this method the Isle of Wight has been shown to have a gene pool much more open to contributions from without than the Welsh border population studied by W.R. Williams. Doubtless this is not the most telling of comparisons, but at least it seems to be a valid one and it reinforces the view provided by numbers alone: the Isle of Wight's gene pool is of much greater extent than the Island itself.

I shall leave this topic of the coincident birthplaces of parents and children by remarking that it would be the happier for having a convenient handle. The parallel with the coincident birthplace of spouses suggests "endogeny"; Dennis (1977) uses "endemicity". This usage of either is novel, but perhaps "endogeny" is formally more correct.

(c) Endogamy

In principle the difficulties which attend the comparison of "endogeny" between regions apply also to considerations of endogamy. In practice, there are touchstones at two levels of resolution which make the problems less formidable. On a broad scale, the theoretical skeleton which leads us to expect endogamy to have consequences for genetic structure in smaller populations rather than larger is fleshed out by a series of empirical studies which show endogamy to be prescriptive only by choice in social isolates and, perforce, in rather remote geographical ones. On a narrower scale, studies within Britain have demonstrated systematic changes in endogamy rates through time (Küchemann *et al.*, 1967; Clegg, 1975) and with population size (Coleman, 1977a).

Studies of islands round Britain which discuss endogamy include those of Colonsay and Jura (Sheets, 1978, 1979), Barra (Morton *et al.*, 1977), Lewis and Harris (Clegg, 1975), the Orkneys (Boyce *et al.*, 1973) and Holy Island (Cartwright, 1973a). Compared with the Isle of Wight all these islands are remote and have small populations, and yet by the standards of the isolates of anthropological fame all but the Orkneys have low endogamy and isolation.

In this context, the small proportion of endogamous marriages among the blood donors and the parents of the school children is not surprising. Clearly, a population which has sample estimates of 25% and 19% of marriages endogamous must be considered as part of a larger breeding unit.

Whilst the figures presented in Tables 4.41, 4.42 and 4.43 confirm the view of generally high immigration to the Island, they highlight the particular importance of migrant marriages in contributing immigrants to the population, and also in causing a deviation from random mating between immigrants and Island-born. However, there is no evidence of non-random mating among members of these two groups when they are living on the Isle of Wight before marriage.

(d) Distance Measures

The measures of distance describing the Isle of Wight population's mobility will be discussed with two main objectives in mind; firstly, comparison of the Island with other British data and, secondly, comparison between generations of the present survey.

For the purposes of comparison with other surveys the birthplace distance of marriage partners is the most satisfactory because the most widely used. One must, of course, be wary of the term "marriage distance" itself on account of its different meanings in different contexts, but authors are for the most part explicit about the definition they use. Historical demography employing Anglican parish registers is constrained to use people's places of residence rather than of birth, and the effect of this in reducing apparent mobility has been demonstrated both by Jeffries _et al_. (1976) and by Coleman (1977a).

The Population Investigation Committee's survey analysed by Coleman (1973, 1977a, b) samples the population of Great Britain south of the Caledonian canal, aged 16-59 years old in 1960. This means that no particular locality or region is described by the sample statistics, but rather that general patterns for the whole area are discovered. Subdivisions of the data allow trends through time and with population size to be demonstrated, and these will be used for comparison with the Isle of Wight.

Coleman (1973) Figure 6 shows the effects of population size on the distribution of marriage distance. Comparison of these graphs with Figures 4.9 and 4.22 of the present work shows the shape of the Isle of Wight population's distribution to conform with expections made on the basis of population size. The J-shaped curves observed are characteristic of populations of up to 100 000, which is approximately the total Isle of Wight population.

Trends of birthplace distance distribution through time are analysed in Coleman's 1977b paper. The data from Table 2 therein describe a secular trend in birthplace distance for exogamous marriages by comparing the cumulative proportions of marriages at given distances between birthplaces for four decades of marriage (1920-1929, 1930-1939, 1940-1949, 1950-1959). Secular change within the present survey sample has been sought by comparison of the movement distributions between generations. This has been done in the school children sample for parent-offspring distance (Figure 4.8) and birthplace distance of marriage partners (Figure 4.12) and in the blood donor sample for the same variables (Figures 4.21 and 4.25). The plots of birthplace distance distribution seem to indicate secular change within each series. The comparison of parent-offspring distances in the donors is not completely satisfactory for reasons described above but parent-offspring distributions in the school children again suggest an increase in mobility with time.

This interpretation is consistent with much work in the British Isles which documents the expansion of the gene pool through time, by measurement of isonymous marriage (for example, Roberts and Rawling, 1974), endogamy (for example, Küchemann et al., 1974) or marital distances (for example, Küchemann et al., 1974). However, the rather regular increases in mobility through generations seen here contrasts somewhat with that observed in the PIC data by Coleman (1977b); this may be the place to mention again the possibility of bias in the Isle of Wight survey due to the increase in missing data as one goes back in time. If the respondents selectively remember the birthplace of parents and grandparents of local origin, then the apparent increase in mobility may be an artefact. A tendency to claim that both grandparents were born in the same place because they were both always associated with that place in the respondent's memory would produce the same effect. Again, there is no evidence that such a bias does occur here, but its possibility must be allowed.

CHAPTER FIVE GENETIC VARIATION

I Introduction

The purpose of this chapter is to describe the frequencies of phenotypes and genes at a number of marker loci among the Isle of Wight blood donor sample. Comparisons will then be made between these results and those of selected appropriate surveys, usually of the English mainland. The intention here is, of course, to see whether there is any systematic difference in the distribution of genetic markers on and off the Isle of Wight; the information about population history and about migration and marriage presented in Chapters 2 and 4 has suggested that such a difference is unlikely to exist at this level of resolution. An alternative approach to answering the same question will be made by sub-dividing the donor sample according to birth or "ancestry" on the Island, and comparing those with Isle of Wight birth or "ancestry" to those without such a qualification.

It should perhaps be mentioned now rather than left to a discussion of these results that both these procedures seem to have important drawbacks which reduce confidence in whatever conclusions they suggest. The comparison between surveys is weakened by the fact that samples have been collected at different times and according to very different sampling criteria. With the possible exceptions only of the ABO and Rhesus D systems, simply not enough is known of the distribution of genetic markers on a scale as local as that within the United Kingdom to enable us to say whether crude variations in sample frame are of any consequence. This makes it difficult to assess the significance of differences in genetic frequencies between surveys.

Comparisons made within a single survey at least control for the extremes of variation in sample frame, but as has been suggested in Chapter 4, the comparison between native-born and immigrant residents of a region may well detect variation due to causes other than simply a difference of birthplace.

II Results

In spite of these caveats it seems worth while to tabulate the Isle of Wight blood donor sample's gene frequencies, in part because this itself increases the distributional evidence, and so may contribute towards resolution of the doubts which have been mentioned above; this worthy aim does not aid interpretation at the present, however. Table 5.1 shows the phenotype and gene frequencies of the Isle of Wight population as estimated from the sample of blood donors. Phenotype distributions have been tested for agreement with Hardy-Weinberg equilibrium where

Table 5.1 Genetic markers in Isle of Wight blood donors

I ABO

Phenotypes		Gene Frequencies	
A_1	523	$p_1 = .201$	$p = .271 \pm .008$
A_2	149	$p_2 = .068$	
B	134	$q = .062$	$q = .064 \pm .008$
A_1B	42	$r = .669$	$r = .665 \pm .018$
A_2B	19		
O	695		
n =	1 562		

$ABO_{HW}\chi^2_1 = 1.1430 \quad p > .05$

II MN

Phenotypes		Gene Frequencies
M	423	$m = .567 \pm .027$
MN	603	$n = .433 \pm .027$
N	251	
n =	1 277	

$\chi^2_{HW} = 1.859 \quad p > .05$

III Ss

Phenotypes		Gene Frequencies
S+	556	$S = .278 \pm .020$
S-	605	$s = .722 \pm .020$
n =	1 161	

Table 5.1 continued

IV Rhesus

(i) D locus only

Phenotypes	
D+	1 206
D-	355
n =	1 561

Gene Frequencies

D = .477 ± .022

d = .523 ± .022

(ii) Rhesus chromosome frequencies

Phenotypes

C	c	D	E	e	
+	+	+	+	+	210
+	+	+	+	-	3
+	+	+	-	+	438
+	+	-	-	+	3
+	-	+	+	+	3
+	-	+	-	+	188
-	+	+	+	+	77
-	+	+	+	-	24
-	+	+	-	+	12
-	+	-	+	+	4
-	+	-	-	+	259

n = 1 221

Chromosome Frequencies

r	.428
r'	.003
r"	.004
r^y	.000
R_o	.010
R_1	.417
R_2	.133
R_z	.005

V Duffy

Phenotypes	
Fy^a+	723
Fy^a-	462
n =	1 185

Gene Frequencies

Fy a = .375 ± .022

b = .625 ± .022

Table 5.1 continued

VI Kell

Phenotypes		Gene Frequencies
K+	69	K = .033 ± .029
K-	997	k = .967 ± .029
n =	1 066	

VII Kidd

Phenotypes		Gene Frequencies
JK^a+	235	JK a = .443 ± .029
JK^a-	103	JK b = .557 ± .029
n =	338	

VIII Transferrin

Phenotypes		Gene Frequencies
C	1 508	Tf C = .992 ± .005
BC	26	Tf B = .008 ± .005
n =	1 534	

χ^2 HW = 0.112 $p > .05$

IX Esterase D

Phenotypes		Gene Frequencies
1-1	1 199	ESD-1 = .891 ± .016
2-1	285	ESD-2 = .109 ± .016
2-2	21	
n =	1 505	

χ^2 HW = 0.743 $p > .05$

Table 5.1 continued

X Haptoglobin

Phenotypes		Gene Frequencies
1-1	235	Hp-1 = .387 ± .025
2-1	701	Hp-2 = .613 ± .025
2-2	577	

n = 1 513

χ^2 HW = 0.833 $p > .05$

XI Acid Phosphatase

Phenotypes		Gene Frequencies
A	188	EAP a = .341 ± .024
BA	608	EAP b = .612 ± .025
B	568	EAP c = .047 ± .011
CB	95	
CA	43	
C	2	

n = 1 504

χ^2 HW = 3.544 $p > .05$

XII Adenylate Kinase

Phenotypes		Gene Frequencies
1-1	1 291	AK-1 = .960 ± .010
2-1	107	AK-2 = .040 ± .010
2-2	2	

n = 1 400

χ^2 HW = .020 $p > .05$

Table 5.1 continued

XIII Phosphoglucomutase

Phenotypes		Gene Frequencies
1-1	743	PGM-1 = .787 ± .023
2-1	354	PGM-2 = .213 ± .023

$n = 1\,169$

$\chi^2_{HW} = 10.9 \quad p < .001$

possible (the ABO method is the one used by Cavalli-Sforza and Bodmer, 1971). Gene frequencies have been estimated by gene counting or from the assumption of Hardy-Weinberg phenotype proportions. The Rhesus chromosome frequencies are least squares estimates obtained by a private FORTRAN program provided by K.S. Sawnhey; I have no variance estimates for them. Estimates of ABO gene frequencies have been obtained by Bernstein's method with Bernstein's correction (given in Mourant et al., 1976). The standard errors for the ABO system are those of the maximum likelihood gene frequency estimates tabulated by Li (1970); they are appropriate for use with Bernstein's corrected ABO gene frequency estimates (Li, 1976). A_1A_2BO gene frequencies have been estimated by the method shown in Li (1976), and have no estimates of standard error.

Wherever possible, gene frequency estimates are shown plus or minus 1.96 times the standard error; this spans the range of a population's true value with 95% probability. Such a tabulation reminds us that to give frequencies to even three decimal places is often unjustifiably optimistic, and that the widespread convention of publishing gene frequencies to four decimal places (see Mourant et al., 1976, for example) is technically useful rather than informative.
Departure from Hardy-Weinberg equilibrium is observed only in the PGM_1 system. Though such tests seem worth doing as a

general "insurance policy", it is often very difficult to interpret individual departures from equilibrium. A deficiency of heterozygotes (as observed here) may be due to wider variety of causes than an excess, but in the absence of very specific background information it is difficult to support any single cause with conviction.

Selection against heterozygotes is unsuspected and unreported in this system, and intensive inbreeding or marked heterogeneity of population (for which there is evidence of neither) would surely not leave other systems unaffected. Typing errors would, by default, provide a plausible though unpalatable explanation. Finally, it must be accepted in that interpreting any such series of statistical tests we may be the dupes of fortune.

III Comparison with other surveys

The data chosen from other surveys for comparison with the blood donors are shown in the rather lengthy Table 5.2. This is divided numerically into genetic systems, and by alphabetic division each system may provide several sets of data, as appropriate or available.

The results of comparing the other data with the Island blood donors, are shown in Table 5.3. The method of comparison is usually by the χ^2 test of phenotype numbers.

Table 5.2 Comparative data for Isle of Wight blood donors' genetic markers

I ABO

(a) Ikin *et al.* (1939) Southern England
Quoted in Race and Sanger, 6th Edition, 1975

Phenotypes		Gene Frequencies
A_1	1 204	p_1 = .209
A_2	342	p_2 = .070
B	297	q = .061
A_1B	91	r = .660
A_2B	22	
O	1 503	
n =	3 549	

(b) Kopeć (1970) Isle of Wight blood donors

Phenotypes		Gene Frequencies
A	348	p = .254
B	69	q = .056
AB	22	r = .690
O	395	
n =	834	

(c) Kopeć (1970) Area 33 (*op.cit.* p.87 map 1)

Phemotypes		Gene Frequencies
A	6 650	p = .262
B	1 248	q = .057
AB	498	r = .681
O	7 304	
n =	15 700	

Table 5.2 continued

(d) Kopeć (1970) Area 21 (*op.cit.* p.87 map 1)

Phenotypes		Gene Frequencies
A	15 219	$p = .279$
B	2 790	$q = .059$
AB	1 072	$r = .662$
O	14 894	
n =	33 975	

(e) Kopeć (1970) Area 34 (*op.cit.* p.87 map 1)

Phenotypes		Gene Frequencies
A	1 475	$p = .278$
B	271	$q = .056$
AB	83	$r = .666$
O	1 430	
n =	3 259	

(f) Isle of Wight School children (present survey)

Phenotypes		Gene Frequencies	
A_1	84	$p_1 = .205$	$p = .278$
A_2	27	$p_2 = .080$	
B	20	$q = .060$	$q = .050$
A_1B	2	$r = .655$	$r = .672$
A_2B	1		
O	105		
n =	239		

II MN

(a) Taylor and Prior (1938) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
M	121	$m = .524 \pm .048$
MN	200	$n = .476 \pm .048$
N	101	

Table 5.2 continued

II MN continued

(b) Thomas and Hewitt (1939) (in Mourant et al. 1976)

Phenotypes		Gene Frequencies
M	279	m = .552 ± .032
MN	436	n = .448 ± .032
N	185	

III Ss

Cleghorn (1960) (in Mourant et al. 1976)

Phenotypes		Gene Frequencies
S+	517	S = .308 ± .029
S-	483	s = .692 ± .029

IV Rhesus

(i) D locus only

(a) Kopeć (1970) Sutton, sub-regions 1-30

Phenotypes		Gene Frequencies
D+	10 622	D = .574 ± .004
D-	2 365	d = .426 ± .004

(b) Isle of Wight School children (present survey)

Phenotypes		Gene Frequencies
D+	194	D = .566 ± .057
D-	45	d = .434 ± .057

Table 5.2 continued

IV Rhesus continued

(ii) Rhesus chromosome frequencies

Race *et al.* (1948)

r = .389
r' = .010
r'' = .012
r^y = .000
R_o = .026
R_1 = .420
R_2 = .141
R_z = .002

V Duffy

(a) Race *et al.* (1968) (in Mourant *et al.* 1976)

Phenotypes	
Fy^a+	162
Fy^a-	88

Gene Frequencies

Fya = .407 ± .050
Fyb = .593 ± .050

(b) Race and Sanger (1958, 1965) (in Mourant *et al.* 1976)

Phenotypes	
Fy^a+	48
Fy^a+Fy^b+	114
Fy^b	91

Gene Frequencies

Fya = .415 ± .061
Fyb = .585 ± .061

(c) Cleghorn (1965) (in Mourant *et al.* 1976)

Phenotypes	
Fy^a	130
Fy^a+Fy^b+	321
Fy^b+	205

Gene Frequencies

Fya = .443 ± .038
Fyb = .557 ± .038

Table 5.2 continued

VI Kell

(a) Ikin *et al.* (1954) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
KK	1	K = .039 ± .011
Kk	89	k = .961 ± .011
kk	1 076	

(b) Race and Sanger (1949, 1957) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
K+	88	K = .049 ± .024
K-	832	k = .951 ± .024

VII Kidd

(a) Sanger and Race (1951) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
JKa+	173	JKa = .519 ± .057
JKa-	52	JKb = .481 ± .057

(b) Plaut *et al.* (1953) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
JKa+	35	JKa = .582 ± .098
JKaJKb	44	JKb = .418 ± .098
JKb+	19	

Table 5.2 continued

VIII Transferrin

Tills (1975) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
TfC	310	Tf C = .987 ± .012
TfBC	8	Tf B = .013 ± .012

IX Esterase D

Cartwright *et al.* (1978)

Phenotypes		Gene Frequencies
ESD 1-1	815	ESD-1 = .882 ± .020
2-1	211	ESD-2 = .118 ± .020
2-2	18	

X Haptoglobin

(a) Harris *et al.* (1959) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
1-1	33	Hp-1 = 430 ± .073
2-1	88	Hp-2 = 570 ± .073
2-2	58	

(b) Allison *et al.* (1958) (in Mourant *et al.* 1976)

Phenotypes		Gene Frequencies
1-1	22	Hp-1 = .389 ± .066
2-1	121	Hp-2 = .610 ± .066
2-2	69	

Table 5.2 continued

XI Acid Phosphatase

(a) Hopkinson *et al.* (1964) (in Mourant *et al.* 1976)

Phenotypes	
A	29
BA	132
B	92
CB	14
CA	7
C	0

Gene Frequencies

EAPa = .360 ± .056

EAPb = .602 ± .060

EAPc = .038 ± .023

(b) Hopkinson and Harris (1968) (in Mourant *et al.* 1976)

Phenotypes	
A	119
BA	379
B	282
CB	61
CA	39
C	0

Gene Frequencies

EAPa = .373 ± .032

EAPb = .571 ± .033

EAPc = .057 ± .015

XII Adenylate Kinase

Rapley *et al.* (1976) (in Mourant *et al.* 1976)

Phenotypes	
1-1	1 720
2-1	165
2-2	2

Gene Frequencies

AK-1 = .955 ± .009

AK-2 = .045 ± .009

XIII Phosphoglucomutase

Hopkinson and Harris (1968) (in Mourant *et al.* 1976)

Phenotypes	
1-1	635
2-1	378
2-2	61

Gene Frequencies

PGM-1 = .767 ± .025

PGM-2 = .233 ± .025

Table 5.3 Comparisons of Isle of Wight blood donors' genetic data with other samples

I ABO

a $\chi^2_5 = 7.642$, $p > .05$

b $\chi^2_3 = 3.778$, $p > .05$

c $\chi^2_3 = 4.472$, $p > .05$

d $\chi^2_3 = 4.075$, $p > .05$

e $\chi^2_3 = 7.889$, $.01 < p < .05$

f $\chi^2_4 = 4.948$, $p > .05$

II MN

a $\chi^2_2 = 4.767$, $.01 < p < .05$

b $\chi^2_2 = 1.118$ $p > .05$

III S

$\chi^2_1 = 3.120$, $p > .05$

IV Rhesus D locus

a $\chi^2_1 = 18.823$, $p < .001$

b $\chi^2_1 = 1.836$, $p > .05$

Table 5.3 continued

V	Duffy	
a	$\chi^2_1 = 1.253$,	$p > .05$
b	$\chi^2_1 = 0.803$,	$p > .05$
c	$\chi^2_1 = 10.941$,	$p < .001$

VI	Kell	
a	$\chi^2_1 = 1.307$,	$p > .05$
b	$\chi^2_1 = 6.486$,	$.01 < p < .05$

VII	Kidd	
a	$\chi^2_1 = 3.670$,	$p > .05$
b	$\chi^2_1 = 4.633$,	$.01 < p < .05$

VIII	Transferrin	
	$\chi^2_1 = 2.504$,	$p > .05$

IX	Esterase D	
	$\chi^2_1 = 1.150$,	$p > .05$

Table 5.3 continued

X Haptoglobin

a $\chi^2_1 = 2.529$, $p > .05$

b $\chi^2_1 = 9.310$, $.001 < p < .01$

XI Acid Phosphatase

a and b

Compared gene frequencies by ratio of Standard Error of difference to difference. No significant differences at .05 level.

XII Adenylate Kinase

$\chi^2_2 = 1.367$, $p > .05$

XIII Phosphoglucomutase

$\chi^2_2 = 6.149$, $.01 < p < .05$

Considering the ABO results as a whole, and regardless of whether three or four genes are estimated, there is little indication of variation of genetic frequencies within the southern English region considered here. The biggest difference (that between Isle of Wight donors and Kopeć's region 34) is largely due to variations in AB phenotype frequency.

The comparison of Rhesus D and d frequencies between Isle of Wight donors, Isle of Wight school children and southern England donors is instructive on two counts: first, the greater d gene frequency (.523) in the Island donors may well be due to self selection of Rhesus negatives which the sampling only of first time donors by Kopeć eliminates; and second, the lower d frequency (.434) among the Sandown school children, which might tend to support the first point, is not significantly different from the Island donors' estimated frequency (.523), although the mainland donors' frequency (.426) emphatically is: such is the effect of sample size.

Because little is known of the distribution of the remaining genetic systems in the United Kingdom, there is not much to be gained by discussing each in turn. In general, there is no strong suggestion that the frequencies estimated among the Isle of Wight population differ systematically in either direction or degree from those of the English mainland. Thus there is no clear indication of selection or genetic drift having caused differentiation. Only the second of those alternatives has seriously been considered as an agent of micro-evolution in the present case, and its effects had been predicted to be minimal on the evidence of historical and recent migrations.

In detail, we may note that the significant differences in phenotype frequency given in comparisons 5a and 10b seem due to the mainland data rather than the Island donors.

IV Comparison within the Isle of Wight donor survey

Two methods of subdividing the donor sample have been employed. The first divides donors into those born on the Island and those born off; the second partitions them into those born on the Island with their parents and at least three grandparents born on the Island as one category, with those "not so qualified" as the other. This latter method of partition is said to be by "ancestry", and it has already been criticised above (Chapter 4).

The results of subdivision by birthplace are shown in Table 5.4. Comparison is by the χ^2 test performed on phenotype frequencies. In no case are there significant differences at the 5% level between those residents born on the Isle of Wight and those not

Table 5.4 Isle of Wight blood donors: subdivision by birthplace

ABO	Mainland	IW	
A	.409	.462	
B	.084	.073	
AB	.040	.035	
O	.466	.431	
	n = 745	n = 548	$\chi^2_3 = 3.655$, $P > .05$

A versus the rest	Mainland	IW	
A	.409	.462	
Not-A	.591	.538	
	n = 745	n = 548	$\chi^2_1 = 3.308$, $.07 > P > .05$

O versus the rest	Mainland	IW	
O	.466	.431	
Not-O	.534	.569	
	n = 745	n = 548	$\chi^2_1 = 1.434$, $P > .05$

MN	Mainland	IW	
M	.320	.332	
MN	.477	.483	
N	.203	.185	
	n = 637	n = 464	$\chi^2_2 = 0.534$, $P > .05$

Ss	Mainland	IW	
S+	.466	.465	
S-	.534	.535	
	n = 588	n = 430	$\chi^2_1 = 0.001$, $P > .05$

Rhesus D locus	Mainland	IW	
D+	.774	.774	
D-	.226	.226	
	n = 743	n = 548	$\chi^2_1 = 0.004$, $P > .05$

Table 5.4 continued

Duffy	Mainland	IW	
Fy^a+	.397	.372	
Fy^a-	.603	.628	
	n = 592	n = 425	$\chi^2_1 = 0.662$, $P > .05$

Kell	Mainland	IW	
K+	.057	.074	
K-	.943	.926	
	n = 525	n = 390	$\chi^2_1 = 1.099$, $P > .05$

Haptoglobin	Mainland	IW	
HP 1-1	.138	.173	
2-1	.483	.433	
2-2	.379	.394	
	n = 725	n = 531	$\chi^2_2 = 4.299$, $P > .05$

Transferrin	Mainland	IW	
Tf C	.981	.989	
Other	.019	.011	
	n = 732	n = 543	$\chi^2_1 = 0.846$, $P > .05$

Acid Phosphatase		Mainland	IW	
AP	AA	.127	.126	
	BA	.427	.394	
	BB	.358	.383	
CB, CA,	CC	.088	.098	
		n = 716	n = 533	$\chi^2_2 = 1.660$, $P > .05$

Adenylate Kinase	Mainland	IW	
AK 1-1	.921	.918	
2-1, 2-2	.079	.082	
	n = 662	n = 497	$\chi^2_1 = 0.018$, $P > .05$

Table 5.4 continued

Esterase D	Mainland	IW	
ESD 1-1	.811	.791	
2-1,2-2	.189	.209	
	n = 718	n = 532	$\chi^2_1 = 0.597$, $P > .05$

Phosphoglucomutase	Mainland	IW	
PGM 1-1	.637	.626	
2-1	.299	.306	
2-2	.064	.072	
	n = 559	n = 401	$\chi^2_2 = 0.267$, $P > .05$

born there. The comparison which approaches nearest this state is between blood group A frequencies ($\chi^2_1 = 3.308$, $P = .069$).

When comparison between sections of the population is made on the basis of "ancestry" there are similarly no detectable differences in phenotype frequency except for the proportion of blood group A. ($\chi^2_1 = 4.412$, $P = .036$). These comparisons are shown in Table 5.5.

V Discussion

By the use of two flawed methods of comparison it has been demonstrated that the population of the Isle of Wight has substantially the same distribution of genetic markers as the mainland of England, and that within the Isle of Wight there is detectable genetic heterogeneity of population only for the ABO blood groups. Even at the ABO locus the evidence of relationship with birthplace and ancestry is not strong, and I think would surely be discounted for any other genetic system. It is only the previously demonstrated geographical variation in ABO blood groups which permits the inference that the present data may very well represent a variation in the real population.

Because this conclusion may appear to be in defiance of the argument made in Chapter 4 against belief in the results of

Table 5.5 Isle of Wight blood donors:
subdivision by "ancestry"

ABO	Mainland	IW	
A	.408	.506	
B	.086	.071	
AB	.037	.026	
O	.469	.397	
	n = 561	n = 156	$\chi^2_3 = 4.935$, $P > .05$

A versus the rest	Mainland	IW	
A	.408	.506	
Not-A	.592	.494	
	n = 561	n = 156	$\chi^2_1 = 4.412$, $.05 > P > .03$

O versus the rest	Mainland	IW	
O	.469	.397	
Not-O	.531	.603	
	n = 561	n = 156	$\chi^2_1 = 2.229$, $P > .05$

MN	Mainland	IW	
M	.333	.321	
MN	.480	.470	
N	.188	.209	
	n = 469	n = 134	$\chi^2_2 = 0.310$, $P > .05$

Ss	Mainland	IW	
S+	.481	.421	
S-	.519	.579	
	n = 430	n = 126	$\chi^2_1 = 1.445$, $P > .05$

Rhesus D locus	Mainland	IW	
D+	.750	.795	
D-	.250	.205	
	n = 560	n = 156	$\chi^2_1 = 1.111$, $P > .05$

Table 5.5 continued

Duffy	Mainland	IW	
Fy^a+	.611	.593	
Fy^a-	.389	.407	
	n = 437	n = 123	$\chi^2_1 = 0.123$, $P > .05$

Kell	Mainland	IW	
K+	.069	.046	
K-	.931	.954	
	n = 390	n = 108	$\chi^2_1 = 0.740$, $P > .05$

Haptoglobin	Mainland	IW	
HP 1-1	.145	.184	
2-1	.468	.382	
2-2	.387	.434	
	n = 545	n = 152	$\chi^2_2 = 3.827$, $P > .05$

Transferrin	Mainland	IW	
Tf C	.980	.994	
Other	.020	.006	
	n = 553	n = 155	$\chi^2_1 = 0.630$, $P > .05$

Acid Phosphatase		Mainland	IW	
AP	AA	.143	.112	
	BA	.424	.414	
	BB	.361	.375	
CB, CA,	CC	.072	.099	
		n = 538	n = 152	$\chi^2_3 = 1.982$, $P > .05$

Adenylate Kinase	Mainland	IW	
AK 1-1	.931	.903	
2-1, 2-2	.069	.097	
	n = 506	n = 145	$\chi^2_1 = 0.853$, $P > .05$

Table 5.5 continued

Esterase D	Mainland	IW	
ESD 1-1	.823	.762	
2-1, 2-2	.177	.238	
	n = 541	n = 151	$\chi^2_1 = 2.461$, $P > .05$

Phosphoglucomutase	Mainland	IW	
PGM 1-1	.650	.634	
2-1	.285	.295	
2-2	.066	.071	
	n = 411	n = 112	$\chi^2_2 = 0.107$, $P > .05$

the procedure applied above, some evidence in support of the ABO system's claimed exemption from those strictures had better be given now. The discussion in Chapter 4 speculated that if genetic markers were directly associated with migration, age or social class, then apparent differences between "natives" and "immigrants" might not be due simply to differences in geographical origin. The evidence that ABO frequencies are not so ambiguous is provided by the much more detailed knowledge of their distribution even on a local scale (Kopeć, 1970), as well as by the great strength of their variation relative to most other marker systems.

In particular, there is evidence (obtained by the "surname method" of identifying ancestral origins) that the extremes of geographical variation observed throughout the British Isles are preserved even within mixed populations containing one (Fisher and Vaughan, 1939) or several (Hatt and Parsons, 1965) emigrant groups. This indicates that the ancestral component in gene frequency determination at least outweighs any alleged migrational component.

Additionally, in the present survey the direction of ABO variation is towards a higher proportion of blood group A among the Islanders and a lower among the Overners; among Anglesey blood donors the opposite tendency is observed (Smith, 1980). These contrasting results can be reconciled much more plausibly by assuming genetic variation to be due to ancestral origin and subsequently eroded by migration, than by assuming a direct relationship between migration and ABO genes.

CHAPTER SIX THE INFLUENCE OF MIGRATION ON GENETIC VARIATION

I Introduction

In this chapter genetic and demographic variation within the survey region will be examined. The best thing about this analysis is that the matrix technique employed allows a comparison between observed genetic variation and predicted variation based on migration within the survey region.

II Migration

(a) Introduction

The paper upon which this work is chiefly based is by Hiorns, Harrison and Boyce (1969). Approaches to the same topic have been made by several authors; Bodmer and Cavalli-Sforza (1968), Smith (1969) and Cavalli-Sforza and Bodmer (1971) extend the theory to take account of random genetic differentiation, while Kendall (1971a, b) uses matrices based on Anglican marriage registers or, in general, on any "odd bits of information" to generate "maps" by means of Kruskal's multi-dimensional scaling algorithm (Kruskal, 1964, 1971).

Although Hiorns et al.'s approach is one of the least sophisticated it has two things in its favour: firstly, the same authors have complemented their work on migration with a study of genetic variation; secondly, other workers have used the demographic model as a guide, with the result that there are at least four sets of data produced by the same method.

In their 1969 paper, Hiorns et al. use Anglican parish records of marriage to provide the raw data: "The marriage exchanges between every pair of populations are depicted by a square stochastic matrix M of order N, the number of populations, with elements m_{ij} representing the probability that a marriage settling into population i comprises one partner from population j; the other partner here is assumed to originate in population i. The elements m_{ii} will then be the endogamy rates and m_{ij} for $i \neq j$ will be exogamy rates. It will be convenient to define the effective exchange rates, p_{ij}, to represent the proportion of individuals in population i who, prior to their marriages, belonged to population j. These exchange rates comprise a square stochastic matrix P of order N." The raw data used in the present survey are derived from the living rather than the historical populations, and are drawn from individual birthplaces and residence places rather than from marriages. Thus each element of the matrix M here is the number of people living in i who were born in j, and the matrix P is obtained by dividing each element of M by the row total, giving the proportion of people living in i who were born in j. Migration from without the survey region can be accommodated in matrices M and P by including a column vector or vectors which represent the "outside world". Whilst P describes the transition frequencies in one generation, a matrix $A_{(n)}$ has elements A_{ij} which describe the proportion of ancestors of the present population i derived from the founder population of j. For rigour the populations are considered to have no common ancestors at foundation, that is $A_{(o)} = I$.

The ancestor frequencies after one generation of migration at the observed level are given by $A_{(1)} = PA_{(o)}$, and in general by $A_{(n)} = PA_{(n-1)}$.

In terms of original ancestor frequencies, $A_{(n)} = P^n(A_o)$.

The degree of ancestral relationship between a pair of populations is given by the triangular matrix R, in whose elements r_{ij} is computed the proportion of their ancestry which populations i and j share. Thus $r_{ij} = \sum_{s=1}^{N} \min.(a_{is}, a_{js})$.

With each generation of migration the relatedness between populations increases. The authors reckon that $r_{ij} \geqslant 0.95$ is sufficient to consider a pair of populations homogenous. They compute a further triangular matrix, say H, which comprises the number of generations of migration required for pairs of populations to become homogenous.

The advantage of this procedure over the various formal mathematical models of migration is that it predicts relationships between communities based on observed rather than idealised regimes of migration. However, even though unnecessary approximation is avoided the technique is proof against neither bad data nor misapplication; indeed, the algorithm's occult power to produce a result whatever the data can induce complacency. In the work on Otmoor, the inexact analogy between marriage registration and the movement of genes per generation is a drawback. In the present work a similar deficiency may be observed: if the matrix P is used to give a generation's movement, then the distance between an adult's birthplace and place of residence is clearly an underestimate. A tabulation of birthplace of parent against birthplace of child would be preferable. The choice of the former strategy made here is a compromise forced by the number of birthplace-residence data exceeding that of parent-offspring birthplace movement; the bias in the estimate of movement is preferred to the sampling errors which would be introduced by using smaller cell totals.

(b) Subdivision of the survey area

It is easy to introduce errors at this stage, either by drawing boundaries of population in the wrong place, or by creating too many or too few local populations. Again, the first compromise is between subdivisions of the Isle of Wight into "natural" communities on the one hand, and amalgamation to keep cell frequencies high, on the other. As it happens, the population of the Isle of Wight is focused into a few principal towns (or groups of towns), which each also dominates its own surrounding countryside. This means that partitioning into less than a dozen regions looks quite possible on inspection of the Ordnance Survey map.

A more rigorous subdivision can be made by starting with the smallest recorded population units and clustering them according to the migrants they exchange, building up regions until they are of a convenient size (Dennis and Williams, 1979), but I have chosen not to do this, preferring to use my "local knowledge", I think for the only time in this work, explicitly as a short cut to subdivision of the Island. The areas defined in this way will be described in more detail below. Of other potentially informative recipes for subdivision, ecclesiastical parishes are of little use as they were defined when the distribution of the Island's population was markedly different from today; and administrative divisions, though modern, are bewilderingly idiosyncratic. The second method of partition used here is that employed by Kopeć (1970). This has the merit of dividing the Island into five units each of reasonable population size but is not particularly interesting demographically; it makes only the broadest separation of communities and populations, losing detail which is at the least interesting and at the most essential. Its real relevance is, of course, the independent genetic context established by Kopeć, and this is its justification. For convenience, then, we shall say that the Island is divided either into "areas", which are the units of population I have designated, or into "Kopeć's regions". The areas are shown in Figure 6.1, Kopeć's regions in Figure 6.2, and Table 6.1 is a key to named settlements within each subdivision. The least satisfactory aspect of the division into areas is the difference in kind between West Wight, with its widely scattered population, and the others, each of which has a much sharper focus of settlement. Additional trouble comes from Yarmouth and Wootton. Both yield small samples and for that reason are best lumped in with other regions. Whilst Yarmouth combines appropriately with West Wight, the allocation of Wootton to either Ryde or Newport is unsatisfactory, although these are its nearest geographical (and migrational) neighbours. To consign it to one alone denies the strong claim of the other. In practice the matter is less important owing to the very small number of people

Figure 6.1 Isle of Wight partitioned into "areas"

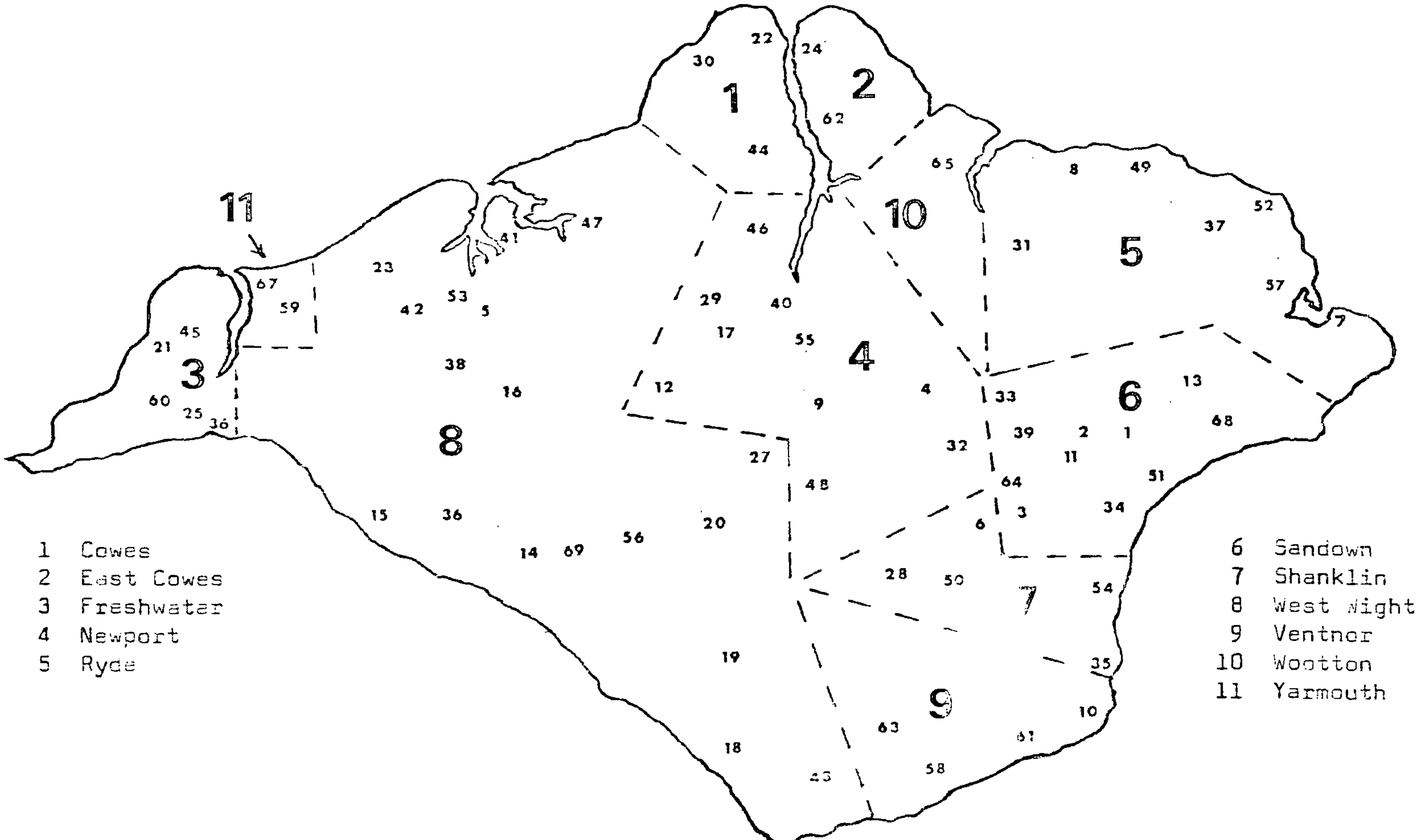


Figure 6.2 Isle of Wight partitioned into Kopeć's regions

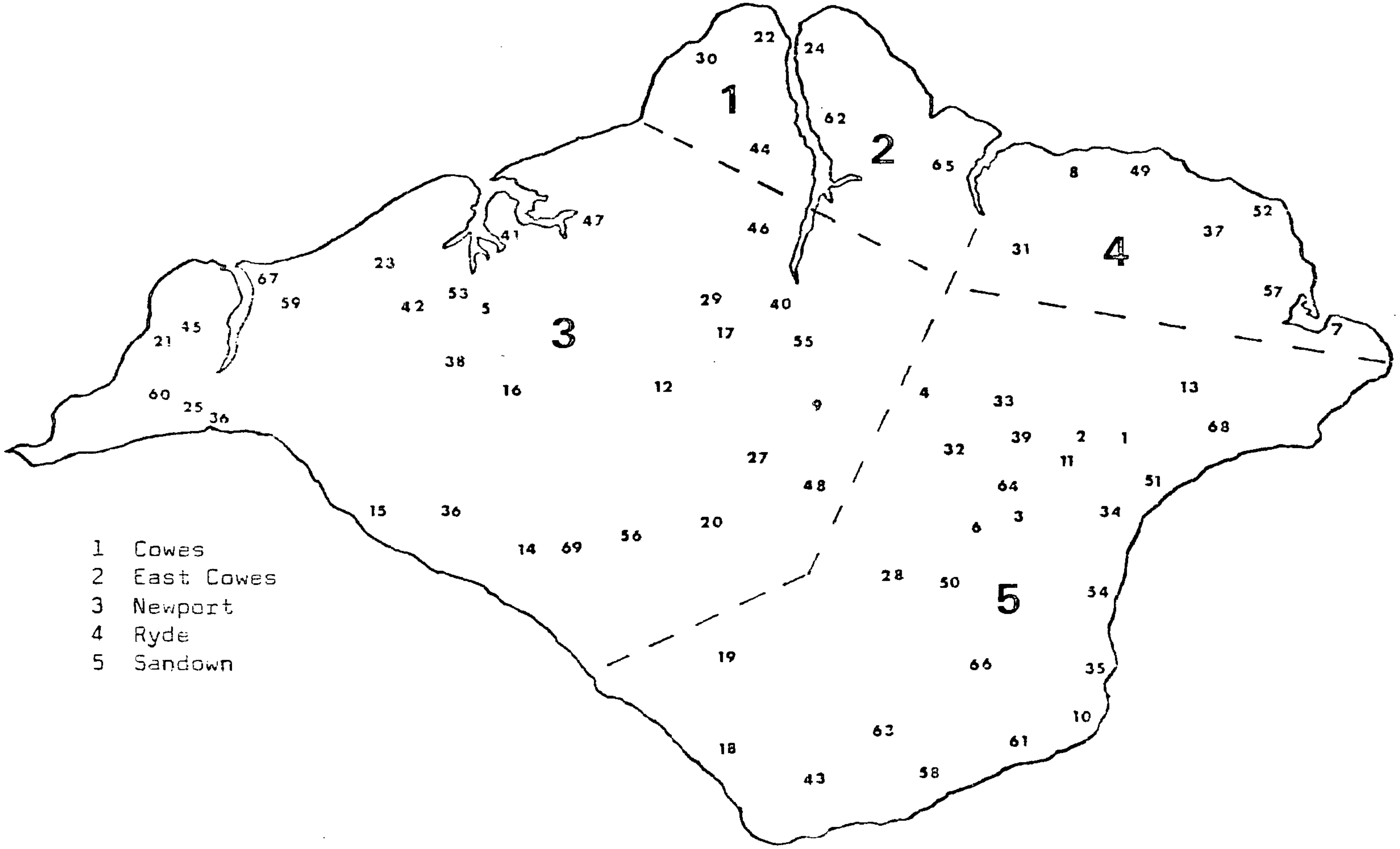


Table 6.1 Key to Isle of Wight localities

1	Adgestone
2	Alverstone
3	Apse Heath
4	Arreton
5	Bartons Corner
6	Bathingbourne
7	Bembridge
8	Binstead
9	Blackwater
10	Bonchurch
11	Borthwood
12	Bowcombe
13	Brading
14	Brighstone
15	Brook
16	Calbourne
17	Carisbrooke
18	Chale
19	Chale Green
20	Chillerton
21	Colwell
22	Cowes
23	Cranmore
24	East Cowes
25	Freshwater
26	Freshwater Bay
27	Gatcombe
28	Godshill
29	Gunville
30	Gurnard
31	Havenstreet
32	Horringford
33	Knighton
34	Lake
35	Luccombe

Table 6.1 continued

36	Mottistone
37	Nettlestone
38	Newbridge
39	Newchurch
40	Newport
41	Newtown
42	Ningwood
43	Niton
44	Northwood
45	Norton Green
46	Parkhurst
47	Porchfield
48	Rookley
49	Ryde
50	Sandford
51	Sandown
52	Seaview
53	Shalfleet
54	Shanklin
55	Shide
56	Shorwell
57	St. Helens
58	St. Lawrence
59	Thorley
60	Totland
61	Ventnor
62	Whippingham
63	Whitwell
64	Winford
65	Wootton
66	Wroxall
67	Yarmouth
68	Yaverland
69	Limerstone

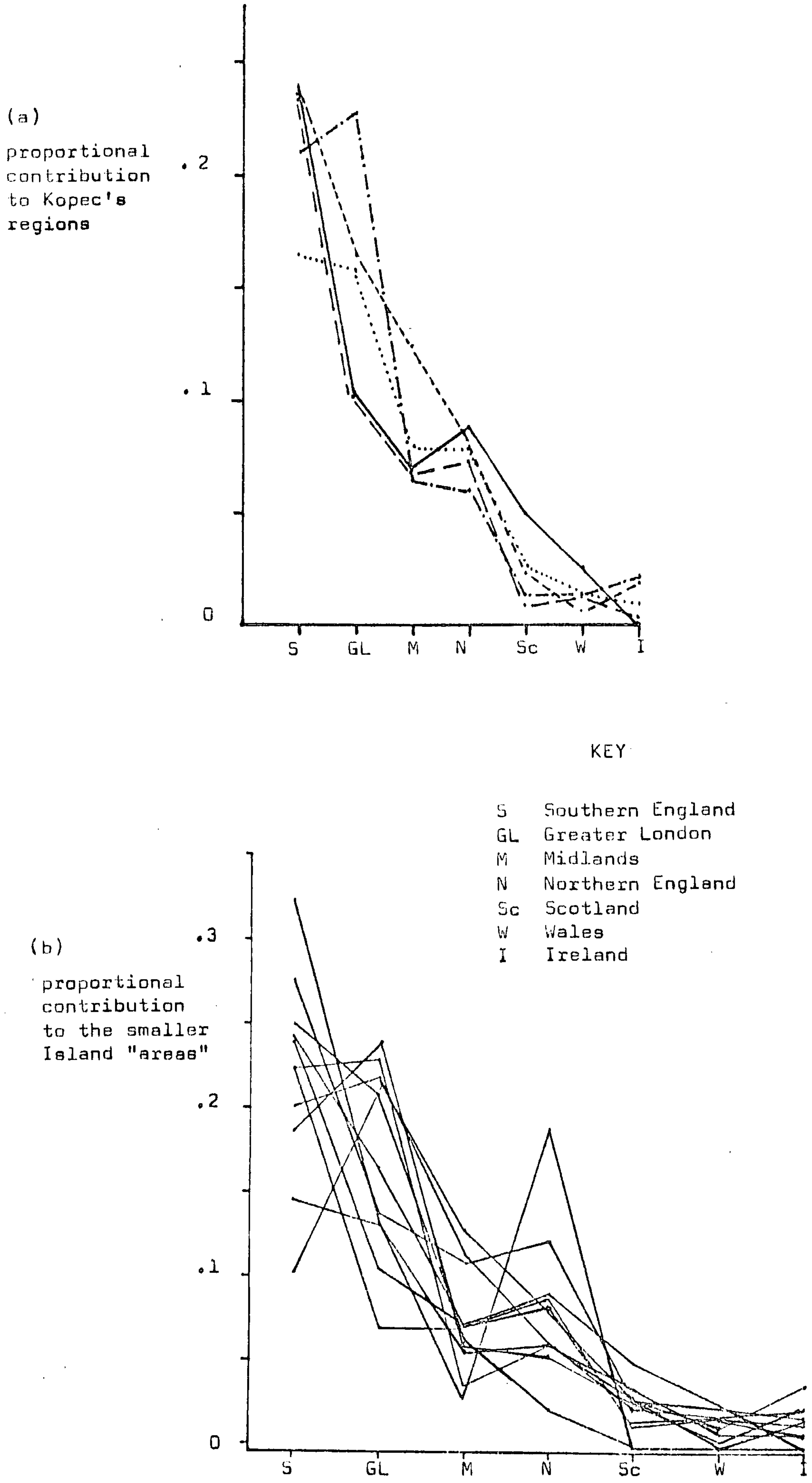
involved, so Wootton's eventual amalgamation with Newport may be seen as not much more than a book-keeping exercise.

The number of people in either the areas or Kopeć's regions has been computed by pooling data of much finer resolution with which the blood donors originally stated their places of birth or residence (Table 6.1). In each system (areas or Kopeć's regions) the regions were conceived first, and constituted "from the top down" rather than "from the bottom up". Whilst in the case of Kopeć's regions boundaries were read from the map without much difficulty, in making the areas, marginal settlements were allocated by answering the question, "does settlement A belong more to region S or region T?" As in the question of Wootton's affiliation (above) marginals were decided by a "first past the post" system rather than by proportional representation, which would have resulted in tedious subdivisions of (usually) very small numbers of people.

(c) Treatment of the outside world

Whether or not the outside world can be considered genetically homogeneous seems to be rather important when, as here, immigrants comprise a lot of the resident population. Were immigration low, on the other hand, the incomers would probably be pooled for the sake of sample size. If each region within the Island receives immigrants from much the same places on the mainland and in more or less equivalent proportions, then the problem is less important. In a rough attempt to assess this the proportions of immigrants to each region of the Isle of Wight from each of the other areas of Britain (defined in Chapter 4) have been plotted in Figure 6.3. Inspection of this suggests at least that immigration tends to decrease rather than to increase genetic differentiation within the Island. This being the case, pooling the regions of the outside world to a single column vector should speed up the Island's approach to homogeneity, but will not misrepresent its direction. Keeping the outside world regions separate will defer the attainment of homogeneity because these regions are assumed to exchange no migrants among themselves. Another way of considering this problem is to use the small number of divisions produced by Kopeć as a convenient model with which to examine the effects of treating immigration as genetically homogeneous. Comparison will be made between the outside world considered as a single vector, or considered as a group of genetically distinct populations, each contributing to the Isle of Wight's population but not exchanging migrants among themselves.

Figure 6.3 Immigration to the Isle of Wight



(d) Results

Movement of the Isle of Wight residents has been examined in a number of ways:

(i) the Island is divided into areas or into Kopeć's regions;

(ii) using Kopeć's regions, the outside world is subdivided or pooled to a single vector;

(iii) the outside world is excluded from consideration or is considered as a single vector in order to compare the relative importance of internal migration and immigration in bringing about genetic homogeneity of the population (after Hiorns _et al._, 1969).

The migration matrices used are based on the movement of blood donors and their spouses from birthplace to present residence. In computing this information one of each married couple of blood donors was randomly excluded. Table 6.2 shows the numbers of donors and spouses resident in each area, subdivided by their birthplace in each area or region of the outside world. Table 6.3 likewise demonstrates the partition into Kopeć's regions. These tabulations are equivalent to Hiorns _et al._'s matrices M.

Table 6.2 Blood donors and spouses:
birthplace and residence with Island divided into areas.
Raw data

Birthplace / Residence	Isle of Wight											Mainland Regions							Total	Out-side world Total	Isle of Wight Total
	Cowes	East Cowes	Freshwater	Newport	Ryde	Sandown	Shanklin	West Wight	Ventnor	Wootton	Yarmouth	South	London	Midlands	North	Wales	Scotland	Ireland			
Cowes	50	9	1	21	4	3	0	1	0	2	1	53	23	16	20	11	6	0	221	129	92
East Cowes	29	31	0	18	5	1	0	1	1	2	0	39	12	12	15	2	3	1	172	84	88
Freshwater	2	1	44	11	3	1	2	4	1	2	4	21	44	26	17	5	5	4	197	122	75
Newport	9	3	4	139	16	3	7	7	3	2	0	52	46	20	21	9	1	8	350	157	193
Ryde	11	1	2	15	122	7	5	0	1	4	0	104	71	31	36	6	7	6	429	261	168
Sandown	5	2	0	8	14	40	13	3	3	2	0	42	54	13	12	5	4	5	225	135	90
Shanklin	2	0	0	4	5	16	26	1	7	0	0	37	38	6	10	5	2	6	165	104	61
West Wight	1	1	0	6	2	0	0	10	0	0	0	18	9	7	8	2	0	1	65	45	20
Ventnor	1	0	0	4	1	2	0	2	30	0	0	23	25	13	7	4	1	1	114	74	40
Wootton	2	1	0	8	5	1	0	0	1	4	0	12	10	3	1	0	0	0	48	26	22
Yarmouth	0	0	2	2	0	0	1	1	2	0	4	12	5	1	7	0	0	0	37	25	12

n = 2 033

Table 6.3 Blood donors and spouses:
birthplace and residence with Island divided into Kopeć's regions.
Raw data

Birthplace / Residence	Isle of Wight					Mainland Regions							Total	Out-side World Total	Isle of Wight Total
	Cowes	East Cowes	Newport	Ryde	Sandown	South	London	Midlands	North	Wales	Scotland	Ireland			
Cowes	50	11	24	4	3	53	23	16	20	11	6	0	221	129	92
East Cowes	31	38	27	10	4	51	22	15	16	2	3	1	220	110	110
Newport	12	9	230	21	23	105	101	51	50	16	5	13	636	341	295
Ryde	11	5	17	122	13	104	71	31	36	6	7	6	429	261	168
Sandown	8	4	22	20	142	110	120	35	32	14	8	12	527	331	196

n = 2 033

The effective exchange matrices, P, are derived by dividing individual cell frequencies by their row total. After one generation of migration the ancestor frequencies matrix (A_1) is identical to the effective exchange matrix (P), and from this the relatedness matrix R has been calculated. The iteration $A_{(n)} = P.A_{(n)}$ was made by a private FORTRAN program MIGR (see Appendix IV) until the matrix H (of generations of migration required to achieve homogeneity between pairs of populations) could be completed.

The procedures of the previous paragraph were repeated, and the matrices P, R and H are tabulated, for the combinations set out below:

(i) the Island divided into Kopeć's regions, considering immigration from a subdivided outside world, Table 6.4;

(ii) the Island divided into Kopeć's regions with immigration pooled to a single vector, Table 6.5;

(iii) the Island divided into Kopeć's regions with immigration excluded from consideration, Table 6.6.

(iv) the Island divided into areas, with immigration pooled to a single vector, Table 6.7;

(v) the Island divided into areas with immigration excluded from consideration, Table 6.8;

Table 6.4 Blood donors and spouses:
matrices P, R and H. Island divided into Kopec's regions,
with the outside world subdivided

	Isle of Wight					Mainland Regions						
	Cowes	East Cowes	Newport	Ryde	Sandown	South	London	Midlands	North	Wales	Scotland	Ireland
Cowes	.2262	.0498	.1086	.1081	.0136	.2398	.1041	.0723	.0905	.0498	.0272	.0000
East Cowes	.1409	.1727	.1227	.1455	.0182	.2318	.1000	.0682	.0727	.0091	.0136	.0046
Newport	.0189	.0142	.3616	.0330	.0362	.1651	.1588	.0802	.0786	.0251	.0079	.0204
Ryde	.0256	.0117	.0396	.2844	.0303	.2424	.1655	.0723	.0839	.0140	.0163	.0140
Sandown	.0152	.0076	.0417	.0380	.2694	.2086	.2276	.0663	.0606	.0265	.0158	.0227
South	.0000	.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000	.0000	.0000	.0000
London	.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000	.0000	.0000
Midlands	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000	.0000
North	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000
Wales	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.000	.0000	.0000
Scotland	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000
Ireland	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000

Cowes		.854	.641	.729	.598
East Cowes	3		.653	.641	.583
Newport	3	4		.644	.638
Ryde	4	3	4		.675
	3	4	3	4	

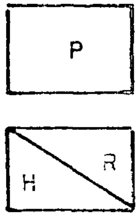


Table 6.5 Blood donors and spouses: matrices P, R and H. Island divided into Kopeć's regions with immigration pooled

	Cowes	East Cowes	Newport	Ryde	Sandown	Outside World
Cowes	.2262	.0498	.1086	.0181	.0136	.5837
East Cowes	.1409	.1727	.1227	.0455	.0182	.5000
Newport	.0189	.0142	.3616	.0330	.0362	.5361
Ryde	.0256	.0117	.0396	.2844	.0303	.6084
Sandown	.0152	.0076	.0417	.0380	.2694	.6281
Outside World	.0000	.0000	.0000	.0000	.0000	1.0000
Cowes		.831	.709	.692	.680	
East Cowes	1		.707	.641	.621	
Newport	2	2		.670	.670	
Ryde	2	2	2		.739	
Sandown	2	3	2	2		

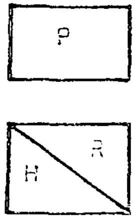


Table 6.6 Blood donors and spouses: matrices P, R and H. Island divided into Kopeć's regions with immigration excluded

	Cowes	East Cowes	Newport	Ryde	Sandown
Cowes	.5435	.1195	.2609	.0435	.0326
East Cowes	.2818	.3455	.2454	.0909	.0364
Newport	.0407	.0305	.7797	.0712	.0779
Ryde	.0655	.0297	.1012	.7262	.0774
Sandown	.0408	.0204	.1122	.1021	.7245
Cowes		.723	.408	.272	.249
East Cowes	3		.424	.324	.301
Newport	6	6		.320	.322
Ryde	9	8	8		.342
Sandown	9	9	8	7	

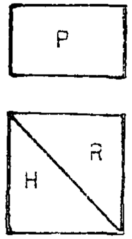
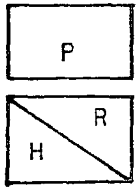


Table 6.7 Blood donors and spouses:
matrices P, R and H. Island divided into areas with immigration pooled

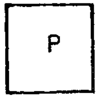
	C	EC	F	N	R	S	SH	WW	V	W	Y	OW
Cowes	.2263	.0407	.0045	.0950	.0181	.0136	.0000	.0045	.0000	.0091	.0045	.5837
East Cowes	.1686	.1802	.0000	.1047	.0291	.0058	.0000	.0058	.0058	.0116	.0000	.4884
Freshwater	.0101	.0051	.2233	.0558	.0152	.0051	.0102	.0203	.0051	.0102	.0203	.6193
Newport	.0257	.0086	.0114	.3971	.0457	.0086	.0200	.0200	.0086	.0057	.0000	.4486
Ryde	.0256	.0023	.0047	.0350	.2844	.0163	.0117	.0000	.0023	.0093	.0000	.6084
Sandown	.0222	.0089	.0000	.0356	.0622	.1778	.0576	.0133	.0133	.0089	.0000	.6000
Shanklin	.0121	.0000	.0000	.0242	.0303	.0970	.1576	.0061	.0424	.0000	.0000	.6303
West Wight	.0154	.0154	.0000	.0923	.0308	.0000	.0000	.1538	.0000	.0000	.0000	.6923
Ventnor	.0088	.0000	.0000	.0351	.0088	.0175	.0000	.0175	.2632	.0000	.0000	.6491
Wootton	.0417	.0208	.0000	.1667	.1042	.0208	.0000	.0000	.0208	.0833	.0000	.5417
Yarmouth	.0000	.0000	.0541	.0541	.0000	.0000	.0270	.0270	.0541	.0000	.1081	.6756
Outside World	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000



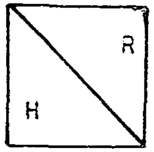
	C	EC	F	N	R	S	SH	WW	V	W	Y
Cowes		.830	.698	.619	.692	.695	.656	.729	.654	.740	.651
East Cowes	3		.601	.640	.598	.610	.571	.646	.558	.708	.554
Freshwater	3	4		.592	.703	.709	.695	.726	.700	.648	.783
Newport	4	3	4		.590	.617	.558	.616	.536	.718	.563
Ryde	3	4	3	4		.761	.705	.692	.680	.737	.662
Sandown	3	4	3	4	3		.841	.704	.697	.714	.689
Shanklin	3	4	3	4	3	3		.703	.738	.650	.730
West Wight	3	4	3	4	3	3	3		.719	.696	.757
Ventnor	4	4	3	4	3	3	3	3		.633	.756
Wootton	3	3	3	3	3	3	4	3	4		.617
Yarmouth	3	4	3	4	3	3	3	3	3	4	

Table 6.8 Blood donors and spouses:
matrices P, R and H
Island divided into areas, with immigration excluded

	C	EC	F	N	R	S	SH	WW	V	W	Y
Cowes	.5435	.0978	.0109	.2283	.0435	.0326	.0000	.0109	.0000	.0217	.0108
East Cowes	.3295	.3523	.0000	.2045	.0568	.0114	.0000	.0114	.0114	.0227	.0000
Freshwater	.0267	.0133	.5867	.1467	.0400	.0133	.0267	.0533	.0133	.0267	.0533
Newport	.0466	.0155	.0207	.7202	.0829	.0155	.0363	.0363	.0155	.0105	.0000
Ryde	.0655	.0060	.0119	.0893	.7262	.0417	.0298	.0000	.0060	.0238	.0000
Sandown	.0556	.0223	.0000	.0889	.1556	.4444	.1444	.0333	.0333	.0222	.0000
Shanklin	.0328	.0000	.0000	.0656	.0810	.2623	.4262	.0164	.1147	.0000	.0000
West Wight	.0500	.0500	.0000	.3000	.1000	.0000	.0000	.5000	.0000	.0000	.0000
Ventnor	.0250	.0000	.0000	.1000	.0250	.0500	.0000	.0500	.7500	.0000	.0000
Wootton	.0909	.0455	.0000	.3636	.2273	.0455	.0000	.0000	.0454	.1818	.0000
Yarmouth	.0000	.0000	.1667	.1667	.0000	.0000	.0833	.0833	.1667	.0000	.3333



	C	EC	F	N	R	S	SH	WW	V	W	Y
Cowes		.719	.294	.382	.269	.275	.185	.383	.193	.462	.199
East Cowes	3		.284	.368	.258	.280	.189	.373	.184	.443	.189
Freshwater	8	8		.347	.244	.278	.202	.280	.227	.280	.460
Newport	6	6	7		.298	.345	.263	.481	.217	.550	.275
Ryde	9	9	9	8		.406	.257	.245	.187	.460	.137
Sandown	9	9	9	8	7		.636	.294	.255	.423	.239
Shanklin	10	10	9	9	9	6		.195	.297	.270	.280
West Wight	6	6	8	5	8	8	9		.200	.496	.250
Ventnor	11	11	10	10	11	10	9	11		.241	.317
Wootton	7	7	8	6	7	7	8	7	10		.212
Yarmouth	9	9	7	8	10	9	8	9	8	9	



(vi) the Island divided into areas, with Wootton incorporated into Newport, and Yarmouth into West Wight, with immigration pooled to a single vector, Table 6.9;

(vii) the Island divided as in (vi), with immigration excluded from consideration, Table 6.10.

(e) Discussion

(i) Exclusion of the outside world, subdivision of the survey region, and the approach to homogeneity

Inspection of the homogeneity matrices in Tables 6.5 to 6.10 shows clearly the important effect of immigration in decreasing the genetic diversity between communities. Without looking at the fine variation within the homogeneity matrices we can see that in the case of Kopeć's regions it takes three or four times as long, and in the case of the areas two or three times as long, to achieve 95% relatedness without the homogenising influence of immigration as it does with it.

The extent to which this decay of variation is exaggerated by wrongly considering the outside world to be homogeneous can be seen by comparing the Matrix H in Tables 6.4, 6.5 and 6.6, and in more detail by plotting the cell frequencies

Table 6.10 Blood donors and spouses:
matrices P, R and H
Island divided into modified areas, with immigration excluded

	C	EC	F	"N"	R	S	SH	"WW"	V
Cowes	.5435	.0978	.0109	.2500	.0435	.0326	.0000	.0217	.0000
East Cowes	.3295	.3523	.0000	.2273	.0568	.0114	.0000	.0114	.0113
Freshwater	.0267	.0133	.5867	.1733	.0400	.0133	.0267	.1067	.0133
"Newport"	.0512	.0186	.0186	.7116	.0977	.0186	.0326	.0325	.0186
Ryde	.0654	.0060	.0119	.1131	.7262	.0417	.0297	.0000	.0060
Sandown	.0556	.0222	.0000	.1111	.1556	.4444	.1444	.0334	.0333
Shanklin	.0328	.0000	.0000	.0656	.0820	.2623	.4262	.0164	.1147
"West Wight"	.0312	.0312	.0625	.2500	.0625	.0000	.0313	.4688	.0625
Ventnor	.0250	.0000	.0000	.1000	.0250	.0500	.0000	.0500	.7500

P

	C	EC	F	"N"	R	S	SH	"WW"	V
Cowes		.721	.299	.414	.271	.287	.191	.388	.204
East Cowes	3		.287	.368	.259	.280	.189	.369	.184
Freshwater	8	6		.358	.244	.278	.202	.462	.227
"Newport"	7	7	7		.334	.381	.267	.463	.220
Ryde	9	9	9	8		.406	.258	.260	.198
Sandown	9	9	8	7	7		.637	.325	.367
Shanklin	9	9	9	8	9	6		.269	.297
"West Wight"	7	8	6	6	9	8	8		.262
Ventnor	11	11	10	11	11	10	9	10	

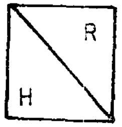
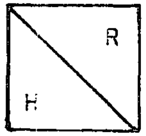


Table 6.9 Blood donors and spouses:
matrices P, R and H
Island divided into modified areas, with immigration pooled

	C	EC	F	"N"	R	S	SH	"WW"	V	OW
Cowes	.2263	.0407	.0045	.1041	.0181	.0136	.0000	.0090	.0000	.5837
East Cowes	.1686	.1802	.0000	.1163	.0291	.0058	.0000	.0058	.0058	.4884
Freshwater	.0101	.0051	.2233	.0660	.0152	.0051	.0102	.0406	.0051	.6193
"Newport"	.0276	.0101	.0101	.3844	.0528	.0100	.0176	.0176	.0100	.4598
Ryde	.0256	.0023	.0047	.0443	.2844	.0163	.0117	.0000	.0023	.6084
Sandown	.0222	.0089	.0000	.0445	.0622	.1778	.0578	.0133	.0133	.6000
Shanklin	.0121	.0000	.0000	.0242	.0303	.0970	.1576	.0061	.0424	.6303
"West Wight"	.0098	.0098	.0196	.0784	.0196	.0000	.0098	.1471	.0196	.6863
Ventnor	.0088	.0000	.0000	.0351	.0088	.0175	.0000	.0175	.2632	.6491
Outside World	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000

P

	C	EC	F	"N"	R	S	SH	"WW"	V
Cowes		.831	.699	.643	.692	.700	.658	.713	.659
East Cowes	3		.601	.660	.598	.610	.571	.618	.558
Freshwater	3	4		.604	.703	.709	.695	.790	.700
"Newport"	4	3	4		.613	.639	.570	.625	.550
Ryde	3	4	3	4		.761	.705	.701	.680
Sandown	3	4	3	4	3		.841	.719	.697
Shanklin	3	4	3	4	3	2		.719	.738
"West Wight"	3	4	2	4	3	3	3		.739
Ventnor	4	4	3	4	3	3	3	3	



of the matrices R in Tables 6.6 and 6.4 against those of R in Table 6.5. This is shown in Figures 6.4 and 6.5, where the only slight deviation of points from the positive diagonal in the case of Figure 6.5 suggests that the homogenising effect of immigration is not much overestimated when we consider the outside world as genetically uniform; it should be remembered that the sub-divided outside world envisaged without genetic exchange between the subdivisions underestimates immigration's homogenising influence.

Whilst the relative importance of immigration in the decay of genetic variation can readily be appreciated by this method within any one survey, comparison between surveys must be more tentative.

Tables 6.11 to 6.16 show some H matrices from the studies of the Otmoor parishes, some parishes around Pocklington in North Yorks, Greater Reading and the Isle of Wight. Broadly, we can see a distinction between the rural, historical parish populations and the larger and more mobile present-day ones, (and this is admittedly a pleasant confirmation of the predictable). More detailed comparison and evaluation beyond a crude ordering by population size and simplicity of the survey region, however, would seem to be precluded by our lack of knowledge of the behaviour of the measures under

Figure 6.4 Relatedness due to migration between Kopeć's regions (1)

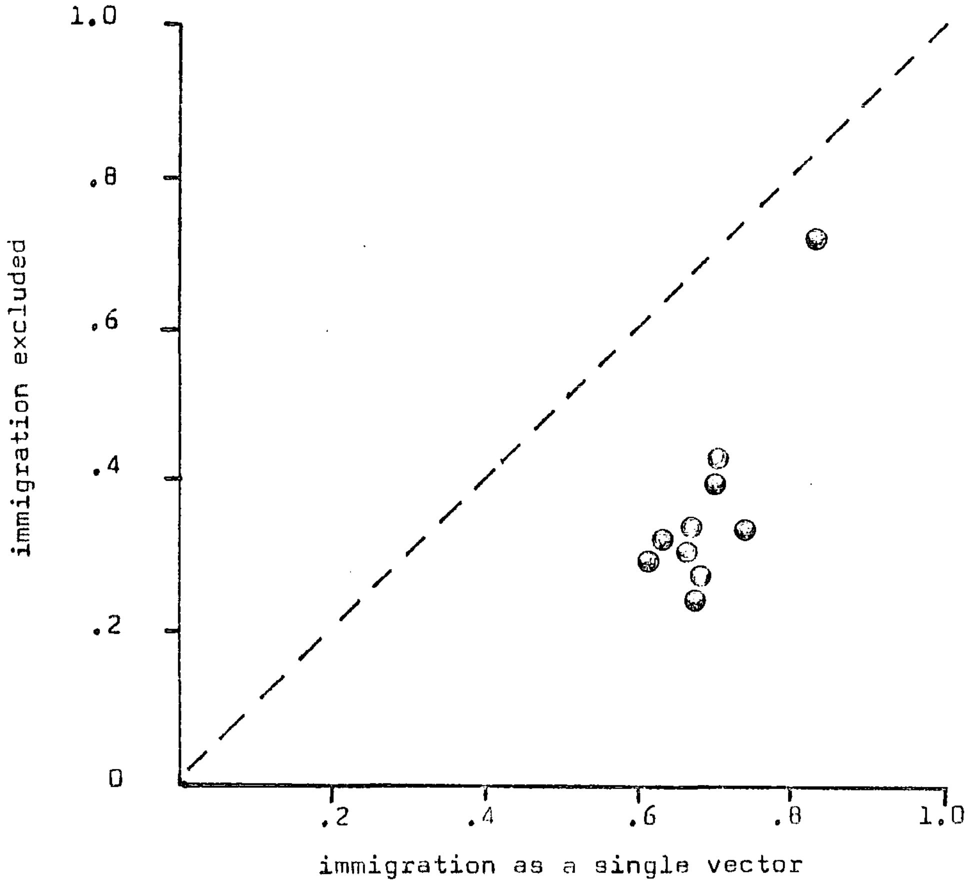


Figure 6.5 Relatedness due to migration between Kopeć's regions (2)

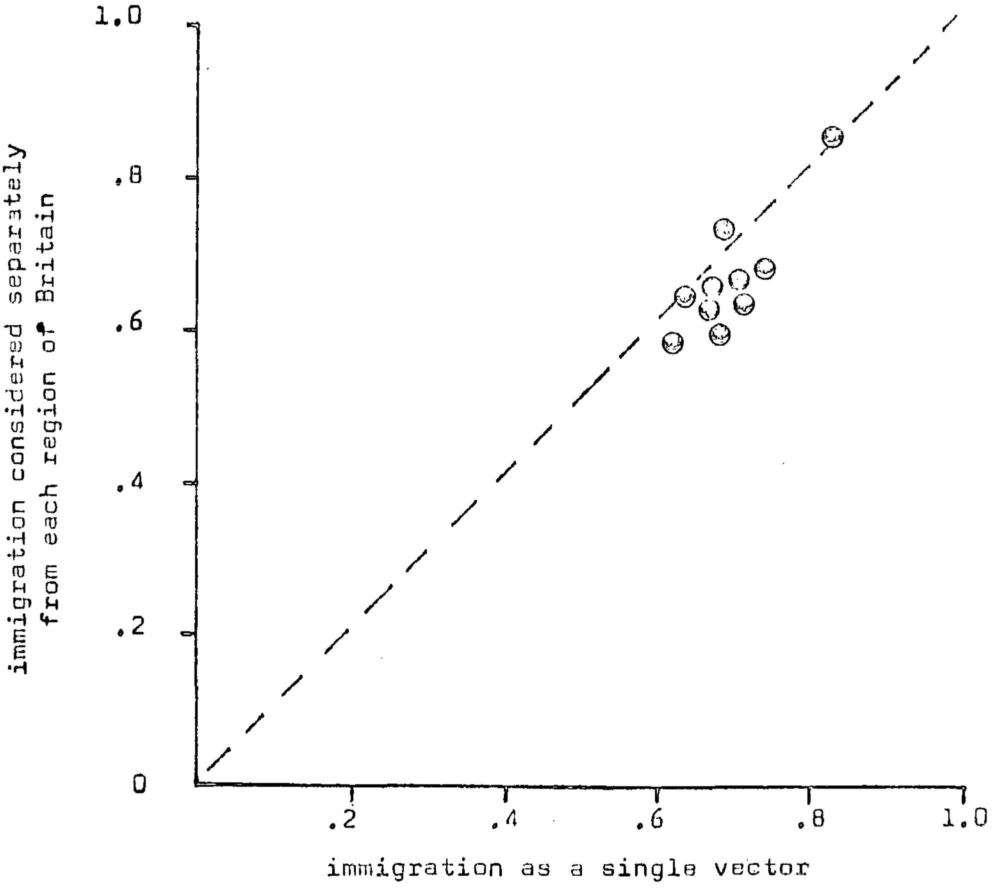


Table 6.11 Otmoor parishes prior to 1850:
Matrix H

Outside world excluded

	BHS	CFM	O	M	WS	WN	AAB	B
BHS								
CFM	100							
O	104	44						
M	112	60	60					
WS	142	133	128	127				
WN	115	68	66	38	123			
AAB	107	78	85	77	137	85		
B	96	85	82	88	128	89	99	

Outside world included

	BHS	CFM	O	M	WS	WN	AAB	B
BHS								
CFM	19							
O	19	15						
M	20	16	16					
WS	23	22	22	21				
WN	21	20	19	20	23			
AAB	20	19	19	19	23	19		
B	20	20	20	21	23	15	19	

from Hiorns *et al.* (1969)

Table 6.12 Otmoor parishes 1851 – 1966:
Matrix H

Outside world excluded

	BHS	CFM	O	M	WS	WN	AAB	B
BHS								
CFM	177							
O	181	16						
M	188	73	50					
WS	207	146	140	130				
WN	195	109	99	86	105			
AAB	192	93	73	31	124	80		
B	162	75	95	118	146	136	130	

Outside world included

	BHS	CFM	O	M	WS	WN	AAB	B
BHS								
CFM	11							
O	11	6						
M	10	10	9					
WS	10	11	10	10				
WN	10	11	11	9	9			
AAB	12	11	11	10	12	12		
B	9	9	10	8	10	9	11	

from Hiorns *et al.* (1969)

Table 6.13 Pocklington and surrounding parishes 1798 - 1844: Matrix H

Outside world included

	P	GG	M	KP	B	W	BW	T	H	Y	A
Pocklington											
Great Givendale	20										
Millington	18	16									
Kilnwick Percy	18	13	15								
Burnby	21	14	19	16							
Wilberfoss	22	14	20	17	15						
Bishop Wilton	20	12	18	15	14	13					
Thornton	22	23	23	23	23	23	23				
Hayton	19	15	17	15	16	18	16	22			
Yapham	20	10	17	14	13	13	10	23	15		
Allerthorpe	17	16	15	15	19	19	17	21	14	16	

Beyond the fact that no pair becomes homogenous after 10 generations, no information is available about the approach to homogeneity of these parishes when migration from the outside world is excluded.

from Constable (1980)

Table 6.14 Reading Survey area:
Matrix H

Outside world excluded

	C	T	S	W	E	Wo	Ca	Sh	Wi	Wok	Cr	Tw	H	So	G	P	B	Th
Centre																		
Tilehurst	3																	
Southcote	3	4																
Whitley	4	4	4															
Earley	4	4	5	5														
Woodley	6	7	7	6	6													
Caversham	4	4	5	4	5	6												
Shinfield	5	6	6	6	5	4	5											
Winnersh	5	6	6	6	4	6	6	5										
Wokingham	8	8	8	8	7	7	8	6	7									
Crowthorne	9	9	9	8	9	7	9	8	9	7								
Twyford	14	14	14	13	14	13	14	14	14	13	10							
Henley	15	15	15	14	15	14	15	14	15	14	13	10						
Sonning	9	9	9	8	9	7	8	8	9	9	8	10	13					
Goring	8	7	8	8	7	9	8	8	7	8	8	15	15	10				
Pangbourne	7	7	7	7	6	8	7	6	6	7	10	14	15	10	5			
Bradfield	6	5	6	6	5	8	6	5	5	8	10	14	15	10	6	5		
Theale	6	5	6	6	5	7	6	4	4	7	9	14	15	9	6	5	4	

Outside world included

	C	T	S	W	E	Wo	Ca	Sh	Wi	Wok	Cr	Tw	H	So	G	P	B	Th
Centre																		
Tilehurst	2																	
Southcote	3	3																
Whitley	4	5	4															
Earley	2	3	3	4														
Woodley	5	5	5	6	5													
Caversham	3	3	3	3	4	5												
Shinfield	3	3	4	5	3	4	4											
Winnersh	3	3	3	4	3	5	4	3										
Wokingham	4	4	5	5	4	4	5	4	4									
Crowthorne	4	4	5	6	4	4	5	3	4	3								
Twyford	5	5	5	6	5	4	5	5	5	4	4							
Henley	5	5	5	6	5	5	5	5	5	5	5	4						
Sonning	4	4	4	5	4	4	5	4	4	4	4	4	4					
Goring	4	4	4	5	4	5	4	4	4	4	5	5	5	4				
Pangbourne	3	4	4	4	4	6	4	4	4	5	5	6	6	5	4			
Bradfield	4	3	4	5	3	5	4	3	3	4	4	5	5	4	3	4		
Theale	4	4	5	5	4	4	5	3	4	3	3	4	5	4	4	5	4	

From Coleman (1980)

Table 6.15 Greater Reading:
Matrix H

Outside world excluded

	C	T	S	W	E	W
Centre						
Tilehurst	3					
Southcote	3	3				
Whitley	3	3	3			
Earley	2	3	3	3		
Woodley	2	3	3	3	3	
Caversham	3	3	3	3	3	3

Outside world included

	C	T	S	W	E	W
Centre						
Tilehurst	2					
Southcote	3	3				
Whitley	3	4	3			
Earley	2	2	4	4		
Woodley	4	4	5	5	4	
Caversham	2	2	3	3	3	5

from Coleman (1980)

Table 6.16 Isle of Wight areas: Matrix H

Outside world excluded

	C	EC	F	N	R	S	SH	WW	V	W	Y
Cowes											
East Cowes	3										
Freshwater	8	8									
Newport	6	6	7								
Ryde	9	9	9	8							
Sandown	9	9	9	8	7						
Shanklin	10	10	9	9	9	6					
West Wight	6	6	8	5	8	8	9				
Ventnor	11	11	10	10	11	10	9	11			
Wootton	7	7	8	6	7	7	8	7	10		
Yarmouth	9	9	7	8	10	9	8	9	8	9	

Outside world included

	C	EC	F	N	R	S	SH	WW	V	W	Y
Cowes											
East Cowes	3										
Freshwater	3	4									
Newport	4	3	4								
Ryde	3	4	3	4							
Sandown	3	4	3	4	3						
Shanklin	3	4	3	4	3	3					
West Wight	3	4	3	4	3	3	3				
Ventnor	4	4	3	4	3	3	3	3			
Wootton	3	3	3	3	3	3	4	3	4		
Yarmouth	3	4	3	4	3	3	3	3	3	4	

different conditions. Intuitively, the scale of the subdivision of the populations appears to be important, since this may produce proportionately very high or low numbers of migrants in a finely subdivided system with small population and, through the nature of the model, treat these as systematic variations in migration rather than as sampling effects.

Further than this generalisation, the circumstances of immigration peculiar to the survey region may be required to interpret the matrix (as by Coleman, 1980), and this must reduce the matrix's value to stand alone as a measure for comparison. At the moment, I do not feel that enough is known about the differences between the matrices obtained by respectively including and excluding the outside world from consideration for these to have precise values in either summarising or predicting migration patterns. However, the subject looks as though it will repay further investigation, including simulation studies.

In the context of the present survey we must be content that the measure demonstrates the importance of immigration in reducing genetic variability. On a wider scale there seems to be justification for two generalisations: firstly, the smaller the population units into which the survey area is divided, the slower will be the approach to homogeneity;

secondly, the more unequal the immigration into the survey subdivisions, the more slowly will genetic uniformity be achieved.

(ii) The relationship of migration to geographical distance

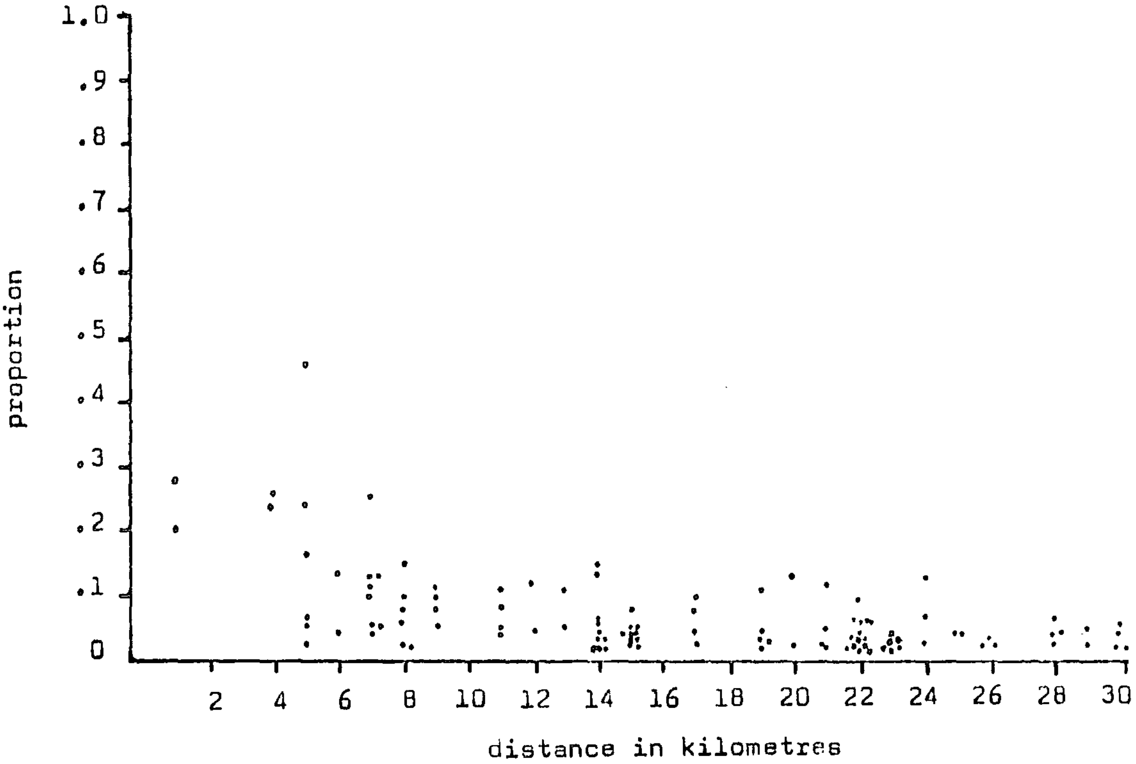
(1) Introduction

In many species the distribution of mating frequency with distance tends to be skewed towards the origin. Mathematical analogies to this observed distribution in man include gravitational and diffusional models (Cavalli-Sforza, 1958). Whilst there is considerable variation in the distribution of marital migration (Majumder, 1977) Cavalli-Sforza found the gravitational model described the observation in Europe of a high proportion of non-migrants rather better than the diffusional.

Although the relationship between age at marriage and distance between birthplaces of spouses fits well the idea of migration as a "random walk" (Cavalli-Sforza, 1962) the most plausible behavioural model of migration, the "neighbourhood knowledge" concept (Boyce, Küchemann and Harrison, 1967) is in effect closely related to the gravitational (Majumder, 1977). This behavioural model has provided a good fit to the data observed in the historical populations of Otmoor (Boyce, Küchemann and Harrison, 1968, 1971) and Deerfield, Mass. (Swedlund, 1972); for reasons which Fix (1974) explains, it is not so readily applied to villages of the Senoi Semai of Malaysia. The behaviour which is said to predicate migration in matrimony is short-term exploratory behaviour of the neighbourhood made from and returning to the home base. This is indeed plausible, though so far as I know the only study actually to have recorded such "visiting frequencies" is Fix's one of the Semai.

Some of the Isle of Wight data on migration from birthplace to residence can be plotted in a similar way to the figures in Küchemann, Boyce and Harrison (1967), Swedlund (1972) and Fix (1974), which show the proportion of the population of surrounding villages who move as mates to Charlton, Deerfield or Satak respectively. The difference between the present figures and theirs is that the latter contain information about the contributions from several places to one central place only whereas the Island data combine the effects of regarding each place in turn as the central place. Figure 6.6 shows the proportion of the population born in town X resident at some distance from X. According to the observed convention, only migrants are considered. Inspection shows this plot to describe the

Figure 6.6 Proportion of population born in X resident at some distance from X



characteristic curve, though with perhaps more cases of low migration between close villages than is commonly observed. If large settlements act as more powerful magnets to immigrants than small ones then to consider only a single settlement as the goal of migration might bias generalisation. Among the published material Charlton is not larger than its surrounding villages, Satak is, and Deerfield does not say.

Figure 6.7 shows the effect of considering only movements from a smaller place to a larger. This, of course, halves the number of points in the plot, but it also sharpens the curve near the origin by eliminating seven points at 5, 6 and 7 kilometers distance, where the proportional contribution from a larger population to a smaller was very low (less than 0.05). This comparison demonstrates the bias whose occurrence was originally suspected in any study centred on the largest community of a region. We might reasonably eliminate this by somehow pooling the reciprocal contributions between pairs of settlements. Figure 6.8 plots on the vertical axis the number of migrants from A to B plus the number from B to A, divided by the combined number sampled from the resident populations of A and B; the horizontal axis is again distance. This seems to give as clear an inverse relationship with distance as any of

Figure 6.7 Proportion of population born in X resident in a larger town at some distance from X

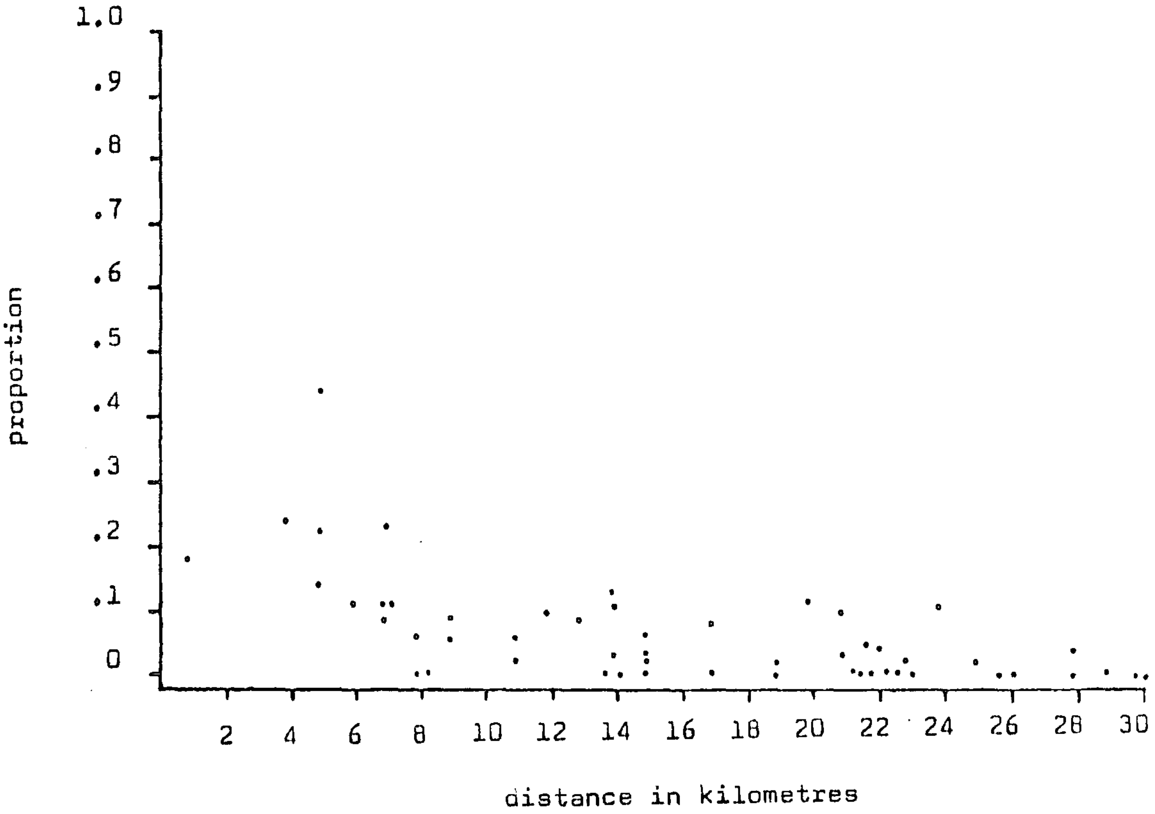
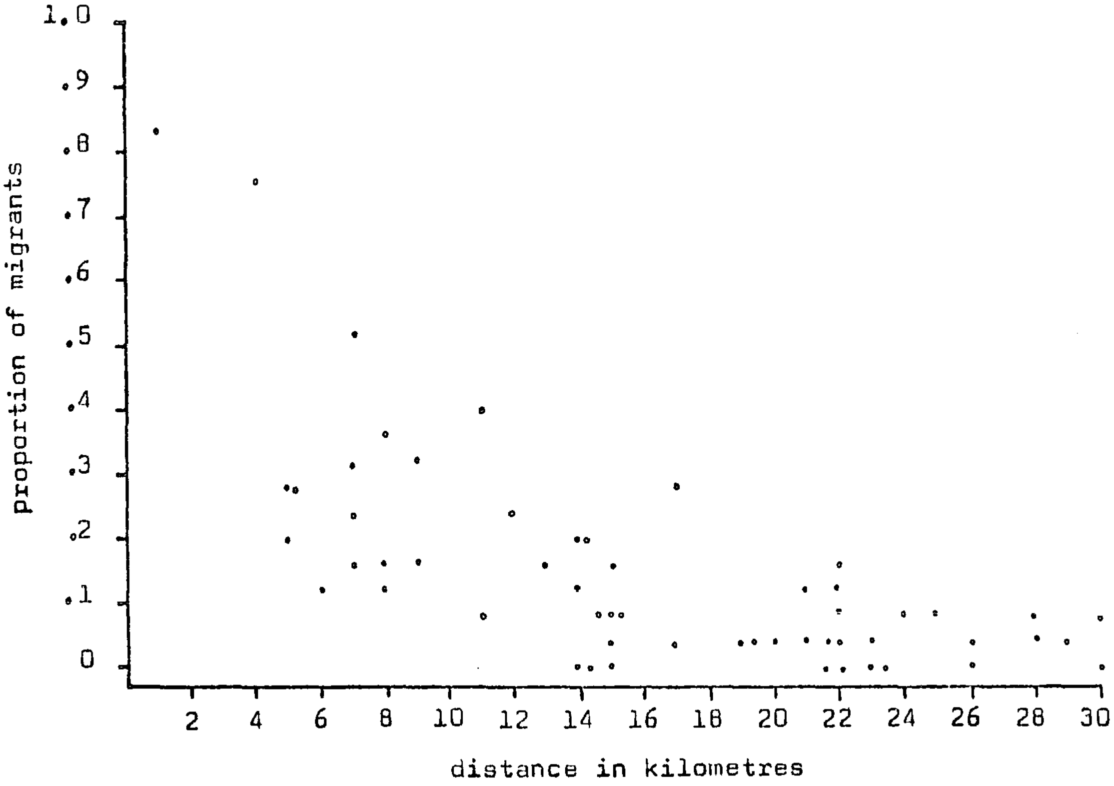


Figure 6.8 Reciprocal migration between pairs of settlements at distance X from each other



the published examples, though it is worth noting that as far as one can tell from the limits of the Charlton and Satak data, this curve does not appear to flatten out as close to the origin as theirs do.

The above discussion establishes for the Isle of Wight survey data the dependence of migration between pairs of settlements upon distance which has been observed elsewhere. By means of the matrix technique we may examine whether this relationship predicts a similar dependance of genetic similarity upon distance. The factor which raises such an inquiry above the trivial is the contribution towards the genetic relatedness of two populations of immigration from elsewhere, either within the survey region or beyond. The pooled areas with or without immigration as a single vector (Tables 6.9 and 6.10) will be used.

(2) Contributions from elsewhere in the survey region

In computing the relatedness of two populations from the ancestor frequency matrix after migration we may distinguish how much of their similarity is due to migration between themselves and how much to shared migration from "third parties". The relatedness due to reciprocal migration alone is given by

$$r_{ij} = a_{ij} + a_{ji}$$

whereas the total relatedness was given by

$$r_{ij} = \sum_{s=1}^{N} \min. a_{is}, a_{js}$$

These matrices are displayed in Tables 6.10 and 6.17.

(3) Contributions from beyond the survey region (that is, immigration)

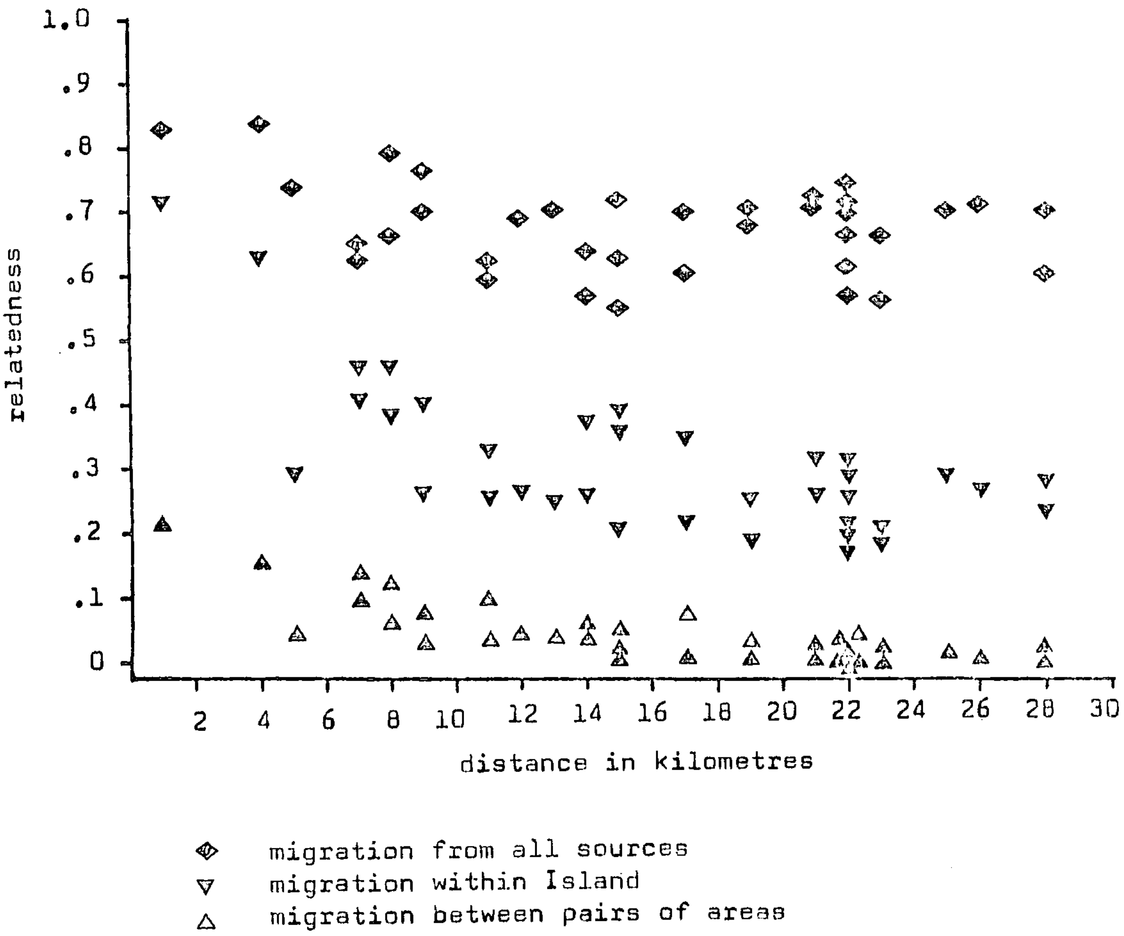
Some effects of immigration have been considered above; by examining the geographical origins of the immigrants to Isle of Wight localities (in Figure 6.3) we have allowed that immigration be considered genetically homogeneous, and this seems to give little loss of accuracy (Figures 6.4, 6.5). It seems reasonable, then, to expect that immigration of this nature will reduce the differences between Isle of Wight areas; this has been borne out by consideration of the number of generations of migration required to achieve homogeneity of population (Tables 6.5 to 6.10). The question now to be asked and answered is whether immigration alters the inverse relationship between genetic similarity and geographical distance which migration within the Isle of Wight has led us to expect. The matrix of relatedness based on all migration is presented in Table 6.9.

The relationship of similarity due to migration with road distance is plotted in Figure 6.9. The three categories

Table 6.17 Blood donors and spouses: relatedness between areas due to reciprocal migration between pairs of areas only

	C	EC	F	"N"	R	S	SH	"WW"	V
Cowes									
East Cowes	.2093								
Freshwater	.0146	.0051							
"Newport"	.1317	.1264	.0761						
Ryde	.0437	.0314	.0199	.0971					
Sandown	.0358	.0147	.0051	.0545	.0785				
Shanklin	.0121	.0000	.0102	.0418	.0420	.1548			
"West Wight"	.0188	.0156	.0602	.0960	.0196	.0133	.0159		
Ventnor	.0088	.0058	.0051	.0451	.0111	.0308	.0424	.0371	

Figure 6.9 Relatedness due to migration plotted against road distance



of relatedness used are:

(1) that due to direct migration between pairs of areas;

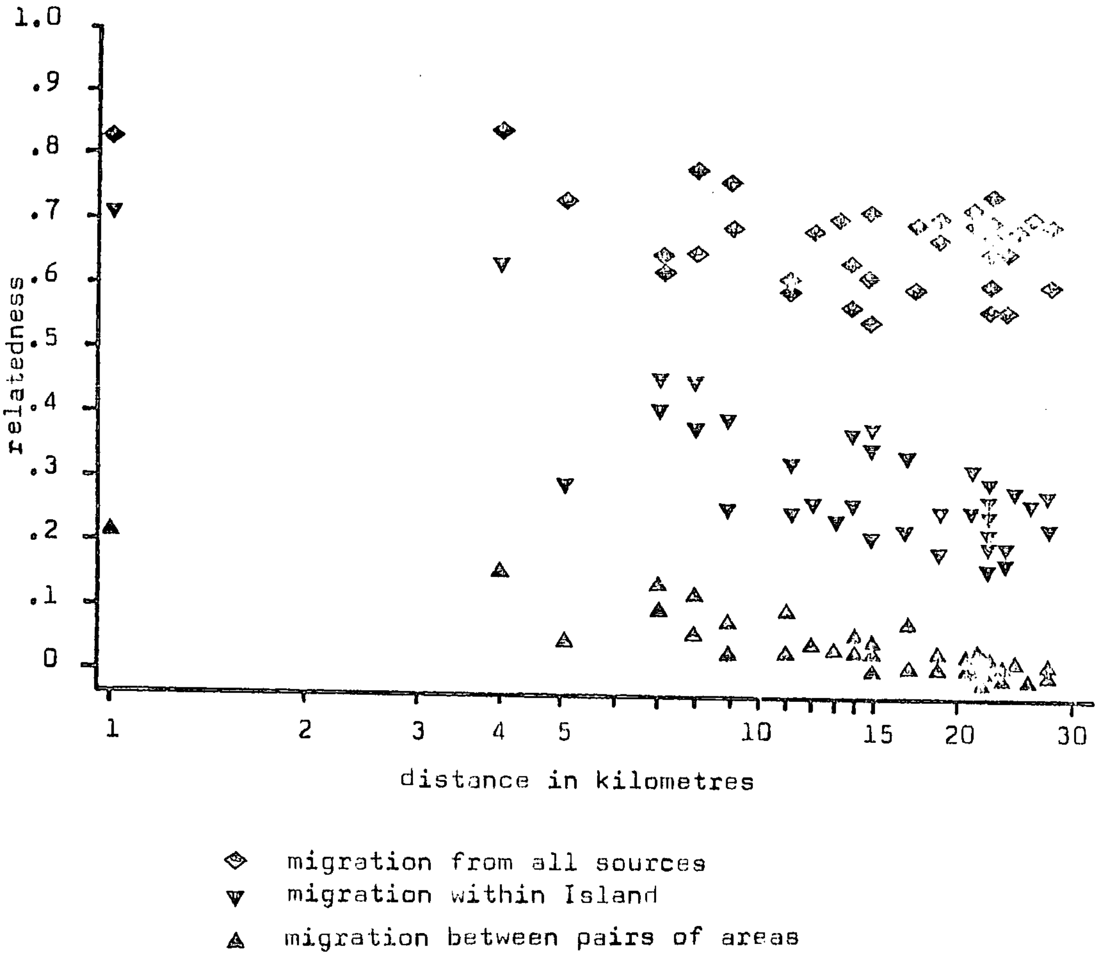
(2) that due to shared migration from all areas within the Island; and

(3) that due to shared migration from all sources.

Inspection of this figure shows that the relatedness between areas increases as the categories of migration are extended. It also seems apparent that the relationship between relatedness and distance which exists for (1) and (2) is much weaker for (3). This can be more clearly seen by plotting road distance on a log. scale, as in Figure 6.10. Relatedness due to migration from all sources fits but poorly (correlation coefficient -.4691) a straight line whose slope is slight (least squares regression -.1146). Relatedness due to migration between pairs of areas only gives a much better fit to a straight line (correlation coefficient -.8714), though again with a fairly gentle slope (least squares regression -.1440). Relatedness due to shared migration from all areas of the Isle of Wight also gives a good fit to a straight line (correlation coefficient -.8214) and has the steepest slope (least square regression -.3323).

The conclusion to be drawn from the foregoing discussion is that the delicate pattern of genetic isolation with

Figure 6.10 Relatedness due to migration plotted against road distance on a log scale



distance which local migration predicts, can be obliterated if immigration is homogeneous and heavy. From the observed pattern of total migration we must predict that within the Isle of Wight distance-dependent local variation in gene frequencies will not be found.

III Genetic Distance: Methods and Results

An essential characteristic of genetic distance is that it can combine in (or reduce to) a single figure the differences between populations at a number of independent gene loci, thus producing a measure of "over-all" difference between them. Many different measures have been proposed according to various statistical, algebraic and methodological criteria (Cavalli-Sforza and Bodmer, 1971; Weiner and Huizinga, 1972; Crow and Denniston, 1974). The theoretical argument for using one measure rather than another is often confounded by the extreme similarity of outcome of using each (Constandse-Westermann, 1972; Gower, 1972). The choice here of Edwards's new E^2 (Edwards, 1971; Constandse-Westermann, 1972) was governed as much by the availability of a computer program to evaluate it as by its author's standing or his statistic's superiority over others.

It would appear to the cynic that the chief drawback of genetic distance analysis is its power to give spurious authority to feeble sets of data; in the present case the choice of statistic seems less critical than getting the regional boundaries in more or less the right place.

The gene frequency data from which the genetic distances have been computed are shown in Tables 6.18 to 6.20. Table 6.18 is based on a residence qualification of all surveyed donors within each of Kopeć's divisions, and is thus equivalent to her sample frame; Table 6.19 is based on the birthplace of donors within the same regions, and so excludes immigrants; Table 6.20 shows gene frequencies of samples of residents from each of the pooled smaller areas of the Island. Samples were judged too small to represent these areas adequately with recruitment by birthplace.

The matrices of genetic distance between Kopeć's regions of the Isle of Wight given by their resident and by their native-born populations are displayed in Tables 6.21 and 6.22. Genetic distances based on the residents of the different areas are shown in Table 6.23.

Table 6.18 Blood donors:
gene frequency variation between
resident populations of Kopeć's regions

		Cowes	East Cowes
ABO	p	.2595 ± .0463	.2900 ± .0539
	q	.0536 ± .0223	.0535 ± .0247
	r	.6870 ± .0655	.6565 ± .0719
	n =	202	164
Rhesus	D	.5228 ± .0689	.5447 ± .0762
	d	.4772 ± .0689	.4553 ± .0762
	n =	202	164
MN	M	.5460 ± .0764	.5248 ± .0771
	N	.4540 ± .0764	.4752 ± .0771
	n =	163	161
Ss	S	.2542 ± .0675	.2465 ± .0678
	s	.7458 ± .0675	.7535 ± .0678
	n =	160	155
Duffy	a	.4191 ± .0765	.4119 ± .0765
	b	.5809 ± .0765	.5881 ± .0765
	n =	160	159
Kell	K	.0161 ± .0197	.0328 ± .0280
	k	.9839 ± .0197	.9672 ± .0280
	n =	157	155
HP	1	.3889 ± .0679	.4660 ± .0768
	2	.6111 ± .0679	.5340 ± .0768
	n =	198	162
Tf	C	.9950 ± .0097	.9847 ± .0189
	Other	.0050 ± .0097	.0153 ± .0189
	n =	202	163
AK	1	.9715 ± .0235	.9628 ± .0305
	2	.0285 ± .0235	.0372 ± .0305
	n =	193	148
PGM	1	.8184 ± .0565	.7900 ± .0652
	2	.1816 ± .0565	.2100 ± .0652
	n =	179	150
ESD	1	.8781 ± .0452	.8851 ± .0493
	2	.1219 ± .0452	.1149 ± .0493
	n =	201	161
AP	A	.3109 ± .0501	.3956 ± .0621
	B	.6617 ± .0650	.5570 ± .0699
	C	.0274 ± .0161	.0470 ± .0237
	n =	201	158

Table 6.18 continued

	Newport	Ryde	Sandown
ABO p	.2722 ± .0309	.2868 ± .0374	.2579 ± .0339
q	.0677 ± .0163	.0642 ± .0188	.0731 ± .0190
r	.6601 ± .0424	.6489 ± .0500	.6690 ± .0478
n =	473	337	375
Rhesus D	.5064 ± .0451	.5816 ± .0527	.4888 ± .0509
d	.4936 ± .0451	.4184 ± .0527	.5112 ± .0509
n =	472	337	375
MN M	.5425 ± .0548	.6053 ± .0537	.5814 ± .0552
N	.4575 ± .0548	.3947 ± .0537	.4186 ± .0552
n =	318	318	307
Ss S	.2761 ± .0532	.2759 ± .0516	.3030 ± .0536
s	.7239 ± .0532	.7241 ± .0516	.6970 ± .0536
n =	271	288	282
Duffy a	.4226 ± .0565	.3345 ± .0544	.3285 ± .0555
b	.5774 ± .0565	.6655 ± .0544	.6715 ± .0555
n =	294	289	275
Kell K	.0261 ± .0189	.0321 ± .0241	.0499 ± .0261
k	.9739 ± .0189	.9679 ± .0241	.9501 ± .0261
n =	272	206	267
HP 1	.3933 ± .0451	.3599 ± .0516	.3719 ± .0500
2	.6067 ± .0451	.6401 ± .0516	.6281 ± .0500
n =	451	332	360
Tf C	.9913 ± .0085	.9925 ± .0093	.9918 ± .0093
Other	.0087 ± .0085	.0075 ± .0093	.0082 ± .0093
n =	460	332	365
AK 1	.9558 ± .0197	.9643 ± .0203	.9545 ± .0233
2	.0442 ± .0197	.0357 ± .0203	.0455 ± .0233
n =	419	322	308
PGM 1	.7602 ± .0510	.7905 ± .0464	.7876 ± .0492
2	.2398 ± .0510	.2095 ± .0464	.2124 ± .0492
n =	269	296	266
ESD 1	.9018 ± .0276	.8904 ± .0340	.8903 ± .0165
2	.0982 ± .0276	.1096 ± .0340	.1097 ± .0165
n =	448	324	360
AP A	.3161 ± .0339	.3506 ± .0411	.3583 ± .0396
B	.6233 ± .0430	.6067 ± .0498	.5944 ± .0472
C	.0606 ± .0159	.0427 ± .0156	.0473 ± .0157
n =	446	328	360

Figures given to 4 figures to reduce rounding errors in later computation.

Table 6.19 Blood donors:
gene frequency variations between
populations born in Kopeć's regions

		Cowes	East Cowes
ABO	p	.2580 ± .0769	.3816 ± .1202
	q	.0417 ± .0327	.0510 ± .0482
	r	.7003 ± .1094	.5674 ± .1380
	n =	73	41
Rhesus	D	.5467 ± .1142	.4369 ± .1518
	d	.4533 ± .1142	.5631 ± .1518
	n =	73	41
MN	M	.4577 ± .1158	.5000 ± .1590
	N	.5423 ± .1158	.5000 ± .1590
	n =	71	38
Ss	S	.2536 ± .1019	.3025 ± .1076
	s	.7464 ± .1019	.6975 ± .1076
	n =	70	37
Duffy	a	.4434 ± .1156	.4730 ± .1631
	b	.5566 ± .1156	.5270 ± .1631
	n =	71	36
Kell	K	.0375 ± .0452	.0308 ± .0589
	k	.9625 ± .0452	.9692 ± .0589
	n =	68	33
HP	1	.4306 ± .1144	.3947 ± .1554
	2	.5694 ± .1144	.6053 ± .1554
	n =	72	38
Tf	C	1.0000 ± .0000	.9878 ± .0336
	Other	.0000 ± .0000	.0122 ± .0336
	n =	73	41
AK	1	.9786 ± .0339	.9342 ± .0788
	2	.0214 ± .0339	.0658 ± .0788
	n =	70	38
PGM	1	.8281 ± .0924	.7917 ± .1237
	2	.1718 ± .0924	.2083 ± .1237
	n =	64	36
ESD	1	.8356 ± .0850	.8902 ± .0957
	2	.1644 ± .0850	.1098 ± .0957
	n =	73	41
AP	A	.3767 ± .0897	.3780 ± .1198
	B	.5959 ± .1049	.5610 ± .1375
	C	.0274 ± .0267	.0610 ± .0526
	n =	73	41

Table 6.19 continued

		Newport	Ryde	Sandown
ABO	p	.2716 ± .0472	.3329 ± .0678	.2609 ± .0618
	q	.0533 ± .0222	.0535 ± .0294	.0677 ± .0332
	r	.6751 ± .0652	.6136 ± .0839	.6714 ± .0867
	n =	202	116	114
Rhesus	D	.5175 ± .0689	.5745 ± .0900	.5224 ± .0917
	d	.4925 ± .0689	.4255 ± .0900	.4776 ± .0917
	n =	202	116	114
MN	M	.6086 ± .0776	.5972 ± .0925	.6075 ± .0992
	N	.3914 ± .0776	.4028 ± .0925	.3925 ± .0992
	n =	153	108	93
Ss	S	.2801 ± .0752	.2023 ± .0791	.3414 ± .1020
	s	.7199 ± .0752	.7977 ± .0791	.6586 ± .1020
	n =	137	99	83
Duffy	a	.2268 ± .0694	.3243 ± .0957	.3274 ± .1004
	b	.7732 ± .0694	.6757 ± .0957	.6726 ± .1004
	n =	140	92	84
Kell	K	.0296 ± .0284	.0353 ± .0426	.0595 ± .0425
	k	.9704 ± .0284	.9647 ± .0426	.9405 ± .0425
	n =	137	72	78
Hp	1	.4010 ± .0684	.3584 ± .0884	.3670 ± .0905
	2	.5990 ± .0684	.6416 ± .0884	.6330 ± .0905
	n =	197	113	109
Tf	c	.9950 ± .0097	1.0000 ± .0000	.9865 ± .0215
	Other	.0050 ± .0097	.0000 ± .0000	.0135 ± .0215
	n =	201	115	111
AK	1	.9553 ± .0303	.9587 ± .0373	.9536 ± .0419
	2	.0447 ± .0303	.0413 ± .0373	.0464 ± .0419
	n =	179	109	97
PGM	1	.7559 ± .0747	.7448 ± .0872	.8041 ± .0904
	2	.2441 ± .0747	.2552 ± .0872	.1959 ± .0904
	n =	127	96	74
ESD	1	.9016 ± .0420	.8761 ± .0607	.9167 ± .0521
	2	.0984 ± .0420	.1239 ± .0607	.0833 ± .0521
	n =	193	113	108
AD	A	.3196 ± .0516	.3423 ± .0701	.3500 ± .0710
	B	.6263 ± .0653	.6036 ± .0854	.6000 ± .0856
	C	.0541 ± .0228	.0541 ± .0302	.0500 ± .0292
	n =	194	111	110

Table 6.20 Blood donors:
gene frequency variation between resident populations of pooled Island areas

		Cowes	East Cowes	Freshwater
ABO	p	.2595 ± .0463	.2771 ± .0608	.2408 ± .0562
	q	.0535 ± .0223	.0627 ± .0307	.0844 ± .0347
	r	.6970 ± .0657	.6602 ± .0828	.6748 ± .0816
	n =	202	124	129
Rhesus	D	.5228 ± .0689	.5248 ± .0879	.5221 ± .0869
	d	.4772 ± .0689	.4752 ± .0879	.4779 ± .0869
	n =	202	124	127
MN	M	.5460 ± .0764	.5123 ± .0887	.4186 ± .1475
	N	.4540 ± .0764	.4877 ± .0887	.5814 ± .1475
	n =	163	122	43
Ss	S	.2542 ± .0675	.2727 ± .0794	.2615 ± .1499
	s	.7458 ± .0675	.7273 ± .0794	.7385 ± .1499
	n =	160	121	33
Duffy	a	.4191 ± .0765	.4108 ± .0877	.4000 ± .1920
	b	.5809 ± .0765	.5892 ± .0877	.6000 ± .1920
	n =	160	121	25
Kell	K	.0161 ± .0197	.0342 ± .0327	.0599 ± .0709
	k	.9839 ± .0197	.9658 ± .0327	.9401 ± .0709
	n =	157	119	43
Hp	1	.3889 ± .0679	.4549 ± .0884	.3911 ± .0859
	2	.6111 ± .0679	.5451 ± .0884	.6089 ± .0859
	n =	198	122	124
Tf	C	.9950 ± .0097	.9797 ± .0249	.9881 ± .0189
	Other	.0050 ± .0097	.0203 ± .0249	.0119 ± .0189
	n =	202	123	126
AK	1	.9715 ± .0235	.9727 ± .0304	.9538 ± .0377
	2	.0285 ± .0235	.0273 ± .0304	.0462 ± .0377
	n =	193	110	119
PGM	1	.8184 ± .0565	.8034 ± .0720	.6810 ± .1199
	2	.1816 ± .0565	.1966 ± .0720	.3190 ± .1199
	n =	179	117	58
ESD	1	.8781 ± .0452	.8750 ± .0582	.9106 ± .0504
	2	.1219 ± .0452	.1250 ± .0582	.0894 ± .0504
	n =	201	124	123
AP	A	.3109 ± .0501	.4215 ± .0727	.3238 ± .0654
	B	.6617 ± .0650	.5248 ± .0784	.6230 ± .0822
	C	.0274 ± .0161	.0537 ± .0288	.0532 ± .0286
	n =	201	121	122

Table 6.20 continued

		"Newport"	Ryde	Sandown
ABO	p	.2793 ± .0374	.2868 ± .0374	.2617 ± .0529
	q	.0579 ± .0184	.0642 ± .0188	.0697 ± .0288
	r	.6628 ± .0393	.6490 ± .0500	.6686 ± .0740
	n =	329	337	156
Rhesus	D	.5107 ± .0480	.5816 ± .0527	.4282 ± .0776
	d	.4893 ± .0480	.4184 ± .0527	.5718 ± .0776
	n =	330	337	156
MN	M	.5580 ± .0576	.6053 ± .0537	.5677 ± .0842
	N	.4410 ± .0576	.3947 ± .0537	.4323 ± .0842
	n =	284	318	137
Ss	S	.2745 ± .0858	.2759 ± .0516	.3077 ± .0822
	s	.7255 ± .0858	.7241 ± .0516	.6923 ± .0822
	n =	247	288	121
Duffy	a	.4268 ± .0960	.3090 ± .0533	.3631 ± .0915
	b	.5732 ± .0960	.6910 ± .0533	.6369 ± .0915
	n =	280	289	106
Kell	K	.0211 ± .0259	.0321 ± .0241	.0566 ± .0453
	k	.9789 ± .0259	.9679 ± .0241	.9434 ± .0453
	n =	239	206	100
Hp	1	.4035 ± .0591	.3599 ± .0516	.3451 ± .0782
	2	.5965 ± .0591	.6401 ± .0516	.6549 ± .0782
	n =	317	332	143
Tf	C	.8758 ± .1080	.9925 ± .0093	.9966 ± .0094
	Other	.1242 ± .1080	.0075 ± .0093	.0034 ± .0094
	n =	324	332	147
AK	1	.9500 ± .0251	.9643 ± .0203	.9440 ± .0389
	2	.0500 ± .0251	.0357 ± .0203	.0560 ± .0389
	n =	290	322	134
PGM	1	.7880 ± .0544	.7905 ± .0464	.8319 ± .0681
	2	.2120 ± .0544	.2095 ± .0464	.1681 ± .0681
	n =	217	296	116
ESD	1	.8952 ± .0341	.8904 ± .0174	.8947 ± .0488
	2	.1048 ± .0341	.1096 ± .0174	.1053 ± .0488
	n =	310	324	152
AP	A	.3252 ± .0522	.3506 ± .0411	.3367 ± .0599
	B	.6117 ± .0543	.6067 ± .0498	.6166 ± .0739
	C	.0631 ± .0271	.0427 ± .0156	.0467 ± .0242
	n =	309	328	150

Table 6.20 continued

		Shanklin	"West Wight"	Ventnor
ABO	p	.2509 ± .0616	.3369 ± .0848	.2513 ± .0693
	q	.0890 ± .0384	.0620 ± .0386	.0580 ± .0351
	r	.6601 ± .0875	.6011 ± .0875	.6907 ± .0993
	n =	111	75	88
Rhesus	D	.5448 ± .0926	.4970 ± .0978	.5477 ± .1040
	d	.4552 ± .0926	.5030 ± .0978	.4523 ± .1040
	n =	111	75	88
MN	M	.6438 ± .1099	.5625 ± .1400	.5663 ± .1066
	N	.3562 ± .1099	.4375 ± .1400	.4337 ± .1066
	n =	73	48	83
Ss	S	.2662 ± .1074	.2929 ± .2139	.3156 ± .1025
	s	.7338 ± .1074	.7071 ± .2139	.6844 ± .1025
	n =	65	42	79
Duffy	a	.3297 ± .1109	.4422 ± .2425	.2509 ± .0938
	b	.6703 ± .1109	.5578 ± .2425	.7490 ± .0938
	n =	69	45	82
Kell	K	.0796 ± .0625	.0247 ± .0676	.0189 ± .0298
	k	.9204 ± .0625	.9753 ± .0676	.9811 ± .0298
	n =	72	41	80
Hp	1	.3514 ± .0888	.4275 ± .1167	.4253 ± .1039
	2	.6486 ± .0888	.5725 ± .1167	.5747 ± .1039
	n =	111	69	87
Tf	C	.9955 ± .0125	1.0000 ± .0000	.9773 ± .0311
	Other	.0045 ± .0125	.0000 ± .0000	.0227 ± .0311
	n =	111	69	88
AK	1	.9725 ± .0336	.9688 ± .0426	.9552 ± .0495
	2	.0275 ± .0336	.0312 ± .0426	.0448 ± .0495
	n =	91	64	67
PGM	1	.7342 ± .0974	.7317 ± .1356	.7632 ± .1104
	2	.2658 ± .0974	.2683 ± .1356	.2368 ± .1104
	n =	79	41	57
ESD	1	.8864 ± .0593	.9155 ± .0647	.8924 ± .0683
	2	.1136 ± .0593	.0845 ± .0647	.1076 ± .0683
	n =	110	71	79
AP	A	.3796 ± .0740	.2569 ± .1070	.3841 ± .0853
	B	.5694 ± .0851	.6875 ± .1136	.5854 ± .0985
	C	.0510 ± .0297	.0556 ± .0561	.0305 ± .0265
	n =	108	72	82

Table 6.21 Blood donors:
genetic distance between resident populations of Kopeć's regions

	C	EC	N	R
Cowes				
East Cowes	.0474			
Newport	.0391	.0393		
Ryde	.0453	.0482	.0424	
Sandown	.0534	.0506	.0398	.0329

Table 6.22 Blood donors:
genetic distance between populations born in Kopeć's regions

	C	EC	N	R
Cowes				
East Cowes	.0786			
Newport	.0927	.0904		
Ryde	.0750	.0815	.0538	
Sandown	.0851	.0731	.0497	.0681

Table 6.23 Blood donors:
genetic distance between resident populations
of pooled Island areas

	C	EC	F	"N"	R	S	SH	"WW"
Cowes								
East Cowes	.0542							
Freshwater	.0747	.0661						
"Newport"	.0369	.0452	.0631					
Ryde	.0495	.0574	.0750	.0475				
Sandown	.0576	.0657	.0742	.0500	.0550			
Shanklin	.0749	.0699	.0736	.0673	.0445	.0604		
"West Wight"	.0562	.0759	.0719	.0470	.0676	.0693	.0786	
Ventnor	.0671	.0614	.0800	.0640	.0439	.0724	.0700	.0881

Table 6.24 ABO and Rhesus blood group variation
in the Isle of Wight:
Kopeć's data

	n	O	A	B	AB	p	q	r	D-
Cowes	177	90	61	18	8	.2180	.0760	.7060	31
East Cowes	104	44	49	9	2	.2874	.0546	.6580	17
Newport	241	111	103	25	2	.2506	.0581	.6913	51
Ryde	159	74	72	10	3	.2736	.0418	.6846	30
Sandown	153	76	63	7	7	.2615	.0456	.6920	33

IV General Discussion

(a) Introduction

Kopeć's divisions will be discussed first, and then the smaller areas will be compared with the predictions of the migration model described above.

(b) Kopeć's divisions

The reason for using Kopeć's divisions of the Isle of Wight is twofold. Firstly, their large size enables genetic distance between regions computed on the basis of birthplace to be compared with that computed on the basis of residence; secondly, the genetic variation recorded by Kopeć can be compared with that observed in the present survey. As most of the regions are rather large, no attempt can be made to interpret genetic distances in terms of geographical ones.

In contrast to the division of the Isle of Wight into smaller areas, there was not a great deal of difference between the relatedness of regions due to migration whether or not the outside world is included. This may in part be due to the only small number of regions whose relationship may change, and to the amalgamation into single regions of communities with distinct migration patterns which will apparently disappear. In general, we may predict that the recorded migration patterns including immigration will fit genetic distance measured on the basis of residence rather than on the basis of birthplace. Inspection of Figures 6.11 and 6.12 shows that this is indeed the case, if we allow the point representing Cowes and East Cowes to be excluded as an aberration. Aside from this, there is a reasonably clear relationship of increasing genetic distance with decreasing similarity due to migration, when genetic distance is computed on the basis of residence. No intelligible relationship exists, however, when genetic distance is computed on the basis of a birthplace qualification. It is tempting to suggest that genetic distance based on birthplace should reflect internal migration, excluding the outside world, but this is obviously not the case.

(c) Kopeć's blood group data

The ABO and Rhesus blood groups sampled by Kopeć show some variation within the Isle of Wight (Table 6.24). In particular, there is a considerable difference in ABO gene frequencies between Cowes and East Cowes, and this is the extreme of variation observed. It is a striking difference in view not only of the physical closeness of the regions, but also of their high shared migration. Using Kruskal's NMMS algorithm

Figure 6.11 Genetic distance between Kopeć's regions plotted against similarity due to migration from all sources

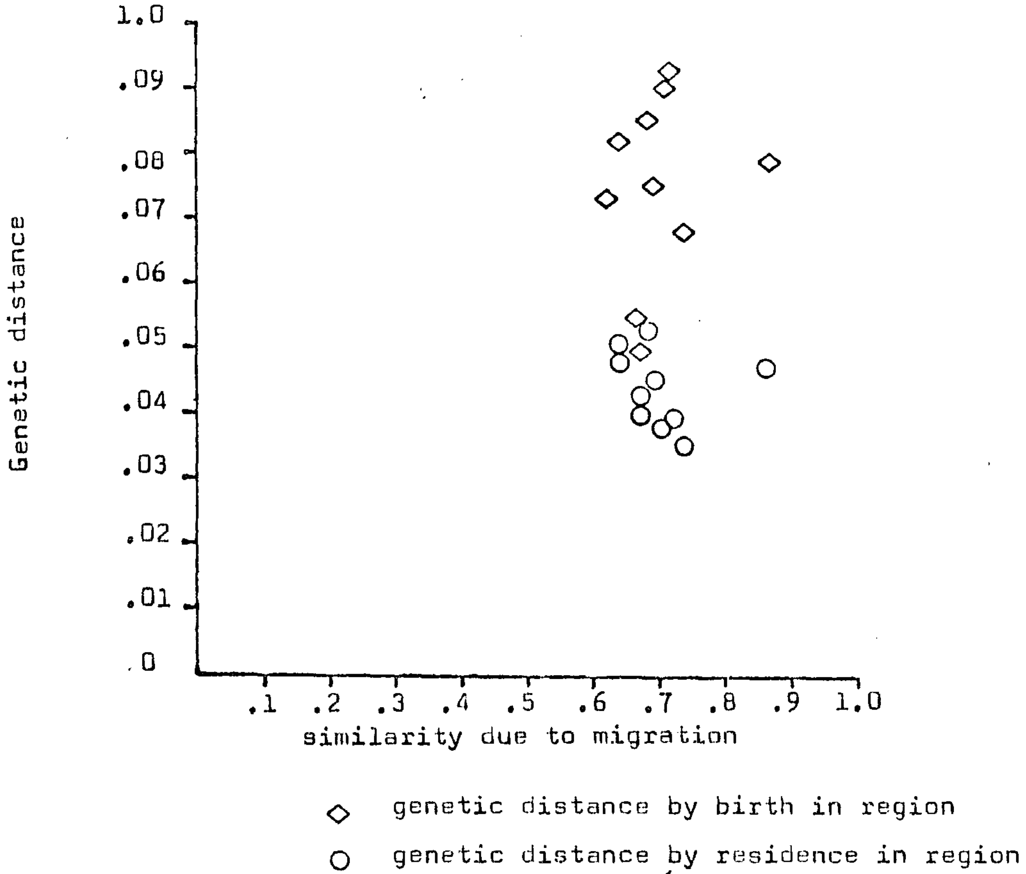
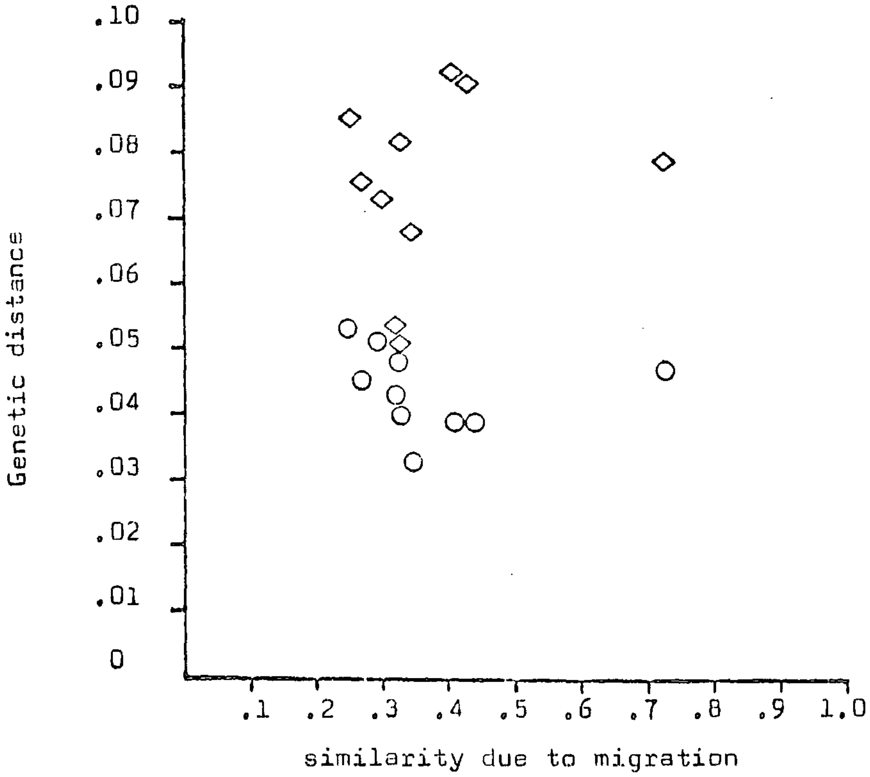
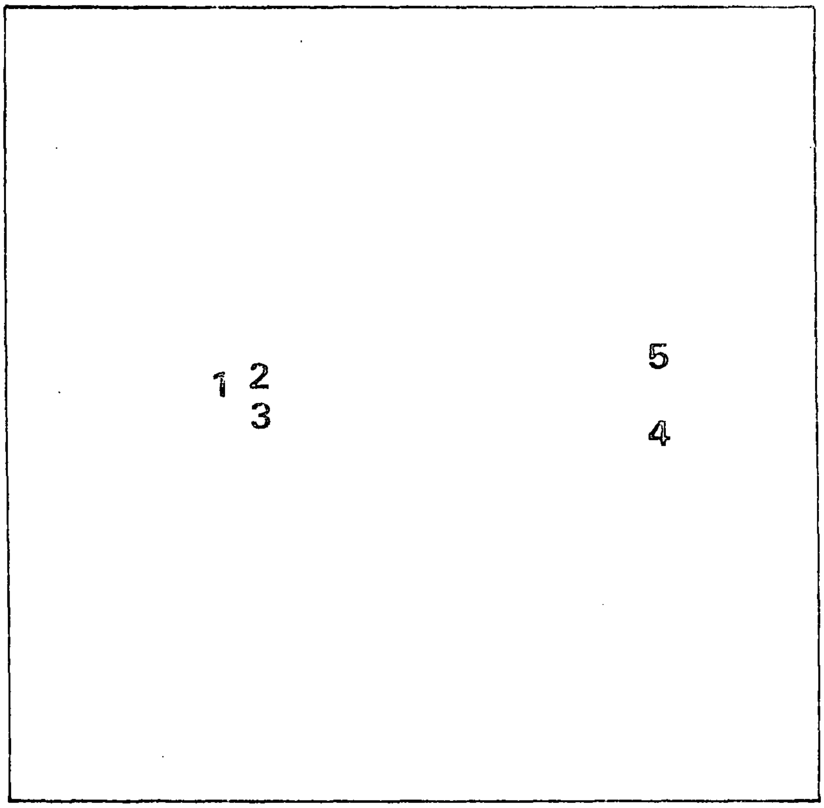


Figure 6.12 Genetic distance between Kopeć's regions plotted against similarity due to migration within the Island only



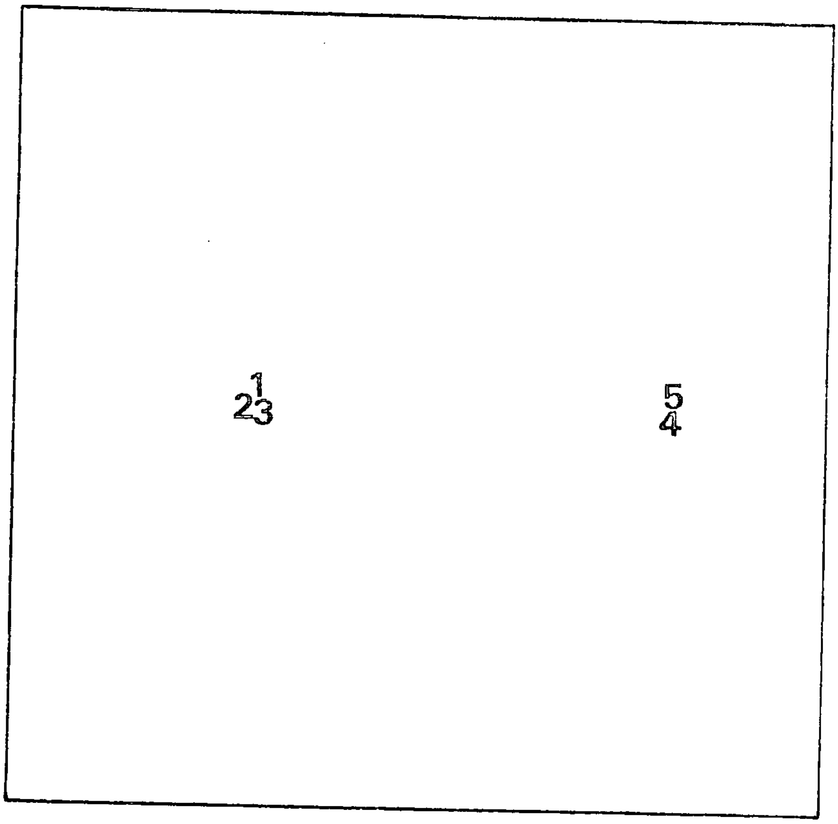
plots of relatedness due to migration are produced by the SPACES program package (Schneider, 1977), and these show Cowes and East Cowes to be closely related by migration whether or not immigration is considered (Figures 6.13, 6.14). Indeed, it is this exceptionally high intermigration rate which in part caused the aberrant points referred to earlier (Figures 6.11, 6.12). The other causal factor is of course their moderately high genetic distance. Looking at ABO gene frequencies individually (Tables 6.18, 6.19) the present survey does not record such an extreme variation among the resident population, but an even more marked one is observed when the population is partitioned by birthplace. This may in some measure be a sampling effect, and I am inclined to reject any suggestion that Kopeć in her survey in the 1950s observed progress in the reduction by migration of previously greater ABO differences between Cowes and East Cowes. The fact remains, however, that the genetic differences between the two towns belie their close migrational links (Figures 6.15, 6.16). Reflection upon Table 6.3 may go some way to providing a clue about this, for the migration is by no means isotropic. Almost as many of the resident population of East Cowes were born in Cowes as in East Cowes (31 against 38), whereas in Cowes there are nearly five times as many Cowes-born as East Cowes-born (50 against 11). It is perhaps not too fanciful to suggest that some of the differences between the two towns are due to selective migration, and the fairly distinct social and economic character of the two may lend weight to this view.

Figure 6.13 SPACES NMMS plot of relatedness due to migration between Kopeć's regions: immigration excluded



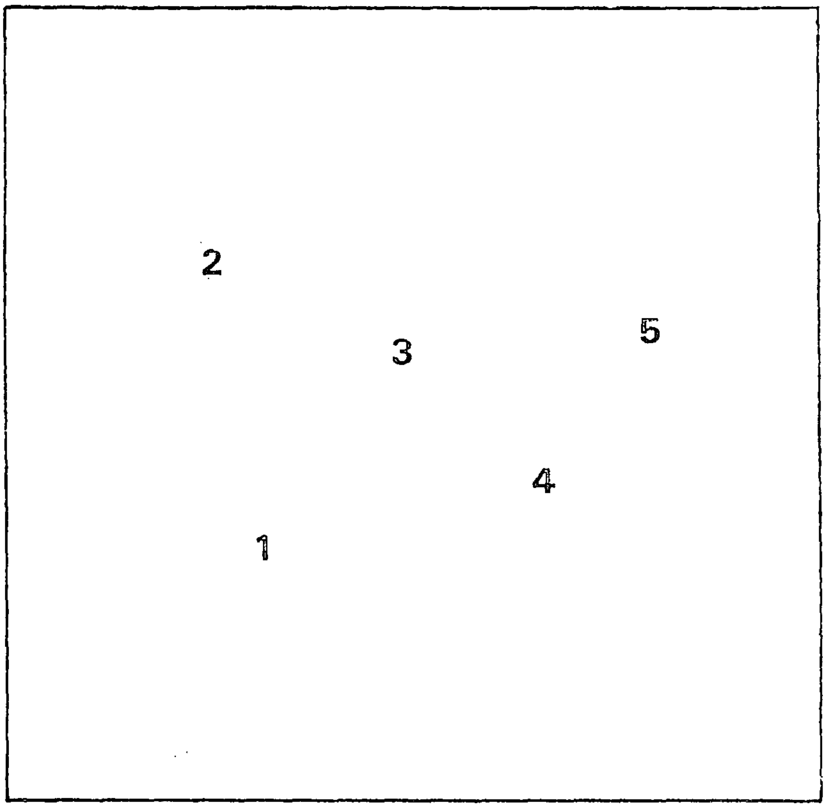
1	Cowes
2	East Cowes
3	Newport
4	Ryde
5	Sandown

Figure 6.14 SPACES NMMS plot of relatedness due to migration between Kopeć's regions: immigration included



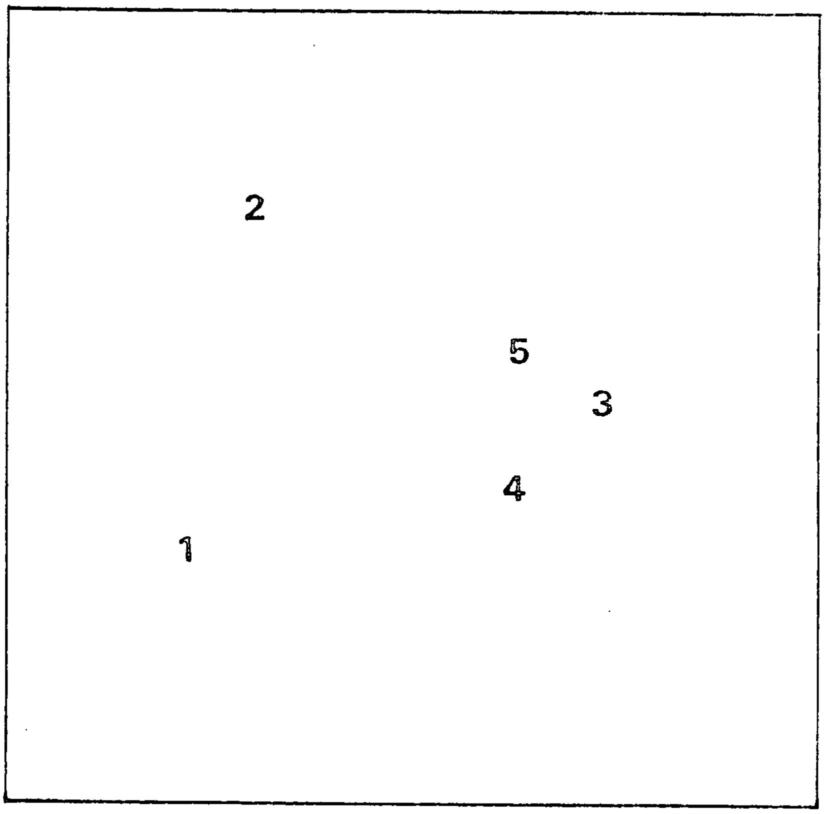
1	Cowes
2	East Cowes
3	Newport
4	Ryde
5	Sandown

Figure 6.15 SPACES NMMS plot of genetic distance between Kopeć's regions, by residence in those regions



1	Cowes
2	East Cowes
3	Newport
4	Ryde
5	Sandown

Figure 6.16 SPACES NMMS plot of genetic distance between Kopeć's regions, by birth in those regions



1	Cowes
2	East Cowes
3	Newport
4	Ryde
5	Sandown

(d) The smaller areas

The prediction made on the basis of migration matrices was that owing to the swamping effect of immigration, no relationship should exist within the Isle of Wight between genetic distance and geographical distance. This can easily be tested by plotting the one against the other, as in Figure 6.17. Surprisingly, there is a clear positive relationship between the two, although there is also quite a large spread of points around a straight line fitted to them (correlation coefficient .5070). Some of this spread seems to be accounted for by the relatively large genetic distance of smaller populations and samples at each distance, at least up to 20 kilometers.

Now, unless the cause of local genetic differentiation is selection (which in this case seems highly unlikely and has not been considered as an explanation), the relationship between genetic variation and distance is brought about through migration; the relationship of genetic to geographical distance is a shorthand which implies migratory behaviour as the cause.

Figure 6.18 plots genetic distance against predicted genetic similarity due to migration from all sources. This seems to defy interpretation, unless claim is made that the migration

Figure 6.17 Genetic distance between pooled areas plotted against road distance

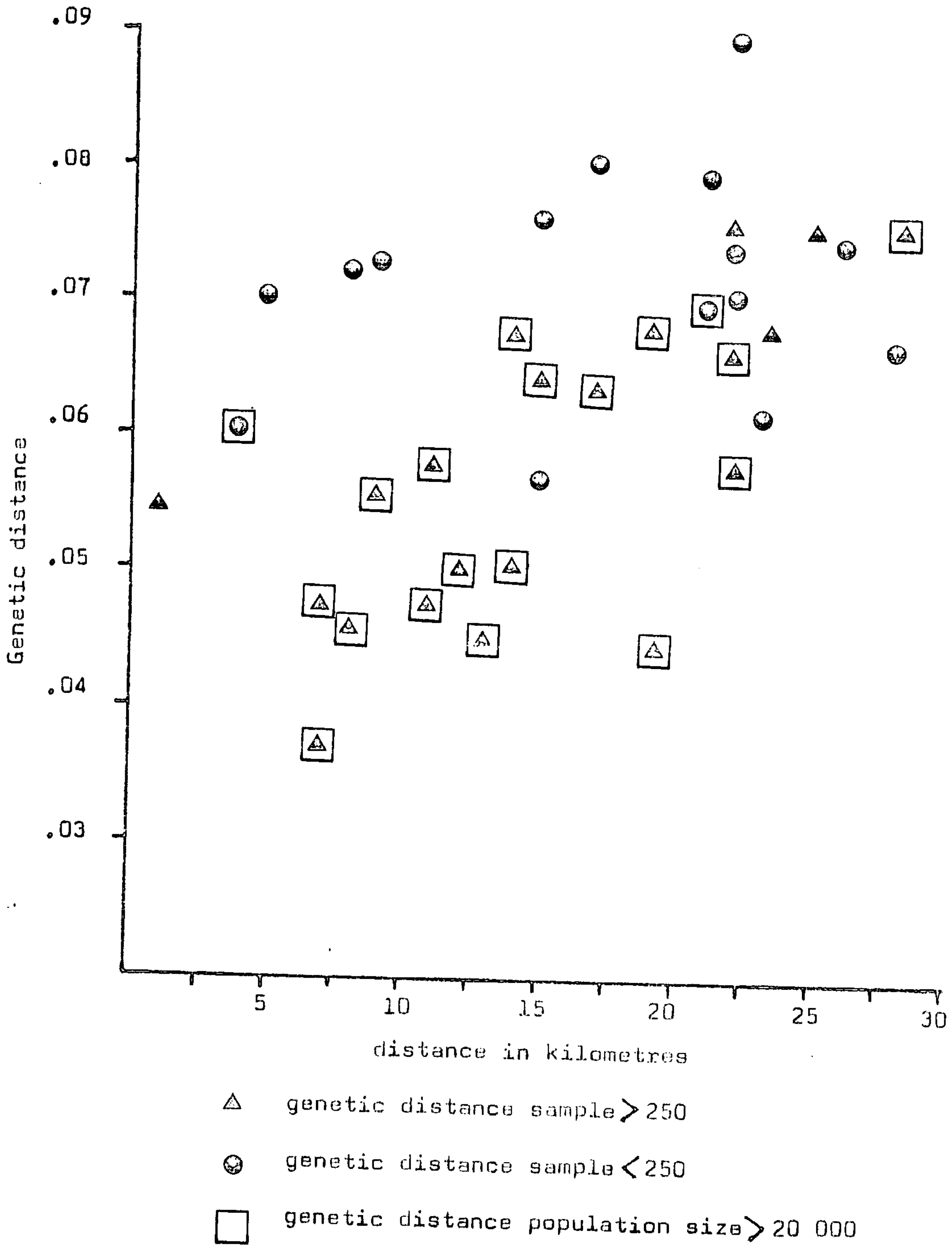
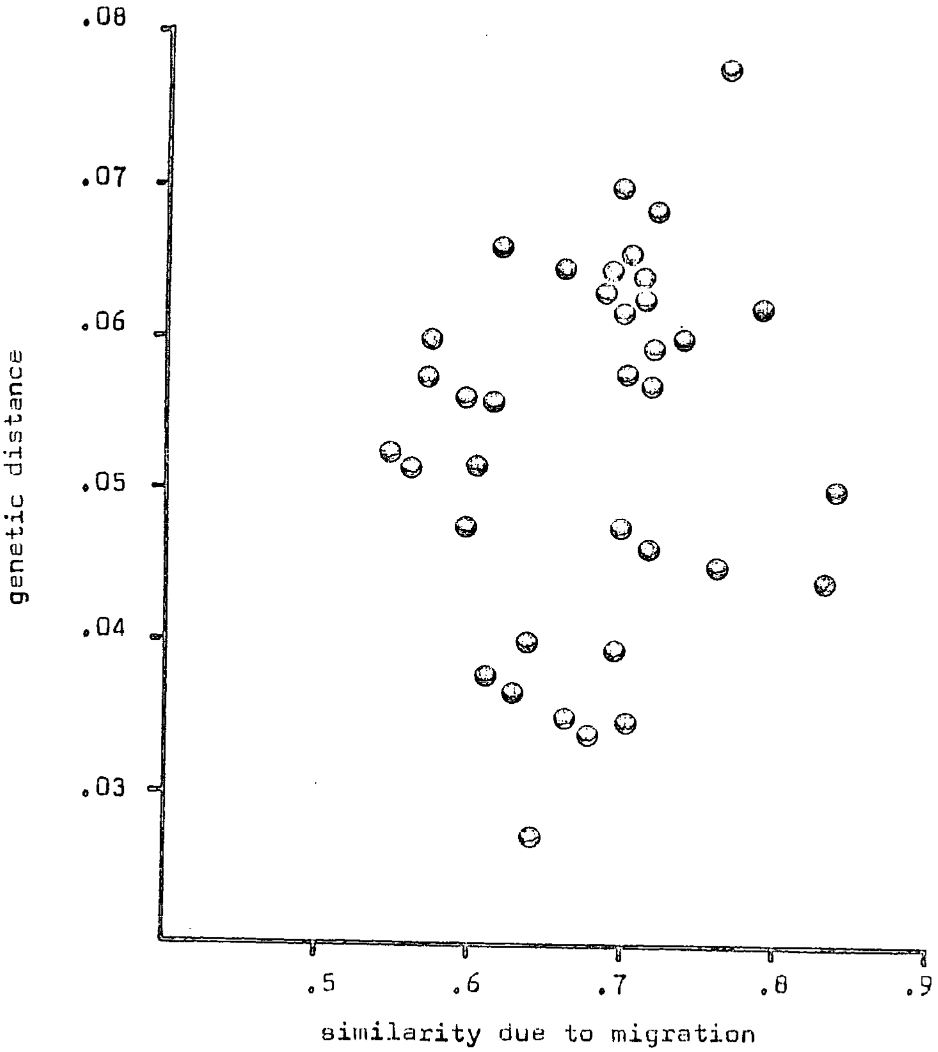


Figure 6.18 Genetic distance between pooled areas plotted against similarity due to migration from all sources



matrix does not predict accurately or that the genetic distance does not measure properly. These points must be returned to in discussion.

Figure 6.19 plots genetic distance against similarity due to migration within the Isle of Wight alone. This makes sense as a graph, giving at least an indication of a decrease in genetic distance as migration increases. Where it lacks sense, however, is in predicting that genetic variation should reflect only migration within the Isle of Wight when there is and has been considerable immigration. In Figure 6.20 the points are marked according to the geographical distance between areas under consideration. There is quite tight clustering of the points reflecting distance above 20 kilometres, with fairly uniform high genetic distance and low migration, but with decreasing distance the spread of points seems less predictable.

By means of NMMS plots, Figure 6.21 shows the relationship between areas on the basis of migration within the Isle of Wight, and Figure 6.22 demonstrates the genetic distance matrix. There is a marked contrast between the two. The migration matrix fits quite realistically, though with some distortion, a physical map of the Island (Transparent Overlay 6.1), whereas the genetic distance plot seems to make sense more in terms of smaller peripheral populations and larger central ones, and this again may reflect the importance of population or sample size in either causing or simulating random genetic differentiation.

Figure 6.19 Genetic distance between pooled areas plotted against similarity due to migration within the Island only

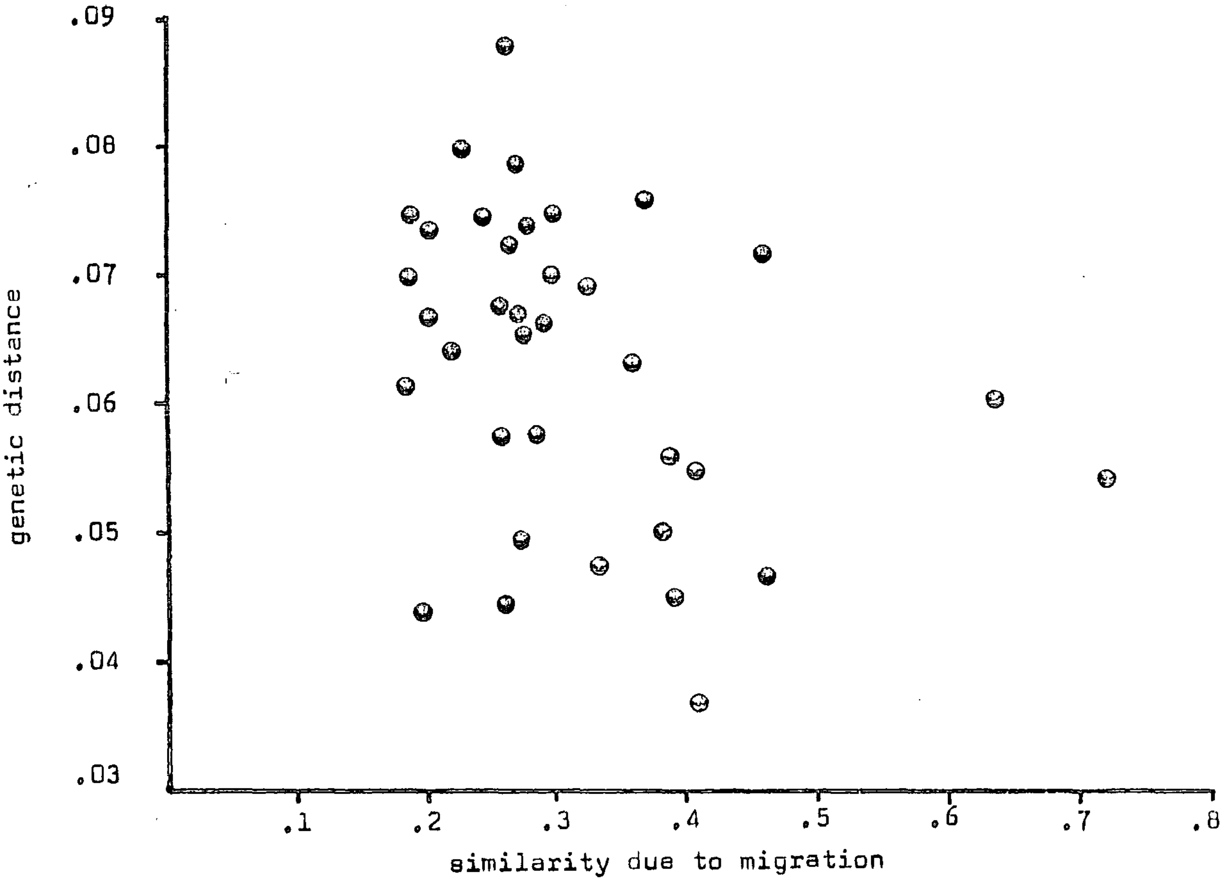


Figure 6.20 Genetic distance between pooled areas plotted against similarity due to migration within the Island: road distance indicated as a third variable

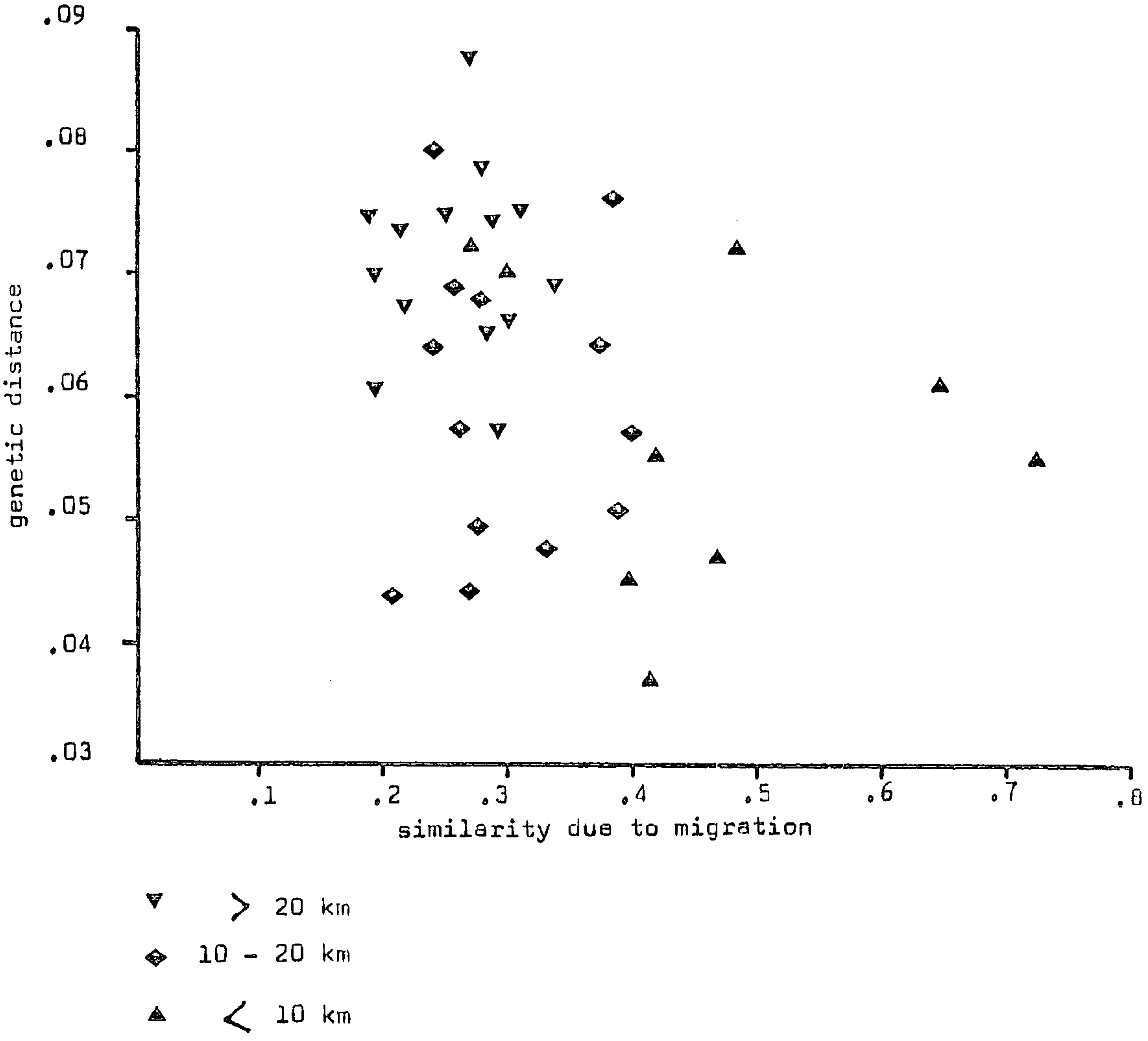
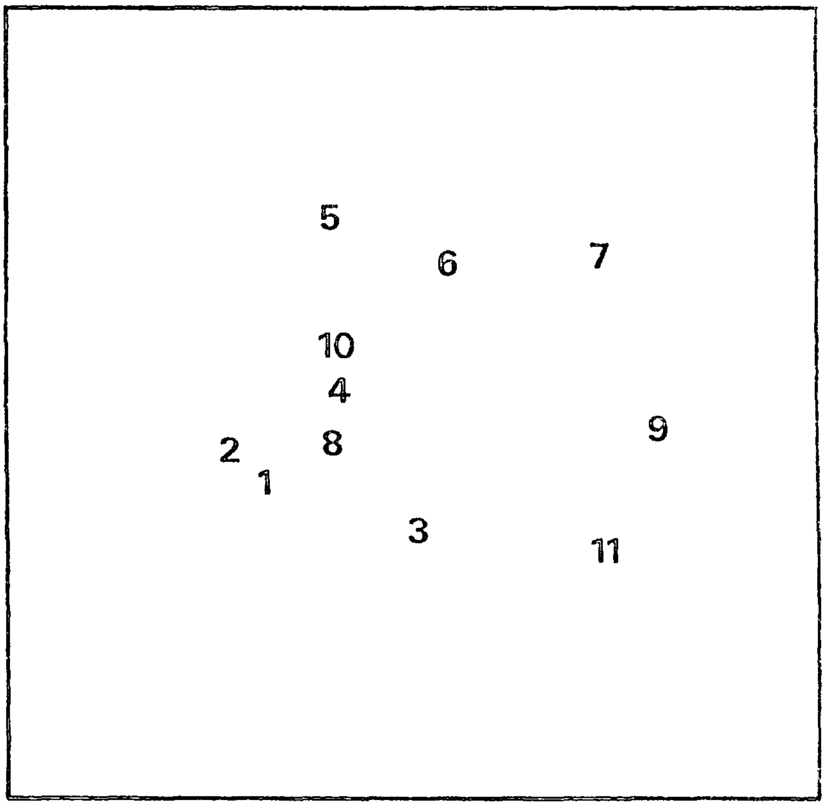
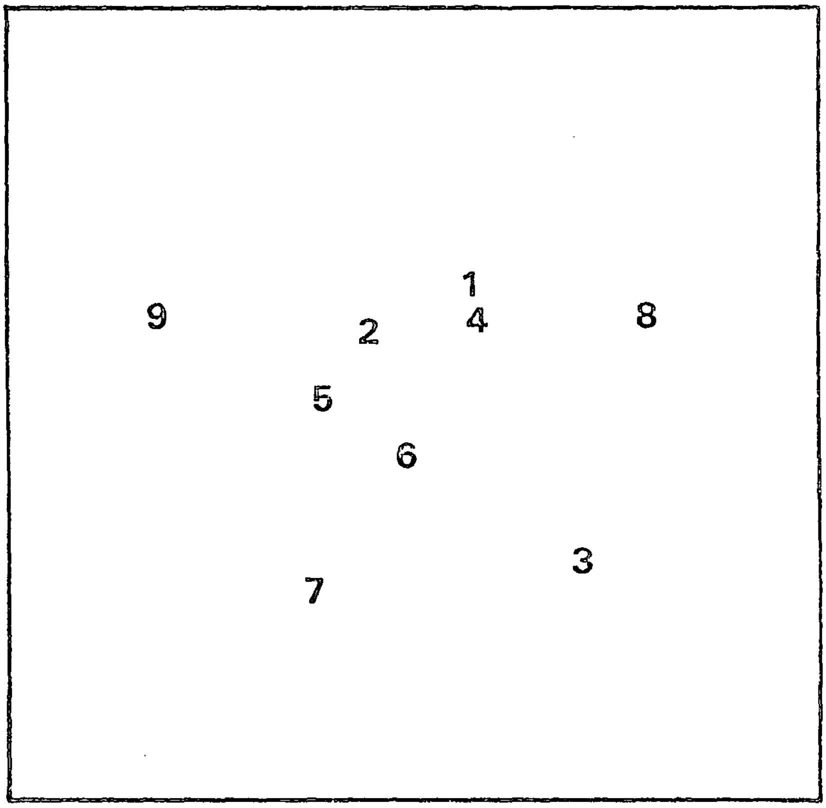


Figure 6.21 SPACES NMMS plot of similarity between areas, based on migration within the Isle of Wight



1	Cowes
2	East Cowes
3	Freshwater
4	Newport
5	Ryde
6	Sandown
7	Shanklin
8	West Wight
9	Ventnor
10	Wootton
11	Yarmouth

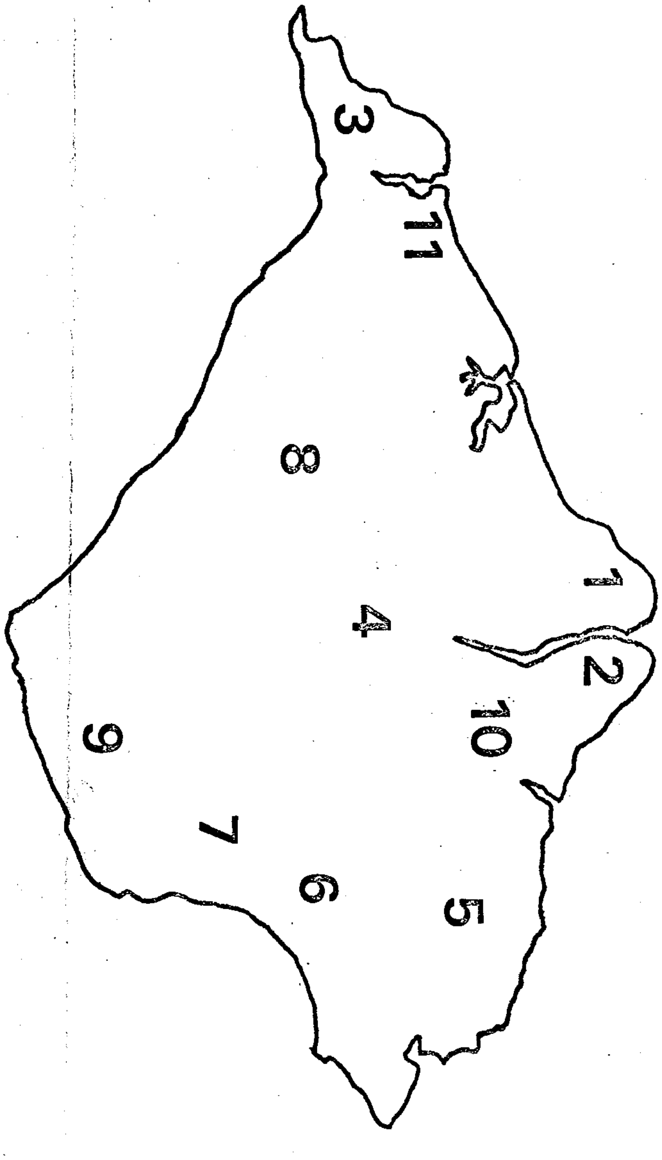
Figure 6.22 SPACES NMMS plot of genetic distance between pooled areas



1	Cowes
2	East Cowes
3	Freshwater
4	Newport
5	Ryde
6	Sandown
7	Shanklin
8	West Wight
9	Ventnor

Transparent Overlay 6.1

Geographical position of
Isle of Wight regions



The population sizes for the various areas at the 1971 census are shown in Table 6.25, column 1. Columns 2 and 3 of this table show the sample sizes on which the genetic distance and migration statistics are based. There is an approximate proportionality between population size and sample size, and this is confusing if either of them influences, say, the genetic distance between samples. In Figures 6.23 and 6.24 the genetic distance is plotted against population size and sample size; clearly both give a good fit to the data.

If sampling were the crucial factor, we should expect migrational similarity to be even more influenced in this way, since it is almost always based on a smaller sample than genetic distance. Figure 6.25 plots migrational similarity against combined sample size, and in showing no increase with population size corresponding to genetic distance's decline, gives us some faith in the relationship of genetic distance with decreasing population size.

There remains to be explained the relationship (or lack of one) between genetic distance and the two predictions of similarity due to migration. The most plausible solution seems to be that whilst the pattern of migration within the Isle of Wight has endured for generations, the pattern of immigration is changing. The matrix model including the outside world gives immigration and internal migration equal weight in terms of the time that the presently-observed pattern of migration has persisted.

Table 6.25 Population and sample sizes of Isle of Wight areas

	1971 Population	Genetic distance sample	Internal migration sample
Cowes	10 280	185	92
East Cowes	8 543	121	88
Freshwater	5 895	89	75
Newport	22 309	290	193
Ryde	26 476	309	168
Sandown	11 624	135	90
Shanklin	8 900	93	61
West Wight	8 738	59	20
Ventnor	6 931	80	40
Wootton	1 000	38	22
Yarmouth	984	20	12

Figure 6.23 Genetic distance plotted against population size

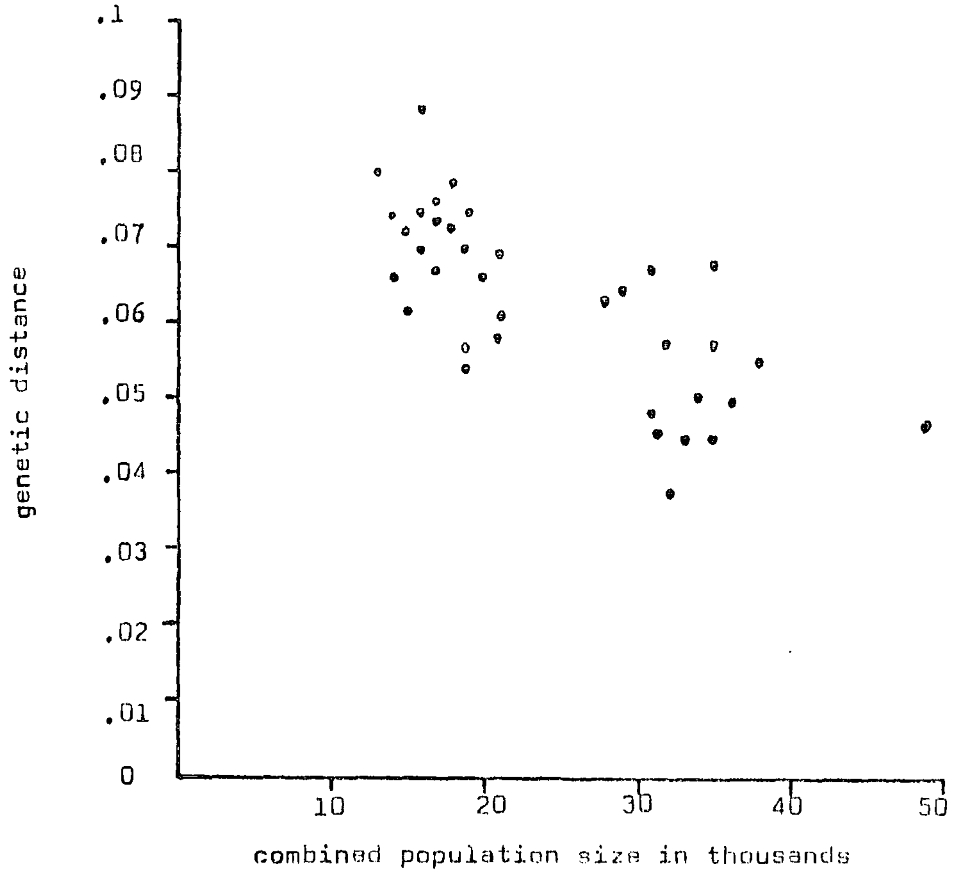


Figure 6.24 Genetic distance plotted against sample size

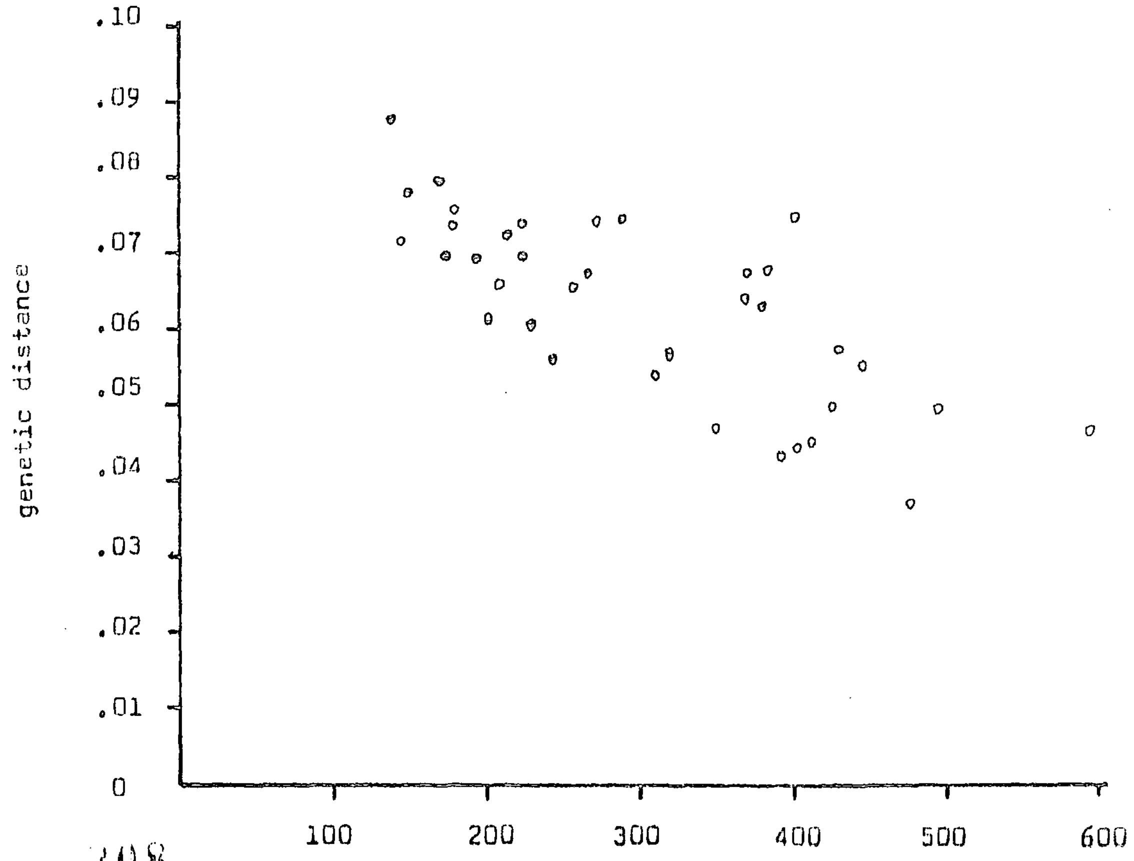
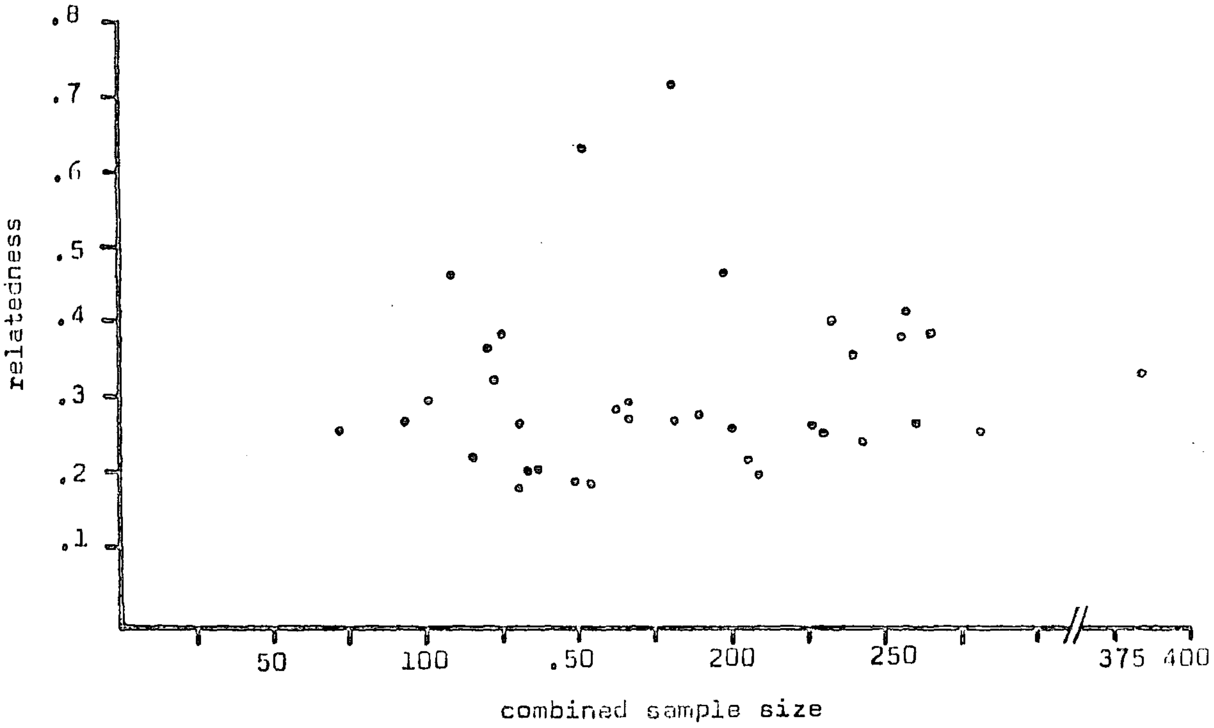


Figure 6.25 Relatedness between pooled areas due to migration within Island plotted against sample size



In probability, an enduring pattern of internal migration has had linked to it a changing pattern of immigration. If the observed distribution of immigrants is a novel one then the equal weighting is utterly misleading. The fit of the genetic distance data to the internal migration matrix's prediction may perhaps be explained as a reflection of standing genetic variation which has been blurred by "noise" of considerable but varying immigration. Another demonstration of this fit is given by Figure 6.26 which plots the mean of each area's values in the two migration matrices and in the genetic distance matrix against distance. This seems to be the best way to make sense of these data, but it surprises me that the present pattern of immigration is as unrepresentative of past generations as the conclusion implies. An approach to checking this could be made through historical demography.

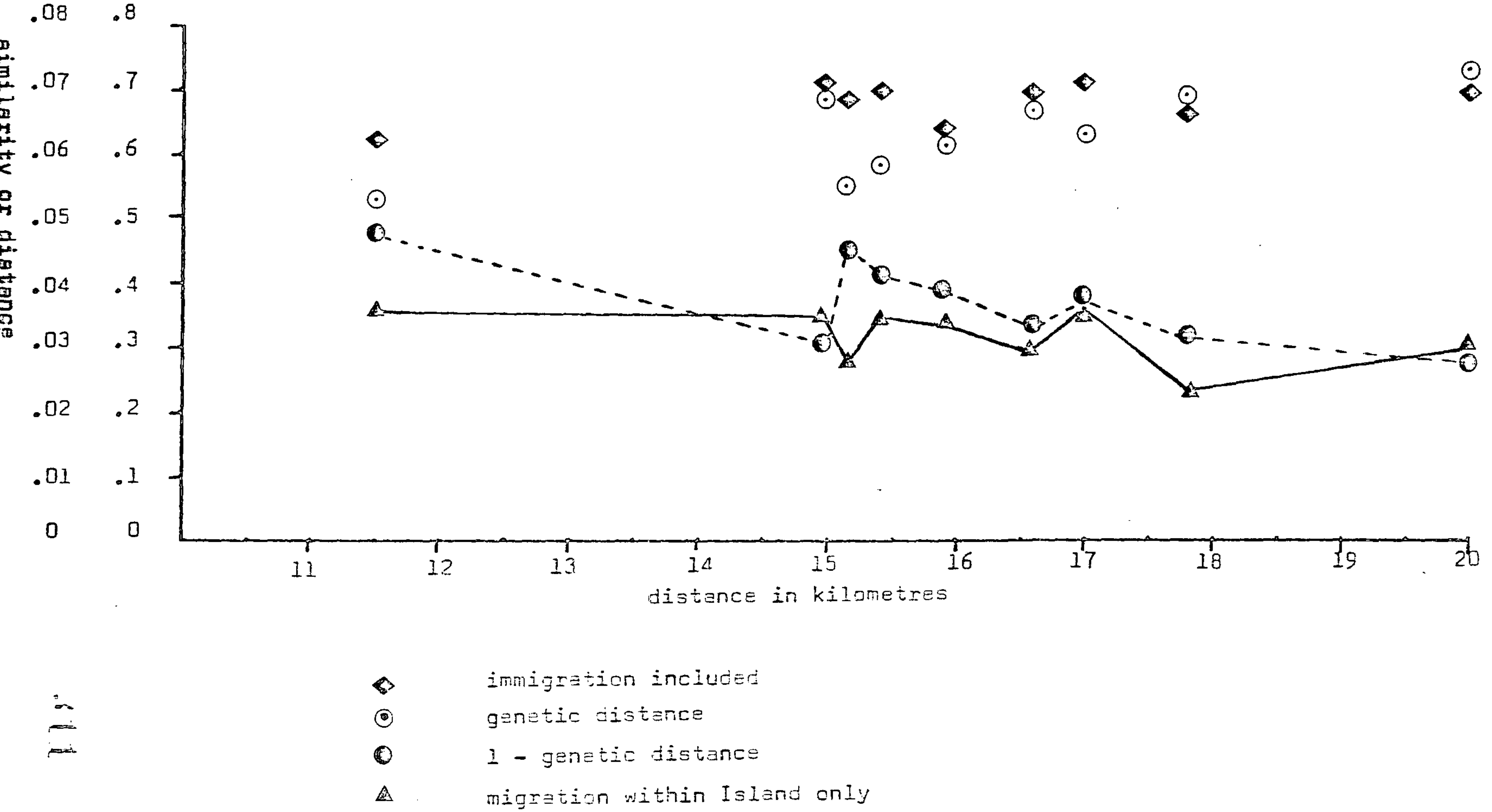


Figure 6.26 Mean genetic distance and mean similarity due to migration associated with each pooled area, plotted against mean road distance

CHAPTER SEVEN GENERAL DISCUSSION

I Introduction

The purpose of this chapter is twofold: firstly, the particular threads of evidence spun in each chapter must be woven together, and the resulting fabric examined for holes or faults; secondly, the techniques and methods used in the present work should be examined to see how well they do the job required.

To begin with, it seems appropriate to mention the way in which I have approached each chapter, and what I have hoped to discover in each. In general, I have tried to make a "blind" analysis chapter by chapter; by this I mean that I have endeavoured to make a prediction or a statement about the Isle of Wight's genetic variation based on the internal evidence of that chapter alone, and regardless of any corroboration or refutation which (by the time of writing) I knew to be supplied by the material of other chapters.

There are two comments to be made about this practice. Firstly, and at risk of protesting too much, it does seem well worth binding oneself to make some positive statement at each stage, if only because such an obligation concentrates the mind and material wonderfully. This was never more apparent than in Chapter two, where the policy deprecated retention of many miscellaneous items of information, mined as nuggets but seen as fool's gold in the light of day. Secondly, this "blind" analysis has happened to suggest conclusions that are relatively harmonious, and so there has been but little test of the ingenuousness which I am at pains to display.

II Genetic differences between the Isle of Wight and Mainland

Chapters two and four were concerned to predict from the past and present populations respectively whether or not genetic variation between the Island and the mainland was to be expected. Using very different data and even different methods of inference they were agreed that such a genetic distinction was hardly likely: there was no good evidence of any genetically distinct founding populations, and there was ample evidence of persistent and sizeable movement, migration and marriage between the Island and the English coast. Elementary theory shows that the genetic consequences of migration on this scale is not only the prevention of random differentiation but also the convergence of gene frequencies between the populations concerned. This conclusion seems inescapable, in spite of the paradoxical fact that the distributions of birthplace and of migration distances have all been heavily skewed towards the Isle of Wight.

The direct test of these predictions, made in Chapter five, was the comparison of phenotype frequencies between the total Isle of Wight sample and "appropriate" mainland control samples. The defect of this comparison has already been discussed; we do not know the tolerances of unmatched control samples, because we know so little about the distribution of the markers employed and not much about the samples' composition. Accepting this as a limitation of the technique we can still be confident in this case that the samples revealed no systematic difference in gene frequencies between the populations.

III Genetic variation within the Isle of Wight

This subject was dealt with rather tentatively in Chapter two. The recent historical evidence suggested migration heavy enough to homogenise gene frequencies, but the possibility was raised that Newport and the more rural West Wight might have rather less immigrant genes that Cowes and the East Wight towns supporting tourism.

The only evidence bearing directly on the problem in Chapter four is the distributions of birthplace and birthplace-residence distances among blood donors and spouses born and living on the Island. These distributions suggest that even within the confines of the Island migration and genetic exchange decreases sharply with distance, but this social isolation is unlikely to be extreme enough to have genetic consequences.

The fullest predictions of genetic variation within the Isle of Wight are made by the migration matrices in Chapter six, and from these two clear inferences may be drawn. The first is that when migration only within the Isle of Wight is considered, the predicted pattern of genetic variation fits, though imperfectly, the geographical road distances between towns. The second is that when all migration including immigration is given equal weight in the matrix, the decline of genetic relatedness with distance gets swamped, and only the very closest settlements geographically (for example, Cowes and East Cowes) rise above the general level of predicted relatedness.

In view of the large amount of immigration believed to have occurred not only for the last two generations but also for the last two hundred years I had expected the genetic distance measures between populations to be similarly unconnected with road distance. If they showed any pattern at all, it was most likely to be a contrast between the rural west and the urban east, anticipated above.

It was surprising, therefore, when Figures 6.17 and 6.19 showed a clear relationship of genetic distance with geographical, and a detectable though rather more diffuse one with internal migration. The explanation of this offered (namely that the pattern of immigration recorded from the blood donors was unrepresentative of immigration in the past, but that the geographically-governed internal migration had persisted for much longer) is at least susceptible to further investigation but is not supported by any good evidence to hand at the moment. In Chapter four, in discussion of Figure 4.31, it was suggested that perhaps immigration was more recent in the Isle of Wight than in the Welsh borders, but frankly I did not consider this evidence strong enough to carry weight beyond its immediate illustrative context.

Aside from the genetic distance statistics, the other measure of internal genetic differences is made in Chapter five, where division of the blood donor sample by birthplace and "ancestry" is the analytical procedure employed. I have disparaged this technique as well as using it, and the results suggest no more than an ABO phenotype frequency difference, with proportionally more A genes among the "native" population. Such a difference is consistent with the general pattern of ABO frequencies in the British Isles as revealed by Kopec (1970). Beyond the well-documented ABO system this method could be misleading, and I value the critique of it more than the results of its application.

As for the differences between rural West Wight and urban East Wight, they have not emerged, and perhaps they have not been sought assiduously enough. Were such differences to occur they might predictably do so among the ABO system rather than any other. However, the ABO gene frequencies in Table 6.20 do not shows any pattern in the direction suggested. This is a superficial analysis since it ignores the structure of these donor samples, and a fundamental drawback may be the nature of donor samples themselves. I have mentioned previously the bias towards town-dwellers in donor sampling; it may be a particularly clumsy device for the detection of differences between urban and rural populations.

IV Comments on methodology

Under this heading I intend to examine the limitations of some of the methods used in this survey, as well as to mention some analytical techniques ignored, or discovered too late to be applied.

As mentioned in Chapter one, a major methodological constraint on my treatment of the survey population is simply the scale of the Island.

Whilst in archaeological and historical secondary sources it is often too small to figure except as a satellite or appendage of Wessex, it seemed too large to be amenable to the techniques of local history and historical demography which have so illuminated Colyton (Wrigley, 1966, 1975), Oxfordshire (Küchemann et al. 1967) or, my nearest model here in Durham, Holy Island (Cartwright 1973). In consequence of this omission I have relied upon narrative local histories, some of them rather lightweight, to sketch the population's development. The resulting house is, I fear, built upon sand; some quantitative historical analysis based upon Anglical parish registers and the 1851, 1861 and 1871 Censuses not only would put Chapter two on a firmer foundation, but also would give perspective to the present-day migration rates described in Chapter four and used in Chapter six to predict genetic relationships within the Island. This seems to me to be a considerable omission from the present work, but it is one which could be filled in the future.

From the point of view of sampling genetic and demographic information, the Island's size and disposition of population has proved suitable. This is not quite more by luck than judgement, but the rough estimates of blood donors' and school children's numbers which then seemed an adequate basis for procedure, do not now seem to comprise a proper sampling strategy. In particular, the difference in sampling needs between a study of internal variation and a comparison of the Island with the mainland had not been recognised. The inclusion of (almost) all resident and willing donors is logistically the easiest method of recruitment; it approximates to sampling the population on a proportional basis (about 1½% in this case) and thus, if unbiased, is ideal for comparing the Island with elsewhere, but it takes no thought for the adequate representation of numerically small sub-populations within the Island, for example, Yarmouth, for the purpose of internal comparison. One of the results of this is the confusion between the effects of population size and sample size.

The number of genetic samples that can be analysed, and the number of questions that can be asked of volunteers, are matters about which it is impossible to generalise. In a study of this sort these, as well as the choice of genetic markers to be assayed, depend largely on the manpower and expertise locally available.

The effects of scale on the analysis may be summarised as follows: the Isle of Wight is too small to be very usefully represented in works of archaeology or history; it was considered too large for systematic study by the methods of historical demography; it is about the right size to predict and detect internal genetic variation among the living populations, as well as variation between it and elsewhere.

A general criticism of methodology which may be directed at this work is that the analytical techniques chosen are often rather crude. There is, of course, no general objection to simplicity: quite the contrary. On a number of occasions, however, I have used methods which, were the work to be repeated, I should replace. The reason for retaining them now follows quite simply from this; to replace them the work would have to be repeated. Some examples of this defect are listed below:

(a) Measurement of distances with a ruler on a map would be improved by obtaining straight line measures from map references by Pythagoras's theorem. This would not necessarily increase the accuracy of the measures but it would allow the distances to be generated rapidly by computer once the initial coding was done. (Within the Isle of Wight road distances are preferable, but for relatively long-distance migration the crow flies accurately enough.)

(b) The most efficient way of estimating gene frequencies, the method of maximum likelihood, was not used. Computer programs to do this are available.

(c) The migration matrix model used to predict genetic similarity does not incorporate random differentiation.

The more sophisticated ones do (Bodmer and Cavalli-Sforza 1968; Morton et al. 1971, 1976; Smith 1969).

(d) The genetic distance and plotting programs were used because they were the most readily available, and no attempt was made to test the significance of genetic distances. The use of the methods employed has been justified at an earlier state; they are mentioned again here to suggest that one of the kinship estimating programs (see for example Kirk et al. 1977; Morton et al. 1977) might have been a better choice. The value of using a kinship measure is that it may be predicted from independent sets of data such as migration, surnames, genetics or genealogies and in each case give a measure which has the same evolutionary meaning (Morton, Yee et al. 1971). Except that surnames were not collected as completely as possible, there is no reason why kinship analysis should not later be applied here.

(e) The comparison of matrices might be done in a rather more sophisticated manner than by scatter diagrams and the measurement of linear relationships. There are computer methods of comparing matrices, but these have come to my attention only recently (Crawford 1980).

The cumulative effect of these evasions and simplifications is not inconsiderable. Although it cannot remove a shadow from the present work, the silver lining to this cloud is that the raw data are preserved and may be reworked with new methods in the future. Praise of raw data may seem faint indeed, but the general lack of distributional evidence in the British Isles and the uncertainties in comparative study alluded to in previous chapters, give this the lie. If attempts at collaboration and synthesis are to avoid the ambiguities which presently must beset them, the provision of full demographic and social information should accompany any genetic sample. It is for this reason that the absence of social class and surname data from the blood donor sample strikes me as a greater blemish, because beyond repair, than some of the technical weaknesses listed above.

Finally, I shall give some thought to the justification of studies like this one, monographs whose primary focus is a population rather than a problem. In this distinction lies a good part of the answer; we have seen that the wider range of the former blunts at least some of the researcher's analytical tools, whilst a narrower particular problem may be dealt with more incisively. For a monographic study to be justified and to succeed, the population must be illustrative of a particular problem or evolutionary process. The direction in which I started out, of undertaking a general genetical survey of the Isle of

Wight population, has been diverted from disaster (I hope) only by changing orientation towards the problem of migration. The physical separateness of an Island lends itself well to this kind of study, providing a null hypothesis more exact than could be given by an inland region. Almost by chance, migration and genetic variation within the Isle of Wight were appropriate subjects of study, owing to the size of population and the pattern of settlement.

Off-shore islands beguile the individual researcher into a monographic treatment; their finite populations and distinctiveness of place suggest that his single candle has the power to illuminate every facet. There is great appeal in the notion that one will examine a population from the earliest times to the present day, and by doing so explain its genetic structure. It is, I think, the attraction of comprehensiveness (which procrastinates choice) as well as the compelling anthropological possessive ("my people") which combine to produce this effect. But we and our successors must beware: what attracts us to small islands may be the sirens' song.

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Appendix I Form for recording blood donors' demographic data

UNIVERSITY OF DURHAM

Department of Anthropology,
South End House, South Road,
Durham City.

ISLE OF WIGHT STUDY

NAME ....

PLACE OF BIRTH ....

FATHER'S PLACE OF BIRTH ....

MOTHER'S PLACE OF BIRTH ....

FATHER'S FATHERS PLACE OF BIRTH ....

FATHER'S MOTHERS PLACE OF BIRTH ....

MOTHER'S FATHERS PLACE OF BIRTH ....

MOTHER'S MOTHERS PLACE OF BIRTH ....

BIRTHPLACE OF SPOUSE ....

APPENDIX II Letter to parents and schoolchildren's demographic questionnaire

Department of Anthropology,
University of Durham,
South End House,
South Road,
DURHAM.

BIOLOGICAL STUDY OF THE ISLE OF WIGHT

Dear Parent,

I am an ex-pupil of Sandown School and am now a post-graduate in the above department. I am being financed by the Medical Research Council to carry out a research project about genetic variation and marriage patterns in the Isle of Wight. My particular concern is variation in blood group frequencies, and one of the aims of the project is to discover whether the people of the Isle of Wight can be distinguished from those of other areas by such genetic factors as blood groups.

Material for this is being collected in a number of ways, but much important basic information can be gathered by taking small blood samples and obtaining background information from a large number of school children.

The enclosed questionnaire will give me valuable information about marriage patterns and family size. The blood sample consists of a few drops only and will be taken by the finger-prick method. This is a virtually painless technique which is commonly used in preliminary tests at blood donor sessions.

I should like to express my gratitude to the Education Committee, the County Education Officer, the Governors and the Headmaster for allowing me to ask the help of parents and pupils in this way. Also I must emphasise that your and your child's participation is entirely voluntary, and that any information given will be held by me in confidence.

I shall be most grateful if you will give permission for your child to take part in this project, which may be of value to biological and medical research in the future.

Yours faithfully,

Malcolm Smith

I give/do not give permission for my son/daughter to take part in the survey outlined above.

SIGNED ....
(Parent/Guardian)

APPENDIX II continued

NAME ....

FORM ....

CONFIDENTIAL

PERSON	SEX	SURNAME & INITIALS	DATE OF BIRTH	PLACE OF BIRTH (Town & County)	OCCUPATION
SELF					
BROTHERS &/or SISTERS					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
FATHER					
FATHER'S FATHER					
FATHER'S MOTHER					
MOTHER					
MOTHER'S FATHER					
MOTHER'S MOTHER					

Number of Father's brothers and sisters =

Number of Mother's brothers and sisters =

APPENDIX III

Freezing and Recovery of Red Cells in liquid Nitrogen

A. Reagents

(1) N_2 freezing solution
350 gms Glycerol
40 gms Sorbitol
make up to litre with 0.9% saline

(2) N_2 recovery solution
160 gms Sorbitol
make up to litre with 0.9% saline

B. Freezing

(1) to washed red cells add an equal volume of the above N_2 freezing solution (mix thoroughly but quite slowly).

(2) 1.5 ml of the above mixture is then pipetted into screw-cap nitrogen ampoules and cap screwed tightly. (In fact I just pipette red cells into ampoule and then an equal volume of freezing mixture and mix - this saves a lot of time).

(3) Sealed ampoules can then be frozen down quickly at -196°C in anodised aluminium racking.

(4) Storage at this temperature can either be in liquid or vapour phase of N_2.

C. Recovery

(1) The amouples are removed from storage container using utmost care and dropped into a +45°C water bath for two minutes.

(2) Thawed cells are then centrifuged and supernatant removed.

(3) Cells are then resuspended and washed once in the nitrogen recovery mixture, followed by two further washes in isotonic saline (0.9%).

(4) Cells are now ready for use, recovery being approximately 60-70%.

N.B. Red cell grouping has to be done soon after this, as the recovered cells tend to lyse quickly.

Reference: Krijnen *et al.* (1964).

Appendix IV MIGR

```
$l migr
>       DIMENSION A(7,7),P(7,7),R(7,7),ATEMP(7,7),ATRANS(7,7)
>       DIMENSION MFOR (4)
>       READ(5,11)MFOR
>    11 FORMAT(4A4)
>       READ(5,12)N,NGENS
>    12 FORMAT(I3)
>       READ(5,13)((P(J,K),K=1,N),J=1,N)
>    13 FORMAT(16F5.4)
>       DO 33 J=1,N
>       DO 33 K=1,N
>       ATEMP(J,K)=0.0000
>    33 CONTINUE
>       DO 44 J=1,N
>       DO 44 K=1,N
>       ATRANS(J,K)=0.0000
>    44 CONTINUE
>       DO 55 J=1,N
>       DO 55 K=1,N
>       IF (J .EQ. K) GO TO 23
>       A(J,K)=0.0000
>       GO TO 55
>    23 A(J,K)=1.0000
>    55 CONTINUE
>       ITER=0
>   555 CONTINUE
>       DO 66 J=1,N
>       DO 66 K=1,N
>       R(J,K)=0.0000
>    66 CONTINUE
>       DO 88 J=1,N
>       DO 88 K=1,N
>       SUM=0.0000
>       DO 77 L=1,N
>       SUM=SUM+A(J,L)*P(L,K)
>    77 CONTINUE
```

```
      ATEMP(J,K)=SUM
   88 CONTINUE
      DO 99 J=1,N
      DO 99 K=1,N
      A(J,K)=ATEMP(J,K)
   99 CONTINUE
      NLESS=N-1
      DO 100 J=1,NLESS
      JPLUS=J+1
      DO 100 M=JPLUS,N
      DO 100 K=1,N
      IF (A(J,K) .LT. A(M,K)) GO TO 24
      R(J,M)=R(J,M)+A(M,K)
      GO TO 100
   24 R(J,M)=R(J,M)+A(J,K)
  100 CONTINUE
      ITER=ITER+1
      WRITE(6,14)ITER
   14 FORMAT(1H1,I3)
      DO 122 J=1,N
      DO 122 K=1,N
      ATRANS(J,K)=A(K,J)
  122 CONTINUE
      WRITE(6,MFOR)ATRANS
      WRITE(6,MFOR)R
      IF (ITER .LT. NGENS) GO TO 555
      STOP
      END
```