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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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3

To the memory of my father

C O N T E N T S

ACKNOWLEDGEMENTS

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 contin-

uous 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 pre-

diction 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
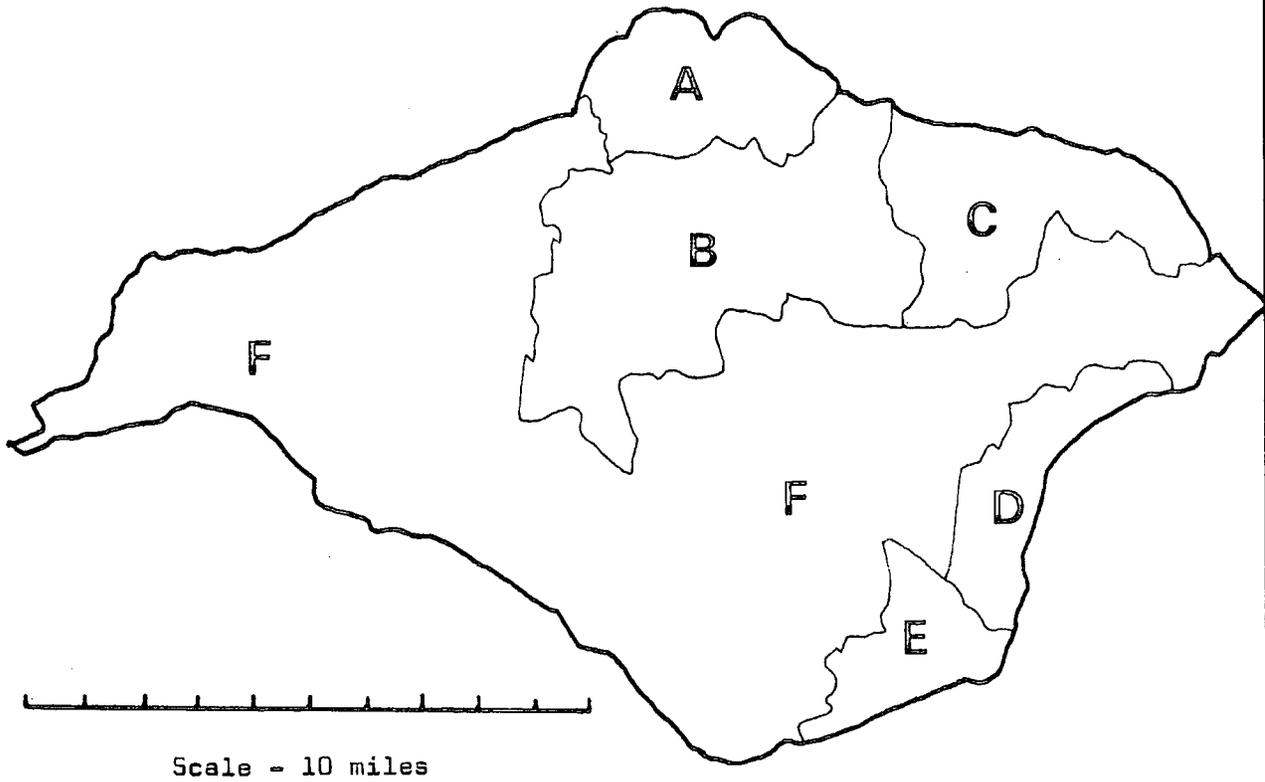
KEY   Population at 1971 Census

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 develop-

ment 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 distri-

bution 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 pre-

dicted 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 simil-

arity 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 de-

pendent 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 Meso-

lithic 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 pre-

dominantly 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 impli-
cation 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 distri-
bution 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 suffi-
cient new evidence to prove the Isle of Wight's part in the tin
trade it is indicative of some kind of trade and therefore con-
tact 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 communi-
cations 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 implant-

ation 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 en-

ough to those from Kent (Figures 3, 4 Leeds, 1957) for the argu-

ment 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 represent-
ing 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 docu-

mentary 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 main-

land, 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 characteristic-ally "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 system-
atic 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 docu-
mentation, 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 develop-
ment 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 break-

down 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 gentle-

men 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
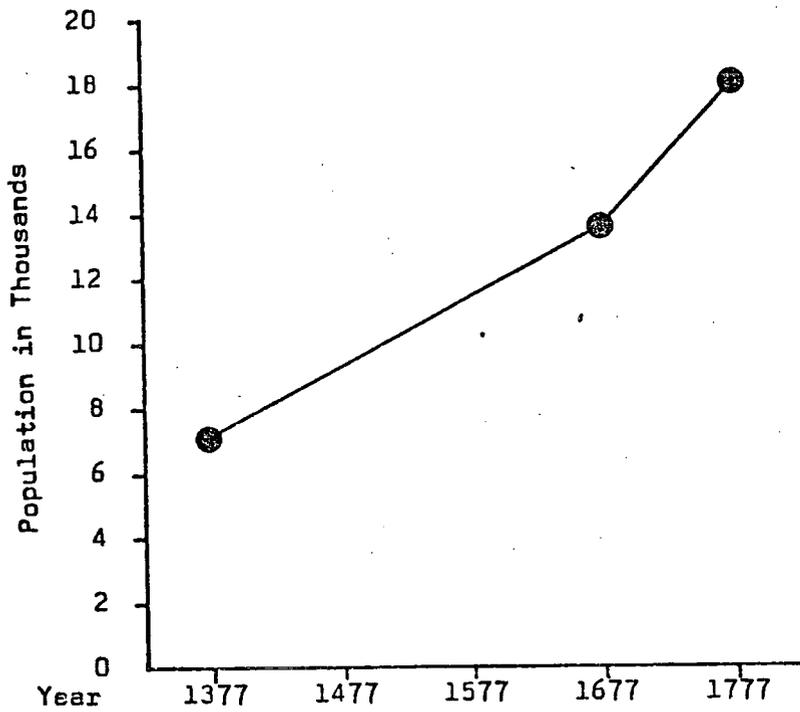
Figure 2.2 Isle of Wight population 1377 - 1777:
a second possibility
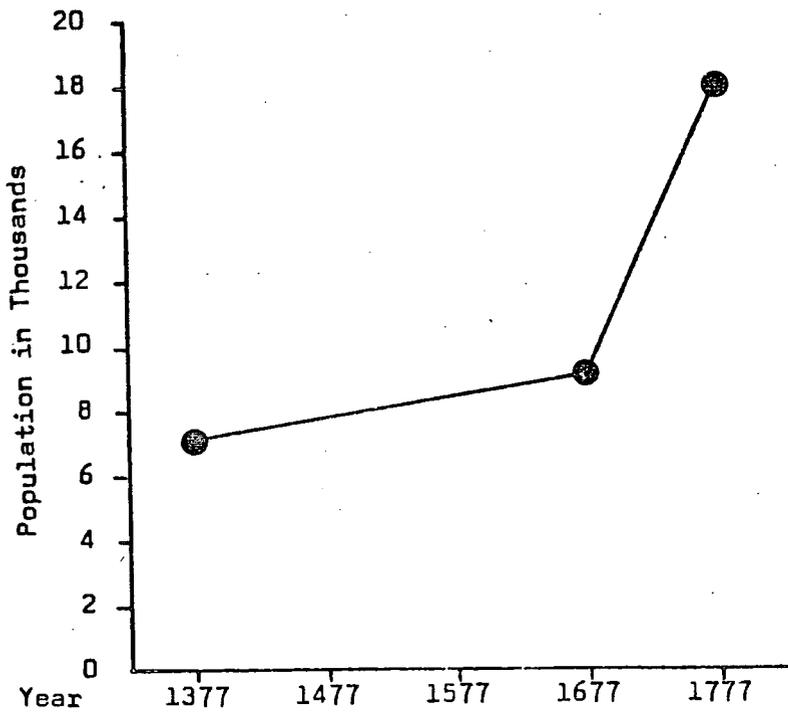
The appreciation of natural beauty fostered by the Romantic movement made the Island both a desirable place of residence and a holiday venue for the leisured classes. The extra-ordinarily mild climate, the clean air and the quick-witted entrepreneurs made it no less fashionable a health resort. When 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 re-flected the previous importance of the Island's towns. In the east, for example, Newchurch and Brading lost their trad-itional 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
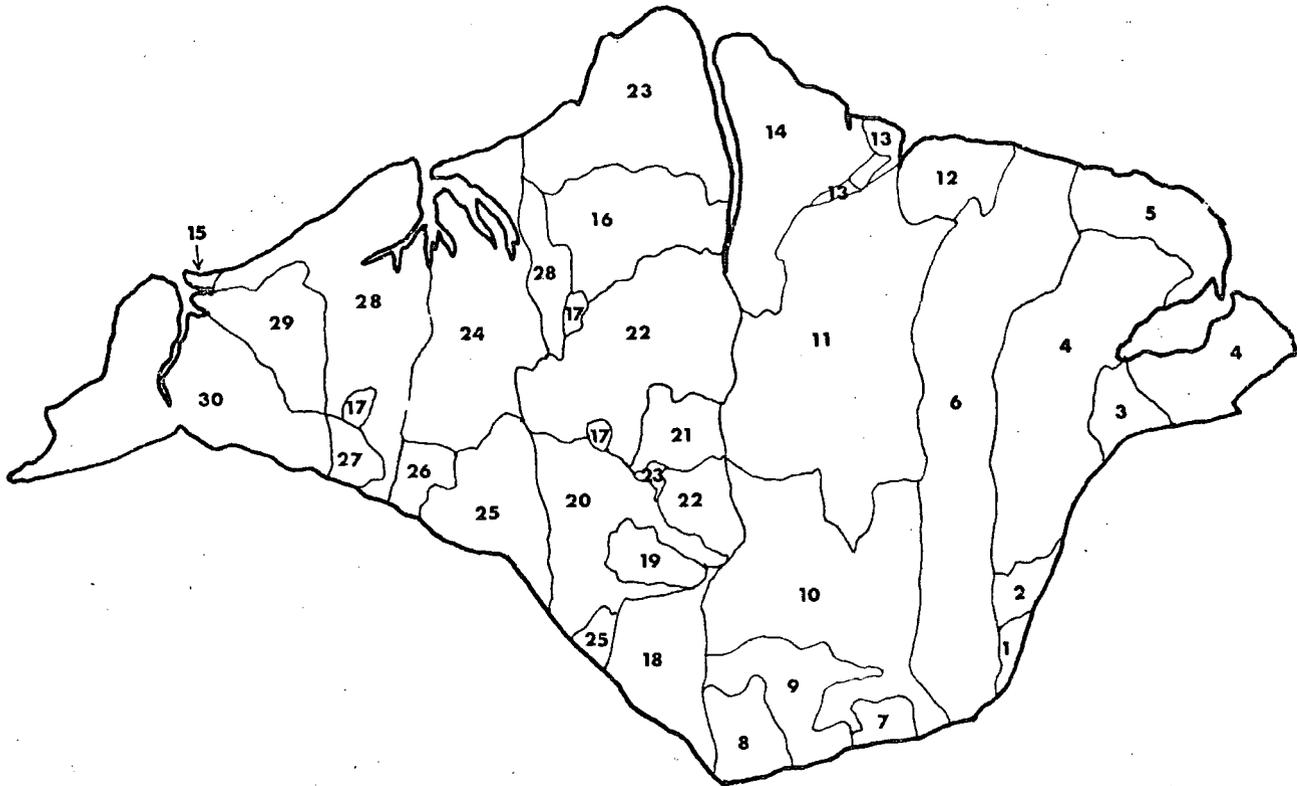
KEY

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 nine-

teenth 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 communi-

cations 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
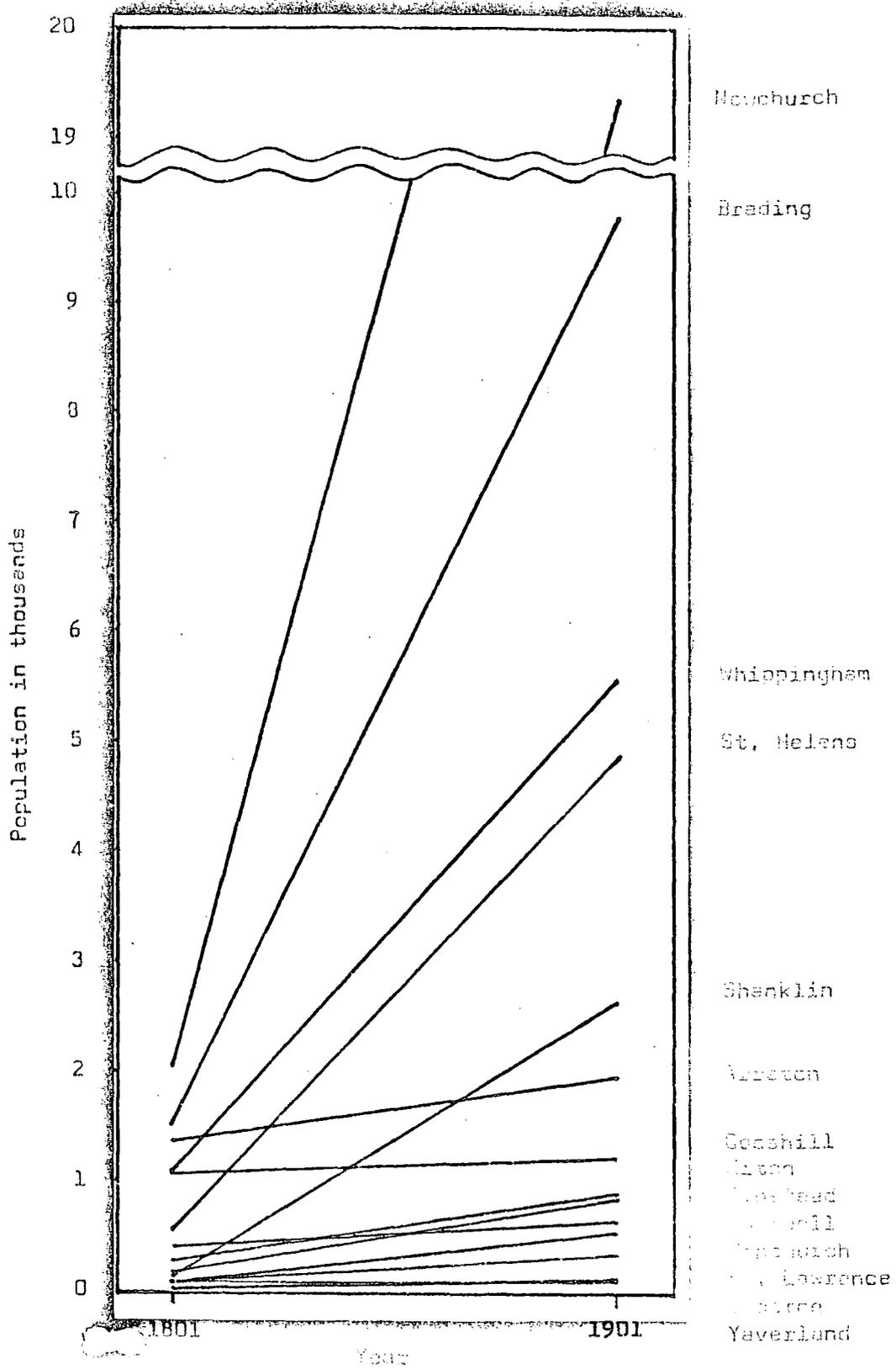
Figure 2.5 Growth of West Wight Parishes
1801 – 1901
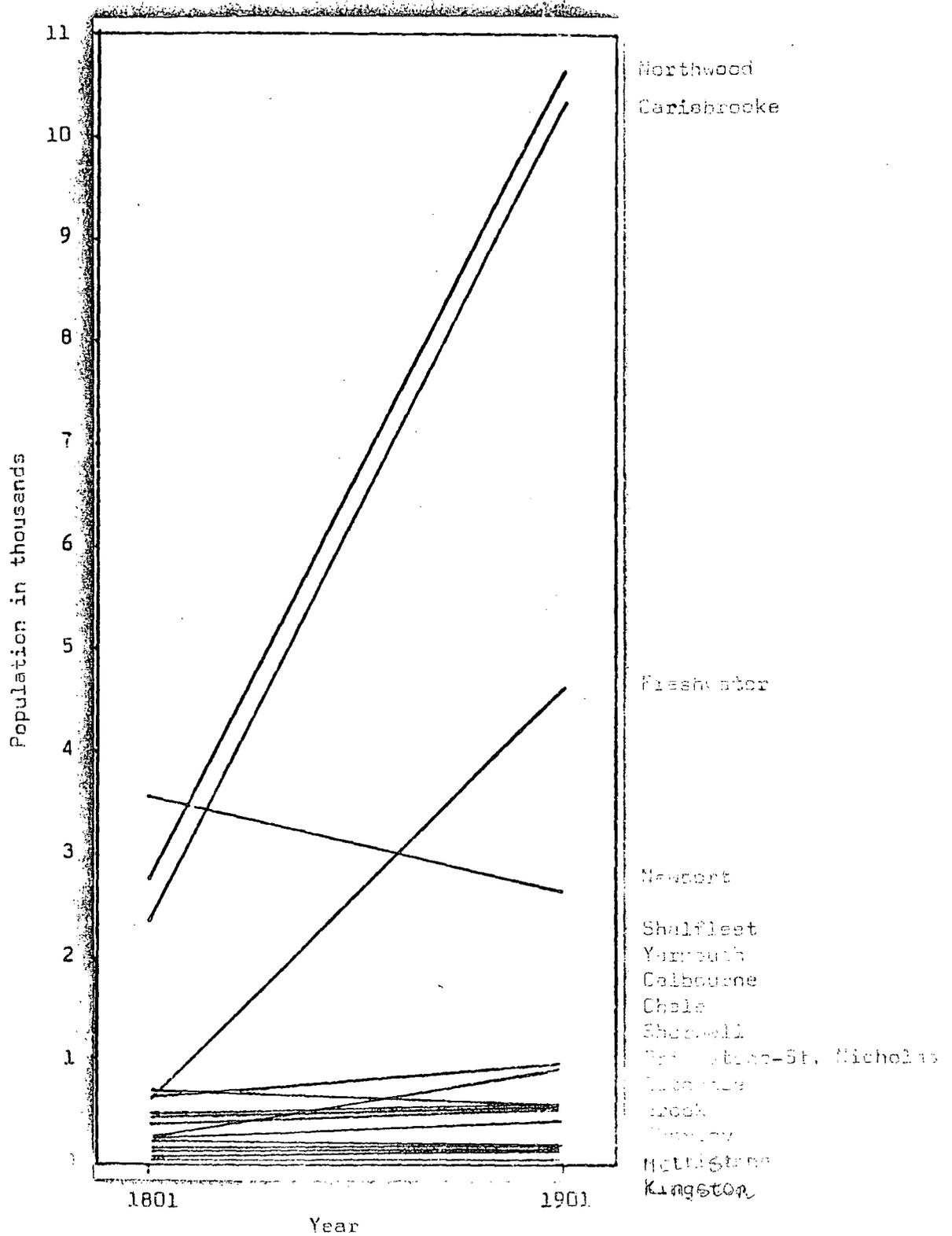
to be opened, reaching their greatest extent by 1900 (Figure
2.6 and Table 2.3). During the twentieth century the railways
have suffered competition from bus services and private cars,
so that at present the only remaining link is between Ryde
Pier Head and Shanklin.

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 con-
nected 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 communi-
cation 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
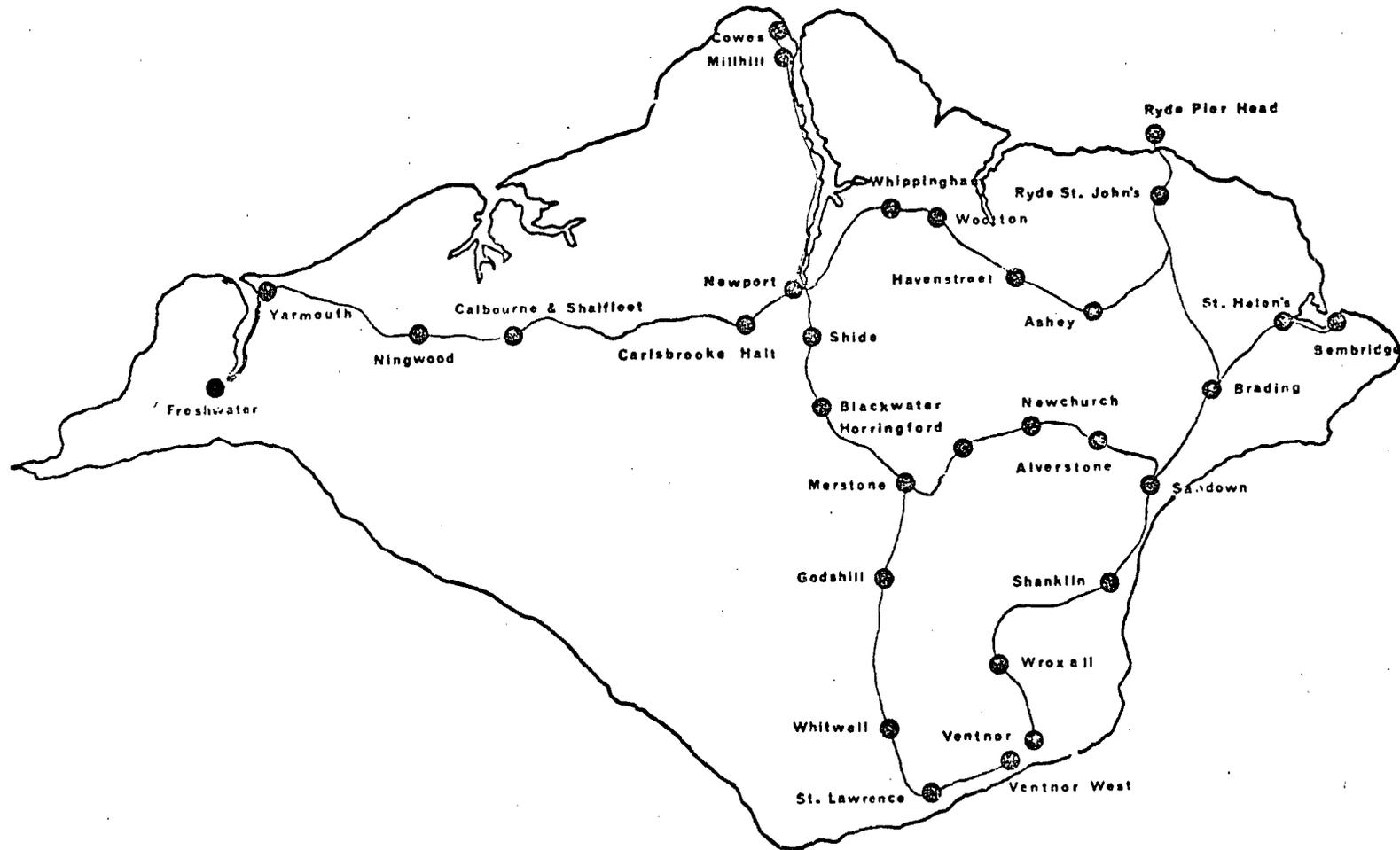
Table 2.3   Isle of Wight Railways:
             Opening of principal lines

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
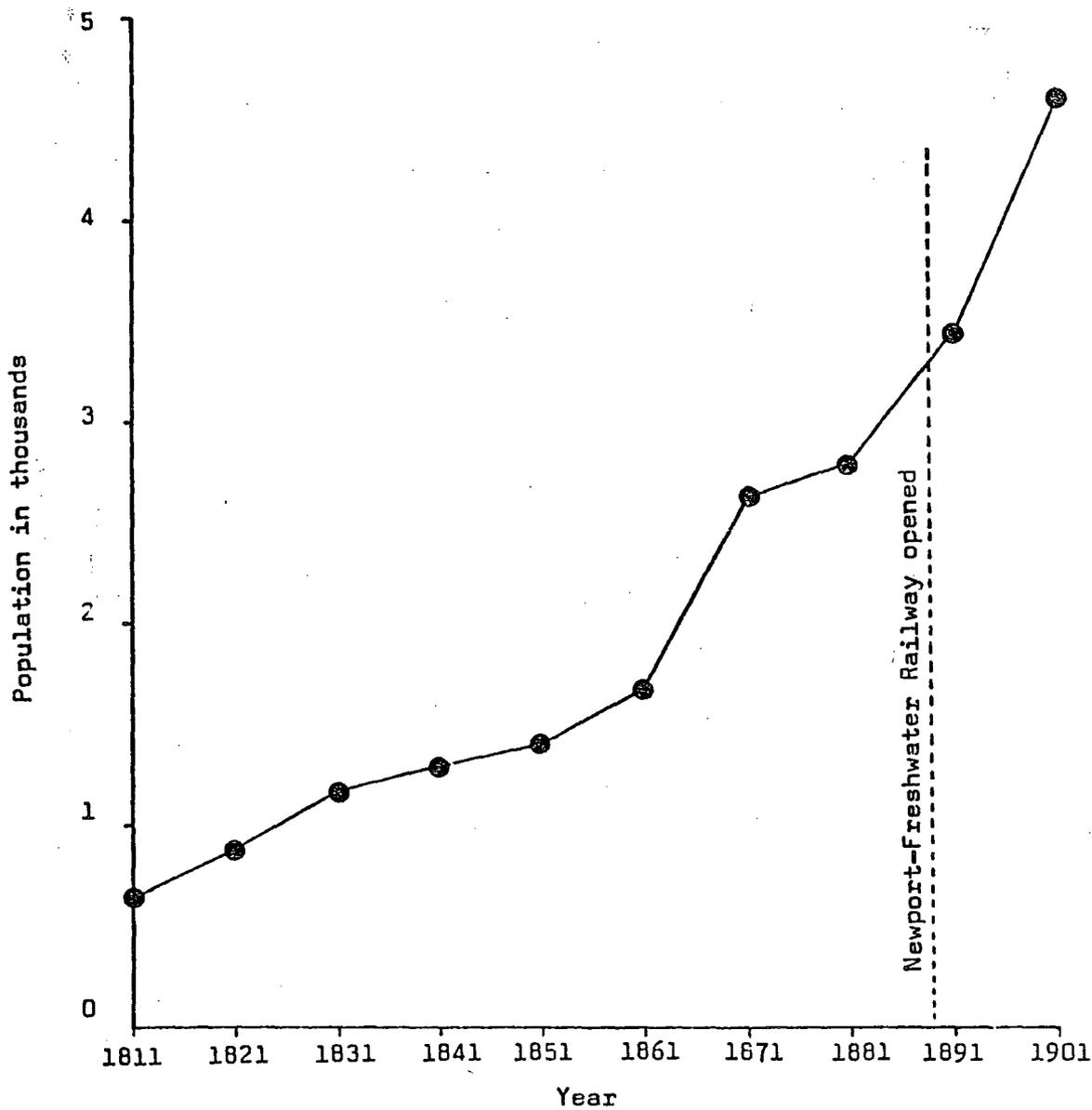
Figure 2.8 Growth of Brading parish 1801 - 1901
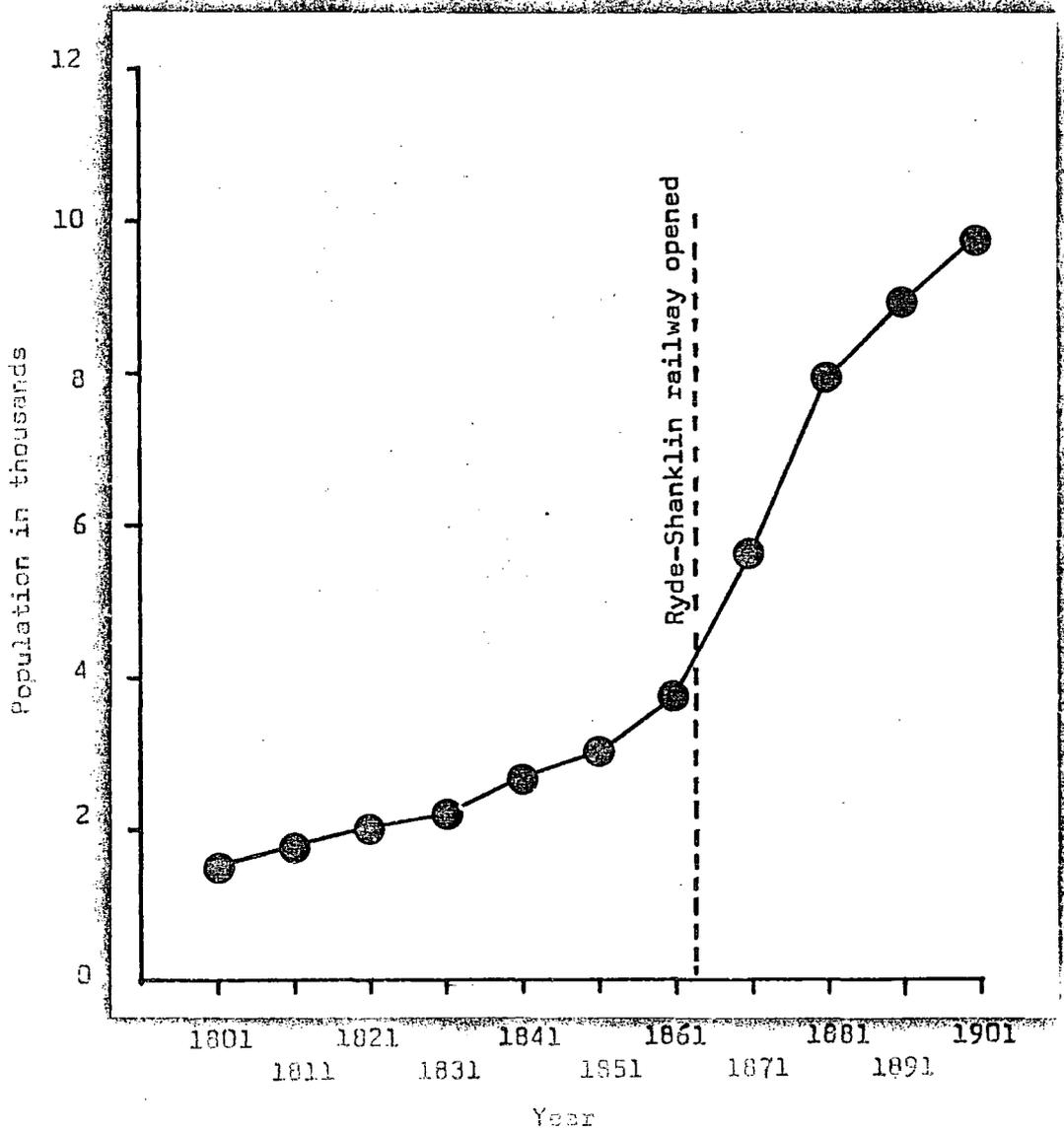
Table 2.4   Isle of Wight Population
1801 - 1971

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
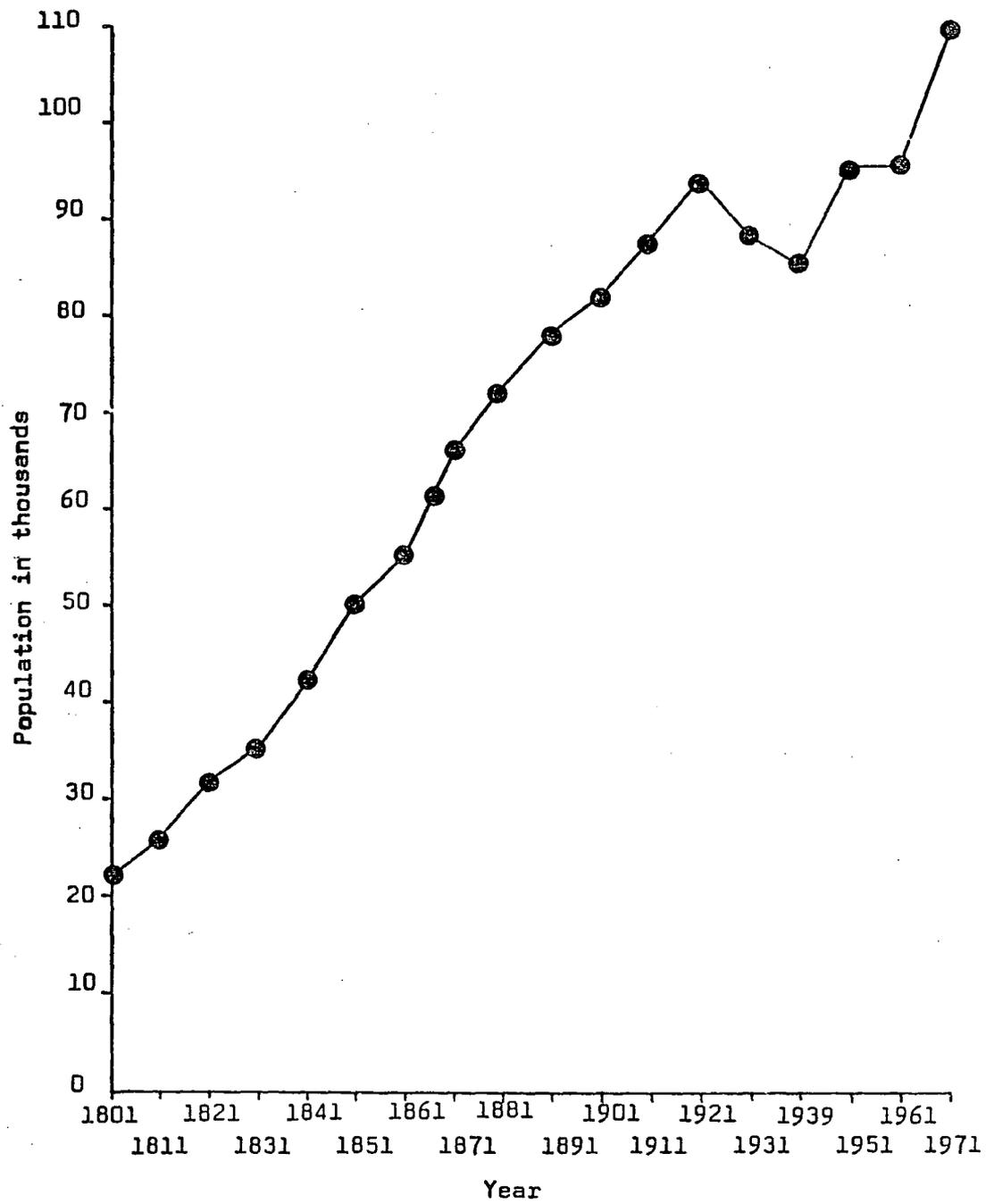
Second World War. The reduction of population between the Wars

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 holi-

days. 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 counter-
part 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 immi-
gration 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 bur-
geoned 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 popu-
lations 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 fol-
lowed, 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 develop-ment 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 demo-
graphic 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
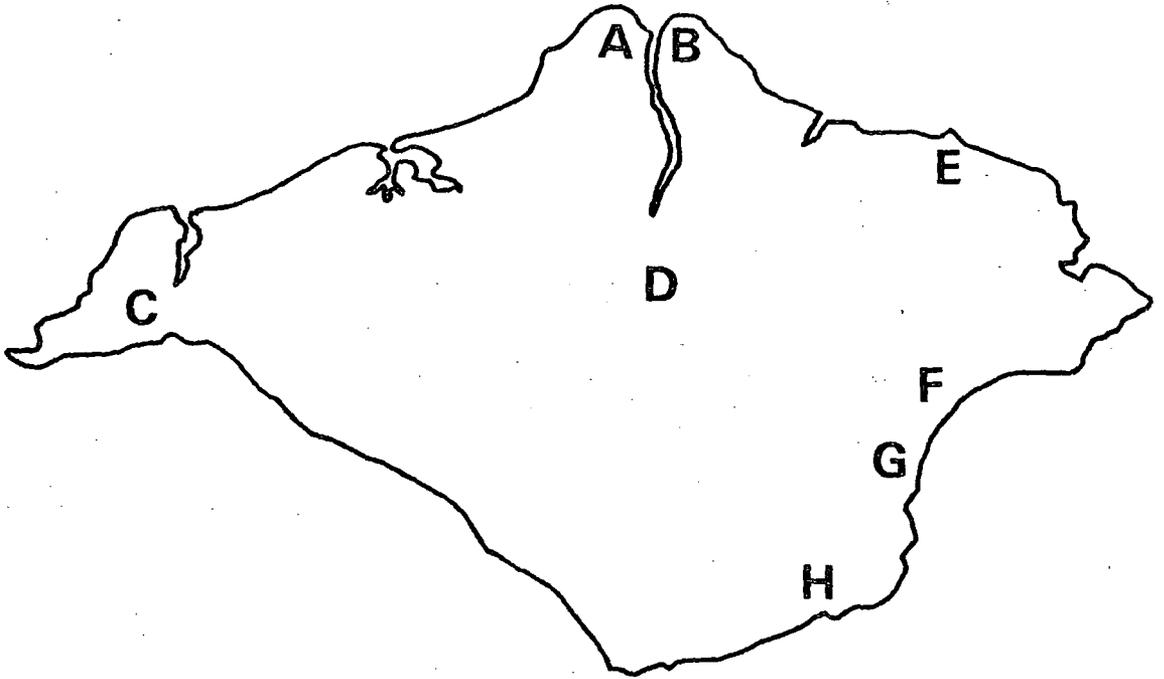
KEY

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 inter-
viewed. 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

DATE:	LOCATION AND TEL. NO. OF SESSION:	DEP.	RTH	SESSION TIMES:	HALL BOOKING CONTACT:	TEAM: (Subject to Alteration)	REMARKS:
MON. 23rd SEPT.	TRANSFUSION CENTRE					MRS.DOMONEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidbell Mrs.Slade, Mrs.Freebody.	
	VENTNOR - ISLE OF WIGHT Victoria Hall Victoria Street. 954-85256	Centre 0815		1330-1545 1700-1915	Mr.D.A.Weaver 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 23864.	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.Wincott, 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.DOMONEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidbell Mrs.Slade, Mrs.Freebody.	Accom. avail. 1230 Lunch avail. Crown Hotel.
	FRESHWATER-ISLE OF WIGHT Memorial Hall The Avenue. 954-83-2956	Ryde 1015		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.Wincott, 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.DOMONEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidbell 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 Fardell 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.Wincott, Miss Chapple	
THUR. 26th SEPT.	SOUTHSEA Central Hall FRATTON ROAD. 0705-22745	1045		1330-1545 1700-1915	Mr.Jenkins Portsmouth 22745	MRS.DOMONEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidbell 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 Fardell 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. 88-2241	1115		1330-1545 1700-1915	Mr.Johnson Central Clinic S. 34321	MISS VANDENBULCK, Miss Veal Miss Johnson, Miss Tinham Mrs.McKay, Miss Weeks Mrs.Wincott, Miss Chapple	
FRI. 27th SEPT.	CHRISTCHURCH Town Hall High Street. 070-15-4321	1045		1330-1545 1700-1915	Town Clerk's Department Christchurch 4321	MRS.DOMONEY, Mrs.Longman Mrs.Hibbert, Mrs.Woodnutt Miss Thomas, Miss Tidbell 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

Week Commencing - 30th September, 1974

DATE:	LOCATION AND TEL. NO. OF SESSION:	DEP.	ATT	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.DOWNEY, 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.Adney 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 2501	MRS.DOWNEY, 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.	Jr locked, at 16 Caesar 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.DOWNEY, 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.DOWNEY, 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.DOWNEY, 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

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. Windsett Mrs. Oakley, Mrs. Bickell	Leave equip. stacked at for out of Ealt. Stay Ryde.
	DUNLA'L-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. Lovey Mrs. McManus, Mrs. Emm Miss Littlehales, Mrs. Edworth, Miss Poulter	Accom. Avail. 12.30 Lunch avail. Crown Hale.
	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. Windsett 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 Edworth, Miss Poulter Mrs. McLoughlin.	
	NEWPORT - ISLE OF WIGHT Red Cross Hall, 1 Bunny 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. Windsett 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. Windsett Mrs. Thomas, Mrs. Slade Mrs. Freebody.	
THURS. 10th OCT.	COSHAM - PORTSMOUTH St. Cuthbert's Hall Hayling Avenue. 0705-25316(tr.Shaw opp.)	1030		1330-1545 1700-1915	Mr. B. Walters P'mouth 4101	MISS HENWOOD, Mrs. Emm, Mrs. McLoughlin, Mrs. McManus Miss Littlehales, Miss Poulter Miss Edworth.	
	EAST COWES - I.O.W. B.H.C. Social Club, Church Path, York Road, 956-3494/3342	Ryde 0900		1030-1200) Firm 1245-1500) 1515-1545) Pub 1700-1830) lic	Mr. R. Vincett Cowes 4101 Ex. 308	MISS VANDENBULCK, Miss Veal, Miss Tinham, Miss Johnson, Mrs. McKay, Mrs. Windsett 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. Percy, 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, Mrs. Poulter, Mrs. Emm, Miss Littlehales, Miss Edworth.	
	BRITISH HOVERCRAFT CORP.LTD. BHC Social Club, Church Path, York Rd., 956-3494/3342	Ryde 0800		0900-1200 1330-1430	Mr. R. Vincett Cowes 4101 Ext. 308	MISS VANDENBULCK, Miss Veal, Miss Tinham, Miss Johnson, Mrs. McKay, Mrs. Windsett Mrs. Oakley, Mrs. Bickell.	Return to R.T.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 question-

naire 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	sex
date of birth	marital status
place of residence	year of marriage
birthplace	number of children
birthplace of parents	year of move to Isle of Wight
birthplace of grandparents	whether treated as new donor
birthplace of spouse	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	number of sibs
date of birth	number of father's sibs
birthplace	number of mother's sibs
birthplace of parents	father's occupation
birthplace of grandparents	grandfathers' occupations
father's date of birth	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 anti-
serum 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 iso-
tonic 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.

74

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

xo 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 immed=
iately 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 electro-
phoresis 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 demo-
graphic 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 question-
naire 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 volun-
tary 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 dis-

belief. 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 collec-

ted 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 popu-

lation, 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
$\geqslant$ 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 sib-
ship 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 counter-

part 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, demo-

graphy 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   93

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

98

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 contri-
butions 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 adminis-
trative 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 unob-
tainable 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 demon-

stration 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 gener-

ation. 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 popu-
lation. 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

| F's M | F's f | Father | Child | Mother | M's F | M's M |

Ireland
Scotland
Wales

.9

North

.8

Midlands

.7

.6 Greater
London

.5

.4

South

.3

.2

Isle of
Wight

.1
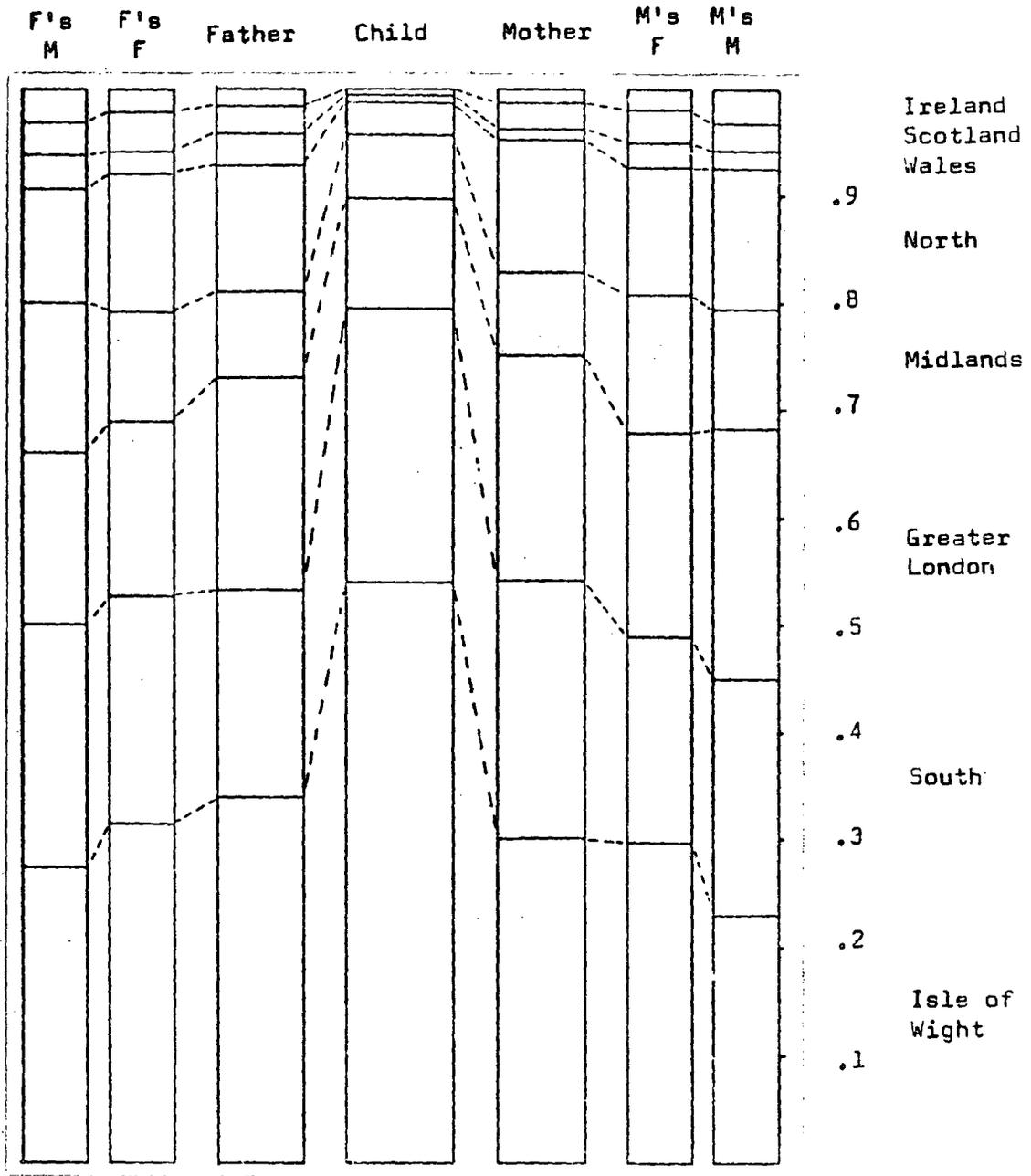
Finally, these data may be reduced to a level where the only

concern is whether or not an individual was born on or off the

Isle of Wight. Concordance and discordance between gener-

ations can then be demonstrated. Table 4.6 does this for

the children and their parents. The columns denote the relation-

ship and the rows the concordance or discordance of birth-

places. 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 (X^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 off-

spring, 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 endoga-

mous 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' birth-
places. 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 dis-

tances 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 birth-

place 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
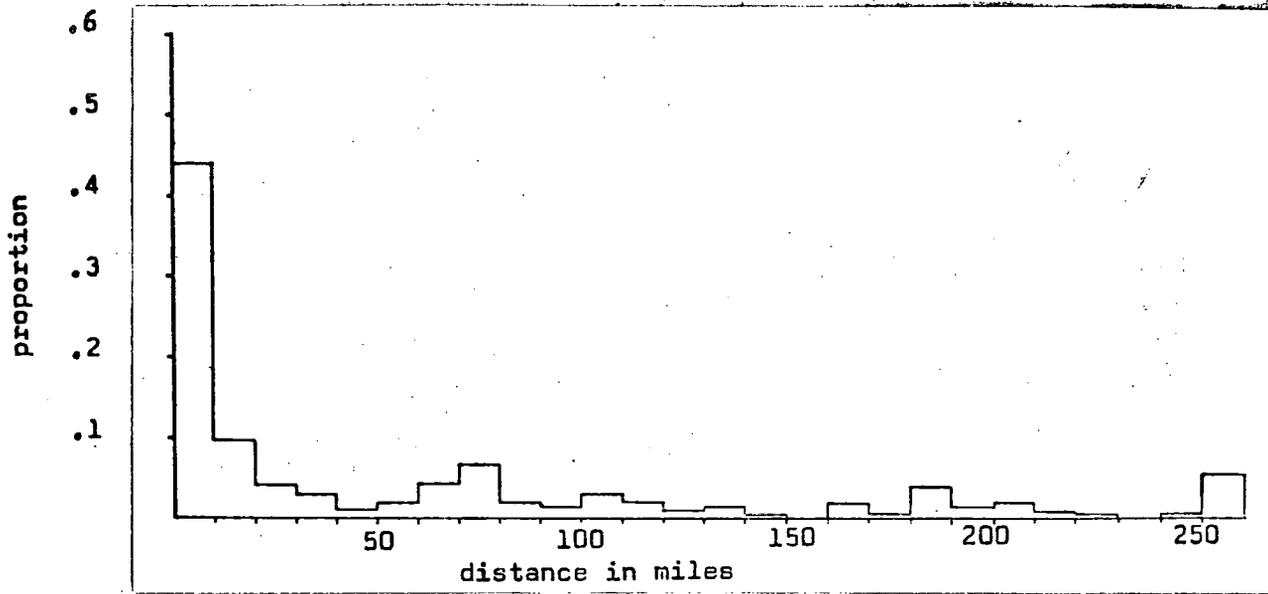
Figure   4.3   School children:
                distribution of mother-offspring distance
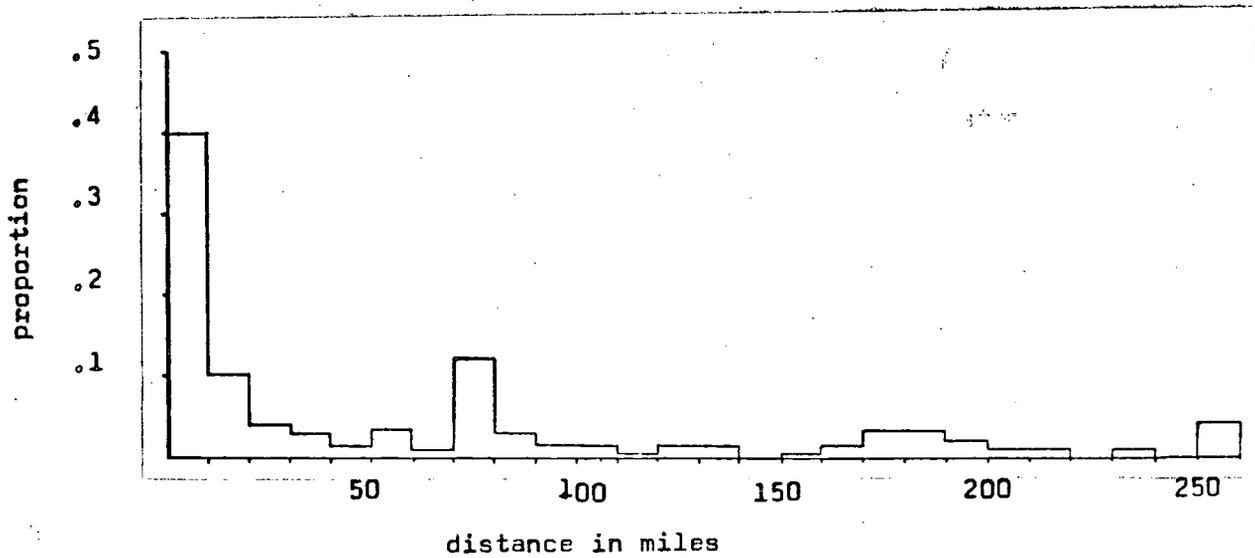
as histograms in Figures 4.4, 4.5, 4.6 and 4.7, these data

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 pro-

portion 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 cate-

gories 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

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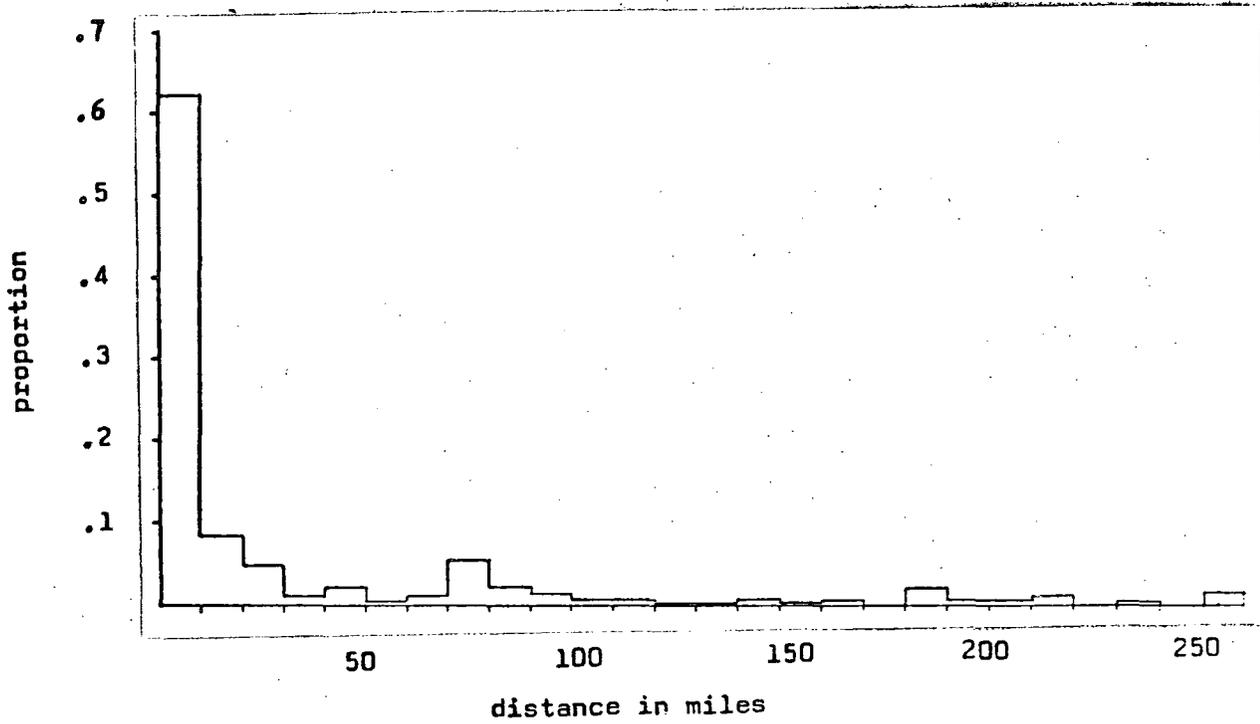
Figure 4.5   School children:
              distribution of mothers'
              father-offspring distance
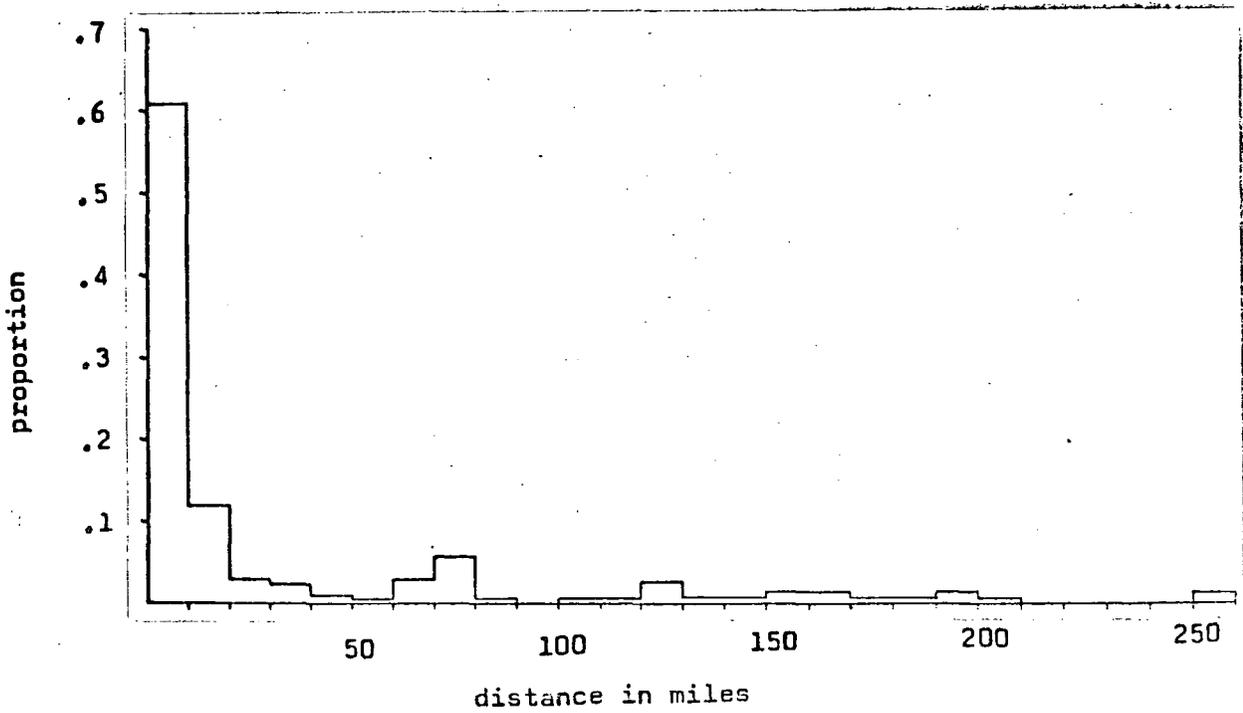
distance in miles

Figure 4.6 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
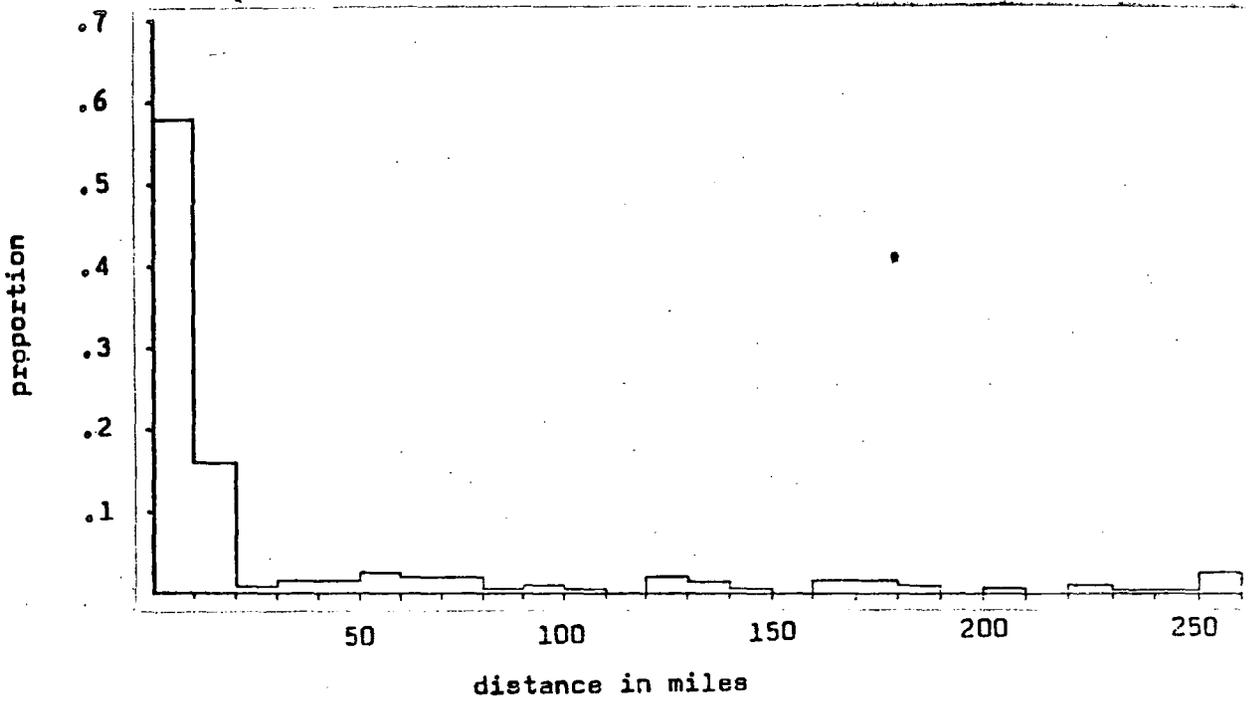
Figure 4.7 School children: distribution of mothers' mother-offspring distance
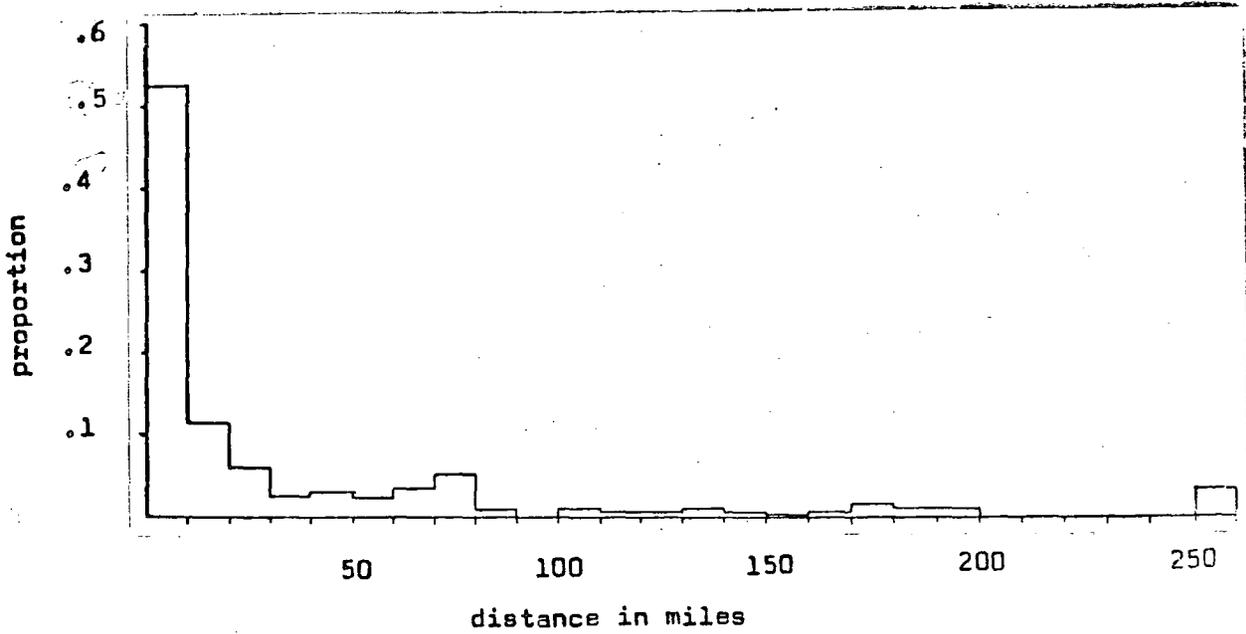
Table 4.9   School-children: parent-offspring
             distances, cumulative proportions

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

parents' parent-offspring distance
father-offspring distance
mother-offspring distance

distance in miles
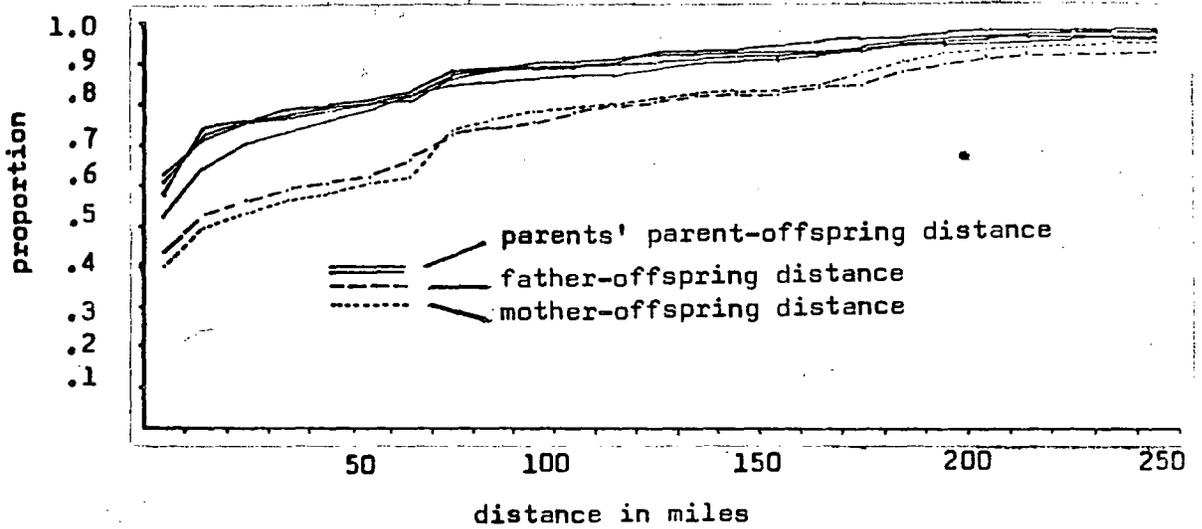
Figure 4.9   School children:
              distribution of
              parents' birthplace distance

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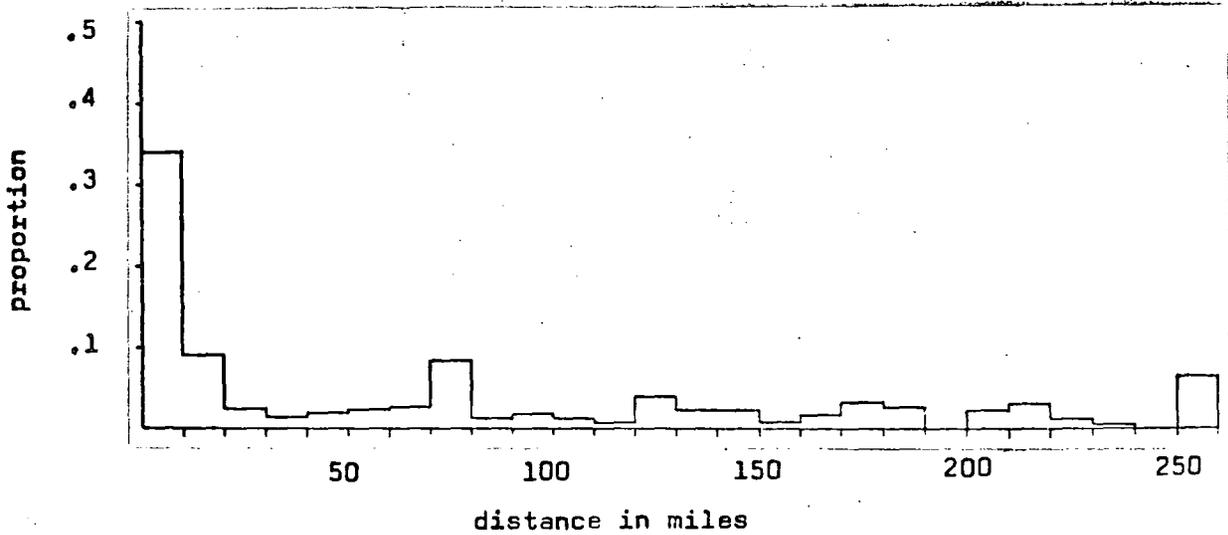
contingency table of generation against distance. This is
done in Table 4.10.

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 local-
ities 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 dis-
tance as an analogy for the size of the gene pool is consider-
able, though its difference in kind from the other measures
should not be forgotten. Table 4.11 shows the distribution

118

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 distri-

bution 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 distri-

bution among (a) their own control group of nine and ten-year-

old children, (b) the Isle of Wight total population (infor-

mation from schools about all school children) and (c) seven-

Figure 4.10 School children:
distribution of fathers'
parents' birthplace distance
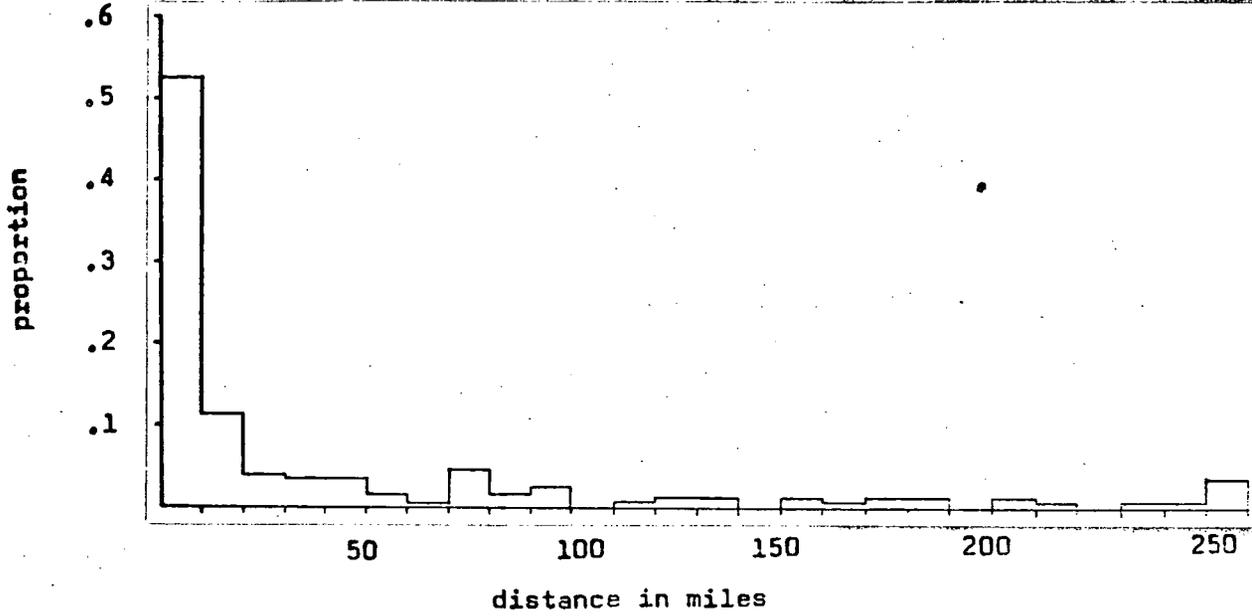
Figure 4.11 School children:
distribution of mothers'
parents' birthplace distance
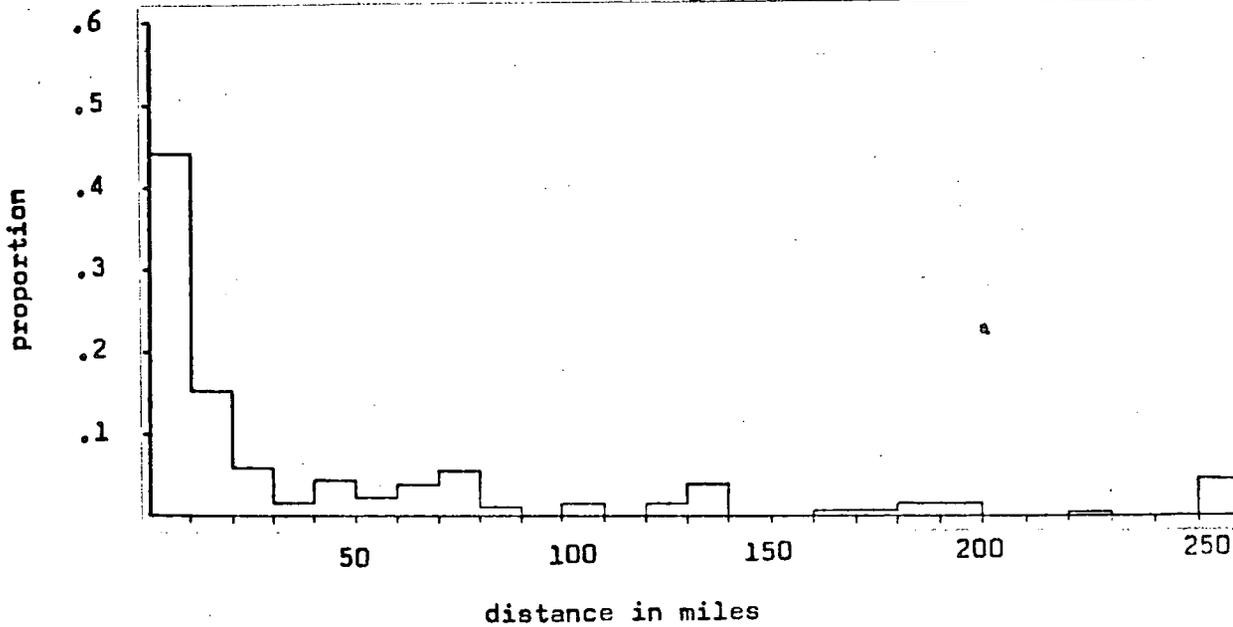
Table 4.12   School children: parents'
            birthplace distances,
            cumulative proportions

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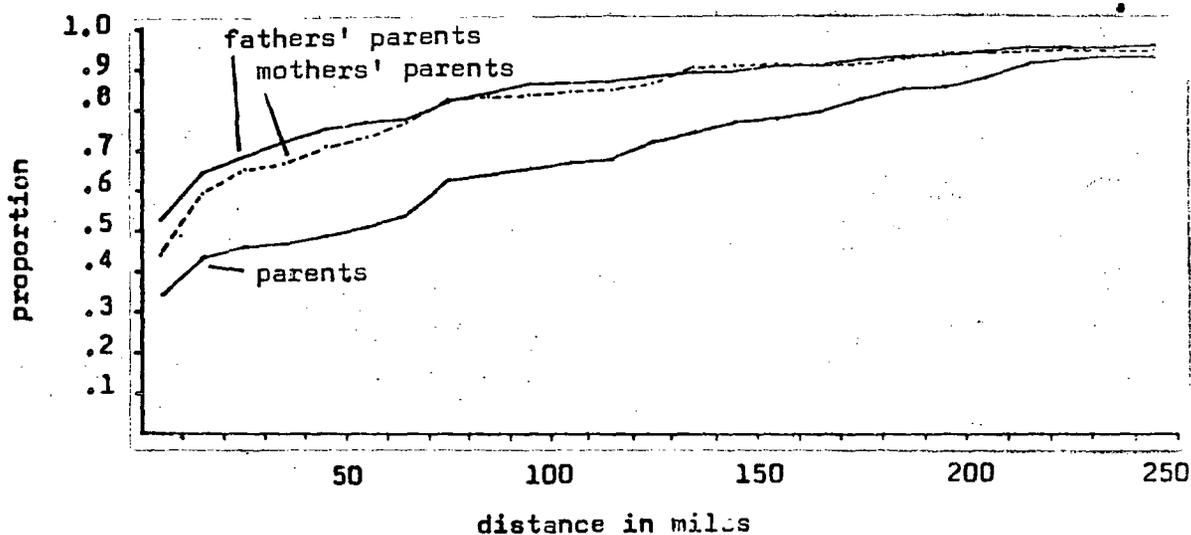
Table 4.13   School children:
              distribution of social class
              based on father's occupation

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

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

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

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

birth on the Isle of Wight: χ^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

$$\chi^2_1 = 0.015 \quad p > .05$$

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

$$\chi^2_1 = 1.658 \quad p > .05$$

thus produced might be a contract 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		
	Non-manual	(n = 101)	47.4	0.7	-1.09	.277
Mother	Manual	(n = 105)	42.5	0.5		
	Non-manual	(n = 102)	43.9	0.5	-1.92	.056
Both parents	Manual	(n = 103)	44.5	0.6		
	Non-manual	(n = 100)	45.7	0.5	-1.59	.112

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		
	Non-manual	(n = 101)	32.1	0.7	-0.96	.337
Mother	Manual	(n = 105)	27.3	0.5		
	Non-manual	(n = 102)	28.6	0.5	-1.80	.073
Both parents	Manual	(n = 103)	29.3	0.5		
	Non-manual	(n = 100)	30.4	0.5	-1.47	.143

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 com-
pleted 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 dis-

tance 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 genera-
tional 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 con-
sidered 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

$$\chi_1^2 = 9.005 \qquad p < .01$$

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	I	3	2	3	6	0	0
	II	2	17	5	18	3	2
social	IIIN	0	3	7	5	3	1
	IIIM	2	13	2	30	11	2
class	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 (χ^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

$$\chi^2_1 = 3.181 \quad .08 > p > .05$$

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

$$\chi^2_1 = 2.134 \quad p > .05$$

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

Social class \ Birthplace	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

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

$\chi^2_1 = 6.982$ 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 com-

paring 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 con-

straint 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 differ-

ences 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.

149

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.

152

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 re-

flects the comparative age-structure of the two groups and

the dependence of migration upon age, rather than the differ-

ences 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
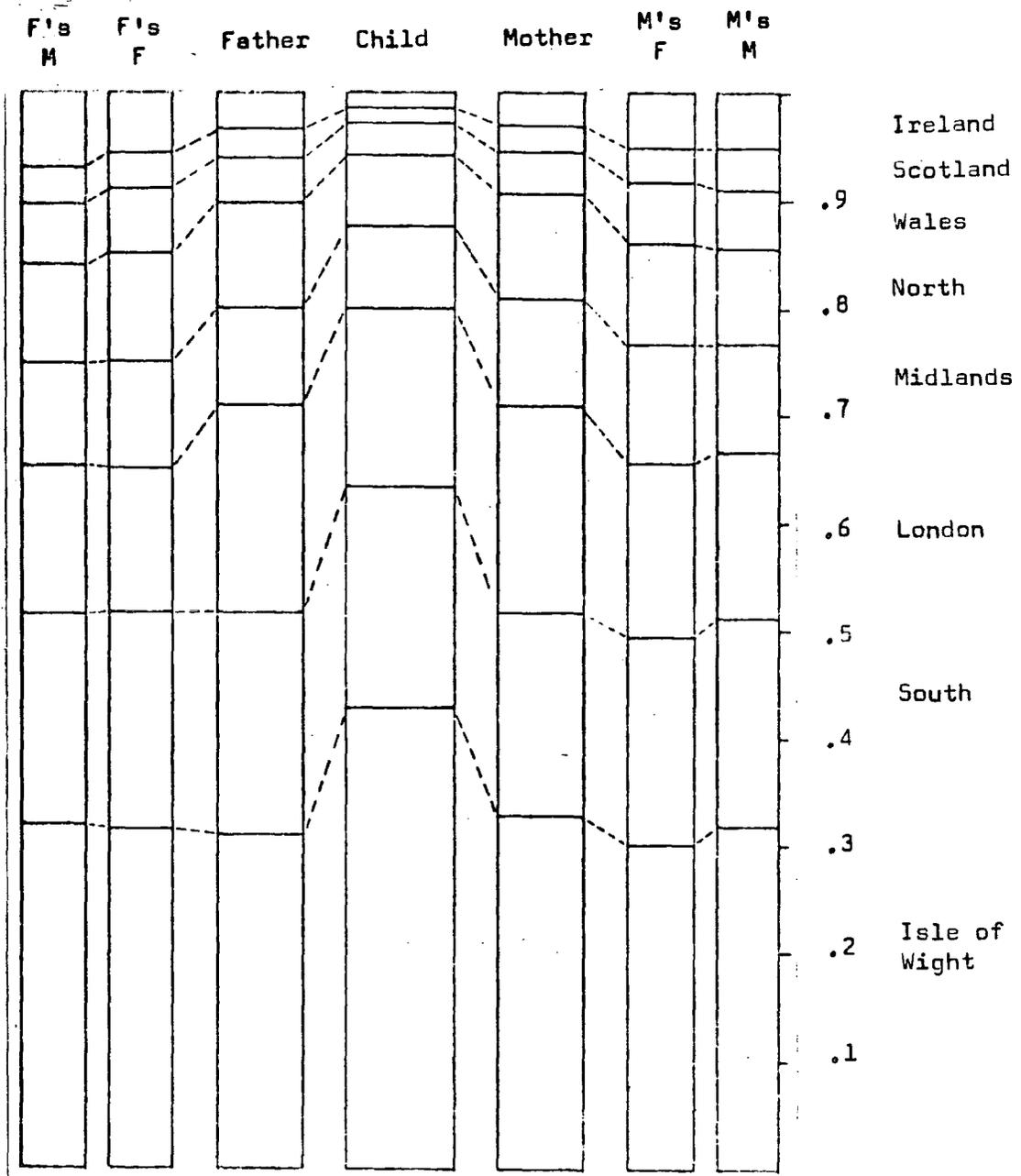
and both generational and matrimonial concordances of birth-
place were examined. For the blood donors only the latter will
be considered. In Table 4.41 the marriages are described as
endogamous, as exogamous with either the male or the female
migrating, or as "migrant", where both partners were born 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 immi-
grant 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 ans-
wer 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
(X^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 limit-
ing 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 know-

ledge 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
$\leq$ 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
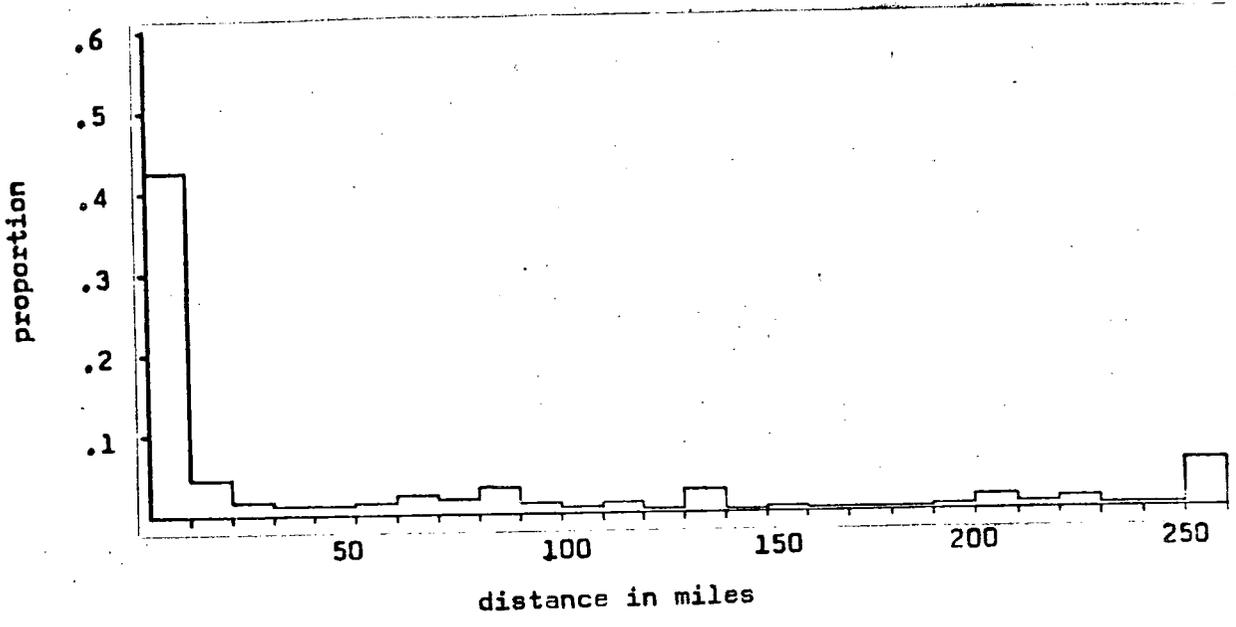
Figure 4.15   Blood donors:
distribution of father-offspring distance
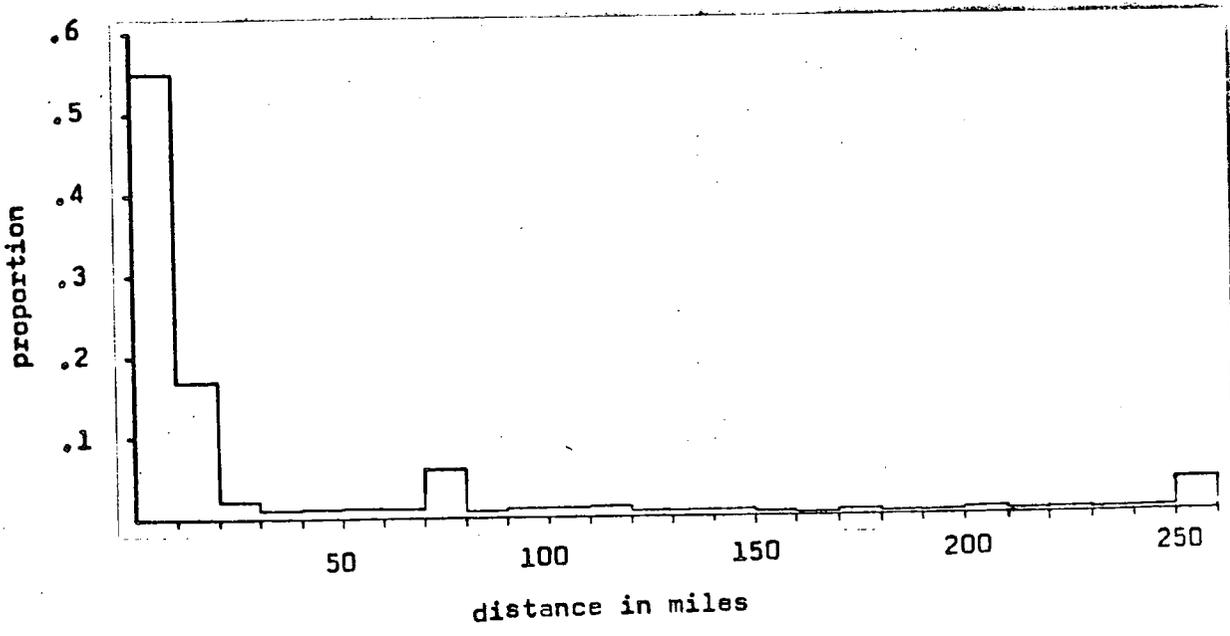
residence-distance of this generation are the mother-offspring

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 possi-

bility of secular change in mobility. Table 4.45 shows the

distribution of parent-offspring distances for the present

generation (M O, F O, as well as for the previous one (FF O,

FM O, MF O, MM O), 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	.012	.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
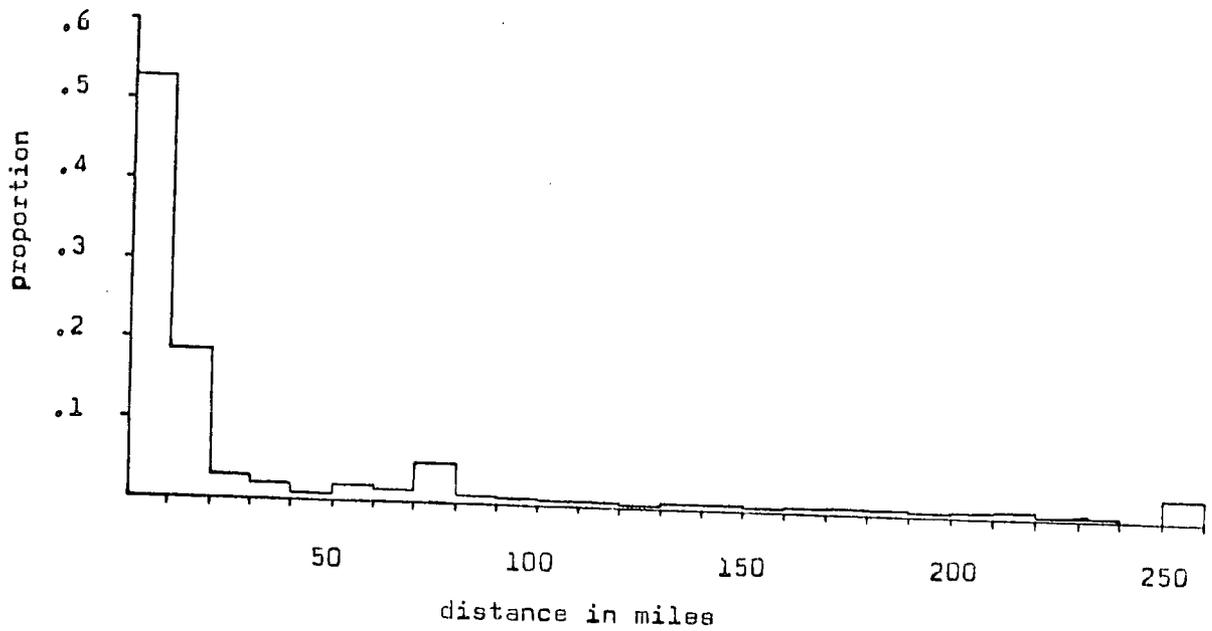
Figure 4.17   Blood donors:
distribution of fathers'
father-offspring distance
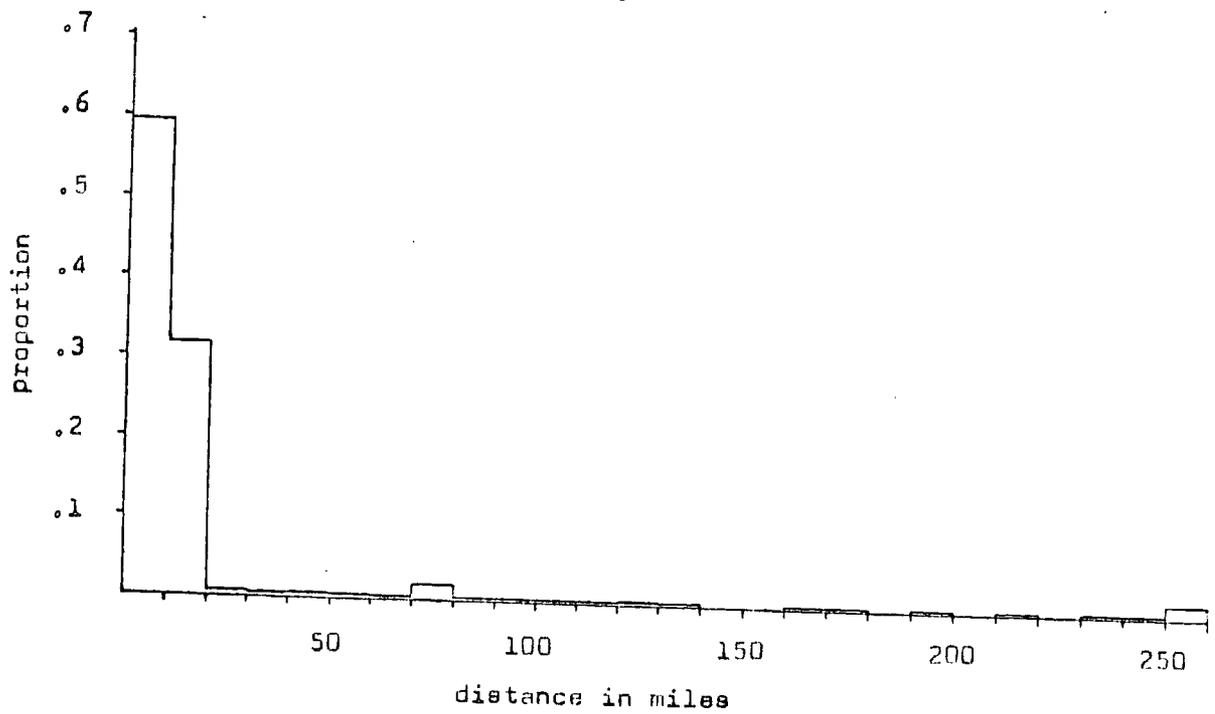
Figure 4.18   Blood donors:
               distribution of fathers'
               mother-offspring distance
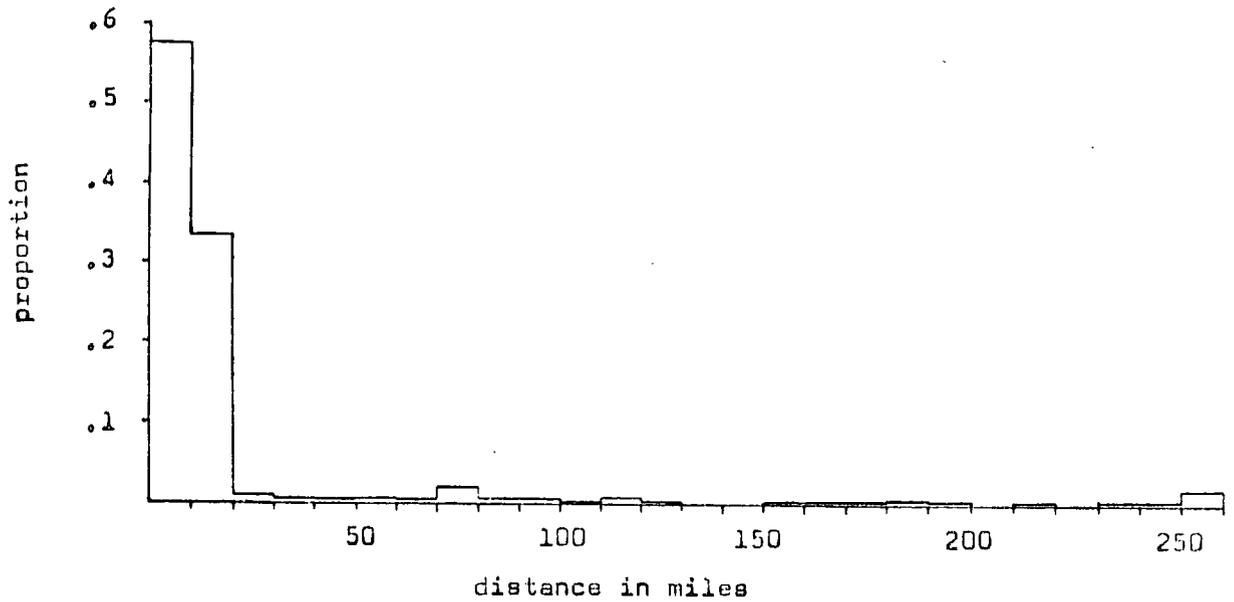
Figure 4.19   Blood donors:
               distribution of mothers'
               father-offspring distance
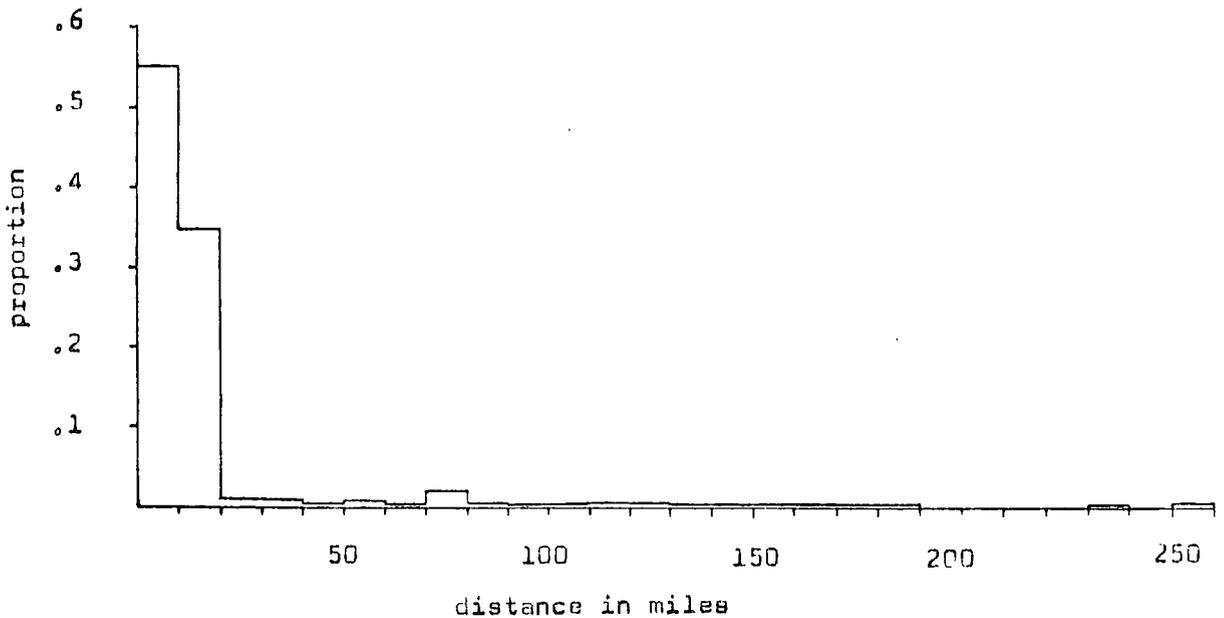
Figure 4.20   Blood donors:
              distribution of mothers'
              mother-offspring distance
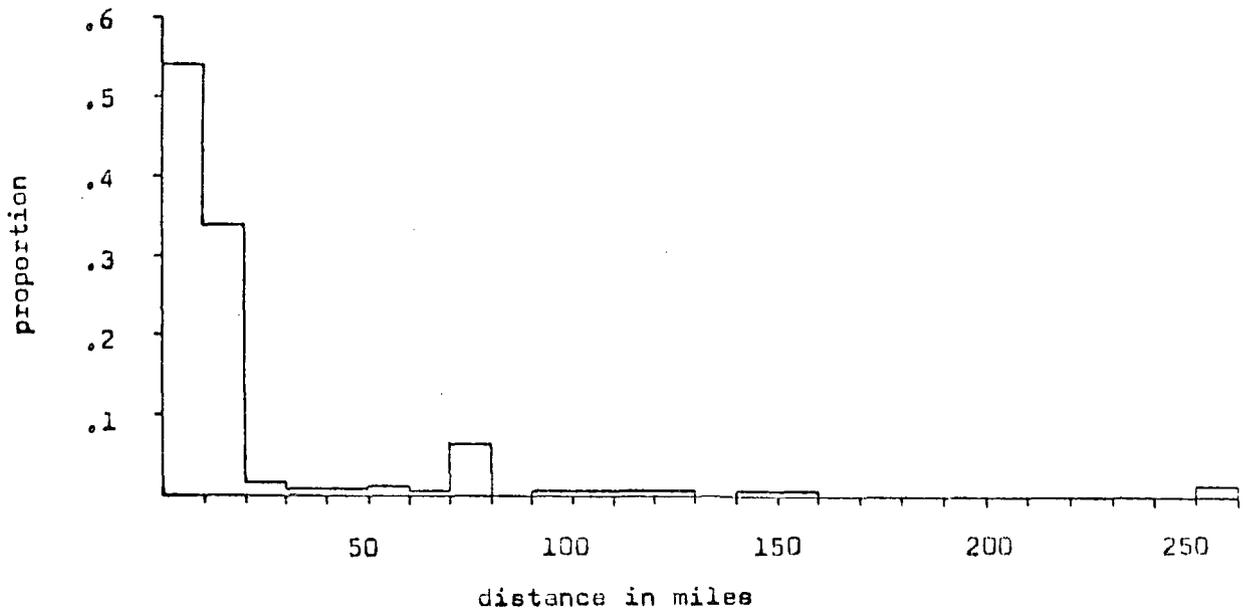
Figure 4.21   Blood donors:
              parent-offspring distances,
              cumulative proportions

donors' parents' generation

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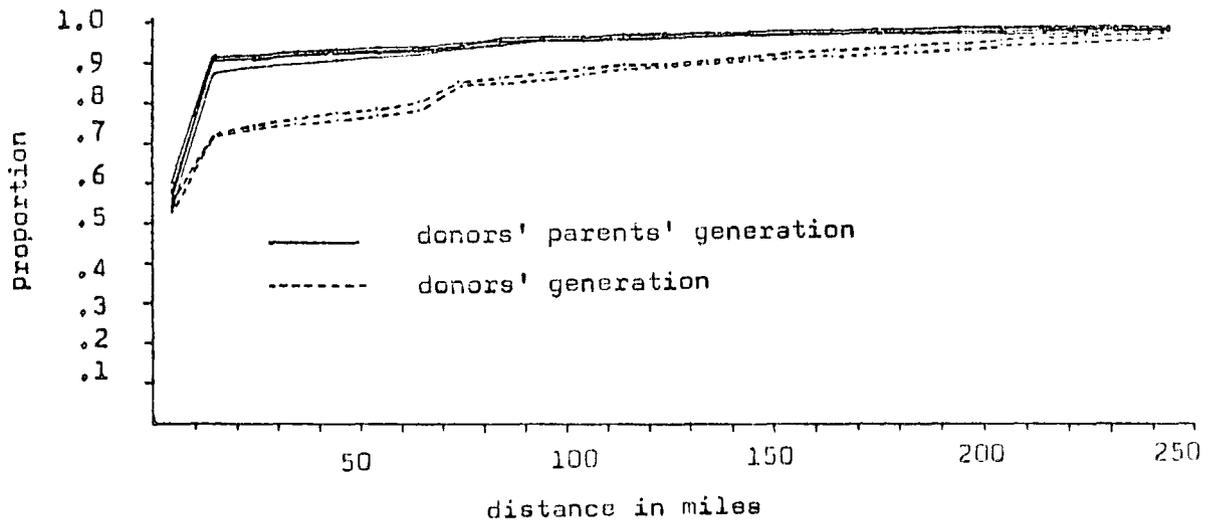
Table 4.46   Blood donors:
             birthplace - residence distances,
             cumulative proportions

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 resi-

dents 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
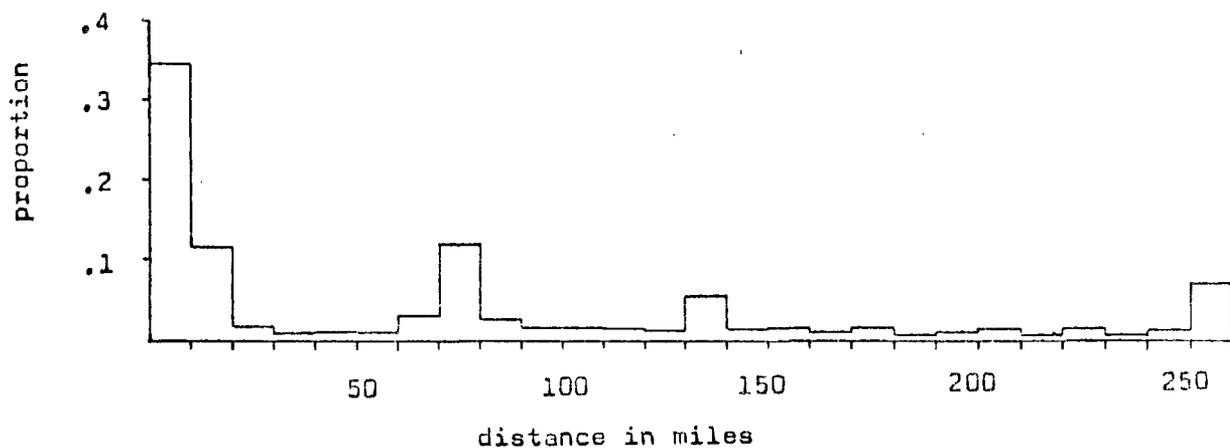
Figure 4.23   Blood donors:
               distribution of parents' birthplace distance
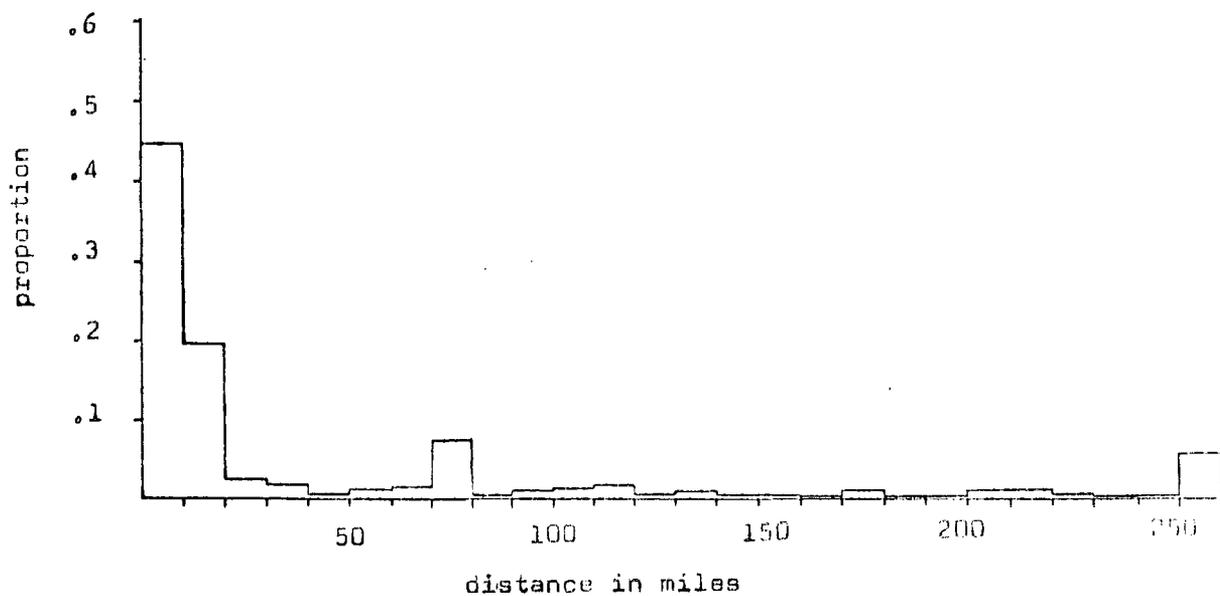
Figure 4.24 Blood donors:
distribution of fathers'
parents' birthplace distance
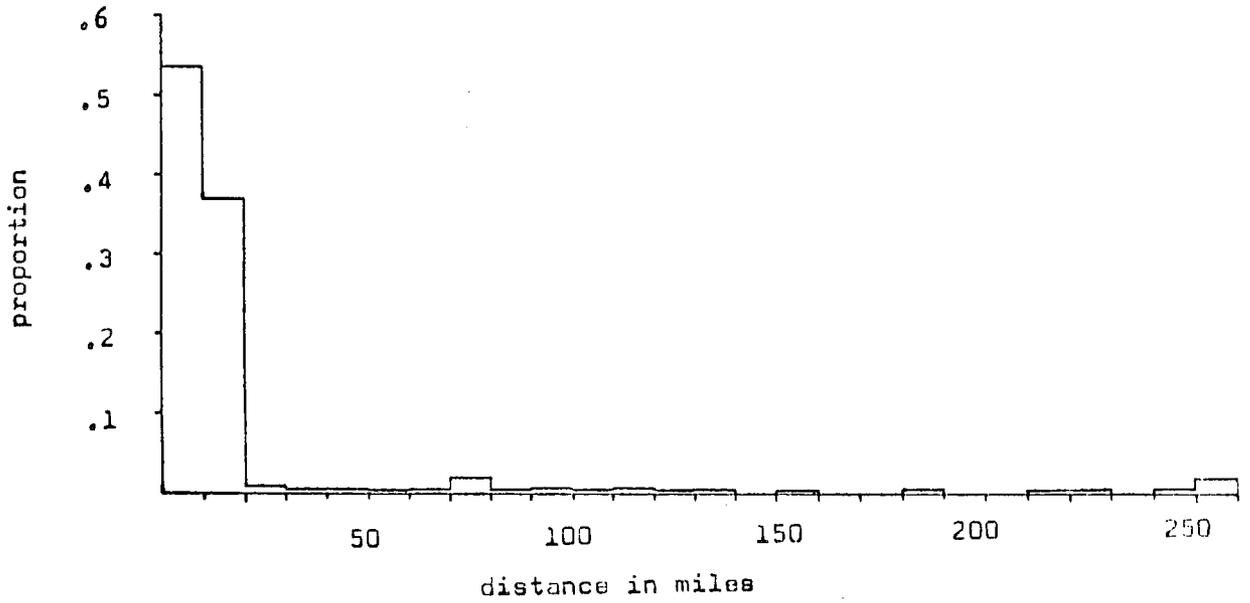
Figure 4.25 Blood donors:
distribution of mothers'
parents' birthplace distance
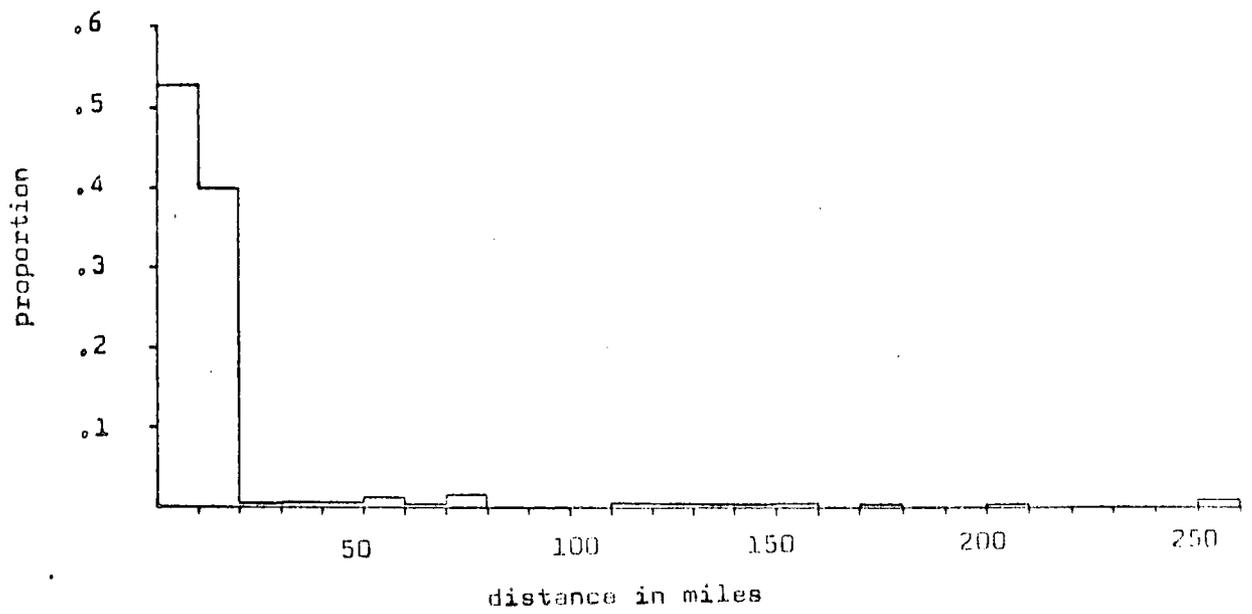
Table 4.50   Isle of Wight Blood donors:
birthplace distances,
cumulative proportions

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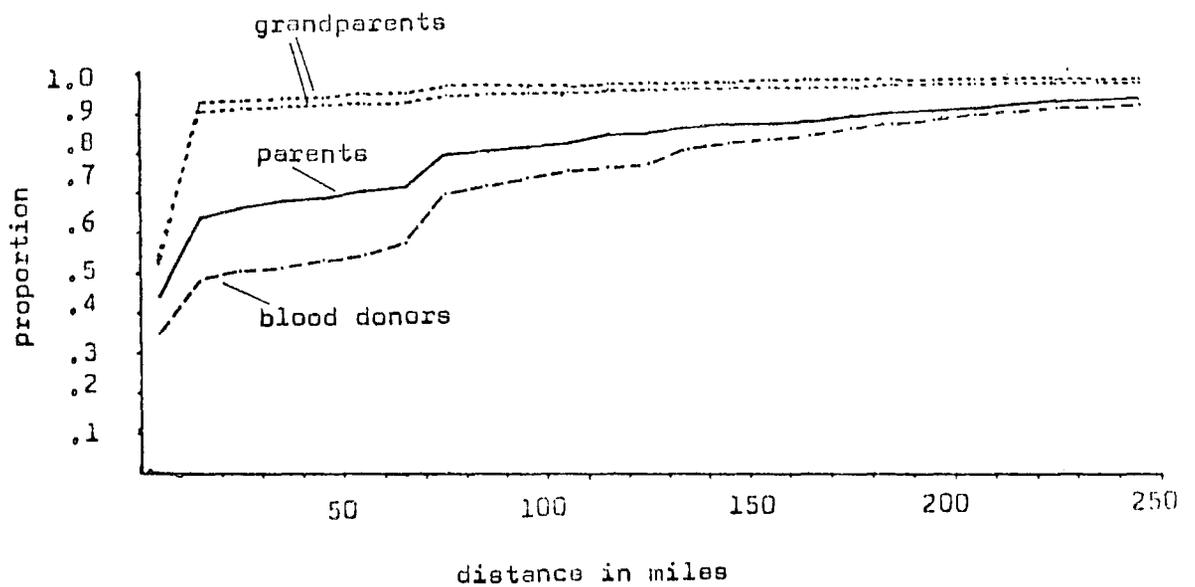
Table 4.51   Blood donors:
birthplace-residence distances
among those born and living on
the Isle of Wight

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
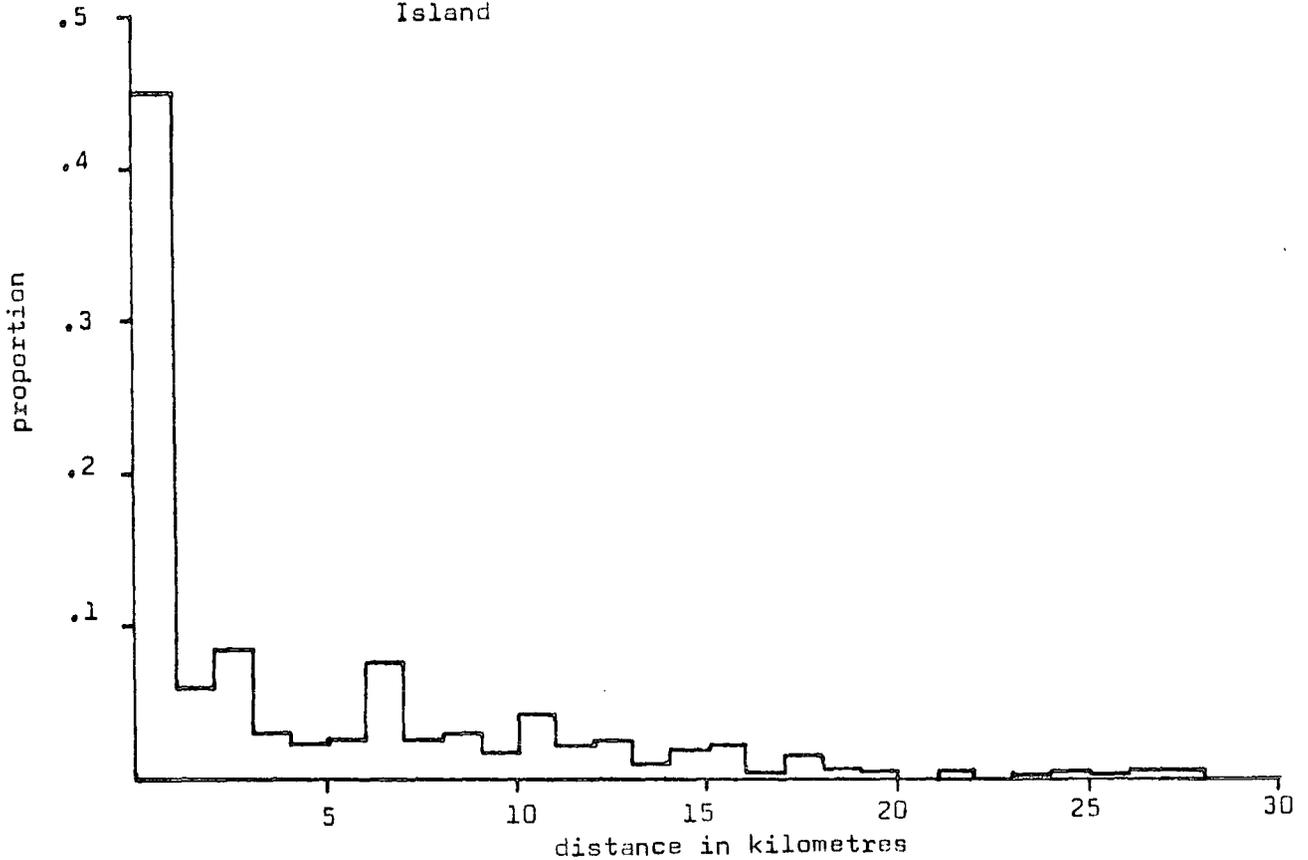
Figure 4.28 Blood donors:
distribution of birthplace-residence distances
among donors and spouses born and living on the
Island
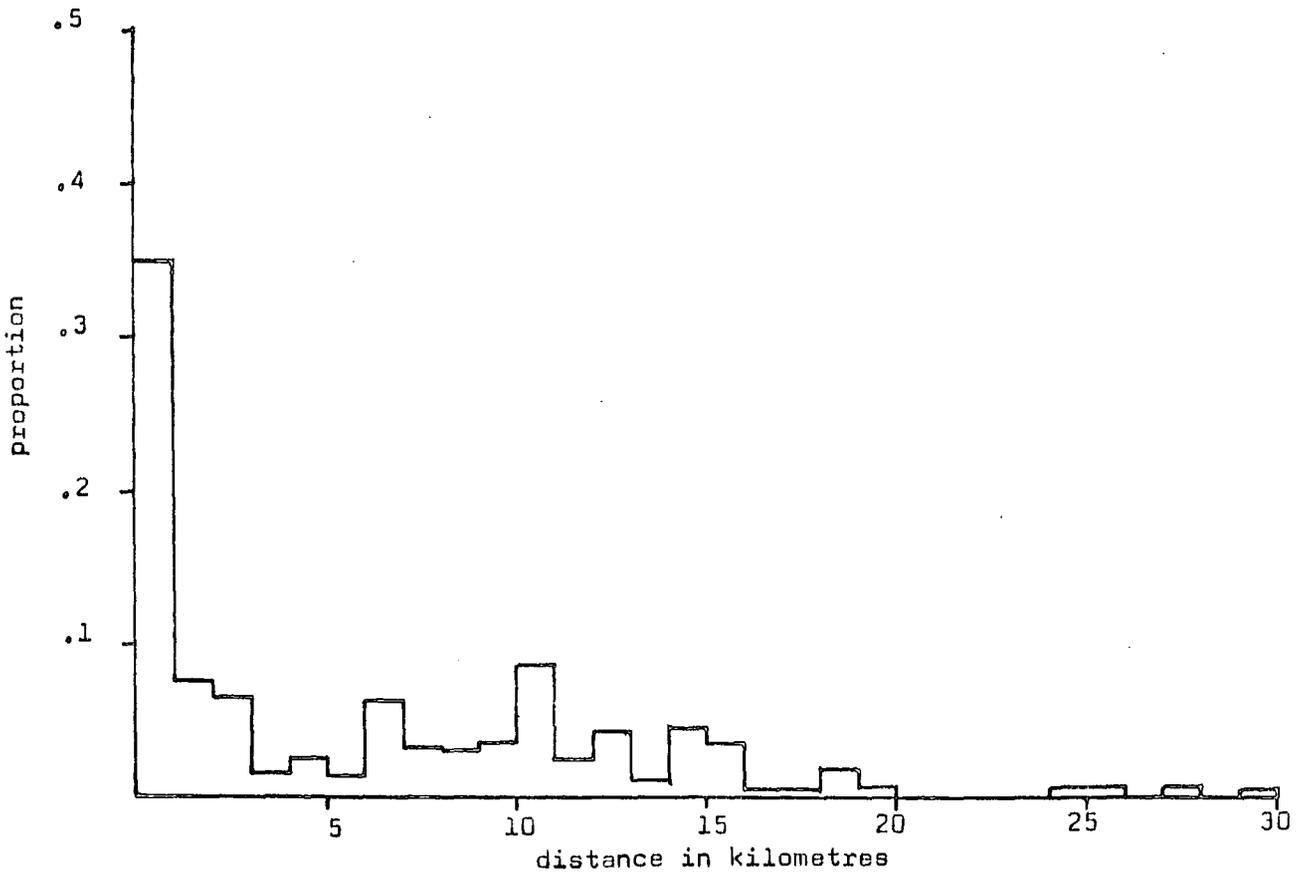
Table 4.52   Blood donors:
              birthplace distances among those born
              and living on the Isle of Wight

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 pos-
sible 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 mis-
leading 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 grand-
parents 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

F's   F's   Father   Child   Mother   M's   M's
F   M   F   M

                                                           Overseas
                                                           Ireland
                                                           Scotland
                                                      .9   Wales

                                                      .8   North

                                                      .7
                                                           Midlands

                                                      .6   Greater
                                                           London
                                                           South
                                                      .5

                                                      .4

                                                      .3   Welsh
                                                           Borders
                                                           survey
                                                           region
                                                      .2

                                                      .1
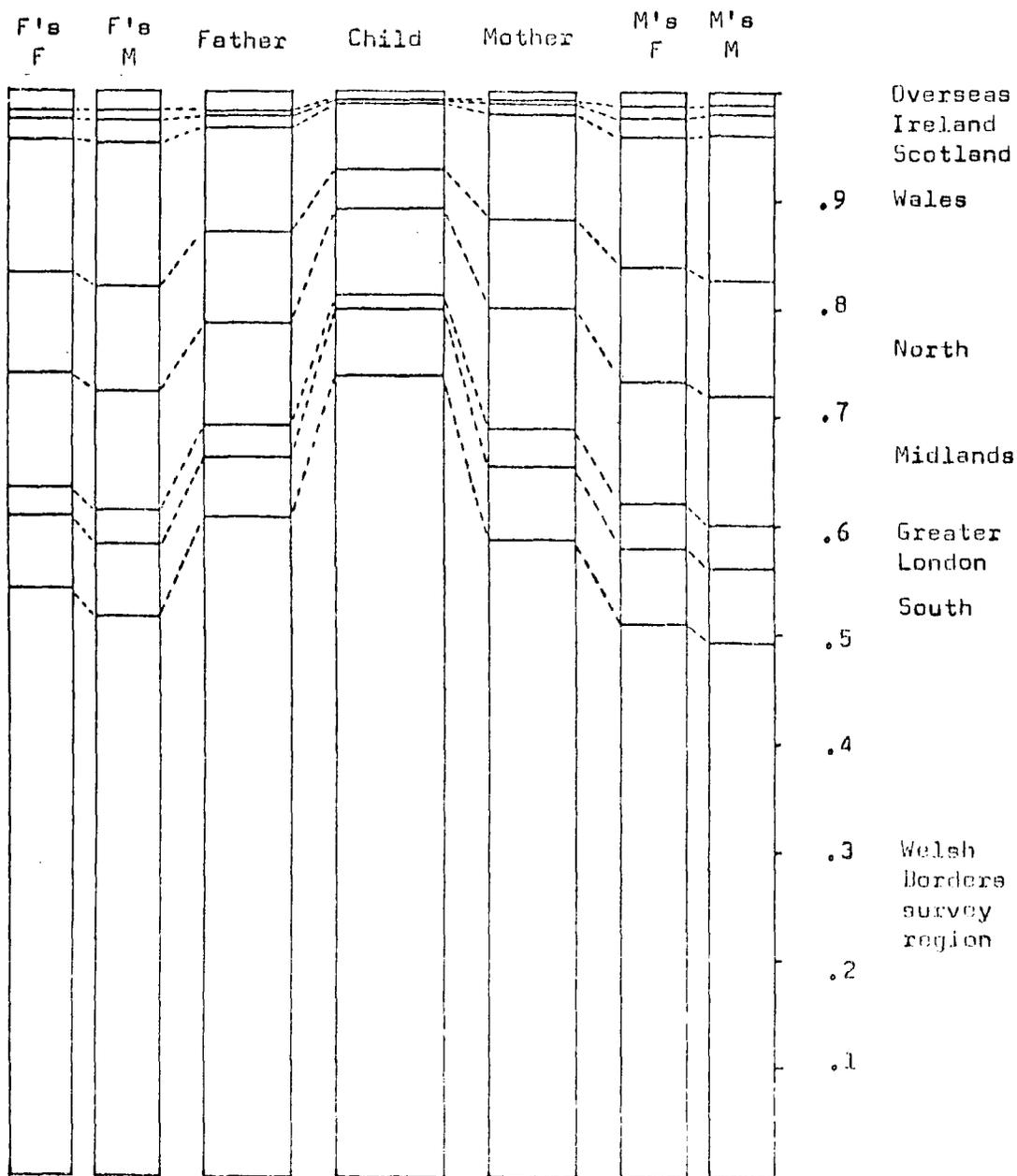
Figure 4.30   Reading marriage survey:
              regions of birth of spouses and parents

Old Commonwealth
New Commonwealth
Europe
.9   Eire
Ulster
Scotland
Wales
.8   (Yorks, Humberside,
(North, Northwest

E & W Midlands
.7
(South-West
(East Anglia

.6   (Remainder of
(South-East

.5

Greater
London

.4
Neighbouring
towns

.3
Reading
region

.2

.1

Greater
London
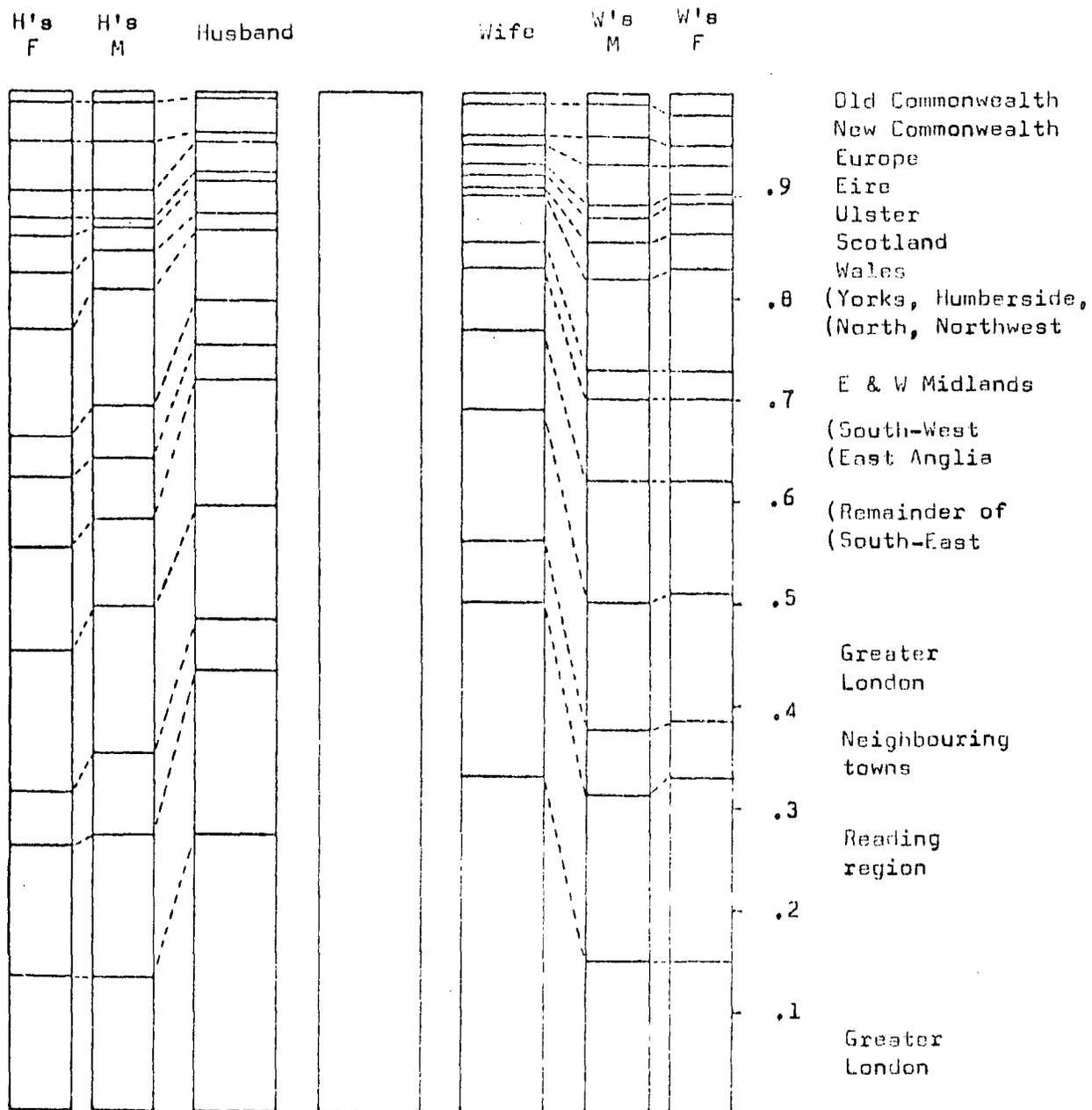
assumption of knowledge of an order more sophisticated than

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

Place of residence \ Birthplace	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 catch-

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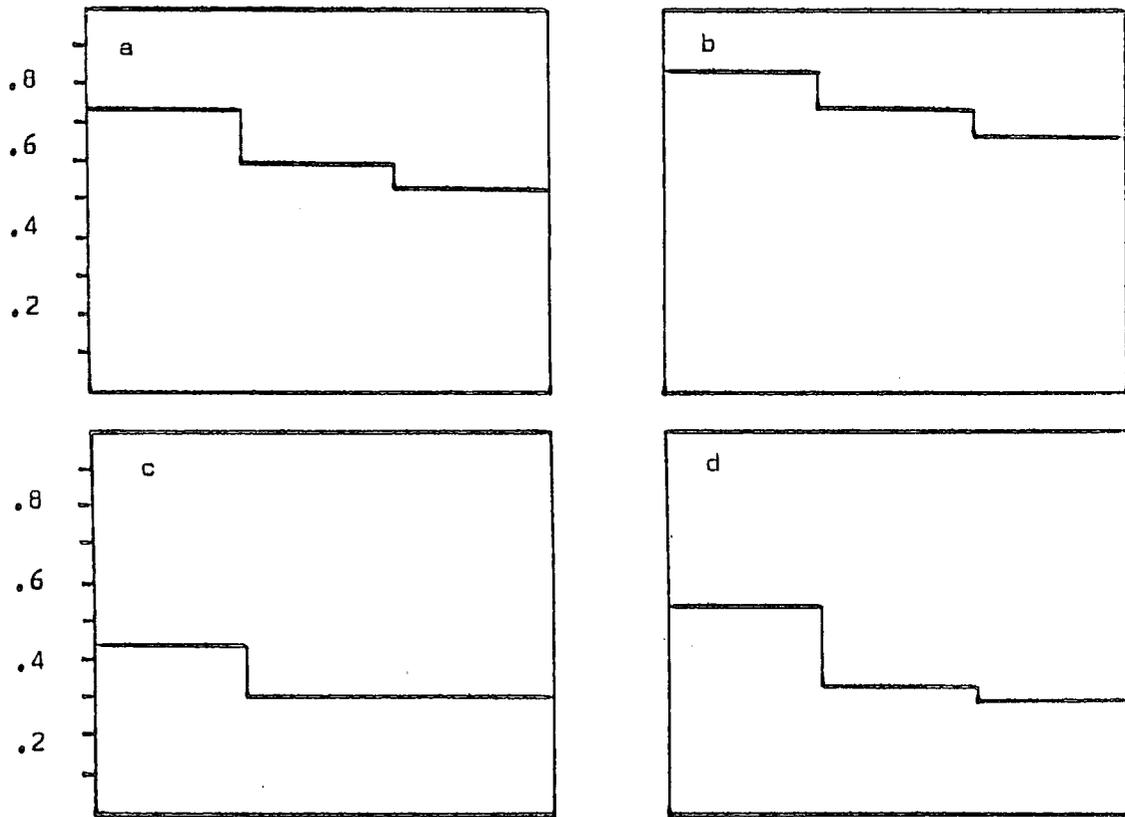
a   Welsh borders
b   Co. Durham, adults
c   Isle of Wight, blood donors
d   Isle of Wight, school children

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 grand-

parents' 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 des-

cribed by the distribution of grandparental birthplaces (or

the proportion of indigenous grandparents) alone. This statis-

tic can be usefully employed in mapping the origins of a popu-

lation 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 circum-

stances.

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 endog-

amy. 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 anthro-

pological 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 popu-

lation'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 genera-
tions 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 differ-

ence 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 answer-

ing the same question will be made by sub-dividing the donor

sample according to birth or "ancestry" on the Island, and com-

paring 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 what-

ever 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                    Gene Frequencies

     D+    1 206                    D  = .477 ± .022

     D-      355                    d  = .523 ± .022

     n =  1 561


(ii)       Rhesus chromosome frequencies

     Phenotypes                    Chromosome Frequencies

     C c D E e                          r      .428

     + + + + +  210                     r'     .003

     + + + + -    3                     r"     .004

     + + + - +  438                     r^y    .000

     + + - - +    3                     R_o    .010

     + - + + +    3                     R_1    .417

     + - + - +  188                     R_2    .133

     - + + + +   77                     R_z    .005

     - + + + -   24

     - + + - +   12

     - + - + +    4

     - + - - +  259

          n = 1 221
```

```
V      Duffy

     Phenotypes                    Gene Frequencies

     Fy^a+   723                   Fy a = .375 ± .022

     Fy^a-   462                      b = .625 ± .022

     n = 1 185
```

Table 5.1 continued

VI Kell

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

VII Kidd

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

VIII Transferrin

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

χ^2 HW $= 0.112$ p $> .05$

IX Esterase D

Phenotypes		Gene Frequencies
1-1	1 199	ESD-1 $= .891 \pm .016$
2-1	285	ESD-2 $= .109 \pm .016$
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 $\pm$ .025

2-1   701   Hp-2 = .613 $\pm$ .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 $\pm$ .024

BA   608   EAP b = .612 $\pm$ .025

B   568   EAP c = .047 $\pm$ .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 $\pm$ .010

2-1   107   AK-2 = .040 $\pm$ .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 $= .787 \pm .023$

    2-1   354   PGM-2 $= .213 \pm .023$

    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 tabu-

lation reminds us that to give frequencies to even three decimal

places is often unjustifiably optimistic, and that the wide-

spread 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 inter-
pret 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)   Kopec (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)   Kopec (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	$m = .552 \pm .032$
MN	436	$n = .448 \pm .032$
N	185	

III   Ss

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

Phenotypes		Gene Frequencies
S+	517	$S = .308 \pm .029$
S-	483	$s = .692 \pm .029$

IV   Rhesus

(i)   D locus only

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

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

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

Phenotypes		Gene Frequencies
D+	194	$D = .566 \pm .057$
D-	45	$d = .434 \pm .057$

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   Gene Frequencies

Fy^a+ 162 $Fya = .407 \pm .050$
Fy^a- 88 $Fyb = .593 \pm .050$

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

Phenotypes   Gene Frequencies

Fy^a+ 48 $Fya = .415 \pm .061$
Fy^a+Fy^b+ 114 $Fyb = .585 \pm .061$
Fy^b 91

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

Phenotypes   Gene Frequencies

Fy^a 130 $Fya = .443 \pm .038$
Fy^a+Fy^b+ 321 $Fyb = .557 \pm .038$
Fy^b+ 205

Table 5.2 continued

VI   Kell

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

Phenotypes   Gene Frequencies

KK   1   K = .039 $\pm$ .011

Kk   89   k = .961 $\pm$ .011

kk   1 076

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

Phenotypes   Gene Frequencies

K+   88   K = .049 $\pm$ .024

K-   832   k = .951 $\pm$ .024

VII   Kidd

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

Phenotypes   Gene Frequencies

JKa+   173   JKa = .519 $\pm$ .057

JKa-   52   JKb = .481 $\pm$ .057

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

Phenotypes   Gene Frequencies

JKa+   35   JKa = .582 $\pm$ .098

JKaJKb 44   JKb = .418 $\pm$ .098

JKb+   19

Table 5.2 continued

VIII   Transferrin

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

Phenotypes		Gene Frequencies
TfC	310	$Tf\ C = .987 \pm .012$
TfBC	8	$Tf\ B = .013 \pm .012$

IX   Esterase D

        Cartwright et al. (1978)

Phenotypes		Gene Frequencies
ESD 1-1	815	$ESD-1 = .882 \pm .020$
2-1	211	$ESD-2 = .118 \pm .020$
2-2	18	

X   Haptoglobin

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

Phenotypes		Gene Frequencies
1-1	33	$Hp-1 = 430 \pm .073$
2-1	88	$Hp-2 = 570 \pm .073$
2-2	58	

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

Phenotypes		Gene Frequencies
1-1	22	$Hp-1 = .389 \pm .066$
2-1	121	$Hp-2 = .610 \pm .066$
2-2	69	

Table 5.2 continued

XI Acid Phosphatase

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

Phenotypes		Gene Frequencies
A	29	EAPa = .360 $\pm$ .056
BA	132	EAPb = .602 $\pm$ .060
B	92	EAPc = .038 $\pm$ .023
CB	14	
CA	7	
C	0	

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

Phenotypes		Gene Frequencies
A	119	EAPa = .373 $\pm$ .032
BA	379	EAPb = .571 $\pm$ .033
B	282	EAPc = .057 $\pm$ .015
CB	61	
CA	39	
C	0	

XII Adenylate Kinase

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

Phenotypes		Gene Frequencies
1-1	1 720	AK-1 = .955 $\pm$ .009
2-1	165	AK-2 = .045 $\pm$ .009
2-2	2	

XIII Phosphoglucomutase

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

Phenotypes		Gene Frequencies
1-1	635	PGM-1 = .767 $\pm$ .025
2-1	378	PGM-2 = .233 $\pm$ .025
2-2	61	

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

I   ABO

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

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

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

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

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

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

II   MN

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

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

III   S

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

IV   Rhesus   D locus

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

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

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

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

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

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

XIII Phosphoglucomutase

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

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 Kopec'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 Kopec 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 these 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 differ-

ences 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 sub-

stantially the same distribution of genetic markers as the main-

land 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	$\chi^2_3 = 4.935, \quad P > .05$

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

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

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

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

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

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 com-
parison 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 sophis-
ticated 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 popu-
lation 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 mathe-
matical models of migration is that it predicts relationships
between communities based on observed rather than idealised
regimes of migration. However, even though unnecessary approxi-
mation 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 tabu-
lation 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 accord-

ing 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 distri-

bution 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 Kopec (1970). This has the merit

of dividing the Island into five units each of reasonable

population size but is not particularly interesting demo-

graphically; it makes only the broadest separation of communi-

ties 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

Kopec, 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

"Kopec's regions". The areas are shown in Figure 6.1, Kopec's

regions in Figure 6.2, and Table 6.1 is a key to named settle-

ments 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"
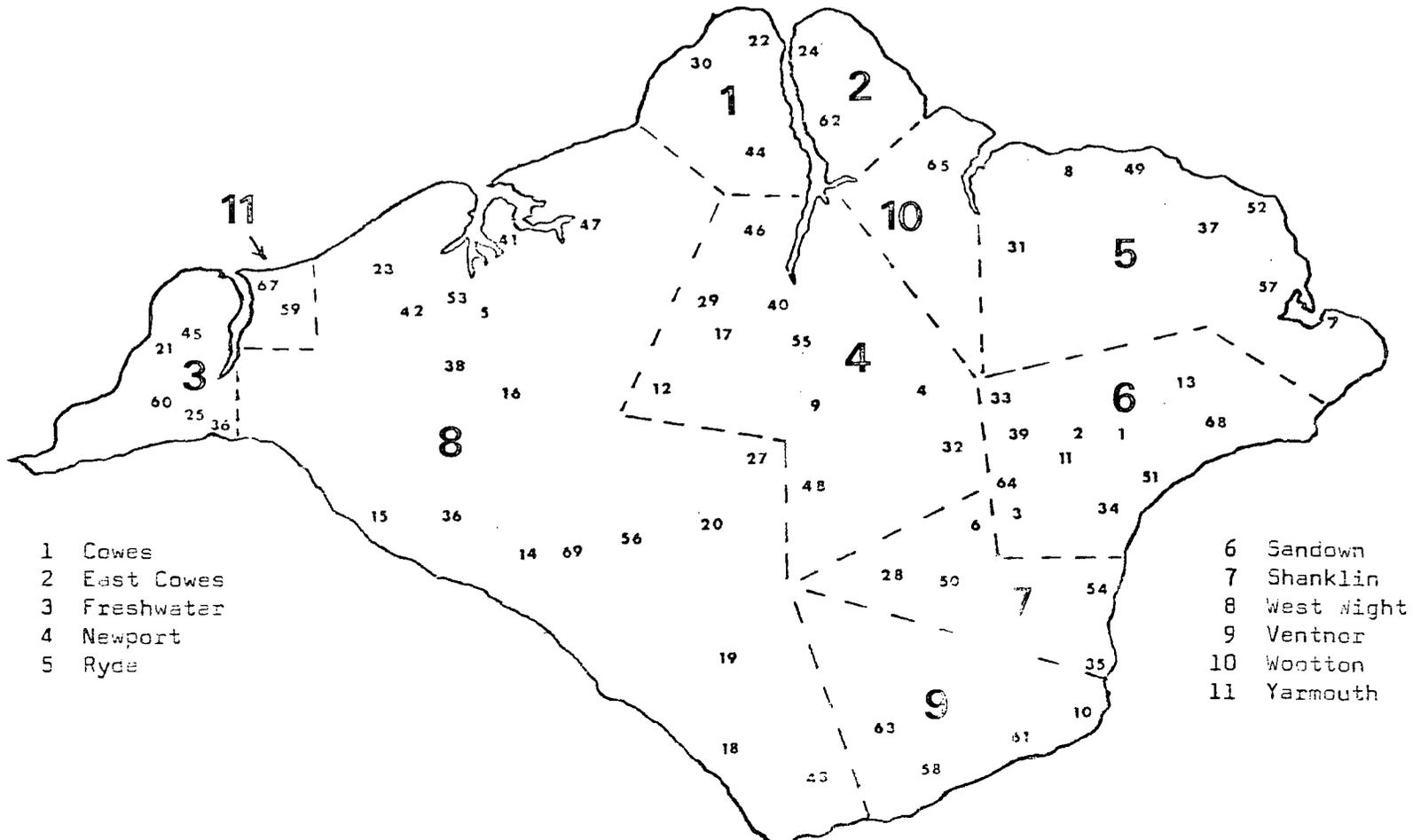
1 Cowes
2 East Cowes
3 Freshwater
4 Newport
5 Ryde

6 Sandown
7 Shanklin
8 West Wight
9 Ventnor
10 Wootton
11 Yarmouth

Figure 6.2 Isle of Wight partitioned into Kopeć's regions

1 Cowes
2 East Cowes
3 Newport
4 Ryde
5 Sandown
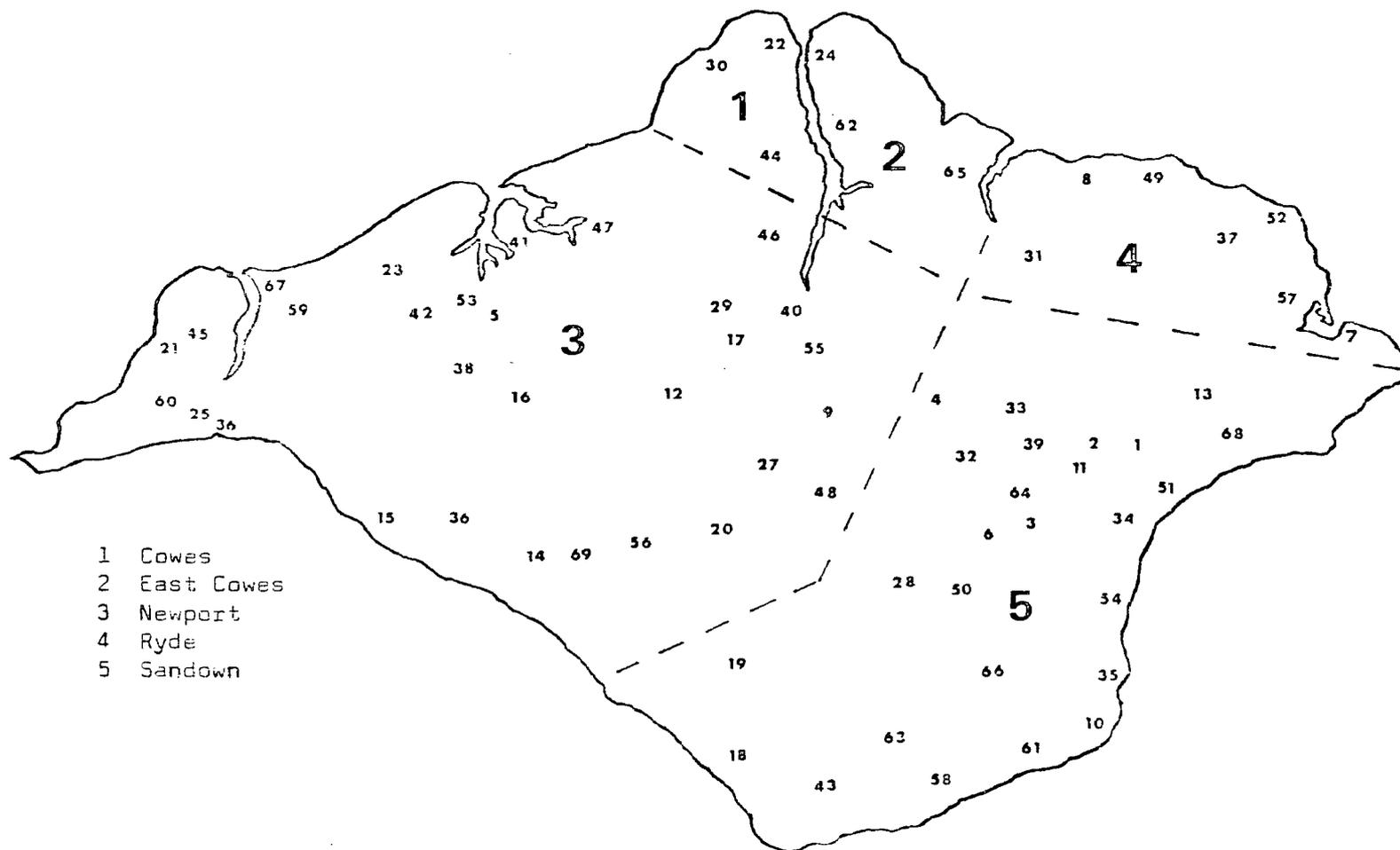
Table 6.1 Key to Isle of Wight localities

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 Kopec'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 Kopec's regions) the regions were conceived first, and con-

stituted "from the top down" rather than "from the bottom up".

Whilst in the case of Kopec'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

(a)

proportional
contribution
to Kopec's
regions

.2

.1

0

S   GL   M   N   Sc   W   I
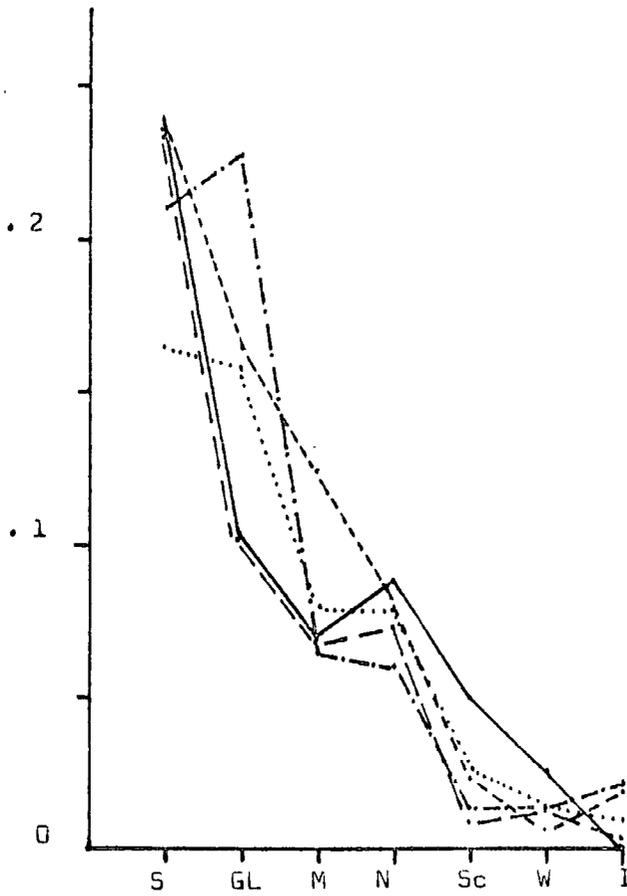
KEY

S   Southern England
GL   Greater London
M   Midlands
N   Northern England
Sc   Scotland
W   Wales
I   Ireland

(b)

proportional
contribution
to the smaller
Island "areas"

.3

.2

.1

0

S   GL   M   N   Sc   W   I
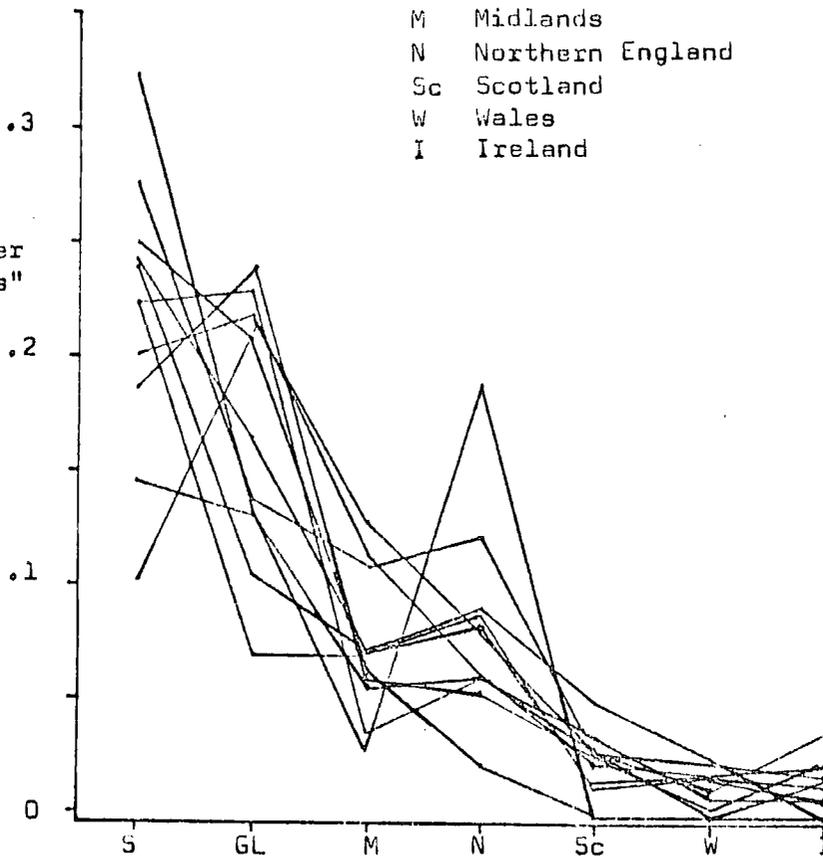
(d)   Results

Movement of the Isle of Wight residents has been examined in

a number of ways:

(i)   the Island is divided into areas or into Kopec's

       regions;

(ii)   using Kopec'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 Kopec'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	Outside 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 immi-

       gration pooled to a single vector,   Table 6.5;

(iii) the Island divided into Kopeć's regions with immi-

       gration 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	

P

H / R

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

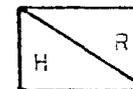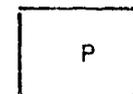|	Cowes	East Cowes	Newport	Ryde	Sandown	Outside World
Cowes	.2262	.0498	.1086	.0181	.0136	.5837
East Cowes	.1409	.1727	.1227	.0455	.0182	.5000
Newport	.0189	.0142	.3616	.0330	.0362	.5361
Ryde	.0256	.0117	.0396	.2844	.0303	.6084
Sandown	.0152	.0076	.0417	.0380	.2694	.6281
Outside World	.0000	.0000	.0000	.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		

P

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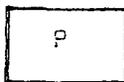
Table 6.6   Blood donors and spouses: matrices P, R and H. Island divided into Kopeć's regions with immigration excluded

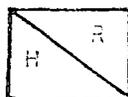|	Cowes	East Cowes	Newport	Ryde	Sandown
Cowes	.5435	.1195	.2609	.0435	.0326
East Cowes	.2818	.3455	.2454	.0909	.0364
Newport	.0407	.0305	.7797	.0712	.0779
Ryde	.0655	.0297	.1012	.7262	.0774
Sandown	.0408	.0204	.1122	.1021	.7245
Cowes		.723	.408	.272	.249
East Cowes	3		.424	.324	.301
Newport	6	6		.320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

P

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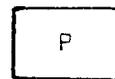
Table 6.7 Blood donors and spouses:
matrices P, R and H. Island divided into areas with immigration pooled

	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
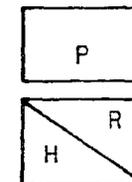
	C	EC	F	N	R	S	SH	WW	V	W	Y
Cowes		.830	.698	.619	.692	.695	.656	.729	.654	.740	.651
East Cowes	3		.601	.640	.598	.610	.571	.646	.558	.708	.554
Freshwater	3	4		.592	.703	.709	.695	.726	.700	.648	.783
Newport	4	3	4		.590	.617	.558	.616	.536	.718	.563
Ryde	3	4	3	4		.761	.705	.692	.680	.737	.662
Sandown	3	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	

P

R / H

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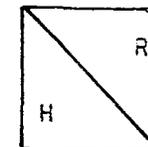Island divided into areas, with immigration excluded

	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

P

	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	

H / R

(vi)   the Island divided into areas, with Wootton incorporated

into Newport, and Yarmouth into West Wight, with immi-

gration 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 Kopec'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% related-

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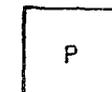
	C	EC	F	"N"	R	S	SH	"WW"	V
Cowes		.721	.299	.414	.271	.287	.191	.388	.204
East Cowes	3		.287	.368	.259	.280	.189	.369	.184
Freshwater	8	6		.358	.244	.278	.202	.462	.227
"Newport"	7	7	7		.334	.381	.267	.463	.220
Ryde	9	9	9	8		.406	.258	.260	.198
Sandown	9	9	8	7	7		.637	.325	.367
Shanklin	9	9	9	8	9	6		.269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

P

R

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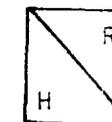
Table 6.9   Blood donors and spouses:
matrices P, R and H
Island divided into modified areas, with immigration pooled

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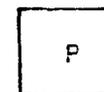
	C	EC	F	"N"	R	S	SH	"WW"	V
Cowes		.831	.699	.643	.692	.700	.658	.713	.659
East Cowes	3		.601	.660	.598	.610	.571	.618	.558
Freshwater	3	4		.604	.703	.709	.695	.790	.700
"Newport"	4	3	4		.613	.639	.570	.625	.550
Ryde	3	4	3	4		.761	.705	.701	.680
Sandown	3	4	3	4	3		.841	.719	.697
Shanklin	3	4	3	4	3	2		.719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

R

H
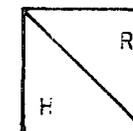
of the matrices Ȓ in Tables 6.6 and 6.4 against those of R

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 con-

sider the outside world as genetically uniform; it should

be remembered that the sub-divided outside world envisaged

without genetic exchange between the subdivisions under-

estimates 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

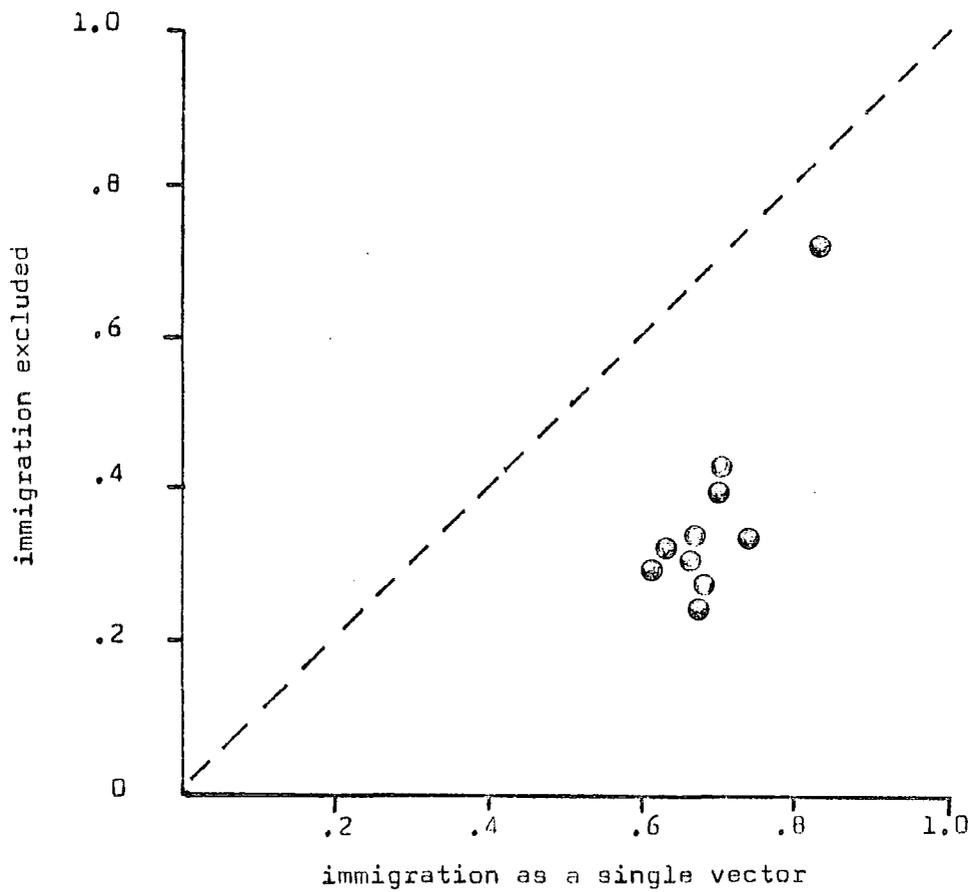Figure 6.4   Relatedness due to migration between Kopeć's regions (1)

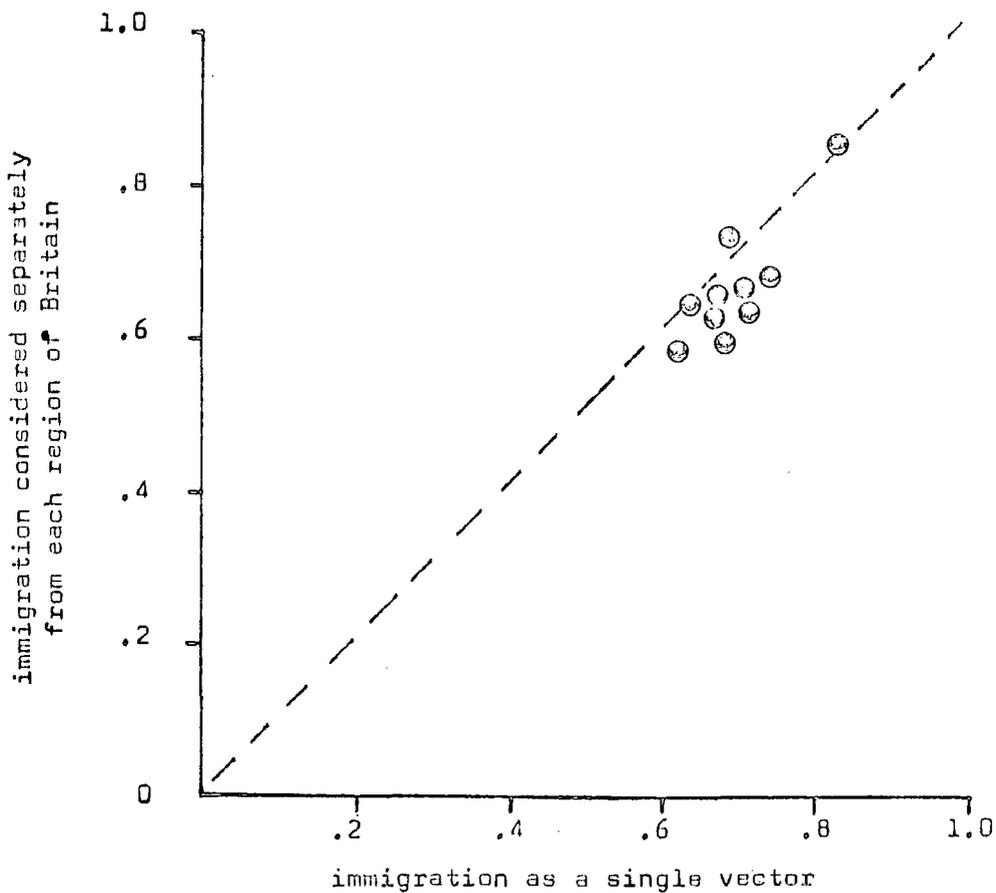Figure 6.5   Relatedness due to migration between Kopeć's regions (2)

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 sub-
division 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 pro-

    portion 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 histori-
cal 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 matri-
mony is short-term exploratory behaviour of the neighbour-
hood 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
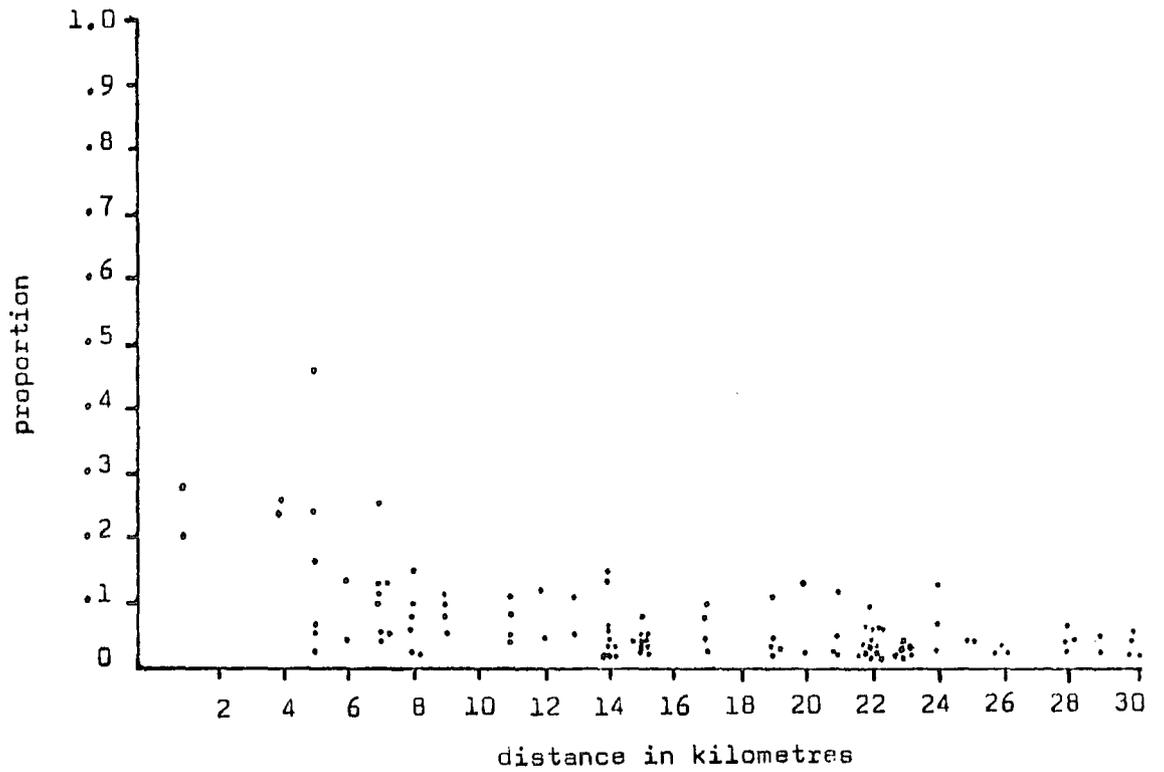
characteristic curve, though with perhaps more cases of

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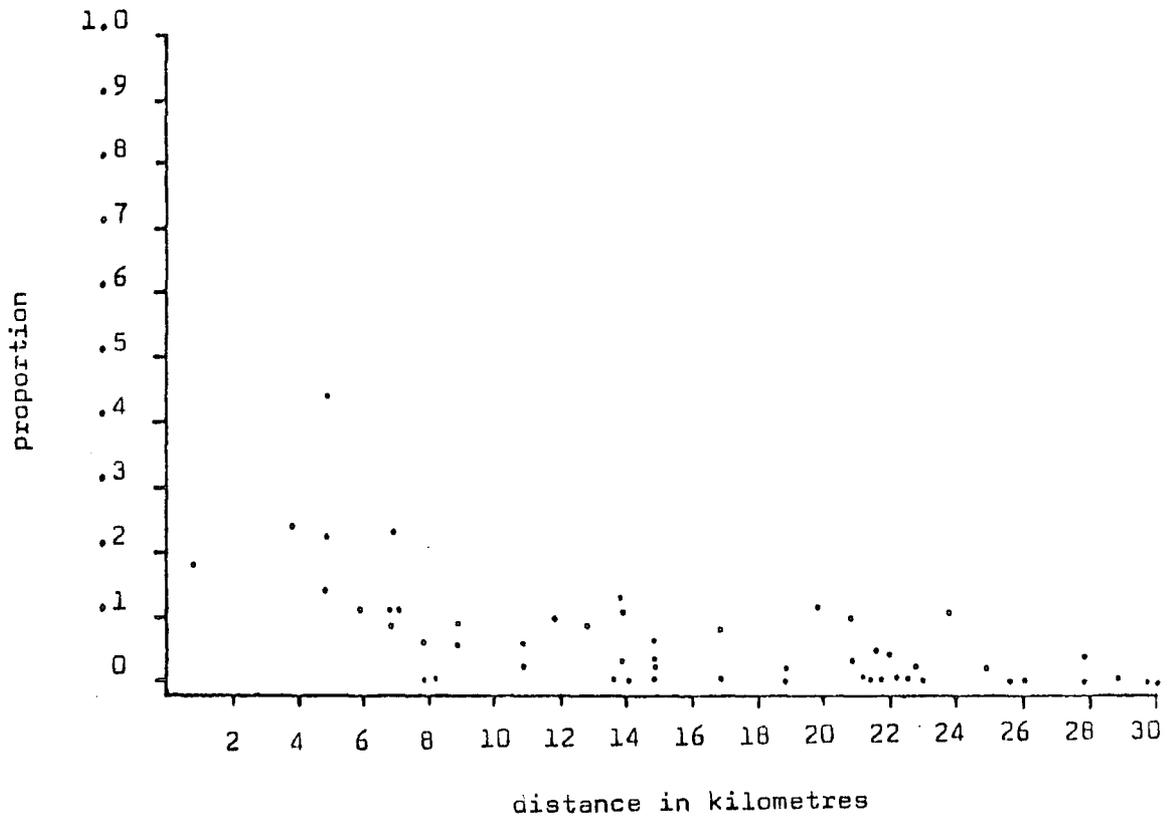
the published examples, though it is worth noting that as
far as one can tell from the limits of the Charlton and
Satak data, this curve does not appear to flatten out as
close to the origin as theirs do.

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 else-
where. 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 distin-
guish 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 homogen-
eous, 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
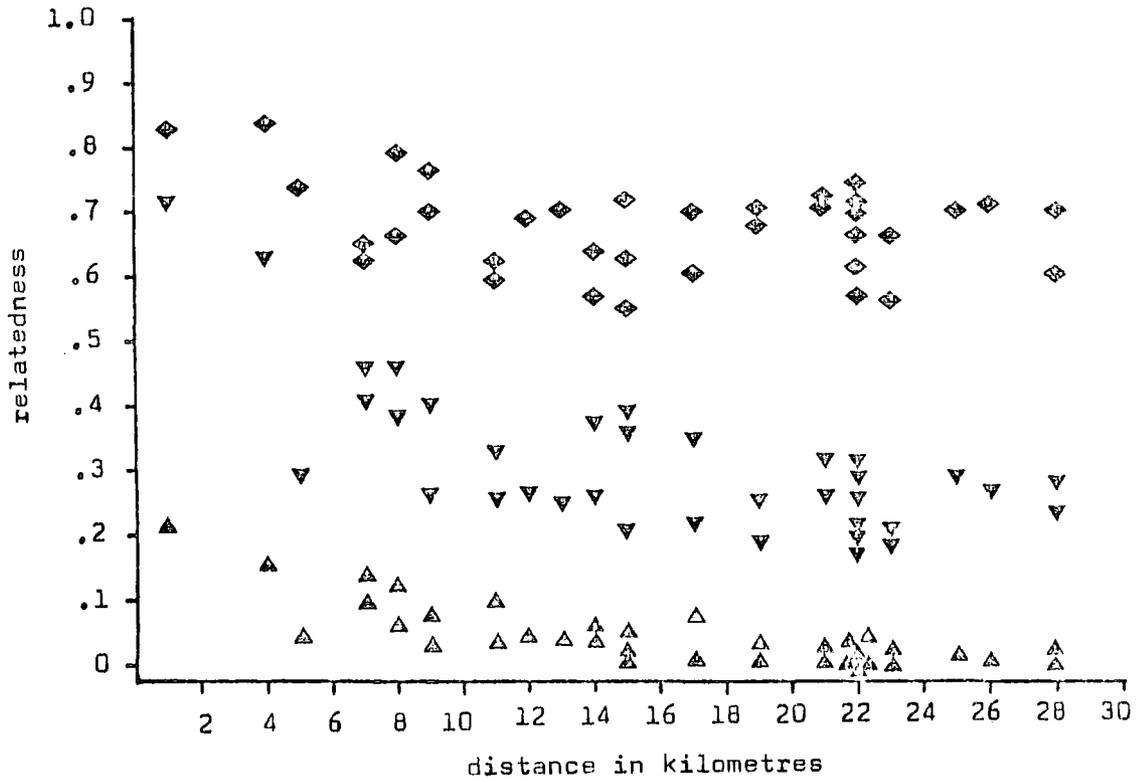
migration from all sources
migration within Island
migration between pairs of areas

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
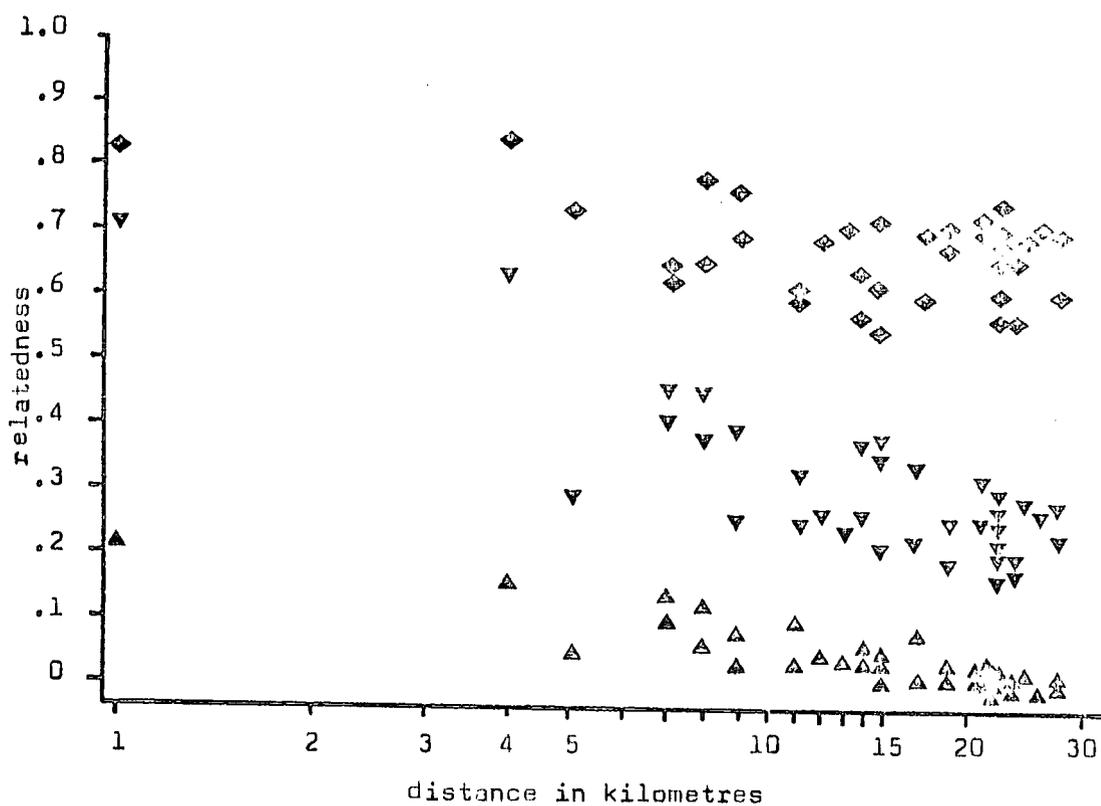
◈   migration from all sources
▼   migration within Island
▲   migration between pairs of areas

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 Kopec'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 Kopec'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	¦55
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
Se	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	$.2580 \pm .0769$	$.3816 \pm .1202$
	q	$.0417 \pm .0327$	$.0510 \pm .0482$
	r	$.7003 \pm .1094$	$.5674 \pm .1380$
	n =	73	41
Rhesus	D	$.5467 \pm .1142$	$.4369 \pm .1518$
	d	$.4533 \pm .1142$	$.5631 \pm .1518$
	n =	73	41
MN	M	$.4577 \pm .1158$	$.5000 \pm .1590$
	N	$.5423 \pm .1158$	$.5000 \pm .1590$
	n =	71	38
Ss	S	$.2536 \pm .1019$	$.3025 \pm .1076$
	s	$.7464 \pm .1019$	$.6975 \pm .1076$
	n =	70	37
Duffy	a	$.4434 \pm .1156$	$.4730 \pm .1631$
	b	$.5566 \pm .1156$	$.5270 \pm .1631$
	n =	71	36
Kell	K	$.0375 \pm .0452$	$.0308 \pm .0589$
	k	$.9625 \pm .0452$	$.9692 \pm .0589$
	n =	68	33
HP	1	$.4306 \pm .1144$	$.3947 \pm .1554$
	2	$.5694 \pm .1144$	$.6053 \pm .1554$
	n =	72	38
Tf	C	$1.0000 \pm .0000$	$.9878 \pm .0336$
	Other	$.0000 \pm .0000$	$.0122 \pm .0336$
	n =	73	41
AK	1	$.9786 \pm .0339$	$.9342 \pm .0788$
	2	$.0214 \pm .0339$	$.0658 \pm .0788$
	n =	70	38
PGM	1	$.8281 \pm .0924$	$.7917 \pm .1237$
	2	$.1718 \pm .0924$	$.2083 \pm .1237$
	n =	64	36
ESD	1	$.8356 \pm .0850$	$.8902 \pm .0957$
	2	$.1644 \pm .0850$	$.1098 \pm .0957$
	n =	73	41
AP	A	$.3767 \pm .0897$	$.3780 \pm .1198$
	B	$.5959 \pm .1049$	$.5610 \pm .1375$
	C	$.0274 \pm .0267$	$.0610 \pm .0526$
	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	.0681

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

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

(b)   Kopec's divisions

The reason for using Kopec'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 Kopec 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 reason-
ably clear relationship of increasing genetic distance with
decreasing similarity due to migration, when genetic distance
is computed on the basis of residence. No intelligible relation-
ship 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)   Kopec's blood group data

The ABO and Rhesus blood groups sampled by Kopec show some
variation within the Isle of Wight (Table 6.24). In parti-
cular, 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 Kopec's regions plotted against
similarity due to migration from all sources

◇   genetic distance by birth in region

○   genetic distance by residence in region
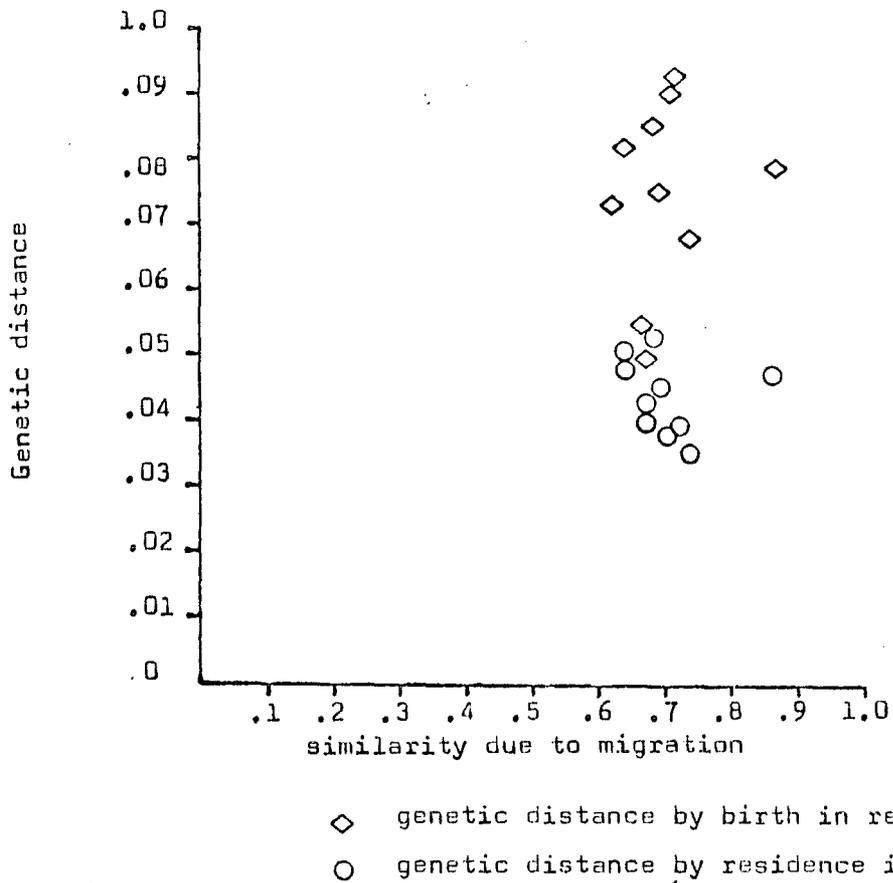
Figure 6.12   Genetic distance between Kopec's regions plotted against
similarity due to migration within the Island only
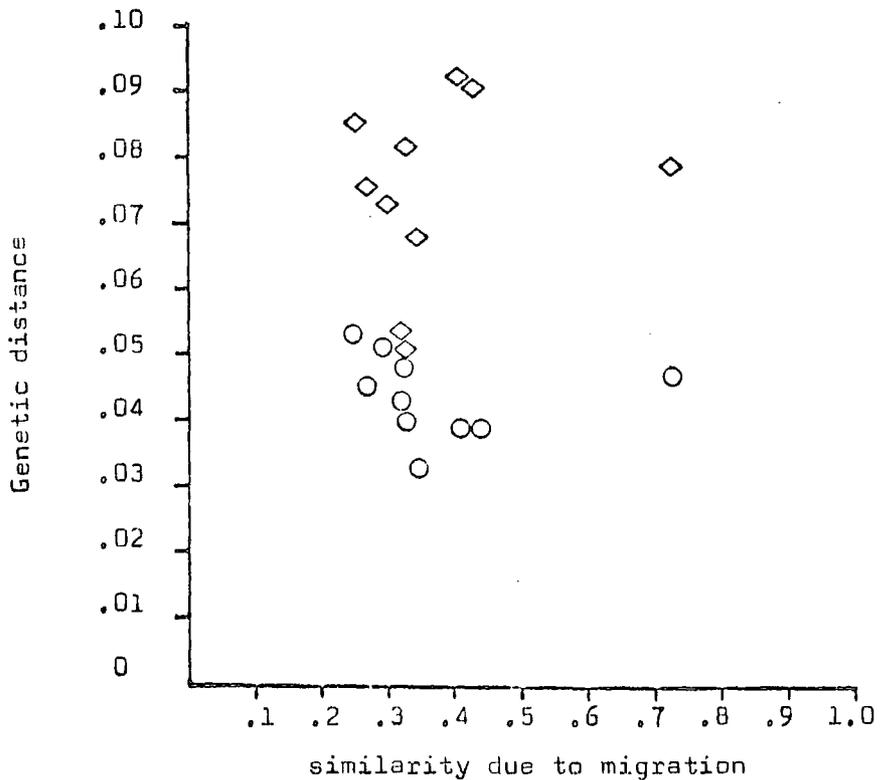
plots of relatedness due to migration are produced by the
SPACES program package (Schneider, 1977), and these show Cowes
and East Cowes to be closely related by migration whether or
not immigration is considered (Figures 6.13, 6.14). Indeed,
it is this exceptionally high intermigration rate which in
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 fre-
quencies 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 sel-
ective 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
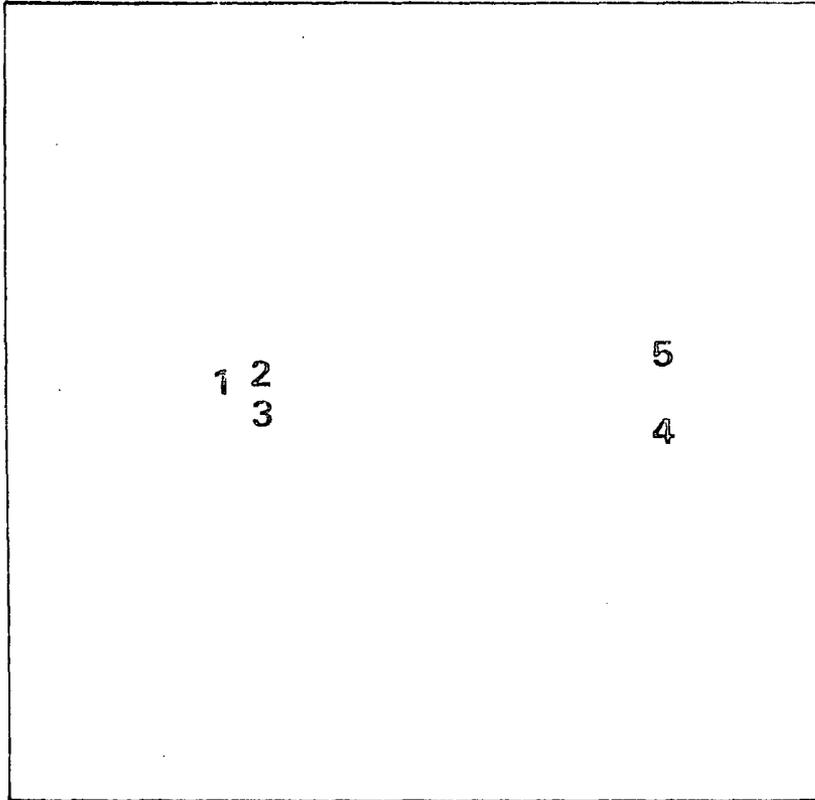
1 Cowes
2 East Cowes
3 Newport
4 Ryde
5 Sandown

Figure 6.14 SPACES NMMS plot of relatedness
due to migration between Kopeć's
regions: immigration included
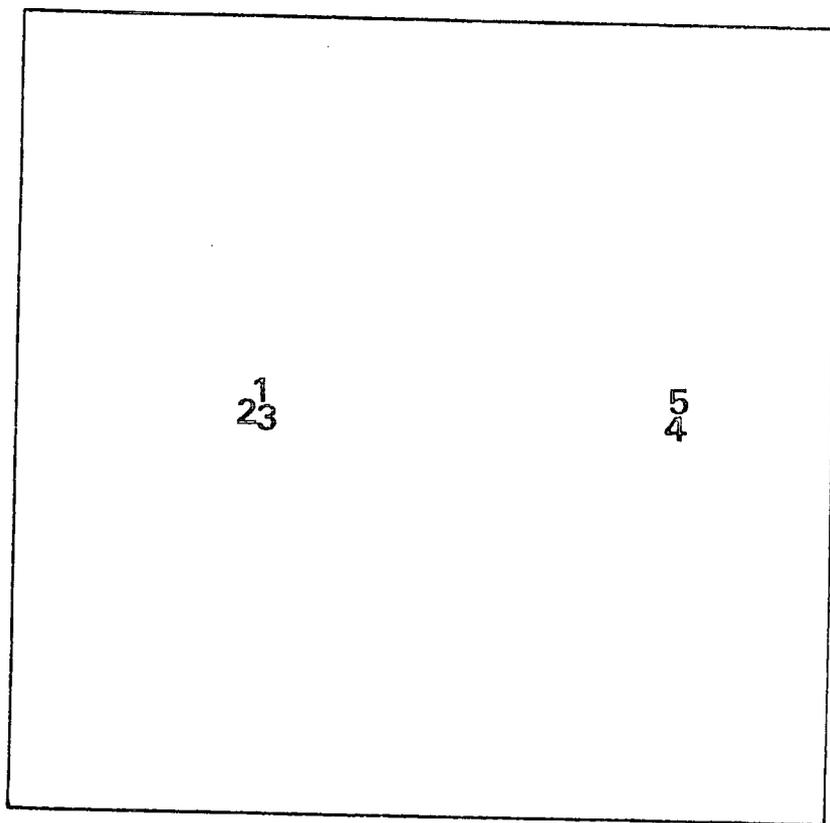
1 Cowes
2 East Cowes
3 Newport
4 Ryde
5 Sandown

Figure 6.15   SPACES NMMS plot of genetic
distance between Kopeć's regions,
by residence in those regions
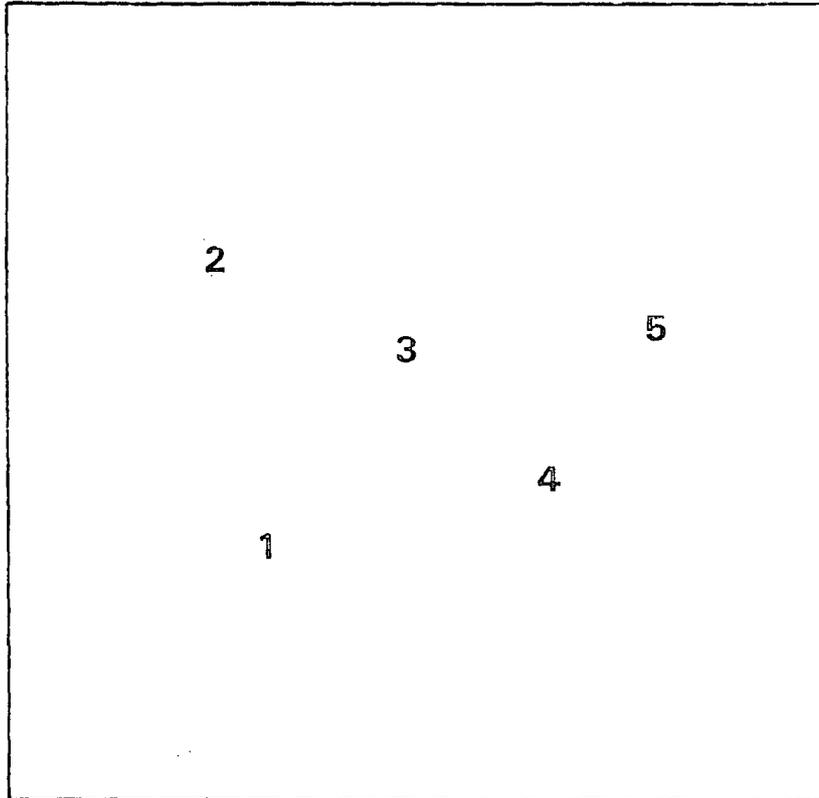
1   Cowes
2   East Cowes
3   Newport
4   Ryde
5   Sandown

Figure 6.16   SPACES NMMS plot of genetic
               distance between Kopec's regions,
               by birth in those regions
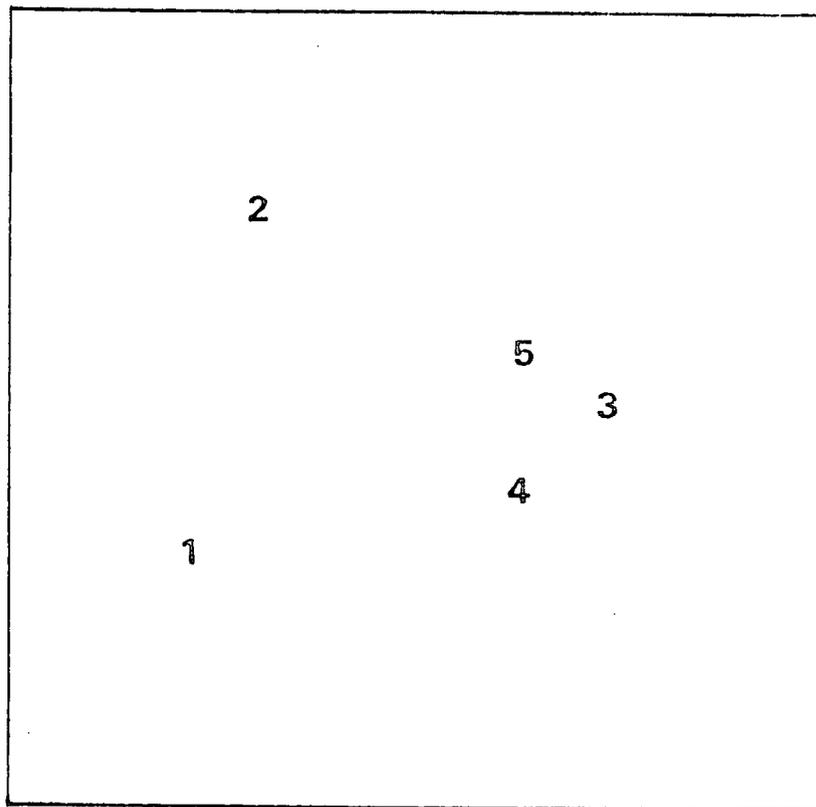
1   Cowes
2   East Cowes
3   Newport
4   Ryde
5   Sandown

(d)   The smaller areas

The prediction made on the basis of migration matrices was
that owing to the swamping effect of immigration, no relation-
ship 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 popu-
lations and samples at each distance, at least up to 20 kilo-
meters.

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
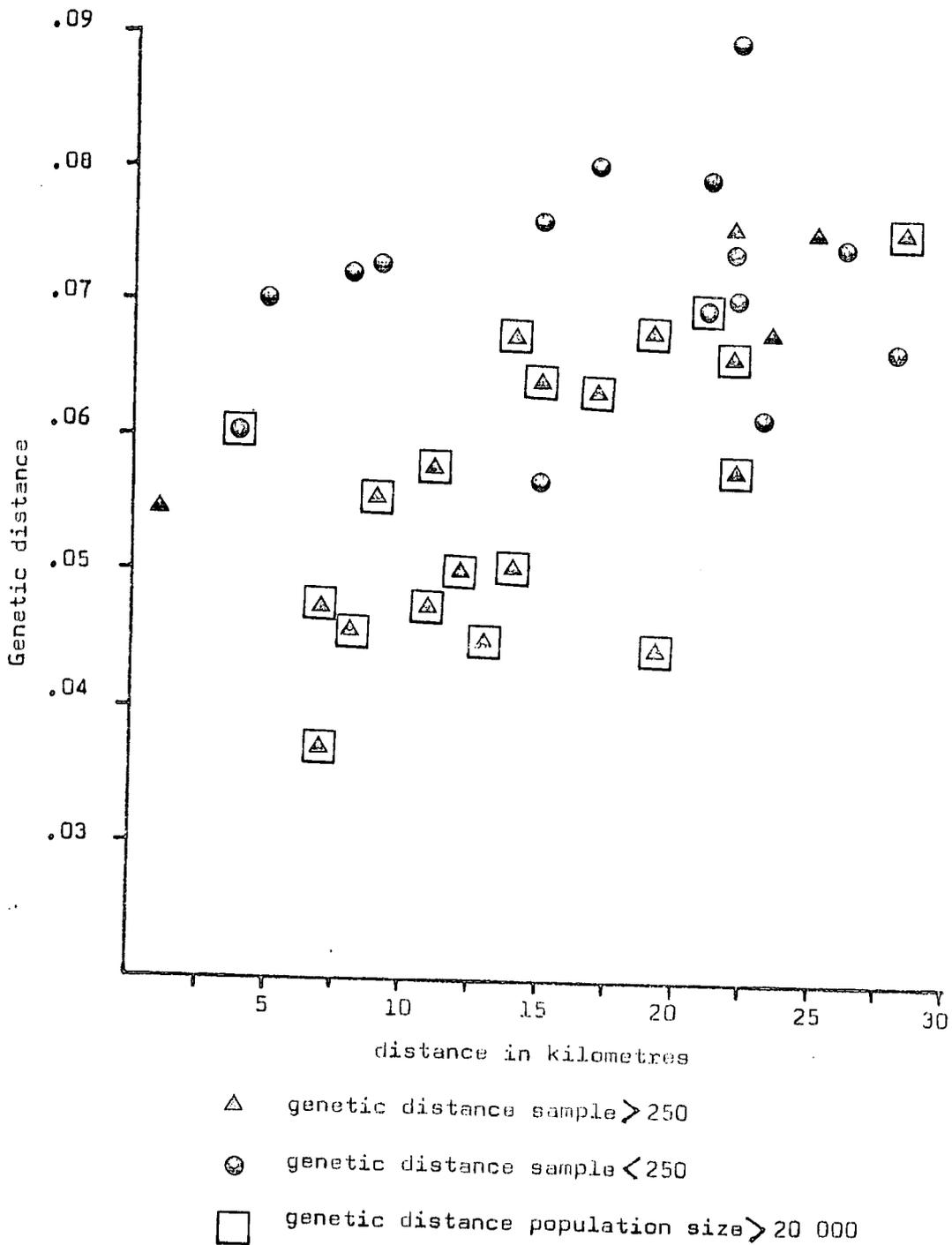
Figure 6.18 Genetic distance between pooled areas plotted against similarity due to migration from all sources
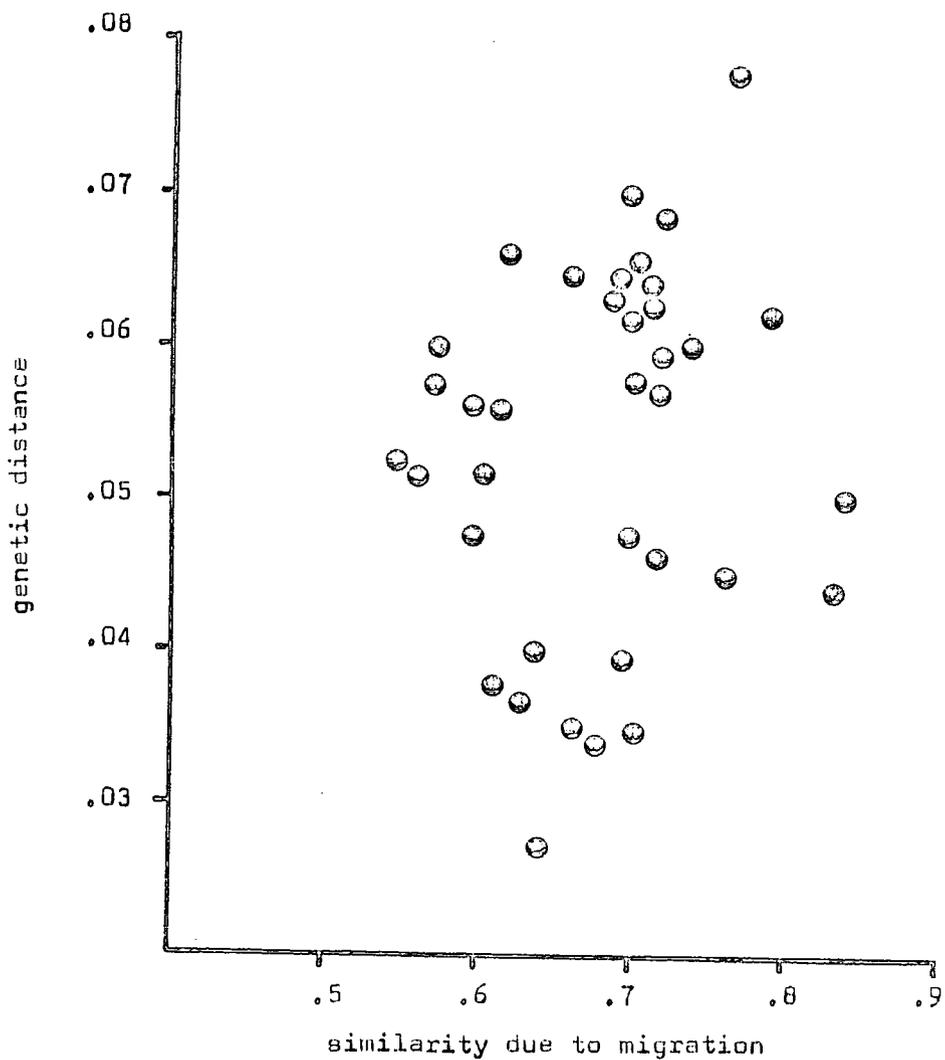
matrix does not predict accurately or that the genetic distance
does not measure properly. These points must be returned to
in discussion.

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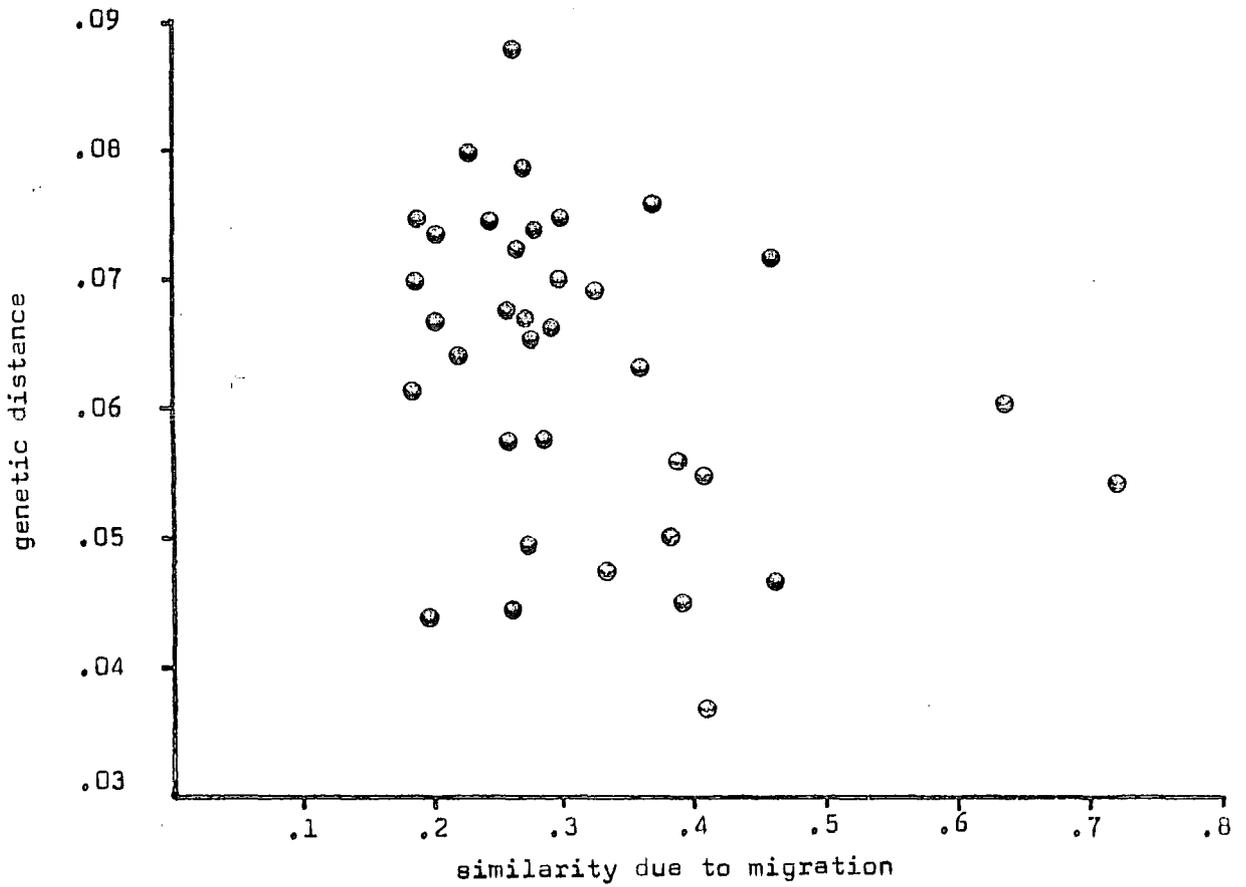
Figure 6.20 Genetic distance between pooled areas
plotted against similarity due to
migration within the Island:
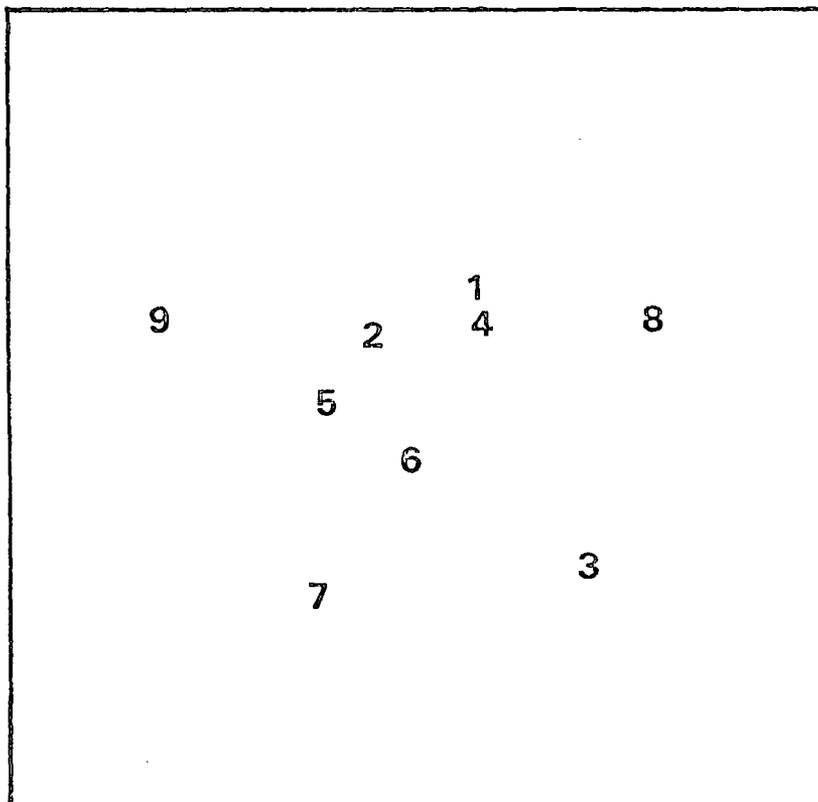road distance indicated as a third variable

▽ > 20 km

◆ 10 - 20 km

▲ < 10 km
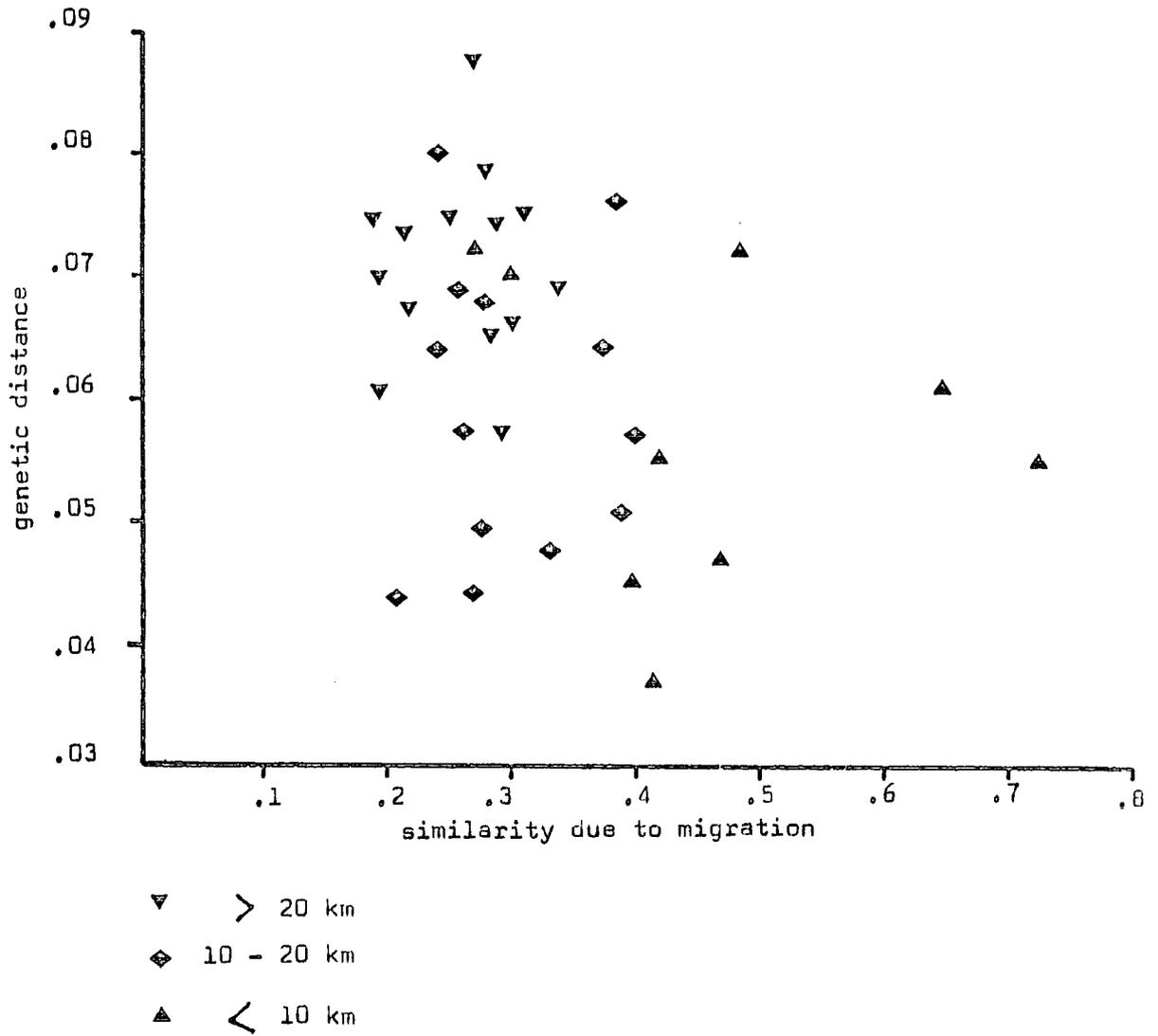
Figure 6.21 SPACES NMMS plot of similarity between areas, based on migration within the Isle of Wight
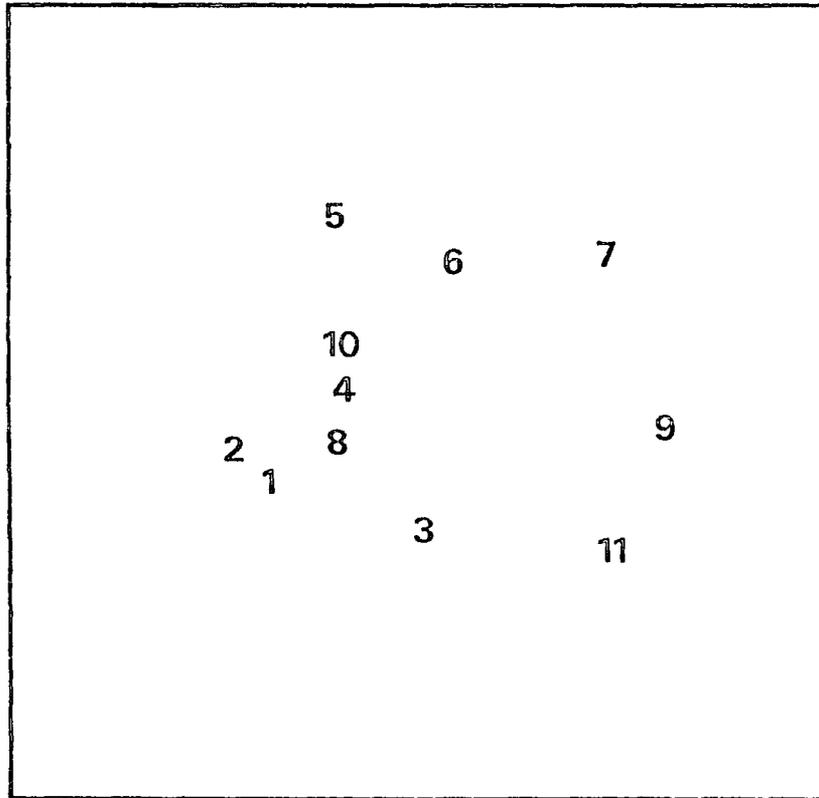
1 Cowes
2 East Cowes
3 Freshwater
4 Newport
5 Ryde
6 Sandown
7 Shanklin
8 West Wight
9 Ventnor
10 Wootton
11 Yarmouth

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
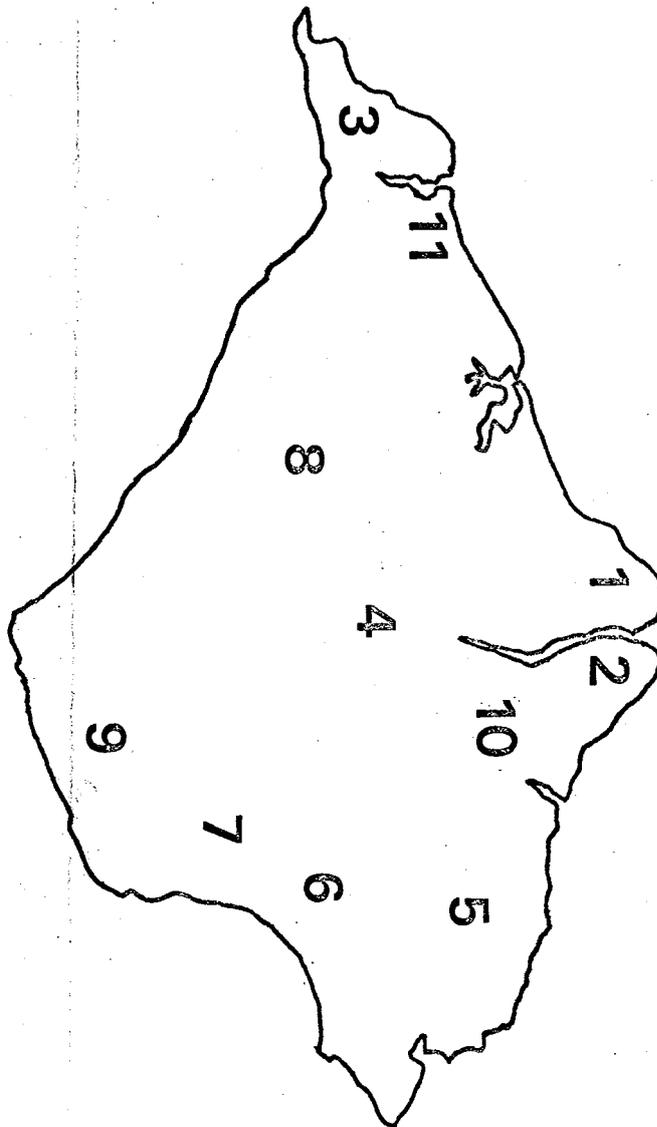
The population sizes for the various areas at the 1971 census
are shown in Table 6.25, column 1. Columns 2 and 3 of this
table show the sample sizes on which the genetic distance and
migration statistics are based. There is an approximate
proportionality between population size and sample size, and
this 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 popu-
lation 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

genetic distance (y-axis)
combined population size in thousands (x-axis)
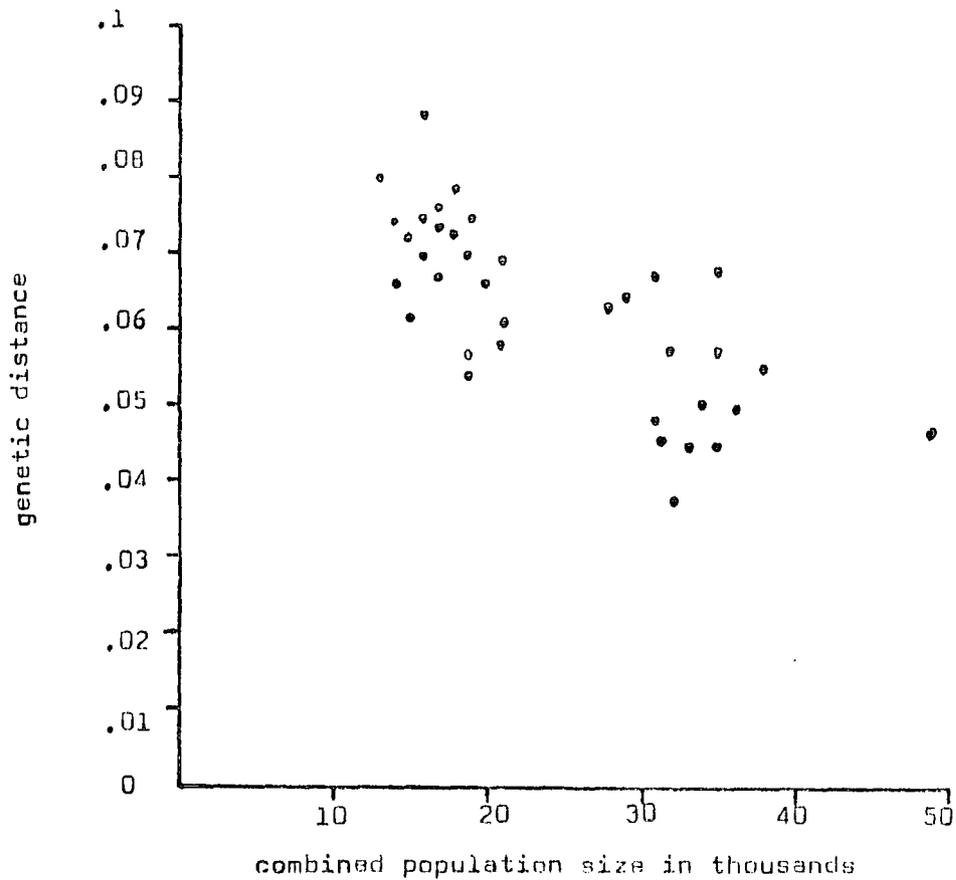
Figure 6.24   Genetic distance plotted against
               sample size

genetic distance (y-axis)
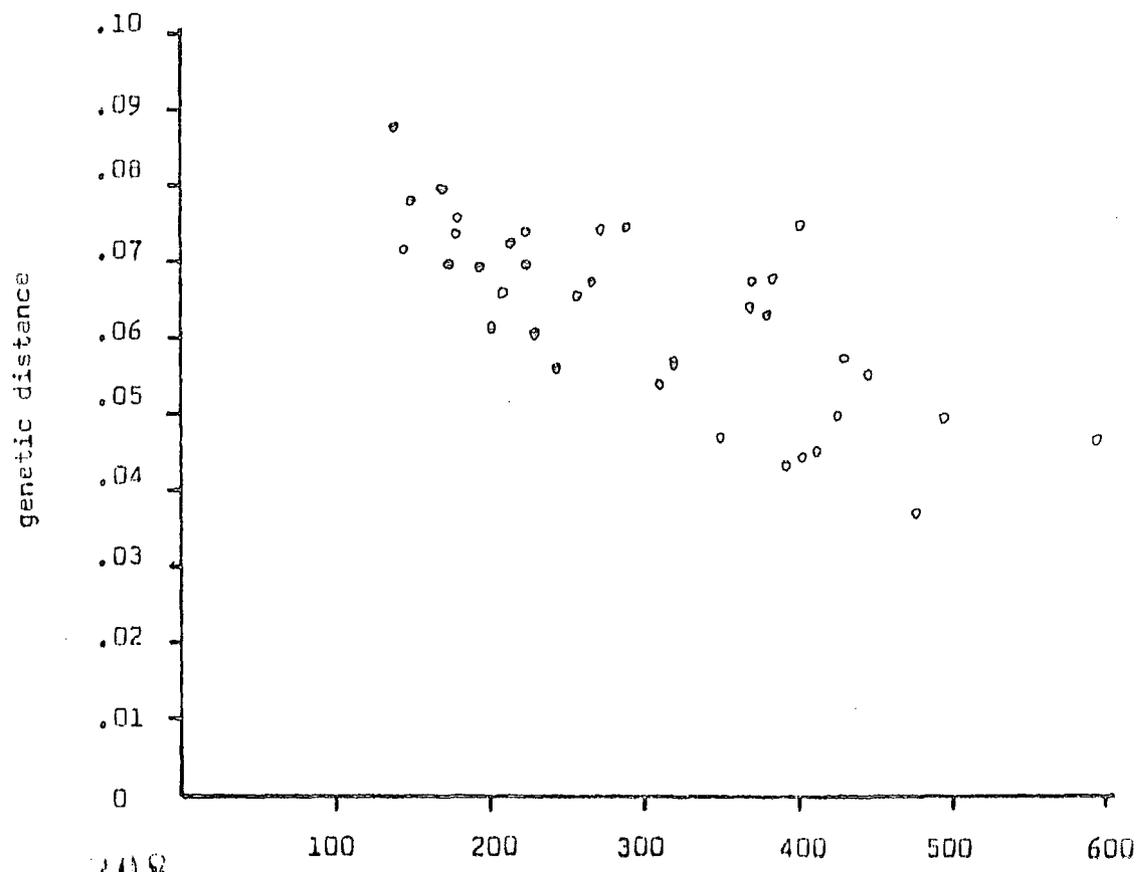
Figure 6.25   Relatedness between pooled areas
due to migration within Island
plotted against sample size
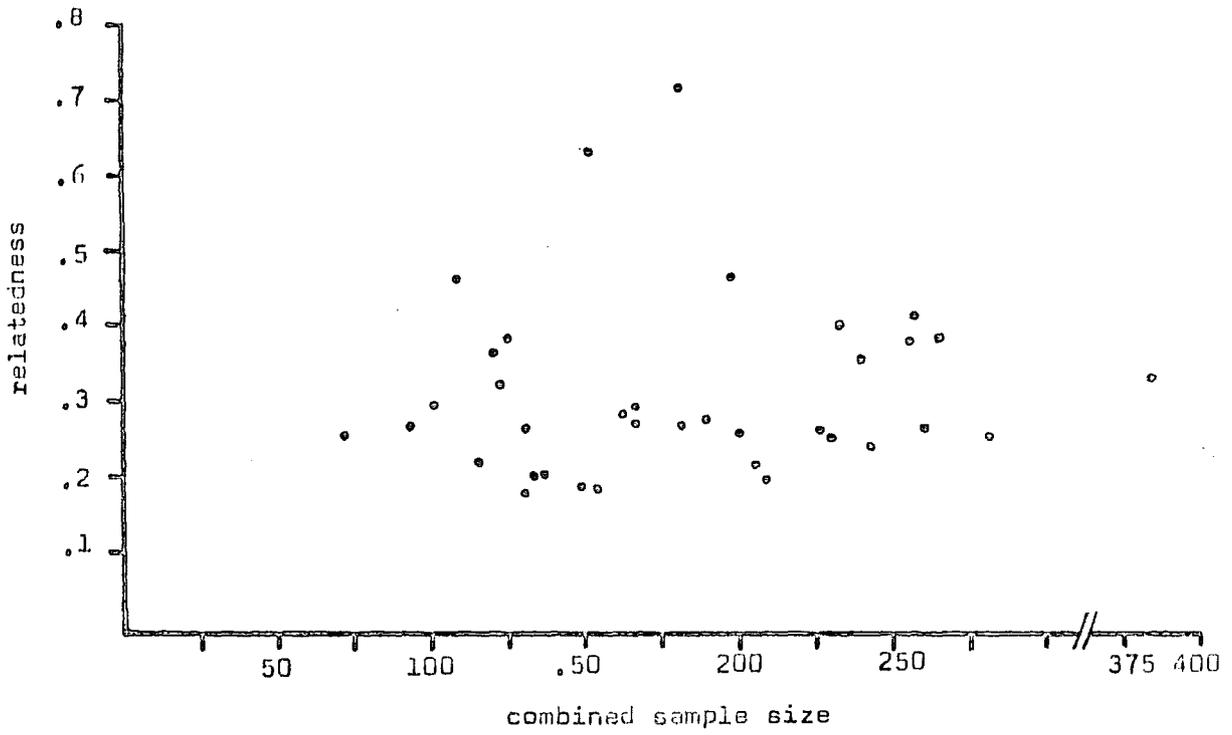
In probability, an enduring pattern of internal migration has

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
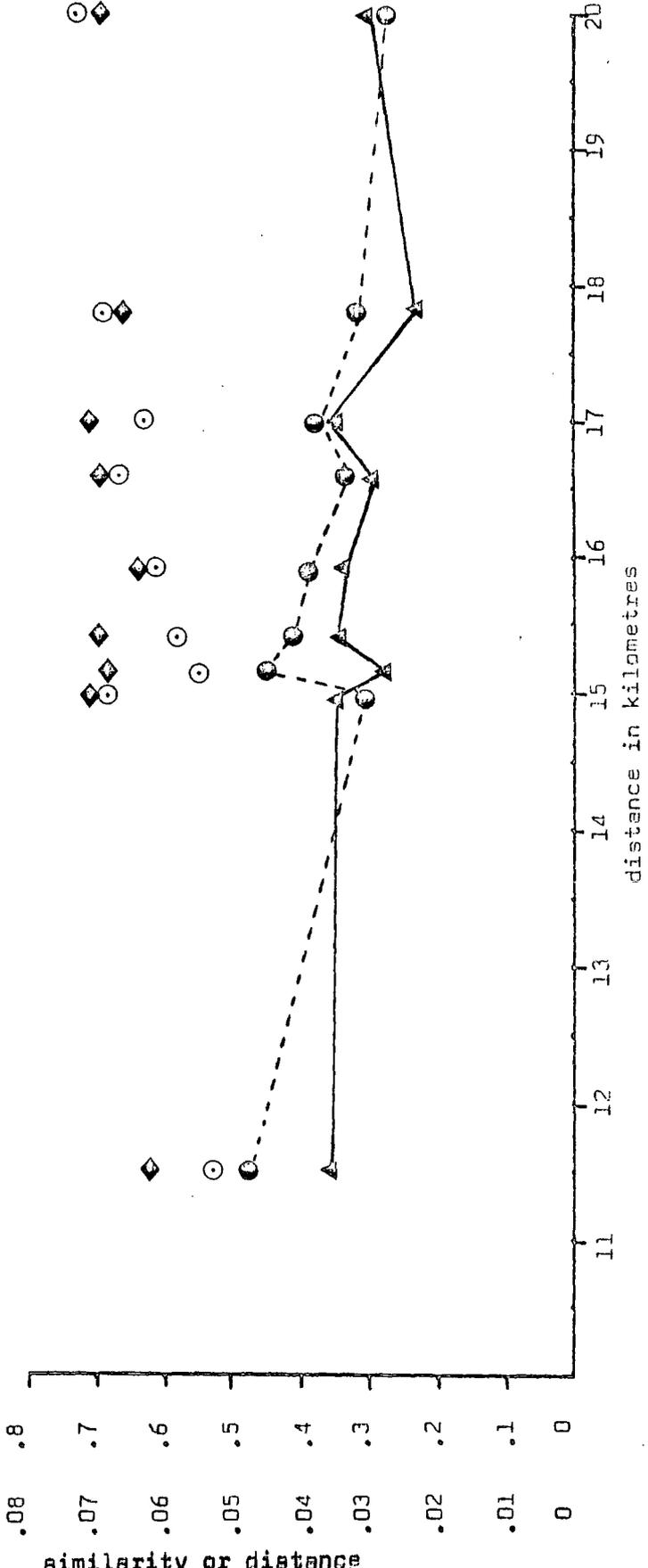
Legend:
◆ immigration included
◉ genetic distance
◑ 1 - genetic distance
◁ migration within island only

similarity or distance

distance in kilometres

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 dis-

cover 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 miscel-
laneous 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   <u>Genetic differences between the Isle of Wight and Mainland</u>

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 frequen-
cies between the populations concerned. This conclusion seems

inescapable, in spite of the paradoxical fact that the distri-
butions 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 detect-
able 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 immi-
gration 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 appli-
cation.

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 super-

ficial 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 illumin-
ated Colyton (Wrigley, 1966, 1975), Oxfordshire (Kuchemann 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 recruit-

ment; it approximates to sampling the population on a proportional

basis (about $1\frac{1}{2}\%$ 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 pro-

grams (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 indepen-

dent 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 distinc-
tiveness 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 pro-
crastinates 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 ....

BLOOD GROUP ....

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)

NAME ....

FORM ....

OCCUPATION

NUMBER	SEX	SURNAME & INITIALS	DATE OF BIRTH	PLACE OF BIRTH (Town & County)	OCCUPATION
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

APPENDIX   III

<u>Freezing and Recovery of Red Cells in liquid Nitrogen</u>

<u>A.</u>   <u>Reagents</u>   (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

<u>B.</u>   <u>Freezing</u>

(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 $-196^{o}C$

      in anodised aluminium racking.

(4)   Storage at this temperature can either be in liquid or

      vapour phase of N_2.

<u>C.</u>   <u>Recovery</u>

(1)   The amouples are removed from storage container using

      utmost care and dropped into a $+45^{o}C$ 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 approxi-

        mately 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).

```
$1 migr
>        1              DIMENSION A(7,7),P(7,7),R(7,7),ATEMP(7,7),ATRANS(7,7)
>        2              DIMENSION MFOR (4)
>        3              READ(5,11)MFOR
>        4           11 FORMAT(4A4)
>        5              READ(5,12)N,NGENS
>        6           12 FORMAT(I3)
>        7              READ(5,13)((P(J,K),K=1,N),J=1,N)
>        8           13 FORMAT(16F5.4)
>        9              DO 33 J=1,N
>       10              DO 33 K=1,N
>       11              ATEMP(J,K)=0.0000
>       12           33 CONTINUE
>       13              DO 44 J=1,N
>       14              DO 44 K=1,N
>       15              ATRANS(J,K)=0.0000
>       16           44 CONTINUE
>       17              DO 55 J=1,N
>       18              DO 55 K=1,N
>       19              IF (J .EQ. K) GO TO 23
>       20              A(J,K)=0.0000
>       21              GO TO 55
>       22           23 A(J,K)=1.0000
>       23           55 CONTINUE
>       24              ITER=0
>       25          555 CONTINUE
>       26              DO 66 J=1,N
>       27              DO 66 K=1,N
>       28              R(J,K)=0.0000
>       29           66 CONTINUE
>       30              DO 88 J=1,N
>       31              DO 88 K=1,N
>       32              SUM=0.0000
>       33              DO 77 L=1,N
>       34              SUM=SUM+A(J,L)*P(L,K)
>       35           77 CONTINUE
```

```
>   36         ATEMP(J,K)=SUM
>   37      88 CONTINUE
>   38         DO 99 J=1,N
>   39         DO 99 K=1,N
>   40         A(J,K)=ATEMP(J,K)
>   41      99 CONTINUE
>   42         NLESS=N-1
>   43         DO 100 J=1,NLESS
>   44         JPLUS=J+1
>   45         DO 100 M=JPLUS,N
>   46         DO 100 K=1,N
>   47         IF (A(J,K) .LT. A(M,K)) GO TO 24
>   48         R(J,M)=R(J,M)+A(M,K)
>   49         GO TO 100
>   50      24 R(J,M)=R(J,M)+A(J,K)
>   51     100 CONTINUE
>   52         ITER=ITER+1
>   53         WRITE(6,14)ITER
>   54      14 FORMAT(1H1,I3)
>   55         DO 122 J=1,N
>   56         DO 122 K=1,N
>   57         ATRANS(J,K)=A(K,J)
>   58     122 CONTINUE
>   59         WRITE(6,MFOR)ATRANS
>   60         WRITE(6,MFOR)R
>   61         IF (ITER .LT. NGENS) GO TO 555
>   62         STOP
>   63         END
```