NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION NEWSLETTER

THE FIRST TWENTY YEARS.

RADIOCARBON DATES FOR SOUTH ISLAND MOA-HUNTER SITES, 1955 - 74.

Beverley McCulloch
Michael Trotter

ABSTRACT: A review and assessment of radiocarbon dates which have been obtained for early sites in the South Island over the last two decades, including some dates published for the first time. Dates are grouped according to the material used for dating, their geographical distribution is shown on maps and the assembled data are graphed. A comparison is made of the probable reliability of dates obtained from the different materials and an attempt is made to interpret the archaeological significance of the overall pattern. Some general comments are made on the use of radiocarbon dating in archaeology and finally details are given of new dates used in the paper.

INTRODUCTION:

The first radiocarbon dates to be obtained for the Polynesian occupation of the South Island were officially released in 1955. They were for the Wairau Bar Moa-hunter site in Marlborough, the material dated was charcoal, and the results obtained were 850 ± 50 years B.P. and 935 ± 110 years B.P.; the former was from the Dominion Physical Laboratory in Lower Hutt and the latter from the Yale University Geochronometric Laboratory in New Haven, Connecticut.

At the conference of the New Zealand Archaeological Association held in Blenheim in 1974, three new dates for the Wairau Bar site were announced; 590 ± 60 years B.P. (for moa bone collagen), 680 ± 50 years B.P. (for marine shell), and 780 ± 80 years B.P. (for human bone). These are the only other dates to have been obtained from this famous site, the 'type specimen' for New Zealand Moa-hunter sites.

However in the intervening years approximately one hundred and seventy more dates have been obtained for archaeological sites of all ages throughout the South Island.

In this paper eighty-eight of these are considered.

SELECTION OF DATES:

Our reasons for the inclusion or omission of particular sites or dates are relevant.

To consider omissions first. As we are dealing with only early or Moa-hunter sites, obviously late or 'Classic' sites are excluded, as also are those which contain both 'early' and 'late' occupation, and where published information does not make it absolutely clear from which layer the dating material was obtained. As well some dates were rejected because we were not able to obtain a sufficiently definite indication of the 'cultural age' of the site. There were too, some which were 'not available' because they have not been published. All bone carbonate dates are ignored. These were mostly obtained in the earlier days of radiocarbon dating; they nearly always give comparatively recent results, and indeed the New Zealand

Laboratory is no longer willing to process such material, regarding it as wholly unsuitable. Finally, one date obtained for moa bone collagen from the Tai Rua site in Otago was a laboratory experiment, involving a contaminated sample. As such it cannot be considered as a reliable archaeological result.

The inclusion of a date was based on only one criterion, that it could clearly be shown to have been obtained from a culturally early site, or a culturally early layer in a stratified site. Our selection of a site or layer as "culturally early" was made on archaeological evidence alone without reference to dates obtained from it. This evidence included artifact types, materials used, size and nature of cooking areas, faunal remains (particularly of moa and other extinct bird species) and site location.

Obviously not all sites possessed the full range of diagnostic features and in some cases evidence was circumstantial rather than actual. For example, we consider *all* the rock-art shelters to be early, because where diagnostic evidence is available it indicates overwhelmingly that this is the case. There is virtually no evidence of utilization of rock-art shelters between Moa-hunter times and the period of European contact, so although some dated shelters contain little or no diagnostic material we have taken the presence of prehistoric drawings to be indicative of early occupation.

Also there were problems associated with what might be termed 'transitional' sites. Three of these in particular, Lagoon Flat, Motunau Beach and Kairaki, can be discussed, as they are known personally to the authors.

The Lagoon Flat site, at the mouth of the Conway River, has yielded numerous typically Moa-hunter artifacts, and as well, some scarf-cut greenstone and a number of 'Classic-type' burials. This is an extensive site, partly disturbed by ploughing, but such excavation as has been undertaken indicated that there is no cultural stratification, all material quite definitely relating to one period of occupation.

The date of 480 ± 60 B.P. was obtained from human bone, a relatively unknown quantity in radiocarbon analysis, and is a little earlier than we would have expected. Because the burials appeared to relate to the 'Classic' rather than the Moa-hunter aspects of the site, for this reason we decided to omit the site from consideration, as we cannot define it as truly Moa-hunter.

The Motunau Beach site is much eroded by flooding, but a date of 410 ± 54 B.P. was obtained from a deposit of very large paua shells at some depth below sand dunes. While there are records of 'moa' ovens being discovered adjacent to the shell deposit, and there are still firestones and greywacke spawls on the surface today, we were unable to positively relate the shell to the apparently early materials. This site too is therefore omitted.

Finally the Kairaki shell midden (No.13) has been included mainly on the somewhat slender evidence of a single orthoquartzite flake and the large size and thickness of midden shells (cockle and pipi). Although these species continued to live locally throughout the

human period, they do not appear to have ever regained this distinctive heavy form since the excessive exploitation which took place as moas were exterminated from the area. An important characteristic of the Kairaki site however is the total absence of any material pertaining to Classic culture.

We consider then that all those sites we have included belong quite definitely to that period or aspect of Polynesian prehistory that was broadly defined by Duff as Moa-hunter and which is also variously designated as Archaic, Early N.Z. Eastern Polynesian, or, in some cases, simply Early.

Because sites were selected in this manner, some that have produced early dates but do not conform to our criteria have been omitted. As an example, a very early date of 880 ± 39 years B.P. was obtained for the remains of a wooden upright of a house on Katiki Point, North Otago. But all other evidence puts the site as being only two, or at the most, three centuries old. There is in fact better reason to suggest the use of sub-fossil timber in the house construction than to accept, on the evidence of this single date, that occupation was in an early period.

We have felt it essential in a study of this nature to consider (if only to reject), *all* known dates for each of the selected sites. If radiocarbon analysis is acceptable as a method of obtaining archaeological dates, then *every* result obtained must be given due consideration. Where a date is outside the possible (or even likely) period of human activity, then we have tried to find an explanation for the discrepancy. Where a collector arbitrarily discards dates that fall outside a preconcieved range, and at the same time accepts those that fit into the supposed occupational pattern, he surely casts grave doubt on the validity of them all. If his archaeological and collection methods are sound, he is in fact doubting the constancy of the radiocarbon method itself.

Unacceptable dates are usually due to the use of unsuitable materials for dating or to the misinterpretation of the archaeological significance of the sample. The accuracy of acceptable dates can also be affected by the same two factors, but is harder to detect.

PRESENTATION OF DATES:

All dates in this paper are as given by the laboratory and have been checked for accuracy. (Some dates in particular seem to be persistently misquoted). All are calculated with respect to the 'old' half-life using the 0.95 NBS oxalic acid standard for charcoal, and N.Z. standards for bone and shell. No secular 'corrections' such as those of Michael & Ralph have been applied. (Some dates were originally published using other standards and these have been corrected here to these N.Z. standards).

While there is increasing use of the 'new' half-life for C^{14} and of 'correction' tables to try to produce radiocarbon results that more closely approximate true age in calendar years, we have not used these for two reasons. Firstly, most of the dates have already been published using the 'old' half-life and the use of different figures from the same original analyses could be confusing, and secondly 'corrections' of ten or twenty years are of little account compared

with the large range of results produced by different materials.

On the following four maps the geographical distribution of dated South Island Moa-hunter sites is shown, each map representing a 'set' of dates obtained from particular materials, moa bone collagen, marine shell, charcoal and wood, and others. A key giving site names and N.Z.Archaeological Association numbers is included. At this stage we merely comment on each 'set' of dates as an individual unit, without comparison with or reference to other 'sets'.

MOA BONE COLLAGEN DATES:(Fig.1)

There are twenty dates in this group, representing eleven sites, ranging from Wairau in the North to Hampden in the South. All except two are from the large 'classic' east coast Moa-hunter sites (if one can have a 'classic' Moa-hunter site) and reflect not only the distribution of these dominant sites, but also the continuing archaeological interest which is taken in them.

There are some notable gaps, such as around Kaikoura in the north, south of and around Dunedin, and the whole of the West Coast. These gaps should certainly not be taken as indicating an absence of moas or moa hunting in these areas. Some of the gaps in the south can be accounted for by the use of carbonate rather than collagen dates in early years and by the unavailability of unpublished results. Material has already been obtained from a Kaikoura site and it is hoped to process it before too long. Finally the absence of dates from the West Coast reflects mainly the comparative absence of archaeological work in this area.

The principal advantages of moa bone collagen dates are that moa bone is one material which we can be almost certain represents early occupation of a site; it is not readily subject to contamination from either the atmosphere or the soil, nor is it liable to compositional change, so that we can be fairly sure of the sequential accuracy of results. Its disadvantage is that it is often difficult, if not impossible, to obtain. There are many early cultural deposits from which moa bone certainly was once, but is not now, available. From the large Shag River site, from which three waggon loads of bones were taken to a bone-works, we have not been able to obtain a single piece of moa bone from an archaeological context. At Awamoa, so named by Walter Mantell because of the quantities of moa remains he found there in 1852, a variety of European activities has left little apart from charcoal and burnt stones.

With one exception, the Timpendean date of 1525 B.P., the range of collagen results is remarkably constant, the earliest some 735 years B.P., and the latest 421.

The Timpendean result warrants a closer look. The material was obtained from the rock-shelter of that name which contained as well a good range of other diagnostically early cultural material. However, during our investigations we also discovered a considerable amount of 'natural' moa bone from this and other shelters in the vicinity, which had no occupational deposit.

Although 1525 years B.P. is not a too outlandishly impossible date for human occupation of the area, taken into consideration with other dates and from what is known of Polynesian use of 'natural' bone

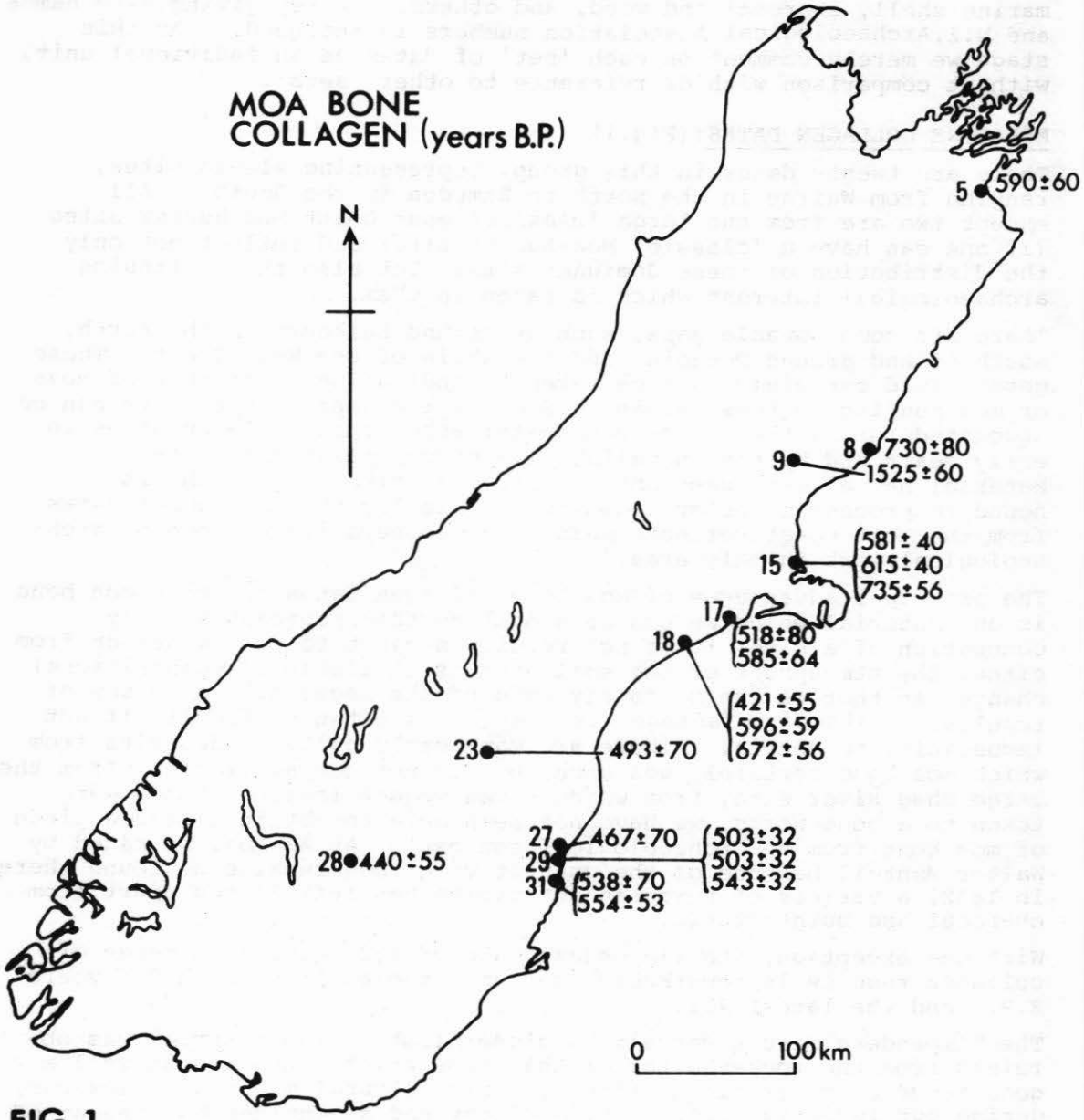
MOA BONE
COLLAGEN (years B.P.)
N
5 590±60
8 730±80
9 1525±60
15 581±40
615±40
735±56
17
18 518±80
585±64
421±55
596±59
672±56
23 493±70
27 467±70
29 503±32
503±32
31 538±70
554±53
543±32
28 440±55
0
100 km

FIG. 1

deposits, it seems far more likely that in this instance they were utilising 'natural' bone, a theory which is supported by the finding of moa bone artifacts in the occupational deposit.

For these reasons we consider that the Timpendean date should be dropped when moa bone dates are being used to assess the time-span of moa hunting in the South Island, although this in no way alters the Timpendean site's status as culturally early or indeed as a moa hunter site.

MARINE SHELL DATES: (Fig.2)

There are eighteen dates for this material, obtained from seventeen sites. Again, the distribution is largely coastal, as one would expect for shell deposits. There are two or three inland sites and two from the West Coast. Marine shell is of course the most common of all faunal materials from New Zealand sites and the distribution of dated sites in no way reflects its absence from sites not represented on the map. Once again, however, it does indicate where most archaeological research has been undertaken.

There are some technical difficulties connected with the dating of marine shell. Recent research suggests that shell standards vary in different parts of New Zealand - for instance, if a shell sample is dated with respect to a Canterbury standard instead of the usual N.Z. standard from South Otago, the result would be 96 years younger. Whether this is due to habitat, species or geographical regions is not yet clear.

Shell used for dating should as well still retain its original aragonite form of calcium carbonate. If the aragonite has started to recrystallise to calcite, then the date may be of doubtful accuracy.

The dates shown range from an extremely early 910 ± 32 years B.P., from a North Canterbury rock shelter site, to an unacceptably late 238 ± 53 years B.P., also for a North Canterbury rock shelter.

The former of these lies just within the possible period of human occupation in the area. The latter is unacceptable, not necessarily as an inaccurate date, but as representing a culturally early deposit. Here we can only surmise that we have the anomalous situation of a culturally early rock-shelter site with drawings and a single occupational deposit, returning a date which can only be ascribed to a late period.

There are two alternative solutions. In the first we would accept the date as representing accurately the time of deposition of the dating material, thus accepting two periods of occupation for the shelter, one early in which the drawings were done and one later at which time the shells were deposited.

There is, however, the possibility that this date is not representative of the time of occupation. A marine shell sample from another North Canterbury site required considerable pre-treatment before it gave an archaeologically acceptable result and it is possible that the Glen Gynk shell was similarly affected by contamination or calcite reversion.

At this stage we are not in a position to decide which of these two possibilities (if either) is correct. However, whatever the truth may

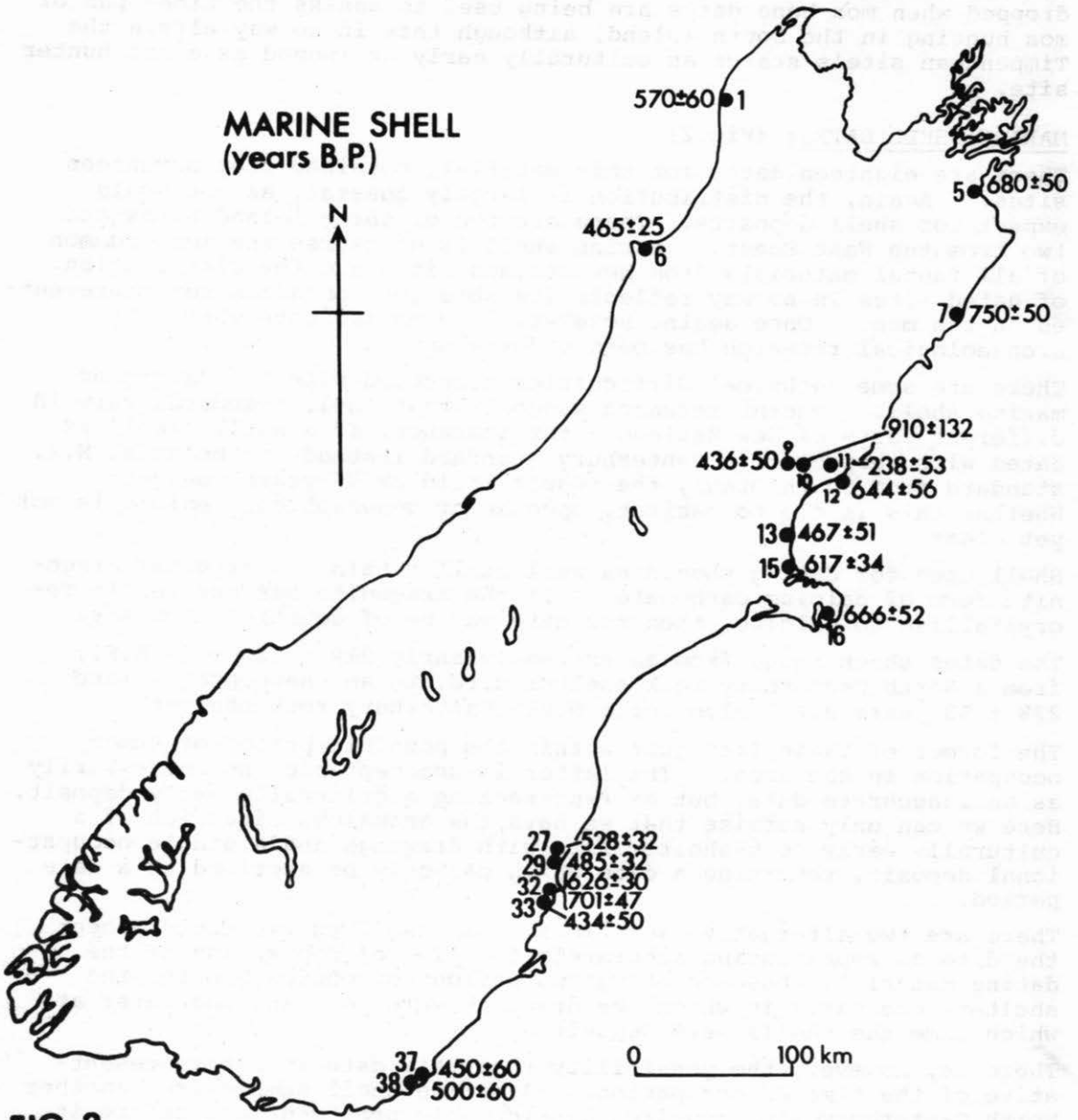
MARINE SHELL
(years B.P.)
N
570±60 1
5 680±50
465±25
6
7 750±50
910±132
436±50
11 238±53
12 644±56
13 467±51
15 617±34
16 666±52
27 528±32
29 485±32
32 626±30
33 701±47
434±50
37 450±60
38 500±60
0
100 km

FIG. 2

be we cannot seriously consider the actual date of 238 years B.P. as representing even the topmost end of a time scale pertaining to early South Island occupation. Nor are we prepared to concede that the rock shelter may in fact not necessarily be culturally early.

If we exclude this date, then our youngest figure for shell becomes a much more realistic 434 years B.P. Nevertheless, having to discard a date without being able to find good and sufficient reason for doing so, other than that it 'doesn't fit', means that the reliability rating of marine shell (or conversely McCulloch and Trotter's archaeology), must be lowered a notch.

CHARCOAL AND WOOD DATES: (Fig.3)

Dates from these materials represent half of the total dates obtained from our selected sites, there being forty-four results from twenty-seven sites. This can, at least largely, be accounted for by its ready availability on virtually all sites.

Geographically a much wider range of sites is represented, with proportionately many more from inland areas, although West Coast sites are again conspicuous by their absence.

There are considerably more difficulties connected with obtaining archaeological dates from charcoal than from any other material commonly dated. This does not mean that a date itself is necessarily wrong, merely that for one reason or another it does not represent the time of archaeological deposition in the site of the material dated.

As well, it has been demonstrated by workers such as Goh and Molloy that charcoal readily absorbs humic contaminants which have a considerable effect on its radiocarbon age, small pieces of charcoal being affected to a greater degree than larger pieces. Findings such as this could negate any advantages thought to be obtained by the selection of twig material rather than trunk or branchwood for dating.

All material should also be identified as to species before processing.

Dates on this third map range from an oldest of 9540 ± 145 to a youngest of 442 ± 52 years B.P., hardly a reasonable time span for early New Zealand culture by anybody's standards.

The two nine thousand year dates for Oturehua, however, tempt the romantically minded to be wildly speculative, not from the point of view of suggesting Polynesian occupation on a permanent basis from that time, but about a possible isolated excursion to New Zealand at a time long before the age of Polynesian population spread, perhaps from Australia or its northern neighbours.

They can easily be accounted for, however, from the point of view of Polynesian occupation, by suggesting the use of relict logs, which abound in Central Otago in an excellent state of preservation.

Excluding these dates we have a time range oldest to youngest of 1315 ± 80 to 442 ± 52 years B.P., with a fairly representative spread of all centuries in between, although there is a noticeable weighting of 'older' dates as opposed to younger; two of greater than 1000 years B.P., five of 900, eleven of 800, eight of 700, nine of 600, three of 500, three of 400; that is, twenty-six dates older than 700 years B.P., as opposed to fifteen later.

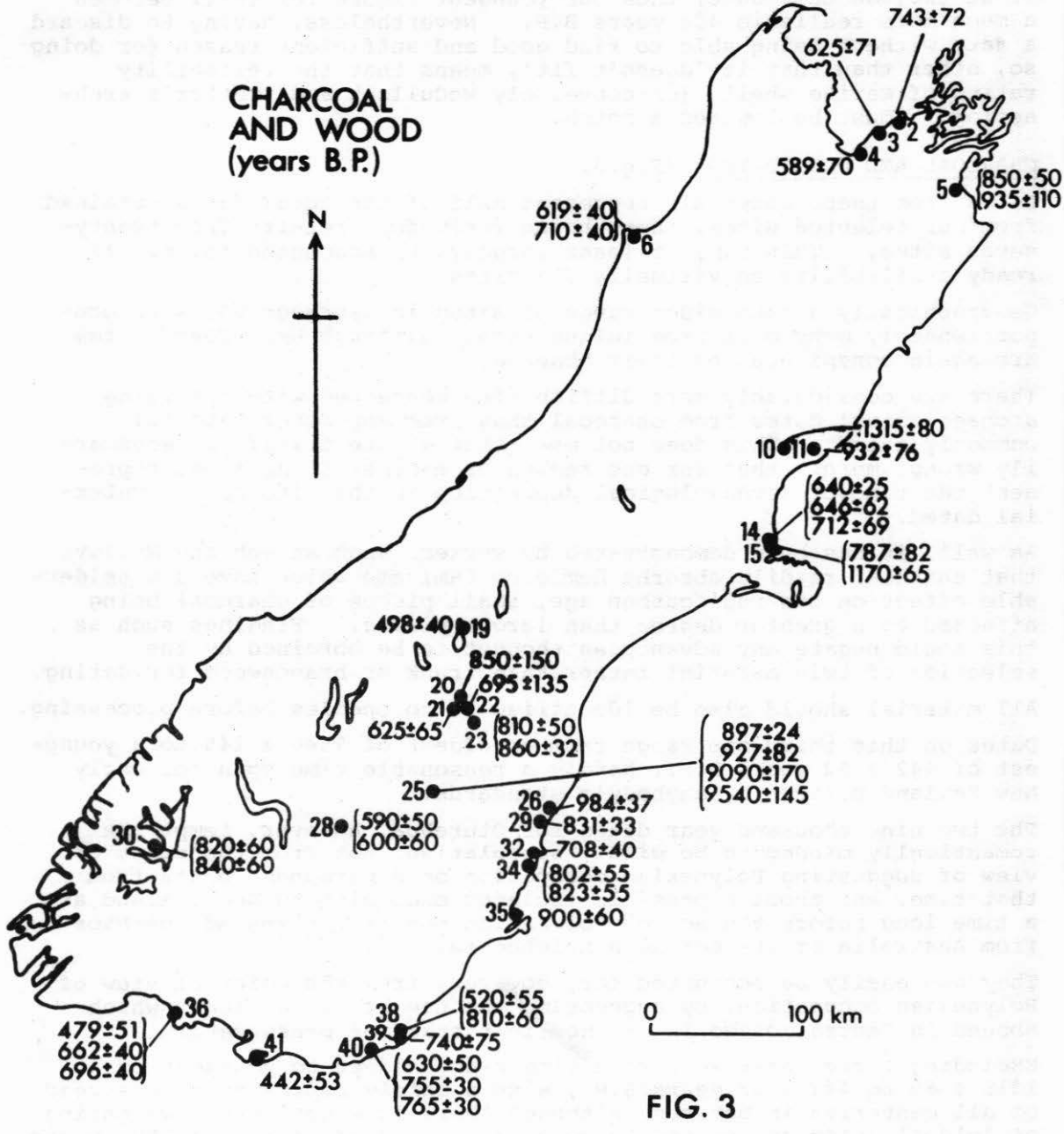
CHARCOAL
AND WOOD
(years B.P.)
N
743±72
625±71
589±70
619±40
710±40
850±50
935±110
1315±80
932±76
640±25
646±62
712±69
787±82
1170±65
498±40
850±150
695±135
625±65
810±50
860±32
897±24
927±82
9090±170
9540±145
984±37
831±33
708±40
802±55
823±55
900±60
590±50
600±60
820±60
840±60
520±55
810±60
740±75
630±50
755±30
765±30
479±51
662±40
696±40
442±53
0
100 km

FIG. 3

OTHER DATES: (Fig.4)

These comprise a very small proportion of the total, six dates, representing six widely separated sites and five different materials, (shown symbolically on the map); human bone, freshwater mussel shell, ash, seal bone and tussock. In only one case, the Awamoko rock shelter from North Otago, is the site not represented on other maps by dates from other materials.

Of these, we would consider the very late tussock date for Takahe Valley as unacceptable as representing the time of occupation, and the freshwater mussel date from North Otago as unlikely but not impossible. The remainder fall within a reasonable and acceptable time-span, but in the absence of comparable dates for the same materials from other sites, they can only be viewed at this time as interesting additional evidence to that gained from the sites as a whole.

GRAPH: (Fig.5)

In order to summarize the evidence so far from both a technical and an archaeological point of view, we have assembled the data in graph form. Detours to unacceptable dates are shown as dashed lines of the relevant colour. Where two or more dates from the same material have been obtained for one site, these have been averaged on the graph. While this is not an ideal answer it was the only practicable solution. Sites have been assembled in a north to south order from left to right.

Moa bone collagen (red) can be seen to give very constant results in a limited time-range of about 300 years. There is also a trend towards progressively younger results from north to south. This could show population spread towards the south and in fact would indicate that the actual period of 'moa hunting' within any one area, once a sizeable human population moved in, may have been little more than a century. Such a suggestion supports the overseas theories of workers such as Paul Martin.

Marine shell (green) with a range of 476 years has a greater time-span over all, but the same general tendency towards younger results in the South. The time-range is accentuated by the single early date of 910 years B.P. for site 10 (Pentland Downs), which is over 150 years older than any other, but even so it is to be expected that shellfish would have been available during the whole of the Moa-hunter period, whereas moa obviously was not.

Charcoal and wood (solid black), it can be clearly seen, give dates consistently earlier than those obtained for other materials and a much greater time-span, almost 850 years. As well there are greater vagaries of time site to site on the graph, but this can in part be accounted for by the much greater number of dates. The north-south age trend is not so apparent here, and would be almost entirely dependent on the Pentland Downs (site 10) date of 1315 years B.P., which is only barely acceptable as indicative of time of occupation. Exclusive of this date we get a time-span of about 450 years which accords well with that of marine shell except that the range is somewhat earlier.

The fine dotted black line represents the same charcoal and wood dates minus an arbitrary two hundred years. An over all survey of radiocarbon dates from South Island archaeological sites shows quite clearly that charcoal dates tend to be earlier than others on any multi-dated

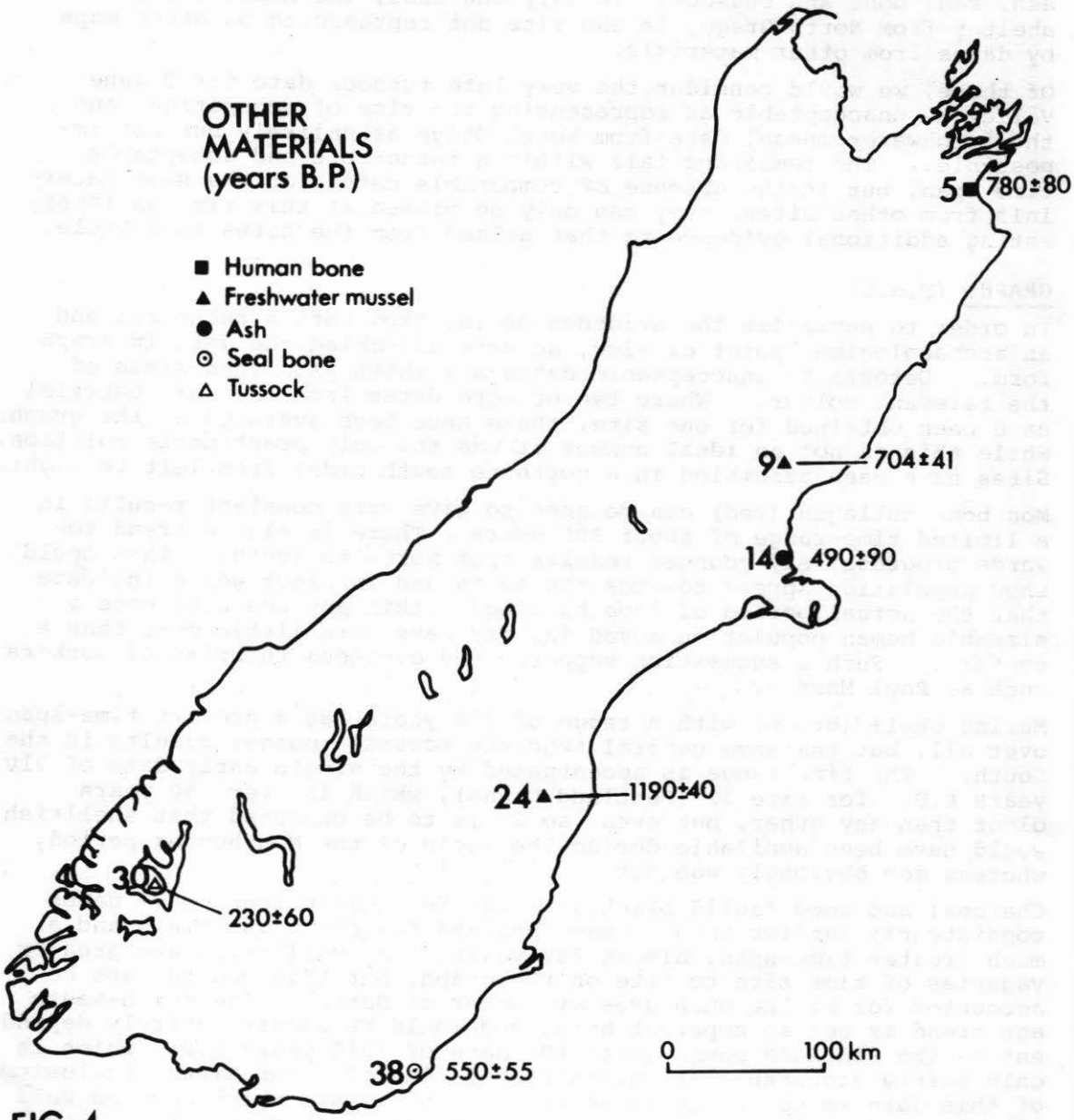
OTHER
MATERIALS
(years B.P.)
■ Human bone
▲ Freshwater mussel
● Ash
⊙ Seal bone
△ Tussock
5 ■ 780±80
9 ▲ 704±41
14 ● 490±90
24 ▲ 1190±40
30 △ 230±60
38 ⊙ 550±55
0 100 km

FIG. 4

site, the differences ranging from four up to six hundred and sixty-nine years (excluding Glen Gynk with its doubtful shell date and the Oturehua arche-archaic examples). This is a mean difference overall of about two hundred years. (An average taken on multi-dated sites alone is closer to three hundred years).

Dates obtained from materials other than moa bone collagen, marine shell, and charcoal and wood have been plotted as individual points on the graph, but these give us very little useful information.

It is perhaps worth noting that the human bone collagen date for Wairau Bar (site 5) is somewhat older than the moa bone or shell dates for that site. This accords with the only other human bone date we have obtained, that from Lagoon Flat, which, as we mentioned earlier, was older than expected.

Apart from the obvious difficulties associated with its use, human bone is probably the most promising of these more unusual materials, although further research on freshwater mussel may enable useful dates to be obtained.

DISCUSSION:

Basically, the graph indicates a main, early cultural era of some 400 years duration - ranging from 800 to 400 years B.P. Duration-wise this accords fairly well with most accepted ideas of the early time-span for the South Island, but is perhaps a little later than is normally thought of as the Moa-hunter cultural period. The moa dates would indicate a buildup of population between 600 and 700 years ago in the North - moving steadily southward over the next two or three hundred years. The dates also suggest that exploitation of the West Coast and some inland sites may have been somewhat later than initial east coast settlement.

Nothing in the shell or miscellaneous dates really contradicts this premise, but it is dependent on the acceptance of a time shift of some length being applied to charcoal.

If we do not apply or accept this time shift we are faced with three alternatives.

First, we can ignore the charcoal dates altogether as forming no recognizable pattern, and being almost completely out of line with all other dating materials, that is, the unreliability rating of charcoal is such that it is safer to ignore it.

Alternatively we can accept these dates at their face value. This would suggest somewhat incongruously that the occupants of the sites lit their fires some centuries before collecting their food - or perhaps they developed a taste for raw moa.

Finally, we could consider the charcoal dates as correctly indicating the time of occupation, and the remainder out of line. The difficulty with this solution is that we *know* that many charcoal dates are wrong because of the use of heart wood, dead timber, etc.

One question which obviously arises is how this analysis of some aspects of prehistory, as shown by radiocarbon dating, ties in with currently held ideas on South Island settlement as a whole. There would appear to be no major points of disagreement, and the fact that the apparent abrupt termination of actual moa hunting would appear to

coincide with the probable period of east coast forest burn-off, is surely more than a coincidence.

None of this, of course, implies that all parts of the South Island were not known from a very early period, but the over all pattern of dates is stronger as an indicator of general demographic trends.

In fact, one of the main points we would make is that the greatest value of radiocarbon dates is apparent when they are used collectively.

Insofar as the relative reliability of the various materials goes, at the present stage of research, moa bone collagen obviously takes first place, providing we can be sure that the bone being dated originated from a bird which was killed by the occupants of the site.

Marine shell we find to be some degrees less reliable, but useful if results are treated with caution. It is infinitely preferable to the ubiquitous charcoal.

While realizing that there are many who will disagree with us, we are completely convinced that charcoal dates, while they *may* be useful in determining the age of wood samples, are just not acceptable as indicators of the time of occupation of a site. The unreliability of charcoal dates is such as to make suspect even those that fall within acceptable limits.

USES OF RADIOCARBON DATING:

In at least one respect we must agree to differ from most other archaeological workers in New Zealand. We insist, and have so stated in previous papers, that the conversion of radiocarbon years before present into calendar years *anno Domine* cannot be justified for reasons of either convenience or convention. After all, we find no fault or difficulties associated with the use of B.C. dates and despite arguments to the contrary, it *is* just as easy to think of a site as being five hundred or seven hundred years old, as it is to allot it an A.D. date.

Our main objections are, of course, that not only do calendar years not correspond to radiocarbon years, but that a calendar year represents a known and definite span of time, and an A.D. date indicates the exact position within time, of that year. Radiocarbon years are at the best approximate, and radiocarbon dates are far from exact in their positioning of them.

While archaeologists may appreciate this fact, most of the general public, including many interested amateurs, do not. So the conversion of radiocarbon results to calendar dates can be dangerously misleading in its implication of exactitude.

But however radiocarbon dates are presented, they surely should not be used in such a way that they supersede archaeology in interpreting the age of a site. Far too often at recent conferences and in discussions surprise has been expressed that although the speaker had first considered a site to be of a particular age, when a radiocarbon date was obtained he found that his estimate was wrong, and that the site was in fact some hundreds of years older or younger as the case might be.

The name of the game is Archaeology!

The archaeologist employs many tools, not the least of which are experience and judgement. Radiocarbon analysis is only *one* of the available tools, and one which, in our present state of knowledge, we should be most cautious of wielding with too heavy or definitive a hand. This is not to imply that where a date differs considerably from the investigator's preconceived ideas of age it is necessarily wrong, but merely that all the relevant facts should be weighed and assessed, and none either over or underrated.

Frequently too, pleas are made for dates to be published as soon as possible so as to be available to all. This should not be allowed to get out of perspective.

Rather the plea should be for the whole archaeological report to be published as soon as possible. A date is only one part of a site report and should be given no more weight than all the other data pertaining to that site.

While it may not be practicable to finalise a report immediately after an excavation, it is certain that for a published date to be at all useful, it must be accompanied by at least a brief description of the site type and the archaeological evidence it contained.

But the final decision on publication of a date remains the privilege of the collector and the laboratory. Many dates are obtained for experimental purposes or as a part of an over all study of some aspect of prehistory, and as individual results, would contribute little to the corpus of archaeological knowledge.

Nevertheless, there is surely an onus on collectors to make their dates available to others within a reasonable time. Our feeling is that if a date is worth obtaining, it is worth publishing - regardless of the results.

As final comments, firstly we hope that someone will sometime produce an analysis similar to this for the North Island sites.

Secondly, if we have missed any dates from this paper that someone is sure we should have included, we would be very pleased to hear about them.

And lastly, but most importantly, we tender our most grateful thanks to the Director and staff of the Institute of Nuclear Sciences. They give a dating service for New Zealand archaeologists which is second to none in the world. And free!! If at times in our comments we may have seemed sceptical of the value of radiocarbon dates, this implies no criticism of their methods or the accuracy of the results. Rather it expresses doubt as to our own ability to use and interpret them.

For the future, it's back to the field, with the hope of filling the gaps, both archaeological and technical.

Beverley McCulloch
Michael M. Trotter

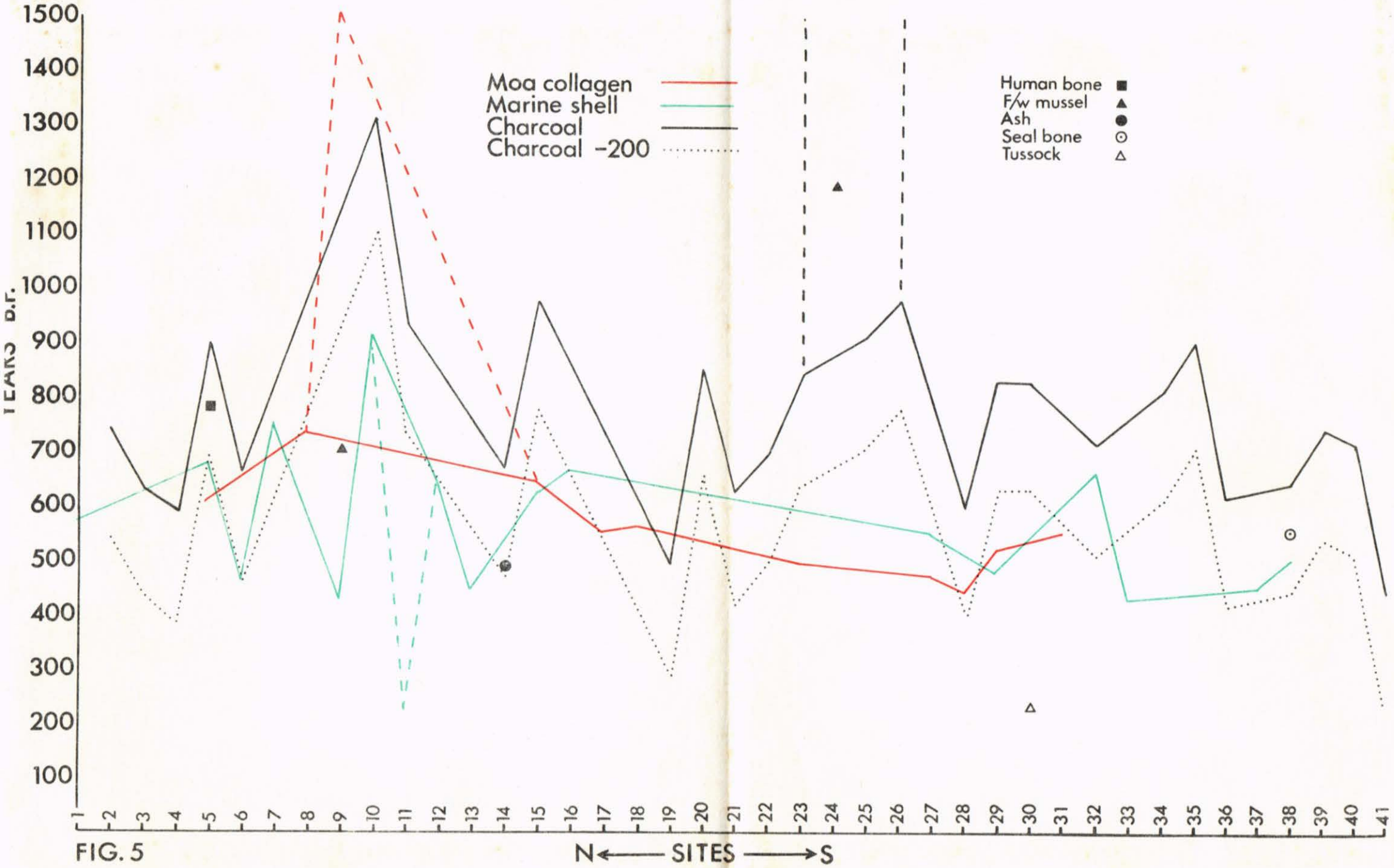
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
YEARS B.P.
Moa collagen
Marine shell
Charcoal
Charcoal −200
Human bone
F/w mussel
Ash
Seal bone
Tussock
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
N ← SITES → S

FIG. 5

KEY NUMBER (as on maps)	*NAME*	*N.Z.A.A. SITE NUMBER*
1	Heaphy	S7/1
2	Whangamoa	S15/8
3	Rotorua	S14/1
4	Tahunanui	S20/2
5	Wairau Bar	S29/7
6	Buller	S24/8
7	Clarence	S42/10
8	Hurunui	S62/10
9	Timpendean	S61/4
10	Pentland Downs	S61/20
11	Glen Gynk	S61/24
12	Motunau Is.	S68/29
13	Kairaki	S76/39
14	Moa-Bone Point Cave	S84/77
15	Redcliffs Flat	S84/76
16	Takamatua	S94/36
17	Rakaia Mouth	S93/20
18	Wakanui	S103/1
19	Boltons Gully	S100/5
20	Gooseneck Bend	S117/8
21	Ahuriri	S117/4
22	Junction Point	S117/7
23	Woolshed Flat	S117/3
24	Awamoko	S127/40
25	Oturehua	S134/1
26	Awamoa	S136/4
27	Ototara	S136/2
28	Hawkesburn	S143/2
29	Tai Rua	S136/1
30	Takahe Valley	S140/2
31	Hampden	S146/16
32	Waimataitai	S146/2
33	Shag Point	S146/5
34	Shag River	S155/5
35	Kaikais	S164/17
36	Wakapatu	S176/4
37	Cannibal Bay	S184/4
38	Pounawea	S184/1
39	Hina Hina	S184/2
40	Papatowai	S184/5
41	Tiwai Point	S181/16

List of sites considered in this paper in north-south order.

APPENDIX:

The following radiocarbon dates used in this paper have not previously been published. All are calculated with respect to the New Zealand standards for bone and shell using the "old" C^{14} half-life of 5568 years. Ages are given in radiocarbon years before A.D. 1950.

S42/10 CLARENCE RIVER MOUTH
An extensive Moa-hunter site on the south bank of the Clarence River, Marlborough.
NZ 1836 Shell aragonite (*Lunella*) 750 ± 50 B.P.

S62/10 HURUNUI RIVER MOUTH
A Moa-hunter oven near the mouth of the Hurunui River, Marlborough. Typical Moa-hunter adzes and other artifacts have been found near by.
NZ 1839A Moa bone collagen (*Euryapteryx*) 730 ± 80 B.P.

S55/19 LAGOON FLAT
A site containing moa bone, Moa-hunter artifacts and secondary burials with nephrite artifacts, near the Conway River mouth, Marlborough.
NZ 1834 Human bone collagen 480 ± 60 B.P.

S68/29 MOTUNAU BEACH
A predominantly paua shell midden; moa bone and early artifacts have been found near by.
NZ 1538 Shell aragonite (*Haliotis iris*) 410 ± 54 B.P.

REFERENCES:

GOH, K.M. and MOLLOY, B.P.J. 1972. Reliability of Radiocarbon Dates from Buried Charcoals. *Proceedings of the 8th International Radiocarbon Dating Conference*. Wellington.

MARTIN, Paul S. 1967. Prehistoric Overkill, in *Pleistocene Extinctions*, Martin and Wright (eds), Yale University Press.

RAFTER, T.A., JANSEN, H.S., LOCKERBIE, L. and TROTTER, M.M. 1972. New Zealand Radiocarbon Reference Standards. *Proceedings of the 8th International Radiocarbon Dating Conference*, Wellington.