ART. XV.—*Maori Numeration: Some Account of the Single, Binary, and Semi-vigesimal Systems of Numeration formerly employed by the Maori.*

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MAORI numeration is a subject which appears to have received little attention from writers who have dealt with the customs of the Native race, and of what has been placed on record a certain proportion thereof is certainly erroneous and misleading. The following notes, albeit somewhat brief and incomplete, will serve to give the reader some idea of the system of numeration which obtained among the Tuhoe Tribe of Maoris prior to the arrival of Europeans in New Zealand.

There were, in former times, two different methods of numeration in use among the Maori people, single and binary. Some profess to see in the dual system a primitive method of enumeration which obtained in times long past, before the arrival of the race in Polynesia. From information obtained in this district of Tuhoeland, it would appear that the binary system was used in counting game, &c.: that is to say, such items were counted, or tallied, in pairs—hence the term used (*topu*) in this method is equivalent to our word "brace."

The systems of numeration of primitive peoples are often quoted by anthropologists as a sign of the grade of culture to which such peoples have attained. Thus we read of tribes of so low a culture as to have no system of counting beyond five, or even three. It will be seen that the Maori, a barbarous people, had evolved, or borrowed, a very good system of numeration, and doubtless quite elaborate enough for their purposes. Some writers have stated that the Natives of New Zealand did not count above one hundred, any number above that not being counted with precision, but simply styled as "numberless," or "a great many," "a multitude." It does not, however, appear to have been so, although it is probable that the statement given would be correct if applied to thousands instead of hundreds. Albeit the term *mano* has been used to define "a thousand" in modern times—*i.e.*, since European settlement in these isles—yet it is not clear that it was so used in ancient times. I am inclined to think that the word *mano* may have been originally used as the term *tini* is at the present time—viz., to imply a great number, a multitude. The Ngati-Kahungunu Tribe have an expression—*mano tini ngeangea*—which is used to denote a great number. It ap-

pears to equal our expression "in countless numbers"—like unto the sands of the sea-shore, or leaves in the Vale of Vallombrosa. Both *mano* and *tini* are used separately, or together, to denote a great number, a myriad; hence *mano* does not necessarily imply a specific number, as a thousand. The word *ngeangea* is probably an intensive. Ellis expresses his astonishment at the completeness of the Polynesian system of enumeration in these words: "The precision, regularity, and extent of their numbers has often astonished me."

The Native terms for the numerals were as given below:—

NUMERALS.

Cardinals.

Tahi = one.	Ono = six.
Rua = two.	Whitu = seven.
Toru = three.	Waru = eight.
Wha = four.	Iwa = nine.
Rima = five.	Ngahuru = ten.

Of these terms the first nine are still used, but the word *ngahuru* is no longer employed in counting, being replaced by the term *tekau*, which latter appears to have been used in pre-European times to denote twenty—but of which more anon.

To the above terms various prefixes are applied. When using any of these expressions for numbers in conversation, or when enumerating articles, the term *ko* is prefixed to the first, which thus becomes *kotahi*. From two to nine inclusive the prefix is *e*. To *ngahuru* no prefix is applied as a cardinal, but as an ordinal *tua* is so employed: *tua-ngahuru* = tenth. *Tekau*, the modern term for ten, never bears a prefix, the ordinal being expressed by the use of the definite article: *te tekau* = the tenth. Thus we have the cardinal numbers as follows

Ko-tahi = one	E-ono = six
E-rua = two	E-whitu = seven
E-toru = three	E-waru = eight
E-wha = four	E-iwa = nine
E-rima = five	Ngahuru, *or* tekau = ten

as used in Maori. These terms are often used when counting. But an ancient, and more correct, style of actual enumeration is by prefixing *ka* to the numerals. Probably, however, *ka* is not a true prefix in this case: for my own part, I do not so regard it. In Williams's Maori Dictionary we find "*ka* = a verbal particle, denoting the commencement of a new action or condition, or a state of things new to the speaker." Here we have the key to the matter—in this wise: when, in counting a number of articles, a person says "*ka wha*," the expression means that that number is attained, the counted

items have become four; *ka rima* = they have become five, a new state of things is attained. Hence I should write this method of counting as follows,—

Ka tahi	Ka ono
Ka rua	Ka whitu
Ka toru	Ka waru
Ka wha	Ka iwa
Ka rima	Ka ngahuru, *or* ka tekau,

and not look upon *ka* as a true prefix.

Ordinals.

The ordinal numbers are formed by prefixing *tua* to the numerals.

Tua-tahi	= first.	Tua-ono	= sixth.
Tua-rua	= second.	Tua-whitu	= seventh.
Tua-toru	= third.	Tua-waru	= eighth.
Tua-wha	= fourth.	Tua-iwa	= ninth.
Tua-rima	= fifth.	Tua-ngahuru	= tenth.

These terms are usually written without the hyphen, as *tuatahi, tuarua,* &c.

Again, we often hear Natives using the definite article before the cardinals to express the ordinals, and dropping the prefix *tua*: as, *te rima* = the fifth; *te ono* = the sixth; &c.

The prefix *toko* is used only in speaking of persons. It is prefixed to the numerals two to nine inclusive, and not to one or ten. Thus, in speaking of persons, the numerals are thus used (see Table No. 3):—

Kotahi	= one.	Tokoono	= six.
Tokorua	= two.	Tokowhitu	= seven.
Tokotoru	= three.	Tokowaru	= eight.
Tokowha	= four.	Tokoiwa	= nine.
Tokorima	= five.	Tekau	= ten.

During a residence of eleven years' duration among the Tuhoe Tribe, once only have I heard *toko* prefixed to *tahi*. *Toko* was not prefixed to *ngahuru*, but the term *ti-ngahuru* was applied to persons only.

Toko is also prefixed to the interrogative numeral *hia*: *Tokohia nga tangata* = How many persons? And also to the words *iti* (few, a small number), *maha* (many), *ouou* (few), and a few others, but only when speaking of persons: *He tokomaha nga tangata kua tae mai* = Many persons have arrived.

Tekau (ten) is often preceded by *kotahi* (one) in these days, hence *kotahi tekau* (one ten) is the usual method of denoting that number. It would seem, however, that this has only obtained in late times—*i.e.*, since *tekau* has been adopted to express ten, which figure has now become the basis of Maori numeration. *Kotahi tekau* (one ten) is quite a

natural use when *rua tekau* (two tens) is used for twenty, and *toru tekau* (three tens) for thirty, and so on. It prevents any misunderstanding as to how many tens are meant. But in former times, when *tekau* was used to denote twenty, it was not preceded by *kotahi*.

Another prefix to numerals is the word *taki*. This, as Williams's Dictionary states, "gives a distributive force to numerals": hence *takitahi* = singly; *takirua* = by twos, two at a time; *takitoru* = by threes; and so on. Again, it is used before other words, "denoting that what is said applies to each one individually," to quote the same authority: *Ka takiomaoma ki te ngaherehere* = Every one of them fled to the forest.

We will now give the modern system of Maori numeration, such as has been used since the early days of European settlement. The old system has been retained up to nine, but *ngahuru*, the ancient term for ten, has been rejected, and *tekau* substituted for it. This *tekau* is now the multiple of Maori numeration. Observe:—

Tekau	10.
Tekau ma tahi	11 (ten and one).
" rua	12 (" two).
" toru	13 (" three).
" wha	14 (" four).
" rima	15 (" five).
" ono	16 (" six).
" whitu	17 (" seven).
" waru	18 (" eight).
" iwa	19 (" nine).
Rua tekau	20 (two tens).
" ma tahi	21 (two tens and one).
Toru tekau	30 (three tens).
Wha tekau	40 (four tens).
Kotahi rau	100.
" ma tahi	101 (one hundred and one).
" kotahi tekau	110 (one hundred one ten).
" kotahi tekau ma tahi ..	111 (" one ten and one.)
" e rua tekau	120 (" two tens).
E rua rau	200.
Kotahi mano	1000.
Kotahi mano e toru rau e wha tekau ma tahi	1341.

And so on.

Here we note that ten has become the common multiple of Maori numeration. Apparently this change was made in order to assimilate the Maori system of numeration to that of the invading race. I can find no proof among the Tuhoe people that this system given above was used in pre-European days: hence it would appear that ten was not used as a multiple in former times.

It might be claimed that two was a multiple in the ancient

Maori system, but it resolves itself into a custom of counting by pairs, or braces; and it was not used in all cases—counting singly was also common. Persons were not counted in pairs, or braces, as was game, &c. These Natives would never have used *ka wha pu* to denote eight persons. But in one way a semi-binary system was used in counting persons; and this brings us to another prefix—viz., the word *hoko*. *Hoko*, as a prefix to numerals, is said by Williams to signify ten times the subjoined numeral; but when applied to persons the Tuhoe Tribe give it the value of twenty times the subjoined numeral, or ten times in pairs, whichever way you please to take it. Thus *hokorua* applied to persons signified forty; *hokotoru* = sixty; and so on. This system is similar to that of Aitutaki, described by Mr. J. T. Large at page 260, vol. xi, of the "Journal of the Polynesian Society." He says, in the first place, that *okotai takau* (the aspirate is not used in the Cook Islands) stood for twenty, &c., and then states, "A correlative system of enumeration was also used indifferently with the above. This was distinguished by the prefix *oko:* for instance, *okorua* was twenty doubled, or forty; *okotoru* was sixty; and so forth, up to *okoiva*, which was 180; but it seems to have been confined to those limits." This is exactly the Tuhoe case. From *hokorua* = forty, up to *hokoiwa* = 180, this system of counting obtained; but I have never heard *hokotahi* used to denote twenty, although it would seem that it was probably so used. Mr. Tregear looks upon *hoko* as a causative prefix, as *hokowhitu* = to make seventy.*

It is probable that the prefix *hoko* was here used in both ways—viz., as signifying ten times the subjoined numeral, and also ten times doubled. Thus *hokorua* might mean either twenty or forty. In these cases the Maori could make his meaning clear by adding a word of explanation—either *takitahi* (singly) or *topu* (double—*i.e.*, pairs). Thus *hokorua takitahi* would mean ten times two singly = twenty, and *hokorua topu* would be ten times two in pairs, or doubled = forty.† This point is not, however, yet quite clear. We have seen the value of the prefix *hoko* as given by Williams's Maori Dictionary—a most reliable work—but, still, my informants of the Tuhoe Tribe will not admit that *hokorua* signified twenty, and *hokotoru* thirty, and so on, but always double those figures, which would give the prefix *hoko* the power of multiplying the subjoined numeral twenty times, not ten times A confirmation of this comes from the east coast. The Rev. H. W. Williams, of Gisborne, informs me that he was told by

* "Journal of the Polynesian Society," vol. i, p. 56.

† Most of the old Natives state that *hoko* multiplied by twenty the subjoined numeral in former times.

Mohi Turei, of the Ngati-Porou Tribe, that *hokorua* signified forty, and *hokotoru* = sixty, but that eighty was *hokorua topu*. This last term is very singular. Judging from the value of *hoko* before *rua* and *toru*, then eighty should be *hokowha*, as used by the Tuhoe people. It was surely a very strange break, or change, in this system of numeration to jump from *hokotoru* for sixty to *hokorua topu* for eighty. I cannot help thinking that this is an error. If, however, it was really the case that *hokorua topu* = eighty, then it is a proof that *hoko* really multiplied by twenty the subjoined numeral. Only one local authority has informed me that the *hoko* system was used in both ways, singly and doubly: as *hokorua takitahi* = twenty, and *hokorua topu* = forty, and so on. This would mean that Williams's Dictionary is correct that *hoko* multiplies by ten, and that *hokorua topu* simply means ten times two doubled, and not twenty times two. Anyhow, Vaux's statement was correct when he said that *hoko* was used for multiples of ten.*

An examination of the Native methods of enumeration given in this sketch will show that several systems were employed—viz., counting singly, and the binary system of counting in pairs. There were also some differences in counting persons, and different words for various by-terms pertaining to enumeration: for example, the words *kehe*, *taukehe*, and *tautahi* all denoted an odd number. The terms *paepae* and *tuma* both mean an odd number in excess, as an incomplete ten or hundred. Tuhoe use the former word, and in this manner: *kotahi rau, hokorua te paepae* (one hundred, forty the excess) for 140. *Tauhara* and *tauwhara* are also terms for an odd number. By "an odd number" I do not necessarily mean the odd numbers three, five, seven, &c.; the terms are also used to denote (as in preserving birds) an incomplete ten. If eighty-three, or eighty-five, or eighty-six birds were put into a calabash, that vessel would be said to contain *hokowha* (eighty), *ka whakarerea nga tauwhara* (the odd ones are omitted).

The verb "to count" in Maori is *tatau*. Counting singly, as we do, would be described as *tatau takitahi*, and the dual method as *tatau topu*. *Pu* and *topu* bear much the same meaning—a pair, couple, brace. *Takitahi*, as we have seen, means—by ones, singly, once told.

It is possible that the last migration of Polynesians to New Zealand brought with them a somewhat different system of numeration to that in use among the original peoples, the descendants of Toi and the old-time tribes of these isles. They were certainly more advanced than the latter in some

* Trans. N.Z. Inst., vol. viii, p. 38.

arts—*e.g.*, in cultivation. If so, this would explain some singular discrepancies and confusion noted when examining the methods of numeration employed by the Maori.

Before giving longer tables of the Maori systems of numeration, we offer a few remarks on some of the terms already quoted.

Rima = five. This term is said by many writers to be a survival of the primitive method of counting on the fingers. *Ringa* is the Maori word for hand, but *linga* and *lima* bear the same meaning in various Polynesian dialects: in Tahitian, *rima* = five, and also the hand; Hawaiian, *lima* = five, also the hand; Rarotongan, *rima* = five, also the hand; &c.* The Maori still counts on his fingers in certain cases, as when repeating a genealogy, in order to count the number of generations from a certain ancestor.

Ngahuru.—This is the old Maori word for ten, now replaced by the term *tekau*. This word, recognisable under various letter-changes, is in use over a wide area in the Pacific: Rarotongan, *ngauru* = ten; Hawaiian, *anaulu* = ten days; Samoan, *gafulu* = ten. (See Tregear's Dictionary for many other comparatives.) *Ngahuru* is misspelt in Thomson's paper in the fifth volume of the "Transactions of the New Zealand Institute," as also are many other Maori words. *Ngahuru pu* (= twenty) in Maori is literally ten pairs. Only once have I encountered this word in a different form among the Maori of New Zealand, and that was when an old man of the Tuhoe Tribe gave me the term *tekau mahangahuru* (or *tekau maha ngahuru*) as the ancient expression for thirty, in single counting. This is somewhat puzzling, and needs confirmation from other authorities.† *Tekau* was twenty, and presumably the most likely term for thirty would be *tekau ma ngahuru* (twenty and ten), as there existed no special terms for thirty, fifty, seventy, and ninety in the Tuhoean system, according to my informants. But I have noted in various works that *angahuru* is supposed to have been an ancient term for ten in Polynesia (*cf.* Hawaiian *anaulu* above; though Tregear's example has *anahulu*). Hence I have thought that the expression above quoted should perhaps be written *tekau ma hangahuru*, which appears more natural when bearing in mind various Polynesian resemblances. Mr. J. T. Large states that the ancient term for ten at Aitutaki was *ngaungauru*. *Hagavulu* is used for ten in the New Hebrides.

An old-time Maori proverb is this: "*Ngahuru kei runga, ngahuru kei raro*"; which the late Sir George Grey translated

* Compare our use of the term "digit."

† Confirmation obtained from two tribes, 23rd December, 1905.

thus: "Never mind, I've ten teeth in my upper jaw and ten in my lower; hard or not, a hungry man can eat it." It was used in reference to hard or tough foods.

For my own part, I but seldom theorize anent matters Maori. I am too busy at field work—*i.e.*, collecting information from original sources. But I have a lone theory, and it concerns the word *ngahuru*, as used to denote ten. This I will proceed to give—*hai kata ma te marea*—though it leave me theoryless.

When a Maori proceeds to count on his fingers in the ancient manner he holds up his left hand open, fingers straight, in front of him. In beginning to count he takes hold of the top of the little finger of the left hand with the thumb and forefinger of the right. As he counts "one" he turns down the little finger until it touches, or nearly so, the palm of the hand. He then in like manner takes hold of the top of the next finger and turns that down as he counts "two," and so on until he reaches "five," when he turns the thumb in. Observe now the cream of my theory. All the fingers of the left hand have now become *huru*, or *hurua*—contracted, drawn in (from the verb *huru* = to contract, or draw in). This is one *huru*, or *ringa huru;* but it will not bear the plural of the definite article—*i.e.*, *nga*—as a prefix. But he proceeds with his counting up to ten, which he tallies on the fingers of his right hand in the same manner as he did on the left, using the thumb and forefinger of the left hand to turn down the fingers of the right, but keeping the other three fingers of the left hand still closed on the palm. On completing the ten (*ngahuru*) he holds up both hands, with all fingers closed, as he repeats the word *ngahuru*. Here is where the plural comes in. Both hands (all the fingers thereof) are *huru*, or *huru u*—contracted; hence *nga huru*, or *nga ringa huru*—two contracted hands, ten fingers are *huru*'d. I want you to be careful of this theory, and treat it with all respect. I shall not make up any more: it is too exhausting.

John Fraser states in his excellent paper on Polynesian numerals that *ngahuru* and allied terms originally meant "the whole"—that is, the whole of both hands: hence ten. Judging from some of the terms quoted by Fraser, it would appear that *huru* alone meant ten: as in the Samoan *e lua fulu* (*e rua huru*) for twenty—literally, two *huru;* also in *e fa ga fulu* (*e wha nga huru*) for forty—literally, four *huru*. In the Polynesian isle of Bukabuka the term *katoa*, a word signifying "all," is used to denote ten.

Another form of the word for ten is *tingahuru*. This form was used only when speaking of persons. A person asks, "*Tokohia te whakareka?*" (How many persons are there of

the invitation party?) and one might answer, "*He tingahuru*" (There are ten), or "*He ti-ngahuru pea taua ope whakarieka.*" It is difficult to say what was the origin of this *ti* before the ordinary word for ten. *Ti* is a causative prefix in Maori, as in *tiwaha*, *tirama*, &c. Vaux states that the causative prefix *whaka* is placed before "ten" in order to form the ordinal, just as *tua* was used. He gives as examples *tua-iwa* and *whaka-tekau* (*tekau* for ten)—ninth and tenth. I have never heard *whaka* so used, but it may be employed thus by tribes with which I am not acquainted. (Yes; see Maunsell's Grammar.)

Tekau.—This term, as already observed, is now applied to ten, but the old men of the Tuhoe Tribe agree that in pre-European days it was applied to twenty only, never to ten. They also state that no decimal system, or multiples of ten, were in use among the Natives prior to the arrival of Europeans in these isles. Nor was any quinary system in use, although there was a vigesimal method of numeration, as we shall presently see.

In regard to the change made by Europeans in Native systems of numeration, we have on record cases of such made by early missionaries in Rarotonga, the Hawaiian isles, and elsewhere. Many writers have been misled by the modern system of counting among the Maori people of New Zealand, and have treated it in their essays as though it were the ancient system of the land, by which the value of their remarks or researches has been much impaired. I cannot prove that among all the Maori tribes of New Zealand *tekau* = twenty, but it was certainly so used among the Tuhoe, Ngati-Awa, and Ngati-Porou Tribes. In counting by pairs or braces the term *ngahuru topu* (ten pairs) was used for twenty.

We shall see that there are three main points to explain in Maori numeration, if not three systems—viz., counting singly, the binary, and the vigesimal or semi-vigesimal methods—not to speak of the modern system, or the changes made when speaking of persons. The binary or dual method was not used in counting persons, although the vigesimal system was, where *hokorua* = forty, and *hokotoru* = sixty.

As to *tekau* for twenty: In the far-distant Paumotu Group we find that twenty is *rari takau*—literally, "one *takau*," *rari* meaning "one" or "alone." In Tahitian, *taau* = twenty; Tongan, *tekau* = twenty, also *fakakau* = to put in scores or twenties; Marquesan, *tekau* = twenty; Mangaian gives *takau* = ten pairs; in Mangareva, *takau* = a double ten, *takao* = twenty. This is good evidence in favour of the Maori statement that *tekau* was originally used for twenty. Mr. J. T. Large states that at Aitutaki Island twenty was expressed by the term *okotai takau* (*okotai* is *hokotahi* in the New Zealand dialect).

It seems probable that *tekau* was originally *te kau*, two distinct words; and it is the opinion of several Maori scholars that *kau* represents an original Polynesian word meaning "collection, assemblage." (See Tregear's Dictionary.)

The late Mr. A. S. Atkinson mentions, in a pamphlet published by him in 1893, that both Archdeacon Maunsell and Bishop Williams—two excellent Maori scholars—agreed in saying that among some tribes *ngahuru* meant ten, and *tekau* eleven: Bishop Williams saying that they counted by elevens, the eleventh being a tally; and he compares our "baker's dozen." Thompson, in his paper on "Barata Numerals,"* gives *tekau* for eleven, but does not quote any authority, except as to spelling. At page 137 he gives the Maori numerals one to ten, where he spells *tahi* (one) "*tahai*," *toru* appears as "*torou*," *wha* as "*t'fa*," *ono* as "*oné*," *ngahuru* as "*anga hourou*." After that, small wonder that he made "eleven" of *tekau*: we should be thankful that he made it nothing worse.

At page 61, vol. i, of the "Transactions of the New Zealand Institute" Mr. Phillips gives *tekau ma ngahuru* as meaning twenty, which is obviously an error, that term meaning thirty in Maori.

I have not been able to obtain locally any confirmation of the above remark concerning *tekau* as having been used for eleven, or of any system of counting by elevens; but it is possible that some tribes did so use the term. Many customs differed to some extent among various tribes.

THE VIGESIMAL SYSTEM OF ENUMERATION (TABLE No. 1).

It appears to me that at some period of their history the Maori must have used a vigesimal numerical method—a system of counting by scores, or twenties. I shall include in this paper a table showing the method so far as I have been able to ascertain it from my local Native friends. It will be observed that there was a special term (*tekau*) for twenty, but none for thirty; a special term (*hokorua*) for forty, but none for fifty; a special term (*hokotoru*) for sixty, but none for seventy; and so on. Thirty was twenty and ten; thirty-one was twenty, ten, and one; and so on to thirty-nine. Forty was again a special term, then forty and one, then forty and two, and so on to forty-nine. Fifty was forty and ten; fifty-one was forty and ten and one, &c. (See Table No. 1.)

In the "Journal of the Polynesian Society," vol. x, p. 101, Professor Cyrus Thomas gives a short paper on the vigesimal system of enumeration. In it he observes that traces of a

* Trans. N.Z. Inst., vol. v, p. 131.

former system of vigesimal numeration have been observed in Oriental lands—in south-eastern Asia, Cambodia, and Malaysia—but long overlaid by the decimal system. The Cambodia system, as given by Aymonier, much resembles that of the Maori. There are characters for each of the nine digits, for twenty, and for a hundred (and presumably for ten). "The character for twenty is distinct, and not two tens. In order to indicate thirty-seven, there is first the character for twenty, then for ten, and last for seven." All this is the same as the Maori system. He goes on to say that forty is two twenties, sixty is three twenties, &c., there being a separate character for a hundred. "A mingling of the two systems is apparent in some of the examples given by Aymonier," &c. Now, this is just the Maori case. We note how the vigesimal and the *topu* or binary methods are sometimes confused by Natives, not in the special terms for scores so much as in the intermediate items. Doubtless, however, much of this confusion arises from the fact that these old-time methods of the Maori have been laid aside in favour of the decimal system introduced by Europeans, albeit the latter system is expressed in purely Maori terms. The older generation of living Natives can only recall the old-time numerical terms by an effort of memory; indeed, some have forgotten many of them. The younger generation know practically nothing of these matters. It is when an old Native is repeating tribal traditions, &c., that one hears quotations from the old numerical systems, but seldom under other circumstances.

Professor Thomas states that among the Maya people "The numbers from one to eleven had specific names, but from twelve to nineteen [were formed] by the addition of units. There was a specific name for twenty, four hundred, and four thousand. Numbers from twenty to four hundred were formed mostly by twenty as the multiple, and units." He notes some confusion, however, and evidence of the quinary and decimal systems.

In vol. xi. of the "Polynesian Journal" Mr. Large mentions a vigesimal system used by the Natives of Aitutaki, which is practically the same as that of the New Zealand Maori, the same terms being used, although the Cook Islands dialect has lost the *h* and aspirated *w*, the *w* having become *v*. In that system *okorua* = forty, *okotoru* = sixty, and so on.

In the same volume Mr. Percy Smith states that the Natives of Niue counted fish by twenties, *te kau* (or "two tens") being the term used, though it would appear that *tekau* was a specific term for twenty, and not "two tens." Was *kau* = ten, and *te* a plural, or "two," that *tekau* should be given as = two tens? Elsewhere it appears to be a special term for twenty. *Tekau* does not appear in the Niue

vocabulary published by the Polynesian Society, neither does *te*; *kau* is given as meaning "company, troop." *Kau* is probably the root of the word, *te* being the definite article.

Since writing the above I have unearthed a long-buried copy of Maunsell's Maori Grammar, 3rd edition, 1882. I quote a few remarks therefrom to show how numeration differed in some districts, the result, perhaps, of tribal isolation. He explains the modern method of numeration by multiples of ten, but states in a note that "It should be here noticed that this is the new mode of reckoning brought in by Europeans, and now fast spreading over the land. The old mode is not so convenient, but it is often heard; 240 would, according to it, be thus expressed: *kotahi rau ma rua*—literally, one hundred and two. *Rua* here stands for (twice ten) twenty doubled. 250 would run thus: *kotahi rau, ma rua pu, tautahi*—one hundred and two double, and a *tautahi* (odd one)." Now, the above was the method of counting in the Waikato district. Observe that it was the dual system, couples or pairs being always implied, while *ma rua*, "and two," is made to serve for "and twenty" (couples understood). In the second illustration he gives the term *pu*, signifying "pairs," or "twice told," or "doubled"—thus, one hundred, and two pairs (for twenty doubled); this "two pairs," or "two doubled," being perhaps an abbreviation, though noticeable all over the Island. The term *tautahi* is used in a similar manner among Tuhoe. It is usually applied to a single odd number—*e.g.*, *e waru pu, tautahi*, for eight brace (or couples) and an odd one = seventeen. In Maunsell's example, however, it stands for ten, or an odd ten.

Maunsell, in giving the modern system, stated that *hokorua* is used for twenty, but explains in a note, "The Maori mode of counting has always heretofore been by pairs: thus *hokorua*, twenty, stands for twenty pair—*i.e.*, forty—and so on. When they wish it to be understood singly they postfix *takitaki* to the numeral adjective—*i.e.*, *hokorua takitaki* = twenty." This *takitaki* may be a misprint for *takitahi*, the term in general use to denote "singly," or "by ones." Here we have evidence that *hokorua*, *hokotoru*, &c., really mean twenty, thirty, &c., but that the term *topu* or *pu* (pairs) is understood, unless the expression *takitahi* be added, in which case hearers understand that counting singly is meant. Thus evidence accumulates to show that Maori numeration was dual in its character, and that the term *topu* (or *pu*) was by no means always used when employing that system, but was understood to be implied; also, that it was necessary to use the term *takitahi* to show that single numeration was meant.

Maunsell goes on to say that among the Ngapuhi Tribe

ngahuru was used for ten and *tekau* for eleven, while in the centre of the Island *ngahuru* and *tekau* both represent ten. Judging from Polynesian comparatives, the use of *tekau*, both for ten and eleven, seems to be of local origin, though it may, strictly speaking, have meant ten pairs He also gives a variation in the form of the distributive prefix, or a plural form thereof, where *tataki* is used for *taki*, the example being, *Kia tataki rua pu nga utu i te tangata* (Let each man have four payments). In speaking of the ordinals he gives three ways of expressing such—(1) By *tua* prefixed to the cardinal, as *tua toru* = third; (2) by *whaka* prefixed, as *whaka-tekau* = tenth; (3) by the simple cardinal with the definite article, as *te wha* = the fourth. The first and third of these modes have been given as in use among the Tuhoe Tribe, but *whaka* I have not heard so used. Was it used before ten only, or might it be used before any of the digits?

Having now (7th January, 1906) obtained some further information anent Maori numeration, I proceed to add the same to above notes.

Tekau.—Several old Natives of the Tuhoe and Ngati-Awa Tribes confirm the statement that *tekau* was formerly used to denote twenty, and was not used for ten. As *kau* seems to have been a Polynesian word meaning "collection" or "assembly," then the expression would probably have been originally *te kau* = the whole, or the assembling of the ten fingers and ten toes, *te* being the definite article singular.

Table No. 1: This shows the ordinary mode of counting singly, as formerly used. It includes, in a singular way, a vigesimal system—that is to say, it is partially vigesimal. It has the special term for ten which, however, was not used as a multiple. It has a special term for twenty, but none for thirty; a special term for forty, but none for fifty; for sixty, but none for seventy; and so on. Thirty was "twenty and ten." Thirty-one was "twenty, ten, and one"; and so on to thirty-nine. Forty was a distinct term (*hokorua*), and then another twenty was commenced It will be observed that the vigesimal system was never carried beyond 180 (*hokoiwa*), or nine twenties, except in conjunction with the *rau* (hundred): *e.g.*, *kotahi rau, hokowhitu*, for 340—*i.e.*, one hundred twice told and seventy couples. A common form, however, was to abbreviate such terms: as *kotahi rau ma whitu*, or *he rau ma whitu*, for 340; *kotahi rau ma rua*, for 120 doubled; and so on.

I have consulted a great many Natives as to the value of the prefix *hoko*, and the majority state that this prefix conveyed the meaning of twenty times the subjoined numeral. Some, however, maintain that it merely implied ten times the

subjoined numeral when the word *takitahi* (single, or singly) was added: as *hokorua takitahi*=twenty; *hokotoru takitahi*=thirty; and so on.

Confirmation has been received regarding the term *tekau maha ngahuru* for thirty, not only local, but also from the Ngati-Awa Tribe. I am unable to account for the syllable *ha*.

Table No. 2: This gives the dual system of numeration formerly in use among the Maori people, the counting by pairs, which was a common custom. This form of binary numeration was used only for game, baskets of food, and so forth, but was not applied to the *genus-homo*. I have remarked above that the binary method was not used when counting persons. This remark needs some explanation. Certainly the dual method of numeration, as given in Table No. 2, was not used for persons, but another form of counting in pairs* was used for persons. Apart from the matter as to whether the prefix *hoko* multiplied the numeral ten or twenty times, there were other expressions used which doubled the number given. We have seen that *kotahi rau ma whitu* (one hundred and seventy) was used for 340. This was certainly applied to persons, as in giving the numbers of a war-party. This, and *hokowhitu* for 140 men, were such common terms that the word *topu* does not seem to have been employed to denote the fact that the number given meant so-many couples. But with other numbers the evidence seems to be in favour of the term *topu*, or *takitahi*, having been used: as *kotahi rau takitahi* (one hundred, singly, or once told), and *E wha rau topu taua ope* (That party consisted of four hundred [persons] twice told, or doubled). These expressions are used when speaking of persons, and seem to have been so used formerly. Many of my old Native friends say, "*Kaore i takirua te tatau mo te tangata*"—*i.e*, persons were not counted in pairs. I believe they mean that, when actually counting a number of persons, the system given in Table No. 2 was not used. And it certainly was not. A person would not have counted persons in this manner—*ka tahi, pu* (two), *ka rua pu* (four), *ka toru pu* (six), &c.—as he would in counting game, &c.; nor would he have said *ka toru pu, tautahi*, for seven persons. He would count them singly, and for seven persons he would have used *tokowhitu* (see Table No. 3). But if he had counted, say, 240 persons, and was asked how many there were, he would have replied, "*Kotahi rau, hokorua*"—one hundred (*topu* understood) and a *hokorua*; or "*Ko tahi rau ma wha*"—one hundred and forty (*topu* understood). In

* Or not exactly in pairs, as in Table No. 2, but the doubling of stated numbers, a "twice-told" mode.

stating numbers between one hundred and another, the terms *ma rua, ma toru, ma wha,* &c., were used to imply "and twenty," "and thirty," "and forty," and so on, though, strictly speaking, the expressions mean "and two," "and three," &c. Another ancient method of stating 240 was *kotahi rau, hokorua te paepae*—one hundred (*topu* understood), the excess a *hokorua.*

But to return to Table No. 2: In this is shown the method employed in counting by pairs—*i.e.*, the terms used for every number from 2 to 102, and a few of the leading figures from that number up to 1,000, which the reader will have no difficulty in following. But it must be mentioned here that a person engaged in counting a number of articles by the dual method would not make use of all these terms; he would not count the odd numbers, where the expression *tautahi* is employed. The terms for odd numbers are merely inserted to show what words express such numbers. Such are used only to express the total when that total contains an odd number. Observe: A fowler visits his bird-snares every morning in order to collect the birds. Having completed his round, he proceeds to count the birds taken. This he does by taking up two birds at a time and laying them aside. For the first brace he counts "*Ka tahi pu*"; for the second, "*Ka rua pu*"; for the third pair, "*Ka toru pu*"; for the fifth, "*Ka rima pu*"; for the tenth brace, "*Ngahuru pu.*" Here the word *ka* is dropped, but it is sometimes resumed for eleven brace, as *ngahuru pu, ka tahi pu,* and so on; *ngahuru pu, ka iwa pu,* for thirty-eight. It is not usual to use *ka* before *hokorua, hokotoru,* &c, but it is sometimes resumed after them: as *hokorua, ka tahi pu,* for forty-two; *hokorima, ka whitu pu,* for 114, &c. Indeed, I am inclined to believe that this was the more correct way of expressing numbers when actually engaged in counting.

Suppose our friend the fowler has taken seventy-seven birds: he goes on counting by the brace (*pu*) up to seventy-six—*hokotoru, e waru pu* (or *ka waru pu*); then, casting the remaining bird on the heap, he says, "*tautahi*" (an odd one). The number of birds taken is expressed by *hokotoru, e waru pu, tautahi* (sixty, eight brace, odd one).—*Q.E.D.*

The singular feature of this system of counting is the combination of the dual and vigesimal systems. It is purely dual up to twenty, but from the number twenty-two onwards to thirty-nine the numbers hinge upon twenty—as "ten brace, one brace," "ten brace, two brace," and so on—until the next twenty (*i.e.*, forty) is reached, where we note the special term *hokorua,* which again has pair after pair added to it until sixty (another special term) is attained, and so on to 199.

For 200 we find a new term employed—viz., the *rau*, or hundred, doubled. Upon this new base the *pu* and *hoko* systems are built up until 400 is attained, when we find the term *rua rau* (two hundred—brace understood) employed. The same system is repeated until 600 (*toru rau*), and so on. In actual counting, a person would probably say "*Ka rua rau, ka toru rau*," &c., and not "*E rua rau, e toru rau.*" But if simply stating a number, not counting, he would probably use the particle *e*: "*E hia nga kete riwai i a koe?*" (How many baskets of potatoes have you?) and the answer would be, "*E rua rau*," or "*Hoko toru*," or whatever the number might be. But if the questioner used the verbal particle *ka*, then the answer would be preceded by that term: "*Ka hia au manu?*" Answer, "*Ka rua rau*," or "*Ka wha pu*," &c.

We have seen that *paepae* was used to imply an excess number. For instance, in counting by the dual system, 460 would often be given as *e rua rau, hokotoru te paepae* (two hundred—*pu* or *topu* understood), the *paepae* being sixty. This term for an excess number seems to have been used between hundreds only—*i.e.*, for numbers between 100 and 200, between 200 and 300, and so on. It is said to have been used in counting objects (game, &c.) only, and not in counting persons. The word *paepae* means the odd or excess numbers stretching forward towards the next hundred. *Pae* means "a step; direction; perch; to lie across; lie ready for use," &c. *Whakapae* = to lay across. *Paepae* and *paewai* = threshold. *Paepae* is the step towards the next hundred. Of these numbers between hundreds an old Native remarked, "*E pae tonu ana, kia tae ki te rau, kua kore e kiia he pae*" (They are all in the *pae* stage; when the next hundred is attained, the term *pae* is not applied). But it is again employed when the next hundred is commenced.

Another common expression for an excess number is *tuma*. Thus *ngahuru tuma* means "ten and an excess"; and it may be used for any number from eleven to nineteen inclusive. *Kotahi rau tuma* stands for one hundred and an excess, and may be used for any number from 101 to 199 inclusive. Such usage is equivalent to our expressions "twenty odd" and "one hundred odd," &c. These illustrations are from the single method of counting. Maunsell gives an illustration from the dual method—viz., *e rua mano ma wha, hokorima te tuma*, for 4,900; but literally it is "two thousand and four, *hokorima*"—the words "hundred doubled," or "hundred pairs," are omitted after the word "four," but are understood. In the modern system of counting by multiplying by ten we often hear the word *tuma* for the excess numbers between tens. But then, ten was not a multiple in the ancient system, nor was *tekau* used for ten. As old Tutaka expressed

it, "*Tekau* as a term for ten is a modern usage. It was the white man and his books that made it known to us."

Makere is another term used to imply an excess number. *Ngahuru makere* (ten odd) seems to bear the meaning of "ten onwards," and may be used in relation to any number from eleven to nineteen inclusive. When explaining to me the meaning of the expression *ngahuru tuma*, a Native said, "*Mo te tekau makere tena karanga*" (That term is used to denote ten onwards). Here, of course, *tekau* is used with its modern meaning of ten.

And again, we have the word *rerenga* used in a like manner. *Rerenga* is a verbal noun (*rere* = to run, flow, &c.). *Kotahi tekau, e whitu te rerenga*, means "one ten, the balance or excess being seven." This, again, is the modern *tekau* = ten. Again, *kotahi rau me nga rerenga* stands for "one hundred and the balance" (or excess over 100).

The terms *tauwhara* and *tauhara* bear a similar meaning of excess numbers. When explaining to me the ancient binary system of counting, a Native said, "Game was so counted in former times, when the birds or rats were taken from the snares, but when they were potted in calabashes the odd numbers were omitted, and eighty-five birds would be styled a *hokowha* (eighty). (*Kia maoa rawa nga manu, kia uru ki te ngutu iti, ka whakarerea nga tauwhara.*)

Still again, we have the terms *kehe* and *taukehe* as meaning odd numbers. *Taukehe* is sometimes used in place of *tautahi*, when counting by the dual method: hence *ka rua pu, taukehe*, would be used for five; *ngahuru pu, taukehe* = twenty-one; and so on. *Kehe* is often used to express an odd number. When looking at a hut in course of erection a Native said to me, "*E he ana nga heke, kua kehe*" (The rafters are wrong, there is an odd one). It is a Native custom to always put an even number of rafters on either side of a roof. It is a sign of bad luck to put an odd number.

Williams's Maori Dictionary gives the following words not used among the Tuhoe Tribe: *Hara* = excess above a round number—*kotahi rau, e iwa nga hara*. *Hemihemi* = excess over a definite number—*kotahi rau ma whitu, hemihemi* (one hundred and seven and over).

Whakamoe (or *whakamoe mātū*) is an expression employed to denote the counting of game in braces, laying aside each brace as counted—*Kai te whakamoe a Turei i nga manu o te taha.*

In counting *koko* (tui) birds prepared for preserving, a *pu* or brace consisted of four birds (I am not a Milesian)—*i.e.*, they were set aside by fours, but the four were only called one *pu*. Possibly this was on account of the smallness of

the bird. (*Mo te koko, kia makiritia, ka penei te karanga, he pu koko, mo te wha takitahi tena karanga*).

Although I have given in Table No. 2 that form of dual numeration which I believe was generally used in this district, yet some of my authorities differed from it in their accounts; for instance, one man gave a different method of counting from twenty-two to thirty-eight inclusive. Observe:—

20. Ngahuru pu.
22. Ngahuru ma tahi (ten and one; "pu" understood).
24. " rua (" two; "brace" understood).
26. " toru (" three ").
28. " wha (" four ").
30. " rima (" five ").
32 " ono (" six ").
34. " whitu (" seven ").
36. " waru (" eight ").
38. " iwa (" nine ").
40. Hokorua.

Here we see pairs added to ten pairs until thirty-eight was reached, after which it was the same as Table No. 2—pairs added to twenties.

Another differed in his term for twenty only. He used *tekau* instead of *ngahuru pu*, and added pairs to it as in Table No. 2—*tekau, kotahi pu* (twenty-two), *tekau, e rua pu* (twenty-four), &c. This man is one of those who maintain that persons were always counted singly. He says that, when speaking of persons, *hoko* multiplies the subjoined numeral by ten only—*hokorua* = twenty, *hokotoru* = thirty, &c.—while it multiplies the numeral by twenty in counting game, &c. Another old Native, a man of much knowledge, also maintains that *hoko* was used in both ways—*i.e.*, *takitahi* and *takirua*—which supports Williams's Dictionary. Thus *hokorua takitahi* would be twenty, while *hokorua topu* would stand for forty. This latter (Native) authority states that if in stating a number a person simply said "*Hokowha*," he would be asked, "*Hokowha aha?*" (Forty what?) and the reply would be "*Hokowha takitahi*," or "*Hokowha topu*," as the case might be. Also that, in using the dual method, the terms *hokorua, hokotoru*, &c., should really be followed by *pu*, but that it is usually omitted. Again, he states that prefixes were often omitted—*e.g.*, *ngahuru pu, tahi pu* (twenty-two); *ngahuru pu, rua pu* (twenty-four), &c.—when counting.

When, in counting his bag, a fowler found he had taken, say, 105 or 107 birds, he would often wait until he had made the number up to, say, 110 before returning home, to abolish the *taukehe*.

One of my old Native authorities is confident that in former times the Tuhoe people counted up to 1,000 readily,

but did not carry the system beyond that number. Still, it is clear that they could express any number up to 2,000 by the use of the term *topu*—as *E whitu rau ma rima topu* = seven hundred and fifty pairs = 1,500; *kotahi mano topu* = one thousand pairs = 2,000. Higher numbers were, he says, expressed by such terms as *tini*, &c. (see *ante*).

The words *nui* and *maha* mean "many," the latter being prefixed by *toko* when applied to persons. *Iti* is sometimes used as = "few," though, strictly speaking, its meaning is "small" (*tokoiti*) when applied to persons. *Tokohinu* = some. *Ouou, ruarua,* and *torutoru* are also used for "few," and are sometimes, not always, given the prefix *toko*—*i.e.*, when speaking of persons. The two last expressions are, it may be observed, formed by doubling the words *rua* (two) and *toru* (three). In Williams's Maori Dictionary we find *rūrŭa* = both equally. (*E tika rurua ana raua* = They are both equally correct.)

We have seen that *măno* is used for 1,000—a specific term for that number; also that it is employed with a more vague sense—"numberless," or "multitudinous"—though often coupled with other expressions, as *mano tini* or *mano raua ko tini, mano tini whaioio.* The last is sometimes merely *tini whaioio.* Williams gives *hea* = multitude, majority; and *mano tuauruuri* = very many. The numeration terms *ngera, makehua, maioio, rea,* given by Maunsell, I have not heard used, nor yet the expression *tini whakarere.* They are probably peculiar to tribes of the Waikato, or northern districts. *Tini makehua* is a peculiar term. I cannot refrain from thinking *makehua* allied to *makahua,* a generic term for stones. Tylor, in his "Anthropology," gives some account of the origin of numeration and ciphering, showing how many people reckoned with stones used as counters; as also the origin of the Latin *calculare,* and our word *calculate,* from *calculus* = a pebble.

As observed, none of the Maori terms for the digits seem to have any connection with the names of the fingers, although the word for five (*rima*) is apparently an old-time Polynesian word for hand. The names of the fingers are *takonui* (thumb), *takoroa* (forefinger), *manawa, mapere, toiti.* These are termed the *tokorima a Maui* (the five of Maui). The prefix *toko* is employed because the five were persons—*i.e.*, the personifications of fire. For these were the Fire Children of Mahuika, the Maori fire-goddess, who were destroyed by Maui when he obtained fire for man. If, when offering food to a Native, you apologize for the lack of knife and fork, he will say, "Never mind, I have the *tokorima a Maui.*"*

* Sometimes simply *tokorima.* Ex., "*E aurakina nei e oku tokorima.*"

It is a very ancient myth, and curious withal, that of the origin of fire—that is to say, of the Fire Children. "It was in an age long past away, before man was, that the thought came to the son of Tangotango [*i.e.*, to the sun] that he would send his child to the lower world to convey to his descendants there a great boon, the blessing of fire. Hence he said to his child, to Auahi-tu-roa, 'Go you to convey a boon to our descendants in the world.' And his son asked, 'How shall I give it?' The sun replied, 'Give them fire' [*tokorima*]. So Auahi-tu-roa descended to the earth. He came to Mahuika, younger sister to Hine-nui-te-Po [goddess of Hades], and ere long she gave birth to five children, whose names were Takonui, Takoroa, Manawa, Mapere, and Toiti. Those children were the Fire Children." Here we see how fire originally came from the sun. But this is digression. Return we to our numeration.

Williams gives a word I have not before met with, *makiu* = very numerous. Ex., "*Tuauriuri whaioio, makiu, makiu.*"

The modern method of adding units to 100 is by means of the conjunction *ma: kotahi rau ma whitu*—one hundred and seven. But in the old system of single counting this phrase seems to have stood for 170. *Kotahi rau ma rua* = one hundred and twenty (literally, one hundred and two). This method was used between hundreds, to express the odd tens, and is the only item in Tuhoe numeration of pre-European days that is decimal in its nature.

An ancient way of adding units to hundreds was by using the particle *e—kotahi rau, e whitu,* for 107. *Kotahi ma whitu* was not only an exact term for 170, but also a vague expression employed for any number of persons between 100 and 200. *Rau ma whitu* was used in the same manner, applied to a war-party, or company of travellers. It simply meant between 100 and 200. In like manner the term *hokowhitu* was used in the same vague way, when applied to a company of people. As my informant put it, "*Kia eke rawa ki te rau, katahi ka karangatia.*" It was only when the hundred was attained that the term was altered.

In that very singular work, "Te Ika a Maui," by the Rev. R. Taylor, are some curious remarks anent Maori counting. He says, "The old Maori way of counting was evidently at first by the fingers up to ten, then a shake of both hands was given, which signified one ten—this was called a *ngā huru,* or the entire ten fingers; one hand being shaken implied five, or the half; ten shakes of the two were 100; and so on. Thus *kotahi* was one finger; *ka rua,* two, &c.; *ka tekau,* ten: then a shake of the hands was given

—this was *nga huiu*, the whole ten fingers; *tekau ma tahi*, eleven; *tekau ma rua*, twelve, &c.; *rua tekau*, twenty; and so on to *kotahi rau*, 100, and *kotahi mano*, 1,000: beyond that all numbers were *mano tuitini* . . . Unless they added *takitahi* (once told) to these shakes they meant double: thus *kotahi rau* would signify 200, unless they said *kotahi rau takitahi* (a hundred once told). *Pu* also signifies counting by pairs, unless qualified by the word *topu*: thus *kotahi pu topu* is simply two, but *e rua pu* is two pairs, or four; *ngahuiu* (ten) is thus twenty. The word *hoko* signifies the doubling of twenty: *nga hoko rua*, forty; *nga hoko toru*, sixty; *nga hoko tekau*, two hundred . . . *kotahi rau hoko whitu*, one hundred doubled and seven twenties. *Topu* also signifies a pair doubled, or four."

The items in the above which arrest our attention are: The shaking of the hand, or hands, to show that five, or ten, is complete; and the use of *tekau* for ten, which the reverend author seems to imply was an ancient custom. It would be interesting to know what tribe these notes were obtained from. His remarks on the terms *pu* and *topu* are peculiar. I cannot see how *topu* qualifies *pu*. *Pu* means a pair, and requires no qualification. *Kotahi pu topu* sounds very tautological, while *hoko* scarcely signifies the doubling of twenty, but the multiplying by that number.

We may note that the Maori had no knowledge of cipher-ing, or any form of abacus, so far as we know. They possessed, apparently, one only mnemonic aid to memory in their genealogical staves. This was a piece of hardwood about 1 in. in diameter and 3 ft. or so in length. It had on one side a series of square-edged notches cut in it, the pieces of wood left between the notches being about $\frac{1}{2}$ in. or $\frac{3}{4}$ in. These represented each a generation. These staves were, if necessary, used in a boustrophedon manner. They were but a crude aid to memory, and their use does not appear to have been very common.

The word *mutu* is sometimes used after a round number to show that no excess exists—*e.g.*, *kotahi rau mutu* (one hundred and no excess).

Ngahoro is another term used to imply an excess number: thus *hokorua ngahoro* is equivalent to *hokorua makere*, &c., and means a *hokorua* and an excess number. If *hokorua* is used in the *topu* sense, then the above expression may be used for any number from forty-one to fifty-nine inclusive.

Table No. 3: In this table we see the old-time Maori method of enumerating persons. The prefix *toko*, used only when speaking of persons, has already been noted, as also the terms *tingahuru* and *tekau*.

Although the *topu* or binary system of counting, as given in Table No. 2, was not applied to persons, yet the double *hoko* and *rau* methods were. Thus *hokorua* was usually employed to denote forty persons, *hokotoru* for sixty, and on to *hokowa* for 180. The single *hoko* system appears to have been sometimes employed when stating an excess over a round number (see Table No. 3 for examples). The single *rau*, or hundred, seems to have been seldom applied to persons, 100 being expressed by *hokorima*. But 200 was *kotahi rau topu—i.e.*, one hundred doubled, or one hundred pairs. The word *topu* was not actually used, as a rule, but was left to be inferred. Thus 140 was termed a *hokowhitu*; 340 was a *rau hokowhitu*.

I have given many terms in Table No. 3, so that the reader may know the exact terms for precise numbers; but it must be here explained that the Maori usually gave round numbers for persons, and seldom expressed exact numbers between twenties. He would use the term *hokorua makere* for any number between forty and sixty, and would not specify the excess unless under peculiar conditions—*e.g.*, in answer to a question. In like manner the expression *kotahi rau tuma* might be used for any number between 200 and 300, unless he employed the *takitahi* method, in which case it might stand for any number between 100 and 200. The table shows the forms employed to express the excess numbers, when required. The number 101 might also be expressed by *hokorima, kotahi te tuma;* 102 by *hokorima, tokorua te tuma;* and so on to 119 = *hokorima ngahuru ma tahi te tuma* (or *paepae*); 122 might be given as *hokoono, tokorua te tuma*, and so on; 130 as *hokoono, he ti ngahuru te tuma;* 131, *hokoono, ngahuru ma tahi te tuma*, and so on. The different terms used to denote a given number are perplexing in the extreme. Possibly different methods, or different expressions, were formerly used among different tribes, and the modern Maori has confused them.

If the single *hoko* and *rau* terms are used, then the system of numeration may be termed decimal; but if the double *hoko* method be employed (as *hokorua* = forty, &c., and *kotahi rau* = 200), then the system is vigesimal.

Regarding the numbers eleven to nineteen in Table No. 3, these were given to me by Te Puia, of Tuhoe, as—eleven, *ti ngahuru, kotahi;* twelve, *ti ngahuru, tokorua;* thirteen, *ti ngahuru, tokotoru;* nineteen, *ti ngahuru, tokowa*. He also gave—fifty-one as *hokorua, ngahuru takitahi, kotahi;* fifty-two as *hokorua, ngahuru takitahi, tokorua;* fifty-three as *hokorua, ngahuru takitahi, tokotoru;* and so on to *hokotoru* = sixty.

The Ngati-Awa Tribe, according to Matutaera Hatua,

objected to applying the *topu* system of counting to persons because it interfered with their *kawa tapu*. Probably this was on account of food-supplies being counted by the *topu* or binary system. As almost all local authorities agree that persons were counted singly, and not by the *tatau topu*, I feel certain that the double *hoko* and *rau* methods (*hokorua* = forty, &c.; *kotahi rau* = 200) are not viewed by Natives as being binary in their nature, but that that expression is applied only to the system of counting in pairs, as given in Table No. 2; and, moreover, that the vigesimal (or double *hoko*) method was a system of numeration known to, and used by, the Polynesian peoples in times long past away. Thus, the reader will bear in mind that the vigesimal system, as given in Table No. 3, seems to have been that in common use for enumerating persons. The variant forms, as *kotahi rau takitahi* for 100, *kotahi rau ma rua* and *kotahi rau, hokorua takitahi te paepae*, for 120, &c., do not seem to have been so much used, at least according to evidence now obtainable.

In regard to Table No. 1, it seems probable from the evidence of many Natives that the terms *hokorua makere, hokotoru makere*, and so on, were also much more commonly used than a perusal of that table would lead one to suppose. I have given the definite terms between twenties, in order to place my notes on record, and to render the table complete; but a Native would very often say *hokorua makere* for any number from forty-one to fifty-nine inclusive. This is equivalent to our system of counting by scores, when we say, "Three score odd," &c.

A singular form obtains among some of the Waikato Natives, of expressing the numbers twelve to nineteen in the numeration of persons, as—*tekau ma tokorua*, for twelve; *tekau ma tokotoru*, for thirteen; and *tekau ma tokoiwa*, for nineteen.

Puihi Maru-tawhao, an old man of Tuhoe, has given me the following notes lately: The *pu koko* (see *ante*) consisted, in this district, of six birds. These were, presumably, considered equal to two pigeons or *kaka*. Both the single and double *hoko* systems were formerly used here—*e.g.*, *hokorua takitahi* stood for twenty, and *hokorua topu* for forty. He says that *hokotahi* was not here used. Fish, as well as birds, were counted in pairs—*i.e.*, the binary method was employed; but baskets of *kumara*, &c., were counted singly.

And here endeth such notes as we have collected anent the systems of enumeration employed by the Tuhoe Tribe in days of old. They are not remarkable for clearness, but represent, nevertheless, much work in collection, and close questioning of many persons.

TABLE No. 1.

TATAU TAKITAHI (SINGLE METHOD OF NUMERATION).

1. Kotahi.
2. E rua.
3. E toru.
4. E wha.
5. E rima.
6. E ono.
7. E whitu.
8. E waru.
9. E iwa.
10. Ngahuru.

11. Ngahuru ma tahi (ten and one).
12. " rua (" two).
13. " toru (" three).
14. " wha &c., &c.
15. " rima
16. " ono
17. " whitu
18. " waru
19. " iwa
20. Tekau.

21. Tekau ma tahi (twenty and one).
22. " rua (" two).
23. " toru (" three).
24. " wha &c., &c.
25. " rima
26. " ono
27. " whitu
28. " waru
29. " iwa
30. Tekau maha ngahuru (twenty and ten).

31. Tekau, ngahuru ma tahi (twenty, ten and one).
32. " " rua (" " two).
33. " " toru &c., &c.
34. " " wha
35. " " rima
36. " " ono
37. " " whitu
38. " " waru
39. " " iwa
40. Hokorua topu (forty, *or* ten twos doubled), *or* hokowha takitahi.

41. Hokorua ma tahi; *or* hokorua, kotahi te tuma.
42. " rua; *or* " e rua "
43. &c., &c.
44
45 *Or simply* hokorua makere.
46.
47.
48.
49.

50. Hokotoru, ngahuru takitahi
51. „ ngahuru ma tahi
52. „ „ rua
53. „ „ toru
54. „ „ wha
55. „ „ rima
56. „ „ ono
57. „ „ whitu
58. „ „ waru
59. „ „ iwa

(forty, ten single; *or* ten twos doubled and ten single).
(forty, ten and one; *or* ten twos doubled and one).
or hokorua makere (sometimes "te tuma" (the excess) added to terms for fifty to fifty-nine inclusive).

60. Hokotoru topu, *or* hokoono takitahi.

61. Hokotoru ma tahi; *or* hokotoru, kotahi te tuma
62. „ rua; *or* „ e rua „
63. „ toru; *or* „ e toru „
64. „ wha; *or* „ e wha „
65. „ rima; *or* „ e rima „
66. „ ono; *or* „ e ono „
67. „ whitu; *or* „ e whitu „
68. „ waru; *or* „ e waru „
69 „ iwa; *or* „ e iwa „

or hokotoru makere.

70. Hokotoru, ngahuru takitahi
71. „ ngahuru ma tahi
72. „ „ rua
73. „ „ toru
74. „ „ wha
75. „ „ rima
76. „ „ ono
77. „ „ whitu
78. „ „ waru
79. „ „ iwa

Sometimes the words "te tuma" (the excess) are used after each term; *or* hokotoru tuma (sixty and excess) used for any number from sixty-one to seventy-nine, *or* hokotoru makere is so used.

80. Hokowha topu, *or* hokowaru takitahi.

81 Hokowha ma tahi; *or* hokowha, kotahi te tuma
82. Hokowha ma rua; *or* hokowha, e rua te tuma
83 &c., &c.
84.
85.
86.
87.
88.
89.
90. Hokowha, ngahuru takitahi
91. Hokowha, ngahuru ma tahi
92. „ „ rua
93. „ „ toru
94. „ „ wha
95. „ „ rima
96. „ „ ono
97. „ „ whitu
98. „ „ waru
99. „ „ iwa

Te tuma sometimes added; *or* hokowha tuma (*or* makere, *or* ngahoro) used for any number from eighty-one to ninety-nine.

100. Hokorima topu; *or* kotahi rau takitahi.
101. Hokorima ma tahi; *or* hokorima, kotahi te tuma; *or* kotahi rau, kotahi.

102. Hokorima ma rua; *or* hokorima, e rua te tuma; *or* kotahi rau, e rua.
103. Hokorima ma toru; *or* hokorima, e toru te tuma; *or* kotahi rau, e toru.
104. Hokorima ma wha; *or* hokorima, e wha te tuma; *or* kotahi rau, e wha.
105. Hokorima ma rima; *or* hokorima, e rima te tuma; *or* kotahi rau, e rima.
106. Hokorima ma ono; *or* hokorima, e ono te tuma; *or* kotahi rau, e ono.
107. Hokorima ma whitu; *or* hokorima, e whitu te tuma; *or* kotahi rau, e whitu.
108. Hokorima ma waru; *or* hokorima, e waru te tuma; *or* kotahi rau, e waru.
109. Hokorima ma iwa; *or* hokorima, e iwa te tuma; *or* kotahi rau, e iwa.
110. Hokorima, ngahuru takitahi te tuma.
111. " " ma tahi "
120. Hokoono topu; *or* kotahi rau ma rua.
121. Hokoono ma tahi; *or* hokoono, kotahi te tuma.
122. " rua; *or* " e rua "
140. Hokowhitu topu; *or* kotahi rau ma wha.
160. Hokowaru topu; *or* " ono.
180. Hokoiwa topu; *or* " waru.
190. Hokoiwa, ngahuru takitahi; *or* kotahi rau ma iwa.
191. " ngahuru ma tahi.
199. " " iwa.
200. E rua rau (takitahi).
201 to 219. E rua rau tūmā. (The excess number stated if necessary.)
220. E rua rau, hokorua takitahi; *or* e rua rau ma rua.
221. E rua rau, hokorua ma tahi te paepae (*or* tumā), &c.
230. " hokotoru takitahi te paepae (*i.e.*, two hundred, thirty once told the excess); *or* e rua rau ma toru.
240. " hokowha takitahi te paepae; *or* e rua rau ma wha.
250. " hokorima " *or* " ma rima.
260. " hokoono " *or* " ma ono.
300. E toru rau (takitahi).
400. E wha " "
1000. Kotahi mano.

TABLE No. 2.

TATAU TOPU (THE BINARY OR DUAL SYSTEM OF COUNTING, USED WHEN COUNTING GAME, FISH, ETC.).

1.
2. Ka tahi pu (one brace or pair).
3. " tautahi (one brace (and an) odd one).
4. Ka rua pu (two brace).
5. " tautahi (two brace (and an) odd one).
6. Ka toru pu (three brace).
7. " tautahi.
8. Ka wha pu (four brace).
9. " tautahi.
10. Ka rima pu.
11. " tautahi.
12. Ka ono pu.
13. " tautahi.

14. Ka whitu pu.
15. " tautahi.
16. Ka waru pu.
17. " tautahi.
18. Ka iwa pu.
19. " tautahi.
20. Ngahuru pu (ten brace).
21. " tautahi (ten brace (and an) odd one).
22. " kotahi pu (ten brace, one brace).
23. " " tautahi (ten brace, one brace, odd one).
24. " e rua pu (ten brace, two brace).
25. " " tautahi (ten brace, two brace, odd one).
26. " e toru pu.
27. " " tautahi.
28. " e wha pu.
29. " " tautahi.
30. " e rima pu.
31. " " tautahi.
32. " e ono pu.
33. " " tautahi.
34. " e whitu pu.
35. " " tautahi.
36 " e waru pu.
37. " " tautahi.
38. " e iwa pu.
39. " " tautahi.
40. Hokorua.
41. Hokorua, tautahi.
42. " kotahi pu.
43. " " tautahi.
44. " e rua pu.
45. " " tautahi.
46. " e toru pu.
47. " " tautahi.
48. " e wha pu.
49. " " tautahi.
50. " e rima pu.
51. " " tautahi.
52. " e ono pu.
53. " " tautahi.
54. " e whitu pu.
55. " " tautahi.
56. " e waru pu.
57. " " tautahi.
58. " e iwa pu.
59. " " tautahi.
60. Hokotoru.
61. Hokotoru, tautahi.
62. " kotahi pu.
63. " " tautahi.
64. " e rua pu.
65. " " tautahi.
66. " e toru pu.
67. " " tautahi.
68. " e wha pu.
69. " " tautahi.
70. " e rima pu.
71. " " tautahi.
72. " e ono pu.

73. Hokotoru, e ono pu, tautahi.
74. " e whitu pu.
75. " " tautahi.
76. " e waru pu.
77. " " tautahi.
78. " e iwa pu.
79. " " tautahi.
80. Hokowha.
81. " tautahi.
82 " kotahi pu.
83. " " tautahi.
84. " e rua pu.
85. " " tautahi.
86. " e toru pu.
87. " " tautahi.
88. " e wha pu.
89. " " tautahi.
90. " e rima pu.
91. " " tautahi.
92. " e ono pu.
93. " " tautahi.
94. " e whitu pu.
95. " " tautahi.
96 " e waru pu.
97. " " tautahi.
98. " e iwa pu.
99. " " tautahi.
100. Hokorima.
101. " tautahi.
102. " kotahi pu.
110. " e rima pu.
120. Hokoono.
121. " tautahi.
122. " kotahi pu.
140. Hokowhitu.
160. Hokowaru.
180. Hokoiwa.
200. Kotahi rau (*i.e.*, one hundred; brace, "pu," understood).
210. " e rima pu.
220. " ngahuru pu.
240. " hokorua.
260. " hokotoru.
280. " hokowha.
300. " hokorima.
301. " " tautahi.
302. " " kotahi pu.
400. E rua rau (*i.e.*, two hundred; brace, or pairs, "pu," understood).
401. " tautahi.
402. " kotahi pu.
403. " " tautahi.
500. " hokorima.
600. E toru rau.
700. " hokorima.
800. E wha rau.
900. " hokorima.
1000. E rima rau (*i.e.*, five hundred, "pu" understood).
2000. Kotahi mano ("pu" understood).

Table No. 3.

Tatau Tangata (Enumeration of Persons).

1. Kotahi.
2. Tokorua.
3. Tokotoru.
4. Tokowha.
5. Tokorima.
6. Tokoono.
7. Tokowhitu.
8. Tokowaru.
9. Tokoiwa.
10. Tingahuru.
11. Tingahuru ma tahi (*or abbreviated to* ngahuru ma tahi).
12. " rua (ten and two).
13. " toru (ten and three).
14. " wha &c., &c.
15. " rima
16 " ono
17. " whitu
18. " waru
19. " iwa
20. Tekau, *or* hokorua takitahi.
21. Tekau ma tahi (twenty and one).
22. " rua (" two).
&c., &c. (see Table No. 1).
30. Tekau, maha ngahuru.
31. " ngahuru ma tahi.
&c., &c. (see Table No. 1).
40. Hokorua topu, *or* hokowha takitahi.
41. " kotahi te tuma; *or* hokorua makere.
42. " tokorua " *or* "
43. " tokotoru " *or* "
44. " tokowha " *or* "
45. " tokorima " *or* "
46. " tokoono " *or* "
47. " tokowhitu " *or* "
48. " tokowaru " *or* "
49. " tokoiwa " *or* "
50. " ngahuru takitahi *or* "
51. " ngahuru ma tahi te tuma, *or* hokorua makere.
52. " " rua " *or* "
53. " " toru " *or* "
60. Hokotoru topu, *or* hokoono takitahi.
61. Hokotoru kotahi te tuma; *or* hokotoru makere.
62. " tokorua " *or* "
70. " ngahuru takitahi *or* "
71. " ngahuru ma tahi te tuma; *or* hokotoru makere.
80. Hokowha topu, *or* hokowaru takitahi.
100. Hokorima topu, *or* kotahi rau takitahi.
The numbers 101 to 119 would usually be given as kotahi rau (takitahi), tuma = one hundred and an excess; *or* hokorima tuma takitahi.
120. Hokoono topu; *or* kotahi rau ma rua; *or* kotahi rau, hokorua takitahi te paepae.
140. Hokowhitu topu; *or* kotahi rau ma wha; *or* kotahi rau, hokowha takitahi te paepae.
170. Kotahi rau ma whitu (takitahi); *or* kotahi rau, hokowhitu takitahi te paepae; *or* hokowaru makere.

180. Kotahi rau ma waru (takitahi); *or* kotahi rau, hokowaru takitahi te paepae; *or* hokoiwa topu.
190. Kotahi rau ma iwa takitahi; *or* kotahi rau, hokoiwa takitahi te paepae; *or* hokoiwa topu, he tingahuru te paepae.
200. Kotahi rau topu; *or* e rua rau takitahi.
220. Kotahi rau topu hokorua takitahi te paepae; *or* e rua rau ma rua, takitahi.
230 Kotahi rau topu, hokotoru takitahi te paepae; *or* e rua rau ma toru, takitahi.
240. Kotahi rau topu, hokorua te paepae; *or* kotahi rau ma rua topu.
250. Kotahi rau topu, hokorima takitahi te paepae.
260. Kotahi rau ma toru topu; *or* kotahi rau, hokotoru.
300. Kotahi rau ma rima topu; *or* kotahi rau, hokorima.
340. Kotahi rau ma whitu; *or* kotahi rau, hokowhitu.
400. E rua rau topu.
500. E rua rau ma rima topu; *or* e rua rau, hokorima.
600. E toru rau topu.
700. E toru rau ma rima topu; *or* e toru rau, hokorima.
800. E wha rau topu.
900. E wha rau ma rima topu; *or* e wha rau, hokorima
1000. E rima rau topu.
1100. E rima rau ma rima topu; *or* e rima rau, hokorima.
1200. E ono rau topu.
2000 Kotahi mano topu.

TABLE NO. 4.

THE MODERN DECIMAL SYSTEM ADOPTED DURING THE FIRST HALF OF THE NINETEENTH CENTURY, BUT WHICH WAS UNKNOWN IN ANCIENT TIMES.

1 to 9. Same as Table No. 1.
10. Tekau (kotahi tekau = one ten, to be explicit).
11. Tekau ma tahi (ten and one).
12. " rua (" two).
13. " toru (" three).
14. " wha (" four).
15. " rima &c., &c.
16. " ono
17. " whitu
18. " waru
19. " iwa
20. E rua tekau (two tens).
21. E rua tekau ma tahi (two tens and one).
22. " rua (" two).
23. " toru (" three).
24. " wha &c., &c.
25. " rima
26. " ono
27. " whitu
28. " waru
29. " iwa
30. E toru tekau (three tens).
31. " ma tahi (three tens and one).
32. " ma rua (" two).
40. E wha tekau (four tens).
50. E rima tekau (five tens).
60. E ono tekau (six tens).
90. E iwa tekau (nine tens).

100. Kotahi rau.
101. Kotahi rau ma tahi (one hundred and one).
102. „ ma rua („ two).
110. „ kotahi tekau (one hundred, one ten).
111. „ „ ma tahi (one hundred, one ten, and one).
115. „ „ ma rima.
120. „ e rua tekau.
121. „ „ ma tahi.
199. „ e iwa tekau ma iwa.
200. E rua rau.
201. „ ma tahi.
202. „ ma rua.
250. „ e rima tekau.
300. E toru rau.
400. E wha rau.
500. E rima rau.
1000. Kotahi mano.
1001. „ ma tahi.
1100. „ kotahi rau.
1101. „ „ ma tahi.
1102. „ „ ma rua.
1906. „ e iwa rau ma ono.
2000. E rua mano.
3000. E toru mano.
10000. Kotahi tekau mano.
100000. Kotahi rau mano.

Art. XVI.—*Two New Species of Leech in New Zealand.*

By W. B. Benham, D.Sc., University of Otago.

[*Read before the Otago Institute, 13th November*, 1906.]

Plates VIII and VIIIa.

Up to the present time two species of leech have been described from this region—the first by Dendy and Olliver in 1900, and three years later I added a second species. Since that date I have been trying to obtain leeches—which undoubtedly occur in our streams in various parts of the Island—but with only limited success. In the present communication I give an account of the anatomy, internal and external, of two new species, and add a short description of the internal anatomy of *Hirudo antipodum*. The four leeches now known to occur in New Zealand are here systematically arranged.

Order RHYNCHOBDELLIDA.

Fam. GLOSSOSIPHONIDÆ.

Microbdella, Moore, 1900.

M. novæ-zealandiæ, Dendy and Olliver.

Placobdella, Blanchard, 1893.

P. maorica, n. sp.