Chapter 2

NUMBER SYSTEM LIMITS

With respect to the limits to which the number systems of the various uncivilized races of the earth extend, recent anthropological research has developed many interesting facts. In the case of the Chiquitos and a few other native races of Bolivia we found no distinct number sense at all, as far as could be judged from the absence, in their language, of numerals in the proper sense of the word. How they indicated any number greater than *one* is a point still requiring investigation. In all other known instances we find actual number systems, or what may for the sake of uniformity be dignified by that name. In many cases, however, the numerals existing are so few, and the ability to count is so limited, that the term *number system* is really an entire misnomer.

Among the rudest tribes, those whose mode of living approaches most nearly to utter savagery, we find a certain uniformity of method. The entire number system may consist of but two words, *one* and *many*; or of three words, *one*, *two*, *many*. Or, the count may proceed to 3, 4, 5, 10, 20, or 100; passing always, or almost always, from the distinct numeral limit to the indefinite *many* or several, which serves for the expression of any number not readily grasped by the mind. As a matter of fact, most races count as high as 10; but to this statement the exceptions are so numerous that they deserve examination in some detail. In certain parts of the world, notably among the native races of South America, Australia, and many of the islands of Polynesia and Melanesia, a surprising paucity of numeral words has been observed. The Encabellada of the Rio Napo have but two distinct numerals; *tey*, 1, and *cayapa*, 2. The Chaco languages of the Guaycuru stock are also notably poor in this respect. In the Mbocobi dialect of this language the only native numerals are *yña tvak*, 1, and *yfioaca*, 2. The Puris count *omi*, 1, *curiri*, 2, *prica*, many; and the Botocudos *mokenam*, 1, *uruhu*, many. The Fuegans, supposed to have been able at one time to count to 10, have but three numerals, *kaoueli*, 1, *compaipi*, 2, *maten*, 3. The Campas of Peru possess only three separate words for the expression of number, *patrio*, 1, *pitteni*, 2, *mahuani*, 3. Above 3 they proceed by combinations, as 1 and 3 for

4, 1 and 1 and 3 for 5. Counting above 10 is, however, entirely inconceivable to them, and any number beyond that limit they indicate by *tohaine*, many. The Conibos, of the same region, had, before their contact with the Spanish, only *atchoupre*, 1, and *rrabui*, 2; though they made some slight progress above 2 by means of reduplication. The Orejones, one of the low, degraded tribes of the Upper Amazon, have no names for number except *nayhay*, 1, *nenacome*, 2, *feninichacome*, 3, *ononoeomere*, 4. In the extensive vocabularies given by Von Martins, many similar examples are found. For the Bororos he gives only *couai*, 1, *maeouai*, 2, *ouai*, 3. The last word, with the proper finger pantomime, serves also for any higher number which falls within the grasp of their comprehension. The Guachi manage to reach 5, but their numeration is of the rudest kind, as the following scale shows: *tamak*, 1, *eu-echo*,2, *eu-echo-kailau*,3, *eu-echo-way*,4, *localau*, 5. The Carajas counted by a scale equally rude, and their conception of number seemed equally vague, until contact with the neighbouring tribes furnished them with the means of going beyond their original limit. Their scale shows clearly the uncertain, feeble number sense which is so marked in the interior of South America. It contains *wadewo*, 1, *wadebothoa*, 2, *wadeboaheodo*, 3, *wadebojeodo*, 4, *wadewajouclay*, 5, *wadewasori*, 6, or many.

Turning to the languages of the extinct, or fast vanishing, tribes of Australia, we find a still more noteworthy absence of numeral expressions. In the Gudang dialect but two numerals are found *pirman*, 1, and *ilabiu*, 2; in the Weedookarry, *ekkamurda*, 1, and *kootera*, 2; and in the Queanbeyan, *midjemban*, 1, and *bollan*, 2. In a score or more of instances the numerals stop at 3. The natives of Keppel Bay count *webben*, 1, *booli*, 2, *koorel*, 3; of the Boyne River, *karroon*, 1, *boodla*, 2, *numma*, 3; of the Flinders River, *kooroin*, 1, *kurto*, 2, *kurto kooroin*, 3; at the mouth of the Norman River, *lum*, 1, *buggar*, 2, *orinch*, 3; the Eaw tribe, *koothea*, 1, *woother*, 2, *marronoo*, 3; the Moree, *mal*, 1, *boolar*, 2, *kooliba*, 3; the Port Essington, *erad*, 1, *nargarick*, 2, *nargarickelerad*, 3; the Darnly Islanders, *netat*, 1, *naes*, 2, *naesa netat*, 3; and so on through a long list of tribes whose numeral scales are equally scanty. A still larger number of tribes show an ability to count one step further, to 4; but beyond this limit the majority of Australian and Tasmanian tribes do not go. It seems

most remarkable that any human being should possess the ability to count to 4, and not to 5. The number of fingers on one hand furnishes so obvious a limit to any of these rudimentary systems, that positive evidence is needed before one can accept the statement. A careful examination of the numerals in upwards of a hundred Australian dialects leaves no doubt, however, that such is the fact. The Australians in almost all cases count by pairs; and so pronounced is this tendency that they pay but little attention to the fingers. Some tribes do not appear ever to count beyond 2 a single pair. Many more go one step further; but if they do, they are as likely as not to designate their next numeral as two-one, or possibly, one-two. If this step is taken, we may or may not find one more added to it, thus completing the second pair. Still, the Australian's capacity for understanding anything which pertains to number is so painfully limited that even here there is sometimes an indefinite expression formed, as many, heap, or plenty, instead of any distinct numeral; and it is probably true that no Australian language contains a pure, simple numeral for 4. Curr, the best authority on this subject, believes that, where a distinct word for 4 is given, investigators have been deceived in every case. If counting is carried beyond 4, it is always by means of reduplication. A few tribes gave expressions for 5, fewer still for 6, and a very small number appeared able to reach 7. Possibly the ability to count extended still further; but if so, it consisted undoubtedly in reckoning one pair after another, without any consciousness whatever of the sum total save as a larger number.

The numerals of a few additional tribes will show clearly that all distinct perception of number is lost as soon as these races attempt to count above 3, or at most, 4. The Yuckaburra natives can go no further than *wigsin*, 1, *bullaroo*, 2, *goolbora*, 3. Above here all is referred to as *moorgha*, many. The Marachowies have but three distinct numerals, *cooma*, 1, *cootera*, 2, *murra*, 3. For 4 they say *minna*, many. At Streaky Bay we find a similar list, with the same words, *kooma* and *kootera*, for 1 and 2, but entirely different terms, *karboo* and *yalkata* for 3 and many. The same method obtains in the Minnal Yungar tribe, where the only numerals are *kain*, 1, *kujal*, 2, *moa*, 3, and *bulla*, plenty. In the Pinjarra dialect we find *doombart*, 1, *gugal*, 2, *murdine*, 3, *boola*, plenty; and in the dialect described as belonging to "Eyre's Sand Patch," three definite terms are

given *kean*, 1, *koojal*, 2, *yalgatta*, 3, while a fourth, *murna*, served to describe anything greater. In all these examples the fourth numeral is indefinite; and the same statement is true of many other Australian languages. But more commonly still we find 4, and perhaps 3 also, expressed by reduplication. In the Port Mackay dialect the latter numeral is compound, the count being *warpur*, 1, *boolera*, 2, *boolera warpur*, 3. For 4 the term is not given. In the dialect which prevailed between the Albert and Tweed rivers the scale appears as *yaburu*, 1, *boolaroo*, 2, *boolaroo yaburu*, 3, and *gurul*for 4 or anything beyond. The Wiraduroi have *numbai*, 1, *bula*, 2, *bula numbai*, 3, *bungu*, 4, or many, and *bungu galan*or *bian galan*, 5, or very many. The Kamilaroi scale is still more irregular, compounding above 4 with little apparent method. The numerals are *mal*, 1, *bular*, 2, *guliba*, 3, *bular bular*, 4, *bular guliba*, 5, *guliba guliba*, 6. The last two numerals show that 5 is to these natives simply 2-3, and 6 is 3-3. For additional examples of a similar nature the extended list of Australian scales given in Chapter V. may be consulted.

Taken as a whole, the Australian and Tasmanian tribes seem to have been distinctly inferior to those of South America in their ability to use and to comprehend numerals. In all but two or three cases the Tasmanians were found to be unable to proceed beyond 2; and as the foregoing examples have indicated, their Australian neighbours were but little better off. In one or two instances we do find Australian numeral scales which reach 10, and perhaps we may safely say 20. One of these is given in full in a subsequent chapter, and its structure gives rise to the suspicion that it was originally as limited as those of kindred tribes, and that it underwent a considerable development after the natives had come in contact with the Europeans. There is good reason to believe that no Australian in his wild state could ever count intelligently to 7.

In certain portions of Asia, Africa, Melanesia, Polynesia, and North America, are to be found races whose number systems are almost and sometimes quite as limited as are those of the South. American and Australian tribes already cited, but nowhere else do we find these so abundant as in the two continents just mentioned, where example after example might be cited of tribes whose ability to count is circumscribed within the narrowest limits. The Veddas

of Ceylon have but two numerals, *ekkame[=i]*, 1, *dekkameï*, 2. Beyond this they count *otameekaï, otameekaï, otameekaï*, etc.; *i.e.*"and one more, and one more, and one more," and so on indefinitely. The Andamans, inhabitants of a group of islands in the Bay of Bengal, are equally limited in their power of counting. They have *ubatulda*, 1, and *ikporda*, 2; but they can go no further, except in a manner similar to that of the Veddas. Above two they proceed wholly by means of the fingers, saying as they tap the nose with each successive finger, *anka*, "and this." Only the more intelligent of the Andamans can count at all, many of them seeming to be as nearly destitute of the number sense as it is possible for a human being to be. The Bushmen of South Africa have but two numerals, the pronunciation of which can hardly be indicated without other resources than those of the English alphabet. Their word for 3 means, simply, many, as in the case of some of the Australian tribes. The Watchandies have but two simple numerals, and their entire number system is *cooteon*, 1, *utaura*, 2, *utarra cooteoo*, 3, *atarra utarra*, 4. Beyond this they can only say, *booltha*, many, and *booltha bat*, very many. Although they have the expressions here given for 3 and 4, they are reluctant to use them, and only do so when absolutely required. The natives of Lower California cannot count above 5. A few of the more intelligent among them understand the meaning of 2 fives, but this number seems entirely beyond the comprehension of the ordinary native. The Comanches, curiously enough, are so reluctant to employ their number words that they appear to prefer finger pantomime instead, thus giving rise to the impression which at one time became current, that they had no numerals at all for ordinary counting.

Aside from the specific examples already given, a considerable number of sweeping generalizations may be made, tending to show how rudimentary the number sense may be in aboriginal life. Scores of the native dialects of Australia and South America have been found containing number systems but little more extensive than those alluded to above. The negro tribes of Africa give the same testimony, as do many of the native races of Central America, Mexico, and the Pacific coast of the United States and Canada, the northern part of Siberia, Greenland, Labrador, and the arctic archipelago. In speaking of the Eskimos of Point Barrow,

Murdoch says: "It was not easy to obtain any accurate information about the numeral system of these people, since in ordinary conversation they are not in the habit of specifying any numbers above five." Counting is often carried higher than this among certain of these northern tribes, but, save for occasional examples, it is limited at best. Dr. Franz Boas, who has travelled extensively among the Eskimos, and whose observations are always of the most accurate nature, once told the author that he never met an Eskimo who could count above 15. Their numerals actually do extend much higher; and a stray numeral of Danish origin is now and then met with, showing that the more intelligent among them are able to comprehend numbers of much greater magnitude than this. But as Dr. Boas was engaged in active work among them for three years, we may conclude that the Eskimo has an arithmetic but little more extended than that which sufficed for the Australians and the forest tribes of Brazil. Early Russian explorers among the northern tribes of Siberia noticed the same difficulty in ordinary, every-day reckoning among the natives. At first thought we might, then, state it as a general law that those races which are lowest in the scale of civilization, have the feeblest number sense also; or in other words, the least possible power of grasping the abstract idea of number.

But to this law there are many and important exceptions. The concurrent testimony of explorers seems to be that savage races possess, in the great majority of cases, the ability to count at least as high as 10. This limit is often extended to 20, and not infrequently to 100. Again, we find 1000 as the limit; or perhaps 10,000; and sometimes the savage carries his number system on into the hundreds of thousands or millions. Indeed, the high limit to which some savage races carry their numeration is far more worthy of remark than the entire absence of the number sense exhibited by others of apparently equal intelligence. If the life of any tribe is such as to induce trade and barter with their neighbours, a considerable quickness in reckoning will be developed among them. Otherwise this power will remain dormant because there is but little in the ordinary life of primitive man to call for its exercise.

In giving 1, 2, 3, 5, 10, or any other small number as a system

limit, it must not be overlooked that this limit mentioned is in all cases the limit of the spoken numerals at the savage's command. The actual ability to count is almost always, and one is tempted to say always, somewhat greater than their vocabularies would indicate. The Bushman has no number word that will express for him anything higher than 2; but with the assistance of his fingers he gropes his way on as far as 10. The Veddas, the Andamans, the Guachi, the Botocudos, the Eskimos, and the thousand and one other tribes which furnish such scanty numeral systems, almost all proceed with more or less readiness as far as their fingers will carry them. As a matter of fact, this limit is frequently extended to 20; the toes, the fingers of a second man, or a recount of the savage's own fingers, serving as a tale for the second 10. Allusion is again made to this in a later chapter, where the subject of counting on the fingers and toes is examined more in detail.

In saying that a savage can count to 10, to 20, or to 100, but little idea is given of his real mental conception of any except the smallest numbers. Want of familiarity with the use of numbers, and lack of convenient means of comparison, must result in extreme indefiniteness of mental conception and almost entire absence of exactness. The experience of Captain Parry, who found that the Eskimos made mistakes before they reached 7, and of Humboldt, who says that a Chayma might be made to say that his age was either 18 or 60, has been duplicated by all investigators who have had actual experience among savage races. Nor, on the other hand, is the development of a numeral system an infallible index of mental power, or of any real approach toward civilization. A continued use of the trading and bargaining faculties must and does result in a familiarity with numbers sufficient to enable savages to perform unexpected feats in reckoning. Among some of the West African tribes this has actually been found to be the case; and among the Yorubas of Abeokuta the extraordinary saying, "You may seem very clever, but you can't tell nine times nine," shows how surprisingly this faculty has been developed, considering the general condition of savagery in which the tribe lived. There can be no doubt that, in general, the growth of the number sense keeps pace with the growth of the intelligence in other respects. But when it is remembered that the Tonga Islanders have numerals up to 100,000, and the Tembus, the Fingoes, the Pondos, and a dozen

other South African tribes go as high as 1,000,000; and that Leigh Hunt never could learn the multiplication table, one must confess that this law occasionally presents to our consideration remarkable exceptions.

While considering the extent of the savage's arithmetical knowledge, of his ability to count and to grasp the meaning of number, it may not be amiss to ask ourselves the question, what is the extent of the development of our own number sense? To what limit can we absorb the idea of number, with a complete appreciation of the idea of the number of units involved in any written or spoken quantity? Our perfect system of numeration enables us to express without difficulty any desired number, no matter how great or how small it be. But how much of actually clear comprehension does the number thus expressed convey to the mind? We say that one place is 100 miles from another; that A paid B 1000 dollars for a certain piece of property; that a given city contains 10,000 inhabitants; that 100,000 bushels of wheat were shipped from Duluth or Odessa on such a day; that 1,000,000 feet of lumber were destroyed by the fire of yesterday, and as we pass from the smallest to the largest of the numbers thus instanced, and from the largest on to those still larger, we repeat the question just asked; and we repeat it with a new sense of our own mental limitation. The number 100 unquestionably stands for a distinct conception. Perhaps the same may be said for 1000, though this could not be postulated with equal certainty. But what of 10,000? If that number of persons were gathered together into a single hall or amphitheatre, could an estimate be made by the average onlooker which would approximate with any degree of accuracy the size of the assembly? Or if an observer were stationed at a certain point, and 10,000 persons were to pass him in single file without his counting them as they passed, what sort of an estimate would he make of their number? The truth seems to be that our mental conception of number is much more limited than is commonly thought, and that we unconsciously adopt some new unit as a standard of comparison when we wish to render intelligible to our minds any number of considerable magnitude. For example, we say that A has a fortune of $1,000,000. The impression is at once conveyed of a considerable degree of wealth, but it is rather from the fact that that fortune represents an annual

income of $40,000 than, from the actual magnitude of the fortune itself. The number 1,000,000 is, in itself, so greatly in excess of anything that enters into our daily experience that we have but a vague conception of it, except as something very great. We are not, after all, so very much better off than the child who, with his arms about his mother's neck, informs her with perfect gravity and sincerity that he "loves her a million bushels." His idea is merely of some very great amount, and our own is often but little clearer when we use the expressions which are so easily represented by a few digits. Among the uneducated portions of civilized communities the limit of clear comprehension of number is not only relatively, but absolutely, very low. Travellers in Russia have informed the writer that the peasants of that country have no distinct idea of a number consisting of but a few hundred even. There is no reason to doubt this testimony. The entire life of a peasant might be passed without his ever having occasion to use a number as great as 500, and as a result he might have respecting that number an idea less distinct than a trained mathematician would have of the distance from the earth to the sun. De Quincey incidentally mentions this characteristic in narrating a conversation which occurred while he was at Carnarvon, a little town in Wales. "It was on this occasion," he says, "that I learned how vague are the ideas of number in unpractised minds. 'What number of people do you think,' I said to an elderly person, 'will be assembled this day at Carnarvon?' 'What number?' rejoined the person addressed; 'what number? Well, really, now, I should reckon perhaps a matter of four million.' Four millions of *extra* people in little Carnarvon, that could barely find accommodation (I should calculate) for an extra four hundred!" So the Eskimo and the South American Indian are, after all, not so very far behind the "elderly person" of Carnarvon, in the distinct perception of a number which familiarity renders to us absurdly small.