

# Prehistories of Counting

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Submitted 8 June, 2009

## 1 Introduction

Counting is easily taken for granted. Its rudiments are handily mastered by small children, and before long most of us can count higher than we'll ever need in work or recreation. It rests at the heart of everyday reckoning and abstract mathematics. It is intuitive, systematic, and simple. Counting is such a familiar and ubiquitous activity in most people's lives that it is hard to imagine a world without it.

Yet that is just what the authors considered here attempted. While the question of counting's origins is at least as old as Aristotle, it attained a new prominence and urgency between 1853 and 1896. The period began with the publication of one of the most influential passages on the origins of counting ever written. Spanning a mere three pages of gentleman explorer Francis Galton's *Narrative of an Explorer in Tropical South Africa* and describing a series of transactions with a native tribe, the passage seems at first glance to have nothing to do with the topic.<sup>1</sup>

The ensuing decades saw one appropriation of Galton's story after another in debates over the antiquity of man and the course and meaning of his evolution. Gradually, Galton's words morphed from an example of the low intelligence of a particularly unfavourable tribe to striking evidence about the numeracy of man's earliest ancestors. They were taken as amusing anecdote and serious fact, quoted at length and referred to without attribution. In many ways, the history of the prehistory of counting after Galton is a story about the different uses and abuses of his short narrative.

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<sup>1</sup>Galton's travels took place long before his more famous work on eugenics and heredity.

Galton figures particularly strongly in the period considered here, which ends with Levi Leonard Conant's *Number Concept* (1896).<sup>2</sup> This is due, in part, to the nature of the evidence available to our authors. The turn of the twentieth century witnessed a synthesis in child psychology and the theory of education, leading to new cognitive theories for the origin of counting. The inter-war period brought the first major archaeological discoveries of primeval counting's material artefacts. The most famous of these was Karl Absolon's 1937 'exceedingly valuable find' of a wolf bone 'engraved with fifty-five deeply inscribed notches... in groups of five' in the 'Moravian Diluvial metropolis' of Vestonice, Czechoslovakia (Absolon, 552). Before these two watersheds, would-be prehistorians of counting had to draw primarily from linguistic and anthropological sources.

The second half of the nineteenth century marked the meteoric rise of two distinct but related areas of study. The first, fueled by the narratives of missionaries, explorers, and colonial officers, was developmental anthropology.<sup>3</sup> A new generation of anthropologists drew from a Prichardian 'armchair' comparative ethnography centred on collecting and scrupulously comparing accounts from sources scattered across the globe. Their work coincided with a rapidly growing colonial interest in Africa and East Asia which both was made possible by and facilitated the explorations of those like Galton (Stocking, 79–81).

Increased colonial exploration and settlement necessitated increased attention to the diversity of number systems and practices throughout the world. Explorers needed such information for trade and navigation from their native informants. Colonial administrators needed native numbers for trade as well, but also for taxation, the organisation of labour, and census-taking.<sup>4</sup> In the colonial context, reports sent to the centre from the periphery were distinguished by their active, deliberate, and persistent attention to the

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<sup>2</sup>Galton's influence was especially strong in the anglophone world, to which we restrict our attention in this paper. Whilst anthropology and linguistics in this context were greatly affected by work elsewhere in Europe, especially in French and German, the most important texts cited by British and American authors on the origins of counting were, for the most part, either composed in English or available in translation.

<sup>3</sup>On missionaries' contribution to anthropology, see Porter, 241. On that of British cultural colonialism, see MacKenzie, 283–286. For geographic exploration, see Stafford, 299–302, 310–316. On the relation of race and governance to colonial ethnology see also Prakash, 22–23, 26–30, and Bayly, 465.

<sup>4</sup>On numbers in colonial administration in Africa, see Zaslavsky, 9.

ethnographic features of the tribes and cultures the explorers and administrators encountered.<sup>5</sup> Those back home, on the other hand, started to apply the new wealth of detailed information to foundational developmental problems surrounding the origins of man and civilisation.

The second area of study to rise to prominence in this period was comparative philology. Exemplified and driven by the linguistic researches of the likes of Wilhelm and Alexander von Humboldt and Max Müller, linguistic scholars probed new depths of etymology and structural interrelation amongst a vastly wider array of languages than had ever before been considered. Such studies encompassed works both old and new, including the dictionaries, vocabularies, and guides rapidly being compiled by colonial administrators, missionaries, and scientific explorers. Often, the study of developmental anthropology and the development of languages could be found in the same work. E. B. Tylor, for instance, was strongly influenced by both traditions, and his writing exemplifies this intermixing (Leopold; Stocking, 157–158).

Developmental anthropologists and comparative philologists had the means to probe counting's distant origins, but what of their motivations? The growing body of evidence might have been destined for an entirely different use had the late 1850s not witnessed two great changes to the scientific status of mankind. First came a new scholarly consensus regarding man's antiquity, emblematised by Sir Charles Lyell's 1859 address to the British Association for the Advancement of Science, and almost instantaneously expanding the scope of human history from under six thousand years to tens or even hundreds of thousands. In that address, Lyell alluded to the second change by heralding a book to be released two months later: Charles Darwin's *The Origin of Species* (Lyell, 1860, 95).

Suddenly scholars were faced with a long human history spanning geological, not Biblical, time. As Alfred Russel Wallace (1876, 409) retrospectively put it: 'the question of the mere "Antiquity of Man" almost sank into insignificance at a very early period of the inquiry, in comparison with the far more momentous and more exciting problem of the development of man from some lower animal form, which the theories of Mr. Darwin and of Mr. Her-

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<sup>5</sup>On the importance of racial considerations to the Imperial project, see Hawkins, 203–206.

bert Spencer soon showed to be inseparably bound up with it.’ A burgeoning science of race joined with an evolutionary interest in man’s descent to foreground fundamental inquiries after the growth and character of civilisation.<sup>6</sup> There was one new body of evidence perfectly suited to all these questions. It concerned *savage numeration*.

Savage numeration refers to the numerical and counting practices of peoples viewed by their European investigators as civilisationally inferior. Little by little, accounts like Galton’s were seen to be about far more than the context-bound practices of isolated peoples. Studies of individual primitive number practices from recent history were reinterpreted as case studies for the prehistoric condition of every race. Savage numeration became a window into prehistory. It enabled both anthropology and philology to draw from living cultures, texts, and languages to infer about the contours of the long lost past.

The anthropologist Edward Burnet Tylor uses a striking analogy for this historiographical problem. Number words, he explains in his 1871 *Primitive Cultures*, come to us ‘rolled and battered like pebbles by the stream of time’ (271). For Tylor, languages and cultures change over time. But they do not just add words and structures, becoming more complex. They are also worn away like pebbles in a stream. Their process of development involves both accretion and smoothing, and the rough edges of crude early forms are lost.

These scholars, therefore, wrote in a fundamentally *reconstructive* tradition. Their researches sought and clung to the *traces* of early man, wherever they could find them—traces like the ones they found in Galton’s story. Starting with smooth pebbles, they searched for the marks and scars which would indicate the rough stones from whence they came.

This essay examines what we can learn from the particular marks and scars they found important, as well as the particular means by which they reconstructed their rough stones of early language and culture. Through the changing contours of their work, we trace a developing notion of prehistory which came to annex and shape a wide body of ideas and people.

Galton’s reception came in five sometimes-overlapping phases. In the first, his story was linked to man’s antiquity. The second brought the distant savages of the first into a continuous developmental history of civilisation.

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<sup>6</sup>On the interaction between racial and evolutionary theory, see Stepan, 47–82.

Alongside the phase tying Galton's narrative to man's descent was a third body of work synthetically anthologising stories, like Galton's, of primitive cultures. A fourth phase involved the separation of counting itself from the ability to count, joining civilisation to biology. Finally, Galton's story found voice in considerations about numbers themselves, and not just their users.

In each phase, the very subject of Galton's account changes: from primeval man to the ancestors of modern man to case studies in cognition, culture, and number. In each phase, Galton's story was a trace of something different. As a mark of counting's origin, each view of Galton's tale works to reconstruct a different stone in a different configuration. Galton's reception, then, shows how a story's meaning is as much directed by its ends as by its means.

## **Methodological Considerations**

### **Counting**

Our focus, shared by most of our authors, is on counting and cardinal numbers. None of these authors wrote exclusively about the origins of counting. They paired the subject with discussions about the development of ordinals, number symbols, and arithmetic, or placed it amidst larger linguistic or anthropological considerations. Part of our story concerns the sheer variety of contexts to which the prehistory of counting pertained.

Moreover, what counts as counting shifts subtly across authors and works. The very notions of number and counting were often negotiated in and between the lines of these texts. Our authors sometimes disagree on what activities entail counting, how to characterize counting as an ability, and how to interpret the number words and practices of their subjects. We shall keep as close as possible to counting as it is understood by each author.

We avoid where possible, however, the ancillary considerations these authors associated with counting's prehistory. Nor will we advance our own story of counting's origins, nor assess the plausibility of the ones here considered.

### **Savages and Subalterns**

Accounts of so-called savage cultures and their numeration play a central part in our story, whether or not these accounts corresponded, as often they

did not, to the practices or understandings of their subjects. As Edward Said (1978) argues, the savage other frequently serves as a canvas for the thoughts, prejudices, and anxieties of those who would describe him. We read these accounts of savage numeration not to learn of the savages, for these were as much figments of colonial imagination as real thinking, feeling people, but as a window into the views of those writing the accounts and into their respective societies. There is an important place for accounts seeking to recover and better understand the knowledge and customs of once or still marginalised peoples, but this is not such an account.

In that spirit, with our attention turned to the writers rather than the subjects of these stories, we attempt to stay close to the categories and terms with which those stories were elucidated. This is manifested mundanely in the sometimes widely differing spellings or common names for the same groups of people adopted by different writers, and which we have preserved where possible. More perniciously, we must bracket and leave aside the problematic categorisations and visions which made and enforced these assignments.

One will also notice a lack of women, both among the voices in the debate and in the subjects in the debaters' imaginations. Although women were sometimes contributors to geographical and ethnographic discussions in learned societies at the time, they did not participate visibly in discussions over the prehistory of counting until the turn of the twentieth century, when professional educators such as Susan Cunnington (1904) began to take the subject's mantle. It was another woman, Claudia Zaslavsky (1973), who produced the best-known critical historiography of numeracy, in her case on African mathematics, including an attempt to recover the actual counting practices of those stories' subjects. Women also appear from time to time in ethnographic accounts, including some later used with respect to counting's prehistory. In the period considered, however, the presumed abstract intellectual status of numbers gave discussants little reason to infuse gender into their observations. Where linguistic data came from colonial exchanges, numerical information almost invariably came from male informants. The result was a story very much about primeval *man* and *his* counting.

## Prehistory

Prehistory is conventionally taken to mean a time without written records (cf. Gosden). The term was coined in this sense in 1862 by Daniel Wilson and institutionalized with the help of John Lubbock's 1865 *Prehistoric Times* (Tylor, 1876). Particularly where the prehistory of counting was concerned, however, the term took on a range of meanings scarcely confined to the usual definition. Differing conceptions of the scale of time and civilisation produced starkly different senses of prehistory.

Conant (1896) exemplifies one extreme in meaning. For him, early man is as much a heuristic device as an actual person. Conant's first counters, reconstructed from their present-day counterparts, belong to no time or place in particular, but rather to a stage in the growth and progress of the number concept. One can hardly call his writing 'history' as it is usually meant, nor does 'prehistory' seem quite appropriate. He is writing what he understands to be a prehistory, and, indeed, it is an account of human progress set before the advent of writing. But it is less an account of a particular epoch than of certain abstract principles of progress and form in mathematics.

Our nineteenth-century anthropological writers also infused their accounts with many of the heuristic overtones of Conant's. But their prehistories, standing outside of particular moments in time or space, were nonetheless rooted in definite stages of human development. Stages were both abstract *and* believed to reflect actual tranches of civilisational time. Primitive savages lived, for them, in both the present and the past. They were traces and embodiments, models and exemplars, of early man, and often many of these things at once.

Moreover, prehistory and history often blurred in the abstractive process. Evidence in these accounts was rarely limited to a particular region, population, or period. The shape of Roman numerals (history) stood alongside observations of hand counting (history?) which stood alongside philological interpolations (prehistory?) and claims about the earliest men (prehistory). Historical written records tell our authors a great deal about life before the advent of writing. Philosophy and ethnography say still more. Even where authors explicitly aimed to write prehistories, one senses that prehistory itself was not what they were after.

We think it better, then, to use 'history' and 'prehistory' in an etymolog-

ically justifiable but perhaps unnatural sense. By ‘history’, we mean a *story* about the past. By ‘prehistory’, we indicate that such a story is meant to describe the distant past, where the distance can be temporal, civilisational, or otherwise. In both cases, the past does not necessarily represent a location on the scale of time. As our authors negotiated the dawn of counting, the antiquity of man, the growth of civilisation, and the development of number, they also negotiated the meaning of history, the past, the present, and often the future. This essay joins them in a suspension, sometimes wilful and sometimes not, of these fraught and complex concepts.

## 2 Early Works

This section gathers those works from before 1853 considered most relevant by Galton’s successors. They offer some intellectual context for future arguments, and we shall see in later sections how their claims were given widely varying meanings by subsequent authors.

Cunnington (1904) offers a comprehensive Classical catalogue including Ovid, Pliny, Seneca, Æschylus, and Homer (7, 218). In most cases the origin of counting is a consideration incidental to or inferred from her excerpts. The exception is from book fifteen of Aristotle’s *Problems*, which explicitly speculates on the possible reasons for the prevalence of base ten numeration (see Heath, 258–260).

The first modern text to receive significant attention is Flacourt’s 1658 chronicle of his journey to Madagascar. His twenty-eighth chapter includes a page on the numbers of the local people (88, quotations are my translation). ‘The original inhabitants of Madagascar,’ he begins, ‘count just as the Nations of Europe.’ He then describes their number system and gives some number words. Observing that ‘some authors... have written that they [the inhabitants] do not know how to count up to ten,’ Flacourt explains that while some, indeed, do not count, one can no more infer that the natives of Madagascar do not count than one can draw the same conclusion of the French by looking at its peasants, many of whom ‘surpass the Madecasses in rudeness and ignorance.’ Flacourt concludes by describing a system of counting soldiers in which the soldiers pass through a gate and their captains drop stones as each one passes. He explains that the stones are then



counted conventionally in groups of ten, ‘until they know in the end their number, such as we count money on a table.’

A century later, in 1758, Montucla published his sprawling *Histoire des Mathematiques*. Observing that arithmetic precedes all other mathematics and that the first societies had little need of counting, he attempts an account of its origins. Montucla agrees with Aristotle’s final explanation for the near-universal prevalence of the decimal system: ‘It is that all men, in the infancy of their reason, had started to count on their fingers’ (48, my translation). Although ‘any other progression’ could replace the decimal system, he explains that the vigesimal (base twenty) system involves too many different characters, whereas the binary (base two) system requires too many repeated characters.

Austrian Jesuit Martin Dobrizhoffer’s ethnographical account of his eighteen years as a missionary in Paraguay among the Abipones and Guaranies was first published in Latin and German in 1784 and translated into English in 1822 (quotations are from the anonymous English translation). Discussing the Abipone language, he writes that ‘Most of the American nations are extremely deficient in words to express number. The Abipones can only express three numbers in proper words’ (II:168–9). After transcribing their first three numbers, he explains that the other numbers are rendered ‘by various arts,’ as by reference to the fingers of an emu or a five-coloured skin, or by use of fingers and toes, repeatedly shown if necessary (II:169). Dobrizhoffer also describes spatial reckoning of quantity, such as estimating how much of the marketplace a row of horses would fill (II:169–170). Handfuls of sand or grass indicate particularly immense quantities (II:170). ‘But,’ cautions Dobrizhoffer, ‘when number is spoken of, take care you do not readily credit whatever the Abipones say,’ for they are averse to arithmetic and often show any number of fingers or respond ‘many’ or ‘innumerable’ to avoid a computation (II:170). Dobrizhoffer describes their limited ordinals and distributive numerals, and also gives number words of the Guarany, ‘who cannot go beyond the number four’ (II:170–1). Finally, he notes that ‘as a knowledge of numbers is highly necessary in the uses of civilized life, and above all, in confession, the Guaranies were daily taught at church to count in the Spanish language’ (II:171–2).

Dobrizhoffer’s work was followed by two highly influential travel nar-

ratives. Alexander von Humboldt's 1814 analysis of his findings from the Americas supplies a table of number words and a speculation that the 'symbolical writing of the Mexican nations,' based on powers of twenty, 'recalls to mind that of the fingers and toes of the hands and the feet' (307). An 1832 summary of Humboldt's travels by MacGillivray includes a further observation on counting among the Chayma, who do not surpass six in their own tongue and struggle to reach fifty in Spanish (118). Spix and Martius's account of their travels in Brazil from 1817 to 1820 contains just two sentences on native counting, which does not reach beyond three (II:255).

The introduction from Wilhelm von Humboldt's *Über die Kawi-Sprache auf der Insel Java*, posthumously published in 1836, situates number in the theory of linguistics in its final two pages, on the evolution of polysyllabic structures. He describes the combination of numbers with concrete objects and concludes that, originally, numerical words 'are all of them substantives' (Humboldt, 1988, 286–7).

English mathematician Augustus De Morgan explained counting's origins in two arithmetical texts. His *Elements of Arithmetic* (1830) argues that 'a savage could reckon every thing which is necessary for him' by comparing things side-by-side and collecting pebbles corresponding in number to that which he wishes to count. Some present-day savages, he notes, continue to practice 'Something of this sort' (2). Each collection of pebbles would then be named, and the savage's fingers would allow him to reckon with small numbers and supply names for numbers from one to ten. 'As his wants increased,' the savage would create new numbers from old ones (3), and a list of English number words illustrates this principle. De Morgan acknowledges that his history is rather heuristic, but explains that 'I have used the foregoing explanation because it is very probable that our system of numeration, and almost every other which is used in the world, began from the practice of reckoning on the fingers, which children usually follow when first they begin to count' (6).

De Morgan's second arithmetic (1836) considers the subject's derivation in chapter two. There, it is argued that arithmetic's first ideas come from observation (4). The reader is invited to imagine the formation of his number system through a story involving finger counting, followed by an explanation and discussion of place notation and a comparison of notation in bases nine

and ten (5–6).

Finally, John Stuart Mill discusses numbers within the inductive foundations of mathematics in his 1843 *System of Logic* (139–45). Like De Morgan, Mill asserts that the science of number is induced from observations of physical fact, and ‘Each of the numbers. . . denotes physical phenomena, and connotes a physical property of those phenomena’ (140–141). This is because different numbers of apples or horses are physically distinguishable from each other, though in practice this distinction may be difficult. Number names signify the aggregation of objects (142), and ‘All numbers must be numbers of something: there are no such things as numbers in the abstract’ (283). Creating sums, e.g. of pebbles, ‘is a truth known to us by early and constant experience: an inductive truth; and such truths are the foundation of Number’ (285–286).

Broadly speaking, then, there were two types of counting stories in circulation by 1853. Philosophical works like Montucla’s history, Wilhelm von Humboldt’s linguistics, De Morgan’s arithmetics, or Mill’s logic drew from hypothetical cases and generalisations to speculate on counting’s origins. Ethnographical works like Flacourt’s, Dobrizhoffer’s, and Alexander von Humboldt’s travel narratives, on the other hand, centred on descriptions of numeration in their everyday context whilst only sometimes venturing an isolated speculation about counting in general. Galton wrote in this latter genre. It was not until the 1860s that these two genres were combined in a new generation of anthropological theorization.

### 3 Galton and the Damara

In 1850, Francis Galton set out ‘to fill up that blank in our maps which, lying between the Cape Colony and the western Portuguese settlements, extends to the interior as far as the newly discovered Lake ‘Ngami’ (iii), in present-day Botswana and Namibia. Financially independent after inheriting his father’s wealth, Galton had travelled in the Middle East and lived as a country gentleman in England. His course in Africa brought him into a region just breached the year before by legendary explorer David Livingstone. There, he encountered the ugly but moral Ovampo and the beautiful but lowly Damara (Stocking, 92–93).

Galton's 1853 narrative embraces a curious brand of comprehensivity, shaped by the lens of a European explorer. He records among the Damara, for instance, 'no word at all for gratitude; but on looking hastily over my dictionary I find fifteen that express different forms of villainous deceit' (194). He characterizes Damara numeracy in a three-page section near the middle of the work.

Numbers, for Galton, arise in trade and navigation. Part and parcel with Damara numeracy is their poor notion of time and distance, rendering the advice of their guides 'most provokingly indistinct' (132). On a page headed 'Damara Obtuseness' (133), he explains that, whatever they may actually possess, the Damara use no numeral greater than three in practice. Crucially, Galton is not interested in any general capacity for counting among the Damara, only in their practical use of abstract numbers. In fact, Galton recognizes several number-related or number-replacing activities, including finger reckoning and managing herds of oxen by recognizing faces.

Next, Galton recounts his difficulties in trading sticks of tobacco for sheep, where 'each sheep must be paid for separately' with two sticks of tobacco. He once handed a tribesman four sticks of tobacco and took two sheep. The tribesman first took two of the sticks and matched them to the first sheep, and then was surprised to find that there were exactly two sticks of tobacco remaining. Suspecting he had been tricked, the tribesman aborted the trade and Galton had to start over, returning to two-for-one transactions.

On the next page, headed 'Inability to Count', Galton explains that 'When a Damara's mind is bent upon number it is too much occupied to dwell upon quantity' (134). By way of illustration, he describes bartering ten sticks of tobacco for a heifer. Ordinarily, one places one stick of tobacco on each of the tribesman's ten fingers in order to transact the trade. Galton found that if, instead, he placed only a half stick of tobacco on each finger, the tribesman was 'equally satisfied at the time, but occasionally finds it out and complains the next day.' Because his Damara counterpart does not complain of being cheated on the day of the encounter, Galton infers that the tribesman's mind is so simple as to forbid simultaneous reckoning of quantity and number. Numerical reckoning, for Galton, thus involves far more than the mere ability to use, communicate, or gather numerical information: here, it also involves immediately contesting foul trades.

In the third part of Galton's passage, he notes that his 'faithful cur, Dinah' seemed distressed after being reunited with her recent litter of puppies. He speculates that 'She evidently had a vague notion of counting, but the figure was too large for her brain,' and muses that his beloved dog compares quite well with the Damara tribesman standing to the other side of him when it comes to counting ability: 'Taking the two as they stood, dog and Damara, the comparison reflected no great honour on the man.' Crucially, Dinah's difficulty was in counting, not in recognizing the faces of her young. Recognizing animal faces, after all, is something Galton already acknowledges to be routine for the Damara.

He finishes the section as he started it, lamenting his difficulty in obtaining reliable information about time and distances. It came down to Damara impertinence: 'lastly, as truth telling was the exception and not the rule, I found their information to be of little practical use' (134–5).

Galton's assessment is not surprising. The Damara could not have been expert counters. They were a brutish and deceitful people, and their innumeracy was an inevitable correlate to their decrepit condition. It mattered little which of a number of possible amusing anecdotes he used to impress his captivated readers of this foregone fact.

Indeed, later writers turned to Galton's anecdote as much for entertainment as for evidence. It was 'an amusing account of the Damaras' in Wilson's in his 1862 *Prehistoric Man* (469). In 1865, Lubbock called Galton's story 'so admirable and at the same time so amusing' that he 'cannot resist quoting it in full' (293). Wood's 1868 *Natural History of Man* explains that 'Mr. Galton gives a very amusing description of a Damara in difficulties with a question of simple arithmetic' before also quoting the entire section (344–345). Where Galton's writing is not outrightly called amusing, one invariably senses a certain smugness in its presentation.

It is tempting to dismiss Galton's writing as a curious artefact of its historical environs. But we are still left to account for the remarkable staying power of his tale. Part of its success surely derives from its narrative intimacy. The same features that made Galton's story amusing also made it credible and accessible. His tale lasted in large part because it offered a memorable picture of how counting (or the lack thereof) appeared in primitive practice.

Here was an earnest explorer who tried his best to patch the gaping

holes in the map of Africa, coming face-to-face with the consequences of relying on constitutionally innumerate informants. Galton's travel narrative added an anecdotal stratum to accounts of savage numeration based primarily on number-words. Indeed, his tale is completely devoid of number words and relatively free of native terms altogether, aside from place and personal names. Convincingly dramatising the limited number sense of a primitive people, his anecdotal account was accessible to the masses and meaningful to specialists. Importantly, it could be readily appropriated by later authors seeking to write accessible works of their own.

## 4 Counting in Antiquity

Stories like Galton's formed the core of a new literature on the prehistory of counting in the 1860s. Yet whatever its message about savage numeration, Galton's account is not about the origins of counting. The question would not have even occurred to Galton, who wrote his narrative well before the decade's-end consensus on man's antiquity. In order to trace the formation of this new prehistorical literature, we shall have to trace how accounts such as Galton's came to be seen as evidence regarding the earliest forms of numeration.

The transition was not a sudden one. Already in 1860, at which date Daniel Wilson, a professor at University College in Toronto, completed the manuscript for his 1862 *Prehistoric Man*, Galton's account of Damara innumeracy played a role in dating the advent of man (469). Wilson drew two images to face the respective title pages of the work's two volumes. The first is of a 'Chimpseyan Chief' gazing knowingly at the reader.<sup>7</sup> The second is of 'Caw-We-Litcks. A Flathead Woman and Child,' simultaneously exotic and domestic. The child from this second image was engraved on the front covers of the publisher's binding for both volumes.

How is it that prehistoric man should be represented by a present-day flathead infant? Wilson explains that he studied the Indians of North America because 'man is still seen there in a condition which seems to reproduce some of the most familiar phases ascribed to the infancy of the unhistoric world' (xi). The North American Indian is, for him, 'can be shown to have

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<sup>7</sup>On the American noble savage in ethnography, see Kuklick, 1–4.

attained maturity, exposed only to such influences as are the offspring of his own progress' (ix). Here is an attempt to study traces in the least battered of pebbles. 'Here then appears to be a point from whence it seems possible to obtain,' writes Wilson, 'a parallax of man, already viewed in Europe's prehistoric dawn; to look on him as on the stars seen from Teneriffe above the clouds; and to test anew what essentially pertains to him, and what has been artificially, or even accidentally superadded by external circumstances' (xii). Wilson's reference to cutting-edge astronomy<sup>8</sup> is joined by an analogy between the ethnographer and naturalist, along with general allusions to modern science (vii–viii).

Numerals join prehistory in Wilson's final chapter, on 'Guesses at the age of man' (455). 'The idea of number,' explains Wilson, 'is one of the earliest presented to the human mind, and may indeed be regarded as coexistent with the intelligent exercise of the human faculties.' Thus, 'The appreciation of numbers is accordingly frequently made a test of intellectual development' (469). Galton's claim that the Damara do not count past three is followed by an observation about the persistence of dual forms in some languages. The juxtaposition places savage numeration alongside linguistic traces as evidence of the prehistoric past. Though they have no more need for arithmetic than the Damaras, American languages have 'a complete decimal vocabulary of numerals.' The American Indian's conception of number, however, is wholly without abstraction. Thus five dogs and five fingers are not seen to have some number 'five' in common (470). This, he compares with Indo-European languages, noting the 'primitive repetition of units which betrays itself as the natural form of numeration' (471).

Early in 1862, John Crawfurd, the influential President and Chair of the Ethnological Society of London, presented a paper 'On the Numerals as Evidence of the Progress of Civilisation.' Crawfurd's *tour de force* synthesizes linguistic and social data from across the globe, including number words from some thirty Australian and more than seventy African languages. He draws from established debates over the scale of civilisation, the development of languages, and the differences between the races, and applies to them both old and new data on the relevant contours of savage numeration.

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<sup>8</sup>Edinburgh astronomer Charles Piazzi Smyth's high altitude astronomy experiments at Tenerife were than less than four years old. Brück.

Crawfurd was a civil servant in several South and East Asian outposts of the British Empire, publishing works on the peoples, customs, and histories of these regions both before and after his 1828 retirement (Turnbull). His ethnological writings were influenced by ongoing interests and advocacies in colonial commerce and politics. Writing in the context of man's new antiquity, Crawfurd did not hesitate to pronounce that 'the numerals must be considered as evidence of the unfathomable depth of the antiquity of man' (*op. cit.*, 102).

The link in Crawfurd's essay between savage numeration and the first counters is, however, more circumstantial than direct. The essay establishes a scale of civilisational development indexed by varying degrees of numeracy. Though savages rest at the same point on the civilisational scale as the distant ancestors of their European counterparts, their widely varying counting practices do not themselves serve as evidence of the earliest states of counting. Thus, 'all rude people' have numbers in 'a mere embryo state' (84), but this germ need not be the same as that for more advanced civilisations. Crawfurd uses 'Mr. Galton's graphic account' to place the Damara on par with the Australians in 'their numeral ignorance' (88).

Eminent geologist Charles Lyell published his own contribution on *The Geological Evidences of the Antiquity of Man* in 1863. Both the races of man and their languages are important for Lyell, particularly when addressing man's development (cf 380, 387–391, 464–465). While Lyell does not address counting directly, an anecdote and a long counterfactual passage place numbers and arithmetic among the highest indices of intellectual achievement (378–379). Published in the same year, Thomas Henry Huxley's *Evidence as to Man's Place in Nature* is more concerned with physiological continuities between man and animals. Nonetheless, Huxley makes room for the importance of a socially inherited intellectual development (cf. 102n).

Crawfurd reviewed both books together for the Ethnological Society that April. That two books which so differed on the matter of evolution were discussed non-contrastively in the same breath shows the latent role of evolutionary theory at this stage in debates over the growth of civilisation (see Stepan, 51, 70, 78). On Lyell's question of the duration of languages, Crawfurd observes that 'There has existed no cause for change in the languages of the savages of Australia,' who are at the bottom of Crawfurd's earlier numero-



civilisational scale. ‘There is no reason,’ he writes, ‘why the language of a people in so stationary a condition may not have remained essentially unchanged for thousands of years’ (65). Culturally static present-day savages, in this view, began to offer an increasingly clear and unproblematic view of the far distant past.<sup>9</sup>

The first to explicitly theorise savage culture as evidence for prehistory was John Lubbock, in his 1865 *Prehistoric Times*. Lubbock was a wealthy banker and politician and was informally tutored in natural history by Charles Darwin, a good friend of Lubbock’s father (Alborn; Stocking, 150–151). Darwin both greatly influenced and frequently cited Lubbock’s work. Lyell’s geology also served as an explicit model for Lubbock’s researches into the natural history of man.

Lubbock’s aims were, methodologically, ‘to elucidate... the principles of pre-historic archaeology’ and, programmatically, to explore its implications for ‘the condition of man in primeval times’ (vi). The first two-thirds of the text consider archaeological evidence relating to the antiquity of man, and are derived from a series of lectures and essays from 1861–1864. Adapting his essays for the book, Lubbock added a section on ‘the Manners and Customs of Modern Savages, confining myself to those tribes which are still, or were, when first visited by travellers, ignorant of the use of metal’ (viii). In Lubbock’s view, the science of ethnology was undergoing ‘a phase from which other Sciences have safely emerged’ (ix). Like astronomy and geology before it, ethnology would soon excite little of the ‘distrust and apprehension’ which then greeted its conclusions and claims to scientificity (ix).

Geology and its leading exponents figure prominently in Lubbock’s bid to legitimise the search ‘for the earliest traces of the human race,’ a project Lubbock ties to both Darwin and Lyell (334). His first chapter on modern savages begins by describing the sparse and spotty nature of the historical record regarding ‘the early condition of man’ (335). He attributes this to the relatively late advent of writing and the general unreliability of oral tradition, which he illustrates with a few examples. Thus, ‘the archaeologist can only follow the methods which have been so successfully pursued in geology’ (336). Firstly, this meant studying material traces of past cultures: ‘the rude bone-

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<sup>9</sup>Related views of racial stasis would become an important point of compromise between monogenists and polygenists over the next decade. Stepan, 85.

and stone-implements of bygone ages' as well as 'remains of extinct animals.' But 'The analogy may be pursued even further than this.' Just as living pachyderms or marsupials in, respectively, Asia and Africa or Australia and South America help us to understand their extinct cousins, so too are 'the antiquities of Europe' illuminated by comparison 'with the rude implements and weapons still. . . used by savage races in other parts of the world.'<sup>10</sup> Put directly: 'the Van Diemaner and South American are to the antiquary, what the opossum and the sloth are to the geologist' (336).<sup>11</sup>

Lubbock's work on modern savages consists of two chapters of descriptions of different savage cultures, followed by a chapter of synthetic analysis. He repeatedly turns to a limited collection of canonical accounts, including Galton's and Crawford's. Discussions of savage numeration are sparse in the tribe-by-tribe chapters. Crawford's 1863 survey of Australian languages joins the end of a short wordlist from colonial medical officer Scott Nind's 1831 report to the Royal Geographical Society to characterize numeracy in Australian languages. Crawford and Nind's Australians count as high as, respectively, four or five. Even these limited achievements are qualified, for the highest numeral 'turns out to be only the word for "many" ' (354).<sup>12</sup> Lubbock cites Arctic explorers William Parry and John Rae to establish the weak arithmetical capacity of the Esquimaux. They are said to struggle to reach ten, often finding fifteen impossible, and have difficulties enumerating their children, 'even though they may not have more than four or five' (410).

The synthetic final chapter places his account of numeracy, labeled 'Deficiencies in Numeration,' between the 'Intellectual Inferiority of Savages' and their 'Absence of Religion' (466–468). The juxtaposition is no coincidence. On the one hand, 'The names for numbers are, . . . among the lower races, the best, or at least the most easily applicable test of mental condition' (466). Lubbock's pronouncement directly follows the conclusion from Crawford's

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<sup>10</sup>Both Lubbock's animal and savage specimens are placed outside of Europe. His marsupials miraculously share continents with the most primitive of his present-day counters.

<sup>11</sup>In 1881, Lubbock's presidential address to the British Association elaborated: 'On all of these the comparison of the various lower races still inhabiting so large a portion of the earth's surface has thrown much light; while even in the most cultivated nations we find survivals, curious fancies, and lingering ideas; the fossil remains as it were of former customs and religions embedded in our modern civilisation, like the relics of extinct animals in the crust of the earth.' 406.

<sup>12</sup>In Nind's list (50), the word for 'five' is one of two words given for 'many'.

paper, also cited in this section. To his prior claims about the Esquimaux and Australians, Lubbock adds an extended quote from Galton's work indicating that practical counting among the Dammaras is limited to four or five (467). Spix and Martius are enlisted for their observation about Brazilian Indians counting only to three. After that, Lubbock returns to Australia for a list of number words from one to six involving repetitions of the words for one and two—evidence that they 'can hardly be said to go beyond two' (367).

Lack of religion is introduced as 'another proof of extreme mental inferiority' (467). A clear line of difficulty in the face of abstraction runs through the three consecutive sections. To start, modern savages have limited vocabularies for simple abstract adjectives and concepts. A void in abstract numbers follows. Finally, an inability to conceive of any deity, much less the Christian God, rounds out the savage failures in abstraction. Modern savages are thus inextricably bound to the earth beneath their feet, their immediate surroundings, and their simple concrete ideas.

The values of abstract counting thereby reinforce 'The great principle of natural selection, which . . . in man affects the mind and has little influence on the body' (491). Savages are bound to their bodies, but true moderns are not. Lubbock can dream of a day when 'our descendants will understand many things which are hidden from us now' and 'avoid much of that suffering to which we are subject' only because he can contrast himself to the witless, godless, innumerate savages who stand in for his own racial past (492). A progressive narrative of counting-as-abstraction suggests such a story and makes it plausible. Lubbock dreams of a great future because he can posit, with the help of the present, a deplorable past.

Lubbock again considered the place of number in man's prehistory in an essay on 'The Early Condition of Man' read before the British Association for the Advancement of Science in 1867. Arguing against Archbishop Whately's degenerationist account, he explains that 'I feel great difficulty in supposing that any race which had learnt to count up to ten, would ever unlearn a piece of knowledge so easy and yet so useful' (8). A variety of examples confirms the persistence of savages who cannot count to ten and illustrates the digital<sup>13</sup> derivation of numbers among others. Contrary to Crawford's Australians,

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<sup>13</sup>*Digital* refers here to the fingers.

whose language may have been stable for thousands of years, Lubbock's exemplary languages are subject to the same evolutionary pressures as all other tongues. Thus, he finds in uncorrupted words with clear anatomical etymologies evidence of the recent indigenous advent of higher number terms (9).

Where Crawfurd saw numerals as an index of civilisation, Lubbock made them evidence of its progressive development. But it was not evidence for everyone. Counting loomed large for those who found it instructive, but was still safely ignored by those with different priorities. In the discussion following Lubbock's talk, only Crawfurd spoke to Lubbock's numeral argument (15–16). The Duke of Argyll published a short book in 1869 to refute Lubbock's essay. Argyll foregrounded Lubbock's argument that a race would not lose religion after having acquired it, but ignored his parallel argument for counting to ten.<sup>14</sup>

Counting's progressive development was a key source of ammunition for the general progressive claims underlying the methodologies of Lubbock, Tylor, and others (see Stepan, 56–57). Only if man had risen from a state of original savagery could modern savages shed light on his past. Reviewing the 1869 second edition of Lubbock's *Prehistoric Times* in *Nature*, Tylor wrote that 'The more widely and deeply the study of ethnography and prehistoric archæology is carried on, the stronger does the evidence become that the condition of mankind in the remote antiquity of the race is not unfairly represented by modern savage tribes' (105).

The 1860s constituted the first full decade to be informed by a scholarly consensus over the antiquity of man. Man's new antiquity required new means of study, and counting was deeply implicated in the decade's emerging methodologies. Crawfurd began by linking savages to antiquity along the scale of civilisation. Numeration, as his scale's principal index, both legitimated and amplified Crawfurd's link. Tribes could be assessed according to their ability to count. Thus calibrated, primitive cultures could be compared to reveal other facts about man's development. Eventually, the scale was turned back to counting, and counting's development could be inferred from its status among the lowliest of civilisations.

Counting worked as a scale because of its clear, unidirectional growth.

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<sup>14</sup>See Moore on religion and the reception of evolutionary theory.

Victorian anthropology relied on reconstruction. But while languages and words changed, numbers and counting themselves would not be eroded by the river of time. Lubbock made this view a centrepiece of his refutation of civilisational devolution.

At the same time, savages were brought into the fold by analogy to geological inquiry. Their usefulness, in part, derived not from their position on a single scale of development but from their assumed cultural homology to early human societies. Early man lacked sophisticated language, abstraction, religion, and social organisation, and so too did the great number of primitive tribes who were ever increasingly encountered and scrutinized by the 1860s.

European colonialism brought forth vast new data on primitive counting and spurred their synthesis and investigation. A new urgency to understand the strange worlds of colonial subjects dovetailed perfectly with a simultaneously emergent urgency to understand the strange world of prehistoric man. The next decade would see these concerns merge more explicitly with the evolutionary question of man's descent and the mechanism of civilisational development. This new matrix of questions formed the core of Victorian developmental anthropology, and counting again played an essential role.

## 5 Counting and Descent

Lubbock's writing neatly captures the different images and ends of savage numeration between the 1860s and 1870s. In *Prehistoric Times*, his study of savages established man's antiquity, and savages served as a foil to civilised Europeans. By the time of his 1870 *Origin of Civilisation*, however, Lubbock's attention had turned toward man's evolution. His new savages were thus endowed with a common humanity and a kernel of reason (Stocking, 150–156). The tenuous state of Lubbock's transition is apparent where he turns to savage numeration at the end of the chapter on 'Language'.

His account here is longer than that in *Prehistoric Times* and starts in much the same way, transitioning from the 'Absence of Abstract Terms' in savage languages. 'There is perhaps no more interesting part of the study of language than that which concerns the system of numeration,' writes Lubbock, 'nor any more striking proof of the low mental condition of many savage races than the undoubted fact that they are unable to count their own fin-

gers, even of one hand' (293). Bushmen cannot count past two, and even Spix and Martius's account of the Brazilian Wood-Indians is now read to 'make the same statement'—this, despite Lubbock's own reading, five years earlier, of a limit of three. Lubbock's same table of 'Cape Yorkers of Australia' numeration follows, and the evidence of two-counting is extended by reference to the Lower Murray nations. He claims that 'no Australian can go beyond four, their term for five simply implying a large number,' even as alternative Australian terms for five appear in the preceding sentence ('one hand') and paragraph ('two-two-one').

Galton's account is excerpted over the next two pages without further commentary (294–5). Lubbock then considers the 'Use of the fingers in arithmetic, as shown in the names of numerals' (page heading, 296–7). Savage tribes, he explains, retain the language of fingers in their pristine numerals, whereas 'the numerals of most races are so worn down by use that we can no longer detect their original meaning' (296). Four pages of finger and hand numerals and counting practices, interspersed with with a few alternative means of reckoning, demonstrate the point (296–299).

Lubbock ends, echoing Alexander von Humboldt, by tying the word five 'in our own language' to the hand, and observing 'the true cause of the decimal system of notation.' His 1870 savages, worse at counting than in 1865, became part of the same civilisational progression which produced modern Europeans. Lubbock's final words emphasize that savages were the same basic men on the opposite end of the scale of civilisation: 'we obtain interesting if melancholy, evidence of the extent to which the faculty of thought lies dormant among the lower races of man' (299).

In 1871, Tylor published his two-volume *Primitive Culture*, a copious and rigorous scientific study of the foundations of human culture (references are from the 1873 second edition). Like Lubbock, Tylor came of age surrounded by debate and speculation over Darwinian evolution. His 1865 *Early History of Mankind*, built on contemporary deaf-and-dumb education, probes the foundations of the human mind. It draws on American Indian and Chinese counting to establish the primacy of finger counting (105–106), but the use of savage numeration in this work is not systematic.

*Primitive Culture*, by contrast, builds comparative numeration into a natural theory of human culture analogous to the physical sciences. Tylor's pref-

ace and introduction make clear that he sees the demands of his own object of study as differing only in degree, not kind (*op. cit.* 3, 18). To further this point, Tylor's second edition explicitly applies Darwin and Spencer's evolutionary theories, apologising for having mostly omitted them in the first instance (vii).<sup>15</sup>

Priding himself on his wide variety of source material, Tylor draws little distinction between the subjects of different accounts. Indeed, he approvingly quotes the observation that 'one set of savages is like another,' and claims that 'there shall be scarce a hand's breadth difference between an English ploughman and a negro of Central Africa' (6-7). While most of his evidence for man's first forays into counting comes from 'lower savages', he does not hesitate to learn from, for instance, the 'English street-folk' (268) who are 'At the other end of the scale of civilization' (267).<sup>16</sup> His goal is not to weigh in on divisive questions of race, but rather to understand humanity writ large, with its universal progressive course of development. For, as he notes, 'it appears both possible and desirable... to treat mankind as homogeneous in nature, though placed in different grades of civilization' (7).

Tylor fits evidence to theory by making common observations about different peoples a sign of evidentiary authenticity. Noting the sometimes doubtful credibility of different travellers' testimony, he finds assurance in 'the test of recurrence'. If disparate observers of disparate peoples note the same ethnographic phenomenon, he explains, 'it becomes difficult or impossible to set down such correspondence to accident or wilful fraud' (9). Tylor draws on scientific ideals of observation to de-localise his subject and undergird his method. That different observers see the same thing in different places is not a sign of common biases but of a universal and invariant underlying subject.

The chapter on 'The Art of Counting' in *Primitive Culture*, striking in

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<sup>15</sup>The intervening two years had seen the publication of Darwin's *Descent of Man*, in which Tylor, along with Lubbock, was frequently and generously cited. c.f. Darwin, I:181, 234. For Darwin's favourable impression of Tylor, see Burkhardt, *et al.*, 13: 194 ('what a clever man'), 14:171, 179, 16:851. Contemporaries immediately associated *Primitive Culture* with *Descent of Man*. *Nature*, IV:117, 1871.

<sup>16</sup>Savages were often found at home. Anthropologist W. L. Distant wrote in *Nature* (1882, 101) that 'Our own savages afford as excellent illustrations of the comparative in civilisation as do the primitive peoples of the jungle or the swamp, and hence a large fund of information is still to be supplied and tabulated from our city alleys, prisons, and lunatic asylums.'

both its extent and approach, sets the mould for subsequent anthropological and etymological studies of counting. An 1871 review in *Nature* immediately recognised its novelty, particularly in connecting language to gestures (IV:119). Tylor begins with some general observations about number and learning, citing Mill's *System of Logic* and describing how children learn to count (240). A brief discussion of the upper limits of counting fades into a presentation of 'the lowest living men, the savages of the South American forests and the deserts of Australia,' who lack all but the most basic number words (242). These tribes furnish case-studies in combining elementary number words to represent larger numbers, though even the new numbers remain pitifully small (243).

To create bigger numbers, Tylor argues, these cultures must resort to the 'lower and ruder method' of finger counting (243–4). He describes the pairing of gestures and speech in counting for a range of contexts (245) and ties this to the use of fingers by children first learning to count (246). Tylor's etymological studies combine to show the same processes at work throughout the world. Several continents' examples of number terms are, for him, sufficiently similar to warrant similar developmental trajectories whilst sufficiently different to discount copying or mutual inheritance (247). Where the philological similarities are most profound, Tylor rules the evidence as 'tending to prove rather intercourse than kinship' (267). Elsewhere, different manifestations of gesture counting 'show such uniformity as is due to common principle, but also such variety as is due to independent working-out' (270). Most of his examples involve 'digit-numeral' derivations, and even those which do not (cf. 252) support his endorsement of Wilhelm von Humboldt's thesis that familiar metaphors 'lie at the root of all numerals' (quoted 253).

Tylor's attention is not limited to the titular primitive cultures. He places words such as 'score' and 'pair' alongside primitive number words to highlight the traces of primitivity in his readers' everyday language (257). This theme returns at the end of the chapter, explaining that base ten numeration persists in spite of its mathematical inferiority to base twelve because 'The case is the not uncommon one of high civilization bearing evident traces of the rudeness of its origin in ancient barbaric life' (272). Civilised cultures not only acquired their number words in like manner to their primitive neighbours, but their very number systems are sub-optimal artefacts of their bygone savage past.



Even if numerals have similar, mostly anatomical derivations, Tylor helps to show with his profusion of number words that anything may in principle represent a number. He argues that ‘The moment any series of names is arranged in regular order in our minds, it becomes a counting-machine’ and recalls reading ‘of a little girl who was set to count cards, and she counted them accordingly, January, February, March, April’ (258). Numbers, for Tylor, are purely abstract entities for which number terms are but transient labels. It would be inconceivable that a ‘five’ would have any essential ‘handness’ to it, but the essential five-ness of the hand goes without saying. Part of Tylor’s presentation thus involves the establishment of an abstract onto-epistemology of counting and number.

Tylor’s etymological deluge also clears space for other forms of evidence. Because etymologies of digit-words for all but the lower races ‘seem so philologically doubtful,’ he turns abruptly away from number words as evidence of the origin of counting for the higher races (260). To go beyond the etymologies, ‘another strong argument is available, which indeed covers almost the whole range of the problem’ (260). That argument uses numerical bases.

For Tylor, number systems have a regular and intelligible order reflecting their origins and development. As abstract systemic entities, their systematic features become an explanatory resource. This does not stop him from inserting suggestive number words from time to time (the Arab at a meal euphemizes his hand as ‘the *five*’ in one footnote, 260), nor from resorting to etymologies where they serve his purpose (as in Greek and Finnish, 262–263), but it does allow him to draw the digital origins of counting from rigorously abstract modern decimal numeration.

‘The numerical systems of the world,’ Tylor concludes, ‘by the actual schemes of their arrangement, extend and confirm the opinion that counting on fingers and toes was man’s original method of reckoning, taken up and represented in language’ (260). The prevalence of ‘hand-counting, quinary, decimal, vigesimal, or combined of these’ systems ‘among tribes or nations far enough advanced in arithmetic to count up to five in words’ as well as hybrids therebetween, leaves little doubt as to the digital origins of the counting numbers (261). Tylor declares that ‘decimal arithmetic is based on human anatomy,’ a fact ‘so obvious’ that he can chide Ovid for juxtaposing decimal arithmetic and anatomy in verse without making the connection (261). And

while ‘the quinary system is frequent among the lower races, among whom also the vigesimal system is considerably developed,’ he observes that ‘the tendency of the higher nations has been to avoid the one as too scanty, and the other as too cumbrous, and to use the intermediate decimal system’ (262).

Having established the digital provenance of numbers starting with five, Tylor again draws from Wilhelm von Humboldt to assert the relationship between the first three numerals and the single-dual-plural distinction. Here, even ‘The scheme of grammatical number in some of the most ancient and important languages of the world is laid down on the same savage principle.’ Tylor lists ancient languages using all three forms, contrasting them to ‘the tendency of higher intellectual culture. . . to discard the plan as inconvenient and unprofitable, and only to distinguish singular and plural’ (265).

The lesson of Tylor’s work was that counting connects even the greatest nations to their savage origins. His story was ‘quite conformable to the development-theory of language’ (271), and his savage tribes reached their knowledge of counting ‘by learning and not by unlearning’ (16, see also 21–22). Tylor’s story of counting united all the races of man in a common path of progress on a single scale of development.<sup>17</sup> His conclusion reinforces his claims to scientificity. A good scientific theory of culture should apply universally to all cultures in all stages of development.

Counting, here, was both a model and an exemplar. As an exemplar, it furnished Tylor with his most succinct and clear-cut explanandum, demanding just one full chapter.<sup>18</sup> As a model, it showed how analyses of language and culture could justify the sort of linear progressive development already assumed for its specific case. Tylor’s chapter on counting lent credence to subsequent arguments for which his developmental thesis was not so clear-cut, but it also shaped their direction. In order to argue by (mostly implicit) analogy to counting, Tylor needed a thesis of civilisational development wherein entire cultures grew as neatly and unidirectionally as number systems.

Moreover, Tylor’s link between civilised and savage man carried conse-

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<sup>17</sup>Such progressive narratives were common amidst the sustained economic growth and structural reform of the period. Kuklick, 21–22. On Tylor’s developmentalism, see Stocking, 159.

<sup>18</sup>‘Mythology’ required three and ‘animism’ seven. One other topic lacks a continuation chapter, but its presentation is nearly thrice as long.

quences for racial science. Drawing a line between present-day primitives and moderns, works like Tylor's enforced a decades-old racial hierarchy. Because counting correlated with cognition, the lower races could point towards, and in some cases supply, the elusive links between man and beast required by evolutionary theory. Thus was born a powerful alliance between the old and new sciences of man in the mid-nineteenth century (see Stepan, 55).

Tylor and Lubbock join Galton as key resources in A. H. Sayce's 1874 *Principles of Comparative Philology*. 'Mr Galton's African Dammaras' and their 'hopeless bewilderment' inform Sayce's frequent use of savage language practices throughout the work (25). Counting's origins appear in chapter seven, on 'The Metaphysics of Language'. They offer Sayce a model for the metaphysics of language, for 'What numbers are in themselves, what they mean and how they originate, . . . are metaphysical questions' (243). Numerals themselves 'constitute a link between grammar and vocabulary' and are thus, with pronouns, 'The first words to be brought under scientific treatment' (53). Sayce moves seamlessly between anthropological and philological evidence in his metaphysics of grammar, where 'Observation of factually existing savage races affords abundant illustration' of conclusions from word roots (258–259).

Joining Tylor, Lubbock, and Sayce's argumentative treatises were popular attempts to make evolutionary theory comprehensible to the educated public. Herbert Spencer's use of savage numeration in this context is limited but telling. In his 1876 *Principles of Sociology*, he excerpts four sentences from Galton's account of the Damara. Important for Spencer is not the Damara's purported lack of numeracy, *per se*, but rather that they illustrate 'how the concrete, made to serve in place of the abstract as far as possible, soon fails, and leaves the mind incapable of higher thought' (I:96). Concomitant with civilisation and development, for Spencer, is the ability to abstract and recognise principles of uniformity (I:81–86).

Galton's is the only case of innumeracy Spencer invokes, even though other archetypally counting tribes appear elsewhere in Spencer's volume. He even cites Dobrizhoffer, Spix, and Martius. Nor is number altogether unimportant in Spencer's account. Indeed, it appears precisely because it is an established exemplar of the intellectual movement from concrete to abstract. Spencer needed only to allude to Galton's succinct excerpt because the claim it illustrated was beyond argument.

## 6 Counting in Comparison

Treatises such as Lubbock's, Tylor's, and Sayce's worked from theoretical principles and illustrated and supported their conclusions with selected examples of savage numeration. A different class of works prioritised the thorough documentation of the whole range of known practices. For Wood's 1868 *Natural History of Man*, this meant collecting and anthologising the scattered literature about the world's savage peoples. Building on this tradition, the 1870s saw a number of analytically oriented compilations which combined the mass of newly gathered data with explanatory frameworks based on evolutionary or other theories.

One such contribution was Connecticut historian James Hammond Trumbull's 1874 report to the American Philological Association on the number systems of North American Indians. Trumbull notes the overwhelming prevalence of decimal systems in North America whilst noting reports of South American tribes who 'have not advanced beyond a *quinary*' system, or worse, as well as of vigesimal systems in central America and among the Esquimaux (41–42).<sup>19</sup> Taking finger numeration as given (except for the first three numerals, 46–47), Trumbull focuses on particular manual counting practices, including the order in which fingers are counted, and on accounting for number names in terms of the hands and fingers. The work is anthropological and philological in orientation, but he writes that his results 'might interest comparative philologists, as bearing on the question of the origin of ideas of number and the beginnings of the art of counting' (75).

This genre also encompassed Oscar Peschel's 1874 *Races of Man* and Friedrich Ratzel's 1885–1888 *History of Mankind*. Both authors participated in a German orientalism often translated into English and much remarked-upon by Anglo-American scholars. Peschel was the first to use Dobrizhoffer's collection of Abipone number words to exemplify the diversity of *ad hoc* number words in primitive tribes, though he maintains Alexander von Humboldt's digital thesis (112–113). Praised by Tylor for its copious illustration, Ratzel's volume stresses the diversity and flexibility of savage number practices (I:35,

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<sup>19</sup>Recall that the Esquimaux can scarcely count to fifteen in Lubbock (1865). They are among the most oft-cited vigesimal counters in analyses after Trumbull's, and later refute connections between vigesimal counting and warm (hence barefoot) climates. cf. Eells 1913, 295.

192, 223, II:19, 327–328, 404, III:12).

Synthetic ethnographies came out of the colonies as well. Edward Curr's influential *Australian Race*, begun in the 1870s and published in 1886, could not have arisen in Europe. On hearing an unexpected regional dialect in an Australian town, he undertook to map out the relationships between all the Australian Aboriginal tongues. To do this, he enlisted 'the several Colonial Governments, the press, and a number of stock-owners,' sending out vocabularies of common English words and asking for their translation in the local language (xiv).

The word lists Curr distributed included only the first four numerals, but even that, in Curr's view, was excessive. He elaborates, 'In the majority of our languages there is a distinct word for 3; but very frequently this number is expressed by 1 and 2, or by 2 and 1... When a distinctive word [for four] is given, it frequently, and possibly always, means any number over 3. No Australian Black in his wild state can, I believe, practically count as high as seven.' (31–32).<sup>20</sup> Curr stresses that he has himself witnessed evidence to this end, and his printed vocabularies drive home the point by often parenthetically adding 'many' after the numerals three or four in the English column. He expresses 'much doubt whether those of my correspondents who translate 4 by a specific term have not been imposed upon in every instance' (205). Curr also proposes on linguistic grounds that the Australian Aboriginals originated in Africa. They migrated quite early, as present-day Negroes 'count as high as thousands' whereas Australians certainly do not (204–205).

These works in the 1870s and 1880s joined the data of colonialism to the theories of evolution in order to create comprehensive synthetic accounts. In one sense, they marked a return to Prichardian ethnography, emphasizing compilation rather than collection, particularly with the German orientalist compendia. But Curr's project showed the new force of synthetic ethnography to drive, as well as process, aggressive efforts at documentation. As for counting's implications, for Trumbull it showed a diversity of practices united under one digital principle. For Peschel and Ratzel, just the sheer diversity of counting practices mattered. The opposite held for Curr, whose

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<sup>20</sup>Curr's conclusions were not far from accepted wisdom. Oldfield (1865, 291), for instance, claims that Australian New Hollanders had no number words beyond two, and relates an anecdote where his interlocutor struggles (but ultimately manages, with the help of his fingers) to express fifteen.

theoretical project helped him to see uniformity amidst the diversity.

## 7 From Facility to Faculty

Most discussions over the origins of counting kept close to ethnographic sources. From the large number of biologists involved and everyone's frequent recourse to evolutionary theory, one might expect more recourse to the animal world for insight and analogy.

For three decades, Galton's dog Dinah was the only animal in the conversation. Animals were not seen as irrelevant to the question at hand, but their fundamental innumeracy was widely presumed. Thus, anthropologist George Harris supposed in 1876 that 'Having no . . . faculty of reason which can enable them to compare different ideas one with another, animals have no ideas respecting number' (I:195). Then, in 1884, Lubbock reported preliminary results from a series of attempts at 'training a black poodle, "Van" . . . to communicate freely with us' using English words printed on cards (216). His first 'experiments' were unsuccessful, but three months later he submitted a follow-up letter to the editor of *Nature* reporting his first communicative successes. 'I am still continuing my observations,' he wrote, 'and am now considering the best mode of testing him [Van] in very simple arithmetic' (548).

The following year, Lubbock had results to report to the British Association. While Van could successfully request food, a bone, tea, or a walk, he showed more difficulty with arithmetic. 'Considering . . . the very limited powers of savage men in this respect,' Lubbock surmises, 'we cannot be surprised if other animals have made but little progress' (45). The comparison prompts Lubbock to review the limited extant literature on animal numeration. A crow counts to four and a nightingale to three. He quotes Galton's account of Dinah, recounts his own experience raiding bird nests, and reports on wasps counting food for their young (46).

Biologist George Romanes, replying to Lubbock's report, completes the connection to prehistoric counting. Observing 'the rapidly-increasing difficulty of thus computing . . . by immediate perception,' Romanes speculates 'that primitive man first lays the foundations of arithmetic by marking off the objects or events upon his fingers and toes.' Referring back to Galton's

Damara, Romanes casts doubt on the whole enterprise of teaching dogs to count. For even if they could count, the Damara's difficulty in calculation shows the altogether greater difficulty of attaining an 'abstract conception of number.' He elaborates 'if the man is really *calculating*... his operations are being conducted on a totally different psychological level from those of the bitch who, in surveying her litter of puppies, perceives that there is not so great a mass of them as she remembers' (80).

Romanes compares 'the artifice of numerical notation' to the 'faculty of simple perception.' Where past human-centred accounts often blurred the lines between evidence of practical numeration and the underlying faculty of number, a renewed interest in animals brought out their distinction. An advancing biologism made it possible to speculate not just on the civilisational achievement of one form of numeration or another, but on the very evolutionary acquisition of the capacity to numerate in the first place.

It was in this vein that Alfred Russel Wallace discussed the origins of counting in the 'Darwinism Applied to Man' chapter at the end of his 1889 treatise, *Darwinism*. There, mathematical ability does not seem to follow the laws of statistical distribution Wallace expects for naturally selected traits (469–470). Like 'wit and humour... almost unknown among savages,' the ability to count and reckon 'is altogether removed from utility in the struggle for life, and appears sporadically in a very small percentage of the population' (472).

Wallace attests to 'ample evidence that, in all the lower races of man, what may be termed the mathematical faculty is, either absent, or, if present, quite unexercised.' Bushmen and Brazilian Wood-Indians count no further than two. Galton's anecdote of trading tobacco for sheep proves that the Damaras do not surpass three. Australian tribes use their words for one and two to count as high as six. 'Even the comparatively intellectual Zulus,' according to Wallace, 'can only count up to ten by using the hands and fingers.' Also using their feet, 'Somewhat higher races, as the Esquimaux' are capable of counting to twenty; still others to forty or higher with 'men' (i.e. twenty) as their basis of reckoning. The sparsity of counting and its connection to the scale of races confirm for Wallace Lubbock's view that it is 'improbable that our earliest ancestors could have counted as high as ten' (464).

Moreover, Wallace distinguishes between the ability to reckon and true

numeracy. Noting claims that ‘some Australians can keep accurate reckoning up to 100, or more, when required’ (464n), Wallace cautions against confusing this with a genuine arithmetical faculty. It is their lack of high number words, indicating a void of abstraction and routine use of higher number concepts, which decisively indicates the Australians’ savage innumeracy. Abstract numbers are judged immaterial to the everyday life of savage and prehistoric man: they would have been no use against the elements, wild beasts, or rival savages, nor could they have figured in early migrations or conquests (466–467).<sup>21</sup> ‘We conclude,’ writes Wallace, ‘that the present gigantic development of the mathematical faculty is wholly unexplained by the theory of natural selection’ (467).

The animal-informed biologism of Wallace and others had a second precedent in the question of counting in children. Mill based his theory of number on how children might learn to count, and the same framework supported claims for the digital origin of the dominant numerical bases. There was an insidious connection to be drawn from the origins of counting in prehistoric man and modern child. Evolutionists’ intermixing (and sometimes conflation) of cultural and physical evolution, exemplified in this biologism, permitted frequent analogies between primitive men and civilisationally advanced children on both physiological and intellectual grounds (Kuklick, 86).

Thus, Tylor wrote in *Primitive Culture* that ‘there exists valid evidence to prove that a child learning to count upon its fingers does in a way reproduce a process of the mental history of the human race’ (246) and assumed the ‘arrest of development in the savage, whose mind remains in the childish state which one of our nursery number-rhymes illustrates in a curiously perfect way’ (264). By the turn of the century, educators like Cunnington (1904, 5) could write of arithmetic that ‘In the nursery and the school we may see, writ small, the story of long ages of the human race.’<sup>22</sup>

## 8 Ontology and Philology

Levi Leonard Conant’s 1896 *The Number Concept: Its Origin and Development* was the first book-length treatise devoted exclusively to the anthro-

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<sup>21</sup>On Wallace’s insistence on these sorts of selection pressures, see Stepan, 66–69.

<sup>22</sup>See Gould and Mengal for the history of such recapitulationist thinking.



pological and linguistic study of number. It marked both the apotheosis of the nineteenth-century tradition considered thusfar and a transition to a new sort of analysis which would dominate the next half century. A mathematician, Conant was interested in what the by-then extensive anthropological literature on counting had to say for those who studied numbers, rather than cultures. His work attempts to survey all of the most current and trustworthy elements of that literature as they pertained to the cardinal numbers (v-vi). Reviewing *The Number Concept* for the *American Anthropologist* (1896), D. G. Brinton, a leading anthropologist who had been in contact with Conant during the book's preparation (Conant, 2n2), explained that 'The title of this work might lead the reader to suppose that it is principally mathematical, but the treatment adopted by the author is anthropological' (216). Regretting some of Conant's over-generalisations and omissions, Brinton nonetheless finds the work to 'testify everywhere to the methods of a conscientious, unbiased, and accurate student' (217).

The origins of counting, Conant begins, are beyond the pale of what we can know with certainty. As justification, he invokes the widespread presence of number-reckoning in the human and animal world. It doesn't take much to count as a counter in Conant's story: tribes demonstrate 'a rudimentary number sense' even by distinguishing 'between *one* and *many*,' and the number concept is universally present among men (1-3). Conant quotes at length from Lubbock's 1885 report for elaboration (3-5).

Conant equivocates on finger counting as a basis for *all* number systems, describing several examples of non-digital number words and practices. The Australasian Muralug Islanders, for instance, move in counting from their fingers to their elbows, and so forth, rather than adopting a simple quinary or decimal system (17-18). Nonetheless, fingers play a central role as a sort of ur-tallying.

Tallying is the central conceit for the conceptual origins of counting. Be it with pebbles, notches in a stick, grain, or knots, all counting activity is based on some form of tallying (7). This holds as much for the civilised ('the German student keeps his beer score by chalk marks on the table or on the wall', 8) as the savage ('the Andaman Islander counts on his fingers because he has no other method of counting', 8). He recalls Flacourt's description of counting soldiers in Madagascar, though he omits the secondary numerical

tabulation and builds decimal counting into the process of pebble dropping (8–9).

A long digression follows on the finger counting practices of both savages and schoolchildren. For its importance within Conant’s story, one must follow his seemingly incidental citations to an 1892 article in the *American Anthropologist* by Lieutenant F. H. Cushing. Starting with the premise that ‘there have been three great steps in the intellectual development of man, the biotic, the manual, and the mental,’ Cushing’s article, though it makes no mention of numbers in its first two pages, is primarily about the role of manual practices and their relation to numeration (289). Cushing cites Tylor among those who have shown the decimal consequences of man’s ‘pentadactylic hands’ (291). Conant implicitly adopts Cushing’s emphasis on hands as conceptual apparatus, making them a crucial intermediate link on the way to mental abstraction.

Conant’s second chapter explores the upper limits of various number systems, including anecdotes of those from civilised cultures failing to grasp large numbers (34–36). His next two chapters discuss the origins and derivations of number words. Drawing from philology and linguistic anthropology, he catalogues number words in both European and savage languages, noting additive, multiplicative, and subtractive means of number formation as well as the presence of anatomical words.<sup>23</sup>

All the while, Conant emphasizes the intellectual significance of conceptual abstraction. For instance, he argues that ‘The savage can form no mental concept of what civilized man means by such a word as “soul”; nor would his idea of the abstract number 5 be much clearer’ (72). The consequences for the development of man are clear: ‘It is only when the savage ceases to be wholly an animal, and becomes a thinking human being, that number in the abstract can come within the grasp of his mind. It is at this point that mere reckoning ceases and arithmetic begins’ (73). Further, ‘Beyond 5 primitive man often proceeds with the greatest difficulty’ (76).

Along the scale of abstraction, Conant presents an extensive discussion of adjectival numerals drawing from the Japanese and various indigenous

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<sup>23</sup>Such arithmetical principles were observed in earlier linguistic studies, such as Adolphus Mann’s 1887 report on Yoruba numeration. But where Mann’s focus is on the formation of composite words, Conant appears most interested in the presence and extent of the arithmetical operations themselves.

Canadian languages. He affirms Wilhelm von Humboldt's metaphoric thesis for number words whilst downplaying hands and feet: 'More than enough has been said to show how baseless is the claim that all numeral words are derived, either directly or indirectly, from the names of fingers, hands, or feet. Connected with the origin of each number word there may be some metaphor, which cannot always be distinctly traced; and where the metaphor was born of the hand or of the foot, we inevitably associate it with the practice of finger counting' (97).

The remaining three chapters discuss the range of number systems among the world's known languages, classed according to their numerical base. The wide range of bases both emphasizes the conceptual plurality, and hence flexibility, of the abstract number concept, and firmly places primitive counting in contrast to its modern manifestation. The digital scales of five, ten, and twenty 'are the scales of nature,' whereas the duodecimal (base twelve) system 'is the scale of civilization' (133).<sup>24</sup>

Conant was not the first mathematician to attempt a prehistory of counting.<sup>25</sup> He was the first, however, to attempt one so comprehensive and so informed by the wealth of anthropological and other scholarship outside his discipline. More than his mathematical predecessors, Conant set a precedent that prehistorical scholarship by mathematicians ought to draw from the best available information in all fields. His work ushered in a new era of professional mathematicians entering the fields of history, anthropology, and eventually archaeology, not just as curious hobbyists but as active participants in scholarly exchange, if not original research.

At the heart of Conant's opus, as in works by mathematicians to come, was an attention not just to the anthropological questions of the development of civilisation but also to the very conceptual foundations of the number concept. Conant's exercise was, after all, aimed at a greater understanding not of human culture but of number itself. His concerns were what makes a number a number, how numbers manifested themselves, and what numbers really meant.

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<sup>24</sup>Conant alludes to an unverified report of an African duodecimal tribe, 'a most interesting addition to anthropological knowledge.'

<sup>25</sup>See De Morgan (§2). Prehistories were also part of the general histories of mathematics published in German by Cantor (1880) and Fink (1890), both of whom cite Hankel (1874). See also Cajori (1893).

The particular combination of aims and evidence in Conant's work applied a familiar linguistic theme to mathematics: that of philology informing ontology. Conant's expansive use of number words and their derivations undergirded a philosophy of number based on tallying, finger-counting, and an abstract system of numerical bases. This anthropo-linguistic derivation of numerical ontology would spur a great deal of later interest among mathematicians in the question of number's origins, and contribute to a trend in the twentieth century wherein mathematicians turned to the history of their subject in order to help comprehend, and especially to help teach, its foundations.

## 9 Conclusion

Between 1853 and 1896, a brief remark from Francis Galton's popular travel narrative was transformed into an iconic story about the origins of counting in man. From the 1860s, man's primitive present was gradually made to speak for his prehistoric past, a past which itself only came into being in the decade after Galton's narrative. Evidence in the spirit of Galton's would eventually be joined by several generations of cognitive studies, psychological theories, and archaeological discoveries. It would be made to speak to mathematicians, educators, students, and laymen. Galton's story about trading tobacco for sheep would become such common currency that it was rarely attributed to him in twentieth century works, and the details of its setting and what was being traded were sometimes changed (e.g. Burton, 2; Kline, 31; Scriba, 7).

Given its lasting import, one must not forget that Galton supplied more than a mere anecdotal slate upon which future authors could inscribe their theories. Galton's story worked because it worked for a particular worldview: one where primitive innumeracy was not just a matter of lacking number words, but of a more fundamental incapacity to enumerate. It mattered little that the one story closest to involving pure counting (in trading tobacco for a heifer), the tribesman got along with the counting bit without difficulty. The conclusion was emblazoned atop the page: 'Inability to Count'. Galton's tale provided an ideal context to frame a primeval culture with only the most rudimentary language. But he also enriched the image to include not just a lack of words or numbers but also a constitutional inability to prac-

tically enumerate. Galton's Damara did not merely lack abstract concepts for understanding or expressing numbers: they lacked numbers altogether.

The stories' long survival and great power also had much to do with their interpretive flexibility. Galton takes the anecdote about trading tobacco for sheep to indicate a lack of basic arithmetical ability and practical number use beyond three. But it was also seen in the accounts considered above to show the lack of abstraction in Damara numeration, their inability to process numbers above three, or their general linguistic, arithmetical, or intellectual unsophistication. The story about trading tobacco for heifers is, despite the heading on its page, generally absent from or unremarked-upon in the later literature on counting. Perhaps this was because Galton's intent for it to demonstrate Damara difficulty with simultaneous reckoning in number and quantity might have been muddled or overshadowed by the story's unambiguous admission that the Damara can deal quite handily with numbers above three. Galton's comparison of dog and Damara was drawn to opposite conclusions in different readings: either the Damara can count no more than an innumerate cur, or even animals have a basic capacity for counting which is shared by humans. Counting is either far removed from nature or made a fundamental part of it. Galton draws neither moral clearly.

Galton's brief words were perfectly situated to enjoy the sudden wave of attention, beginning in the next decade, toward counting's origins. His tale was quick, amusing, suggestive, accessible, and flexible. In this way, Galton became a towering figure for the prehistory of counting without ever intending to be.

One is left to wonder what became of Galton. After his travels as a young man, he went on to a career of great prominence in many of the same scientific communities in which writers on the origins of counting circulated. He even wrote books and discussed questions which would seem to lend themselves to a consideration of the subject (e.g. Galton, 1869, 198, 336–340, 350). Yet not a word further was heard from him as far as later accounts of numbers' origins are concerned. Probably, Galton just was not interested in the questions to which his short excerpt spoke so powerfully. His anthropometric and other researches kept him rooted in the present, with a focus on what evolutionary theory should dictate as policy instead of what it implied for the past. Galton's story was at the centre of the prehistory of counting,

but Galton himself was content to rest on its periphery.

Just as Galton's story quietly flowed through and subtly shaped the prehistory of counting, so too did the problem of counting's prehistory stand as silent witness and accomplice to a great series of movements in the scholarly debates of the second half of the nineteenth century. As model and exemplar, counting shifted the contours of evolutionary and civilisational theory, all the while appearing as a mere case-in-point. One is struck, in this regard, by how little attention has been paid to the history of counting's prehistory. When one looks for it, it is everywhere; when one does not, it is invisible.

Zaslavsky (1973, 9–16, 32) shows how even a brief look at the origins of the stories of counting told about just one continent tell much about their story-tellers. Her interest is in the more-than-a-century of appropriations, misrepresentations, and hasty conclusions which have perpetuated racist ideologies concerning the African continent. The anthropology of counting, in her account, follows alongside the story of counting's prehistory described here in order to shape Western views of the African continent. Where Zaslavsky's brief survey is both compelling and thought-provoking, our investigation of the related course of counting's prehistory adds explanatory force to her account. The prehistory and anthropology of counting did not just reflect European racism. By supplying and justifying a successful model of civilisational progress, it helped to create it.

Ultimately, what does it mean to write a prehistory of counting? Especially in this period, it meant fabricating a body of evidence and a theory to go with it, often tangling the two in a chicken-egg relationship which strengthened them both. Counting became a key question at a crucial historical juncture due to an incredible confluence of timings joining data from colonial exploration and governance to interest in race, civilisation, and man's development and antiquity.

Histories are legitimating enterprises, but also sources of inspiration and guidance. Prehistories all the more so. Over the second half of the nineteenth century, counting and its prehistory participated in a grand hierarchization, one driven by the mandates of reason and progress. The new prehistory of this era reflected a rapidly changing relationship between Anglo-American scholars and the world around them. The prehistoric past was a product of a present mired in the politics of colonialism, the science of man, and their

nexus in the biology and evolution of race and culture. In this fecund context counting became a marker of civilisation: its index, its beacon, and its form.

The reconstructive imaginations of Tylor, Lubbock, Crawfurd, and Conant alike found counting's past in its multifarious present traces. These traces, in such iconic stories as Galton's, formed a pliable medium through which new prehistories were shaped and deployed. Battered by the stream of time, counting's mythic origin loomed behind the horizon of new theories of man and culture. Both model and exemplar, primeval counting both shaped and was shaped in the image of its makers.

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