CONTENTS

THE

DESCENT OF MAN,

AND

SELECTION IN RELATION TO SEX.

BY CHARLES DARWIN, M.A., F.R.S. ◂1

SECOND EDITION, REVISED AND AUGMENTED. ◂2

FIFTEENTH, THOUSAND.

With Illustrations.

LONDON:

JOHN MURRAY, ALBEMARLE STREET. ◂3

1882.

1 Darwin earned his Bachelor of Arts (B.A.) degree from Christ's College, Cambridge, in 1831. Four years later, he was automatically awarded a Master of Arts (M.A.) degree, which at Cambridge is conferred on holders of the B.A. six years after students start at the university, as long as two years have passed since they received their B.A. In 1870, Darwin was offered an honorary Doctorate of Civil Law (D.C.L.) degree from Oxford University, but he declined it, citing his poor health. Seven years later, he accepted an honorary Doctor of Laws (LL.D.) degree from Cambridge, attending the ceremony with his family on 17 November 1877. In Emma's account of the proceedings, mischievous undergraduates caused a commotion when a stuffed monkey in cap and gown was dangled from the galleries, followed by a ring with ribbons representing the "missing link." Darwin was then "marched down the aisle behind two men with silver maces, and the unfortunate public orator came and stood by him and got thro' his tedious harangue as well as he could, constantly interrupted by the most unmannerly shouts and jeers."[1]

Earlier printings of *Descent* added "&c." after F.R.S. (Fellow of the Royal Society) signifying Darwin's fellowship in other learned societies including the Royal Geographical Society (F.R.G.S.), Linnean Society (F.L.S.), and Zoological Society of London (F.Z.S.).

2 The second edition of *Descent* was published on 13 November 1874. In addition to extensive textual revisions, the most important of which are summarized in the "Principal Additions and Corrections" table (pp. vii–ix), this edition was augmented with a note on the brains of humans and apes by T. H. Huxley (pp. 199–206) and, beginning with the 1877 printing of the second edition, Darwin's supplemental note on sexual selection in monkeys, reprinted from the 2 November 1876 issue of *Nature* (pp. 620–24).

3 The publishing house of John Murray was founded in London in 1768 by Scottish-born John Murray (1737–1793). It was being run by his grandson John Murray III (1808–1892) by the time Darwin began working with the publisher in the 1840s, on the second edition of his memoir of the *Beagle* voyage. Most of Darwin's subsequent books were published with the Murray imprint (see next page). Darwin was one of many luminaries published by Murray in the eighteenth and nineteenth centuries, when the firm's author list included Jane Austen, Arthur Conan Doyle, Lord Byron, Charles Lyell, Johann Wolfgang von Goethe, Herman Melville, Thomas Robert Malthus, Washington Irving, Sir Walter Scott, Mary Somerville, and many others.[2] The company is still a major publisher, now owned by Hachette UK, part of the French-owned Hachette international publishing group.

1 Darwin's books published by Murray are listed first, beginning with the second edition of his *Journal of Researches*. That book was initially published in 1839 by Henry Colburn as the third volume of the three-volume *Narrative of the Surveying Voyages of His Majesty's Ships* Adventure *and* Beagle *between the Years 1826 and 1836* (listed under Robert FitzRoy in the Bibliography). Early in 1845, Darwin's friend the famed geologist Charles Lyell (1797–1875) approached Murray, his longtime publisher, about producing a new edition of Darwin's book as a stand-alone, expanded memoir.[3] Later that year, Murray published the second edition as volume 12 of the Colonial and Home Library series. Thus began Darwin's forty-year publishing relationship with Murray. Beginning in 1911, the popular *Journal of Researches* appeared under the title *Voyage of the* Beagle, and virtually all editions are now referred to by this title. Today it is Darwin's most-read work after *On the Origin of Species*.

2 Darwin famously referred to the *Origin* as "one long argument."[4] Collectively, his post-*Origin* works can be taken as one *longer* argument, illustrating and expanding upon the evolutionary arguments and themes of the *Origin*.[5] In addition to a half dozen botanical works (on orchids, carnivorous plants, climbing plants, etc.),[6] these include the two-volume *Variation of Animals and Plants under Domestication* (1868), and *Descent of Man* (1871) and its companion volume, *Expression of the Emotions in Man and Animals* (1872).

3 A short biography of Darwin's grandfather Erasmus Darwin (1731–1802), physician, poet, and philosopher. The book originated as an essay by German biologist and writer Ernst Ludwig Krause (1839–1903).[7]

4 Darwin's geological works stemming from the *Beagle* voyage were originally published in three volumes, on coral reefs (1842), volcanic islands (1844), and geology of South America (1846). The latter two were combined into a single second-edition volume, as indicated here. *On the Structure and Distribution of Coral Reefs*, which met with acclaim, is noteworthy as Darwin's first foray into provocative "theorizing" and cemented his close relationship with Charles Lyell.[8]

5 An 1869 English translation of *Für Darwin*, a defense of natural selection published in 1864 by German-born Brazilian naturalist Fritz Müller (of Müllerian mimicry fame). Darwin often arranged translations and republication of supportive works.

1▶ BY THE SAME AUTHOR.

A NATURALIST'S VOYAGE ROUND THE WORLD; or, A Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. 'Beagle,' under the command of Captain FitzRoy, R.N. *Fifteenth Thousand.* 9*s.* Murray.

ORIGIN OF SPECIES BY MEANS OF NATURAL SELECTION; or, The Preservation of Favoured Races in the Struggle for Life. *Twenty-second Thousand.* 7*s.* 6*d.* Murray.

2▶ VARIOUS CONTRIVANCES BY WHICH BRITISH AND FOREIGN ORCHIDS ARE FERTILIZED BY INSECTS. *Third Thousand.* With Woodcuts. 9*s.* Murray.

VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION. With Illustrations. *Fifth Thousand.* 2 vols. 18*s.* Murray.

DESCENT OF MAN, AND SELECTION IN RELATION TO SEX. With Illustrations. *Fifteenth Thousand.* 9*s.* Murray.

EXPRESSION OF THE EMOTIONS IN MAN AND ANIMALS. With Illustrations. *Ninth Thousand.* 12*s.* Murray.

INSECTIVOROUS PLANTS. With Illustrations. Third Thousand. 14*s.* Murray.

MOVEMENTS AND HABITS OF CLIMBING PLANTS. With Illustrations. *Third Thousand.* 6*s.* Murray.

EFFECTS OF CROSS AND SELF-FERTILIZATION IN THE VEGETABLE KINGDOM. *Second Thousand.* 12*s.* Murray.

DIFFERENT FORMS OF FLOWERS ON PLANTS OF THE SAME SPECIES. *Second Thousand.* 10*s.* 6*d.* Murray.

3▶ LIFE OF ERASMUS DARWIN. By Ernest Krause. With Preliminary Notice. 7*s.* 6*d.* Murray.

POWER OF MOVEMENT IN PLANTS. With Woodcuts. *Second Thousand.* 15*s.* Murray.

FORMATION OF VEGETABLE MOULD THROUGH THE ACTION OF WORMS, with Observations on their Habits. *Sixth Thousand.* 9*s.* Murray.

4▶ ON THE STRUCTURE AND DISTRIBUTION OF CORAL REEFS. Second Edition, revised. Smith, Elder, & Co.

GEOLOGICAL OBSERVATIONS ON THE VOLCANIC ISLANDS AND PARTS OF SOUTH AMERICA, visited during the Voyage of H.M.S. 'Beagle.' Second Edition. Smith, Elder & Co.

A MONOGRAPH OF THE CIRRIPEDIA. With numerous Illustrations. 2 vols. Ray Society. Hardwicke.

A MONOGRAPH OF THE FOSSIL LEPADIDÆ, OR PEDUNCULATED CIRRIPEDS OF GREAT BRITAIN. Palæontographical Society.

A MONOGRAPH OF THE FOSSIL BALANIDÆ AND VERRUCIDÆ OF GREAT BRITAIN. Palæontographical Society.

5▶ FACTS AND ARGUMENTS FOR DARWIN. By Fritz Müller. From the German, with Additions by the Author. Translated by W. S. Dallas, F.L.S. With Illustrations. 6*s.* Murray.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.

PREFACE TO THE SECOND EDITION.

DURING the successive reprints of the first edition of this work, published in 1871, I was able to introduce several important corrections; and now that more time has elapsed, I have endeavoured to profit by the fiery ordeal through which the book has passed, and have taken advantage of all the criticisms which seem to me sound. I am also greatly indebted to a large number of correspondents for the communication of a surprising number of new facts and remarks. These have been so numerous, that I have been able to use only the more important ones; and of these, as well as of the more important corrections, I will append a list. Some new illustrations have been introduced, and four of the old drawings have been replaced by better ones, done from life by Mr. T. W. Wood. I must especially call attention to some observations which I owe to the kindness of Prof. Huxley (given as a supplement at the end of Part I.), on the nature of the differences between the brains of man and the higher apes. I have been particularly glad to give these observations, because during the last few years several memoirs on the subject have appeared on the Continent, and their importance has been, in some cases, greatly exaggerated by popular writers.

I may take this opportunity of remarking that my critics frequently assume that I attribute all changes of corporeal structure and mental power exclusively to the natural selection of such variations as are often called spontaneous; whereas, even in the first edition of the 'Origin of Species,' I distinctly stated that great weight must be attributed to the inherited effects of use and disuse, with respect both to the body and mind. I also attributed some amount of modification to the direct and prolonged action of changed conditions of life. Some allowance, too, must be made for occasional reversions of

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1 *The Descent of Man, and Selection in Relation to Sex* was published in two volumes on 24 February 1871, just two weeks after Darwin's sixty-second birthday, and cost just one pound four shillings. By the end of the year, it was in its eighth print run of one thousand copies each. He had been helped with the writing of *Descent* by his wife, Emma, from whom he sought advice, and their daughter Henrietta, who served as editor. When Darwin decided in late 1873 to undertake a new edition, he initially offered to hire Alfred Russel Wallace to help, but Emma insisted their son George do the job instead. The second edition was published on 13 November 1874 in a single octavo volume—as it was longer in word count, this was achieved by reducing the type size and adding several lines per page.

2 In the first months after *Descent* appeared, Darwin was relieved that no firestorm had erupted over its contents. He happily wrote to Henrietta that the book was "very successful, and I have been hardly at all abused. Several reviewers speak of the lucid vigorous style etc."[9] A visitor later recalled that Darwin was "much impressed by the general assent with which his views had been received," remarking that "everybody is talking about it without being shocked."[10] It was not to last: many critical reviews appeared, epitomized by a scathing treatment in the July 1871 *Edinburgh Review*: "Never, perhaps, in the history of philosophy, have such wide generalisations been derived from such a small basis of fact. . . . The view of sexual selection is greatly exaggerated, and altogether inadequate to explain the differences between the sexes. In a word, Mr. Darwin has chosen this crucial test of the truth of natural selection, and it has broken down at every point where it has been tried."[11]

3 The first edition of *Descent* had a total of seventy-six illustrations, the second edition seventy-eight. Two new images were added and four of the original illustrations were replaced. The well-known illustrator Thomas Wood, who had worked on Wallace's *Malay Archipelago*, provided five of the six new illustrations for the second edition of *Descent*. See pages 313, 372.

4 "Darwin's Bulldog," T. H. Huxley triumphed in a months-long rancorous debate with comparative anatomist Richard Owen over the structure of the human brain relative to that of apes. Darwin added the seven-page "Note on the . . . Development of the Brain in Man and Apes," taken from Huxley's *Evidence as to Man's Place in Nature* (1863), to the second edition of *Descent* (see pp. 199–206).

structure; nor must we forget what I have called "correlated" growth, meaning, thereby, that various parts of the organisation are in some unknown manner so connected, that when one part varies, so do others; and if variations in the one are accumulated by selection, other parts will be modified. Again, it has been said by several critics, that when I found that many details of structure in man could not be explained through natural selection, I invented sexual selection; I gave, however,
1▶ a tolerably clear sketch of this principle in the first edition of the 'Origin of Species,' and I there stated that it was applicable to man. This subject of sexual selection has been treated at full length in the present work, simply because an opportunity was
2▶ here first afforded me. I have been struck with the likeness of many of the half-favourable criticisms on sexual selection, with those which appeared at first on natural selection; such as, that it would explain some few details, but certainly was not applicable to the extent to which I have employed it. My conviction of the power of sexual selection remains unshaken; but it is probable, or almost certain, that several of my conclusions will hereafter be found erroneous; this can hardly fail to be the case in the first treatment of a subject. When naturalists have become familiar with the idea of sexual selection,
3▶ it will, as I believe, be much more largely accepted; and it has already been fully and favourably received by several capable judges.

DOWN, BECKENHAM, KENT,
September 1874.

1 Sexual selection was treated most fully in chapter 4 of the *Origin*, but hints at its applicability to humans were given briefly in chapter 6. There, in a section discussing "slight and unimportant variations," including color variations, Darwin commented on "the differences between the races of man, which are so strongly marked." He continued, "I may add that some little light can apparently be thrown on the origin of these differences, chiefly through sexual selection of a particular kind, but without here entering on copious details my reasoning would appear frivolous."[12]

2 Here Darwin uses a mode of argument he has used before. Anticipating pushback on his theory of gradual evolutionary change by natural selection, in the *Origin* (95) he drew a parallel with former resistance to Lyell's vision of gradual geological change: "I am well aware that this doctrine of natural selection . . . is open to the same objections which were at first urged against Sir Charles Lyell's noble views on 'the modern changes of the earth, as illustrative of geology;' but we now very seldom hear the action, for instance, of the coast-waves, called a trifling and insignificant cause, when applied to the excavation of gigantic valleys or to the formation of the longest lines of inland cliffs." Just as Lyell's vision triumphed, he implied, so too would readers come to embrace natural selection. Now, fifteen years later, he intimates that just as natural selection has triumphed, so too will sexual selection as readers come around to it.

3 Darwin was already fighting a rearguard battle by this time, and while he may have triumphed in convincing most naturalists of evolution (a term he began using in the sixth edition of *Origin*, in 1872), support for natural selection as the primary agent of evolutionary change was already waning. Huxley's grandson Julian later coined the phrase "eclipse of Darwinism" to describe the nineteenth- to early twentieth-century period when natural selection was at its nadir, as naturalists sought alternative evolutionary processes.[13] Sexual selection, in particular female choice, never gained wide support as Darwin formulated it (we will call it his *aesthetic* model), while the more Wallacean *adaptive* (benefits-based) model blossomed into a vibrant subdiscipline of evolutionary biology.[14]

TABLE

OF THE

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26	19	Cases of men born with hairy bodies.
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29	23	The rudiments of a tail in man.
32, note.	24, note,	Bianconi on homologous structures, as explained by adaptation on mechanical principles.
40	70	Intelligence in a baboon.
42	71	Sense of humour in dogs.
44	72–3	Further facts on imitation in man and animals.
47	75	Reasoning power in the lower animals.
50	80	Acquisition of experience by animals.
53	83	Power of abstraction in animals.
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64	92	Pleasure from certain sounds, colours, and forms.
78	104	Fidelity in the elephant.
79	104	Galton on gregariousness of cattle.
81	105–6	Parental affection.
90, note.	112–113, note.	Persistence of enmity and hatred.
91	114	Nature and strength of shame, regret, and remorse.
94	117, note.	Suicide amongst savages.
97	120, note.	The motives of conduct.
112	28	Selection, as applied to primeval man.
122	35–6	Resemblances between idiots and animals.
124, note.	39, note.	Division of the malar bone.
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128–9	41–2	Further cases of muscles proper to animals appearing in man.
146	55, note.	Broca: average capacity of skull diminished by the preservation of the inferior members of society.

1 This three-page table of principal additions and corrections attests to the "fiery ordeal" (see Preface, p. v) that the first edition of the book underwent. Many of these changes are elaborated upon in this annotated second edition.

First Edition. — Vol. I.	Present Edition.	
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149	57	Belt on advantages to man from his hairlessness.
150	58–9	Disappearance of the tail in man and certain monkeys.
169	134–5	Injurious forms of selection in civilised nations.
180	143	Indolence of man, when free from a struggle for existence.
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245	195–6	Darkness of skin a protection against the sun.
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290	235	Period of development of protuberances on birds' heads determines their transmission to one or both sexes.
301	243–4	Causes of excess of male births.
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315	255–6	Excess of males perhaps sometimes determined by selection.
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338	272	Sexual selection amongst spiders.
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349	280	The humming noises of flies.
350	281	Use of bright colours to Hemiptera (bugs).
351	282	Musical apparatus of Homoptera.
354	284–5	Development of stridulating apparatus in Orthoptera.
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387	308	Sounds produced by moths.
397	315	Display of beauty by butterflies.
401	319	Female butterflies, taking the more active part in courtship, brighter than their males.
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14	341	Further facts on courtship of fishes, and the spawning of Macropus.
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91	398	Further facts on display by the Argus pheasant.
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120	419	Albino birds not finding partners, in a state of nature.
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157	446	Cases with pigeons of colour transmitted to one sex alone.
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256	513–514	Prong-horned variety of *Cervus cirginianus*.
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316	556	Difference of complexion in men and women of an African tribe.
337	572	Speech subsequent to singing.
356	586	Schopenhauer on importance of courtship to mankind.
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373	598–9	Power of choice of woman in marriage, amongst savages.
380	603	Long-continued habit of plucking out hairs may produce an inherited effect.

CONTENTS.

◂1

1 *Descent*'s twenty-one chapters are divided into three parts: human origins (chapters 1–7, plus a supplemental essay by Huxley), sexual selection (chapters 8–18), and sexual selection as applied to humans and a general conclusion (chapters 19–21). Darwin also appended a four-plus page "Supplemental note" on sexual selection in monkeys. The most significant differences from the first edition are the separation of those final chapters into a third section—presumably as a way to underscore Darwin's overarching argument in the book for the significance of sexual selection in understanding humans—and the supplemental material.

CHAPTER XIV.

BIRDS—*continued.*

CHAPTER XV.

BIRDS—*continued.*

CHAPTER XVI.

BIRDS—*concluded.*

CHAPTER XVII.

SECONDARY SEXUAL CHARACTERS OF MAMMALS.

CHAPTER XVIII.

SECONDARY SEXUAL CHARACTERS OF MAMMALS—*continued.*

THE DESCENT OF MAN;

AND

SELECTION IN RELATION TO SEX.

INTRODUCTION.

THE nature of the following work will be best understood by a brief account of how it came to be written. During many years I collected notes on the origin or descent of man, without any intention of publishing on the subject, but rather with the determination not to publish, as I thought that I should thus only add to the prejudices against my views. It seemed to me sufficient to indicate, in the first edition of my 'Origin of Species,' that by this work "light would be thrown on the "origin of man and his history;" and this implies that man must be included with other organic beings in any general conclusion respecting his manner of appearance on this earth. Now the case wears a wholly different aspect. When a naturalist like Carl Vogt ventures to say in his address as President of the National Institution of Geneva (1869), "personne, en Europe "au moins, n'ose plus soutenir la création indépendante et de "toutes pièces, des espèces," it is manifest that at least a large number of naturalists must admit that species are the modified descendants of other species; and this especially holds good with the younger and rising naturalists. The greater number accept the agency of natural selection; though some urge, whether with justice the future must decide, that I have greatly overrated its importance. Of the older and honoured chiefs in natural science, many unfortunately are still opposed to evolution in every form.

In consequence of the views now adopted by most naturalists, and which will ultimately, as in every other case, be followed by

1 The full passage in *Origin*'s conclusion (488) reads: "In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history." In the sixth edition of *Origin*, which came out in 1872 on the heels of *Descent*, Darwin intensified this with the addition of one word: "Much light will be thrown."

2 German-born August Christoph Carl Vogt (1817–1895) became professor of geology and zoology at the University of Geneva, Switzerland, in 1852, and was later appointed director of the university's Institute of Zoology. An outspoken materialist and supporter of Darwinism, Vogt disagreed with Darwin over the origin of human races, favoring the polygenist view that the races evolved from different ape species. Vogt collaborated with Darwin on the French editions of *The Variation of Animals and Plants under Domestication* and *The Descent of Man*, and contributed a preface to both books.[1] Vogt's statement here translates as follows: "There is no one, at least in Europe, who would dare to still uphold the independent creation of species in all their parts."

3 This passage echoes the conclusion to the *Origin* (482): "I look with confidence to the future, to young and rising naturalists, who will be able to view both sides of the question with impartiality." Darwin feared that the message of the *Descent*, like that of the *Origin* before it, would prove a bridge too far for older, well-established naturalists to accept. He looked instead to the up-and-coming generation less burdened with prejudice and preconceptions on the subject.

4 This sentence is unchanged from the first edition of *Descent*, which marked the second time the word "evolution" appeared in Darwin's works. The first was in the second volume of *Variation* (1868), and after *Descent* it occurred some eight times in the sixth edition of *Origin*, which appeared in 1872. "Evolved" appeared earlier, as the final word in the *Origin*'s first edition and several times in *Variation*.

others who are not scientific, I have been led to put together my notes, so as to see how far the general conclusions arrived at in my former works were applicable to man. This seemed all the more desirable, as I had never deliberately applied these views to a species taken singly. When we confine our attention to any one form, we are deprived of the weighty arguments derived from the nature of the affinities which connect together whole groups of organisms—their geographical distribution in past and present times, and their geological succession. The homological structure, embryological development, and rudimentary organs of a species remain to be considered, whether it be man or any other animal, to which our attention may be directed; but these great classes of facts afford, as it appears to me, ample and conclusive evidence in favour of the principle of gradual evolution. The strong support derived from the other arguments should, however, always be kept before the mind.

The sole object of this work is to consider, firstly, whether man, like every other species, is descended from some pre-existing form; secondly, the manner of his development; and thirdly, the value of the differences between the so-called races of man. As I shall confine myself to these points, it will not be necessary to describe in detail the differences between the several races—an enormous subject which has been fully discussed in
1▶ many valuable works. The high antiquity of man has recently been demonstrated by the labours of a host of eminent men, beginning with M. Boucher de Perthes; and this is the indispensable basis for understanding his origin. I shall, therefore, take this conclusion for granted, and may refer my readers to
2▶ the admirable treatises of Sir Charles Lyell, Sir John Lubbock, and others. Nor shall I have occasion to do more than to allude to the amount of difference between man and the anthropomor-
3▶ phous apes; for Prof. Huxley, in the opinion of most competent judges, has conclusively shewn that in every visible character man differs less from the higher apes, than these do from the lower members of the same order of Primates.

This work contains hardly any original facts in regard to man; but as the conclusions at which I arrived, after drawing up a rough draft, appeared to me interesting, I thought that they
4▶ might interest others. It has often and confidently been asserted, that man's origin can never be known: but ignorance more frequently begets confidence than does knowledge: it is those who know little, and not those who know much, who so positively assert that this or that problem will never be solved by science. The conclusion that man is the co-descendant with other species of some ancient, lower, and extinct form, is not in

1 How far back in time humanity could be traced was a compelling question in the eighteenth and nineteenth centuries, with profound theological, philosophical, and scientific implications.[2] By the 1870s, archaeological and paleontological research had established the "high antiquity" of humans, but age estimates became possible only with the advent of isotopically based dating methods in the twentieth century. Jacques Boucher de Crèvecoeur de Perthes (1788–1868) made significant archaeological discoveries in the Somme valley beginning in the 1830s. He made a case for the early antiquity of humans in his three-volume treatise *Antiquités celtiques et antédiluviennes* (1847–64).

2 Here Darwin is referring to Charles Lyell's *Geological Evidences of the Antiquity of Man* (1863) and John Lubbock's *Pre-Historic Times* (1865). Lubbock, Darwin's neighbor and protégé, readily embraced his mentor's transmutational ideas, while Darwin's mentor, Lyell, was slow to accept them. While Darwin admired some aspects of Lyell's book, he was also very unhappy with Lyell's treatment of the topic; he wrote to Lyell: "I have been greatly disappointed that you have not given judgment & spoken fairly out what you think about the derivation of Species."[3]

3 Thomas Henry Huxley (1825–1895), English zoologist, was a staunch defender of Darwin and the importance of science in Britain's national advancement. At the 1860 meeting of the British Association for the Advancement of Science (BAAS), in the midst of a debate about the comparative anatomy of the brain in humans and higher apes, Huxley teased Samuel Wilberforce, the bishop of Oxford, that he would prefer an ape as an ancestor to a learned man who "should use his logic to mislead an untutored public"—a much mythologized moment.[4] Huxley later undertook a series of anatomical studies of humans in relation to other primates, the most famous of which was his demonstration that the brains of primates and humans are fundamentally similar. Darwin added the seven-page "Note on the . . . Development of the Brain in Man and Apes" by Professor Huxley to the second edition of *Descent* (pp. 199–206).

4 This is a famous passage, often quoted as a lucid (and perhaps deliberately provocative) declaration of the power of scientific method.

any degree new. Lamarck long ago came to this conclusion, which has lately been maintained by several eminent naturalists and philosophers; for instance, by Wallace, Huxley, Lyell, Vogt, Lubbock, Büchner, Rolle, &c.,[1] and especially by Häckel. This last naturalist, besides his great work, 'Generelle Morphologie' (1866), has recently (1868, with a second edit. in 1870), published his 'Natürliche Schöpfungsgeschichte,' in which he fully discusses the genealogy of man. If this work had appeared before my essay had been written, I should probably never have completed it. Almost all the conclusions at which I have arrived I find confirmed by this naturalist, whose knowledge on many points is much fuller than mine. Wherever I have added any fact or view from Prof. Häckel's writings, I give his authority in the text; other statements I leave as they originally stood in my manuscript, occasionally giving in the foot-notes references to his works, as a confirmation of the more doubtful or interesting points.

During many years it has seemed to me highly probable that sexual selection has played an important part in differentiating the races of man; but in my 'Origin of Species' (first edition, p. 199) I contented myself by merely alluding to this belief. When I came to apply this view to man, I found it indispensable to treat the whole subject in full detail.[2] Consequently the second part of the present work, treating of sexual selection, has extended to an inordinate length, compared with the first part; but this could not be avoided.

I had intended adding to the present volumes an essay on the expression of the various emotions by man and the lower animals. My attention was called to this subject many years ago by Sir Charles Bell's admirable work. This illustrious anatomist

[1] As the works of the first-named authors are so well known, I need not give the titles; but as those of the latter are less well known in England, I will give them:—'Sechs Vorlesungen über die Darwin'sche Theorie:' zweite Auflage, 1868, von Dr. L. Büchner; translated into French under the title 'Conférences sur la Théorie Darwinienne,' 1869. 'Der Mensch, im Lichte der Darwin'sche Lehre,' 1865, von Dr. F. Rolle. I will not attempt to give references to all the authors who have taken the same side of the question. Thus G. Canestrini has published ('Annuario della Soc. d. Nat.,' Modena, 1867, p. 81) a very curious paper on rudimentary characters, as bearing on the origin of man. Another work has (1869) been published by Dr. Francesco Barrago, bearing in Italian the title of "Man, made in the image of God, "was also made in the image of the "ape."

[2] Prof. Häckel was the only author who, at the time when this work first appeared, had discussed the subject of sexual selection, and had seen its full importance, since the publication of the 'Origin,'; and this he did in a very able manner in his various works.

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1 "Naturalist" and "philosopher" were Darwin's preferred terms for those who observed nature, made experiments, and wrote about natural knowledge and human society in systematic ways (he does not use the term "scientist," introduced by William Whewell in 1833). By these terms, he included, as did his contemporaries, those who made a professional living from scientific study (increasingly common among the younger generation) and those, like himself, who made science their avocation, depending on another source for their daily bread. "Naturalist" was the humbler term; "philosopher" implied grand intellectual aspirations. Notably, Darwin does not tend to use in *Descent* the common "men of science," thus not explicitly excluding women from the ranks of contributors to scientific knowledge.[5]

2 An 1868 exposition of evolution based on a series of popular lectures by German zoologist Ernst Haeckel (1834–1919), later dubbed the "German Darwin." Boldly affirming the human–primate evolutionary connection, the frontispiece of the first edition caused an uproar with its depiction of the heads of apes and humans of different races.[6]

3 Although Darwin gave a brief description of intra- and inter-sexual competition—the "struggle of war or charms"—in the unpublished "Sketch" of his evolutionary ideas in 1842,[7] his earliest known use of the term "sexual selection" is found in notes he took in 1856 on Robert Knox's *Races of Men*.[8]

4 Charles Bell (1774–1842) was a noted Scottish anatomist, anatomical artist, neurologist, and theologian. Darwin was interested in Bell's work on the muscular action behind emotional facial expression and the anatomy and physiology of facial expression as a guide for painters and sculptors (*Essays on the Anatomy of Expression in Painting*, 1806). He drew upon Bell in discussions of these subjects in *The Expression of the Emotions in Man and Animals* (1872).

1▶ maintains that man is endowed with certain muscles solely for the sake of expressing his emotions. As this view is obviously opposed to the belief that man is descended from some other and lower form, it was necessary for me to consider it. I likewise wished to ascertain how far the emotions are expressed in the same manner by the different races of man. But owing to the
2▶ length of the present work, I have thought it better to reserve my essay for separate publication.

1 While admiring Bell's anatomical work, Darwin strongly disagreed with Bell's conclusions that humans alone possessed certain muscles whose sole function was emotional expression and that this was evidence for humans as the unique creations of a deity. The key word here is "solely." Darwin's overarching argument, of course, is that humans are descended from primate ancestors, and all aspects of our anatomy are thus inherited—including muscles used in emotional expression. Structures may have specialized functions in humans, but he is convinced that no structure exists solely in humans (also the crux of the Huxley–Owen debate on the hippocampus major—see pp. 148, 199). Rather, structures can be traced from species to species, modified or developed in different degrees, supporting the existence of evolutionary relationships.

2 Darwin alludes to his original intent to include this analysis in *Descent*. The subject ballooned, however, as was so often the case with his projects, resulting in the separately published essay referred to here, *The Expression of the Emotions in Man and Animals* (1872), a kind of companion volume to *Descent*.

It is possible for a structure to be uniquely adapted for a particular use in a modern species that differs from the original use for which the structure evolved ancestrally. This is the principle of co-option, discussed in the *Origin*. As an example, there Darwin cited lungs of terrestrial animals, derived from a swim bladder-like structure in marine-going ancestors. To Bell's point, one could envision facial muscles *uniquely* functioning in emotional expression in humans but *derived from* muscles adapted for another (original) purpose in ancestral species. In *Expression*, however, Darwin argues that the very same emotions found in humans are found in other animals, even if developed to a lesser degree, *and* that they tend to be expressed with the very same musculature—doubly underscoring the evolution of humans from earlier animal ancestors.

PART I.

THE DESCENT OR ORIGIN OF MAN.

CHAPTER I.

THE EVIDENCE OF THE DESCENT OF MAN FROM SOME LOWER FORM.

Nature of the evidence bearing on the origin of man—Homologous structures in man and the lower animals—Miscellaneous points of correspondence—Development—Rudimentary structures, muscles, sense-organs, hair, bones, reproductive organs, &c.—The bearing of these three great classes of facts on the origin of man.

HE who wishes to decide whether man is the modified descendant of some pre-existing form, would probably first enquire whether man varies, however slightly, in bodily structure and in mental faculties; and if so, whether the variations are transmitted to his offspring in accordance with the laws which prevail with the lower animals. Again, are the variations the result, as far as our ignorance permits us to judge, of the same general causes, and are they governed by the same general laws, as in the case of other organisms; for instance, by correlation, the inherited effects of use and disuse, &c.? Is man subject to similar malconformations, the result of arrested development, of reduplication of parts, &c., and does he display in any of his anomalies reversion to some former and ancient type of structure? It might also naturally be enquired whether man, like so many other animals, has given rise to varieties and sub-races, differing but slightly from each other, or to races differing so much that they must be classed as doubtful species? How are such races distributed over the world; and how, when crossed, do they react on each other in the first and succeeding generations? And so with many other points.

The enquirer would next come to the important point, whether man tends to increase at so rapid a rate, as to lead to occasional severe struggles for existence; and consequently to

1 As in the first edition, this first part of the book consists of seven chapters, although some of the chapter titles and the order of treatment of material differ between the editions.

2 In this opening chapter, Darwin argues that humans exhibit unity through common descent with other animals, most closely the primates. He presents three lines of evidence: basic physiological and structural similarities; embryological similarities; and most importantly for him, the persistence of rudimentary or vestigial characters. For Darwin, organisms can be "read" like a book, the tale of their common descent told in their anatomical structure.

3 At the outset, as he did in the *Origin*, Darwin frames the question of human evolution in terms of natural selection's key ingredients of heritable variation and struggle for existence such that "beneficial variations" are preserved and "injurious ones eliminated," and groups replace groups over time. This is how he set up his argument for natural selection generally in the *Origin*, with the first two chapters making a case for an abundance of heritable variation, the third arguing for incessant and intense "struggle for existence," leading to the fourth on the phenomenon of natural selection. Also as in the *Origin*, Darwin invokes parallel lines of evidence. Via the rhetorical device of the disinterested inquirer, he considers whether human "races" or subraces grade into each other, how they are geographically distributed, and whether interbreeding between races exhibits predictable expressions of variation.

4 In the *Origin* (47–52) Darwin cited "doubtful species"—species with uncertain taxonomic status—as evidence for evolutionary transition between species and varieties, as he does here.

5 In *An Essay on the Principle of Population*, Thomas Malthus argued that human population growth sparked a struggle for existence, as famine, disease, and war checked human populations. Darwin read Malthus in September 1838. The seesaw of population growth and decline immediately became a fundamental building block in his theory of evolution by natural selection, "a force like a hundred thousand wedges" driving weaker forms out of "the oeconomy of nature" and making space for beneficial variations.[1]

beneficial variations, whether in body or mind, being preserved, and injurious ones eliminated. Do the races or species of men, whichever term may be applied, encroach on and replace one another, so that some finally become extinct? We shall see that all these questions, as indeed is obvious in respect to most of them, must be answered in the affirmative, in the same manner as with the lower animals. But the several considerations just referred to may be conveniently deferred for a time: and we will first see how far the bodily structure of man shows traces, more or less plain, of his descent from some lower form. In succeeding chapters the mental powers of man, in comparison with those of the lower animals, will be considered.

The Bodily Structure of Man.—It is notorious that man is constructed on the same general type or model as other mammals. All the bones in his skeleton can be compared with corresponding bones in a monkey, bat, or seal. So it is with his muscles, nerves, blood-vessels and internal viscera. The brain, the most important of all the organs, follows the same law, as shewn by Huxley and other anatomists. Bischoff,[1] who is a hostile witness, admits that every chief fissure and fold in the brain of man has its analogy in that of the orang; but he adds that at no period of development do their brains perfectly agree; nor could perfect agreement be expected, for otherwise their mental powers would have been the same. Vulpian[2] remarks: "Les différences réelles qui existent entre l'encéphale de "l'homme et celui des singes supérieurs, sont bien minimes. Il "ne faut pas se faire d'illusions à cet égard. L'homme est bien "plus près des singes anthropomorphes par les caractères "anatomiques de son cerveau que ceux-ci ne le sont non-"seulement des autres mammifères, mais même de certains "quadrumanes, des guenons et des macaques." But it would be superfluous here to give further details on the correspondence between man and the higher mammals in the structure of the brain and all other parts of the body.

It may, however, be worth while to specify a few points, not directly or obviously connected with structure, by which this correspondence or relationship is well shewn.

Man is liable to receive from the lower animals, and to com-

[1] 'Grosshirnwindungen des Menschen,' 1868, s. 96. The conclusions of this author, as well as those of Gratiolet and Aeby, concerning the brain, will be discussed by Prof. Huxley in the Appendix alluded to in the Preface to this edition.

[2] 'Leç. sur la Phys.' 1866, p. 890, as quoted by M. Dally, 'L'Ordre des Primates et le Transformisme,' 1868, p. 29.

1 Darwin, along with many contemporaries, expected the expansion of European colonial settlement to drive indigenous peoples to extinction (see pp. 181–92). Though Darwin rarely discusses archaeological evidence in *Descent*, contemporaries attuned to prehistory contemplated the possibility that Europe's former "savage" inhabitants, such as those represented by remains found in Germany's Neander valley, had gone extinct.[2]

2 Darwin deployed a similar rhetorical device in the *Origin*: the hypothetical "enquirer" is inexorably led to answer in the affirmative, but note his not-so-subtle parallel: "in the same manner as with the lower animals." Humans vary, struggle, evolve, Darwin is arguing, in exactly the same manner as other organisms. We, too, are products of the evolutionary process.

3 Theodor Ludwig Wilhelm von Bischoff (1807–1882), distinguished German embryologist who held professorships at Bonn, Heidelberg, Giessen, and Munich universities over his career. Bischoff supported natural selection but scorned human descent from apes.[3]

4 Edmé Félix Alfred Vulpian (1826–1887), French physician and neurophysiologist. The quote comes from Vulpian's *Leçons sur la physiologie générale et comparée du système nerveux* (1866): "The real differences between the brain of man and that of the higher apes are indeed minimal. One must not have illusions in this respect. In terms of the anatomical characters of his brain, man is much closer to the humanoid apes than these are not only to other mammals, but even to certain non-human primates, such as guenons and macaques."

municate to them, certain diseases, as hydrophobia, variola, the glanders, syphilis, cholera, herpes, &c.;[3] and this fact proves the close similarity[4] of their tissues and blood, both in minute structure and composition, far more plainly than does their comparison under the best microscope, or by the aid of the best chemical analysis. Monkeys are liable to many of the same non-contagious diseases as we are; thus Rengger,[5] who carefully observed for a long time the *Cebus Azaræ* in its native land, found it liable to catarrh, with the usual symptoms, and which, when often recurrent, led to consumption. These monkeys suffered also from apoplexy, inflammation of the bowels, and cataract in the eye. The younger ones when shedding their milk-teeth often died from fever. Medicines produced the same effect on them as on us. Many kinds of monkeys have a strong taste for tea, coffee, and spirituous liquors: they will also, as I have myself seen, smoke tobacco with pleasure.[6] Brehm asserts that the natives of north-eastern Africa catch the wild baboons by exposing vessels with strong beer, by which they are made drunk. He has seen some of these animals, which he kept in confinement, in this state; and he gives a laughable account of their behaviour and strange grimaces. On the following morning they were very cross and dismal; they held their aching heads with both hands, and wore a most pitiable expression: when beer or wine was offered them, they turned away with disgust, but relished the juice of lemons.[7] An American monkey, an Ateles, after getting drunk on brandy, would never touch it again, and thus was wiser than many men. These trifling facts prove how similar the nerves of taste must be in monkeys and man, and how similarly their whole nervous system is affected.

Man is infested with internal parasites, sometimes causing

[3] Dr. W. Lauder Lindsay has treated this subject at some length in the 'Journal of Mental Science,' July 1871; and in the 'Edinburgh Veterinary Review,' July 1858.

[4] A Reviewer has criticised ('British Quarterly Review,' Oct. 1st, 1871, p. 472) what I have here said with much severity and contempt; but as I do not use the term identity, I cannot see that I am greatly in error. There appears to me a strong analogy between the same infection or contagion producing the same result, or one closely similar, in two distinct animals, and the testing of two distinct fluids by the same chemical reagent.

[5] 'Naturgeschichte der Säugethiere von Paraguay,' 1830, s. 50.

[6] The same tastes are common to some animals much lower in the scale. Mr. A. Nicols informs me that he kept in Queensland, in Australia, three individuals of the *Phaseolarctus cinereus;* and that, without having been taught in any way, they acquired a strong taste for rum, and for smoking tobacco.

[7] Brehm, 'Thierleben,' B. i. 1864, s. 75, 86. On the Ateles, s. 105. For other analogous statements, see s. 25, 107.

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1 British comparative anatomist Richard Owen (1804–1892) introduced the "homology" and "analogy" concepts in 1843, defining homologues as "the same organ in different animals under every variety of form and function."[4] For anti-evolutionist Owen, homologies revealed the natural world's underlying divine order. Darwin and Wallace cited homology as important evidence for common descent, something Darwin discussed in the *Origin* and develops here in terms of the "bodily structure" of humans.

2 For Darwin, common susceptibility to the same diseases illustrates a physiological evolutionary link between humans and other animals that underscores the anatomical links. The anonymous author of the critical review Darwin refers to in footnote 4 paid special attention to this claim, writing dismissively that "in many cases [these arguments] do not bear the test of careful analysis, and some assertions crumble into dust as soon as they are exposed to investigation. We shall find reason to doubt the validity of Mr. Darwin's inferences concerning chemical composition, as well as concerning minute structure."[5]

3 "Consumption" is an early name for tuberculosis, an infectious disease of the lungs caused by the bacterium *Mycobacterium tuberculosis* and related species. Swiss naturalist Johann Rudolph Rengger (1795–1832) explored Paraguay between 1818 and 1826 (see p. 32). He reported this observation regarding illnesses of *Cebus azarae* (Azaras's capuchin, now *Sapajus cay*), and the monkeys' responses to the same medications as humans, in the natural history he published in 1830.[6] More recently, neurobiologist Robert M. Sapolsky documented bovine tuberculosis decimating whole troops of baboons at his study site in east Africa.[7]

4 For Darwin, qualitative anecdotes—sourced to an ostensibly reliable observer—constituted valuable evidence. Anecdotes begat anecdotes. Arthur Nichols, reading the first edition of *Descent*, wrote Darwin to offer a similar instance of koalas' "inordinate love of tobacco and rum." Darwin added these observations to the second edition, quoting them in footnote 6.[8]

5 Alfred Edmund Brehm (1829–1884) was lead author and editor of *Illustrirtes Thierleben*, a six-volume zoological encyclopedia published between 1864 and 1869, popularly referred to as *Brehm's Life of Animals*, which Darwin drew upon extensively for information and illustrations for *Descent*. Economizing on illustration costs, Darwin obtained stereotype plates of some of the woodcuts Brehm used in his book for illustrations in *Descent*.[9] (See pp. 361, 372 for more on Darwin's use of Brehm's illustrations.)

fatal effects; and is plagued by external parasites, all of which belong to the same genera or families as those infesting other mammals, and in the case of scabies to the same species.[8] Man is subject, like other mammals, birds, and even insects,[9] to that mysterious law, which causes certain normal processes, such as gestation, as well as the maturation and duration of various diseases, to follow lunar periods. His wounds are repaired by the same process of healing; and the stumps left after the amputation of his limbs, especially during an early embryonic period, occasionally possess some power of regeneration, as in the lowest animals.[10]

The whole process of that most important function, the reproduction of the species, is strikingly the same in all mammals, from the first act of courtship by the male,[11] to the birth and nurturing of the young. Monkeys are born in almost as helpless a condition as our own infants; and in certain genera the young differ fully as much in appearance from the adults, as do our children from their full-grown parents.[12] It has been urged by some writers, as an important distinction, that with
1▶ man the young arrive at maturity at a much later age than with any other animal: but if we look to the races of mankind which inhabit tropical countries the difference is not great, for the orang is believed not to be adult till the age of from ten to fifteen years.[13] Man differs from woman in size, bodily strength,
2▶ hairiness, &c., as well as in mind, in the same manner as do the

[8] Dr. W. Lauder Lindsay, 'Edinburgh Vet. Review,' July 1858, p. 13.

[9] With respect to insects see Dr. Laycock, "On a General Law of Vital Periodicity," 'British Association,' 1842. Dr. Macculloch, 'Silliman's North American Journal of Science,' vol. xvii. p. 305, has seen a dog suffering from tertian ague. Hereafter I shall return to this subject.

[10] I have given the evidence on this head in my 'Variation of Animals and Plants under Domestication,' vol. ii. p. 15, and more could be added.

3▶ [11] "Mares e diversis generibus "Quadrumanorum sine dubio di- "gnoseunt feminas humanas a ma- "ribus. Primum, credo, odoratu, "postea aspectu. Mr. Youatt, qui "diu in Hortis Zoologicis (Besti- "ariis) medicus animalium erat, "vir in rebus observandis cautus et "sagax, hoc mihi certissime pro "bavit, et curatores ejusdem loci et "alii e ministris confirmaverunt. "Sir Andrew Smith et Brehm no- "tabant idem in Cynocephalo. Il- "lustrissimus Cuvier etiam narrat "multa de hâc re, quâ ut opinor, "nihil turpius potest indicari inter "omnia hominibus et Quadrumanis "communia. Narrat enim Cyno- "cephalum quendam in furorem in- "cidere aspectu feminarum ali- "quarum, sed nequaquam accendi "tanto furore ab omnibus. Sem- "per eligebat juniores, et dignos- "cebat in turbâ, et advocabat voce "gestûque."

[12] This remark is made with respect to Cynocephalus and the anthropomorphous apes by Geoffroy Saint-Hilaire and F. Cuvier, 'Hist. Nat. des Mammifères,' tom. i. 1824.

[13] Huxley, 'Man's Place in Nature,' 1863, p. 34.

1 Darwin, citing T. H. Huxley, claims that children of "tropical races" matured at an earlier age, comparing them to orangutans in this respect. Common European prejudice in Darwin's time held that tropical peoples were closer to primate relatives than extratropical peoples (Europeans, in particular). Huxley, in *Evidence as to Man's Place in Nature*, drew upon Salomon Müller and Hermann Schlegel's *Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche overzeesche Bezittingen* (1839–44) as his primary source for the estimated age of maturation of orangutans.[10]

2 Here Darwin extends supposed mental differences between males and females to *all* mammals. The lack of citations or supporting evidence reflects how this view was taken as a given. While not universally shared, even among his contemporaries, Darwin's assumptions reflect centuries of sexist thinking grounded in religious, natural philosophical, and garden-variety popular explanations of the differences between men and women.

3 Translation:

> Without a doubt, males of diverse kinds of primates distinguish human females from males. First, I believe, by odor, after that by appearance. Mr. Youatt, long a veterinarian in the Zoological Garden (the Bestiary), a man in observational matters circumspect and sagacious, has certainly proved it to me as most certain, and others there have confirmed it, using their expertise. Sir Andrew Smith and Brehm have noted the same in yellow baboons [*Papio cynocephalus*]. The illustrious Cuvier also has many things to say on this matter. Nothing shared between humans and primates, in my opinion, can be found to be more obscene. He says, in fact, that the appearance of some females caused one baboon to fall into a frenzy, but that his frenzy was not at all roused so greatly by all of them. He was always selecting the younger women, distinguishing them [from the other women] in the crowd, and summoning them by voice and gesture.

In this passage, Darwin cites authorities who assert that captive male yellow baboons not only distinguish human males from females but can even be driven to a state of sexual excitement by the presence of certain women. The passage is in Latin to protect unwary readers from obscenity and offensiveness. An undated draft of the passage suggests that Darwin translated it into Latin from English and French, following, intriguingly, medieval, rather than Classical Latin grammar.[11] Such measures, however, did not stop Victorian readers, beginning with *Origin*, from seizing on the salacious animal-human sexuality that Darwin's theory implied, using it to mock Darwin and natural selection.[12]

two sexes of many mammals. So that the correspondence in general structure, in the minute structure of the tissues, in chemical composition and in constitution, between man and the higher animals, especially the anthropomorphous apes, is extremely close.

Embryonic Development.—Man is developed from an ovule, about the 125th of an inch in diameter, which differs in no respect from the ovules of other animals. The embryo itself at a very early period can hardly be distinguished from that of other members of the vertebrate kingdom. At this period the arteries run in arch-like branches, as if to carry the blood to branchiæ which are not present in the higher vertebrata, though the slits on the sides of the neck still remain (*f*, *g*, fig. 1), marking their former position. At a somewhat later period, when the extremities are developed, "the feet of lizards and "mammals," as the illustrious Von Baer remarks, "the wings "and feet of birds, no less than the hands and feet of man, all "arise from the same fundamental form." It is, says Prof. Huxley, [14] "quite in the later stages of development that the young human being presents marked differences from the young "ape, while the latter departs as much from the dog in its "developments, as the man does. Startling as this last assertion "may appear to be, it is demonstrably true."

As some of my readers may never have seen a drawing of an embryo, I have given one of man and another of a dog, at about the same early stage of development, carefully copied from two works of undoubted accuracy.[15]

After the foregoing statements made by such high authorities, it would be superfluous on my part to give a number of borrowed details, shewing that the embryo of man closely resembles that of other mammals. It may, however, be added, that the human embryo likewise resembles certain low forms when adult in various points of structure. For instance, the heart at first exists as a simple pulsating vessel; the excreta are voided through a cloacal passage; and the os coccyx projects

[14] 'Man's Place in Nature,' 1863, p. 67.

[15] The human embryo (upper fig.) is from Ecker, 'Icones Phys.,' 1851–1859, tab. xxx. fig. 2. This embryo was ten lines in length, so that the drawing is much magnified. The embryo of the dog is from Bischoff, 'Entwicklungsgeschichte des Hunde-Eies,' 1845, tab. xi. fig. 42 B. This drawing is five times magnified, the embryo being twenty-five days old. The internal viscera have been omitted, and the uterine appendages in both drawings removed. I was directed to these figures by Prof. Huxley, from whose work, 'Man's Place in Nature,' the idea of giving them was taken. Häckel has also given analogous drawings in his 'Schöpfungsgeschichte.'

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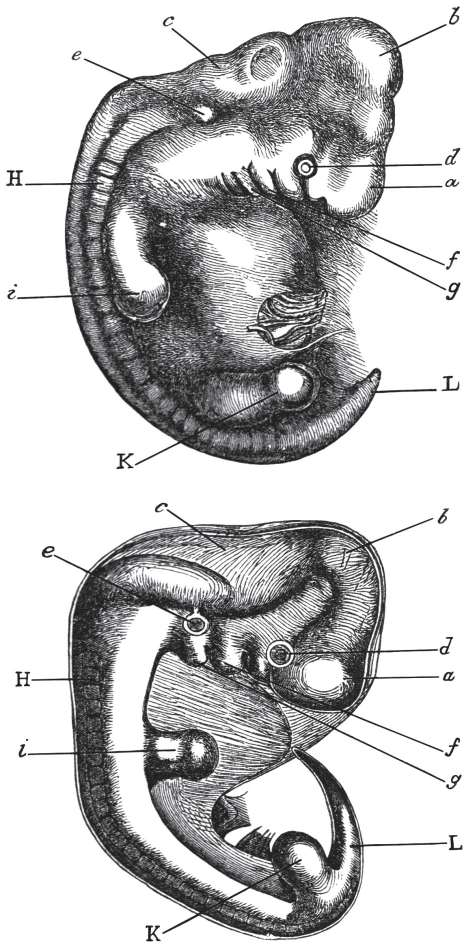
1 The evolutionary insights from embryology were so compelling to Darwin that he boldly concluded his discussion of embryological evidence for common descent in the *Origin* (457–58) with the declaration that "the several classes of facts which have been considered in this chapter, seem to me to proclaim so plainly, that the innumerable species, genera, and families of organic beings, with which this world is peopled, have all descended, each within its own class or group, from common parents, and have all been modified in the course of descent, that I should without hesitation adopt this view, even if it were unsupported by other facts or arguments."

2 Now termed "pharyngeal arch arteries" or "aortic arches," these six paired vascular structures of the embryo give rise to the main arteries of the head and neck. The aortic arches represent the vasculature associated with the pharyngeal arches, which appear during the fourth week of development. These are homologous to branchial or gill arches in fish, which support the gills. In mammals they develop into skeletal and muscular components of the jaw, inner ear, trachea, and so forth.

3 Karl Ernst von Baer (1792–1876) was a German anatomist and embryologist whose major contributions to embryology were made during his sixteen years at the University of Königsberg, where he taught zoology and anatomy, established a zoological museum, and served as dean of the medical faculty and rector of the university, among other roles. Von Baer accepted a kind of transmutationism: he rejected Darwin and Wallace's model of natural selection but believed that change in species over time was driven by changes during development. His pioneering diagrams visualizing the developmental history of vertebrate embryos in the 1820s and 1830s are, in effect, among the earliest phylogenetic trees.[13]

1 In selecting these embryos for illustration, Darwin appears to have taken a cue from Huxley's comment, quoted on the previous page, that young apes depart "as much from the dog in its developments, as the man does. Startling as this last assertion may appear to be, it is demonstrably true." Huxley goes further in his text, continuing, "and it alone appears to me sufficient to place beyond all doubt the structural unity of man with the rest of the animal world, and more particularly and closely with the apes."[14] Darwin borrowed Huxley's copies of Rudolph Wagner's *Icones physiologicae* (2nd ed., 1851–59, edited by Alexander Ecker) and Bischoff's 1845 *Entwicklungsgeschichte des Hunde-Eies* (Developmental history of the dog-egg) to make copies of these illustrations.[15]



1▶ Fig. 1. Upper figure human embryo, from Ecker. Lower figure that of a dog, from Bischoff.

a. Fore-brain, cerebral hemispheres, &c.
b. Mid-brain, corpora quadrigemina.
c. Hind-brain, cerebellum, medulla oblongata.
d. Eye.
e. Ear.
f. First visceral arch.
g. Second visceral arch.
H. Vertebral columns and muscles in process of development.
i. Anterior } extremities.
K. Posterior }
L. Tail or os coccyx.

like a true tail, "extending considerably beyond the rudi-
"mentary legs."[16] In the embryos of all air-breathing vertebrates, certain glands, called the corpora Wolffiana, correspond with, and act like the kidneys of mature fishes.[17] Even at a later embryonic period, some striking resemblances between man and the lower animals may be observed. Bischoff says that the convolutions of the brain in a human fœtus at the end of the seventh month reach about the same stage of development as in a baboon when adult.[18] The great toe, as Prof. Owen remarks,[19] "which forms the fulcrum when standing or walking, is "perhaps the most characteristic peculiarity in the human structure;" but in an embryo, about an inch in length, Prof. Wyman[20] found "that the great toe was shorter than the others; "and, instead of being parallel to them, projected at an angle "from the side of the foot, thus corresponding with the per-
"manent condition of this part in the quadrumana." I will conclude with a quotation from Huxley,[21] who after asking, does man originate in a different way from a dog, bird, frog or fish? says, "the reply is not doubtful for a moment; without "question, the mode of origin, and the early stages of the "development of man, are identical with those of the animals "immediately below him in the scale: without a doubt in "these respects, he is far nearer to apes than the apes are to "the dog."

Rudiments.—This subject, though not intrinsically more important than the two last, will for several reasons be treated here more fully.[22] Not one of the higher animals can be named which does not bear some part in a rudimentary condition; and man forms no exception to the rule. Rudimentary organs must be distinguished from those that are nascent; though in some cases the distinction is not easy. The former are either absolutely useless, such as the mammæ of male quadrupeds, or the incisor teeth of ruminants which never cut through the gums; or they are of such slight service to their present possessors, that we can hardly suppose that they were developed under the

[16] Prof. Wyman in 'Proc. of American Acad. of Sciences,' vol. iv. 1860, p. 17.

[17] Owen, 'Anatomy of Vertebrates,' vol. i. p. 533.

[18] 'Die Grosshirnwindungen des Menschen,' 1868, s. 95.

[19] 'Anatomy of Vertebrates,' vol. ii. p. 553.

[20] 'Proc. Soc. Nat. Hist.' Boston, 1863, vol. ix. p. 185.

[21] 'Man's Place in Nature,' p. 65.

[22] I had written a rough copy of this chapter before reading a valuable paper, "Caratteri rudimentali in ordine all' origine del uomo" ('Annuario della Soc. d. Nat.,' Modena, 1867, p. 81), by G. Canestrini, to which paper I am considerably indebted. Häckel has given admirable discussions on this whole subject, under the title of Dysteleology, in his 'Generelle Morphologie' and 'Schöpfungsgeschichta.'

◀1

◀2

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◀4

1 Darwin describes embryological "recapitulation," which can be summarized in Ernst Haeckel's formulation that "ontogeny recapitulates phylogeny." In the 1830s (when Darwin began formulating his ideas), recapitulation, which showed linear progress from lower to higher forms of organization, had been preached by progressive, antiestablishment London medical men, including Robert Grant, who had taught Darwin at the University of Edinburgh.[16] Though recapitulation was controversial in the nineteenth century, and in its strictest form not borne out by embryology today, the general point—that one can see connections between developing structures in the human embryo and related structures in other creatures—holds true.

2 Darwin's discussion here underscores continuity between humans and other primates, as revealed by embryological evidence, while the anti-evolutionist Richard Owen justified taxonomic separation by emphasizing the uniqueness of human traits (see p. 148), in this case citing the human big toe as a key trait that enables walking, which distinguishes the foot from the hand, and thus "gives the character to his order (*Bimana*)"—the only "two handed" primate.[17] Darwin rebuts him by pointing to the embryological report of Owen's onetime American student Jeffries Wyman (1814–1874), curator of the Peabody Museum of Archaeology and Ethnology at Harvard University, suggesting that early in development this toe resembles the size and configuration of the big toe of great apes, the "Quadrumana" (see p. 21).

3 In the work Darwin cites here, the combative Huxley asserted it had long been obvious to all with eyes to see that humans originated in a similar way to other animals, noting the answer to this question "has not been doubtful any time these thirty years."[18] "These thirty years" may be a reference to the considerable work in comparative anatomy and embryology stimulated in large part by Karl Ernst von Baer's work of the 1820s and 1830s showing the close embryological affinities of vertebrates.

4 The lion's share of this chapter, from here to its conclusion, is dedicated to the subject of rudimentary or vestigial structural traits that speak to the close relationship of humans and primates. Darwin first distinguishes between rudimentary and nascent structures.

conditions which now exist. Organs in this latter state are not strictly rudimentary, but they are tending in this direction. Nascent organs, on the other hand, though not fully developed, are of high service to their possessors, and are capable of further
1▶ development. Rudimentary organs are eminently variable; and this is partly intelligible, as they are useless, or nearly useless, and consequently are no longer subjected to natural selection. They often become wholly suppressed. When this occurs, they are nevertheless liable to occasional reappearance through reversion—a circumstance well worthy of attention.

The chief agents in causing organs to become rudimentary seem to have been disuse at that period of life when the organ is chiefly used (and this is generally during maturity), and also inheritance at a corresponding period of life. The term "disuse" does not relate merely to the lessened action of muscles, but includes a diminished flow of blood to a part or organ, from being subjected to fewer alternations of pressure, or from becoming in any way less habitually active. Rudiments, however, may occur in one sex of those parts which are normally present in the other sex; and such rudiments, as we shall hereafter see, have often originated in a way distinct from those here referred to. In some cases, organs have been reduced by means of natural selection, from having become injurious to the species under changed habits of life. The process of reduction is probably often aided through the two principles of compensation and economy of growth; but the later stages of reduction, after disuse has done all that can fairly be attributed to it, and when the saving to be effected by the economy of growth would be very small,[23] are difficult to understand. The final and complete suppression of a part, already useless and much reduced in size, in which case neither compensation nor economy can come into
2▶ play, is perhaps intelligible by the aid of the hypothesis of pangenesis. But as the whole subject of rudimentary organs has been discussed and illustrated in my former works,[24] I need here say no more on this head.

Rudiments of various muscles have been observed in many parts of the human body;[25] and not a few muscles, which are

[23] Some good criticisms on this subject have been given by Messrs. Murie and Mivart, in 'Transact. Zoolog. Soc.' 1869, vol. vii. p. 92.

[24] 'Variation of Animals and Plants under Domestication,' vol. ii. pp. 317 and 397. See also 'Origin of Species,' 5th edit. p. 535.

[25] For instance M. Richard (Annales des Sciences Nat. 3rd series, Zoolog. 1852, tom. xviii. p. 13) describes and figures rudiments of what he calls the "muscle pédieux de la main," which he says is sometimes "infiniment petit." Another muscle, called "le tibial postérieur," is generally quite absent in the hand, but appears from time to time in a more or less rudimentary condition.

1 The points that Darwin makes about rudimentary organs here and in the following paragraph were first made in chapter 13 of the *Origin*. Darwin cites "disuse" as a chief agent in causing organs to become rudimentary, but this should not be read as a Lamarckian argument. As further described here, reduction in a structure owing to lack of need or use can follow from relaxed selection (a slow process of genetic drift). Or it may be selected against and so become eliminated more quickly. In the latter scenario a trait would experience negative selection if it is costly, whether bioenergetically expensive to produce (what Darwin calls "economy of growth"), and/or reduces fitness by increasing the risk of predation, putting the individual at a competitive disadvantage, or is susceptible to disease.

2 Pangenesis was Darwin's theory of heredity, first put forth in *The Variation of Animals and Plants under Domestication* (1868). A theory of blending inheritance in which all structures of the body contribute information packets of sorts, termed "gemmules," that mix together during the reproductive process, pangenesis was already on shaky ground by the time *Descent* was published. Darwin's cousin Francis Galton had published the results of a series of experiments that did not support the theory. In 1871, the year *Descent* was published, Darwin was still fighting back, publishing a response to Galton in *Nature*.[19] Not long after, however, he was forced to abandon the theory. How could pangenes help lead to the "final and complete suppression of a part" that is already greatly reduced in size? Darwin may be suggesting that in his pangenesis theory, such a structure will produce very few gemmules, perhaps few enough to be lost altogether in the reproductive process.

regularly present in some of the lower animals can occasionally be detected in man in a greatly reduced condition. Every one must have noticed the power which many animals, especially horses, possess of moving or twitching their skin; and this is effected by the *panniculus carnosus*. Remnants of this muscle in an efficient state are found in various parts of our bodies; for instance, the muscle on the forehead, by which the eyebrows are raised. The *platysma myoides*, which is well developed on the neck, belongs to this system. Prof. Turner, of Edinburgh, has occasionally detected, as he informs me, muscular fasciculi in five different situations, namely in the axillæ, near the scapulæ, &c., all of which must be referred to the system of the *panniculus*. He has also shewn[26] that the *musculus sternalis* or *sternalis brutorum*, which is not an extension of the *rectus abdominalis*, but is closely allied to the *panniculus*, occurred in the proportion of about three per cent. in upwards of 600 bodies: he adds, that this muscle affords "an excellent illustration of the statement "that occasional and rudimentary structures are especially "liable to variation in arrangement."

Some few persons have the power of contracting the superficial muscles on their scalps; and these muscles are in a variable and partially rudimentary condition. M. A. de Candolle has communicated to me a curious instance of the long-continued persistence or inheritance of this power, as well as of its unusual development. He knows a family, in which one member, the present head of the family, could, when a youth, pitch several heavy books from his head by the movement of the scalp alone; and he won wagers by performing this feat. His father, uncle, grandfather, and his three children possess the same power to the same unusual degree. This family became divided eight generations ago into two branches; so that the head of the above-mentioned branch is cousin in the seventh degree to the head of the other branch. This distant cousin resides in another part of France; and on being asked whether he possessed the same faculty, immediately exhibited his power. This case offers a good illustration how persistent may be the transmission of an absolutely useless faculty, probably derived from our remote semi-human progenitors; since many monkeys have, and frequently use the power, of largely moving their scalps up and down.[27]

The extrinsic muscles which serve to move the external ear, and the intrinsic muscles which move the different parts, are in a rudimentary condition in man, and they all belong to the system

[26] Prof. W. Turner, 'Proc. Royal Soc. Edinburgh,' 1866–67, p. 65.

[27] See my 'Expression of the Emotions in Man and Animals,' 1872, p. 144.

◀1 **1** *Panniculus carnosus* is a kind of subcutaneous muscle that can be found throughout our bodies, though, as Darwin notes here, in some parts it is well developed and in others it is vestigial or absent altogether. Darwin discusses it extensively in *The Expression of the Emotions in Man and Animals* (1872), as several of the muscles involved in facial expression are *panniculus carnosus* muscles. Grazing animals twitch their *panniculus carnosus* (i.e., their withers) to discourage flies or birds.

◀2 **2** Darwin corresponded extensively in the 1860s and 1870s with Sir William Turner (1832–1916), professor of anatomy at the University of Edinburgh, particularly on cases of rudimentary anatomical structures in humans.

◀3 **3** Some people appear to have either better-developed muscles of the scalp or better command of them, able to contract them at will, a party trick. Darwin cites information here from Alphonse de Candolle (1806–1893), professor of botany and director of the botanical gardens in Geneva. De Candolle first described this family with remarkable hereditary scalp-muscle-contracting abilities in a letter dated 2 July 1868, commenting that he personally verified it, "and if I named the family, you would understand that I cannot be mistaken." It was his own family, as de Candolle told Darwin three years later. But he asked him not to publish the name in deference to his relatives—presumably he felt they might not appreciate being outed as champion scalp twitchers.[20]

of the *panniculus*; they are also variable in development, or at least in function. I have seen one man who could draw the whole ear forwards; other men can draw it upwards; another who could draw it backwards;[28] and from what one of these persons told me, it is probable that most of us, by often touching our ears, and thus directing our attention towards them, could recover some power of movement by repeated trials. The power of erecting and directing the shell of the ears to the various points of the compass, is no doubt of the highest service to many animals, as they thus perceive the direction of danger; but I have never heard, on sufficient evidence, of a man who
1▶ possessed this power, the one which might be of use to him. The whole external shell may be considered a rudiment, together with the various folds and prominences (helix and anti-helix, tragus and anti-tragus, &c.) which in the lower animals strengthen and support the ear when erect, without adding much to its weight. Some authors, however, suppose that the cartilage of the shell serves to transmit vibrations to the acoustic nerve; but Mr. Toynbee,[29] after collecting all the known evidence on this head, concludes that the external shell is of no distinct use. The ears of the chimpanzee and orang are curiously like those of man, and the proper muscles are likewise but very slightly developed.[30] I am also assured by the keepers in the Zoological Gardens that these animals never move or erect their ears; so that they are in an equally rudimentary condition
2▶ with those of man, as far as function is concerned. Why these animals, as well as the progenitors of man, should have lost the power of erecting their ears, we cannot say. It may be, though I am not satisfied with this view, that owing to their arboreal habits and great strength they were but little exposed to danger, and so during a lengthened period moved their ears but little, and thus gradually lost the power of moving them. This would be a parallel case with that of those large and heavy birds, which, from inhabiting oceanic islands, have not been exposed to the attacks of beasts of prey, and have consequently lost the power of using their wings for flight. The inability to move the ears in man and several apes is, however, partly compensated by the freedom with which they can move the head in

[28] Canestrini quotes Hyrtl. (Annuario della Soc. dei Naturalisti, Modena, 1867, p. 97) to the same effect.

[29] 'The Diseases of the Ear,' by J. Toynbee, F.R.S., 1860, p. 12. A distinguished physiologist, Prof. Preyer, informs me that he had lately been experimenting on the function of the shell of the ear, and has come to nearly the same conclusion as that given here.

[30] Prof. A. Macalister, 'Annals and Mag. of Nat. History,' vol. vii., 1871, p. 342.

1 Wiggling the ears is another party trick, but as Darwin points out, humans lack the one ear-moving ability that might actually be of some use—namely, pivoting the outer ear to better catch sound. We have all seen how cats, for example, can do this, their upward-directed ears swiveling like antennae to pick up sounds coming from different directions.

2 The outer ear of our closest primate relatives—chimpanzees, bonobos, gorillas, and orangutans—is precisely like ours, complete with poorly developed (vestigial) musculature. Why? Darwin's speculative scenario is one of relaxed selection in our common ancestor, analogous to the vestigial flight muscles of island-dwelling flightless birds. However, the analogy may not be perfect, since selection may actually favor diminished flight ability in the context of remote windswept islands, as Darwin speculated in the *Origin* (136).

a horizontal plane, so as to catch sounds from all directions. It has been asserted that the ear of man alone possesses a lobule; ◂1 but "a rudiment of it is found in the gorilla;"[31] ◂2 and, as I hear from Prof. Preyer, it is not rarely absent in the negro.

The celebrated sculptor, Mr. Woolner, informs me of one little ◂3 peculiarity in the external ear, which he has often observed both in men and women, and of which he perceived the full significance. His attention was first called to the subject whilst at work on his figure of Puck, to which he had given pointed ears. ◂4 He was thus led to examine the ears of various monkeys, and subsequently more carefully those of man. The peculiarity consists in a little blunt point, projecting from the inwardly folded margin, or helix. When present, it is developed at birth, and, according to Prof. Ludwig Meyer, more frequently in man than in woman. Mr. Woolner made an exact model of one such case, and sent me the accompanying drawing. (Fig. 2.) These points not only project inwards towards the centre of the ear, but often a little outwards from its plane, so as to be visible when the head is viewed from directly in front or behind. They are variable in size, and somewhat in position, standing either a little higher or lower; and they sometimes occur on one ear and not on the other. They are not confined to mankind, for I observed a case in one of the spider-monkeys (*Ateles beelzebuth*) in our Zoological Gardens; and Dr. E. Ray Lankester informs me of another case in a chimpanzee in the gardens at Hamburg. The helix obviously consists of the extreme margin of the ear folded inwards; and this folding appears to be in some manner connected with the whole external ear being permanently pressed backwards. In many monkeys, which do not stand high in the order, as baboons and some species of macacus,[32] the upper portion of the ear is slightly pointed, and the margin is not at all folded inwards; but if the margin were to be thus folded, a slight point would necessarily project inwards towards the centre, and probably a little outwards from the plane of the ear; and this I believe to

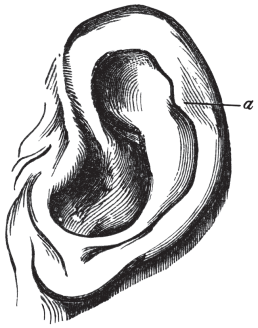

Fig. 2. Human Ear, modelled and drawn by Mr. Woolner.
a. The projecting point.

[31] Mr. St. George Mivart, 'Elementary Anatomy,' 1873, p. 396.

[32] See also some remarks, and the drawings of the ears of the Lemuroidea, in Messrs. Murie and Mivart's excellent paper in 'Transact. Zoolog. Soc.' vol. vii. 1869, pp. 6 and 90.

1 A "lobule" is the earlobe. The shape of the ear is one of the few external physical traits in which humans more closely resemble gorillas than chimpanzees, our closest genetic relatives.

2 Darwin added this comment about earlobes to the second edition of *Descent* after corresponding with English-born German developmental physiologist William Preyer (1841–1897). In letters exchanged in April and May 1871, Preyer described his work on possible functions of the external ear, relevant to Darwin's interest in rudimentary structures. Preyer maintained that only humans possess earlobes and further suggested that "the ears of the negroes have none," though he acknowledged that he could not say whether this was true of all Black Africans.[21] Note that by accepting Preyer's generalization, and (inaccurately) reporting that the earlobe is "not rarely absent in the negro" and juxtaposing this with St. George Mivart's observation that "a rudiment . . . is found in the gorilla," Darwin incorrectly represents African peoples as a linking form between primates and other human races, as was common among nineteenth-century European naturalists.

3 British sculptor and poet Thomas Woolner (1825–1892), a member of the Pre-Raphaelite Brotherhood. In 1869, he made a bust of Darwin. Posing was a "purgatory of sitting for hours," but Woolner, Darwin wrote, "is wonderfully pleasant & lightens, as much as man can, the penance." It was then that they first discussed this feature of the ear, which Darwin dubbed the "Woolnerian tip."[22]

4 Woolner made his acclaimed bronze statuette of Puck in 1847, modeling its prominent, pointed ears on those of monkeys. Darwin recorded that after sketching monkeys' ears in the London Zoological Gardens, Woolner happened to notice similar small, projecting tips along the inner rims of the ears of a person, and "instantly recognized their signification."[23] The structure, present in some human ears (fig. 2), is now variously called Darwin's tubercle or auricular tubercle, but Darwin referred to it as the "Woolnerian tip," and at least one reviewer of *Descent*, Philip Henry Pye-Smith, concurred with naming it after Woolner, dubbing it the "Angulus Woolneri" in the 6 April 1871 issue of *Nature*.[24]

be their origin in many cases. On the other hand, Prof. L. Meyer, in an able paper recently published,[33] maintains that the whole case is one of mere variability; and that the projections are not real ones, but are due to the internal cartilage on each side of the points not having been fully developed. I am quite ready to admit that this is the correct explanation in many instances, as in those figured by Prof. Meyer, in which there are several minute points, or the whole margin is sinuous. I have myself
1▶ seen, through the kindness of Dr. L. Down, the ear of a microcephalous idiot, on which there is a projection on the outside of the helix, and not on the inward folded edge, so that this point can have no relation to a former apex of the ear. Nevertheless in some cases, my original view, that the points are vestiges of the tips of formerly erect and pointed ears, still seems to me probable. I think so from the frequency of their occurrence, and from the general correspondence in position with that of the tip of a pointed ear. In one case, of which a photograph has been sent me, the projection is so large, that supposing, in accordance with Prof. Meyer's view, the ear to be made perfect by the equal development of the cartilage throughout the whole extent of the margin, it would have covered fully one-third of the whole ear. Two cases have been communicated to me, one in North America, and the other in England, in which the upper margin is not at all folded inwards, but is pointed, so that it closely resembles the pointed ear of an ordinary quadruped in outline. In one of these cases, which was
2▶ that of a young child, the father compared the ear with the drawing which I have given[34] of the ear of a monkey, the *Cynopithecus niger*, and says that their outlines are closely similar. If, in these two cases, the margin had been folded inwards in the normal manner, an inward projection must have been formed. I may add that in two other cases the outline still remains somewhat pointed, although the margin of the upper part of the ear is normally folded inwards—in one of them, however, very narrowly. The following woodcut (No. 3) is an accurate copy of a photograph of the fœtus of an orang (kindly
3▶ sent me by Dr. Nitsche), in which it may be seen how different the pointed outline of the ear is at this period from its adult condition, when it bears a close general resemblance to that of man. It is evident that the folding over of the tip of such an ear, unless it changed greatly during its further development, would give rise to a point projecting inwards. On the whole, it still seems to

[33] Ueber das Darwin'sche Spitzohr, Archiv für Path. Anat. und Phys. 1871, p. 485.

[34] 'The Expression of the Emotions,' p. 136.

(continued...)

1 Physician John Langdon Haydon Down (1828–1896) was best known for describing the condition now known as Down syndrome, or trisomy 21. Down corresponded with Darwin in 1873 over the "Woolnerian tip," or auricular tubercle, sending him a photograph of an ear from a microcephalic individual. Ludwig Meyer, also cited here, had maintained in an 1871 paper that the point was not a rudiment, reflecting instead natural variation. Down disagreed with Meyer and supported Darwin's interpretation.[25]

2 These observations were added to the second edition of *Descent*. In March 1871, Darwin asked German-born London illustrator Joseph Wolf (1820–1899) to sketch the head of *Cynopithecus niger* (now *Macaca nigra*, the Celebes crested macaque) in the Zoological Gardens, for illustrating *Expression* (the Wolf drawings appear on 136). After that book was published, British barrister Samuel John Housley wrote to Darwin about the similarity of the monkey's ears in these illustrations to those of his own child: "I felt doubtful whether this really was a reversion to the Ancestral form; but when reading your 'Expressions' I found the drawing of the ear of the *Cynopithecus niger* so closely represent the ear of my child that I could no longer be in doubt."[26]

3 Hinrich Nitsche (1845–1902), German zoologist at the University of Leipzig and, later, the Royal Saxon Academy of Forestry (Königlich-Sächsiche Forstakademie) in Tharandt, Germany. Nitsche corresponded with Darwin in April 1871, sending photographs of the head of a fetal orangutan showing the early stage ear (see fig. 3, next page) as well as photographs of his own ears illustrating the projecting point.