

THE WILLIAM OSLER MEDAL ESSAY

CHARLES DARWIN ON THE ORIGINS OF BEHAVIOR \*

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The revolution in scientific thinking that followed the acceptance of the theory of evolution by natural selection in *The Origin of Species* is an exciting chapter in the history of science and in the history of medicine, in particular. The conception of evolution and dissolution in the central nervous system formulated by J. Hughlings Jackson benefited from this new frame of mind. Less recognized is Charles Darwin's special interest in the nervous system and its relation to behavior, encouraged by his contact, through his physician father, with the common neurological problems of clinical medicine. It is of particular moment that the nervous system and behavior was the first subject studied by Darwin from the point of view of evolution immediately after his theory was formulated, although he did not publish any special work on the mind until about forty years later. His private notebooks and reading annotations can provide a glimpse of his continued interest in the origins of behavior.

Darwin's major contribution regarding the mind is his very theory of evolution by natural selection. The repudiation of the separate creation of the human mind and the assertion of the quantitative, rather than the qualitative, differences of mental phenomena in men and the lower animals had a great influence on the path of psychology. After the *Origin's* tenets were accepted, the minds of animals could be studied in the same way as man's, through analogies with introspective observation of human consciousness. Charles Darwin's personal interest in the origins of behavior is much more wide-ranging than this. His studies as a naturalist on the surveying ship, the *Beagle*, in its voyage around the world were thoroughly and popularly described in his *Journal of Researches*, first published in 1839. His notebooks during the voyage and the publication of the journal indicate no more than a chronicler's

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interest in the behavior of native tribes and their morals and customs. What is said is perceptive, but analysis is unemphasized. A savage may be seen to regard blue beads with more interest than a ship, but this observation is not followed by a comparison with animal behavior or comments on mental evolution so characteristic of later notebook entries (14). However, in July of 1837, a year after his return from the voyage, he began a series of notebooks containing notes and speculations concerning evolution. After completing two evolution-based notebooks by July of 1838, he opened two at once: one on evolution and the other entitled, "The Book Full of Metaphysics on Morals and Speculations on Expression," which was followed by a second notebook on "Metaphysics and Expression" in October, finished by about May of 1840.

In September of 1838, Darwin wrote his friend, the geologist Lyell, of "the delightful number of new views which have been coming in thickly and steadily, on the classification and affinities and instincts of animals—bearing on the question of species . . . facts begin to group themselves *clearly* under sub-laws" (15, p. 298). If one reads the notebooks, the significance of this letter is made clear: within two years after his return from the voyage of the *Beagle*, Charles Darwin was sufficiently convinced of the mechanism of evolution by natural selection to use his theory immediately to unravel another problem of biology which today is as mysterious and controversial as evolution itself: the origins of behavior in men and animals. The fact that Darwin spent the next twenty years until the publication of the *Origin* and most of the rest of his life in supporting the theory of evolution meant that he had little time to return to the problem of the mind alone.

The subjects of the two metaphysical notebooks are those that, as shall be shown, interested Darwin all his life and were prominent in his later publications. The notebooks deal with mental phenomena interpreted through an evolutionary hypothesis, rather than with the evolutionary hypothesis *per se*. Despite their rather unusual title, they deal mainly with instinct. Expression and morals, in that order of emphasis, are discussed primarily in relation to instinct. The notebooks exhibit the characteristics of scattered remarks evoked by reading and observation.

If Darwin's major concern with adequate presentation and support of his theory of evolution cut short the development of his ideas on the mind as a whole, his study of instinct in particular was thorough, but never fully published. There are four versions of the *Origin of Species*: a sketch of 1842, an essay of 1844, and the long version of 1856, of which the publication of 1859 was only an abstract prompted by events follow-

ing Wallace's coincidental conception of the same theory of evolution in 1858. The variation of instinct and other mental attributes receives emphasis prior to 1859 proportionate to its treatment in the notebooks of 1837-1840.

The hurried publication of the abstract (after presentation of the theory before the Linnean Society in 1858) broke up the continuous development of ideas on instinct in Darwin's preliminary drafts and the instinct chapter he had planned to publish. Condensation of the chapter on "Mental Powers" to less than one-half its originally-planned length changes its tone from an essay on the characteristics of instinct explained through natural selection to one largely concerned simply with the way instincts add to the supporting evidence for natural selection.

Darwin's own views on instincts are most completely presented in the long chapter of 1856, "Mental Powers and Instincts in Animals." By this time, early notebook speculation on the separation of migration into "components" of instinct and faculty, as well as the beginnings of his special emphasis on chance variation, is clearly developed. It shows that his interest in instinct extended beyond its support of his theory; it is the fullest development of a continuous, twenty-year pattern of study.

In contrast to the fate of Darwin's views on instinct, his work on the expression of the emotions found separate and complete publication in 1872. Much of the 1838-1840 notebook speculation on expression is almost literally transposed to this later publication. Expression is organized under the following headings: emotions as serviceable associated habits (i. e. producing expression through habit and association rather than because of utility in a particular situation), "antithesis" (the strong and involuntary tendency to perform movements of a directly opposite nature to the state of mind induced), and "actions due to the constitution of the nervous system" (i. e. arising independently of the will and to a certain extent of habit) (16, pp. 28-29). The greater part of the book deals with specific expressions, and it is here that the notebooks of 1838-1840 are most closely followed. The work can clearly show many refinements of, and conclusions from, the notebook speculations.

In this general survey of the development of Darwin's interest in the origin of behavior, it can be concluded that after he became convinced of the theory of evolution by natural selection, he immediately used this theory to explain some puzzling aspects of another segment of biology, the minds of men and animals with particular reference to instinct and expression. His first thoughts have the spontaneity and lack of organization or qualification characteristic of private notes and are eliminated, or

become guarded, in later publication. It is therefore necessary to study the entire range of his writings, published and unpublished, to find his views on the mind.

If Darwin developed his theory of evolution and views on the mind very early in his scientific career and retained them with constancy after this time, he nevertheless relied on a great variety of sources in developing them. He has been very kind to the historian by being quite unkind to his books, many of which contain extensive annotations and added notes. Together with his reading lists, these sources show that his interest in the mind as demonstrative of the forces of evolution by natural selection began in earnest with his reading between February and June of 1838.

Physiognomy, as a method to discern character by outward appearance, served as source material particularly for Darwin's views on expression. During the writing of his preliminary notebooks on the mind, Darwin read Mayo on the pathology of the human mind and the Wells lecture on instinct. By January of 1840 he had completed the first volume of the *Elements of Physiology* by Johannes Müller, with neurophysiology quite appropriately receiving most of his attention. He read the second volume more than a year later, and it contains approximately the same proportion of annotations on mental phenomena as the first. The books were skimmed again before the writing of the *Expression of Emotions* in 1872, for which more page references were gleaned.

It is quite clear that Darwin read Müller with the question of the physical basis of mental phenomena quite prominent in his thoughts. To Müller's mention of Cuvier's view of instinct, "that animals acting from instinct are . . . possessed by an innate idea, by a dream" (12, p. 25), Darwin adds, "The inherited structure of the brain must cause instincts; this structure might as well be bred, as any other adapted structure." Apart from our knowledge of the effect of gross defects on normal brain functions, little more can be said of the behavioral significance of structural variation today (21, p. 346). The effect of habit on the material basis of instinct is hypothesized by Darwin in underlining the statement of Müller that "*There must be something connected with their original foundation, which gives these nerves an especial tendency to reciprocal action*" and noting in the margin, "The connection here is hypothetical, why not custom?" (12, p. 719). Darwin also particularly marks a section by Müller on the expression of emotions and its relation to phrenology:

It is probable that there is in the brain a certain part or element . . . the excitement of which causes every idea to acquire the intensity of emotion . . . but the existence . . . cannot strictly be proved, or its locality be demonstrated . . . the

doctrine of . . . phrenology does not . . . involve any impossibility; but there are no facts . . . to prove the correctness of the hypothesis generally (12, p. 837).

Darwin attempts a personal definition of instinct. After a rather vague passage in the *Physiology* (12, p. 721): “. . . the centripetal action of the nervous principle excites, at the same time, sensation; in the latter case of an instinct it does not, but is still adequate to the production of a reflex motion, or centrifugal reflection,” he remarks, “May not a movement be said to be instinctive, when it becomes reflex, without connection with true sensation at least accompanied by consciousness?”

Following his reading in physiology, Darwin consulted *Blackwell's Researches in Zoology*, with references at the end, “chiefly on instincts” (5, CD 119).

The years 1846 and 1847 seem to be ones of further interest in the subject of instinct and expression, and works on the instinct and intelligence of animals by C. J. Lernz and Flourens were studied. With the exception of Dr. Holland's work on mental physiology read in 1852, no other interest is shown in writings on the mind to the termination of the reading lists in 1860 (5, CD 119, 120, 128).

Besides his written source material, Darwin's thought on the mind was enriched through personal contact with a number of individuals, particularly Sir James Mackintosh and his own father, Dr. Robert Darwin. Sir James was for Charles “The best converser on grave subjects to whom I ever listened” (15, p. 43), but his remarks on the mind in his *Dissertation on the Progress of Ethical Philosophy* received Darwin's most bitter criticism. The claim that the “useful qualities” of the mind are morally improved because “They are entirely conversant with volitions and voluntary actions, and in that respect resemble the other constituents of conscience with which they can blend” (10, p. 277) is marked by Darwin, “Nonsense. Similar association . . . involuntary, unconscious.” The difference between Mackintosh's more cognition-based attitudes toward involuntary action and the biological outlook of Darwin comes out most sharply in response to the former's view that “Conscience . . . has a direct action on the will and a constant mental contiguity . . . to it” (10, pp. 380-383). Darwin adds, “Trash because the primary instinctive feeling leans to action like an emotion.” Then, double-underlined on the next page, we read: “Emotion having been formed by actions will always lead to them.” Mackintosh's discussion is marked “poor” two pages later. It can be inferred that the primary concern with conscious activity evidenced in Mackintosh's general remarks goes quite strongly against Darwin's instinct-centered views. Darwin under-

lines and appears to accept the distinction that: " Perception and emotion are states of mind perfectly distinct; and an emotion of pleasure and pain differs much more from a mere perception than the perceptions of one sense do from those of another " (10, p. 152). It appears that his disagreement with Mackintosh's general remarks on the mind stems from the unclear distinction of the knowing and emotional, or cognitive and affective, states of mind.

Of particular interest in Darwin's source material is his attitude toward a rival evolutionist, J. B. P. A. Lamarck. Darwin has inscribed his copy of Lamarck's *Philosophie zoologique* as a " very poor and useless Book " (13), but he notes on reading volume II that " Habits become hereditary from the instincts of animals.—almost identical with my theory—no facts, and mingled with much hypothesis " (2, p. 91).

Perhaps the most direct medical influence on Charles Darwin's views of the mind came from his father. The first thirty pages of the 1838 notebook on " Metaphysics and Expression " have entries that begin predominantly with " My father says. " Such entries encompass case histories of aphasia, examples of seemingly inherited behavior in the posthumous children of patients, and the like. The case of a Mr. Corbet, who could receive a new train of thought by eyesight and not by ear and could recognize his old gardener by sight and not by name, is discussed at some length. Besides case histories, a good deal of Dr. Darwin's personal brand of psychology is entered in the notebooks without criticism or comment :

My father says there is a perfect gradation between sane people and insane—that everybody is insane at some time. Mania is quite distinct, different also from delirium—peculiar complaint stomach not acted upon by emetics.—people recognized—sudden change of disposition, like people in violent intoxication, often ends in insanity or delirium (1, p. 13).

Darwin may be considered in agreement with Pinel's view that " revolution " produces " mania " in his observation that :

Insanity is produced by mortal causes (ideally by fear Chile earthquakes) in people—Who . . . otherwise would not have been so. In Mr. Hadynge, was caused by thinking over the misery of an attempt at Rome where by accidental delay of money he was nearly thrown into a hospital. My father was nearly drowned at High Enoll, the thought of it for some years after, was far more painful than the thing itself (1, p. 16).

Here Pinel's observations during the French revolution and Darwin's experiences on the *Beagle* voyage lead to the same conclusions that the environment may produce mental disease. Darwin appears to appreciate the difficulty in diagnosing mental disease in saying :

There are numberless people insane of particular ideas, which are never generally, if at all discovered . . . Sometimes comes on suddenly from . . . in others from drinking strong drink. Their brain affected like getting suddenly into passion—There seems no distinction between enthusiasm, passion and madness. My father just believes my grandfather's doctrine is true that the only cure for madness is forgetfulness (1, p. 8).

Senility as well as aphasia is particularly discussed with reference to its clues to the nature of instinct and other mental phenomena:

People in old age exceedingly sharp in some things, though so confused in others. Mrs. P. when in state above described (forgetting that her husband was dead) yet instantly perceived when my Father to direct her attention, took her left hand to feel her pulse—what fails first? How is this? Does memory bring in old ideas? (1, p. 22).

Occasionally the study of mental degeneration is contrasted with lower animals, and the conclusion can be generalized:

(N.B. affections very soon go in . . . maniacs) In Aunt B. the affections seem to have failed even more than the memory. Therefore affections effect on organization which can hardly be doubted when seeing hiena with her puppy. The common remark that fat men are good-natured and vice versa? Walter Scots remark how odious an ill-tempered fat man looks, shows some connection between organization (1, p. 27).

Darwin's wonderings and his interest in aphasia and the effect of cerebrovascular accidents or arteriosclerosis on the function of memory are continued in the comparative study of behavior. He clearly expresses his wish to treat behavior from neurological first principles and claims that his theory of evolution allows him to do this:

Can we deny that brain could be intermediate like rest of body? Do we deny that brain of greyhound and spaniel differs from their bodies. Can we deny relation of mind and brain then can we deny the grandchild doing for me [i. e. "inheriting" behavior from CD] is from some peculiarity of structure of brain?—is this more wonderful than memory affected by diseases, etc. dark consciousness? (4, I, p. 28).

Phrenology was quite widespread, but as widely ridiculed, at the time the notebooks were written. Darwin did not discriminate against such material but studied it with a particular bias towards his materialistic views of the mind. He states, "One is tempted to believe phrenologists are right about habitual exercise of the mind, altering form of head and thus these qualities become hereditary" (1, p. 30).

Darwin's material is very varied in both content and author: Philosophy, biology, and medicine, written treaties and spoken case histories,

are all used for an understanding of the normal and pathological states of the mind from both a theoretical neurological and a behavioral base. Reading, as well as personal observation, plays an important part in Darwin's early speculations, and a study of his books and reactions to them gives a clearer idea of his early views on the origins of behavior.

Darwin's main point of orientation is biological, and he emphasizes this at the outset with the assertion that:

Experience shows the problem of the mind cannot be solved by attacking the citadel itself—the mind is a fraction of body—we must bring some *stable* foundation to argue from (2, p. 5).

The belief of the connection of mind and body was certainly not a new idea: it had been emphasized by the German clinician and chemist Georg Stahl 130 years before Darwin began his notebooks (24). But Darwin's treatment of the subject is interesting to relate. In one early comment, he does not seem far from Lamarck's inherited acquired variation (of behavior, not morphology) when he states:

an habitual action must some way affect the brain in a manner which can be transmitted—this is analogous to blacksmith having children with strong arms.—the other principle of those children which chance produced with strong arms, outliving the weaker ones, may be applicable to the formation of instincts, independently of habits (2, p. 42).

Further speculation on a material base of mental phenomena inquires into the nature of latent feelings:

. . . is an argument for materialism that cold water brings on suddenly in head, a frame of mind, analogistic those feelings, which may be coincident in the potential (1, p. 19).

Utilizing Edmund Burke's *Essay on the Sublime and the Beautiful*, he notes that "on mimicking expression of emotions, the passions are felt . . . the mind sympathizes with internal organs, as action of heat" (2, p. 10).

The autobiographical comment that "everything which I thought or read was applied directly to what I had seen or was likely to see" (15, p. 63) might be modified to "everything which I thought or read was subjected to my evolutionary hypothesis." Plato's ideas or forms, as an example, exist for Darwin only to be reinterpreted:

Plato [wife] Emma says, in *Phaedo* that our "imaginary ideas" arise from the preexistence of the soul, as not observable from experience—read monkeys for preexistence (1, p. 128).

The genesis and development of the moral sense would, from the title of the notebooks, be expected to appear more prominently in Darwin's speculations than is the case. Nevertheless, the subject is studied, as are other more tangible characteristics of the mind, with conclusions drawn from personal observations and reading. Mixing his *Beagle* voyage with reading in philosophy, Darwin notes:

. . . savages (mem. York Minster) consider the thunder and lightning the direct will of God (and hence arises the *Theological* state of science in every nation according to M. le Comte) (1, p. 135).

There is no universal moral sense, and conscience varies in different races. This is "no more wonderful than dogs should have different instincts." Together with a discussion of the origin and nature of the moral sense in man, its relation to instinct through evolutionary hypothesis allows Darwin to state that the strong instinctive desire to live, eat certain foods, and propagate the race through fixed patterns of behavior is the reason that suicide, cannibalism, and sexual perversion are looked upon with such strong feelings of moral distaste (2, p. 100). With this relation to instinct comes a comparison (or discovery) of moral feelings such as shame in dogs and other animals (2, p. 24).

Darwin's most philosophical interest regarding the mind is concerned with the problem of free will and determinism. If the mechanistic theory of evolution by natural selection is accepted, and if man as an organism has very little control over the chance variations which are perpetuated by natural selection to form new races or species, how is he to determine much of the course of his own existence? Free will becomes indeterminate:

appetites urge the man, but indefinitely, he chooses (but what makes him fix!?)—frames of mind, though perhaps he chooses wrongly—and what in frame of mind many do—I really believe free will and chance are synonymous (1, p. 31).

In this respect Darwin would have had Sir William Osler's blessing with his note:

Brown *Religio Medici*, p. 21-24, curious passages showing how easily chance and wish of Deity are confounded: applicable to free will.

In a long passage, it is stated that if puppies have free will, so do all animals, oysters and polyps included. A plant does in some sense, but in the absence of pain and pleasure actions are unavoidable and can only be changed by habits.

Thus free will (if so called) makes change in bodily organization of oyster. So may free will make change in man.—the real argument fuses on hereditary disposition of instincts . . . My wish to improve my temper, what does it arise from but organization (1, p. 73).

Thus free will is possible only in the spontaneous variation necessary for the evolution of new species: such a view of instincts and inherited behavior can be attributed only to someone Darwin calls an "atheistic predestinarian" (1, p. 74).

While anthropological and philosophical interests take up some of Darwin's attention, the bulk of his early speculations and later research on the origin of behavior is concerned with an objective view of its two most evolutionary elements, the nature of instinct and the expression of the emotions.

With the constant change of species introduced by natural selection, morphological classification cannot be absolute, and the fixed number and characteristics of the species of Linnaeus are rendered nonexistent. This same phenomenon prevents absolute classification and description of instinct, habit, and intelligence.

Darwin's notebook comparisons of men with animals are supported by observations largely made by himself in the London Zoo and in his garden at Down House, rather than simply abstracted from reading. Through such personal observations as that of "George the cowardly lion" at the Zoo (2, p. 98), variation in character (in this case the state of particular emotions) can be seen independent of other behavior species. Darwin's closest comparison of monkeys and men is made in observing Jemmy Button, the Fuegian native captured as a hostage by Captain FitzRoy in 1830 and returned to South America on the voyage in which Darwin participated. A monkey in a passion appears to Darwin very much like Jemmy (2, p. 96).

As has been mentioned, Darwin's publications on the origin of behavior were much more conservative than his personal ideas. All versions of the *Origin* chapter on instinct, from 1842 to 1859, contain the remark:

Be it remembered I have nothing to do with origin of memory, attention, and the different faculties of the mind, but merely with their differences in each of the great divisions of nature (17, p. 54).

Darwin laces his argument rather tightly: he states that "It would require a most able metaphysician to explain how many primary qualities of the mind must be changed to cause these diversities of complex dispositions" (17, p. 136)—which does not give much hint of his own notebook speculation on "primary qualities." It has been shown that

Darwin tended to a materialistic explanation for these phenomena in the instinct notebooks. In the essay, he naturally enough wished to present his theory of evolution as irrefutably as possible, and one method to this end was the exclusion of such speculations. There is a slight allusion to the more definitely-phrased materialistic theories of the notebooks when Darwin states, "One is forced to admit that mental phenomena (no doubt through their intimate connexion with the brain) can be inherited" (17, p. 138), but no further discussion of the connection is offered. Despite a lack of speculation on the nature of the mind, sources and observations prevalent in the notebook, particularly those of Müller's physiology and the case histories of Dr. Darwin, reappear frequently in the essay of 1842.

A note added to the essay suggests, "Give some definition of instinct, or at least give chief attributes" (17, p. 141). Darwin appears to find the listing of chief attributes the more possible task. He mentions: invariability, absence of knowledge of the end for which the action is being performed (sometimes associated with reason), and instincts' being subject to mistakes and associated with certain states of the body and time of the year (17, p. 140).

By March of 1858, Darwin completed his chapter on instinct, which was to be cut drastically for publication the following year. The long chapter gives particular source references, which the abstract of 1859 lacks; it also illustrates what Darwin would have liked to mention about instinct, if circumstances had not forced him to "cut his cloth to measure." The years between 1844 and 1856 saw additional research into instinct as well as other subjects treated in the *Origin*. However, a comparison of notebook entries and the long version of the instinct chapter indicates that research after 1844 was undertaken primarily for additional support of conclusions already reached in 1839. In this chapter, a conclusion reached through personal speculations or observations in earlier notes is often supported by a later and nonpersonal reference. Visits to the London Zoo, talks with the "intelligent keeper" (2, p. 97), and observations of cowardly lions are frequently replaced by more reputable, published sources. Another case of such secondary reference relates to the physical base of mental phenomena. By the time of the writing of the instinct chapter, Darwin can state confidently:

Indeed I suppose that it will hardly be disputed that when an instinctive action is transmitted by inheritance in some slightly modified form, this must be caused by some slight change in the organization of the brain. This is expressly Sir B. Brodie's opinion, in his *Psychological Inquiries*, 1854, p. 199 (3, p. 28).

Reference is made again in the long chapter to the case histories of Dr. Darwin, which occur so frequently in the notebooks and appear in the essay of 1844. Again it can be seen that the long chapter provided a greater variety of topics than were treated in the published *Origin* of 1859. It includes a case history of a child, whose father had died in her infancy, who moved her hands in a peculiar fashion as early as her fourth year. Her father had "precisely the same trick" under the same frame of mind (3, p. 32). This case is not mentioned in the published *Origin*, although it illustrates the kind of observation that forced Darwin to discuss the inheritance of acquired habits as a real possibility in his notebook speculations. However, there is a new emphasis on the primacy of chance variations in evolution, as comb-making in bees and slave-making instincts in ants can illustrate:

it is highly important, as it shows, if our theory be true, that the most wonderful and complicated instincts may be acquired through the continued selection of slight modifications of the parental instincts, without the smallest aid having been derived from inherited habits (3, p. 87).

The change in Darwin's emphasis from the rather equal treatment of chance variation and inherited habit can be attributed to the desire for strong support of the theory of natural selection rather than to new facts showing the predominance of chance variation in behavior. It is quite significant that Dr. Darwin's "many cases of children, whose parents had died during their infancy, who inherited all sorts of the slightest peculiarities" (3, p. 32), are mentioned in the section on "instincts under domestication." Acquired instincts therefore arise significantly only under *domestication*; spontaneous variation occurs as the essential part of *natural* selection.

With all of Darwin's concern with, and development of, ideas regarding instinct, he was never able to treat it precisely, as variation was found to be much greater in behavior than in morphology. The problem of formulating a definition of instinct was felt on reading Müller's *Physiology*, as Darwin writes on the flyleaf:

It seems to be most difficult to separate a really habitual (if such there be) hereditary habit from real mental willed actions, which the consciousness does not perceive from want of attention, in same manner as it does not all circumstances impressions of the senses—(12).

The zoologist Owen seems no help in separating habit and instinct, as Darwin adds:

Owen says he can perceive not much difference between reflex actions and effects of habit (he conceives a habitual action takes place through the spinal cord) (12).

Habit, reflex, and mental willed action are all transmitted through different modifications of variation and natural selection, and they need to be distinguished. In the 1842 and 1844 preliminary forms of the *Origin of Species*, Darwin relies on the definition of instinct by Lord Brougham, that animals "do not know objects for which they do it" (17, p. 55). However, this was only a partial characterization of instinct, and in the published *Origin* of 1859, Darwin refuses to offer any definition of instinct, as "every one understands what is meant" by the various observed behavioral patterns entitled "instinct" (18, p. 191). The ambiguity that has surrounded the term instinct ever since Darwin's time has been responsible for its disrepute in the fields of zoology, or more particularly psychology (22), although it has gained recent favor in the ethological writings of Lorenz and Tinbergen. (K. Lorenz, *King Solomon's Ring*, New York: Crowell, [1952]; N. Tinbergen, *The Study of Instinct*, Oxford: Clarendon Press, 1951.)

Following publication of the *Origin of Species*, the particular characteristics of evolution as it applies to man were studied in the *Descent of Man*, published in 1871. The mind is dealt with very pragmatically; indeed, Darwin states, "My object . . . is to show that there is no fundamental difference between man and the higher animals in their mental faculties" (19, p. 66). Such a purpose is certainly in agreement with the notebook speculation thirty years earlier that:

. . . the mind of man is no more perfect than instincts of animals to all and changing contingencies, or bodies of either.—Other descent, there is the Origin of our evil passions!!—The Devil under form of Baboon is our grandfather! (1, p. 123).

As has been stated, Darwin chose to develop the first part of this notebook comment into a strong argument, leaving the latter implication for his popularizers to emphasize.

Instinct is treated more generally in the *Descent* than the *Origin*; the comparative study in the *Descent* leads Darwin to observe that man has some few instincts in common with animals, such as self-preservation, sexual and maternal love, and the desire of the infant to suck; but that he has fewer instincts than animals closest to him in the series (19, p. 66). The fewness and simplicity of instincts in the higher animals contrast sharply with the lower animals, and the more complex instincts seem to have originated independently of intelligence (19, p. 67). Following the *Origin*, Darwin repeats that instinct depends on inherited modification of the brain, here implied by the interference between the development of free intelligence and instinct. The modern view of such a physical basis is more comprehensive but not much more firmly established:

Inherited behavior is not conclusive until the physiological basis of that trait has been demonstrated. The physical basis of behavior under modern genetic theory is based not only on inherited structure of the brain, or neuron arrangement, but also enzymes, and hormones acting outside the central nervous system (21, p. 346).

The one work which best illustrates the constancy of Darwin's treatment of the mind over a period of thirty-five years is the *Expression of the Emotions in Man and Animals*, published in 1872. Much early notebook speculation on instinct and expression is almost transposed to this later publication. Darwin states that his conclusions are based on the study of infants, the insane, the "galvanization" of facial muscles, on art, and on a comparative investigation of expression amongst the various races of mankind and in the animal kingdom (16, pp. 13-17). He treats the origin of expression from the principles of serviceable associated habits, antithesis, and the direct action of the nervous system. This last is the approach we are perhaps most familiar with today, for instance in the work of Cannon (20) and Papez (26). It was not original with Darwin, for he later notes a passage of Maudsley in 1876:

But emotions have other channels of discharge besides muscular movements. . . . When emotional excitement is not discharged by motor channels it is apt to affect the internal viscera; it . . . influences to a great extent the secretions and movements of the stomach and intestines (11, p. 384).

The very great collection of specific examples of expressions in the book is justified as follows:

A brief consideration of the outward signs of some of the stronger sensations and emotions will best serve to show us, although vaguely, in how complex a manner the principle under consideration of the direct action of the excited nervous system of the body, is combined with the principle of habitually associated, serviceable movements (16, p. 69).

Treating the special expression in animals, Darwin emphasized the difference in degrees of expression, as well as instincts; the ruminants "are remarkable from displaying in so slight a degree their emotions or sensations, excepting that of extreme pain" (16, p. 129). On the other hand, the baboon is quite expressive, and can rapidly move his jaws and lips analogous to laughing in man (16, p. 133). Darwin's own visits to the London Zoo thirty-five years earlier led to a number of observations in the notebooks; close to the above remark in the *Expression* is the note:

I see monkeys grin with passion and make noise like stit-tit-tit—quickly, unconsciously through teeth, this the keeper thinks is from pleasure and may be compared to laughter (1, p. 106).

Among the special expressions, weeping is analyzed as an interaction of nerve-force, association, and influence of the will. The emotion of grief underlying the weeping is considered in its more neurological aspect in the earlier notebooks:

Think whether there is any analogy between grief and pain—certain ideas hurting brain, like a wound hurts body—tears flow from both, as when one burns end of nose with a hot razor (2, p. 45).

A comparison of the notebooks and the published work on expression shows how some of the notebook discussions of expression were refined and brought to a conclusion. The comment, "What is absurdity, why does one laugh at it—" (2, p. 113) is answered partially thirty-five years later:

. . . with the mind, something unexpected—a novel or incongruous idea which breaks through an habitual train of thought— appears to be a strong element in the ludicrous (16, p. 200).

Certainly not all of the doubtful points of the notebooks are cleared up with publication of the *Expression*. Darwin remarks in 1838:

. . . is shame, jealousy, envy all primitive feelings, no more to be analyzed than fear or anger? I should think shame would be more analyzed than jealousy, because less discoverable in animals than latter (1, p. 148).

The *Expression* generalizes the query rather than answers the question. Darwin states here: "It is doubtful whether the greater number of the . . . complex states of mind [jealousy, etc.] are revealed by any fixed expression, sufficiently distinct to be described or delineated" (16, p. 261).

One of the most fully-treated groups of expressions in both the notebooks and the *Expression* is that accompanying the emotions of shame and modesty, particularly the phenomenon of blushing. Darwin emphasizes blushing as "the most peculiar and the most human of all expressions (16, p. 309). The main explanation for blushing in the *Expression* is that attention of the mind directed "more frequently and earnestly" to the face than any other part of the body "probably affords a sufficient explanation" for blushing in that area (16, p. 315). In the *Expression*, the initiation of blushing through the idea of self-attention is broadened to include the action of attention directed to other parts of the body, e. g. intestines, glands, and even the heart (16, p. 338). The interest in blushing appears to be pursued actively in the reading of the West Riding Lunatic Asylum reports of J. Crichton Browne, published in 1871-1872. Here there is a suggestion of some rudimentary pharmacological interest,

as Darwin is quite interested in reports of a "case history of an epileptic patient inhaling nitrite of amyl for one-half a minute, bringing a bright red scarlet flush appearing on the face, extending to the nipples" (1871). Later references deal with experiments using ether and nitrous oxide, or conium maculatum, and with the work of Claude Bernard on the effects of opium. Darwin's most provocative comment follows a remark that conia [conium] acts on the motor centers of the brain (9 (1872), p. 27), where he adds, "but I tried Hyoscyamus" (a mydriatic alkaloid). Unfortunately a report of Darwin's pharmacological work is not immediately available. Darwin also notes, in Browne's reports, a reference made to "Dr. Hughlings Jackson's reports of singing by speechless and hemiplegic children, who, at other times were dumb" (9 (1872), p. 297).

An interesting reversal of cause and effect is seen in comparing notes on anger in the notebooks and the *Expression*. The comment of the 1838 notebooks is:

In reflecting over an insane feeling of anger which came over me, when talking one evening when tensed to the pianoforte, it seemed solely to be feelings of discomfort . . . may not passion be the feeling consequent on the violent muscular exertion which accompanies violent attack. Even the worm when trod upon turneth . . . (2, p. 52).

This early view of tenseness as a source of anger is reversed in the *Expression* thirty-five years later: it describes the excited brain during anger affecting the body condition in a number of ways (16, p. 237 ff.).

Another relation of the physical state of the individual to his emotional state refers to disgust: there is the sensation accompanied by nausea "when the stomach is a little upset at thought of almost anything. . . ." The (2, p. 113) association of ideas is mentioned both in the notebooks in a somewhat unusual architectural analysis ("new buildings look ugly because there is some connection between them and great messiness of work (in construction)—") (2, p. 31) and in the *Expression*, which states that ill-treated food is disgusting because of the "association . . . between the sight of food . . . and the idea of eating it" (16, p. 257).

To sum up, Darwin's assertion of the similar emotions of men and animals allowed study of expression as a smooth gradation from the lowest animal to the most civilized man, with savages, children, and the insane exhibiting expression closest to the most intelligent animals.

A comparison of source material with Darwin's later, published writings shows a marked omission of the more philosophic or literary writers prominent in the notebooks thirty-five years earlier; they even exclude a

charming photograph of "Alice in Wonderland" submitted by Lewis Carroll (the Rev. C. L. Dodgson) "a girl about ten years old, made to smile by being asked whether she would not like never to have more lessons" (5, p. 3). References are mainly to naturalists, physiologists, psychologists, and the like.

In the sciences he knew best, Darwin is quite scrupulous. The third edition of Charles Bell's work on *The Anatomy and Philosophy of Expression* was consulted in 1866, and where Bell tries to make a case for mind and muscle:

The most remarkable muscle in the human face is the corrugator supercillii which knits the eyebrows with an enigmatic effect which *unaccountably, but irresistibly conveys the idea of mind* (8, p. 139).

Darwin underlines the above, adds "monkey here? . . . I have seen well developed in monkeys . . . I suspect he never dissected monkey." This can be seen as consistent with his biologically-oriented treatment of the origins of behavior.

The sources most studied by Darwin at the time of writing the *Descent* and *Expression* were the writings of Alexander Bain, whose *Senses and the Intellect* (2nd edition, 1864) and *Emotions and the Will* (2nd edition, 1865) were carefully annotated. Bain reciprocated this interest in a review of the *Expression* in 1873, when he stated that Darwin "has not made use of evolution to explain complex feelings or complex intellectual powers—in the third edition [of *The Senses and the Intellect*] I plan to" (23), which may be the subtlest form of flattery.

Darwin's comments in studying Bain seem, despite his early reading of Müller's *Physiology*, to be behavioral, rather than rooted in a neurophysiological approach. To the comment by Bain, on the supposed neurophysiology of a dog, "But the physical outburst does not represent a mental mood, it only gives evidence of the molecular energy of the nervous centers" (6, p. 700), Darwin adds, "But he does not jump for joy like a child or clap hands." At other times, he harks back to his earlier neurophysiological reading, as in a passage of Bain scored by Darwin:

The completely different expression of the features in different passions shows that, according to the kind of feeling excited, entirely different groups of the fibers of the facial nerve are acted on. Of the cause of this we are quite ignorant (6, p. 279).

Darwin marks in the margin at this point, "Müller." Darwin disagrees with some of Bain's observations on human psychology, as he marks after a passage that describes:

In the gambols of the young, we see the advantage of coupling the two facts—mental delight, and bodily energy. Introduce some acute misery into the mind at that moment, and all is collapse, as if we had struck a blow at the heart (6, p. 292).

Darwin adds, "General effects of pleasurable, exciting and peaceful *expressing*, . . . (?) hardly in young child." He sees that not all emotions can be seen in expression, appending a note on reading Bain (7, p. 6): "When poets speak of green-eyed jealousy they must find it impossible to give certain and plain characteristics. Bain calls Love a sensation not an emotion." This thought becomes the statement in the *Expression* that "painters can hardly portray suspicion, jealousy, envy, etc., except by the aid of accessories which tell the tale; and poets use such vague and fanciful expressions as 'green-eyed jealousy'" (16, p. 79).

Darwin studied a great variety of material for its relevance to his theory of evolution by natural selection and its bearing on the mind. His studies were a constant testing of material with his theory, which can partly account for his lack of acknowledgment to other writers. When more strictly psychological and physiological works were available at the time of his publications, and a choice could be made between them and others, the more scientific studies were preferred. Darwin is seen to examine all material with a very strong bias towards his own theories, effectively ignoring the view of other writers while taking advantage of their "new facts." This bias has been characterized as the "antibodies of natural selection," immunizing Darwin against ideas on the mind contrary to his own (27, p. 400).

A review of all of Darwin's writing, rather than only his best-known works, shows that his interest in the origin of behavior extends beyond the theory of evolution by natural selection, through philosophical, anthropological, and biological considerations, and develops in almost complete form very early in his thought. The thirty-five years between first speculations and final publication are a time of research for substantiation of early thought.

The speculation of the early notebooks is ambitious; Darwin himself announces in the very positive statement that:

Origin of Man now proved—Metaphysics must flourish—He who understands baboon, would do more towards Metaphysics than Locke (1, p. 84).

Acceptance of a theory of morphological evolution would rest on its explanation of the corresponding mental evolution. More than twenty years before publication of the *Origin of Species* and the beginnings of

general acceptance of his theory, Charles Darwin anticipated its acceptance and looked to the furthering of the study of the origins of behavior. By the time he came to publish material on the nature of the mind, he called attention to the new emphasis on the study of such phenomena as the expression of emotions:

We may conclude that the philosophy of our subject has well deserved the attention which it has already received from several excellent observers, and that it deserves still further attention, especially from any able physiologist (16, p. 366).

Darwin's comparisons of the minds of animals and men have been criticized for their optimistic anthropomorphic conclusions. However, in the broadest sense his questions are often as unanswerable, but as enthusiastically studied, today. The biological field of ethology, or the comparative study of animal behavior, reflects much of Darwin's outlook. A relatively new disciple speaks of the "surprisingly modern" character of Darwin's work on behavior and calls attention to the lack of studies in comparative behavior following his publications (25). Arbitrary classification, ignorance of the origin of instinct, and the difficulty of separating it from learned behavior, all plague the modern researcher.

The treatment of mental phenomena with biological hypotheses was of continuing interest to Darwin from his return on the *Beagle* in 1837 until his death in 1882. His conclusions regarding instinct and expression are of significance for the history of psychology, but his greatest influence comes not from these studies but from his strengthening of the conception of the continuity of animal and human origins of behavior, which could have been derived from his more strictly evolutionary writings alone. Darwin's comparative study of animals and men, the primary differentiation being quantitative rather than qualitative, was his chief contribution to the study of the mind.

The present essay, however, does not concern itself with Charles Darwin's most important contribution to any particular field. Rather, it has presented further evidence for his great diversity of interests. His work on geology and biology is well-known; his interest in mental phenomena should be recognized as both continuous and deep.

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