From The Darwinian Heritage, pp. 121-154. Edited by David Kohn. Princeton: Princeton University Press in association with Nova Pacifica, 1985.

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DARWIN'S EARLY INTELLECTUAL DEVELOPMENT: AN OVERVIEW OF THE *BEAGLE* VOYAGE (1831–1836)

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Introduction

In December 1831 H.M.S. *Beagle* departed England on a five-year circumnavigation of the globe. The principal objectives of the *Beagle*'s voyage were to survey the southern coast of South America and to perform a series of chronometric measurements around the world. On board as ship's naturalist sailed a young man, Charles Robert Darwin, who had yet to pass his twenty-third birthday. Earlier that year Darwin had taken a degree at Cambridge University, without honors, in preparation for becoming a clergyman. His self-described qualifications for the post of ship's naturalist were those of an amateur "hunter of beetles, and pounder of rocks", and he was, in fact, the third person to receive the offer (*LL* 1:254). In the words of Professor John Stevens Henslow at Cambridge University, Darwin was quite simply "the best qualified person I know who is likely to undertake such a situation" (*LL* 1:192).

Despite his seemingly modest accomplishments, Darwin subsequently made a number of observations and discoveries during this five-year voyage that were to revolutionize the science of biology. Although Darwin's theory of evolution by natural selection did not become widely known until the publication of the *Origin of Species* (1859), his theory was developed in many of its most essential features by 1838, within two years of his return to England. Quickly recognized as one of England's foremost men of science, Darwin was elected to the Council of the Geological Society of London in 1837 and became its Secretary in 1838. Even before publication of his *Journal of Researches* (1839), he was known well enough that young Joseph Hooker, upon applying in early 1839 for the post of ship's naturalist aboard H.M.S. *Erebus*, was told by Captain Ross that only such a person as Mr. Darwin would be accepted. And to this Hooker replied, "what was Mr.

D[arwin] before he went out? . . . the voyage with FitzRoy was the making of him . . ." (L. Huxley 1918, 1:41).

The role of voyages in the education of nineteenth-century naturalists has yet to be given sufficient attention, as Mendelsohn has noted (1964, p. 53). Charles Lyell, T. H. Huxley, Alfred Russel Wallace, Henry Walter Bates, and Joseph Hooker — to name just a few naturalists — all took extensive voyages to other parts of the world in the tradition of the great Alexander von Humboldt, whose multi-volume *Personal Narrative* of the places he visited served as a model for Darwin's own *Journal of Researches*.[1] Unfortunately, Darwin's *Journal of Researches*, largely rewritten for publication after his return to England, reveals little of the actual change that the *Beagle* voyage brought about in his life. As one commentator has asserted, both the "before" and "after" are apparent in Darwin's *Journal*, but the transition is nowhere to be seen (Hyman 1962, p. 14).[2] Partly owing to this circumstance, many of Darwin's biographers have pointed to certain changes in Darwin's thinking manifested in the *Journal* and have assumed that he reached these conclusions on, or near, the dates recorded in that work. The chronology of Darwin's intellectual development during the voyage has therefore remained problematic on many important points.[3] In addition, documentation of possible influences on young Darwin, and of various precursors of his ideas, has not succeeded in putting his voyage experiences within a satisfactory perspective.[4] For it is first necessary to know what Darwin was thinking *at the time* in order to determine what effect, if any, such influences may have had on his intellectual development.

Darwin's various autobiographical recollections about the voyage have done little to rectify the historian's problems. Part of the difficulty stems from Darwin's portrayal of the voyage as a source of intellectual discontinuity — indeed, as a distinct and crucial watershed in his life. In his *Autobiography* he asserted, for example: "The voyage of the *Beagle* has been by far the most important event in my life and has determined my whole career; . . . I have always felt that I owe to the voyage the first real training or education of my mind" (pp. 76–77). This autobiographical assessment has provided a congenial model for those who would emphasize the *Beagle* voyage's remarkable transforming influence on Darwin. Indeed, in its most dramatic form, the story of the *Beagle* voyage has often been portrayed as the *Origin of Species* "writ large", a tendency that Himmelfarb and other recent Darwin scholars have sought to counteract with a more realistic reconstruction of the voyage period. As Himmelfarb has commented in this connection: "There is, in fact, no real continuity between the Beagle and the *Origin*. Between the two there intervened an idea" (1959, p. 123). More accurately, there intervened a series of ideas; and the proper dating of these has accordingly played a key role in recent reassessments of the *Beagle* voyage and its role in Darwin's life.

In particular, Darwin's conversion to the theory of evolution — once

thought to have been a typical "eureka" experience stemming from his famous visit to the Galapagos Archipelago — is now generally seen as a slow and largely post-voyage development in his scientific thinking (Sulloway 1982c). Deprived of Darwin's conversion (perhaps the most famous symbol of its transforming role in Darwin's life), the *Beagle* voyage remains, more than ever, a seemingly epic event lacking sufficient visible signs of the hero's remarkable transition. Part of the problem is that Darwin's biographers have traditionally sought evidence for Darwin's intellectual development in a fairly restricted domain, namely, in his purely scientific work. There is far more to Darwin's voyage development, however, than his scientific observations and emerging ideas during the five-year period. This development was also closely associated with Darwin as a person; and the key to Darwin's intellectual development lies in unraveling this intricate connection.

The Technique of Content Analysis

In an effort to pinpoint the elusive transition that the *Beagle* voyage represents in Darwin's life, I have employed a somewhat specialized technique known as content analysis. I have applied this technique to a selection of Darwin's voyage letters, primarily those written to Darwin's former professor John Stevens Henslow (Darwin 1967). Both the use of content analysis and the choice of the documents to which it has been applied require some explanation.

Content analysis generally involves a word-by-word analysis of documents in an effort to reveal certain overall themes and patterns. As a technique, content analysis varies considerably in complexity, from the level of simple word counts to far more sophisticated procedures involving multivariate analysis of word co-occurrence patterns within specified units of text. In addition to elucidating potentially significant associations among words, content analysis is also frequently used to analyze relationships among *categories*, or groupings of thematically related words. Because many words are sufficiently synonymous in ordinary usage, they may often be treated, for the purposes of content analysis, as representatives of the same basic category. For example, *I, me,* and *myself* all have in common their reference to a category that might be termed SELF. Similarly, *you, your,* and *yourself* form part of a contrasting category that might be designated OTHER. By formulating a comprehensive series of such categories, it is possible to use them as the basis for comparison of different texts, as well as to analyze changes in texts written over time. Content analysis has been used in this manner to analyze such diverse documents as folktales, political speeches and texts, newspaper editorials, short stories, letters, and autobiographies.[5] The content-analysis procedure is, of course, no substitute for the careful reading of documents. Indeed, detailed scrutiny of a document is a prerequisite for a successful content analysis. Nevertheless, computer-assisted content analysis

can sometimes detect significant patterns of co-occurrence and dissociation that go unnoticed even in the most careful reading of a text. A further advantage of this procedure is that it is replicable by other investigators, thus tending to minimize the influence of various biases and expectations that occasionally interfere with the objective reading of texts. Although content analysis in no way guarantees objectivity, it does entail numerous clearly articulated methodological constraints, which can in turn be related directly back to the conclusions that are derived.

In this study I have applied the technique of content analysis to a series of Darwin's voyage letters. My selection of these documents was determined by several considerations. First, unlike Darwin's *Journal of Researches* or other scientific publications stemming from the *Beagle* voyage, the text chosen for analysis ought to offer a contemporary and unrevised account of Darwin's voyage activities. Potentially suitable in this connection are Darwin's voyage *Diary* and his various letters to family members and friends (*LL*; Darwin 1945; 1967). From this sizable choice of materials, a selection was made in order to bring the amount of text within feasible limits of analysis.[6] Darwin's *Diary* was rejected — in part because of its length and in part because of its predominantly non-scientific focus. Like the *Diary*, Darwin's voyage letters, especially those to his family, give only brief summaries of his scientific work. On the other hand, his voyage letters to his teacher John Stevens Henslow provide a nearly ideal text. These letters were intended to keep Henslow up to date on Darwin's scientific activities during the *Beagle* voyage, as well as to convey information concerning the shipment of specimens. The letters also contain numerous personal details about Darwin's life and thoughts during the voyage. Because they offer a regular and detailed series of scientific reports on his work as ship's naturalist, the letters to Henslow were chosen as the primary text for content analysis.[7] Three extremely short notes to Henslow, written in 1833 and 1834, were not included in the analysis.[8] The two longest of these letters, both written in 1834, were replaced instead by two more substantial and informative letters that Darwin wrote about the same time to a sister and to an old school chum. Altogether, the fifteen letters chosen for analysis encompass more than eighteen thousand words (or about seventy-two pages of double-spaced text) and average one letter every four months. The longest gap between letters is six months.

The first step in the content analysis was to enter the entire text of the letters into a computer and then to generate a key-word-in-context index (or concordance) to the correspondence. This 470-page index was then studied carefully and was used as a guide to formulating the various categories — or groups of similar words — that were judged most appropriate for this particular set of documents. I devised forty-two such categories, based in part on categories that have proved useful in previous content-analysis studies and in part on the nature of Darwin's voyage letters. For

example, the category SPECIES includes the words *species*, *genus*, *family* and *order*; the category COLLECT encompasses words like *collect*, *collections*, and *specimens*; and the category OVERSTATE, which is common in other content-analysis studies, includes emphatic or exaggerated words like *always*, *every*, *exceedingly*, and *never*. Most categories, like BOTANY, ENTOMOLOGY, GEOLOGY, ZOOLOGY, DELIGHT, DISTRESS, SELF, and WE, are self-explanatory. The forty-two categories are listed in full in the Appendix. Altogether, they encompass more than four hundred different words, including almost every word in the letters used more than four times.[9]

As the next step of the content analysis I scored each letter for the presence of words within each category. For each letter there are accordingly forty-two category scores (the basic unit of the content analysis). Scoring was done with the help of the key-word-in-context index, in order to correct for idiomatic and other non-literal word usages.[10] The resulting category scores were normalized according to the length of the letter, thus eliminating an extraneous source of variation in the category scores from different letters. I then subjected the normalized category scores to factor analysis, a multivariate procedure that tests for the degree of association between variables and attempts to group them into interrelated clusters. More specifically, factor analysis takes all the category scores and tries to group together those categories that simultaneously and consistently have high or low scores within each letter. This process is somewhat like trying to depict the distribution of hundreds of pins in a pin cushion by imagining a very small number of pins that best describe the arrangement of all the others. Four such factors, accounting for 60 percent of the variance in the category scores, were extracted by computer using a principal components analysis.[11] These factors are listed in Table 1 and will be explicated in more detail in the remainder of this study.

Table 1. Category loadings for Factors I-IV, grouped in order of absolute loadings [a]

Factor I: Growing Self-Assurance	I	II	III	IV
DATE	.81	.18	.05	.17
SIGN-STRONG	.80	−.22	−.19	.00
HOME*	.71	−.63	.00	−.04
DELIGHT*	.64	−.48	.00	−.32
THEORIZE*	.61	.43	−.48	−.06
GEOLOGICAL-CAUSE*	.40	.80	.24	−.02
SIGN-WEAK	−.39	−.09	.09	.06
DISTRESS*	−.41	−.49	−.12	.56
FOSSILS*	−.47	.00	−.06	−.50
NON-SPECIFIC	−.48	−.21	−.22	.14
COLLECT	−.49	.14	.50	−.24
RESEMBLANCE*	−.56	.27	−.54	.18
NEW	−.59	−.16	.08	.28
SPECIES	−.65	.03	.02	.15
SIZE-REFERENCE	−.66	.23	.13	.10
ZOOLOGY	−.94	.00	−.05	.03

Table 1. (Cont.)	I	II	III	IV
Factor II: Dependence versus Independence				
GEOLOGY	.28	.88	.01	.09
GEOLOGICAL-TIME	.31	.81	.25	.10
GEOLOGICAL-CAUSE*	.40	.80	.24	−.02
SPACE-REFERENCE	.24	.53	−.16	−.23
QUANTITY-REFERENCE	−.16	.52	.49	.04
BOTANY	−.27	.50	−.09	−.27
THEORIZE*	.61	.43	−.48	−.06
CONTRAST	.15	−.43	−.21	−.34
DELIGHT	.64	−.48	.00	−.32
DISTRESS*	−.41	−.49	−.12	.56
SELF	.16	−.59	.35	−.17
HOME*	.71	−.63	.00	−.04
TIME-REFERENCE	.16	−.66	.35	.26
OTHER*	.30	−.67	.47	−.10
NEGATION	.14	−.67	−.09	−.20
IF	.11	−.69	.00	.34
Factor III: Anxiety versus Involvement				
ANXIETY	−.15	.23	.84	−.11
HOPE	−.05	−.07	.52	.32
FUTURE	.06	−.27	.51	.11
COLLECT*	−.49	.14	.50	−.24
ENTOMOLOGY	−.21	−.09	.49	.15
QUANTITY-REFERENCE*	−.16	.52	.49	.04
OTHER*	.30	−.67	.47	−.10
COMMUNICATE*	.25	−.23	.42	−.59
WE*	−.07	−.34	−.40	.63
THEORIZE*	.61	.43	−.48	−.06
RESEMBLANCE*	−.56	.27	−.54	.18
PLACE-REFERENCE*	.03	.07	−.62	.42
INTERESTING	−.07	−.15	−.72	−.01
OVERSTATE	−.05	−.20	−.76	−.02
CURIOUS	.12	.19	−.77	.11
Factor IV: Group versus Individual Identity				
UNDERSTATE	−.20	.10	−.06	.77
VOYAGE	−.36	−.08	.03	.66
WE*	−.07	−.34	−.40	.63
DISTRESS*	−.41	−.49	−.12	.56
APPEAR	−.03	−.11	.03	.56
PLACE-REFERENCE*	.03	.07	−.62	.42
FOSSILS*	−.47	.00	−.06	−.50
COMMUNICATE*	.25	−.23	.42	−.59
SCIENTISTS	.17	−.38	.05	−.69
MY	−.21	.01	−.34	−.83

[a]Categories with absolute loadings of .40 or greater on more than one factor are marked with an asterisk and are listed multiply. Loadings vary within a maximal range of ±1.0.

I have interpreted and given labels to the four factors extracted in this study by examining those letters, and especially those sentences within each letter, that contribute most heavily to the highest associating categories. In other words, by retrieving numerous passages that contribute most directly to the factor structure of the letters, one begins to understand precisely what that structure means in *literary* terms. In this sense the factors are merely guides to an interpretation of the letters by the more customary procedures of historical scholarship. Thus the text of Darwin's voyage letters, not the categories used in the content analysis, is what ultimately has determined the identification and description of the four factors. Moreover, it is this final step in identifying the factors that allows the historian to interpret Darwin's letters in the context of Darwin's own particular literary style, judged not in terms of single words (or their purely literal meanings) but rather in terms of the many personal and social conventions that Darwin observed throughout the voyage in expressing these words as integral parts of sentences. In short, content analysis does not by any means rob Darwin's letters of their numerous linguistic subtleties. This procedure simply provides a preliminary vehicle for attempting to understand the letters — as Darwin wrote them — within the wider framework of his voyage experience as a whole.

Factor I: Growing Self-Assurance

The first factor extracted, which accounts for 17 percent of the total variance, has as its highest positive loading the DATE of the letter.[12] Indeed, the basic underlying dimension of Factor I is time, with the two polar ends of the factor representing early and late preoccupations in the contents of Darwin's voyage letters. Inasmuch as Factor I accounts for the greatest amount of variation in Darwin's letters, this factor not only makes intuitive sense but it also gives promise of clarifying the elusive "transition" that is absent from Darwin's formal scientific writings about the voyage.

The underlying theme represented by the negative end of Factor I (and hence the early period of the voyage) is Darwin's preoccupation with the description and cataloging of his collections, especially those in zoology. Those categories with the highest loadings (ZOOLOGY, SIZE-REFERENCE, SPECIES, NEW, RESEMBLANCE, and COLLECT) reflect Darwin's initial exuberance at the discovery and collection of numerous biological specimens, many of them apparently new to science. This theme of discovery and enumeration is especially evident in Darwin's old hobby, entomology. From Rio de Janeiro, for example, Darwin reported in his first letter to Henslow:

> I have just returned from a walk & as a specimen [COLLECT] how little the insects [ENTOMOLOGY] are know[n]. Noterus [ENTOMOLOGY], according to the Dic. Class. contains solely 3 European species [SPECIES], I, in one

> hawl of my net took [COLLECT] five distinct species [SPECIES]. — is this not quite extraordinary? (Darwin 1967, p. 56; letter of 18 May 1832)

Repeated references to taking new species and genera account for the high loading that the category NEW has on Factor I. The high loading of SIZE-REFERENCE reflects Darwin's numerous expressions about the size of his specimens, as well as of his collections. In this connection Darwin asserted in his first letter to Henslow:

> if what was told me in London is true viz that there are no small [SIZE-REFERENCE] insects in the collections from the Tropics. — I tell Entomologists to look out & have their pens ready for describing. — I have taken as minute [SIZE-REFERENCE] (if not more so) as in England, Hydropori, Hygroti, Hydrobii, Pselaphi, Staphylini, Curculio, Bembididous insects etc etc. (1967, p. 55)

Similarly, Darwin boasted in his second letter to Henslow, "I made an enormous collection of Arachnidae at Rio" (1967, p. 58; letter of 15 August 1832).

The high score of RESEMBLANCE on Factor I is associated with Darwin's various descriptive comments about his collections, including the identity or resemblance of particular specimens to those described in reference works. Nevertheless the primary concern in Darwin's early voyage letters is not the analysis of systematic relationships per se but rather the problem of what names should be given to his various specimens. Although the category SPECIES (*species, genus, family, order*) appears frequently in the first two years of the voyage, more often than not the word *species* itself is used simply as a synonym for *specimen*. Similarly, Darwin's frequent use of NON-SPECIFIC words early in the voyage (for example, *it, thing, one, ones, some*) reflects his uncertainty about the precise identity of many of his zoological specimens, especially his fossil Mammalia.

Perhaps the most noteworthy aspect of Darwin's early letters to Henslow is Darwin's repeated use of expressions that indicate a lack of self-confidence in his own observations and opinions. In this connection, the categories SIGN-WEAK and DISTRESS have moderately high loadings on the negative end of Factor I. For example, Darwin confessed in his first letter to Henslow: "One great source of perplexity to me is an utter ignorance [SIGN-WEAK] whether I note the right facts & whether they are of sufficient importance to interest others. — In the one thing collecting, I cannot go wrong" (1967, p. 53). But even as a collector Darwin soon found himself faced with a source of considerable anxiety. "All I can say," he informed Henslow during the eighth month of the voyage, "is that when objects are present which I can observe & particularize about, I cannot [SIGN-WEAK] summon resolution to collect where I know nothing [SIGN-WEAK]" (1967, p. 58). Similarly, the high loading of SIZE-REFERENCE on Factor I⁻ is also closely associated with

Darwin's worries about the scientific value of his collections and the poor impression they might be making on Henslow. "And now for an apologetical prose about my collection," Darwin wrote in August 1832. "I am afraid you will say it is very small [SIZE-REFERENCE], — but I have not been idle & you must recollect that in lower tribes, what a very small [SIZE-REFERENCE] show hundreds of species make" (1967, p. 58). And in the same letter Darwin remarked: "It is positively distressing [DISTRESS] to walk in the glorious forest, amidst such treasures, & feel they are all thrown away upon one" (1967, p. 58). During the first year of the voyage, Darwin went so far as to discredit his own eyesight three times (in May, August, and November 1832); and he frequently attributed his success as a collector to "luck" (SIGN-WEAK) and his shortcomings to "ill-luck". In November 1832 he commented to Henslow: "As I have nobody to talk to about my luck [SIGN-WEAK] & ill luck [DISTRESS, SIGN-WEAK] in collecting, I am determined to vent it all upon you. — I have been very lucky with fossil bones; . . . as many of them are teeth I trust, shattered & rolled as they have been, they will be recognised" (1967, p. 61). Yet Darwin continued to be plagued by doubts about the value of his collections; and he wrote, a year later, of "not feeling quite sure [SIGN-WEAK] of the value of such bones as I before sent you" (1967, p. 81).

In short, the first two years of Darwin's voyage correspondence with Henslow reflect his underlying conception of himself as an insufficiently trained naturalist who had been sent out to collect specimens by the real scientists back in England.[13] Somewhat jokingly, Darwin even described himself in August 1832 as "a Baron Munchausen amongst Naturalists", an allusion to Rudolf Erich Raspe's fictional character known for his fabulous and exaggerated adventures.[14] On a more serious level Darwin commented to J. M. Herbert, an old schoolmate at Cambridge, during the second year of the voyage: "By the way, you rank my Natural History labours far too high. I am nothing more than a lions' provider: I do not feel at all sure that they will not growl and finally destroy me" (*LL* 1:248).

If the negative pole of Factor I may be said to center around the description and enumeration of Darwin's voyage collections, the positive end concerns ideas and opinions (THEORIZE). In contrast to the anxious and insecure self-image in the early voyage letters, a confident self-image is increasingly manifested in the later letters and is especially associated with the high loading that SIGN-STRONG has on the positive end of Factor I. This trend may be seen not only in Darwin's scientific work — especially in the field of geology — but also in his general observations about the places and peoples he had recently visited. For instance, in a letter written during the fifth year of the voyage Darwin enthusiastically praised the work of the Tahitian missionaries, and he discussed at length the marvelous development of England's grand colony Australia.[15] Phrases like "I think", "I suspect", "I believe", and "I firmly believe" are peppered throughout

these discussions and underscore Darwin's confidence in his own opinions. Nevertheless, it is primarily in connection with Darwin's geological work that we can see most dramatically the transformation in his self-identity from collector to thinker, as reflected by Factor I. This transformation is particularly evident if we consider Factor I in conjunction with the second of the four factors extracted from the correspondence.

Factor II: Dependence versus Independence

Like Factor I, Factor II accounts for 17 percent of the variance in the overall category scores. The clustering of high loadings for IF, NEGATION, and SELF on the negative end of Factor II (Fig. 1) is not uncommon in content-analysis studies and generally indicates a highly defensive style associated with personal uncertainty (Dunphy 1966, p. 331). Examination of the letters with the highest negative loadings on this factor supports this conclusion but suggests, in addition, that Darwin's defensiveness was closely related to his dependence on Henslow. It is this theme of dependence on Henslow that is responsible for the high loading of OTHER (*you, your, yourself*) in this context.

Darwin's defensive style in certain of his letters to Henslow was closely coupled, during the early part of the voyage, with his many self-doubts about his work as a naturalist and collector. For example he remarked in November 1832: "as for one Flustra, if [IF] I [SELF] had not [NEGATION] the specimen to back me up, nobody would believe in its most anomalous structure" (Darwin 1967, p. 63). A similarly cautious and defensive style, involving the co-occurrence of the categories IF, SELF, NEGATION, and SIGN-WEAK, occurs in another early letter. "If I am not mistaken," Darwin asserted in May 1832, "I have already taken some new genera [of spiders]" (1967, p. 55). The high score for TIME-REFERENCE on this same end of Factor II reflects Darwin's repeated need to account for his time and, in this connection, to excuse the poor impression that he believed his collections were making on Henslow. "I have collected during the last month nothing," Darwin confessed in a letter of 15 August 1832 (1967, p. 60). Similarly, he apologized in a letter of 11 April 1833: "And this makes up nearly the poor catalogue of rarities during this cruize" (1967, pp. 72–73).

Above all, these early letters reflect Darwin's feelings of personal responsibility to, and dependence on, Henslow, who had not only secured him the appointment as ship's naturalist on the *Beagle* but who had also agreed to take charge of all Darwin's collections sent home from South America. Henslow therefore assumed in Darwin's letters the simultaneous roles of father confessor, judge, and jury concerning Darwin's activities during the *Beagle* voyage.[17] As Darwin commented in August 1832, toward the end of the first year of the voyage: "I was not fully aware how essential

a kindness you offered me, when you undertook to receive my boxes. — I do not know what I should do without such headquarters" (1967, p. 58). Similarly, statements such as "without you I should be utterly undone" are closely tied to Darwin's repeated requests for advice on packing and preserving different items (1967, p. 63).

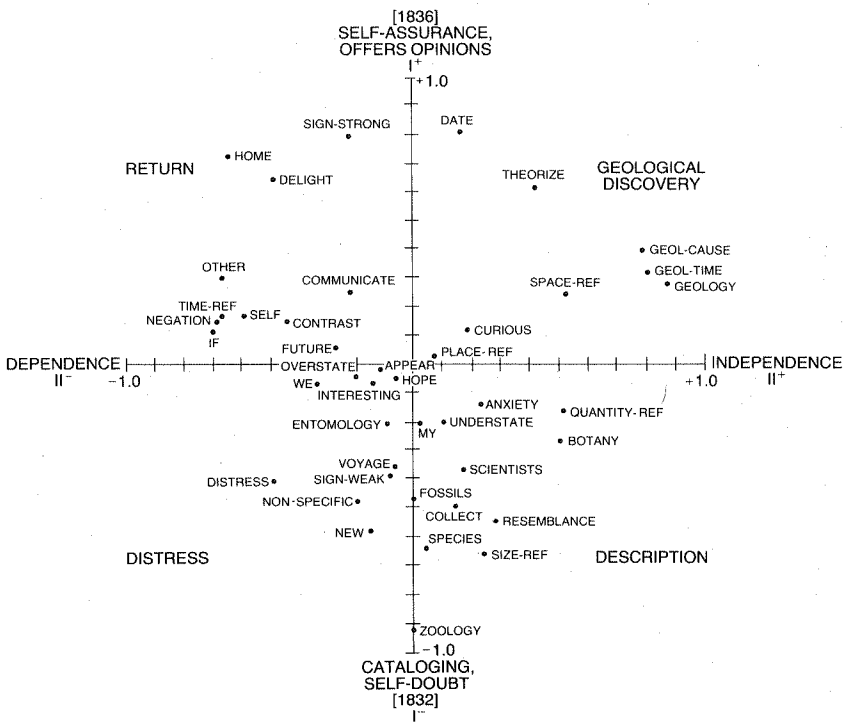

Figure 1. A two-dimensional plotting of the category loadings for Factors I and II (Table 1).[16] Factor I occupies the vertical axis; Factor II, the horizontal axis.

Toward the end of the first year of the voyage Darwin began a recurrent appeal for some reassurance concerning the fate and scientific value of those collections he had already shipped home. Owing to the vagaries of mail shipments to a surveying vessel that was constantly on the move, Darwin heard nothing from Henslow until the third year of the voyage. After waiting for more than a year without hearing from Henslow, Darwin reacted with a large drop in self-confidence, shown in Figure 2 by the document scores of his letters of November 1832 and April 1833.[18] Fearing that silence on Henslow's part signified his teacher's disappointment in his collections, Darwin continued to try to defend himself by emphasizing the amount of time spent by the *Beagle* at sea, and by reiterating his own preference for "the obscure & diminutive tribes of animals" (1967, pp. 64, 75). By

mid-1833 Darwin's self-confidence had recovered somewhat, perhaps owing in part to his having hired a servant to help him in his collecting activities. This enabled him to promise Henslow that there would be "a larger proportion of showy specimens" in the future (1967, p. 75; letter of 18 July 1833). Still, Darwin's dependence on Henslow's approval remained unabated during the first two years of the voyage. "I should be so much obliged," he begged Henslow in July 1833, "if you would write to me. — You only know anything about my collections, & I feel as if all future satisfaction after this voyage will depend solely upon your approval" (1967, p. 75). In short, the first half of the *Beagle* voyage was evidently a trying period for young Darwin owing to his nagging self-doubts about the value of his scientific collections, and his continued dependence for advice and encouragement on a strangely non-respondent Henslow.

With Darwin's receipt, in March 1834, of a very supportive letter from Henslow, and with his subsequent receipt in July of two other equally encouraging letters, Darwin's self-confidence was given a substantial boost (Fig. 2). A major change also occurred at this time in Darwin's overall

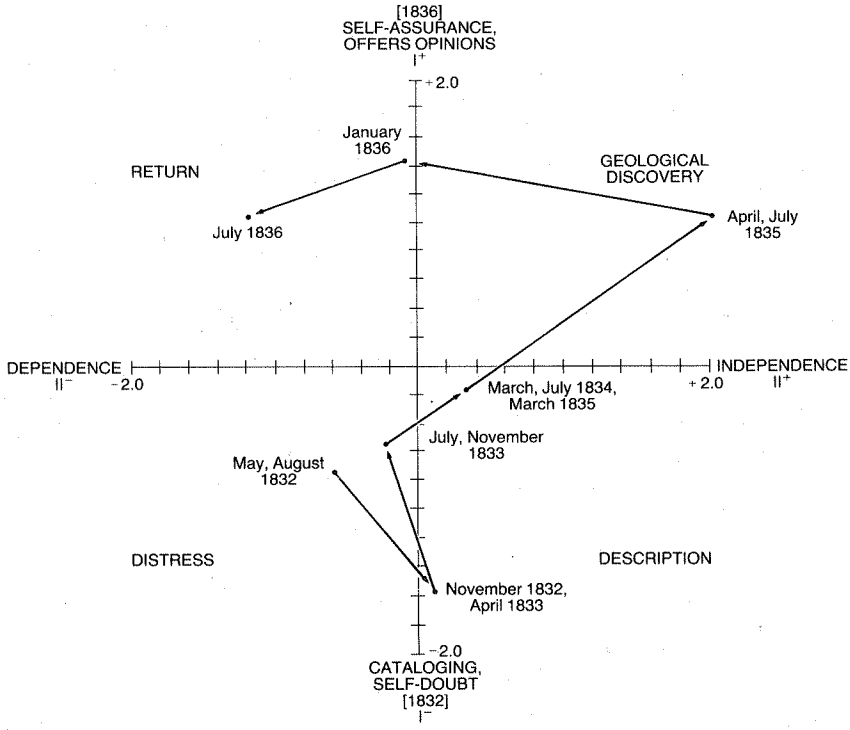

Figure 2. A two-dimensional representation of Factors I and II, with document loadings being substituted for category loadings. Hence the letters themselves, singly or in groups, can be followed temporally through the two-dimensional factor space.

attitude toward the voyage, which he now began to think of in predominantly positive rather than negative terms. At the same time, Darwin's dependence on Henslow — the student-teacher relationship of the earlier letters — began to give way to expressions of growing scientific independence, especially in the sphere of geology. The positive end of Factor II reflects this independent self-image that Darwin increasingly manifested after March 1834. At first his independence emerged in a roundabout way, as reflected by the high loadings that BOTANY and QUANTITY-REFERENCE have on the positive end of Factor II. Having ceased to worry about the value of his collections, Darwin apparently realized that Henslow — who, as a botanist, was naturally pleased with Darwin's plant collections — was now actually dependent on him for further botanical specimens. So the tables were turned! "I am very glad," he replied to Henslow's first letter in March 1834, "[that] the plants give you any pleasure, I do assure you I was so ashamed of them, I had a great mind to throw them away; but if they give you any pleasure I am indeed bound, & will pledge myself to collect whenever we are in parts not often visited by Ships & Collectors" (1967, p. 84). Darwin fulfilled this promise by subsequently sending many seeds and plants (hence the high loadings of BOTANY and QUANTITY-REFERENCE on Factor II) and by discussing those botanical specimens that he thought might especially interest Henslow.

It is in the field of geology, however, that Darwin's scientific independence emerged most clearly in the letters written after March 1834. Whenever Darwin had something of geological interest to write about, he no longer found it necessary to couch his scientific reports in the negative or qualified manner so common in earlier letters. Indeed, by the third year of the voyage Darwin had become sufficiently comfortable with his unresolved geological problems to joke openly about them to Henslow. "I am quite charmed with Geology . . .," he remarked in March 1834. "By the way I have not one clear idea about cleavage, stratification, lines of upheaval. — I have no books, which tell me much & what they do I cannot apply to what I see. In consequence I draw my own conclusions, & most gloriously ridiculous ones they are, I sometimes fancy I shall persuade myself there are no such things as mountains, which would be a very original discovery to make in Tierra del Fuego" (1967, p. 85). Not only did geology increasingly displace biology as Darwin's major preoccupation in the later voyage letters (Fig. 3),[19] but the nature of Darwin's geological discussions underwent a significant change associated with his growing self-confidence and independence of thought.[20] As may be seen in Figure 4, Darwin's references to GEOLOGY (a category composed of purely descriptive terms) actually declined slightly between the second and third years of the voyage. But his references to GEOLOGICAL-CAUSE and GEOLOGICAL-TIME — groups of explanatory terms that are combined and plotted together in Figure 4 as GEOLOGICAL-DYNAMICS — rose sharply over this same one-year period. What this change in geological

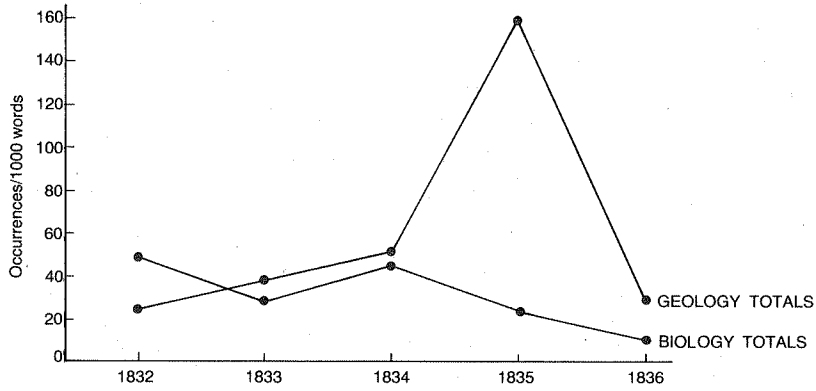

Figure 3. Category scores for BIOLOGY TOTALS and GEOLOGY TOTALS (N=643). BIOLOGY TOTALS=ZOOLOGY, BOTANY, ENTOMOLOGY, and SPECIES. GEOLOGY TOTALS=GEOLOGY, GEOLOGICAL-CAUSE, and GEOLOGICAL-TIME. Reflecting this pattern of changing scientific preoccupations, Darwin wrote to his cousin William Darwin Fox in July 1835: "I am so glad to hear you have some thoughts of beginning Geology. I hope you will; there is so much larger a field for thought than in the other branches of Natural History" (*LL* 1:263).

terminology reflects is Darwin's emergence as a *theoretical* geologist, a new self-image that was associated with three major geological discoveries.

The first of these discoveries was connected with Darwin's researches in southern Patagonia. In March 1834 he excitedly informed Henslow that "the whole of the East coast of South part of S. America has been elevated [GEOLOGICAL-CAUSE] from the ocean, since a period [GEOLOGICAL-TIME], during which Muscles have not lost their blue color" (1967, p. 84). This discovery suggested a very recent time scale for the elevation of the Andes, a conclusion that Darwin knew would greatly interest Charles Lyell, whose controversial uniformitarian views were highly consonant with such facts (1967, p. 93; letter of July–October 1834).

Darwin's second important geological discovery was made the following year, in 1835, and was communicated to Henslow in two letters that have the highest loadings on the positive end of Factor II (Fig. 2). Having seen the effects of the great Concepcion earthquake, and having investigated the geology in the areas of Chile and Valparaiso, Darwin was able to report to Henslow that he could "now prove that both sides of the Andes have risen in the recent period, to a considerable height" (1967, p. 101; letter of March 1835). The following month, when Darwin returned from a trip across the Cordilleras to Mendoza, Argentina, via two different mountain passes, he had even more remarkable confirmation of this view — namely, evidence that the age of the Andes, at a height of roughly 14,000 feet, was no greater than the Tertiary Period. By European standards this was very recent indeed; and Darwin was convinced by other geological

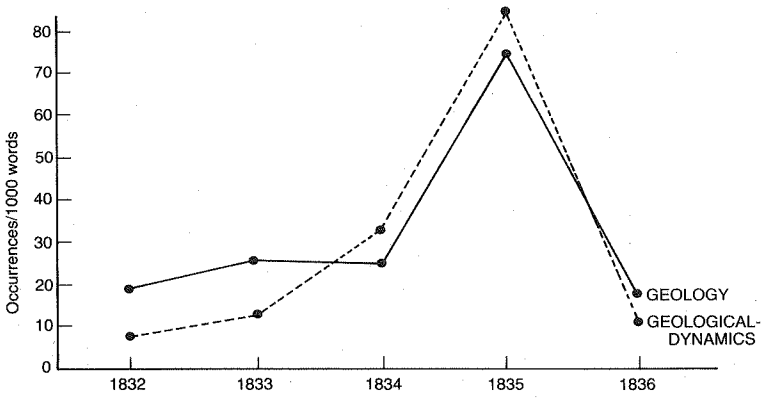

Figure 4. Category scores for GEOLOGY and GEOLOGICAL-DYNAMICS (N=425). The one-year change between 1833 and 1834 is statistically significant (χ^2=6.32, P<.02), as is the combined change between 1832–1833 and 1834–1835 (χ^2=12.43, P<.001).

observations that numerous periods of elevation and subsidence, involving vertical distances of thousands of feet, had all taken place while the Andes themselves were in a gradual process of formation and elevation to their present height (1967, pp. 102–107). As he asserted to his sister Susan in a letter of April 1835, "If this result [the modern age of the Andes] shall be considered as proved, it is a very important fact in the theory of the formation of the world. Because if such wonderful changes have taken place so recently in the crust of the globe, there can be no reason for supposing former epochs of excessive violence" (Darwin 1945, p. 117). By the Spring of 1835 Darwin therefore knew that he would be returning to England with exciting geological findings that would identify him as an active partisan of Lyell's uniformitarian doctrines. Darwin could thus see himself as part of the progressive side of a major revolution in nineteenth-century natural science.[21]

Darwin's third major geological discovery, his theory of coral reef formation, was developed in 1835 while he was still on the shores of South America and had yet to see a coral reef (*Autobiography*, p. 98).[22] In developing this novel theory, Darwin was correcting the views of his geological hero, Charles Lyell; and Lyell subsequently abandoned his own theory in favor of Darwin's. Lyell's theory was that coral reefs are formed on the tops of submerged volcanic calderas, thus explaining their circular form (1830–1833, 3: chap. XVIII). Darwin, in contrast, proposed that coral reefs originate as fringing reefs around volcanic islands, and that the subsequent subsidence of an island causes the coral, which grows upwards, to form a lagoon island in which the original volcanic pinnacle gradually disappears from view (*Coral Reefs*). It is curious that this important theory, which Darwin had a chance to test and confirm over the next year, was never communicated to Henslow. The most plausible explanation for this circumstance is Darwin's having

learned, in June 1836, that Henslow had published extracts from Darwin's previous letters to him as a small pamphlet (*CP* 1:3–16; Darwin 1945, pp. 141–142). In choosing to withhold this geological success story in his next (and last) letter to Henslow, Darwin was effectively making sure that he, and not Henslow, would be the first to reveal his new theory to the British geological community. Thus Darwin's assertion of his intellectual independence from Henslow is evident not only from what he reported to Henslow in his later letters but also from what he elected to keep to himself.

Darwin's last two letters to Henslow exhibit a sharp return toward the vocabulary of dependency that was seen in the early letters of the voyage (Fig. 2). His impending return to England evidently reminded him that he was still greatly dependent on Henslow, not only for advice and assistance in connection with his voyage collections, but also for sponsorship within the formal institutional networks of British science. But in asking Henslow, for example, to propose him for membership in the Geological Society of London (July 1836), Darwin was simultaneously exhibiting an ambitious self-assurance that he clearly lacked at the beginning of the voyage. Such self-confidence is evident as well in Darwin's letters to his family. To his sister Caroline he remarked in April 1836, shortly after having buttressed his coral reef theory with researches at the Keeling Islands: "I am in high spirits about my Geology, & even aspire to the hope that my observations will be considered of some utility by real geologists" (1945, p. 138).

Factor III: Anxiety versus Involvement

Just as Factors I and II help to illuminate Darwin's development during the *Beagle* voyage, so the remaining two factors also add to the understanding of his voyage experience, especially when examined in conjunction with Factor I (time). Factor III, which accounts for 14 percent of the variance in the category scores, highlights Darwin's vacillations between uninhibited involvement in his researches, and his repeated anxieties over the merits of his scientific work.

The high loadings of ANXIETY, HOPE, FUTURE, COLLECT, OTHER, and COMMUNICATE on the positive end of Factor III signify Darwin's sense of anxious expectancy concerning his accomplishments as a collector (Fig. 5). Whereas Factors I^- and II underscore Darwin's preoccupation with his activities, and especially his identity, as a collector, Factor III^+ reveals the degree to which Darwin anxiously equated his future in science, at least during the early part of the voyage, with his *success* as a collector. In this connection the high loading of ANXIETY on Factor III is caused by Darwin's constant worry about the "safety" and "worth" of his collections. The high loadings of HOPE and FUTURE reveal his strong feelings of expectancy

and apprehension concerning what Henslow (OTHER) will think about his specimens, as well as his concern over the care they might require once they arrived in England. Darwin repeatedly expressed his hope that various specimens would interest Henslow, and he commented frequently about when the next opportunity would arise to send (COMMUNICATE) specimens.

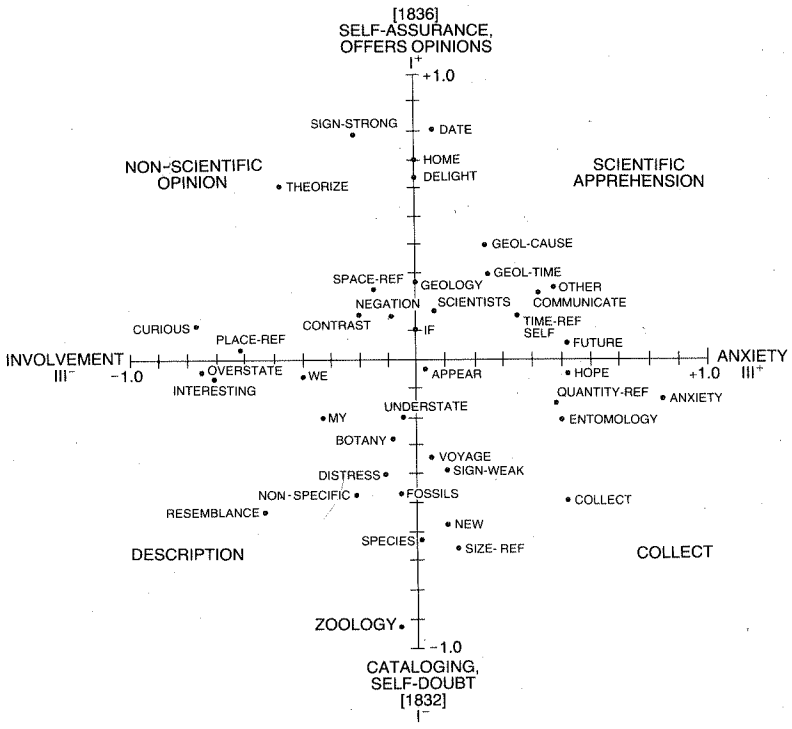

Figure 5. Category loadings for Factors I and III.

After hearing that a French collector had just preceded him around the Horn, Darwin complained of his "ill luck" and exclaimed to Henslow, "I am very selfishly afraid he will [FUTURE] get the cream of all the good things before me" (Darwin 1967, p. 61; letter of 24 November 1832).

Darwin's anxieties reached a peak during the second year of the voyage (Fig. 6), as Henslow's seeming failure to write to Darwin caused him to fear that his teacher was actually too embarrassed to admit how poor his collections really were. With his receipt, at last, of a letter from Henslow (March 1834), Darwin's anxieties temporarily subsided, allowing him to involve himself more freely in reporting the interesting details of his latest voyage findings. This change in the contents of the letters is reflected in the high loadings that the categories CURIOUS, INTERESTING, and PLACE-REFERENCE have on the negative end of Factor III (Fig. 5). When not dominated

by feelings of anxiety, as he especially was during the second year of the voyage, Darwin tended to provide Henslow with relatively enthusiastic reports about the various peoples, places, and natural history objects he was seeing. The high loading that the category OVERSTATE has in these letters is caused by Darwin's frequent use of words like "most", "very", and "exceedingly" in describing his interest in what he has observed. These letters are filled with an uninhibited zeal and bring to mind Darwin's father's comment to Henslow, "There is a natural good humoured energy in his letters just like himself" (1967, p. 111).[23]

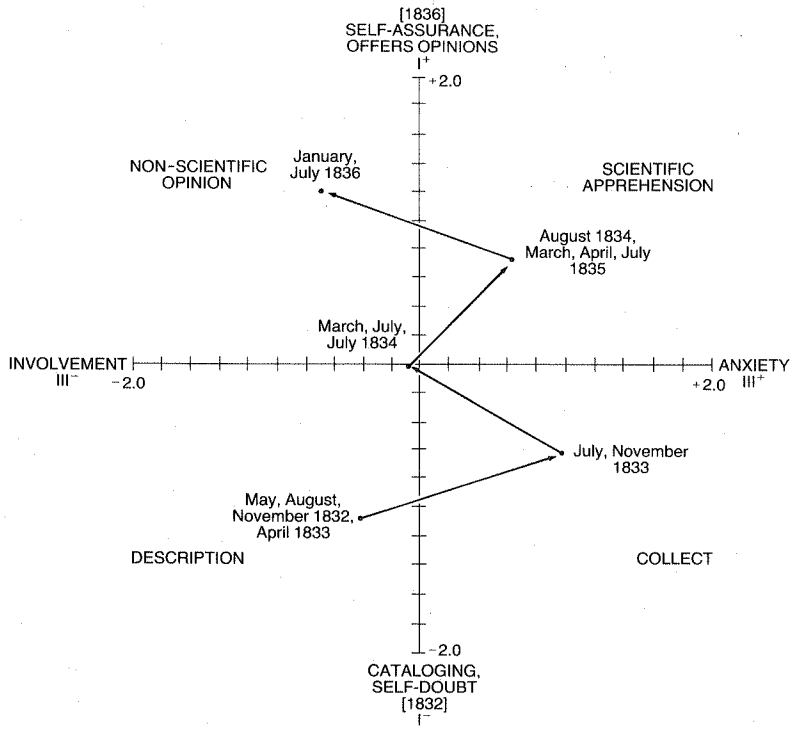

Figure 6. Document scores for Factors I and III.

As Darwin began to develop his geological views more fully during the fourth year of the voyage, the theme of anxiety returned once more to his letters (Fig. 6). This time, however, Darwin's anxieties were connected with ideas and theories rather than with his collections. After propounding a bold theory to Henslow, in July 1835, of how geological changes might be proceeding around the world in an orderly sequence, he added: "I am afraid [ANXIETY] you will tell me to learn my A.B.C. — to know quartz from Feldspar — before I indulge in such speculations" (1967, p. 110). But indulge in such speculations Darwin continued to do, and perhaps the most

insightful of these "speculations" led him to his theory of coral reef formation. Toward the end of the voyage, when Darwin's letters became less theoretical owing to the large proportion of time spent at sea, the theme of anxiety once again gave way to a non-anxious involvement in reporting the events of the voyage (Fig. 6).

In examining the overall pattern of the voyage letters as plotted on Factors I and III, it should be noted that Darwin's feelings of anxiety manifested themselves independently of his growing intellectual self-confidence. During the voyage, anxiety was experienced whenever Darwin felt that he was at the limits of his expertise, whether in collecting or in theorizing. As his self-image changed, so then did the problems that were a cause of anxiety to him. Feelings of anxiety were not therefore something that Darwin outgrew during the *Beagle* voyage, like the numerous self-doubts that nagged him in connection with his initial collecting activities. Rather, the potential to experience intense anxiety appears to have been a fixed aspect of Darwin's personality, one that may well have been responsible, at least in part, for his lifelong nervous symptoms after his return to England (Colp 1977a).[24]

Factor IV: Group versus Individual Identity

Factor IV, which accounts for 12 percent of the variance in category scores, depicts Darwin's identification with his shipmates on the *Beagle* (WE) and, alternatively, his identification with his own work (MY) as ship's naturalist (Fig. 7). The positive end of this factor (group identity) centers around the theme of the voyage (VOYAGE), its moments of discomfort (DISTRESS), and its many future uncertainties. Darwin suspected from the very beginning that he would suffer from seasickness, and this suspicion was unfortunately confirmed throughout the entire course of the voyage. Before sailing, Darwin had taken the precaution of having his contract as ship's naturalist altered in order to allow him to leave the ship at any time he should choose (FitzRoy 1839, p. 19). Adding to this constant temptation to desert the voyage were FitzRoy's projections of its increasing length. Darwin had originally been informed that the voyage would last only two years, but by the time the *Beagle* reached South America this estimate had more than doubled (*LL* 1:193). From Rio de Janeiro Darwin wrote to Henslow that he was determined to give the voyage "a fair trial", but he also confessed that "I am sometimes afraid I shall never be able to hold out for the whole voyage. I believe 5 years is the shortest period it will consume" (Darwin 1967, pp. 52, 56; letter of 18 May 1832). Darwin's increasing uncertainty about his ability to stick with the voyage became especially manifest toward the end of the first year (Fig. 8) and is reflected in his frequent use of words like "only" and "nearly" (UNDERSTATE) in describing the future voyage schedule:

the only drawback is the fearful length of time between this & day of our return. — I do not see any limits to it: one year is nearly completed & the second will be so before we even leave the East coast of S America. — And then our voyage may be said really to have commenced. — I know not, how I shall be able to endure it. (1967, p. 63; letter of 24 November 1832)

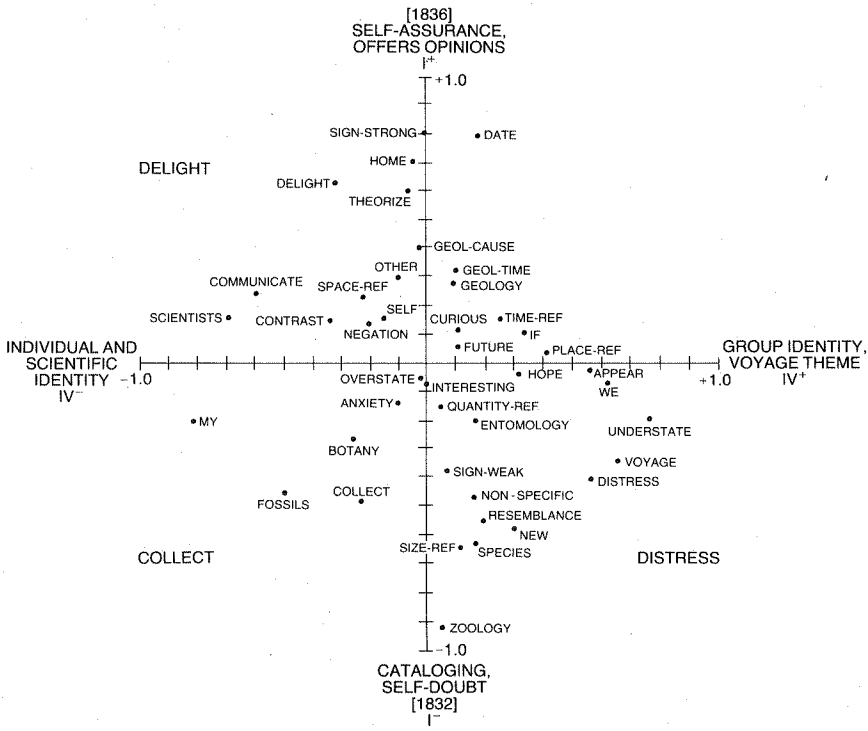

Figure 7. Category scores for Factors I and IV.

During the second year of the voyage, only the prospect of warm Pacific waters and a firsthand look at coral reefs seemed to keep up Darwin's resolution not to resign from his post (1967, pp. 74, 76; letters of 11 April and 18 July 1833).

What is particularly interesting about Darwin's vacillations between group and individual identity is the close association that these contrasting identifications have with Darwin's levels of expressed self-confidence. As may be seen in Figure 8, Darwin's strongest expressions of group identity were always associated with a drop in his level of self-assurance. The first of these confidence-reduction episodes occurred toward the end of the first year of the voyage in connection with worries about completing the voyage, together with increasing doubts about the merits of his scientific work (letters

of November 1832 and April 1833). His subsequent acquisition of a servant to assist him in his collecting labors appears to have boosted his self-assurance and, at the same time, to have increased his sense of individual identity (letters of July and November 1833). Then, in March 1834, word finally came that Henslow was greatly impressed with Darwin's collections. This news, which precipitated another round of growing self-confidence coupled

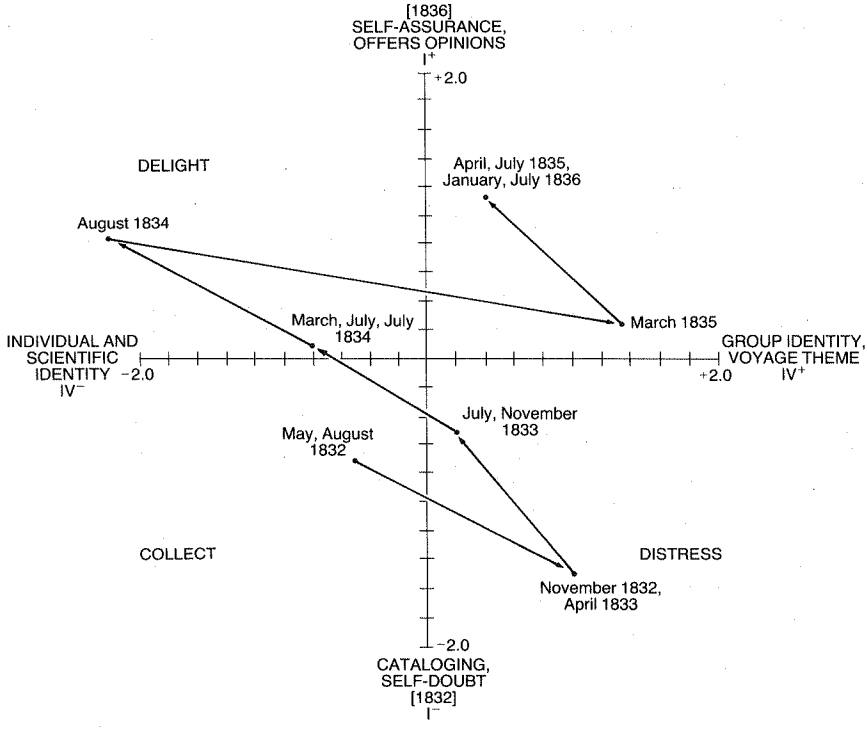

Figure 8. Document scores for Factors I and IV.

with a further increase in Darwin's individual identity, reinforced his resolve to "stick to the voyage", even though, as he quipped, "this may last till we return a fine set of white-headed old gentlemen" (1967, p. 86; letter of March 1834). This trend of growing self-confidence reached a peak in a letter of August 1834, in which Darwin expressed his delight over the reports of eminent scientists regarding the value of his fossil Mammalia (SCIENTISTS, COMMUNICATE). At the same time, he warned that under no conditions should any of the labels be removed from his specimens (MY), lest their scientific value to *him* be destroyed.

Seven months later Darwin once again resumed his identification with his *Beagle* shipmates, jokingly lamenting that the voyage would last "nearly as long as a seven years transportation". No longer concerned about lasting

the voyage, Darwin now found his self-confidence temporarily lowered by a new and contrasting realization, namely, that he would have "but little opportunities for Natural History" during the remainder of the voyage (1967, p. 100; letter of March 1835).[25] With his subsequent geological discoveries about the recent formation of the Andes (letters of April and July 1835), Darwin's self-confidence was restored once more, as also was much of his sense of individual identity.

In short, Darwin's identification with the group (his *Beagle* shipmates) appears to have provided a comforting retreat from individual identity in the face of various distressing or confidence-lowering thoughts about the voyage. Like most human beings, it was apparently much easier for Darwin to suffer with others than to suffer alone. Yet any extensive identification with his *Beagle* shipmates was always relatively brief and was easily overridden by his contrasting identity as a scientist whenever his self-confidence was on the rise.

Summary and Conclusion: The Nature of Darwin's Voyage Transformation

Both common sense and the computer-aided content analysis described in this study agree that time (Factor I) is the single most important variable influencing the substance of the letters included in this study. In examining Factor I (growing self-assurance over time) conjointly with three other non-temporal factors, I have followed this representative selection of Darwin's voyage correspondence through a series of thematic patterns that reflect various changes in mood, in preoccupation, and, even more fundamentally, in Darwin's basic personality. As such, these thematic patterns provide a general "study guide" for understanding both the letters and the man who wrote them.

The most important of the *non*-temporal patterns associated with the voyage correspondence are Darwin's alternation between a deferent-defensive dependence on Henslow and his efforts to assert his own independence (Factor II); Darwin's capacity for intense involvement in his work, on the one hand, and his recurring anxieties concerning himself and his researches (Factor III); and, finally, Darwin's identification with his *Beagle* shipmates and, alternatively, with himself as an individual and a scientist (Factor IV). Problems of dependency, anxiety, and identity are basic aspects of human personality; and one is thus tempted to wonder to what extent these same themes continued as important preoccupations in Darwin's later correspondence, not only with Henslow but also with other friends and colleagues.[26] Nevertheless, the question of the generalizability and permanence of these non-temporal themes of the correspondence is one that goes well beyond the scope of this study.[27]

As for Factor I, which highlights the temporal changes in the correspondence, this aspect of the content analysis indeed gives us some insight into the elusive personal and intellectual transformation that Darwin underwent during the *Beagle* voyage. Perhaps no two categories sum up this transformation better than COLLECT and THEORIZE. As may be seen in Figure 9, the early voyage letters are dominated by Darwin's concerns as a collector of specimens, and they reflect his image of himself as an errand boy sent out by the bona fide scientists back in England. With the development of Darwin's identity as a geologist, especially during the third

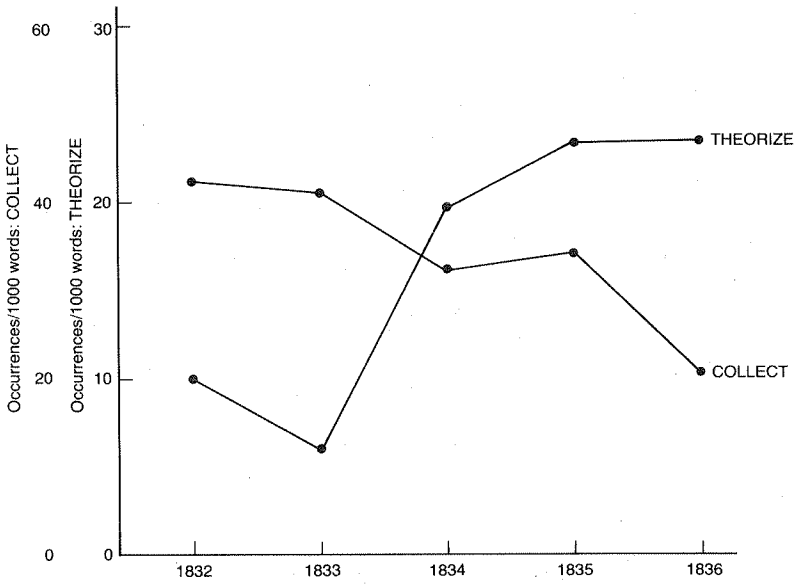

Figure 9. Category scores for THEORIZE and COLLECT (N=359).

year of the voyage, a dramatic change began to take place in Darwin's whole conception of himself. The self-doubting collector became an increasingly confident theorist who could even joke to Henslow about his propensity for drawing "gloriously ridiculous" conclusions. Four decades later, when discussing the voyage in his *Autobiography*, Darwin touched on this aspect of his intellectual development:

> Looking backwards, I can now perceive how my love for science gradually preponderated over every other taste. During the first two years my old passion for shooting survived in nearly full force, and I shot myself all the birds and animals for my collection; but gradually I gave up my gun more and more, and finally altogether to my servant, as shooting interfered with my work, more especially with making out the geological

> structure of a country. I discovered, though unconsciously and insensibly, that the pleasure of observing and reasoning was a much higher one than that of skill and sport. (pp. 78–79)

No matter how "unconsciously and insensibly" this transformation in Darwin's attitude toward science may have occurred, it remains vividly preserved in the text of his voyage letters to Henslow.

Paralleling and, to some extent, building upon this key transformation in Darwin's scientific identity is the related change that occurred in his general level of intellectual self-confidence. This transition is most readily captured by the category scores for SIGN-STRONG and SIGN-WEAK, words that denote self-assurance and self-doubt, respectively (Fig. 10). Like

Figure 10. Category scores for SIGN-STRONG and SIGN-WEAK (N=323).

the category scores for COLLECT and THEORIZE, those for SIGN-STRONG and SIGN-WEAK exhibit the same basic crisscrossing pattern when plotted by year of the voyage. They capture a marked transformation in the *tone* of Darwin's voyage letters and exhibit the steadily growing self-esteem that accompanied Darwin's maturation as a scientist and a thinker. Together, the dual transformations that are apparent in Darwin's voyage identity and self-confidence are probably the single most important legacy of the *Beagle* voyage, providing an essential part of the psychological substratum from which Darwin's scientific genius emerged. The man who could write in his last voyage notebook that "Geology of whole world will turn out simple" was clearly not the same person who, four years earlier, had repeatedly doubted the accuracy of his own eyesight.[28] It is particularly this human and personal side of Darwin's intellectual development that later tended to disappear from his formal accounts of the *Beagle* voyage as soon as he began to rewrite his manuscripts for publication. And this is a major reason why the *Beagle* "transformation" has apparently remained so elusive, since even a detailed

reconstruction of Darwin's scientific development aboard the *Beagle* is only part of an equally significant and harder-to-document development that occurred in Darwin as a human being.

One last question still remains to be considered in this survey of Darwin's intellectual maturation during the *Beagle* voyage. What about Darwin as a biologist? I have purposely left this question to last, and shall treat it only briefly here, since much of Darwin's development as a biological *theorist* — especially his conversion to the theory of evolution — was a post-voyage episode in his scientific career. This is not to say that Darwin failed to exhibit significant development in his biological views during the *Beagle* voyage. As both Hodge (1982) and Sloan (this volume) have shown, Darwin's considerable interest in problems of marine invertebrate zoology led to important changes in his thinking during the voyage — changes that were subsequently to become closely integrated with his earliest attempts to formulate a general theory of transmutation.[29] In this connection it is worth emphasizing that Darwin's voyage interests and intellectual transformations as a biologist were associated in large part with those fields, like ornithology, entomology, and marine invertebrate zoology, in which he had already deeply immersed himself prior to commencing the voyage.[30] But Darwin's overall intellectual development in these and other biological disciplines consisted primarily in acquiring a greater breadth and depth of knowledge about natural history, not in revolutionizing this field, as has so often been thought. In short, devoted as he was to natural history during the voyage, Darwin simply did not possess sufficient expertise, self-confidence, or theoretical vision as a biologist to develop intellectually in the same way that he did as a geologist. Moreover, surprising as it may seem, the category ZOOLOGY (which includes marine invertebrate zoology) has the highest *negative* association with time (Factor I, –.94) of all the categories included in this content analysis.[31] As reported in his letters to Henslow, Darwin's principal scientific preoccupations clearly lay elsewhere.

In recent years the myth of the *Beagle* conversion, long upheld by Darwin's biographers, has finally been laid to rest by Darwin scholars. It is now known, for example, that Darwin left the Galapagos Archipelago in October 1835 without fully realizing or accepting the evolutionary evidence offered by these famous islands. In fact, Darwin failed to collect specimens of the famous Galapagos tortoises for scientific purposes, mistook certain species of "Darwin's finches" for the forms they appear to mimic, and muddled his ornithological collections so hopelessly by island that he was later forced, after his return to England, to borrow the carefully labeled collections of other shipmates in order to test his newly dawning evolutionary suspicions (Sulloway 1982a, 1982b, 1982c). Even then, what was remarkable about Darwin's conversion to the theory of evolution was that it occurred on the basis of evidence that remained sketchy and ambiguous at best. Although John Gould, Richard Owen, George Waterhouse, and other systematists

did much to enlighten Darwin in the Spring of 1837 regarding the full biological significance of his collections, and although these naturalists were able to rectify certain key errors in Darwin's voyage classifications of his specimens, the resulting evidence for evolution was by no means overwhelming. As Darwin himself confessed to Joseph Hooker ten years after his Galapagos visit: "I cannot tell you how delighted and astonished I am at the results of your examination [of the Galapagos plants]; how wonderfully they support my assertion on the differences in the animals of the different islands, about which I have always been fearful" (*LL* 2:22).

Thus Darwin was convinced of the mutability of species based on biological evidence whose complete validity he continued to doubt for nearly a decade! Moreover, of the many naturalists who worked on, or heard detailed scientific discussions about, Darwin's *Beagle* collections, Darwin was the only one compelled to interpret this evidence in terms of the heterodox theory of evolution. How, then, was his conversion possible at all if so many other naturalists, equally or more knowledgeable than he about the science of biology, were unconverted by the *Beagle* "evidence"?

The myth of the voyage conversion has long obscured this interesting historical problem, as well as the nature of Darwin's voyage development more generally. With the myth finally dispelled, along with its "eureka-like" emphasis upon the importance of scientific "facts", one can now see that the key to Darwin's conversion lay as much in Darwin himself as it did in the famous voyage that he undertook. Five years on board the *Beagle* taught Darwin to think for himself and allowed him, especially through his geological work, to envision himself as a theoretician with a penchant for far-reaching explanations and universal laws. Once the anxious collector on the *Beagle* was transformed into an increasingly bold geological theorist, Darwin was able to transfer his developing intellectual talents to many other related fields of science. Thus the influence of the *Beagle* voyage transcended any particular scientific field or discovery on Darwin's part. In the process, the voyage provided Darwin with something much more important, namely, the opportunity to mature intellectually under highly auspicious circumstances and thereby to become the Darwin that history now celebrates.

In concluding, it is appropriate to ask whether the content-analysis procedures employed here have revealed anything that would not otherwise have been apparent from a careful reading of the documents. An answer to this question depends, in part, upon what one means by *apparent*. At one historiographical level, scholars have certainly recognized that Darwin matured intellectually during the *Beagle* voyage and that this development entailed, among other things, a significant increase in his self-confidence. This study, however, suggests something more noteworthy, namely, that Darwin's personal transformation in self-confidence and self-identity — not any specific scientific discovery or his famous Galapagos visit — was actually

the *Beagle* voyage's most important contribution to his subsequent success in science. This is not to say that Darwin's scientific work on the voyage is any less significant than historians have generally believed, but rather that its significance *for Darwin* can only be understood within the parallel context of his personal and psychological development on the *Beagle*.

It is for these reasons that, when the technical aspects of this research were first carried out, more than a decade ago, the principal results came to me as a distinct surprise. Having previously chosen the Henslow correspondence as a vehicle for tracing Darwin's *scientific* development, I did not anticipate that a content analysis would underscore the predominance of *psychological* themes in these letters. Indeed, it would seem that I had actually stacked the deck in the opposite direction by including such a high proportion of purely scientific categories in the study. Yet virtually none of these scientific categories ended up "defining" the four factors extracted in the analysis. Ironically, the computer, one of the greatest symbols of dehumanization in present-day society, succeeded in highlighting Darwin's distinctly "human" preoccupations over his strictly scientific ones.

Similarly, even after repeated readings of Darwin's voyage letters, I was not prepared to find a strongly negative association between Darwin's zoological interests and those categories that reflect his emergence as a *thinking* man of science. Like other Darwin scholars before me, I had read these letters with certain dominant interests and expectations in mind; and it was not therefore surprising that I continued to have these expectations fulfilled as long as I was free to concentrate upon those aspects of the letters that I and others considered of greatest importance. In this respect historical scholarship is really no different from science itself; in both fields of research one naturally looks for and tends to find what the current consensus suggests as the expected result.

By altering some of the basic assumptions that historians now share about Darwin, the progress of Darwin studies over the last decade has made some of the findings of this study less novel than they perhaps once were. Nevertheless, Darwin scholarship is still largely preoccupied with the scientific and intellectual, rather than the personal and psychological, aspects of Darwin's life. Within the burgeoning "Darwin industry", the man has become overshadowed by his own increasingly disembodied concepts.[32] In this connection Darwin's manuscripts and published works have tended to take precedence over those "unwritten" aspects of Darwin's life, such as the intricate dynamics that characterized his personality and intellectual style, that can only be reconstructed with great difficulty. Admittedly, making inferences about a great thinker's psyche is a notoriously subjective business, as may be seen in the highly problematic genre of literature that has come to be known as psychohistory.[33] But the absence of a reliable methodology for understanding the minds of people who produce great thoughts should not deter us from seeking interconnections. I hope that

this study, which has sought to integrate Darwin's personal development with his scientific work during the *Beagle* voyage, will be seen as a step in that direction.

ACKNOWLEDGEMENTS

I thank the following persons for their advice and criticisms in connection with this study: Frederick Burkhardt, Mary S. Campbell, Ralph Colp, Jr., Stephen J. Gould, Judith V. Grabiner, Jerome Kagan, David Kohn, Ernst Mayr, Daniel M. Ogilvie, Sydney Smith, and Philip J. Stone.

Appendix:

LISTING OF CATEGORIES

ANXIETY: afraid, anxious, fear, safety, trouble, worth.
APPEAR: appear, feel, look, observe, see, seem, think.
BOTANY: plant(s), seeds.
COLLECT: box(es), cask(s), collect, collected, collecting, collection(s), find, finding, found, specimen(s), taken, took.
COMMUNICATE: account, hear, heard, letter(s), say, says, said, send, sending, sent, tell, write, written.
CONTRAST: different, distinct, than.
CURIOUS: curious, peculiar.
DATE: *date of letter.*
DELIGHT: delight, delightful, glad, glorious, pleasant, pleasure.
DISTRESS: bad, difficult, disappoint, distressing, dread, growl, ill, miserable, regret, sad, sick, suffer, weary.
ENTOMOLOGY: insect(s), *proper names of insects.*
FOSSILS: bones, fossil(s), Megatherium.
FUTURE: opportunities, opportunity, shall, till, will.
GEOLOGY: bed(s), chain, coast, cordilleras, formation(s), geological, geology, land, lava(s), rock(s), sandstone, strata, structure.
GEOLOGICAL-CAUSE: action, active, alter, altered, alternate, deposited, depression, elevated, formed, injected, owing, produced, sedimentary, undulations, upheaval, volcanic.
GEOLOGICAL-TIME: age, ancient, epoch, modern, period, *proper names of shells*, recent, shell(s), succession, tertiary.
HOME: Cambridge, England, home, return.
HOPE: hope, want, wish.
IF: although, could, excepting, however, if, may, might, or, whether, would.
INTERESTING: extraordinary, interesting, wonderful.
MY: my.
NEGATION: not.
NEW: new.

NON-SPECIFIC: anything, it, one(s), some, something, somewhat, thing(s).
OTHER: you, your, yourself.
OVERSTATE: all, always, entirely, etc., ever, every, everything, exceedingly, excellent, fine, grand, great, how, least, many, most, much, never, no, nothing, quite, so, such, very, whole.
PLACE-REFERENCE: countries, country, here, place(s), *proper names of places*, where.
QUANTITY-REFERENCE: another, few, half, many, number(s), three, two.
RESEMBLANCE: belonged, identical, like, relation, resemblance, same.
SCIENTISTS: Clift, Henslow, Jenyns, Lyell, Sedgwick, Whewell.
SELF: I, me, myself.
SIGN-STRONG: able, can, certain, clearly, could, good, must, no doubt, ought, really, should, sure, true, unquestionable.
SIGN-WEAK: cannot, doubt, doubtful, ignorance, imperfect, impossible, luck, mistake, nothing, not sure, poor, useless.
SIZE-REFERENCE: enormous, immense, large, little, minute, small.
SPACE-REFERENCE: between, lower, over, near, upper.
SPECIES: family, genus, order, species.
THEORIZE: because, believe, conclusion, consequence, convinced, fact(s), imagine, mind, probably, respecting, suppose, suspect, thus, understood.
TIME-REFERENCE: before, during, long, month(s), now, since, time, year(s).
UNDERSTATE: nearly, only, perhaps, rather.
VOYAGE: Beagle, cruize [*sic*], sail, sailed, voyage.
WE: we, our.
ZOOLOGY: animal(s), *proper names of animals*.

Notes

1. Humboldt (1769–1859), a Prussian, used his small inheritance to finance a five-year expedition to Latin America during the years 1799 to 1804. His thirty-four volume account of his travels, published over a twenty-nine-year period, was partially translated into English under the title *Personal Narrative of Travels to the Equinoctial Regions of the New Continent* (Humboldt and Bonpland 1814–1829). Humboldt's narrative of his explorations subsequently inspired many nineteenth-century naturalists, including Darwin, with a desire to travel. Just a month prior to receiving the offer to sail with the *Beagle*, Darwin wrote to his mentor Henslow: "I hope you continue to fan your Canary ardor: I read & reread Humboldt, do you do the same, & I am sure nothing will prevent us from seeing the great Dragon Tree [of Tenerife]" (Darwin 1967, p. 26). For further information on Humboldt's scientific career, see Biermann (1972).
2. Darwin's *Journal of Researches* was prepared from a diary that he kept during the voyage. The changes made in preparing this diary for publication are significant not only for what was added but also for what was deleted. Only about one-half of the original diary appeared in the 1839 edition of the *Journal*, and even less survived in the revised second edition (1845). As Gruber (1981a) has shown by a careful collation of the changes made in the *Journal* between the first and second editions, this work continued to reflect significant revisions associated with Darwin's intellectual development. Even Darwin's voyage *Diary*, published by Nora Barlow in 1933, provides only a partial record of Darwin's intellectual development on the *Beagle*. This is largely because the *Diary* was intended as a personal rather than a scientific record of his travels and was kept separate from his still unpublished notes on geology and zoology. Only occasionally does the *Diary* offer summaries of the more important scientific observations Darwin was making. Darwin's unpublished scientific notes, which were also kept in diary form, are in the Darwin archive of Cambridge University Library (DAR 31–38).
3. The most valuable attempts to clarify this chronology are those of Gruber and Gruber (1962), Limoges (1970c) and Herbert (1974, 1977, 1980). Elsewhere I have shed new light on Darwin's visit to the Galapagos Archipelago and have provided a detailed account of Darwin's conversion to the theory of evolution (Sulloway 1979b, 1982a, 1982b, 1982c, 1983, 1984). The literature on Darwin's early intellectual development, and the role of the *Beagle* voyage in that connection, also includes contributions from Eiseley (1958), Himmelfarb (1959), Greene (1959a), S. Smith (1960), Wichler (1961), De Beer (1963), Ghiselin (1969), Gruber and Barrett (1974), Grinnell (1974), Keynes (1979), and Kohn (1980).
4. See, for example, Glass, Temkin, and Straus (1959).
5. For a selection of such studies, together with a detailed description of the content-analysis procedure, see Stone et al. (1966). This study differs in one important respect from most other content analyses, in that it deals with the work of a single individual who is also generally acknowledged to have been a genius. The use of computers and content-analysis procedures is increasingly common today in the fields of political and socioeconomic history. Nevertheless, there would appear to be some resistance toward applying such techniques in purely biographical research, especially when the figure involved, like Darwin, is eminent and already well studied. At the Darwin Centennial Conference (Florence, 1982) at which this paper was presented, several colleagues expressed their uneasiness and even antipathies in this regard. One colleague in particular asked me if I was not concerned that this study might inspire other computer analyses of Darwin's work, thus turning Darwin scholarship into a sort of "mindless" activity. Whether the application of computer-assisted research techniques in biography will prove to be more or less limited than in other fields of history remains to be seen; but such techniques are certainly no more inherently "mindless" than various other approaches to historical research. Moreover, computers do not usurp the historian's basic functions; rather, they provide a powerful instrument for advancing historical research in ways that would otherwise be excessively time consuming or virtually impossible.
6. The advent of optical readers and sophisticated word processors, which were not available when the technical aspects of this study were originally done (Sulloway 1969), has greatly transformed the potential use of content analysis by making it much easier (and less expensive) to analyze large volumes of text.
7. So impressed were Henslow and his colleagues

with the scientific caliber of these letters that they arranged for substantial portions of them to be privately printed as a pamphlet by the Cambridge Philosophical Society in December 1835, during the fourth year of the voyage (*CP* 1:3–16). This was Darwin's second scientific publication — his first being records of about thirty insects collected in Cambridge, North Wales, and Shrewsbury (published in Stephens 1829).

Whether Darwin's 1835 pamphlet should actually be regarded as a "publication" has been questioned (Freeman 1977, p. 24), since "publication", in its narrowest twentieth-century sense, generally implies that the item concerned has been offered for public sale (whereas the pamplet was not). The broader essence of "publication", however, consists simply in putting an author's work into general circulation, which Darwin's letters to Henslow certainly were within the Cambridge-London scientific community. The printed circulation of the letters even made Darwin something of a scientific "celebrity" prior to his return to England, and parts of them were subsequently reprinted in the *Entomological Magazine, 3* (1836):457–460. It would therefore seem to be quibbling, especially by nineteenth-century standards, to say that Darwin's 1835 pamphlet was not "published" just because it was issued free and in a limited edition intended for distribution among fellow scientists. Under the 1976 United States copyright law (Public Law 94–553, §101), Darwin's pamphlet *would* constitute a publication.

8. Because the category scores for each letter must be normalized according to the length of the letter, extremely short letters tend to produce unrepresentative results and, for this reason, were omitted from the analysis.
9. Not included in the forty-two categories are approximately fifty words (such as common articles, prepositions, and adverbs) that account for 40 percent of the text of Darwin's letters. Another 35 percent of the text is encompassed by the words included in the forty-two categories. This leaves only 25 percent of the text, composed exclusively of words used four times or less, unrepresented in the chosen categories. At this level, adding more words to the categories (or enlarging the number of categories) would only slightly increase the amount of text encompassed in the study. For example, if every word used more than twice by Darwin had been included, the number of individual *words* encompassed by the categories would have doubled but the amount of *text* covered by the analysis would have increased by only 7 percent. For further information on the relationship between word frequency and text coverage, see Stone et al. (1966, pp. 164–165).
10. The expression *no doubt*, for example, connotes a sense of confident certainty (OVERSTATE, SIGN-STRONG) rather than the opposite (NEGATION, SIGN-WEAK). Similarly, a reference to the Cape of Good Hope would be scored under PLACE-REFERENCE rather than under SIGN-STRONG (*good*) and HOPE (*hope*).
11. The number of factors extracted was limited to four because additional factors accounted for a rapidly decreasing amount of variance. (The average variance accounted for by the first four factors is 15 percent per factor, versus only 6 percent per factor for the next four factors). These first four factors were rotated by the orthogonal varimax method in order to clarify their identity and to maximize their independency.
12. Category *loadings* are the measure of association of each category with the factor. Loadings under .3 in either direction are low, between .3 and .5 are moderate, and over .5 are high.
13. Considering the breadth of Darwin's knowledge in the fields of entomology, ornithology, marine invertebrate zoology, and geology, his self-doubts about his competence as a collector betray his desire to fulfill an unusually high set of standards in his scientific work. Darwin would not have been chosen for the position of ship's naturalist if Henslow or anyone else had doubted his abilities. Thus Darwin's self-doubts are of particular interest in revealing his *own* conception of himself, rather than the conception of his mentors.
14. See Raspe (1786) and Darwin (1967, p. 59; letter of 15 August 1832).
15. Darwin (1967, pp. 112–114; letter of January 1836). FitzRoy, impressed during the last year of the voyage by certain passages from Darwin's personal diary, invited Darwin to collaborate with him on an article discussing the work of the missionaries in the Pacific. This article, which included extracts from Darwin's *Diary*, was completed by June 1836, when the *Beagle* reached Cape Town; and the article was subsequently published in the *South African Christian Recorder* (*CP* 1:19–38). It was during the last year of the voyage that FitzRoy also invited Darwin to collaborate with him in publishing the official account of the *Beagle* voyage. FitzRoy's initial plan of citing extracts from Darwin's *Diary* was fortunately not carried out, and Darwin was allowed to

publish a revised version of his *Diary* as the third and last volume of the official record.

16. If sufficient categories are present to allow an accurate identification, labels are provided in the two-dimensional factor plots for those areas, at a forty-five degree angle from the main axes, that are formed by a fusion of the two factor spaces. In Figure 1, four such "fusion factors" are recognizable and are labeled accordingly.
17. "I look up to you as my father in Natural History", Darwin wrote to Henslow in July 1834, "& a son may talk about himself to his father" (1967, p. 95).
18. Because Factor II delineates Darwin's relationship with Henslow, Darwin's letters to Charles Whitley (July 1834) and Caroline Darwin (August 1834) are not included in the document scores plotted in Figure 2. It should perhaps be mentioned here that Darwin received a now-lost letter from Henslow in April 1832, when he arrived in Rio de Janeiro (1967, p. 55). This letter was not in response, however, to any of Darwin's own voyage letters or shipments of specimens, the first of which were not sent until June and August 1832, respectively. Thus Henslow's lost letter could not have supplied Darwin with any feedback concerning the fate and value of his collections or the merits of his scientific work. Two more years passed before Darwin finally heard again from Henslow.
19. In Figures 3–4 and 9–10, the vertical scale ("occurrences/1000 words") is based on the total number of words included in the forty-two categories (6,389). See further note 9.
20. The relative relationship between BIOLOGY TOTALS (ZOOLOGY, ENTOMOLOGY, BOTANY and SPECIES) and GEOLOGY TOTALS (GEOLOGY, GEOLOGICAL-CAUSE, and GEOLOGICAL-TIME) in Figure 3 is almost identical to the relationship observed by Gruber and Gruber (1962, p. 191) in counting the number of manuscript pages that Darwin devoted to these two subjects during each year of the voyage. Only the thirteen letters to Henslow have been used in compiling Figures 3 and 4. Some portion of the year-to-year differences seen in Figure 3 can be attributed to the different opportunities offered in various fields of natural history by the east and west coasts of South America; but, in general, the totals seem to reflect a genuine shift in Darwin's scientific interests.
21. In the *Origin* Darwin later praised Lyell's *Principles of Geology* (1830–1833) with the comment: "the future historian will recognize [this work] as having produced a revolution in natural science . . ." (p. 282).
22. Darwin's claim in his *Autobiography* (p. 98) that he developed his coral reef theory while still on the South American continent is confirmed by the presence of several brief allusions to that theory in his "Santiago" pocket notebook. The "Santiago" notebook contains entries dating from late 1834 through mid-1836. Because Darwin, in his discussions of the coral reef theory, used the word *Pacific* twice without a terminal *k*, these passages can be dated to the period prior to mid-July 1835, when Darwin began spelling *Pacifick* consistently with a *k* (Sulloway 1983). (Darwin was in Lima, Peru, at this time.) The coral reef passages in the "Santiago" notebook probably date from March or April 1835, about the time of Darwin's transection of the Andes (and his confirmation of the geologically recent elevation of this mountain chain).
23. Robert Darwin's comment was made in reference to the receipt of Henslow's printed pamphlet of extracts from Darwin's voyage letters (*CP* 1:3–16). These extracts tend to lack those passages in the original letters that convey Darwin's repeated anxieties and self-doubts. Hence the extracts represent those portions of the letters producing high category loadings on Factors I^+ (self-assurance), II^+ (independence), and III^- (involvement).
24. Darwin experienced fairly severe somatic symptoms of anxiety (such as upset stomach and palpitations of the heart) on several occasions before he went on the *Beagle* voyage. After the voyage these symptoms became chronic beginning with the Fall of 1837, shortly after Darwin opened his first notebook on the transmutation of species and as he was finishing the proofs for his first book. In later years, Darwin's symptoms were often greatly relieved by hydropathy treatments, which generally involved a cessation of work on Darwin's part. Darwin personally associated his symptoms with hard "mental work" or "excitement", and he would take the water cure or a vacation in order to clear his mind of his scientific thoughts. As soon as he returned to his work, however, his symptoms quickly reappeared. See further Colp (1977a).
25. The precedence that Darwin's scientific interests by this time had gained over the issue of the voyage's length may be seen in the following intention, which Darwin briefly entertained in late 1834. When Captain FitzRoy invalided himself from nervous exhaustion in November of that year (requiring the *Beagle*, by standing orders, to

return immediately to England via the Atlantic), Darwin quickly formulated a plan to remain behind in Chile and Peru for at least a year in order to explore the Cordilleras in detail (Darwin 1945, p. 111; letter of 8 November 1834 to Catherine Darwin). FitzRoy's subsequent reconsideration of his decision to give up command of the *Beagle* was welcomed by all, Darwin included, who was especially anxious to see the coral islands of the Pacific.

26. The remainder of Darwin's correspondence with Henslow, who died in 1861, exhibits many of these same basic patterns of communication. Nothing, for example, could be more defensively deferent (Factor II) than Darwin's 11 November 1859 letter to Henslow, in which he informed Henslow that he was sending him a copy of the *Origin of Species* but did not think that Henslow would at all approve of his book. Like those voyage letters scoring highly on the negative end of Factor II, this letter is studded with words referable to the categories IF, NEGATION, and SELF. Other letters written to Henslow between 1837 and 1860 are also frequently deferent and dependent in tone when requesting scientific information (a literary style that Darwin seems to have perfected over the years for just such requests). On the other hand, many letters, such as Darwin's 1 April 1848 announcement of his discovery of complementary males in cirripedes, score comparatively low in the categories IF, NEGATION, and SELF (1967, pp. 158–161, 200), thus reflecting Darwin's independence from Henslow, especially during periods of important scientific discovery.

27. Inasmuch as the Darwin letters project, which will eventually publish Darwin's known correspondence in full, has been conducted with the aid of computers, it may someday be possible to test this and other questions in a systematic manner. One should not, of course, expect the three non-temporal factors (II–IV) found in this content analysis to be *absolutely* identical in Darwin's later correspondence, either with Henslow or with other correspondents. Although independent of time during the five-year period of the *Beagle* voyage, these factors might well be time-dependent over a longer span. Similarly, Darwin's dependence on other naturalists, including Henslow, for information in connection with his researches would perhaps manifest itself somewhat differently according to the relative age and status of his correspondents, or according to how well Darwin personally knew them. Thus the nature of any "factors" present in Darwin's complete correspondence would inevitably prove somewhat different from the ones manifested in this study. The same point naturally applies to Darwin's voyage correspondence with his family and peers, although Factors I, III and IV are obviously important themes in these other letters, and Factor II (dependence versus independence) is manifested as well, albeit in a somewhat different context (dependence with regard to news, family gossip, and especially money matters). Finally, Darwin's continued development after the voyage, which was associated with many new preoccupations as well as with ongoing changes in his personality, introduced into his correspondence numerous new themes that might well provide the basis for important new "factors".

28. See Darwin's *Red Notebook* (*RN* 50). This sentence was probably written about mid-August 1836. The ambitious, free-flowing speculations put forth in this last voyage notebook provide a record of Darwin's developing thoughts between May or June 1836 and the opening of the first notebook (*B*) on the transmutation of species in July 1837. Regarding the dating of this notebook, which contains Darwin's first evolutionary speculations, written about 15 March 1837, see Herbert (1980) and Sulloway (1982c).

29. I do not believe, however, that Darwin's voyage researches in invertebrate zoology were in any way a *necessary* precondition for his eventual conversion to the theory of transmutation, contrary to Sloan's suggestion (this volume). Rather, it seems clear that the three major classes of facts that Darwin himself later cited as having converted him to a transmutationist position (namely, his South American fossil Mammalia, patterns of geographic distribution among living South American species, and the evidence of the Galapagos Archipelago) were the necessary and nearly sufficient intellectual causes of the conversion (*Autobiography*, pp. 118–119). See further, Sulloway (1982c).

30. In light of the increased attention that has been paid in recent years to Darwin's voyage researches in marine invertebrate zoology, I have reanalyzed the Henslow correspondence in order to distinguish between Darwin's discussions within six distinct biological fields. The six fields are listed here in descending order of their contributions to the BIOLOGY category totals. In addition, the *continuity* of Darwin's interest in these six fields is

reflected, albeit only approximately, by the proportion of discussion occurring during the two halves of the *Beagle* voyage: (1) botany (59%/41%) — clearly botany, hardly one of Darwin's major preoccupations during the voyage, rates highly primarily because of his correspondent's interests in the field; (2) invertebrate zoology (63%/37%); (3) fossil vertebrate paleontology (96%/4%); (4) entomology (58%/42%); (5) vertebrate zoology (94%/6%); and (6) ornithology (71%/29%). Altogether, Darwin devoted more space in his letters to the subject of vertebrate zoology (including ornithology and fossil vertebrate paleontology) than he did to invertebrate zoology (including entomology). Nevertheless, his discussions about invertebrate zoology are more evenly distributed throughout the two halves of the *Beagle* voyage (61%/39%) than are his discussions of vertebrate zoology (91%/9%). At least some of this disparity is undoubtedly owing to the differing opportunities offered for observations and researches in these two general fields as the voyage progressed.

Insofar as these statistics may differ somewhat from those derived from an analysis of Darwin's *Beagle* Zoology Diary (Sloan, this volume), it must be emphasized that Darwin reported to Henslow only what he considered to be of greatest scientific importance, either to himself or to his correspondent. The letters therefore act as a sort of information "filter" — a filter separating out the most significant features of Darwin's voyage thoughts and discoveries, as *he* perceived them at the time, from his researches as a whole.

31. The category ZOOLOGY has as its two most *negatively* correlating categories in this study DATE and SIGN-STRONG (words denoting self-confidence). Both correlations are statistically significant ($P < .01$). The correlation between ZOOLOGY and THEORIZE is –.49, which is nearly significant at the level of $P < .05$. In other words, as the voyage progressed, Darwin discussed zoological subjects less and less; whereas his self-confidence and his theoretical interests both increased with time.
32. The work of Gruber (Gruber and Barrett 1974) and Colp (1977) nevertheless represents an exception to this general trend, although even Gruber has favored a "cognitive" over a broadly psychological approach to Darwin's creativity. R. Porter's apt comment about Darwin scholarship is also relevant in this regard: "Whereas the advancement of science used to be the biography of great men, . . . academic history of science has increasingly, in the name of scientific and professional standards, disparaged personal focus. Its goals have become to study problems not people, issues not individuals, ideologies not inspiration. . . . Thus it is striking that no academic historian has written a biography of Darwin over the last twenty years" (1982, p. 18).
33. On the subjectivity of psychohistory, see Stannard's (1980) excellent review of the literature and its pitfalls.