# THE ROLE OF THE COMPUTER IN HUMANISTIC SCHOLARSHIP

Edmund A. Bowles
*Department of Educational Affairs*
*IBM Corporation*
*Armonk, New York*

Within the past dozen years or so, the computer has made itself felt in every aspect of our society. One hundred years ago, it was the Industrial Revolution which wrought profound changes in the economic and social fabric of the western world. Today there is an upheaval of comparable force and significance in the so-called Computer Revolution. Indeed, Isaac Auerbach has characterized the invention of the computer as being comparable to that of the steam engine in its effects upon mankind. He predicted that the computer and its application to information processing "will have a far greater constructive impact on mankind during the remainder of the 20th Century than any other technological development of the past two decades."[1]

To cite but one example, the so-called information explosion has affected all areas of knowledge, scientific and humanistic alike, making analyses both increasingly complex and time-consuming. During much of the century, knowledge is estimated to have doubled every ten years, and journals are proliferating at the astounding rate of over three per day. An overriding problem, or challenge, if you will, is the integration of this new knowledge into the existing world of scholarship as well as the dissemination of these new ideas and concepts within the intellectual community at large. Here again, one turns inevitably to the computer. In fact, we have now reached the point where even an anthropologist speaks about the heritage of a culture being stored in physical objects such as books and computer tapes! More important, however, is the existence of data processing and information retrieval as a new and useful tool of tremendous potential; a fact that must be recognized and accepted by the nonscientific community of scholars.

Let us consider for a moment the principal advantages of the computer to humanistic scholarship in general. Its incredible speed allows the scholar to accomplish in a short time what would otherwise take him a whole lifetime of drudgery to accomplish. Its storage or memory constitutes an infinitely more reliable repository than the mind of the proverbial absentminded professor. Its great accuracy is completely dependable even when untold mountains of statistical data require handling. And finally, its automatic operation is not subject to the vagaries of human fatigue, periods of interruption, or even of mood. To the humanist, I would suggest the most important of these advantages is the immense saving of time gained by the use of computers. It is useful to remind ourselves that the *Oxford*

*English Dictionary* took some 80 years to complete with several generations of editors. Jakob and Wilhelm Grimm's monumental *Deutsches Wörterbuch* began to appear in 1854 and wasn't completed until 1960. Similarly, the manual indexing of the complete works of Thomas Aquinas (approximately 13 million words) would take 50 scholars 40 years to accomplish, but thanks to the computer, the total time required by a few scholars working mainly in Italy was less than one year.[2] A concordance to the Revised Standard Version of the Bible was produced on a high-speed computer within a period of several months as compared to the King James Concordance of the last century which took 54 scholars 10 years to accomplish.[3] The deciphering of the Mayan hieroglyphic script by Russian mathematicians, we are told, took only 40 hours of computer time for which a human being would have needed thousands of years to accomplish.[4] All this leads to the inevitable conclusion that there are a number of scholarly tasks—call them the more tedious clerical chores, if you will—that in this age demand the use of the computer. Certainly, one can no longer think of concordances, dictionaries, or projects involving masses of statistical data and numerous cross-correlations without bringing into play the tools of data processing. Thus, the computer's power can be harnessed to relieve scholars in the humanities of some of their most burdensome activity while at the same time providing their research with the benefits of greater speed and accuracy. More important by far, however, are the more creative uses of data processing as an aid in such areas as stylistic analysis. More of this in a moment.

Unfortunately there is a great deal of suspicion, fear, and ignorance on the part of the humanist concerning the computer and its legitimate role in scholarship. Some see the machine as eventually making decisions that man himself should make. Others find sinister implications in every technological advance, maintaining the attitude that the humanities and technology don't mix. Finally there are those who, ignorant of mathematics, fear they are totally and forever incapable of comprehending the computer and therefore dismiss it. Although no one would suggest burning at the stake the maker of a computerized concordance, as was almost the fate of the first person to make a complete concordance of the English Bible in 1544, the computer-oriented humanist does face some formidable oppositions.

Ironically, while the impact of the computer, as stated at the beginning of this paper, may be compared to the influence of the Industrial Revolution one hundred years ago, there is also an analogous reaction among many highly placed scholars to so-called computer-oriented humanistic research. Not that any misguided intellectual will physically attack "the dark Satanic mills," as did their Luddite ancestors, but we do have their counterparts today who, kowing little of the computer's advantages and limitations, damn the machine as not only useless but dangerous to the world of scholarship. To some of the older, more conservative scholars, putting lines of verse into a computer seems profane, like putting neckties into a Waring Blender, as one professor remarked. More seriously, there are academicians who place no value on the scholar's time, like the professor who, when told that data processing would vastly speed up the production of an English-Old Iranian dictionary, went so far as to say that what is *not* needed is a computer but rather enough money for someone to be completely free for several years so he could sit down and do the necessary work. A Scottish minister and mathematician sent an article on the use of the computer in biblical scholarship to a publisher. It was returned promptly with a notation, "I do not understand this, but I am quite sure that if I did understand it it would be of no value." One scholar said a few years ago that, "If you have to use a computer to answer a question, it is not a question which I would care to put." Fortunately for the humanities, things are changing rapidly.

Let us reveal the negative position for what it is as we now examine some representative projects within various humanistic disciplines which have made extensive use of the computer as both an important and productive tool of scholarship.

In the field of archeology, for example, the computer is of use in studies of shards or fragments of artifacts found in the diggings of ruins. In this connection, Jesse D. Jennings of the University of Utah suggests constructing a matrix of coefficients of similarity of one artifact to another, and thus to all others within a given corpus of objects. The two basic problems are classifying shards as to their cultural provenance and reconstructing whole artifacts from broken fragments. Jennings has a body of some 2,600 shards, each of which has 50 attributes. Obviously, this represents an astronomical number

of comparisons to make by hand, and yet for a computer it is a relatively simple task.[5]

Mr. Dee F. Green, a research associate at the University of Arkansas Museum, is using codes and statistical techniques in correlation studies of burial lots from Eastern and Southwestern Arkansas, and in detailed analyses of ceramic, decorative, and technical complexes and traditions exhibited in certain areas of the state. Following the maxim that pottery is "the essential alphabet of archeology," a code was developed for reducing the individual attributes of some 4000-odd pottery vessels to a numerical system for computer handling. Once the material is classified, the various attributes will be sorted into discrete categories and then statistical techniques applied to lump the attributes into statistically meaningful groups, or ceramic types.

Dr. Paul S. Martin and his associates at the Chicago Natural History Museum have been using the IBM 7094 computer at the University of Chicago to process archeological data from the southwestern United States.[6] By this means they have discovered spatial clusters of both pottery types and pottery design elements within a pueblo site. It was found that the clusters themselves tended to be localized in certain well-defined areas of the site. In addition it was found that certain room-types contained specific clusters of artifact types. In each case, the computer was given frequencies or percentages of different artifact or shard types by provenance. The variables were then correlated and submitted to factor analysis. This allowed comparison of room-floors with one another to find out which rooms were similar and which different. This information was then interpreted in terms of room function, social groups, chronology, and so forth.

As can readily be seen, such projects as these involving many thousands of artifacts, each with numerous attributes, as well as the dozens of correlations between them, really demand the use of computers to handle the sheer mass of information and to derive really meaningful results therefrom.

Historians have faced a new impetus for the application of social science research techniques to the analysis of historical political data. The Inter-University Consortium for Political Research at Ann Arbor is amassing a vast amount of raw data transferred to tape storage on American political history. In addition to the formation of a data repository committee, with close ties to the American Historical Association, is the development of an automated data retrieval system to make available to historians and political scientists alike large bodies of information. The American Historical Association has set up an Ad Hoc Committee on the Collection of Basic Quantitative Data of American Political History under the chairmanship of Professor Lee Benson. Election statistics on presidential campaigns from all counties in the United States from 1824 to the present, roll-call votes during each congressional session since 1789, data on federal court cases, and census and ecological information are all being computerized. Further material awaiting such attention exists in the fields of agriculture, business statistics, industry, religion, economic, social, and cultural data, foreign trade, employment, tax data, and housing. The amount of such unpublished information available is staggering. For but one year in American history, the U.S. Census Bureau Catalog includes over 5000 computer tape reels of data in the above-mentioned fields.

The Inter-University Consortium held a training program during the past three summers consisting variously of elementary courses such as "Introduction to Survey Methods," and "Cases in Survey Research," an eight-week Graduate Pro-Seminar in Behavioral Research Methods and Quantitative Political Analysis, and advanced seminars conducted by both the Department of Political Science and the Survey Research Center of the University of Michigan. To the best of my knowledge, this is the first and only attempt within a given field of humanistic endeavor to provide computer training for its constituents.

One of the earliest historical studies involving the use of data processing was the study of Massachusetts shipping during the early Colonial period made by Professor Bernard Bailyn of Harvard University.[7] Faced with the problem of sketching a realistic picture of the subject, he came upon a perfectly preserved shipping record for an 18-year period containing information not only about the vessels registered but about the owners as well; in other words, material of early American social and economic history. Bailyn not only summarized and tabulated this data in comprehensive fashion but used the opportunity to assess realistically the possibilities of applying machine techniques to historical material and to explore the problems of procedure.

The shipping register in question consisted of 1696 entries, each giving information about a ves-

sel and the people who held shares in it. A total of 4725 punched cards were produced which contained all the information available in the register on the ships and their owners. Codes were developed not only for the purely quantitative data but for such qualitative information as names of people and places, vessel types, occupations, building sites, etc. Although numerous problems were encountered along the way, it is significant that Bailyn's book closes with the statement that only with these tools and techniques was the analysis of the register possible at all.

Two other computer-oriented historical research projects involve content analysis. Professor Richard Merritt of Yale University is studying the developing symbols of the American sense of community or identity as reflected in five colonial newspapers. Professors Robert North and Ole Holsti of Stanford University are analyzing the origins of World War I by means of computer techniques for scanning and reporting the appearance of themes and relationships in a large body of historical material pertaining to decision-making during the 1914 crisis.[8] "Communication is at the heart of civilization," but since students of international relations are considerably more restricted in access to data than most social scientists—direct access to foreign policy leaders is severely restricted—one method is to assess their attitudes, values, and assessments by means of a computer content analysis of political documents at times of crisis. North and Holsti constructed a dictionary of words, such as *abolish, accept,* or *armaments.* They are sought out in historical documents and changes in style are noted as the historical crisis grows in severity in terms of verbal effectiveness, strength or weakness, and activity or passivity. By this means one can explore for examantagonism and the degree of cohesion between the ple the relationship between the level of East-West Soviet Union and China.

Professor William Aydelotte of the University of Iowa has used the techniques of data processing to aid in the study of the voting patterns in the British House of Commons in the 1840's.[9] During Sir Robert Peel's ministry, Commons debated and voted on a number of substantial political issues. There were divisions as well on various aspects of religious questions, the army and fiscal reform. There exists an unexploited source in the so-called division lists giving information on all the men in Parliament so far as they voted on the issues in question. The complexity of this material, the richness thereof, the fact that most members of Parliament did not vote consistently "liberal" or "conservative" on all issues made this entire decade of Parliamentary history ripe for computer analysis; a project which resulted in a total of 6441 four-fold tables each of which was punched on a separate IBM card.

Certainly the most well-known use of computers in the field of literature is the construction of verbal indices. Briefly, there are two forms: first, a simple alphabetical list of text showing the frequency or location of the words or both; and second, a textual concordance showing all the words of a given literary work not only alphabetically but in context as well. In this form, each word appears as many times as there are words within the parameter arbitrarily chosen for it along with the relevant passages of which it is a part. Such a concordance is not only of immense value to a literary scholar from the point of view of time saved, but is useful also to those in other disciplines employing literature as source material. For example, concordances to the poetry of American authors have been issued since 1959 by the Cornell University Press. In the case of the works of Matthew Arnold, the lines of verse were punched on IBM cards, one line per card, to which was added the line number and page number from the standard edition and variance from other collations. A separate title card was punched and inserted before each poem. The entire deck of some 17,000 cards was printed out and transferred to magnetic tape. A computer-generated concordance program was then made and ultimately a tape prepared with all the significant words of Arnold's texts arranged in alphabetical order along with their locations. A final print-out formed the basis for the published index.[10]

In similar fashion, Professors Alan Markman and Barnet Kottler of Pittsburgh and Purdue respectively have prepared a computer concordance to five Middle English poems, perhaps the best known of which is *Sir Gawain and the Green Knight.*[11] Dr. John Wells of Tufts University is making a computerized word-index to the Old High German glosses cribbed between some 140,000 lines of medieval Latin text.

Professor Alice Pollin, working with the Computer Center at New York University, produced a guide, or critical index, to the 43 volumes of the *Revista de Filología Española* from 1914 to 1960, cross-indexed by authors, subject matter, and book

reviews. A total of nearly 900 pages was the result, the product of approximately 60,000 punched cards. The printout sheets were reproduced photographically and issued as a bound volume.[12] In this way a methodology for the machine-indexing of periodicals was established.

However, it is in the area of textual analysis that computer-oriented research in literature shows exceptional and exciting promise for the future. The massive comparison of text where there are several or even dozens of sources presents an almost insurmountable problem for the scholar. To compare in complete detail as few as 40 manuscripts might take the better part of a lifetime. It is this type of activity that cries for the use of data processing techniques.

Perhaps the first such effort was the study by Professors Mosteller and Wallace at Harvard University, and actually continuing over a period of years, to solve the authorship question of 12 disputed *Federalist Papers*.[13] Briefly, literary styles of Madison and Hamilton were identified, then matched with the style of each of the disputed papers. Having found such factors as sentence length, vocabulary and spelling to be of no help (the two authors were remarkably alike), it turned out that differences in the use of so-called key function words—particularly those of high frequency such as *from, to, by, upon, also,* and *because* — served to pin down authorship of the papers in question. From a number of computations, Mosteller and Wallace found that most of the disputed documents were written by James Madison. But consider for a moment the problem of Dr. John W. Ellison, a biblical scholar from Massachusetts who, for his doctoral dissertation, studied 309 manuscripts of the Greek New Testament, then went on to prepare a complete concordance of the revised Standard Version of the Bible. Fortunately, he used a computer to assist him in these gigantic tasks. However, there are over 4600 known manuscripts of the whole or part of the New Testament, with cross-fertilization in the copying process that has been going on for a thousand years or more. Here the use of the computer to determine the interrelationships of the manuscripts of the text is mandatory.

Scholars at other universities, while not faced with such vast problems of correlation, are actively engaged in similar work. For example, a definitive edition of the works of John Dryden is being prepared under Professor Vinton Dearing at U.C.L.A. with textual collation aided by the use of the computer.[14] This grew out of an existing corpus of 240,000 *manually* indexed cards. Variant texts of the final section of Henry James's novel *Daisy Miller* are being collated by computer in a pilot project at New York University under Dr. William Gibson. This, too, is designed to aid the editor faced with a number of varying manuscripts or printed editions in making up an *Urtext* or variorum edition by supplying him with a printout indicating the identifies between the versions, sentence by sentence.

Dr. James T. McDonough of St. Joseph's College has demonstrated with the help of a computer that Homer's *Iliad* indeed exhibits the consistency of one poet.[15] His study was in part a response to the persistent question of whether one poet wrote the epic or if it consists of separate, short ballad-type songs by separate authors from various times and places all strung together. McDonough prepared in systematic fashion a metrical index of the *Iliad,* not by spellings but by the rhythmic function of all 112,000 words in their 157 metrical varieties. Once the rhythm of each of the 15,693 lines was coded and punched, an IBM 650 machine was able to isolate the individual words, sort, count, and print out the resulting wordlists in a matter of hours.

Mrs. Sally Sedelow of Saint Louis University has described the use of the computer for a rigorous description and analysis of pattern attributes of text.[16] She makes the observation that while colleagues in linguistics have been making major contributions to such fields as machine translation and information retrieval—and in return, gaining important insights into the structure of language—those in literature have offered very little and gained very little. The aim of such studies is to discover the differences between writers' styles and to shed light on the changes of an individual author's style over a period of time. Known as "computational stylistics," these techniques deal with the parameters of literary style in terms of its constituent elements: rhythm, texture, and form.

Turning now to the field of musicology, Professor Harry B. Lincoln of Harpur College is using the techniques of information retrieval to compile a catalog of musical incipits (that is, brief melodic quotations of the first six to eight notes of a composition), of the entire body of 16th century Italian *frottole,* a known body of some 600 polyphonic compositions. Since the possible permutations and combinations of the beginning notes of such pieces

are almost infinite, both as to pitch and rhythm, such brief quotations represent unique identifications of the compositions from which they are taken. First the incipit is translated into alphanumerical form by means of a code which can activate a photon printer. This is a device with a high-speed rotating disk containing about 1400 characters (in this case, musical), a light source, lens, and photographic film. This code consists of *even* numbers for the spaces, *odd* numbers for the lines of the musical stave, an *H* for a half note, a *W* for a quarter note, and so forth. One punched aperture card with a 35mm photograph of the particular score set in the right-hand side holds information such as the composer, title, voice part, accession or serial number. The second card contains the proper sequence of note representing the incipit coded for the photon device. When computerized, this code causes the printer to raise or lower its focus to the proper line or space and, when the correct note or other symbol is in place, shoot a beam of light through the proper aperture in the disk exposing the film at that time with the desired musical symbol. At the same time, a computer program extracts from this coded information the intervalic order or melodic profile of the particular incipit. This, then, can be compared to other musical sources for instances of borrowings by one composer from another, or from other works of the composer himself.

A second major area is the use of data processing as an aid in the analysis of the structure of music. For example, Professor Bertram H. Bronson at Berkeley has used computer techniques in the study of folk-songs.[17] By means of punched cards, he coded the important elements of folk tunes including range, modal characteristics, prevailing time signature, number of phrases, the nature or pattern of refrains, final cadences, and so forth. In this way, an entire corpus of folk song material can be recorded both fully and accurately. The various elements can then be analyzed for statistical patterns, comparisons, or indeed subjected to any other query consistent with the data.

A computer can also serve to test hypotheses through simulation and models. Dr. Allen Forte of Yale University is applying machine analysis to help provide insights regarding the structure of the atonal music of Arnold Schönberg. The structure of so-called pre-twelve-tone (or nontonal) music is still somewhat of a mystery. Mr. Forte has found the traditional nonmachine forms of analyses lacking and has stated that a structural description of this music would be virtually impossible without the aid of a computer. If I understand the outline of his program, he is formulating a basic working theoretical hypothesis based upon linguistic and mathematical models for musical structure, developing an analytical method to explore his ideas by means of the computer; he then will test the result.

In quite another application of computer techniques in the analysis of musical style, a program can be written to search for meaningful patterns and relationships which, because of the number and quality of variables, might remain obscured and undiscovered if left to the human brain. From these very patterns, the researcher can then develop new and significant hypotheses. An interesting example of this is the proposal of Professor Jan La Rue of New York University to evolve machine language to describe stylistic phenomena in 18th century symphonies, thereby permitting complex correlations and comparisons far beyond the reach of the hand tabulation. Just as the literary scholar has quantified style in terms of form, rhythm, and texture, the musicologist has developed a set of guidelines for the purpose of stylistic analysis, breaking down the various musical elements into sound, form, harmony, rhythm, and melody. This technique is admirably suited to computer procedures when one would wish, for example, to determine whether or not a symphony attributed to one composer was actually written by him. By this technique, the stylistic attributes of a questionable or anonymous symphony could be compared for correspondences with the stylistic quantification of a given composer's known symphonies stored within the computer memory.

Finally, I must mention the Musical Information Retrieval project at Princeton University being carried out under the direction of Professor Lewis Lockwood. This involves a programming language for an IBM 7094 computer by means of which musical data is stored in the computer for interrogation and manipulation.[18] Information representative of each note in its complete context and relationship within the score is coded manually and then stored in anticipation of the questions to be asked. The pilot project at Princeton involves a stylistic investigation of the 22 masses and mass movements of the Renaissance composer Josquin des Près. In its broader aspects this type of program enables the scholar to search for and locate reliably all elements

within a given category, such as accidentals, or all examples of a particular intervalic progression. In addition the computer program can serve as a check on discrepancies between the original manuscript and later editions or transcriptions.

The projects I have just described to you represent but a few highlight from the growing roster of scholars using the computer in humanistic research. A list of such activities published last spring by the American Council of Learned Societies reveals well over a hundred individuals involved with the tools of data processing.[19] When compared to the state of the sciences versus the computer some 10 years ago, the prognosis for the future is good indeed.

In a lecture at M.I.T., entitled, "The Computer in the University," the prediction was made that in a few years the computer may have settled immutably into our thought as an absolutely essential part of any university program in the physical, psychological, and economic sciences. On the basis of what I have said, I think the time has come to amend that statement to include the humanities. Furthermore, within a short time, I believe a knowledge of data processing will become part of the "common baggage" of research tools and techniques required of every graduate student in the liberal arts. I am even tempted to go a step further and state that with the increasing number of courses in programming being offered at our universities the time may come when some students in the humanities may be as fluent in programming as in writing English composition. Certainly, the computer is fast becoming an important and indispensable research tool for faculty and students alike.

The value of such an acquaintanceship can be seen in the case of a professor of art history and archeology at an eastern college. Describing himself as probably the man on campus "least likely to benefit from a computer," he took a short summer course at the college computer center. Later, in reporting on the instruction, he said, "The course profoundly affected the thinking of all of us. This is the important thing—much more important than the machine itself. Of course we know that it is the brains behind the machine that make these miracles possible. Nonetheless, it is a weapon of such power that all intelligent men and women everywhere should know the kind of things it can do. Once we know that, we can devise ways to make use of it." In this connection it is useful to bear in mind Alfred North Whitehead's remarks 40 years ago that "the reason why we are on a higher imaginative level than the 19th century is not because we have finer imagination, but because we have better instruments—which have put thought on to a new level."

Let us, therefore, see the computer as a means of liberation, freeing the humanist scholar from the time-consuming operations of the past; a tool providing him in rapid fashion with a proliferating series of sources in the form of statistics, collations, printouts, cross-references, frequency counts and hypothetical models upon which he may build a research of new dimensions and complexity. Viewed in this light, it is a device the potentialities and applications of which we cannot afford to ignore.

## REFERENCES

1. Isaac Auerbach, "Information: A Prime Resource," in *The Information Revolution, New York Times,* May 23, 1965, p. 4.

2. Paul Tasman, "Literary Data Processing," *IBM Journal of Research and Development,* vol. I, pp. 249-56 (1960).

3. See the preface to *Nelson's Complete Concordance to the Revised Standard Version Bible,* New York, 1957.

4. Felix Shirokov, "Computer Deciphers Maya Hieroglyphs," *UNESCO Courier,* vol. XV, pp. 26-32, (1962).

5. Jesse D. Jennings, "Computers and Culture History: A Glen Canyon Study," Paper delivered at a meeting of the American Anthropological Association, San Francisco (Nov. 21, 1963).

6. See for example J. A. Brown and L. G. Freeman, Jr., "A UNIVAC Analysis of Shard Frequencies from the Carter Ranch, Pueblo, Eastern Arizona," *American Antiquity,* vol. XXX, pp. 162-167, (1964); and Paul S. Martin, "Archeological Investigations in East Central Arizona," *Science,* vol. CXXXVIII, pp. 825-27 (1962).

7. Bernard Bailyn, *Massachusetts Shipping 1697-1714: A Statistical Study,* Harvard University Press, Cambridge, Mass., 1959, esp. pp. 137-141 ("A Note on Procedure").

8. Ole R. Holsti, "Computer Content Analysis as a Tool in International Relations Research," in *Proceedings of the Conference on Computers for the Humanities,* Yale University, New Haven, Conn., 1965.

9. William O. Aydelotte, "Voting Patterns in the British House of Commons in the 1840's," *Comparative Studies in Society and History,* vol. V, pp. 134-163 (1963).

10. Stephen M. Parrish, *A Concordance to the Poems of Matthew Arnold,* Cornell University Press, Ithaca, N. Y., 1959; see also his "Problems in the Making of Computer Concordances," *Studies in Biography,* vol. XV, pp. 1-14 (1962).

11. See Alan Markman, "Litterae ex Machina: Man and Machine in Literary Criticism," *Journal of Higher Education,* vol. XXXVI, esp. pp. 70-72 (1965).

12. Alice M. Pollin and Raquel Kersten, *Guia para la Consulta de la Revista de Filología Española,* New York University Press, New York, 1964.

13. Frederick Mosteller and David L. Wallace, "Inference in an Authorship Problem," *Journal of the American Statistical Association,* vol. LVIII, pp. 275-309 (1963).

14. On methodology, see Vinton A. Dearing, *Methods of Textual Editing,* University of California Pres, Los Angeles, Calif., 1962.

15. James T. McDonough, Jr., "Homer, the Humanities, and IBM," in *Proceedings of the Literary Data Processing Conference,* IBM Corporation Yorktown Heights, N. Y., 1964, pp. 25-36.

16. Sally Y. Sedelow, "Some Parameters for Computational Stylistics: Computer Aids to the Use of Traditional Categories in Stylistic Analysis," ibid., pp. 211-229.

17. Bertrand H. Bronson, "Mechanical Help in the Study of Folk Song," *Journal of American Folklore,* vol. LXII, pp. 81-86 (1949).

18. See Michael Kassler, "A Simple Programming Language for Musical Information Retrieval," (Project 295D, Technical Report No. 3), Princeton University, Princeton, N. J. (1964).

19. "Computerized Research in the Humanities: A Survey," *ACLS Newsletter,* vol. XVI, no. 5, pp. 7-31 (May 1965).