TRENDS IN NORTH AMERICAN ROCK ART RESEARCH:
A QUANTITATIVE EVALUATION OF THE LITERATURE

Klaus F. Wellmann

The literature to 1979 on North American Indian rock art has been analyzed. It was found to be characterized by a high degree of dispersion, an erratic growth pattern before 1950 followed by an exponential mode of growth thereafter, and a low proportion of multiple-author works. The growth in literary output over the years was largely attributable to an increase in the number of authors, whereas the article/author ratio changed only slightly with time. The proportion of works dealing with general topics rose from 16.4% before 1970 to 41.6% thereafter while the proportion of site reports decreased accordingly. Although all rock art regions participated in the numerical growth of the literature over the decades, their relative proportions varied with time. The Southwest, the Great Plains, and the Eastern Woodland had the greatest number of works with regional emphasis; these three regions accounted for more than 50% of the total literary output. As an instrument of scientific information exchange, the rock art literature in North America appears to be in a comparatively early stage of development and maturation, a feature it shares with the communication system in the social sciences in general.

During the past 10 to 15 years the scientific literature in my primary sphere of endeavor, the biomedical field, has been the subject of several qualitative and statistical analyses. These have yielded interesting results in terms of communication patterns among various groups of researchers (Clarke 1967; Garvey et al. 1970), journal function (Chernin 1975), time lapse between hypothesis and publication (Roland and Kirkpatrick 1975), and dispersion of papers among journals (Goffman and Warren 1969; Warren and Goffman 1972). The recent completion of a major survey of North American Indian rock art (Wellmann 1979a) and, incidental to it, the compilation of a comprehensive and up-to-date bibliography in this field (Wellmann 1978, 1979b) have made it feasible to subject the rock art literature to a similar analysis and, where desirable, to compare the results with those derived from the biomedical studies.

MATERIAL AND METHODS

The material that forms the basis of this report was taken from a recently compiled comprehensive bibliography of North American Indian rock art (Wellmann 1978) and from a subsequently published bibliographic supplement (Wellmann 1979b). Included in the compilations were only those works that deal with North American Indian rock art, either exclusively or in part, published either here or abroad. Except for Baja California (which was treated as a part of California), no region outside of Alaska, Canada, and the contiguous United States was considered. Included also were papers concerned with general topics germane to rock art research (e.g., rock art preservation or the recording of rock drawings), provided they were authored by investigators working in Canada or the United States. All bibliographic entries not fulfilling these criteria were eliminated from consideration.

A total of 1,100 articles, manuscripts, theses, and books remained for analysis. First determined were the number of authors (counting each name, whether listed as author or coauthor, only once) and journals. I deliberated for a long time what to do with the many solitary publications.
(manuscripts, theses, and books), but since much of the pivotal information on rock art is contained in these works, I opted to include them in the tabulations and to treat them like "journals with one publication each." (In the biomedical literature used for comparison such a problem does not exist since the literature is almost exclusively confined to journal articles, very occasional monographs excepted.) Volumes issued periodically (e.g., the annual symposium volumes of the American Rock Art Research Association or the Ballena Press Publications on North American Rock Art) were also accorded journal status.

Initially, all works published during a given 5-year period were placed in the same column; for final evaluation, however, several of these 5-year periods were often combined. It should be noted that data collection for the bibliographic supplement (Wellman 1979b) ended in October, 1979, so that the last 5-year period (1975-79) is incomplete.

Where applicable, each work was assigned to one (or more) of the rock art regions of the continent; these regions (Figure 1) are the same as those delineated in my earlier publications.

Figure 1. The rock art regions of North America (from Wellman 1979a:12; slightly modified from Grant 1967:80).
Table 1. Numerical Characteristics of the Rock Art Literature.

<table>
<thead>
<tr>
<th></th>
<th>Articles</th>
<th>Authors</th>
<th>Journals</th>
<th>Most articles in one journal</th>
<th>Journals with one article</th>
<th>Articles per author</th>
<th>Journal to author ratio</th>
<th>Journal to article ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1100</td>
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<tr>
<td>g = A/a</td>
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<td>J/a</td>
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<tr>
<td>J/A</td>
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</tr>
</tbody>
</table>

(Wellmann 1978:5; 1979a:12). The major content of each work (such as chronology, interpretation, site report, etc.) was determined and tabulated, only one such entry was made for each publication. Studies dealing with diverse rock art topics were listed under the heading of "books and broad surveys." The term "site report" includes works referring to single locations as well as those dealing with clusters of sites.

In order to determine the dispersion characteristics of the rock art literature, Bradford's law was applied. This law states that if scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject, and several groups or zones containing the same number of articles as the nucleus, where the number of periodicals in the nucleus and succeeding zones will be as \(1 : n : n^2 \ldots\) (Bradford 1948; quoted from Goffman and Warren 1969:1203).

If \(A\) is the number of all articles on a given subject, \(m\) the maximal number of divisions in the sense of Bradford, and \(Z\) denotes the number of journals each of which contains only a single paper on the subject, then "the smallest number of articles \(A/m\) which can possibly effect a maximal division of a set of journals containing the literature of a given subject is the number of relevant articles \(j\) belonging to the most productive journal of that subject" (Goffman and Warren 1969:1206). But "the minimal nucleus can consist of a single periodical only if \(j\ldots\) is greater than \(Z/2\). If \(j\ldots\) is less than or equal to \(Z/2\), then the minimal nucleus will consist of the smallest number of journals at the top of the ordered list, the sum of whose publications on the subject of interest is greater than \(Z/2\" (Goffman and Warren 1969:1205). This is so because otherwise there would exist succeeding zones (the last two) with equal numbers of journals containing the same number of articles, contrary to Bradford's law.

As Table 1 shows, the described situation applies with regard to the rock art literature as \(j\) (66) is less than \(Z/2\) (301/2 = 150.5), so that the minimal nucleus will have to consist of the first five journals (Table 2) whose combined total of articles (180) is the smallest number that is greater than \(Z/2\). Bradford's multiplier \(b_m\) is calculated from the number of journals in Zone \(n + 1\) divided by the number of journals in Zone \(n\) (Table 3).

Table 2. Dispersion of Articles among the Journals.

<table>
<thead>
<tr>
<th>Journals</th>
<th>Articles</th>
<th>Journals</th>
<th>Articles</th>
<th>Journals</th>
<th>Articles</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>66</td>
<td>1</td>
<td>19</td>
<td>3</td>
<td>7</td>
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<tr>
<td>1</td>
<td>35</td>
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<td>25</td>
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<tr>
<td>1</td>
<td>23</td>
<td>1</td>
<td>11</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>22</td>
<td>5</td>
<td>9</td>
<td>44</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>21</td>
<td>4</td>
<td>8</td>
<td>301</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 3. Maximal Divisions of Journals and Bradford's Multiplier (\(b_m\)).

<table>
<thead>
<tr>
<th>Zone</th>
<th>Articles</th>
<th>Journals</th>
<th>(b_m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>180</td>
<td>5</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>151</td>
<td>8</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>172</td>
<td>17</td>
<td>2.2</td>
</tr>
<tr>
<td>4</td>
<td>151</td>
<td>30</td>
<td>1.6</td>
</tr>
<tr>
<td>5</td>
<td>446</td>
<td>342</td>
<td>11.4</td>
</tr>
</tbody>
</table>

RESULTS

Numerical Characteristics of Literature and Dispersion of Articles Among Journals

The numerical characteristics of the rock art literature are given in Table 1, and the distribution of the rock art papers among the journals is shown in Table 2. Table 3 records the maximal divisions of journals according to Bradford's law.

It should be noted again that, for the purposes of these compilations, solitary book-length studies, theses, and manuscripts have been accorded the same treatment as journals with one article each. Thus, of the 301 "journals with one article," 142 consisted of books, theses, and manuscripts.

The five periodicals with the largest numbers of papers (Table 2; Zone 1 in Table 3) were the four available annual symposium volumes of the American Rock Art Research Association (66 articles), American Antiquity (35), El Palacio (29), the one existing symposium volume of the Canadian Rock Art Research Associates (25), and American Anthropologist (25).

Growth of Literature

Up to 1950 the growth pattern of the rock art literature (Figure 2) was erratic, displaying several ups and downs in the number of works written during successive 5-year periods. A major downward trend occurred during the 1940s, possibly induced by wartime restrictions on research activities. Since 1950, however, the literature has been growing exponentially. Only 23.4% of the literature was produced in all the years before 1950, while as much as 43.5% of the total output to date was generated during the past decade (1970–1979). In addition, the data for

![Figure 2. Exponential growth of the rock art literature after 1949.](image-url)
1979 are still incomplete, as has been mentioned, so that the last decade’s ultimate proportion should be even higher.

Multiple Authorship and Works/Author Ratio

Before 1930, multiple authorship (Table 4) was exceptional; only 2 of 114 works (1.8%) were written by more than one author. After 1930, and again after 1950, multiple authorship increased, but only the rise after 1950 is statistically significant \( x^2 = 26.21; p < 0.001 \). In the 1970s, the previously attained plateau was maintained, but no further increase occurred. In all, there were 150 multi-author works, amounting to 13.6% of the entire literary output.

The great majority of publications with more than one author had only two names attached. Authorship by three and more authors was rare before 1950; only 2 of 14 multi-author works could be so classified (14.3%). After 1950, 29 of 136 multi-author works (21.3%) were in this category; the difference between the two time periods is not statistically significant.

As Figure 3 shows, the average number of works per author in each 5-year interval since 1930 varied from 0.82 to 1.47; most values are in the neighborhood of 1.2. These averages are lower than the overall work/author ratio \( g = A/a = 1.52 \); Table 1) since many authors wrote papers in more than one 5-year period and thus entered the calculations (for “\( a \)” in \( g = A/a \)) more than once.

Subject Matter

While works in all categories of subject matter experienced an increase in absolute numbers during the last decade (1970–1979), when the last decade is compared with earlier periods, there have been distinct and statistically significant shifts in relative preponderance of many of them (Table 5). The most notable trend was a major decline in the relative number of site reports, from more than three-quarters of all published works before 1970 to only 43.2% during the 1970s \( x^2 = 119; p < 0.001 \). Book-length studies and other broadly based surveys steadily increased their share of the total, rising from 5.8% before 1950 to 15.2% after 1970 \( x^2 = 14.49; p < 0.001 \).

Works dealing with general topics (such as terminology; design classification; techniques and materials involved in producing, recording or reproducing rock art, style, and cultural affiliations; conservation of rock drawings; and reports on rock art activities or the history of rock art research), virtually nonexistent before 1950 and still rare between 1950 and 1970, enjoyed much greater relative popularity among writers after 1970. In contrast, works devoted to questions of chronology or interpretation maintained a more nearly static pattern of relative strength over the years. Of all 621 works published before 1970, only 103 (or 16.4%) dealt with general topics. After 1970, as many as 209 of 479 publications (41.6%) were in that category. The difference between the two periods is statistically significant \( x^2 = 97.4; p < 0.001 \).

<table>
<thead>
<tr>
<th>Table 4. Number of Works with Single and Multiple Authorship.</th>
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</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>1 author</td>
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<tr>
<td>2 authors</td>
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<tr>
<td>3 authors</td>
</tr>
<tr>
<td>4 authors</td>
</tr>
<tr>
<td>&gt; 4 authors</td>
</tr>
<tr>
<td>Total (all works)</td>
</tr>
<tr>
<td>Total (all multi- author works)</td>
</tr>
<tr>
<td>(1.8%)</td>
</tr>
</tbody>
</table>
Figure 3. Average number of works per author for 5-year periods after 1930.

Geographical Distribution

Works with contents not classifiable by region constituted less than 4.5% of the literary output before 1950 and steadily increased thereafter (Table 6) to attain a share of 15.7% during the last decade (1970–1979). This change in proportion is statistically significant ($\chi^2 = 15; p < 0.001$).

While all rock art regions participated in the numerical growth of the literature over the decades, and especially during the exponential growth phase of the post-1950 period, their relative positions did not remain immutable. After 1930, three rock art provinces (California, the Great Basin, and the Northern Woodland) steadily increased their relative standing; their combined total rose from a mere 8% for the two decades from 1930 to 1949 to as much as 35.8% after 1970 (Table 6). In contrast, the number of works dealing with rock art in the Great Plains and in the Eastern Woodland was relatively more prominent before 1970. The proportion of studies concerning the Southwest was generally in the neighborhood of 20% except for the period from 1930

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Books and Broad Surveys</td>
<td>15</td>
<td>33</td>
<td>73</td>
<td>121</td>
</tr>
<tr>
<td>Site Reports</td>
<td>183</td>
<td>277</td>
<td>207</td>
<td>677</td>
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<tr>
<td>Bibliography</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>History, Symposia, Reports</td>
<td>0</td>
<td>2</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Terminology</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Design Classification</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Techniques and Materials</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>for Making Rock Art</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording and Reproduction</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>of Rock Drawings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock Art Conservation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>29</td>
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<tr>
<td>Style</td>
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<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Chronology</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>Cultural Affiliation</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Interpretation</td>
<td>40</td>
<td>22</td>
<td>82</td>
<td>144</td>
</tr>
<tr>
<td>Totals</td>
<td>257</td>
<td>364</td>
<td>479</td>
<td>1,100</td>
</tr>
</tbody>
</table>

Table 5. Main Subject Matter for Each of the 1,100 Works.
Table 6. Geographical Distribution of Rock Art Literature.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Not Classifiable by Region</td>
<td>5 (4.3%)</td>
<td>6 (4.0%)</td>
<td>28 (7.5%)</td>
<td>85 (15.7%)</td>
<td>124 (10.3%)</td>
</tr>
<tr>
<td>Northwest Coast and Arctic Region</td>
<td>13 (11.1%)</td>
<td>12 (8.1%)</td>
<td>12 (3.2%)</td>
<td>21 (3.9%)</td>
<td>56 (4.9%)</td>
</tr>
<tr>
<td>Columbia-Fraser River Plateau</td>
<td>16 (1.7%)</td>
<td>6 (5.4%)</td>
<td>25 (6.7%)</td>
<td>25 (4.6%)</td>
<td>74 (6.3%)</td>
</tr>
<tr>
<td>California and Baja California</td>
<td>11 (9.4%)</td>
<td>6 (4.0%)</td>
<td>39 (10.4%)</td>
<td>82 (15.2%)</td>
<td>138 (11.7%)</td>
</tr>
<tr>
<td>Great Basin</td>
<td>5 (4.3%)</td>
<td>4 (2.7%)</td>
<td>28 (7.5%)</td>
<td>47 (8.7%)</td>
<td>84 (7.1%)</td>
</tr>
<tr>
<td>Southwest</td>
<td>24 (20.5%)</td>
<td>60 (40.3%)</td>
<td>72 (19.2%)</td>
<td>128 (23.7%)</td>
<td>284 (24.0%)</td>
</tr>
<tr>
<td>Great Plains</td>
<td>10 (8.5%)</td>
<td>37 (24.8%)</td>
<td>75 (20.0%)</td>
<td>45 (8.3%)</td>
<td>167 (14.1%)</td>
</tr>
<tr>
<td>Eastern Woodland</td>
<td>25 (21.4%)</td>
<td>14 (9.4%)</td>
<td>61 (16.3%)</td>
<td>43 (8.0%)</td>
<td>143 (12.1%)</td>
</tr>
<tr>
<td>Northern Woodland</td>
<td>8 (6.8%)</td>
<td>2 (1.3%)</td>
<td>35 (9.3%)</td>
<td>64 (11.9%)</td>
<td>109 (9.2%)</td>
</tr>
<tr>
<td>Totals</td>
<td>117 (100%)</td>
<td>149 (100%)</td>
<td>375 (100%)</td>
<td>540 (100%)</td>
<td>1,181 (100%)</td>
</tr>
</tbody>
</table>

Note: Since some works deal with more than one region, the total figure in this compilation (1,181) exceeds the number of publications (1,100).

In 1949 when it soared to more than 40%. Works dealing with the Pacific Northwest (Northwest Coast and Columbia-Fraser River Plateau) rather steadily declined, in relative numbers, from their higher pre-1930 standing.

In terms of total output throughout the entire length of time, the Southwest had the greatest number of works devoted to any one region (284, or 24.0%), followed by the Great Plains (167, or 14.1%), the Eastern Woodland (143, or 12.1%), and California (138, or 11.7%). The Northern Woodland (109 works, or 9.2%), the Great Basin (84, or 7.1%), the Columbia-Fraser River Plateau (74, or 6.3%), and the Northwest Coast and Arctic Region (58, or 4.9%) were in the bottom half of that list. The 124 nonregional works constituted 10.5% of the total output.

DISCUSSION

In their investigation of the dispersion of papers among journals of the medical literature on two diverse subjects, the mast cell and schistosomiasis, Goffman and Warren (1969) found (1) that the journal/author ratio was a constant (0.27) and did not vary with respect to time; (2) that the average output of papers by the authors (1.1 for the mast cell, 1.5 for schistosomiasis), as determined for each time interval of 5 years, did not significantly change over a period of 80 years; and (3) that this paper/author ratio was approximately equal to the minimal constant (multiplier) of Bradford's law of dispersion (Bradford 1948), a law that governs the division of a literature into a nucleus of periodicals more particularly about a subject and succeeding zones containing the same number of articles as the nucleus. While the rock art literature, as analyzed here, conforms to some of these observations, it also displays several notable deviations.

The most obvious of these deviant features is the much greater degree of dispersion that characterizes the literature on rock art. Probably the best measure for the degree of dispersion is the high proportion of solitary publications, i.e., books, manuscripts, theses, and journals with one article each (2). With regard to articles, the proportion of Z amounted to as much as 27.4% (301 of 1,100) for rock art, as compared with only 9.2% (908 of 9,914) for schistosomiasis and 13.8% (326 of 2,378) for the mast cell; and with regard to journals, the proportions were 74.9% (301 of 402) for rock art, 52.2% (908 of 1,738) for schistosomiasis, and 55.9% (328 of 587) for the mast cell. The high Z value, in turn, reduces the possible maximal number of divisions in Bradford's dispersion table to a mere 5 (Table 3), whereas Goffman and Warren (1969) recorded 13 such zones for the literature on the mast cell and 15 for schistosomiasis.
While there is thus an exceptionally large proportion of books and journals with one article at the bottom of the dispersion table (Table 2), the number of core journals at the top of the table appears adequate on first glance and would seem to closely mirror the conditions recorded for the two medical topics. Nevertheless, two of the five leading publications (the ARARA symposium books and the one CRARA symposium volume) are newly created periodicals; the former have existed since 1975 and the latter only appeared in 1979. The nuclear zone of the dispersion table, as it is constituted today, is thus in large measure the progeny of the very last of the successive 5-year periods examined in this analysis. Furthermore, the mentioned symposium volumes are limited-access periodicals containing only papers that have previously been presented at national meetings. Bona fide journals devoted solely to rock art hardly exist even today.

The high proportion of so many one-article periodicals and the recency of the origination of a viable core of leading journals are two telling indicators of the comparative youthfulness of the rock art literature as a means of scientific communication. The point need not be belabored that both the relative unavailability of an adequate number of core journals for a given subject and the excessive degree of dispersion of a large proportion of the literature serve to impede the rapid and efficient dissemination and retrieval of research data in a given field of human endeavor. Ziman's (1969:318) dictum, "the invention of a mechanism for the systematic publication of fragments of scientific work may well have been the key event in the history of modern science" (and may, indeed, harbor the secret to the success of Western science since the seventeenth century), constitutes an apt summation of the situation that is most appropriate in this context. For rock art research, the "mechanism" is obviously still evolving.

Another indicator of a maturing literature appears to be the evolution of a steady pattern of growth, often exponential in type. While the two medical literatures used for comparison grew exponentially from the very beginning, the rock art literature adapted to such a mode of augmentation only after the Second World War (Figure 2).

In their analysis of the mast cell and schistosomiasis literature, Goffman and Warren (1969) emphasized the constancy of the paper/author ratio with regard to time. Therefore, the exponential proliferation of the literature on these subjects was not, as it has been popularly labeled, primarily a "literature explosion"; rather it was a "population explosion" among the paper-writing authors. For the rock art literature, too, the works/author ratio remained fairly constant, if not completely so, from one 5-year period to the next (Figure 3), most often hovering around the 1.2 mark, although reaching extremes of 0.82 and 1.47 and showing a slow rise over the last 25 years. These changes, while greater than any recorded for the mast cell and schistosomiasis literature, still do not account for the major thrust of the exponential growth curve of the rock art literature (Figure 2). For example, if the average productivity of the 1970–1974 authors had been the same as that of the 1975–1979 group (1.47 instead of 1.21), they would have produced an excess of 33 publications over and above their actual output of 152 for that 5-year period. The 1975–1979 authors, however, wrote not 33 but 175 more works than those of 1970–1974, an excess of 142 that is solely to be credited to their swollen ranks. Thus, only 19% of the increased number of publications in 1975–1979 over 1970–1974 is due to any "literature explosion," while 81% of the augmented figure derives from the "population explosion" among the writers.

The more technically complex a scientific subject becomes, the higher will be the proportion of articles written by more than one author. In medicine, multi-author papers are the rule rather than the exception. For instance, of 103 consecutive papers issuing from the Mayo Clinic in recent years, only 13 (12.6%) had a single author while 90 (87.4%) had two or six names attached (Roland and Kirkpatrick 1975); and of 41,012 biomedical articles written between 1948 and 1966, fewer than 25% were in the one-author category (exact figures not stated) (Clarke 1967). The situation is the reverse for the rock art literature (Table 4), for although the proportion of multiple-author works increased after 1930, and again after 1950, these still accounted for only 16.3% of the literary output of the last decade (1970–1979). Furthermore, most multiple-author papers had only two names attached while authorship by three and more writers, common in medicine, remained exceptional. The journal/author ratio for the rock art material (0.56), which is more than twice as high as that recorded for the mast cell and schistosomiasis literature (0.27 for
each), reflects both the considerable degree of dispersion (the high number of journals) and the low ratio of authors per publication.

When one reviews the major contents of the published works (Table 5), one is struck by the observation that up to the end of the 1960s such pivotal topics as terminology, design classification, techniques and materials for making rock drawings, style, and cultural ramifications of the art were rarely, if ever, dealt with. These subjects, and others of a general nature, did receive some coverage in several of the books and monographs, but their virtual absence from the periodical literature during all of these years remains a remarkable feature. It is only after 1970 that writers began to turn much more often toward topics of general significance. Aspects of chronology and interpretation, however, were given comparatively greater attention over the decades, a state of affairs that is hardly surprising, for among all the questions directed at rock drawings probably none get asked more persistently than those concerning their age and meaning.

That the Southwest, with its innumerable rock art sites, should lead in the roster of works devoted to any one region (Table 6) is only to be expected. For those, however, who believe that rock drawings in any number are to be found only west of the Rocky Mountains, it should come as a surprise to note that the next two regions on that list are the Great Plains and the Eastern Woodland. Yet, rock art publications in the Great Plains and Eastern Woodland, often taking the form of single site reports, may have peaked as their respective shares of the total declined significantly during the past decade. Other regions, especially California and the Northern Woodland, appear to be on the rise.

While the foregoing analysis has yielded interesting results about the characteristics and trends of the rock art literature in North America, some additional questions one would like to pose must remain unanswered. It has commonly been acknowledged, for instance, that throughout the decades the majority of papers and books in this field have been written, not by professional anthropologists and archaeologists, but by interested amateurs. Have the relative proportions of these two groups changed over the years? Is my impression that, of late, more professionals have entered the field, but the hard data with which to substantiate such an impression are not at hand.

Another complex of questions, unanswerable at present, relates to the processes of dissemination and assimilation of information among rock art workers, especially during the prepublication phase of their endeavors. For instance, does the time lapse between the first formulation of a research idea and its eventual appearance in print amount to a full 4 years, as it does in the medical sciences (Roland and Kirkpatrick 1975)? In a comparative study of existing communication systems in the physical and the social sciences, Garvey et al. (1970:1172) concluded that scientific communication in the social sciences, in general, is in an early stage of development relative to that in the physical sciences. They wrote:

The elements of the social sciences' communication structure are relatively noncohesive; the flow of scientific information through the communication system follows less predictable sequence; and the processing of information for the archives appears less efficient (more time-consuming, more haphazard, and more diffuse).

These authors (1970:1172) conclude, "Because of this state of affairs in the social sciences, social scientists appear to communicate more randomly than do physical scientists, whose communication system is more highly developed." Garvey et al. (1970:1172) add that "the eclectic ("soft") nature of the social scientists' subject matter probably contributes to this situation."

I feel that these remarks apply equally well to the conditions in North American Indian rock art research, as I perceive them today. But, again, the data necessary for either a confirmation or refutation of such a subjective evaluation are not available. There is thus ample room for further investigative efforts along these lines.

Acknowledgments. Figure 1 was drawn by Bruce Culver and Figures 2 and 3 by Mitchell S. Block, both of Brooklyn, New York.
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TRACE ELEMENT ANALYSIS OF OBSIDIAN ARTIFACTS FROM THREE SHELL MIDDEN SITES IN THE LITTORAL ZONE, CHIAPAS, MEXICO

Fred W. Nelson and Barbara Voorhies

Forty-two obsidian artifacts from the Chontula Zone, Chiapas, Mexico, have been analyzed by neutron activation analysis, and fifteen artifacts were reanalyzed using X-ray fluorescence spectrometry. These artifacts date to the Chontula phase (3000-2000 B.C.), late in the Archaic period, and to a later period or periods. These analyses have made it possible to compare the two methods of analysis and also have made it possible to assign an obsidian source to each artifact. It has been shown that the majority of the obsidian originated from Tajumulco, with smaller amounts coming from El Chayal during the Chontula phase and from El Chayal, San Martin Jilotepeque, and Pachuca during the late period.

Trace element compositions have been determined for 42 obsidian artifacts recovered from three shell midden sites in Chiapas, Mexico. The results of these analyses have been compared with those of several geologic obsidian sources in Guatemala and Mexico. By means of this comparison it has been possible to determine the probable geologic source of each of the analyzed ar-

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