Characteristics of Use of Geology Literature

A citation analysis was made of a selection of the geology literature to determine the characteristics of literature use in current geologic research. More than three-fourths of the citations examined were to serial literature. More than 87 per cent were to literature in the English language. More than one-third were to publications that had appeared during the previous five years. Forty-six titles included half of the journal articles cited. Only 59 per cent of the references were to journals classed by LC in geology; the balance fell in other disciplines.

Geologic Literature apparently does not become outdated as rapidly as the literature of some other sciences. A dozen years have elapsed since the last major study on the topic, and this span was believed to be sufficient to warrant another analysis of geologic literature.

It has been the purpose of this study to analyze the characteristics of use of the literature of geology. The characteristics were defined by Stevens² and included:

- The form, whether book, serial, or other, that the literature of geology took.
- 2. The language distribution of the literature
- 3. The time span over which the literature remained useful to researchers.
- 4. The title distribution which gave an

¹ Charles Harvey Brown, Scientific Serials: Characteristics and Lists of Most Cited Publications in Mathematics, Physics, Chemistry, Geology, Physiology, Botany, Zoology, and Entomology. ("ACRL Monograph Number 16," [Chicago: Association of College and Research Libraries, 1956]), p. 106-7.

² Rolland E. Stevens, Characteristics of Subject Lit-

² Rolland E. Stevens, Characteristics of Subject Literatures. ("ACRL Monograph Number 6," [Chicago: Association of College and Research Libraries, 1953]),

p. 12-17.

Mr. Craig is Librarian of Avon Old Farms, Avon, Connecticut.

- indication of the number of sources which had to be consulted in order to keep abreast of a subject specialization.
- The number of different subject areas which contained information useful to a geologist.

There have been three studies in the past similar to the present one. The Gross and Woodford analysis3 of 1931 examined six American serials published in 1929. From the study can be determined the form dispersion, temporal span, language dispersion, title distribution, and the subject dispersion of the geologic literature of the period. Both Brown⁴ and LaoSunthara⁵ conducted studies of the serial literature of geology in 1956. Brown analyzed the 1953 and 1954 issues of the journals used as source journals in the Gross and Woodford study. The same dispersions, with the exception of form distribution, were discussed by, or could be gathered from, the Brown study. Brown mentioned

³ P. L. K. Gross and A. O. Woodford, "Serial Literature Used by American Geologists," Science, LXXIII (June 19, 1931), 660-64.

⁴ Brown, op. cit., p. 189. ⁵ Maria Eugenia LaoSunthara, "Some Bibliographical Characteristics of Serial Literature in the Field of Geology" (unpublished doctoral dissertation, Indiana University, Bloomington, 1956), 94p.

form dispersion specifically only insofar as citations to books were concerned.⁶

As the basis of a pilot study, Lao-Sunthara utilized the 1952 issues of six of the journals Gross and Woodford found to be most important in their analysis. The pilot study served to determine the source journals for the main investigation. The characteristics analyzed in the present study were covered by LaoSunthara.

The data for this study were obtained from ten source journals which were chosen by requesting that a selected group of librarians in charge of geologic collections from all parts of the United States rank geologic serials in the order of importance to their libraries. The 1960 and 1965 issues of the source journals were studied. The source journals were: Geological Society of America; Bulletin, Journal of Geology, American Association of Petroleum Geologists; Bulletin, American Journal of Science, U.S. Geological Survey; Bulletin, U.S. Geological Survey; Professional Paper, Economic Geology, American Mineralogist; Journal of Geophysical Research; Journal of Paleontology.

Citation counting was used, and for each citation was recorded its subject area, title, language, form, and its date. It was decided that only a sample of the total population was necessary in order to analyze the literature, and through the use of a statistical formula found in Yamane⁷ the necessary sample size was deter-

mined. The formula was $n = \frac{N}{1 + Ne^2}$ where n = the size of the sample, N = the total population, e = the error in per cent. The sample size for both 1960 and 1965 was increased to four hundred to facilitate later computations. After finding the sample size, the most straightforward method of obtaining a

distribution sample from population, according to Wert,⁸ consists of choosing the individual cases by unrestricted random sampling, with the aid of a table of random numbers, an easily applied device for selecting a random sample from population, each number of which can be identified and numbered. The table of random numbers used in this study was The Rand Corporation's A Million Random Digits.⁹

The findings of this analysis show that:

- 1. Serial literature was the most important form of literature used by geologists. In 1965, 75.5 per cent of the citations were to periodicals, with 21.5 per cent to books, and the balance, 3 per cent, divided between maps, theses, and other unpublished papers. Table 1 is an analysis of the form dispersion for 1960 and 1965.
- 2. The language distribution of geologic literature was low when compared to that of some other subject literatures. ¹⁰ Eighty-seven and one half per cent of the citations were to materials published in English in 1965. German was the most frequently used foreign language, followed by French and Dutch. Table 2 indicates the language dispersion for 1960 and 1965.
- 3. In 1965, the temporal distribution of the literature was high. It was determined that the geologist involved in research would have to go back fifteen years to search about 70 per cent of the useful literature, and about twenty-five years to search about 80 per cent of the literature. An analysis of the temporal dispersion is found in Table 3.
 - 4. The title dispersion for the litera-

⁶ Brown, op. cit., p. 106.

⁷ Taro Yamane, Statistics; an Introductory Analysis, 2d ed. (New York: Harper and Row, 1967), p. 579-

⁸ James E. Wert, Charles O. Neidt, and J. Stanley Ahmann, Statistical Methods in Educational and Psychological Research (New York: Appleton-Century-Crofts, Inc., 1954), p. 108-109.

Crofts, Inc., 1954), p. 108-109.

The Rand Corporation, A Million Random Digits with 100,000 Normal Deviates (Glencoe, Illinois: The Free Press, 1955), 400 and 200 p.

¹⁰ The various dispersions of other subjects literature may be found in Stevens' Characteristics of Subject Literatures.

TABLE 1
FORM DISPERSION OF GEOLOGIC LITERATURE

		orm ferer						umber of Citations 1960	Per Cent of Citations 1960	Number of Citations 1965	Per Cent of Citations 1965
Serials								317	79.2	302	75.5
Books								70	17.5	86	21.5
Maps								7	1.7	7	1.7
Theses								3	0.8	3	0.8
Other U	npu	ıbli	shed	Pa	pers			3	0.8	2	0.5
To	-							400	100.0	$\overline{400}$	100.0

TABLE 2

Language Dispersion of Geologic Literature

Language of Material Cited									umber of Citations 1960	Per Cent of Citations 1960	Number of Citations 1965	Per Cent of Citations 1965
English .									349	87.3	350	87.5
German .									6	1.5	15	3.8
French .									13	3.2	10	2.5
Dutch .									2	0.5	10	2.5
Italian .									4	1.0	_	_
Japanese									7	1.8	3	0.8
Norwegian									3	0.8	_	_
Russian .								37	3 5	1.2	3	0.8
Czechoslova	k					-			_		2	0.5
Swedish .									3	0.8	2	0.5
Austrian .			-				- 6		_	_	ī	0.3
Belgian .									_	_	î	0.2
Danish .									3	0.8	î	0.2
Greenlandio								100	_	_	î	0.2
Spanish .				•	•				2	0.5	î	0.2
Brazilian									ī	0.2		-
Finnish .									î	0.2		
Icelandic									î	0.2		_
Totals		i							400	100.0	400	100.0

TABLE 3
TEMPORAL DISPERSION OF GEOLOGIC LITERATURE

Years of Publication								umber of Citations 1960	Per Cent of Citations 1960	Number of Citations 1965	Per Cent of Citations 1965
1961-1965								_		141	35.3
1951-1960 .								207	51.8	148	37.0
1941-1950 .								77	19.3	42	10.5
1931-1940								46	11.5	22	5.5
1921-1930 .								21	5.2	17	4.2
1911-1920 .			30	100				22	5.5	8	2.0
1901-1910 .								5	1.2	8	2.0
1900 and Ea	rl	ier						22	5.5	14	3.5
Totals .								400	100.0	400	100.0

TABLE 4
TITLE DISPERSION FOR 1960

2 U.S. Geologica Paper 4 Economic Geo 5 American Asso Geologists. Bul 6 American Jour 6 Journal of Geo 8 Journal of Geo 9 Journal of Geo 10 American Min 10 Gulf Coast As Societies Tran 10 Mineralogical M 10 Nature 10 Royal Astrono Notices, Geopl 10 Royal Society of 11 Science 12 Akademiia Nat 13 Canada. Geolo 14 Canada. Geolo 15 Summary Repo 16 Geological Soc Special Paper 17 Institute of Ra Proceedings 18 U.S. Bureau of Report of Invet 20 Academy of N Philadelphia. 21 Arkiv for Mine 22 Arkiv for Mine 23 Arkiv for Mine 23 Arkiv for Mine 24 California. Un 25 Geological Soc Memoirs 26 Geological Soc Memoirs 27 Geological Soc Memoirs 28 Geological Soc Memoirs 29 Geological Soc Quarterly Jour 20 Harvard Unive	ciety of America, Bulletin al Survey. Bulletin al Survey. Bulletin al Survey. Professional sology ociation of Petroleum lletin al of Science clogy contology cophysical Research eralogist association of Geological sactions Magazine comical Society. Monthly hysical Supplements of London, Proceedings auk SSSR. Doklady gical Survey. Memoirs gical Survey. Ort ciety of America.	17 15 11 9 8 8 6 5 4 4 4 4 4 4 4 4 3 3	7.00 4.25 3.75 2.75 2.25 2.00 2.00 1.50 1.25 1.00 1.00 1.00 1.00 1.00 1.00	11.25 15.00 17.75 20.00 22.00 24.00 25.50 26.75 27.75 28.75 29.75 30.75 31.75 32.75 33.75 34.50
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Report of Inverses Academy of N Philadelphia. 23 American Che 23 American Meta Bulletin 23 Arkiv for Mina 23 California. Un Geological Sci 23 Discovery Rep 23 Eclogae Geolo 23 Geochimica et 23 Geological Soc Memoirs 24 Geological Soc Quarterly Jour 25 Harvard Universes		. 3	0.75	37.50
Philadelphia. 23 American Che 24 American Met Bulletin 25 Arkiv for Mine 26 California. Un Geological Sci 27 Discovery Rep 28 Eclogae Geolo 29 Geochimica et 20 Geological Soc Memoirs 20 Geological Soc Quarterly Jou 20 Harvard Unive	Mines.	0	0.75	20.25
Philadelphia. 23 American Che 24 American Met Bulletin 25 Arkiv for Mine 26 California. Un Geological Sci 27 Discovery Rep 28 Eclogae Geolo 29 Geochimica et 20 Geological Soc Memoirs 20 Geological Soc Quarterly Jou 20 Harvard Unive	stigations	. 3	0.75	38.25
23 American Che 23 American Met Bulletin 23 Arkiv for Mine 23 California. Un Geological Sci 23 Discovery Rep 23 Eclogae Geolo 23 Geochimica et 23 Geological Soc Memoirs 24 Geological Soc Quarterly Jou 25 Harvard Unive	Proceedings	. 2	0.50	38.75
23 American Meta Bulletin	mical Society. Journal	. 2	0.50	39.25
Bulletin 23 Arkiv for Mine 23 California. Un Geological Sci 23 Discovery Rep 23 Eclogae Geolo 23 Geochimica et 23 Geological Soc Memoirs 24 Geological Soc Quarterly Jou 25 Harvard Unive	eorological Society.		0.00	00.20
23 California. Un Geological Sci 23 Discovery Rep 23 Eclogae Geolo 23 Geochimica et 23 Geological Soc Memoirs 24 Geological Soc Quarterly Jour 25 Harvard Unive		. 2	0.50	39.75
Geological Sci Discovery Rep Eclogae Geolo Geochimica et Geological Soc Memoirs Geological Soc Quarterly Jour Harvard Unive	eralogi och Geologi	. 2	0.50	40.25
23 Discovery Rep 23 Eclogae Geolo 23 Geochimica et 23 Geological Soc Memoirs 23 Geological Soc Quarterly Jour 23 Harvard Unive	iversity. Department of			
23 Eclogae Geolo 23 Geochimica et 23 Geological Soc Memoirs 23 Geological Soc Quarterly Jour 23 Harvard Unive	ences. Bulletin	. 2	0.50	40.75
23 Geochimica et 23 Geological Soc Memoirs 23 Geological Soc Quarterly Jour 23 Harvard Unive		. 2	0.50	41.25
23 Geological Soc Memoirs 23 Geological Soc Quarterly Jour 23 Harvard Unive	gicae Helvetiae	. 2	0.50	41.75
Memoirs	cosmochinica Acta	. 2	0.50	42.25
23 Geological Soc Quarterly Jour 23 Harvard Unive	nety of America.	. 2	0.50	42.75
Quarterly Jour 23 Harvard Unive	ciety of London.	-	0.00	12.10
23 Harvard Unive	rnal	. 2	0.50	43.25
	ersity. Museum			
of Comparativ	e Zoology. Bulletin	. 2	0.50	43.75
23 Japan. Geologi	ical Survey. Bulletin	. 2	0.50	44.25
23 Journal of Atm			0.00	
and Terrestria		. 2	0.50	44.75
23 Journal of Geo		. 2	0.50	45.05
and Geoelectri	ob for Mineralogie	. 2	0.50	45.25
23 Neues Jahrbud	ch fur Mineralogie, Palaontologie	2.	0.50	45.75
23 New York. St	ate Museum. Bulletin	. 2	0.50	46.25
23 Physical Revie	W.	. 2	0.50	46.75
23 Royal Society	ew of London.			20.10
Philosophical	Transactions	. 2	0.50	47.25
23 Societe Geolog	gique de France. Bulletin	. 2	0.50	47.75
23 Societe Geolog	sique de France. Dunedn		0 =0	10.07
France. Memo	gique de	. 2 l on next page)	0.50	48.25

TABLE 4 (Continued)

Rank	Title	Number of Citations	Per Cent of Citations	Cumulative Per Cent of Citations
23	U.S. Geological Survey.			
	Annual Report	2	0.50	48.75
23	U.S. National Bureau of	1012		
	Standards. Journal of Research	2	0.50	49.25
23	U.S. Weather Bureau.		0.70	10
	Monthly Weather Review	2	0.50	49.75
23	Washington Academy of			20.02
	Sciences. Journal	2	0.50	50.25
47	One hundred ninety-nine titles with			
	one citation each: 116 serials, 70 books,			
	7 maps, 3 theses, 3 other unpublished			20000000
	papers	199	49.75	100.0

ture was high. In 1960, the first forty-six journals accounted for just over 50 per cent of the literature, and in order to cover 75 per cent of the literature, one had to search 145 titles. Table 4 indicates the title dispersion for 1960. In 1965, the first thirty-seven serials accounted for 50 per cent of the literature, and in order to cover 75 per cent of the literature, one had to search 127 titles. Table 5 indicates the title dispersion for 1965.

The subject distribution of geologic literature was also high. Subjects other than geology accounted for 43 per cent of the literature used by research geologists in 1960 and 40.8 per cent in 1965. Table 6 is an analysis of the subject dispersion.

The findings of this study have several implications for libraries which either have geologic research collections or are contemplating such collections. Tables 4 and 5, which indicate the title dispersions for 1960 and 1965, may serve as guides to determine which titles to obtain on first purchase. In addition, since these titles have been the most useful to research workers in geology, the tables may offer help in determining which serials to bind for future reference.

Since it was found that serials were the most common form of literature used, a library may decide to allocate the majority of its budget for the purchase of periodicals and divide the balance among the other useful forms of literature.

Because of the dependence upon literature in subject areas other than geology, librarians in charge of geologic collections in a departmentalized university library may work cooperatively with other departments to avoid purchase duplications. In a centralized collection, the geologic researcher will be best served by locating other useful subject areas such as physics and mining engineering near the geologic collection. Librarians in charge of specialized geologic collections must also be aware of these other subject areas so as to be able to provide researchers with the necessary material either through purchase or interlibrary loan.

In hiring personnel, a lack of a language proficiency would seem to be no great barrier to employment, although a working knowledge of French or German would prove helpful.

The temporal distribution may serve as a guide to librarians, indicating to them the degree to which useful information is found in the geologic literature of the past, and should, therefore, be kept in the collection. The temporal dispersion may also serve as a guide to librarians desiring to purchase backfiles of periodicals by indicating how far back in time to purchase.

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TABLE 5
Title Dispersion for 1965

Rank	Title	Number of Citations	Per Cent of Citations	Cumulative Per Cent of Citation
1	Geological Society of America. Bulletin .	29	7.25	
2	Journal of Geophysical Research	23	5.75	13.00
3	Economic Geology	15	3.75	16.75
4	American Association of Petroleum			
	Geologists, Bulletin	12	3.00	19.75
5	U.S. Geological Survey. Bulletin	10	2.50	22.25
5	U.S. Geological Survey. Professional Paper		2.50	24.75
7	Science	9	2.25	27.00
8	Journal of Paleontology	8	2.00	29.00
9	American Mineralogist	6	1.50	30.50
9	Geochimica et Cosmochimica Acta	6	1.50	32.00
11	Geological Society of America. Memoirs .	5	1.25	33.25
12	American Journal of Science	4	1.00	34.25
12	Journal of Geology	4	1.00	35.25
12	Journal of Sedimentary Petrology	4	1.00	36.25
12	Nature	4	1.00	37.25
12	Physical Review	4	1.00	38.25
17	Acta Crystallographica	3	0.75	39.00
17	Mineralogical Magazine	3 3	0.75	39.75
17	Mineralogical Magazine Ohio. Geological Survey. Bulletin	3	0.75	40.50
17	Seismological Society of America. Bulletin	3	0.75	41.25
17	U.S. Geological Survey. Water-		0.10	11.20
	Supply Paper	3	0.75	42.00
22	Academy of Natural Sciences of		0.10	12.00
-	Philadelphia. Proceedings	2	0.50	42.50
22	Akademiia Nauk SSSR. Izvestiya. Seriya	-	0.00	12.00
	Geofizicheskaya	2	0.50	43.00
22	American Geophysical Union. Transactions	2	0.50	43.50
22	Bulletins of American Paleontology	2	0.50	44.00
22	Canada. Geological Survey. Memoirs	2	0.50	44.50
22	Colorado Scientific Society. Proceedings	2	0.50	45.00
22	Eclogae Geologicae Helvetiae	2 2 2 2 2 2	0.50	45.50
22	Geological Society of America. Special	-	0.00	40.00
12	Paper	2	0.50	46.00
22	Paper	2	0.50	46.50
22	Geophysical Journal	. 5	0.50	47.00
22	Geophysics	5	0.50	47.50
22	Georgia, Geological Survey, Bulletin	2	0.50	48.00
22	Icarus	5	0.50	48.50
22	India. Geological Survey. Memoirs	5	0.50	49.00
22	Indian Botanical Society. Journal	. 2 2 2 2 2 2 2 2	0.50	49.50
22	Journal of Applied Physics	2	0.50	50.00
22	Journal of Applied Physics Journal of Atmospheric and Terrestrial	2	0.50	50.00
22		0	0.50	50.50
20	Physics	2	0.50	
22	Journal of Chemical Physics	2 2	0.50	51.00
22	Physical Review Letters	2	0.50	51.50
22	Physical Society of London, Proceedings .		0.50	52.00
22	Philosophical Magazine	2	0.50	52.50
22	Planetary and Space Science	2	0.50	53.00
22	Scientific American	2 2 2 2 2	0.50	53.50
22	Societe Geologique de France. Bulletin	2	0.50	54.00
22	Soil Science	2	0.50	54.50
22	Space Research	2	0.50	55.00
48	One hundred eighty titles with one			
	citation each: 82 periodicals, 86 books,			
	7 maps, 3 theses, 2 other unpublished	100	4 m 00	100.00
	papers	180	45.00	100.00

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TABLE 6
Subject Distribution of Geologic Literature

Subject Area	Number of Citations 1960	Per Cent of Citations 1960	Number of Citations 1965	Per Cent of Citations 1965
Geology (QE)	. 228	57.0	237	59.2
Physics (QC)	. 40	10.0	79	19.8
Science, General (Q)	. 50	12.5	30	7.5
Mining Engineering.				
Mineral Industries (TN)	. 21	5.2	8 7	2.0
Astronomy (QB)	. 7	1.8	7	1.8
Chemistry (QD)	. 6	1.5	7	1.8
Natural History (QH)	. 11	2.7	7	1.8
Mathematics (QA)	. 2 5	0.5	4 3	1.0
Agriculture (S)	. 5	1.2	3	0.8
Electrical Engineering				
and Industries (TK)		_	3	0.8
Aeronautics (TL)	. —	_	2 2 2	0.5
Botany (QK)	. 5	1.2	2	0.5
Chemical Technology (TP)	. 2	0.5	2	0.5
Engineering, General.				
Civil Engineering (TA)	. 3	0.8	2	0.5
Technology, General (T)	. 1	0.2	2	0.5
Economic History and				
Conditions (HC)	. 1	0.2		_
Geography, General (G)	3	0.8	1	0.2
Oceanology and Oceanography (GC	2) 3	0.8	1	0.2
Publications of Learned Societies,				
General (AS)	. 2	0.5	1	0.2
Student Fraternities and				
Societies, U.S. (LJ)		-	1	0.2
Zoology (QL)	. 3	0.8	1	0.2
Totals	400	100.0	400	100.0

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