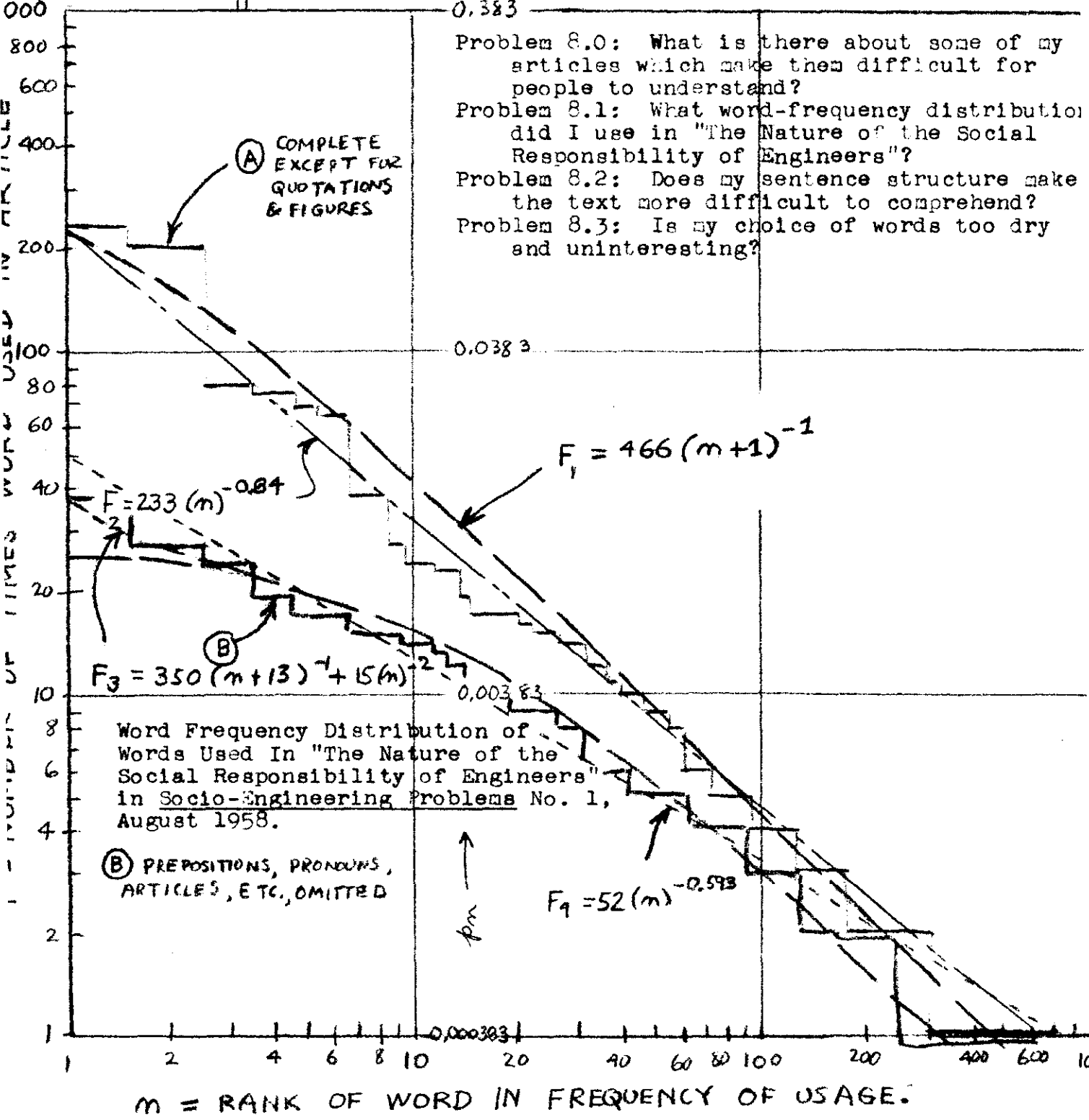


SOCIO-ENGINEERING PROBLEMS

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- Problem 8.0: What is there about some of my articles which make them difficult for people to understand?
- Problem 8.1: What word-frequency distribution did I use in "The Nature of the Social Responsibility of Engineers"?
- Problem 8.2: Does my sentence structure make the text more difficult to comprehend?
- Problem 8.3: Is my choice of words too dry and uninteresting?

Word Frequency Distribution of Words Used In "The Nature of the Social Responsibility of Engineers" in Socio-Engineering Problems No. 1, August 1958.

(B) PREPOSITIONS, PRONOUNS, ARTICLES, ETC., OMITTED

Socio-Engineering Problems
An Inquiry into the Social Consequences
of Engineering and Technology

A series of working paper drafts distributed informally for discussion. The objective is to informally exchange ideas on the problems of our civilization as they are related to the social use of science through engineering and technology.

These notes are not intended for formal publication in the present form. It is hoped that each of these will lead either to (a) revisions due to comments received, or (b) the inspiration of others to pursue the problems in more depth.

Frederick B. Wood

PUBLICATIONS

The formal publications which have so far resulted from this series are:

F. B. Wood, "The Social Responsibility of Engineers and Scientists," 1959 Proceedings of the Western Joint Computer Conference, pp. 310-313. (Available from the Institute of Radio Engineers, 1 East 79th Street, New York 21, N.Y., at \$6.00 per copy)

Frederick B. Wood, "The Social Responsibility of Engineers and Scientists," Progressive World, Vol. XIII, No. 12, Feb. 1960, pp. 6-10, 35-39. (Copies available from P.O. Box 75605, Sanford Station, Los Angeles 5, California, at \$0.40 per copy)

COVER CHART

A count of the frequency of usage of each word in Socio-Engineering Problems No. 1, "The Nature of the Social Responsibility of Engineers," has been made. The number of times each word was used is plotted against the rank of the word on a log-log set of scales on the front cover of this issue. Two curves have been plotted: (A) the complete set except for quotations, references, and notes included in figures, and (B) a reduced set where the prepositions, pronouns, articles, etc., are omitted. Further details are given in the discussion of Problem 8.1.

Problem 8.0: What is there about some of these articles in Socio-Engineering Problems which make them difficult for people to understand? Which of the following factors contribute to the problem?

- (a) Is it my complex and long sentences?
- (b) my word frequency useage,
- (c) my inclusion of material from many widely separated fields,
- (d) the statement of elementary principles in a specialized terminology such as information theory,
- (e) my possible use of words by their correct dictionary definition, but not so well chosen to properly utilize the emotional associations which they have in our culture,
- (f) failure to state my ultimate objectives clearly,
- (g) is there insufficient express relationship to the standards of our culture?
- (h) is there a conflict between the traditional concept of engineering reports being in the third person and these sociological topics which by their nature bring in emotional feelings?

I propose to gradually deal with the possible aspects, one at a time as separate problems. I shall start first with the problems that I can deal with by objective means, such as counting word frequencies, and counting the syllable and word distributions in sentences. Then I shall proceed to the more subjective problems, involving human reactions. Perhaps writing and exchange of notes and letters will not be sufficient to work out some questions, particularly if people's emotional reactions such as facial expression and tone of voice are lost in the written communication.

Problem 8.1: What word-frequency distribution did use in the article: "The Nature of the Social Responsibility of Engineers," Socio-Engineering Problems, No. 1, Aug. 1958? Is it a normal word-frequency distribution? Or is it different due to my attempting to deal with a broad field crossing over the usual boundaries of special fields? Does the rank of useage of the principal words (nouns) give a good indication of the subject matter of the article?

A summary of the word-frequency count is shown in Table I. The most frequently used words from Dewey's tables are shown beside my count for comparison(1). It can be seen from the table that the articles and prepositions were used by in approximately the same distribution as is usually encountered in English text.

1. Relative Frequency of English Speech Sounds(book), Godfrey Dewey. Cambridge: Harvard Univ. Press (1923)

Table I. Listing of Highest Ranking Words

Text of 2607 words used 698 separate words.

Rank	Word-Count(per cent)	Words from Dewey
1	the-233(8.)	the (7.3)
2	of-202(7.7)	of (4.0)
3	in-79(3.0)	and (3.3)
4	to-76(2.9)	to (2.9)
5	a-69(2.7)	a (2.1)
6	and-66(2.5)	is (2.1)
7	is-39(1.5)	
8	ENGINEER 39 (1.5)	
9	SOCIAL 27 (1.04)	
10	SCIENCE 24 (0.96)	
11	for-24	
12	as-23	
13	his-23	
14	some-22	
15	that-20	
16	CHART 19	
17	PROBLEMS 17	
18	SOCIETY 17	
19	this-17	
20	which-17	
21	our-17	
22	with-16	
23	FIELDS 15	
24	FIGURES 15	
25	have-15	
26	RESPONSIBILITY 15	
27	WORK 14	
28	HUMAN 14	
29	on-14	

If we exclude the articles, prepositions, conjunctives, pronouns, and elementary verbs (i.e., to be and to have, etc.) the rank of the remaining words (CAPITALIZED) such as ENGINEER, SOCIAL, and SCIENCE and the other groups enclosed in boxes are useful as abstracts of the article, similar to the techniques discussed by P. B. Baxendale (2).

2. P. B. Baxendale, "Machine-Made Index for Technical Literature-An Experiment." IBM Journal Oct 1958, pp. 354-361.

The frequency-rank plot on the cover is similar to the method of studying word frequency distributions developed by Zipf and refined by Mandelbrot(3). Zipf gives a distribution with the probability of a word of rank "n" occurring as:

$$p_n = P n^{-1} \quad (1)$$

Mandelbrot gives the distribution:

$$p_n = P (n+m)^{-B} \quad (2)$$

On the cover diagram of this report, four distributions are given. F_1 fits the data better at the ends and is of the form (2) given by Mandelbrot. F_2 fits the data better in the middle range and is close but not identical to the distribution of Zipf, form (1).

Another way of plotting the word frequency distribution is shown on the cover by curves F_3 and F_4 . In these cases prepositions, pronouns, articles, etc., are omitted. This selected list of words is sometimes used for abstracting articles. It is interesting to note that omission of the prepositions, etc., causes the distribution to turn up at the high frequency end of the curve.

Mandelbrot also defines an informational temperature of a language (or vocabulary) as:

$$\theta = B^{-1} \quad (3)$$

Looking at the cover diagram, we see that a smaller negative slope (smaller B) for the same frequency of the high ranking words would mean that there were a larger number of words in the language or vocabulary. This would permit a larger selection of distinct ideas to be expressed by the language, corresponding by analogy to a higher temperature in a thermodynamic system or to lower entropy for the same energy transfer or to greater negative entropy (information).

No radical departure from the normal word-frequency distribution in English text is indicated from this analysis. However the exponent of -0.84 in curve F_2 might be a significant departure from Zipf's exponent of -1.0. ² To determine if this is significant the next step might be to make a word-frequency analysis of an article written by the same author on a more specialized subject, such as:

F. B. Wood, "Optimum block length for data transmission with error checking." Communications and Electronics, No. 40, 1959, pp. 855-861.

Another study might be to make a word-frequency analysis of the Russian translation of the above article which is available as follows:

"Optimal'aya Dima Gruppy Dlya Peredachi Dannykh S Provakay Oshi'ok," Zkspress-Infomatsia, Nov. 1959, Sec 44, BT-173 (8 pages)

3. Benoit Mandelbrot "An Informational Theory of the Statistical Structure of Language," paper in Communication Theory, Willis Jackson, editor. N.Y.: Academic Press(1953), pp. 486-502.

Since I have no plans to carry this analysis further, I shall be glad to supply reprints of the above articles to anyone who wants to make the proposed word-frequency studies in English or Russian or both.

Problem 8.2: Does my sentence structure in the same article make the text more difficult to comprehend?

Using the procedure suggested by Flesch, I took a word and syllable count of random sections of the article (4).

Reading Ease = $206.8 - (1015 \times L_{av} + 0.846 \{ \text{syllable}/100 \text{ words} \})$
where L_{av} is the average length of a sentence in words per sentence.

A sampling of my article gave 466 words or 759 syllables in 12 sentences. This reduces to 39 words per sentence and 163 syllables per 100 words. Using the above formula or the nomograph in Flesch's book gives a rating of 29. The scale is

0-30	Very Difficult
30-50	Difficult
60-70	Standard
80-90	Easy

This places my sentence structure in the "(Very Difficult)" class. A further interesting note is that I had to extrapolate his nomograph, because the nomograph was made on the assumption that nobody would use as many words per sentence as I do, in English.

Problem 8.3: Is my choice of words too dry and uninteresting?

Mr. Flesch also has a scale for measuring the human interest score of an article (ref. 4, p. 68). Counting the personal words in the article such as names of persons, personal pronouns like he, she, I, and you, etc. and the words people and folks. These personal pronouns were used 120 times or 5.8 per cent. They occurred in 54 of the 176 sentences. Using the following formula gives:

Human Interest = $3.64 (\text{personal words}/100 \text{ words}) + 0.314 \{ \text{personal sentences per } 100 \text{ sentences} \}$,

or a score of 31 in this case. The scale is interpreted as follows:

0-10	Dull
10-20	Mildly Interesting
20-40	Interesting
40-60	Very Interesting
60-100	Dramatic

By this scale my article comes in the "Interesting" range.

To be continued. I see that I have only covered Problem 8.0, parts (a), (b), and partially (c).

4. Rudolf Flesch, The Art of Readable Writing (book), N.Y.:
Harper and Bros. (1949), p. 213 and inside covers.

A Working Paper Draft

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SOCIO-ENGINEERING PROBLEMS. No. 8-A

A series of manuscripts on the social relations of engineering and related philosophical questions dealing with the interaction of science and society. Distribution is limited to reviewers and discussion groups for criticism prior to consideration for possible publication.

A SAMPLE WORD FREQUENCY
DISTRIBUTION.

Date:	7 30/59	9/59	12 59	1/18/63
Stage:	Count	Curve	No. 8	Detail List

Frederick B. Wood

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Mailing Address: P. O. Box 85, Campbell, California, U. S. A.

A SAMPLE WORD FREQUENCY DISTRIBUTION

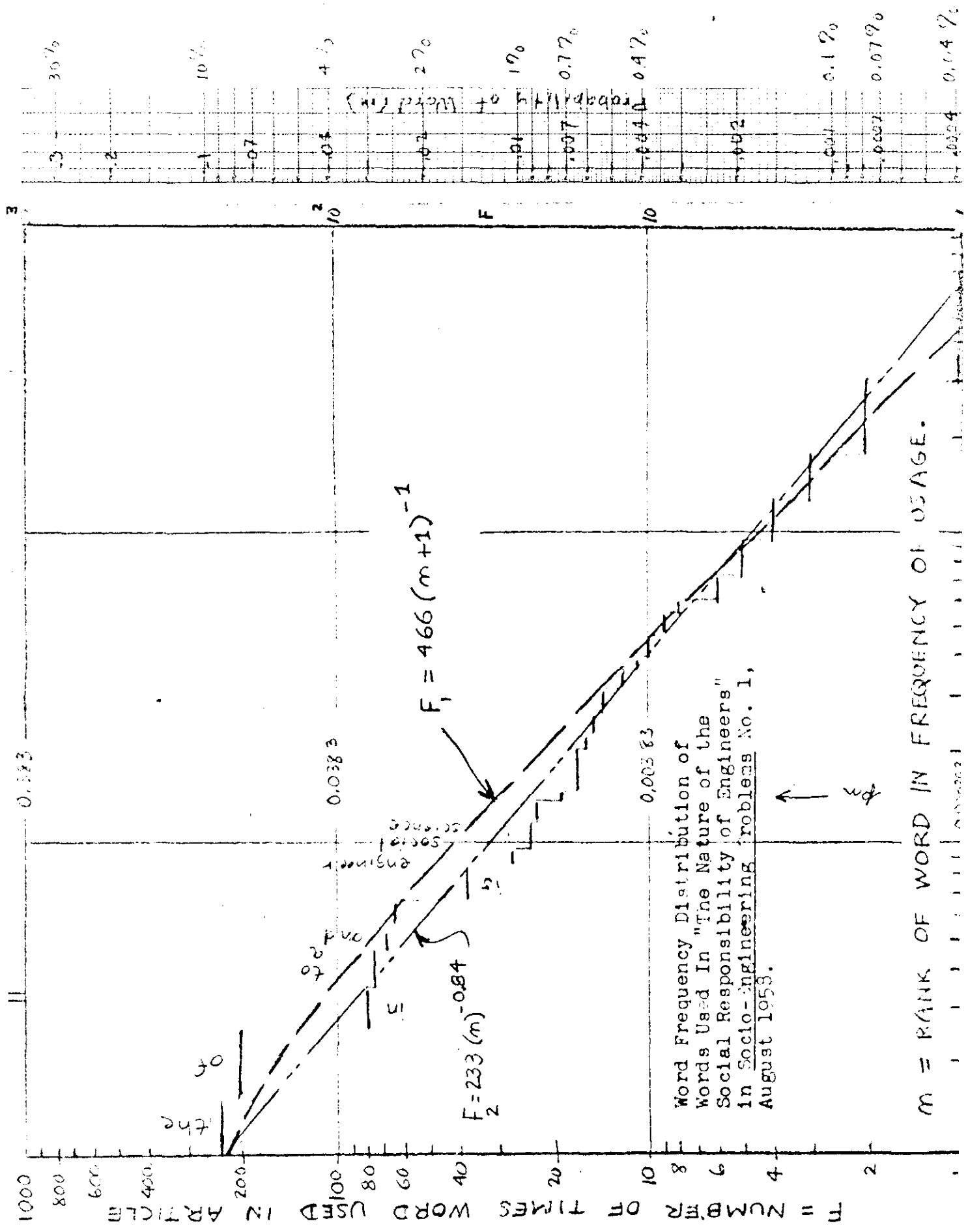
Abstract

The words counted and sorted in this study are taken from Socio-Engineering Problems No. 1, * August 27, 1958. Equations and Figures and Quotations were omitted as described in SEP No. 8, May 8, 1960. A plot of the frequency distribution is given in terms of frequency versus rank with Mandelbrot-Zipf Law approximate curves.

The words are listed both alphabetically and by rank.

Frederick B. Wood

*IBM Research & ASD Library File: PAM-6009



Word Frequency Distribution of Words Used In "The Nature of the Social Responsibility of Engineers" in Socio-Engineering Problems No. 1, August 1953.

m = RANK OF WORD IN FREQUENCY OF USAGE.

Analysis of "The Nature of the Social Responsibility of Engineers,"
Socio-Engineering Problems No. 1, August 1958, pp 3-15.

Word-frequency count: Only text, not quotations or figures.

69-a	3-American	1-astronomy	1-bibliography
2-about	1-amount	1-astrophysics	3-biology
2-above	12-an	4-at	1-biophysics
1-abstract	3-analysis	1-attempt	1-board
3-accepted	66-and	1-attend	2-both
1-accessible	2-animals	1-authors	1-bottom
2-account	3-another	4-automation	1-brought
1-achieve	3-any	2-available	1-build
1-achievements	1-appeared	1-bachelor	1-buildings
1-ACLU	5 application(s)	1-balanced	1-bulletin
1-acquire	1-applying	1-based	1-business
1-action	1-approach	6-basic	3-but
10-activities	10-are	12-be	12-by
1-addition	9-area(s)	4-become(s, -came)	1-by-product
1-advanced	1-argue	6-been	1-California
1-adequately	1-arrange	1-behavior	4-can
1-advisors	1-art	2-behavioral	1-capable
1-affiliated	2-articles	1-behind	1-capital
2-agencies	1-artist	3-being (s)	1-carefully
1-aid	23-as	1-belong	1-case
1-alert	1-ask	1-benefits	1-causes
3-all	1-aspect	1-best	1-center
3-also	3-aspirations	1-better	2-centuries
2-alternative	1-assist	7-between	1-certain

2-chairman	4-communicat(ion, -e)	1-correspondents	1-disabled
2-channel	1-community	5-could	1-discharge
19-chart	2-complicated	2-council	1-discovery
1-chapter	3-computers	3-country	3-discuss(ing)
8-checking	1-Comte	9-cover(ing)	1-discussion
2-cheap	2-completeness	1-co erage	2-distribution
1-chemical	1-color	1-correlate	2-do
4-chemistry	1-combination	2-crisis	2-does
2-children	1-concluded	2-cultural	1-doctor
1-citizen	1-concrete	1-cuts	2-domain
2-city	5-conduct(ed)	1-cycle	1-each
2-civil	1-condition	1-danger	2-earlier
4-civilization	1-conclusions	2-deal(ing)	1-easily
2-claim	1-conference	1-democratic	1-easy
4-classification	2-contact	4-derived	3-economic
1-clearly	2-compounds	1-design	1-editor
1-client	1-contribute	2-determine(d)	2-education(al)
2-close(r)	1-continuous	10-develop(ing, ed)	1-effect
4-code(s)	1-contrast	6-development	1-efficient
1-coding	1-conscience	1-devices	1-effort
3-columns	1-conservative	1-devote	10-electrical
1-comes	1-constructor	6-diagram(s)	1-elementary
3-common	1-contradiction	12-different	2-elements
9-complex(ity)	1-controversies	1-difficult	1-emotional
1-commonplace	1-coordinator	1-direct	1-employer

1-enable	3-extent	1-formed	1-goal
1-enactment	1-extensive	1-formal	1-good
2-energy	1-facilities	1-fortune	3-government
1-encompass	3-faith	1-foundations	1-gradually
39-engineer(s)	2-fallout	1-founders	2-graphical(ly)
11-engineering	2 family	5-four	1-grasp
1-enterprises	1-far	1-framework	6-group(s)
1-equations	1-far-reaching	4-friend(s)	1-growth
1-equivalent	1-federation	11-from	13-has
1-essentially	3-feel	2-fruitful	15-have(ing)
1-established	2-feeling	2-fulfill	14-hé
1-etc.	1-fellowship	1-fully	1-healthy
3-ethics	1-felt	2-function	1-held
1-evaluate	15-fields	1-fundamental	3-help(ing)
1-even	15-figure	1-further	1-highest
6-example	1-financially	1-furthermore	4-him
1-everywhere	3-find(s)	2-future	1-himself
2-examine	1-fit	1-gain	23-his
1-existence	3-five	2-gap	5-historical(ly)
1-existing	2-follow(ing)	2-general	1-hope
2-expect	2-follow(s)	1-genius	1-hospital
1-experience	24-for	1-get	2-horizontal
1-experimental	1-FOR	3-given	6-how
1-experimentation	1-foreign	1-giving	14-human
2-expresses	6-form	1-go	1-humanity

2-hypothesis	1-integrated	5-large	2-management
1-hypothetical	1-intellectual	2-last	5-many
9-I	1-intended	1-law	3-mark(ed)
5-ideas	1-interdisciplinary	2-leadership	1-mathematician
1-idealized	2-interpret	1-led	4-mathematic(s, al)
1-ideals	1-interpretation	2-less	1-matrix
1-i. e.	2-interrelation	1-let	2-matter
2-if	1-intersection	1-letters	8-may
4-illustrat(es, ed)	3-into	2-level	1-meaning
1-immediate	1-intrinsically	2-liberties	1, meeting
4-implication(s)	2-introduction	1-lie(s)	1-membership
1-important	1-invention	1-like	1-mental
19-in	2-investigat(ed, ion)	1-list	1-mention
4-increas(ingly)	1-involved	3-liv(e, ing)	1-mid-morning
1-independent	39-is	2-Los Angeles	6-might
2-individual	2-issue(s)	1-loss	1-milk
2-industrial	8-it	1-loyalty	1-minimum
1-industry	1-joint	1-luxury	1-modes
1-influence	1-key	2-magazines	1-model
2-information	2-kind	1-made	1-modification
1-inside	1-know	1-magnitude	1-monthly
5-institute(ed, s)	8-knowledge	3-maintain(ed)	1-moratorium
1-interconnection	1-lacks	4-make(ing)	10-more
1-interested	1-laid	3-man	2-most
2-interest	1-lagging	3-mankind	1-Mt Sinai

1-moves	1-occasionally	2-part	2-prepare(d)
1-much	1-occur	2-particles	1-present
1-multiple	202-of	3-particular	17-problems
1-must	1-office	4-party	1-processes
2-my	14-on	9-people	1-products
1-name	10-one	1-performing	3-professor
1-national	1-only	4-perhaps	1-profession
1-nations	1-opening	1-periodic	4-professional
1-nature	1-operation	4-perspectives	1-progress
2-necessity	1-opposing	3-phenomena	1-projects
9-needs	11-or	1-philosopher	2-proof
1-needed	2-order	3-philosophy	4-proposed
1-neighbour	5-ordinary	13-physical	1-provided
1-network	1-organizing	1-physiology	1-provision
4-new	5-organization(s)	1-pioneers	3-psychiatry
1-news	4-other(s)	1-placing	2-psychology
1-newspapers	17-our	2-point	1-psychomatic
1-normal	1-ourselves	2-political	1-public
9-not	2-out	1-politician	1-published
1-nothing	1-outside	1-possibly	2-purpose
1-now	1-overlapping	1-potential	1-put
1-NSPE	2-own	5-power	4-questions
2-objective	1-pacifist	3-practical	1-race
2-observation	2-panel	2-practice	1-radiation
2-obvious	1-parallel	2-preliminary	1-radicals

1-radioactive	10-represents	2-series	4-sociology
1-raises	4-representation	1-serves	1-solving
1-rates	1-republican	1-sets	22-some
1-range	2-required	1-several	1-source
1-rapid	5-research	1-severity	1-spare
1-reach	1-responsible	1-shall	5-special
1-reads	15-responsibility	2-share	1-specialist
4-real	1-rest	1-short	2-specialized
1-realize	2-results	1-should	2-specific
1-reality	1-return	6-show(n)	1-Spencer
2-recently	2-review	1-side	1-splitting
1-reconcillation	2-role	1-sign	1-SSRS
2-reforms	1-same	2-significan(ce, t)	2-stage
1-refer	1-sample	1-similar	1-stand
2-relate(s, ing)	1-Santa Clara	2-simple(r)	4-standards
2-related	1-scale	2-simplified	1-starting
5-relations	1-scheme	1-since	1-state
3-relationships	5-school	1-situation	1-statement
3-religion	24-science	1-skill	1-status
1-religious	5-scientists	2-skyscraper	8-Steinmetz
1-rely	3-scientific	3-so	1-step
1-regard	5-sections	27-social	1-stimulate
1-repeat	1-see	9-socialists	1-stopping
1-report	1-segments	17-society	8-stud(ied, y)
5-respect	1-sense	3-sociological	2-student

1-subscribe	5-there	1-uncontrolled	1-wars
1-success	4-these	3-under	6-was
10-such	1-thesis	6-understanding	4-way(s)
2-sufficient	2-they	1-UNESCO	5-we
4-suggest(ed, ion)	1-theories	1-union	1-western
2-support	2-think	1-united	3-what
1-surface	2-three-dimension	1-United States	2-when
1-survival	2-thing	1-unity	1-where
1-superseded	17-this	1-universe	2-whether
1-symbolic	4-three	1-unless	17-which
1-symbols	1-third	1-up	1-whole
2-systems	5-through	1-upon	1-whose
1-synthesis	1-throughout	1-us	6-who
3-table	2-time	5-use	3-will
2-tackl(e, ing)	1-two-dimension	3-useful(ness)	16-with
1-take	76-to	1-using	1-without
1-teachers	2-tools	2-utility	1-why
1-technical	1-top	1-utilized	1-word
1-tell	1-toward	1-valley	14-work
1-ten	1-traditional	1-value	2-would
1-terms	1-treating	2-various	1-working
1-tested	1-tremendous	1-version	1-written
1-than	1-trend	2-vertical	2-year
20-that	1-tubercular	1-view	1-yet
233-the	1-tune	3-viewpoint	1-you
5-their	5-two	1-vonBertalanffy	1-YMCA
1-then	4-type	2-Ward	1-zoology

SUMMARY OF STATISTICS

<u>Rank</u>	<u>Frequency</u>	<u>No. Words in Class</u>	<u>Cumulative No. of Words</u>
1	233	1	1 - 233
2	202	1	2 - 435
3	79	1	3 - 514
4	76	1	4 - 590
5	69	1	5 - 659
6	66	1	6 - 725
7-8	39	2	8 - 803
9	27	1	9 - 830
10-11	24	2	11 - 878
12-13	23	2	13 - 924
14	22	1	14 - 946
15	20	1	15 - 966
16	19	1	16 - 985
17-22	17	6	22 - 1087
23-24	16	2	24 - 1119
25-28	15	4	28 - 1179
29-33	14	5	33 - 1249
34-35	13	2	35 - 1275
36-39	12	4	39 - 1323
40-42	11	3	42 - 1356
43-50	10	8	50 - 1436
51-58	9	8	58 - 1508
59-63	8	5	63 - 1548
64-77	6	14	77 - 1632
78-99	5	22	99 - 1742
100-132	4	33	132 - 1874
133-180	3	48	180 - 2018
181-308	2	128	308 - 2274
309-702	1	394	702 - 2668

List B: by Rank in Decreasing Order of Frequency

<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>
1	233	the	51	9	socialists	101	4	automation
2	202	of	52	9	needs	102	4	can
3	79	in	53	9	not	103	4	chemistry
4	76	to	54	9	people	104	4	civilization
5	69	a	55	8	checking	105	4	classification
6	66	and	56	8	it	106	4	code(s)
7	39	is	57	8	knowledge	107	4	communicatio
8	39	engineer(s)	58	8	may	108	4	become(s, can
9	27	social	59	8	Steinmetz	109	4	derived
10	24	science	60	8	stud(ied, y)	110	4	friend(s)
11	24	for	61	7	between	111	4	him
12	23	as	62	6	basic	112	4	illustrat(es - ec
13	23	his	63	6	been	113	4	implication(s)
14	22	some	64	6	development	114	4	increas(ingly)
15	20	that	65	6	diagram(s)	115	4	make(ing)
16	19	chart	66	6	example	116	4	mathematic(s,
17	17	problems	67	6	form	117	4	new
18	17	society	68	6	group(s)	118	4	other(s)
19	17	this	69	6	how	119	4	party
20	17	which	70	6	might	120	4	perhaps
21	17	our	71	6	show(n)	121	4	perspectives
22	16	with	72	6	understanding	122	4	proposed
23	15	fields	73	6	was	123	4	questions
24	15	figure	74	6	who	124	4	representation
25	15	have(ing)	75	5	application(s)	125	4	sociology
26	15	responsibility	76	5	conduct(ed)	126	4	standards
27	14	work	77	5	could	127	4	suggest(ed. ion
28	14	human	78	5	four	128	4	these
29	14	on	79	5	historical(ly)	129	4	three
30	14	he	80	5	ideas	130	4	type
31	13	physical	81	5	institute(ed s)	131	4	way(s)
32	13	has	82	5	large	132	3	accepted
33	12	be	83	5	many	133	4	professional
34	12	by	84	5	ordinary	134	3	all
35	12	different	85	5	organization(s)	135	3	also
36	12	an	86	5	power	136	3	American
37	11	from	87	5	relations	137	3	analysis
38	11	or	88	5	research	138	3	another
39	11	engineering	89	5	respect	139	3	any
40	10	activities	90	5	school	140	3	aspirations
41	10	are	91	5	scientists	141	3	being(s)
42	10	develop(ing, ed)	92	5	sections	142	3	biology
43	10	electrical	93	5	special	143	3	but
44	10	one	94	5	their	144	3	columns
45	10	represents	95	5	there	145	3	common
46	10	such	96	5	through	146	3	computers
47	9	area(s)	97	5	two	147	3	country
48	9	complex(ity)	98	5	use	148	3	discuss(ing)
49	9	cover(ing)	99	5	we	149	3	economic
50	9	I	100	4	at	150	3	ethics

<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>
151	3	extent	201	2	complicated	251	2	liberties
152	3	faith	202	2	completeness	252	2	Los Angeles
153	3	feel	203	2	contact	253	2	magazines
154	3	find(s)	204	2	compounds	254	2	managemen
155	3	five	205	2	contact	255	2	matter
156	3	given	206	2	council	256	2	most
157	3	government	207	2	crises	257	2	my
158	3	help(ing)	208	2	cultural	258	2	necessity
159	3	into	209	2	deal(ing)	259	2	objective
160	3	liv(e, ing)	210	2	determine(d)	260	2	observatio
161	3	maintain(ed)	211	2	distribution	261	2	obvious
162	3	man	212	2	do	262	2	order
163	3	mankind	213	2	does	263	2	out
164	3	mark(ed)	214	2	domain	264	2	own
165	3	particular	215	2	earlier	265	2	panel
166	3	phenomena	216	2	education(al)	266	2	part
167	3	philosophy	217	2	elements	267	2	particles
168	3	practical	218	2	energy	268	2	point
169	3	professor	219	2	examine	269	2	political
170	3	psychiatric	220	2	expect	270	2	practice
171	3	relationship	221	2	expresses	271	2	preliminar
172	3	religion	222	2	fallout	272	2	prepare(d)
173	3	scientific	223	2	family	273	2	proof
174	3	so	224	2	feeling	274	2	psychology
175	3	sociological	225	2	follow(ing)	275	2	purpose
176	3	table	226	2	follow(s)	276	2	recently
177	3	under	227	2	fruitful	277	2	reforms
178	3	useful(ness)	228	2	fulfill	278	2	relate(s, ir
179	3	viewpoint	229	2	function	279	2	related
180	3	what	230	2	future	280	2	required
181	3	will	231	2	gap	281	2	results
182	2	about	232	2	general	282	2	review
183	2	above	233	2	graphical(ly)	283	2	role
184	2	account	234	2	horizontal	284	2	series
185	2	agencies	235	2	hypothesis	285	2	share
186	2	alternative	236	2	if	286	2	significan(
187	2	animals	237	2	individual	287	2	simple(r)
188	2	articles	238	2	industrial	288	2	simplified
189	2	available	239	2	information	289	2	skyscrape
190	2	behavioral	240	2	interest	290	2	specialize
191	2	both	241	2	interpret	291	2	specific
192	2	centuries	242	2	interrelation(s)	292	2	stage
193	2	chairman	243	2	introduction	293	2	student
194	2	channel	244	2	investigat(ed, ion)	294	2	sufficient
195	2	cheap	245	2	issue(s)	295	2	support
196	2	children	246	2	kind	296	2	systems
197	2	city	247	2	last	297	2	tackl(e, -i:
198	2	civil	248	2	leadership	298	2	they
199	2	claim	249	2	less	299	2	think
200	2	close(r)	250	2	level	300	2	three-dim

<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>
301	2	thing	351	1	bibliography	401	1	democratic
302	2	time	352	1	biophysics	402	1	design
303	2	tools	353	1	board	403	1	devices
304	2	utility	354	1	bottom	404	1	devote
305	2	various	355	1	brought	405	1	difficult
306	2	vertical	356	1	build	406	1	direct
307	2	Ward	357	1	buildings	407	1	disabled
308	2	when	358	1	bulletin	408	1	discharge
309	2	whether	359	1	business	409	1	discovery
310	2	would	360	1	by-product	410	1	discussion
311	2	year	361	1	California	411	1	doctor
312	1	abstract	362	1	capable	412	1	each
313	1	accessible	363	1	capital	413	1	easily
314	1	achieve	364	1	carefully	414	1	easy
315	1	achievements	365	1	case	415	1	editor
316	1	ACLU	366	1	causes	416	1	effect
317	1	acquire	367	1	center	417	1	efficient
318	1	action	368	1	certain	418	1	effort
319	1	addition	369	1	chapter	419	1	elementary
320	1	advanced	370	1	chemical	420	1	emotional
321	1	adequately	371	1	citizen	421	1	employer
322	1	advisors	372	1	clearly	422	1	enable
323	1	affiliated	373	1	client	423	1	enactment
324	1	aid	374	1	coding	424	1	encompass
325	1	alert	375	1	comes	425	1	enterprises
326	1	amount	376	1	commonplace	426	1	equations
327	1	appeared	377	1	community	427	1	equivalent
328	1	applying	378	1	Comte	428	1	essentially
329	1	approach	379	1	color	429	1	established
330	1	argue	380	1	combination	430	1	etc.
331	1	arrange	381	1	concluded	431	1	evaluate
332	1	art	382	1	concrete	432	1	even
333	1	artist	383	1	condition	433	1	everywhere
334	1	ask	384	1	conclusions	434	1	existence
335	1	aspect	385	1	conference	435	1	existing
336	1	assist	386	1	contribute	436	1	experience
337	1	astronomy	387	1	continuous	437	1	experimental
338	1	astrophysics	388	1	contrast	438	1	experimentation
339	1	attempt	389	1	conscience	439	1	extensive
340	1	attend	390	1	conservative	440	1	facilities
341	1	authors	391	1	constructor	441	1	far
342	1	bachelor	392	1	contradiction	442	1	far-reaching
343	1	balanced	393	1	controversies	443	1	federation
344	1	based	394	1	coordinator	444	1	fellowship
345	1	behavior	395	1	correspondents	445	1	felt
346	1	behind	396	1	coverage	446	1	financially
347	1	belong	397	1	correlate	447	1	fit
348	1	benefits	398	1	cuts	448	1	FOR
349	1	best	399	1	cycle	449	1	foreign
350	1	better	400	1	danger	450	1	formed

<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>
451	1	formal	501	1	lacks	551	1	office
452	1	fortune	502	1	laid	552	1	only
453	1	foundations	503	1	lagging	553	1	opening
454	1	founders	504	1	law	554	1	operation
455	1	framework	505	1	led	555	1	opposing
456	1	fully	506	1	let	556	1	organizing
457	1	fundamental	507	1	letters	557	1	ourselves
458	1	further	508	1	lie(s)	558	1	outside
459	1	furthermore	509	1	like	559	1	overlapping
460	1	gain	510	1	list	560	1	pacifist
461	1	genius	511	1	loss	561	1	parallel
462	1	get	512	1	loyalty	562	1	performing
463	1	giving	513	1	luxury	563	1	periodic
464	1	go	514	1	made	564	1	philosopher
465	1	goal	515	1	magnitude	565	1	physiology
466	1	good	516	1	mathematician	566	1	pioneers
467	1	gradually	517	1	matrix	567	1	placing
468	1	grasp	518	1	meaning	568	1	politician
469	1	growth	519	1	meeting	569	1	possibly
470	1	healthy	520	1	membership	570	1	potential
471	1	held	521	1	mental	571	1	present
472	1	highest	522	1	mention	572	1	processes
473	1	himself	523	1	midmorning	573	1	products
474	1	hope	524	1	milk	574	1	profession
475	1	hospital	525	1	minimum	575	1	progress
476	1	humanity	526	1	modes	576	1	projects
477	1	hypothetical	527	1	model	577	1	provided
478	1	idealized	528	1	modification	578	1	provision
479	1	ideals	529	1	monthly	579	1	psychomatic
480	1	i. e.	530	1	moratorium	580	1	public
481	1	immediate	531	1	Mt Sinai	581	1	published
482	1	important	532	1	moves	582	1	put
483	1	independent	533	1	much	583	1	race
484	1	industry	534	1	multiple	584	1	radiation
485	1	influence	535	1	must	585	1	radicals
486	1	inside	536	1	name	586	1	radioactive
487	1	interconnection	537	1	national	587	1	raises
488	1	interested	538	1	nations	588	1	rates
489	1	integrated	539	1	nature	589	1	range
490	1	intellectual	540	1	needed	590	1	rapid
491	1	intended	541	1	neighbour	591	1	reach
492	1	interdisciplinary	542	1	network	592	1	reads
493	1	interpretation	543	1	news	593	1	real
494	1	intersection	544	1	newspapers	594	1	realize
495	1	intrinsically	545	1	no	595	1	reality
496	1	inventor	546	1	normal	596	1	reconciliation
497	1	involved	547	1	now	597	1	refer
498	1	joint	548	1	NSPE	598	1	religious
499	1	key	549	1	occasionally	599	1	rely
500	1	know	550	1	occurs	600	1	regard

<u>Rank</u>	<u>Freq.</u>	<u>Word</u>	<u>Rank</u>	<u>Freq.</u>	<u>Word</u>
601	1	repeat	653	1	technical
602	1	report	654	1	tell
603	1	republican	655	1	ten
604	1	responsible	656	1	terms
605	1	rest	657	1	tested
606	1	return	658	1	than
607	1	same	659	1	then
608	1	sample	660	1	thesis
609	1	Santa Clara	661	1	theories
610	1	scale	662	1	third
611	1	scheme	663	1	throughout
612	1	see	664	1	two-dimens.
613	1	segments	665	1	top
614	1	sense	666	1	toward
615	1	serves	667	1	traditional
616	1	sets	668	1	treating
617	1	several	669	1	tremendous
618	1	severity	670	1	trend
619	1	shall	671	1	tubercular
620	1	short	672	1	tune
621	1	should	673	1	uncontrolled
622	1	side	674	1	UNESCO
623	1	sign	675	1	union
624	1	similar	676	1	united
625	1	since	677	1	United States
626	1	situation	678	1	unity
627	1	skill	679	1	universe
628	1	solving	680	1	unless
629	1	source	681	1	up
630	1	spare	682	1	upon
631	1	specialist	683	1	us
632	1	Spencer	684	1	using
633	1	splitting	685	1	utilized
634	1	SSRS	686	1	valley
635	1	stand	687	1	value
636	1	starting	688	1	version
637	1	state	689	1	view
638	1	statement	690	1	von Bertalanffy
639	1	status	691	1	wars
640	1	step	692	1	western
641	1	stimulate	693	1	where
642	1	stopping	694	1	whole
643	1	subscribe	695	1	whose
644	1	success	696	1	without
645	1	surface	697	1	why
646	1	survival	698	1	word
647	1	superseded	699	1	working
648	1	symbolic	700	1	written
649	1	symbols	701	1	yet
650	1	synthesis	702	1	you
651	1	take	703	1	YMCA
652	1	teachers	704	1	zoology