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An analysis of science textbooks to determine the level of reading difficulty

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BOSTON UNIVERSITY
SCHOOL OF EDUCATION

Thesis

AN ANALYSIS OF SCIENCE TEXTBOOKS TO DETERMINE
THE LEVEL OF READING DIFFICULTY

Submitted by

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In partial Fulfillment of Requirements for
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CHAPTER I
STATEMENT OF THE PROBLEM

The problem.-- The purpose of this study is to determine the level of reading difficulty of several science textbooks, using the Flesch readability formula. The books to be analyzed will include;

1. Two ninth grade general science textbooks
2. Two high school chemistry textbooks
3. Two high school physics textbooks
4. Two high school biology textbooks.

Since science courses usually present material that is new and often difficult, it is important to avoid the additional handicap of reading difficulty. It is not enough for textbooks to set forth the material deemed necessary for the course. It must be presented in a style that is within the ability of the student to comprehend. On the other hand, too simple a style would fail to offer sufficient challenge to the student.

Value of the study.-- This study may prove useful to teachers and administrators as an aid in the selection of textbooks, although its statistical value is limited, since only two books in each subject are to be analyzed. It may prove of greater value to publishers as an indication of the suitability of the books they publish, and to authors as an

aid in writing and revising materials that will be suitable for the grade levels at which they are used.

Readability is one of the factors which should be given careful consideration in the selection of suitable textbooks. With the shift in emphasis from teaching subject matter to teaching individuals, a knowledge of the reading difficulty of textbooks is an essential factor in making better provision for individual differences. Considerable research has been done on the reading difficulty of books used primarily in the teaching of reading at the lower grade levels, but research on the readability of textbooks at the upper grade levels has been limited.

Studies by Mallinson.-- In a study by George Mallinson and others,^{1/} twenty six biology textbooks were analyzed, using the original Flesch formula. Eleven of them were found to have a level of reading difficulty of eighth grade or below, which would not be difficult for the average ninth grade student taking biology. Twelve of the books, with a reading difficulty of eighth grade completed to ninth grade, would be difficult for the below-average student, and three, which were found to have a level of reading difficulty above the ninth grade, would be somewhat difficult even for the superior students.

1/ George G. Mallinson, et al., "Reading Difficulty of Text-Books for High-School Biology," American Biology Teacher (November, 1950), 12:151-156.

In a second study, Mallinson and others^{1/} applied the original Flesch formula to twelve textbooks for each of the three junior high school grades. Of the twelve seventh-grade books, two would be difficult for all but the better students, and the others would be of reasonable difficulty for the average student, but difficult for the lower half of the students. The eighth-grade textbooks would be difficult only for the students of lower reading ability. Of the ninth-grade books, which showed a wider range of difficulty, four would be difficult for all but the better students, while the other books would be difficult only for students of limited reading ability.

Selection of the textbooks to be analyzed.-- The only criteria for the selection of the books to be analyzed are that they shall be of recent publication, and that they shall represent as many different publishing houses as possible. On the basis of these criteria, the following textbooks have been selected:

1. P. F. Bradwein, L. G. Hollingworth, A. D. Beck, and A. E. Burgess, Science for Better Living, Harcourt, Brace and Company, New York, 1950, p.643.
2. Morris Meister, Ralph Keirstead, and Lois Shoemaker, Science for a Better World. Charles Scribners' Sons, New York, 1952, p. 748.

^{1/} George G. Mallinson et al., "Reading Difficulty of Textbooks in Junior High School Science", School Review (December, 1950), 58:536-540.

3. Newton Black and Harvey Davis, Elementary Practical Physics, The Macmillan Company, New York, 1949, p.742.
4. O. H. Blackwood, W. B. Herron, and W. C. Kelley, High School Physics, Ginn and Company, Boston, 1951, p. 670.
5. Truman J. Moon, Paul B. Mann, and James H. Otto, Modern Biology, Henry Holt and Company, New York, 1951, p. 698 and liv.
6. George W. Hunter and F. R. Hunter, Biology in Our Lives. American Book Company, New York, 1949, p. 534.
7. Henry C. Biddle, George L. Bush, and Horace G. Demming, Chemistry Today. Rand McNally and Company, New York, 1949, p. 718.
8. Raymond B. Brownlee, R. W. Fuller, J. E. Whitsit, and W. J. Hancock, Elements of Chemistry. Allyn and Bacon, Boston, 1951, pp. 680 and 28.

Selection of the formula.-- Several factors must be considered in the selection of a readability formula, including the reliability of the formula, its ease of application, and its suitability for the type of reading material to be analyzed. A detailed discussion of some of the more important formulas will follow in a later chapter. It will be sufficient here to point out some of the reasons for the selection of the Flesch formula.

The new Flesch readability yardstick^{1/} is comprised of two formulas. Formula A, which measures complexity and abstraction, has a multiple correlation coefficient of 0.70, which indicates almost as high a predictive value as the previous Flesch formula in which the two were combined ($r = 0.74$). Formula B, with a lower correlation coefficient

^{1/} Rudolph Flesch, "New Readability Yardstick," Journal of Applied Psychology (June, 1948), 32:221-233.

($r = 0.43$), indicates to what extent interest will aid in understanding.

A common factor in all regression formulas is some measure of vocabulary load. In the Flesch formula, the time-consuming vocabulary count is replaced by a syllable count. Flesch points out^{1/} that a measure of word length is a measure of word complexity ($r = 0.87$), and word complexity is a measure of abstraction. Thus the Flesch formula offers a time-saving method of measuring vocabulary load without loss of accuracy.

The type of reading matter to be analyzed is an important factor in the selection of a readability formula. Many of the most widely used formulas, among them the Winnetka formula, are more suited to the analysis of children's reading material. Dale and Chall^{2/} consider the Flesch and Dale-Chall formulas most suitable for the analysis of adult reading material, while Lorge^{3/} considers the Dale-Chall formula best suited to health material, the Lorge suited to school reading material, and the Flesch to magazine reading. Because Flesch felt^{4/} that existing formulas failed

1/Op. cit.

2/Edgar Dale and Jeanne Chall, "Technique for Selecting and Writing Readable Materials", Elementary English, (May, 1949), 26:250-258.

3/Irving Lorge, "Readability Formulas: Evaluation", Elementary English, (February, 1949), 26:86-95.

4/Rudolph Flesch, Marks of Readable Style, Harper's, New York, 1943, p. xiv and p. 237.

to measure the difficulty of reading material above the seventh grade level, the Flesch formula was especially designed for use with upper level reading material.

The Flesch Formula.-- Regression equations commonly use some measure of vocabulary load. In most cases a count of hard words is used, based upon the Thorndyke or Dale word lists. Flesch felt^{1/} that at adult reading levels the abstractness of vocabulary is more important than word recognition. His affix count, replaced in his second formula by a syllable count, was designed to measure abstraction. Dale and Chall^{2/} point out that this count is "just another method of counting hard words," and that all methods of measuring vocabulary load are closely intercorrelated.

The factor of sentence structure is most frequently measured by a count of simple and compound sentences, sentence length, or prepositional phrases, although it has been found that the preposition count is difficult and inaccurate in practice. The Flesch and Dale-Chall formulas use the factor of sentence length, while Lorge uses both sentence length and prepositional phrases.

In his original single formula, Flesch included a factor of personal words. His assumption that personal words added to the readability was criticized. Dale and Chall^{2/} feel that

1/ Op. cit. "Marks of Readable Style"

2/ Edgar Dale and Jeanne S. Chall, "A Formula for Predicting Readability," Educational Research Bulletin (January 21, 1948), 27:11-20, 28.

the name of an unknown individual is not personal but an abstraction, and will add little either to ease of comprehension or to human interest.

In his 1949 revision of his formula^{1/} Flesch included the factor of personal words and a factor of personal sentences in a second, human interest, formula. While the above criticism of Dale and Chall is still valid, in the revised formulas it does not affect Flesch's measure of ease of comprehension. It does, however, cast doubt upon the validity of the human interest scores in social studies material, in which names of unknown individuals are frequently used. It is also doubtful whether the personal pronouns "I", "we", and "you", used abstractly, add appreciably to the interest of reading material.

The factor of personal sentences is also questionable, especially in the analysis of textbooks, which frequently contain lists of questions at the ends of chapters.

In a study to determine the reliability of the Flesch formulas in practice,^{2/} Hayes found that the greatest source of error was in the count of personal sentences. Gramatically incomplete sentences and rhetorical questions caused the greatest difficulty, through, Hayes felt, insufficiently clear directions. In the measure of sentence length there was some disagreement on the division of sentences into units

1/ Op. cit. "New Readability Yardstick"

2/ P. M. Hayes et al, "Reliability of the Flesch Readability Formulas", Journal of Applied Psychology (February, 1950), 34:22-26.

of thought, but the few errors in counting personal words and word length were clerical errors due to carelessness. Hayes concluded that the reliability on word length, sentence length and reading ease is quite high, but that the reliability on personal sentences, and therefore human interest, is lower than considered desirable.

Limitation of readability formulas.-- It should be noted that the authors of readability formulas do not claim that their formulas are definitive, but are merely short cuts in the judging of reading material. Dale and Chall^{1/} point out that most of the formulas are based on only four elements of expression:

1. vocabulary load
2. sentence structure
3. idea density
4. human interest.

They do not measure the difficulty of concepts in the text, nor do they consider the organization of material in the text. Although the formulas do not tell the entire story of readability, they do, however, provide a valuable aid to classifying reading materials into levels of comprehensibility.

1/ Edgar Dale and Jeanne Chall, "Concept of Readability," Elementary English, (January, 1949), 26:19-26.

CHAPTER II

RESEARCH

Readability formulas.-- There have been many regression equations developed to aid in predicting reading difficulty. Most of them depend basically upon some measure of vocabulary load and sentence structure, and, less frequently, on human interest. Some of the more significant studies resulting in the development of readability formulas are reviewed in this chapter.

The Winnetka Formula.-- The Winnetka formula^{1/} was first developed in 1928 by Vogel and Washburne. The median reading grade of the children who liked a book was taken as the grade level at which the book belonged. One hundred and fifty two books were analyzed to correlate such factors as vocabulary and sentence structure with the reading grade of the children who liked the book. The correlations were combined in the following regression equation, which has, on application, a reliability of 0.845.

$$x_1 = 0.085x_2 + 0.101x_3 + 0.604x_4 - 0.411x_5 + 17.43$$

In the above equation,

x_2 = the number of different words in a sample of 1000.

^{1/}Mabel Vogel and Carleton Washburne, "An Objective Method of Determining Grade Placement of Children's Reading Materials," Elementary School Journal (January, 1928), 28:373-381.

x_3 = the number of prepositions in a sample of 1000

x_4 = the number of words in the sample not in Thorndyke's

The Teachers' Word Book

x_5 = the number of simple sentences in 75.

A later study in 1938^{1/} resulted in the revision of the original formula to correct the skewing at the upper and lower levels due to the relatively small number of books selected in these grades. In the revised formula which, on application, has a reliability of 0.86, the preposition count was eliminated because it had proved difficult in practice. The following factors are used in the new formula:

x_2 = the number of different words in a sample of 1000

x_3 = the number of different words uncommon in 1000

x_4 = the number of simple sentences in 75.

The formula:

$$x_1 = 0.00255x_2 + 0.0458x_3 - 0.0307x_4 + 1.294$$

Grey and Leary.-- In 1936, Grey and Leary^{2/} used a population of adults of limited reading ability in their study. Since no existing tests adequately measured the comprehension of general reading material on an adult level, special tests were constructed, using passages from actual books. The test

^{1/}Carleton Washburne and Mabel Vogel Morphett, "Grade Placement of Children's Books," Elementary School Journal (January, 1938) 38:355-364.

^{2/}William S. Grey and Bernice E. Leary, What Makes a Book Readable, University of Chicago Press, Chicago, 1935, p. 292.

scores were corrected to grade levels by comparison with the scores of the experimental group on standardized tests.

Eighty-two elements of difficulty were analyzed, and of these, five elements were selected for use in the final equation, which has, on application, a reliability of 0.64. The following are the factors used in the formula:

x_2 = the number of different hard words (not on Dale's Word List) in 100

x_5 = the number of first, second, and third person pronouns in 100 words

x_6 = the average sentence length in words

x_7 = the per cent of different words

x_8 = the number of prepositional phrases

The formula:

$$x_1 = 0.01029x_2 + 0.00912x_5 - 0.02094x_6 - 0.3313x_7 - 0.01485x_8 + 3.774$$

Lorge.-- The study by Lorge^{1/} in 1939 was based on the previous work of Grey and Leary. Using as a criterion the 376 passages in the McCall-Crabbe Standard Test Lessons in Reading, Lorge selected the following predictors:

1. The average sentence length
2. The ratio of prepositional phrases
3. The ratio of hard words (not on Dale's list of 769 words.)

^{1/}Irving Lorge, "Predicting Reading Difficulty of Selections for Children", Elementary English Review (October, 1939), 16:229-233.

The reading index, expressed as a grade level, is determined by adding the following factors:

- 0.07 multiplied by the average sentence length,
- 13.01 multiplied by the ratio of prepositional phrases,
- 10.73 multiplied by the ratio of hard words, and 1.6126,
- a constant.

On application, the reliability of the formula is 0.77.

Flesch.-- Flesch^{1/} felt that the existing equations failed to predict reading difficulty above the seventh grade level, and that the factor of uncommon words was largely at fault. In his 1943 study, he replaced it with a count of affixed morphemes. In a later study,^{2/} in 1948, Flesch revised his original formula. In this revision the count of affixes, which had proved difficult and inaccurate in practice, was replaced by a syllable count, which has a correlation of 0.87 with the affix count.

Using as a criterion 363 of the passages of the McCall-Crabbe Standard Test Lessons in Reading, an analysis was made of the following factors:

1. sl, the average sentence length in words
2. wl, the average word length in syllables
3. pw, the per cent of personal words
4. ps, the per cent of personal sentences

^{1/}Rudolph Flesch, Marks of Readable Style, Contributions to Education, No. 897, Columbia University, New York, 1943.

^{2/}Rudolph Flesch, "New Readability Yardstick," Journal of Applied Psychology (June, 1948), 32:221-233.

Using the above factors, two formulas were computed.

1. Formula A (Reading Ease)

$$RE = 206.835 - 0.864w1 - 1.015s1$$

2. Formula B (Human Interest)

$$HI = 3.635pw + 0.314ps$$

Formula A alone has almost as high a predictive value ($r = 0.70$) as the single previous formula ($r = 0.74$). Formula B, with a lower correlation coefficient ($r = 0.43$), indicates only to what extent interest will aid in understanding.

Table 1. Conversion of the Flesch Reading Ease Score into Estimated Reading Grades

Description of Style	Reading Ease Score	Estimated Reading Grade
(1)	(2)	(3)
Very easy.....	90-100	5
Easy.....	80-90	6
Fairly easy.....	70-80	7
Standard.....	60-70	8-9
Fairly difficult..	50-60	10-12 (high school)
Difficult.....	40-50	13-16 (college)
Very difficult....	0-40	college graduate

In the reading ease equation, the results are expressed on a scale of 0 to 100, where 0 is very difficult, and 100 very easy. This scale has been converted into "estimated reading grades".

Table 2. Conversion of Human Interest Scores to Interest Levels.

Human Interest Score	Description of style
(1)	(2)
0-10	Dull
10-20	Mildly interesting
20-40	Interesting
40-60	Highly interesting
60-100	Dramatic

Dale and Chall.-- In 1948, Dale and Chall^{1/} developed a two-factor formula, using as a criterion the grade level of a group who could answer half the questions on the passages of the McCall-Crabbe tests. The two factors are:

1. A count of the relative number of words not on the Dale list of 3000 words
2. The average sentence length.

They felt that a larger word count than Lorge's would predict as well as, or better than, Flesch's affix count. This formula, which was developed before the Flesch revision, uses the same predictors as Flesch's new Formula A, substituting a word count for the syllable count. The reliability of the Dale-Chall formula, on application, is 0.70. The reading grade equals:

The Dale score multiplied by 0.1579, plus the average sentence length multiplied by 0.0496, plus a constant, 3.6365.

^{1/}Edgar Dale and Jeanne Chall, "A Formula for Predicting Readability", Educational Research Bulletin (January, 1948), 27:11-20, 28.

CHAPTER III

APPLICATION OF THE FORMULA

Selection of the passages for analysis.-- The textbooks selected were analyzed according to the directions given by Flesch in The Art of Readable Writing.^{1/} Sample passages of 100 words were selected. To insure random selection, a passage was chosen starting with the first paragraph on every tenth page. The first sample in the book was not taken on page one, since introductory passages are not always typical.

Since the comprehension of mathematical and chemical equations is not dependent upon the factors of vocabulary and sentence structure, analysis by the Flesch formula would be meaningless. Therefore, if the first paragraph on the tenth page contained formulas or equations, the first following 100-word passage which did not contain them was used. Directions for experiments and the summaries and questions at the ends of chapters were included in the analysis. Paragraph leads (but not chapter titles) were included in the word count, but not in the sentence count. Notations under pictures, since they are not typical of the style and often not complete sentences, were omitted.

^{1/} Rudolph Flesch, The Art of Readable Writing, Harper's, New York, 1949, p. 237.

Word count.-- In counting words for the 100-word samples, contractions and hyphenated words were counted as one word. Numbers and letters were counted as one word if they were written without spaces. For example, "1948", "eg.", "H₂SO₄", "etc.", would each be counted as one word.

Syllable count.-- The number of syllables in each sample was counted. In the case of numerals and symbols, such as "1948" or "H₂SO₄", the syllables were counted as they would be read aloud. In abbreviations, syllables were counted as the word would be read in full. "Mr.", for example, would be counted as two syllables.

Sentence length.-- To determine the sentence length, the number of sentences in the passage was counted, including the sentence which ended nearest to the one hundredth word, whether it was slightly above or slightly below 100 words. The number of sentences and the number of words in those sentences were recorded.

Count of personal words.-- Personal words, as defined by Flesch, include:

1. All first, second, and third person pronouns, except the neuter pronouns "it", "its", "they", "them", and "their", if referring to things rather than people.
2. All words that have a natural masculine or feminine gender, such as "John Jones", "iceman", "actress", "father".

3. Group words, "people" (with the plural verb) and "folks".

Count of personal sentences.-- The personal sentences include:

1. Spoken sentences, with or without quotation marks
2. Questions, commands, requests, and other sentences addressed directly to the reader
3. Exclamations
4. Grammatically incomplete sentences whose full meaning must be inferred from the text.

Computation.-- Four factors are needed for the application of the formula: word length, sentence length, the per cent of personal words, and the per cent of personal sentences. These factors were obtained from the recorded data.

The number of syllables in 100 words (wl) was determined by dividing the total number of words in all samples by the number of samples.

The average sentence length in words (sl) was obtained by adding the number of sentences in all samples, and the number of words in those sentences. The total number of words was divided by the total number of sentences.

The number of personal words in 100 words (pw) was determined by adding the number of personal words in all samples, and dividing by the number of samples.

To obtain the number of personal sentences in 100 sentences (ps), the total number of personal sentences in all samples was divided by the total number of sentences in all samples, and the result multiplied by 100.

To determine the reading ease score, the following formula was used:

$$RE = 206.835 - 0.864w1 - 1.015s1$$

Using the factors of personal words and personal sentences, the human interest score was obtained from this formula:

$$HI = 3.635pw + 0.314ps$$

CHAPTER IV

READING EASE AND HUMAN INTEREST SCORES

Summary of the results of the analyses.-- The textbooks analyzed, as indicated in Chapter I, were:

- A. Paul F. Brandwein, L. G. Hollingworth, A. D. Beck, and A. E. Burgess, Science for Better Living. Harcourt Brace and Company, New York, 1950, p. 643.
- B. Morris Meister, Ralph Kirstead, and Lois Shoemaker, Science for a Better World. Charles Scribner's Sons, New York, 1952, p. 748.
- C. Newton Black and Harvey Davis, Elementary Practical Physics. MacMillan Company, New York, 1949, p. 742.
- D. Oswald H. Blackwood, W. B. Herron, and W. C. Kelley, High School Physics. Ginn and Company, Boston, 1951, p. 670.
- E. Truman J. Moon, Paul B. Mann, and James H. Otto, Modern Biology. Henry Holt and Company, New York, 1951, p. 698 and liv.
- F. George W. Hunter and F. R. Hunter, Biology in Our Lives. American Book Company, New York, 1949, p. 534.
- G. Henry C. Biddle, George L. Bush, and Horace G. Demming, Chemistry Today. Rand McNally and Company, New York, 1949, p. 718.
- H. Raymond B. Brownlee, R. W. Fuller, J. R. Whitsit, and W. J. Hancock, Elements of Chemistry. Allyn and Bacon, Boston, 1951, p. 680 and p. 28.

Tables 9 to 16 in the Appendix show the results of the analysis of the textbooks using the Flesch formula. The computation of the Flesch scores was simplified by the use of tables

developed by Farr and Jenkins.^{1/} In these tables sentence length and word length are converted directly to the reading ease score, and the personal word count and personal sentence count are converted to the human interest score.

Table 3. Summary of the Analyses of the Textbooks from Columns (2), (3), and (4), Tables 9 to 16 in the Appendix.

Book	Number of Samples	Number of Syllables	Number of Sentences	Number of Words
(1)	(2)	(3)	(4)	(5)
A...	61	9,025	410	6,121
B...	75	11,360	519	7,470
C...	72	11,181	398	7,247
D...	64	9,806	459	6,438
E...	70	11,094	440	6,944
F...	50	7,589	271	4,967
G...	70	12,075	468	7,072
H...	65	11,131	369	6,600

Science for Better Living (Book A).-- From Columns (2) and (3), Table 3, it will be seen that in the ninth grade science book, Science for Better Living, the total number of syllables in 61 samples is 9,025. This is an average of 148 syllables per hundred words. Columns (4) and (5) indicate that in 410 sentences there are 6,121 words, or an average of 15 words per sentence. Using the tables developed by Farr and Jenkins^{2/} for converting word length and sentence length to a Flesch score, this gives a reading ease score of 66.

^{1/} James N. Farr and James J. Jenkins, "Tables for Use with the Flesch Readability Formulas," Journal of Applied Psychology. (June, 1949), 33:275-278.

^{2/} Ibid.

From Columns (2) and (5) of Table 4, it is seen that there are 299 personal words in 61 samples, or an average of 5 personal words in each 100-word sample. Columns (3) and (4) indicate that 81 of the 410 sentences are personal sentences, or 20 per cent personal sentences. From Farr and Jenkins' tables, this gives a human interest score of 24.

Table 4. Summary of the Analyses of the Textbooks, from Columns (3), (5), and (6), Tables 9 to 16 in the Appendix.

Book	Number of Samples	Number of Sentences	Personal Sentences	Personal Words
(1)	(2)	(3)	(4)	(5)
A...	61	410	81	299
B...	75	519	137	156
C...	72	398	73	107
D...	64	459	123	194
E...	70	440	88	133
F...	50	271	55	175
G...	70	468	131	52
H...	65	369	62	66

Science for a Better World (Book B).-- In the ninth grade science book, Science for a Better World, the 75 samples analyzed contain a total of 11,360 syllables (see Columns (2) and (3), Table 3). This is an average of 151 syllables per hundred words. From Columns (4) and (5), there are 7,470 words in 519 sentences, or an average of 14 words per sentence. From Farr and Jenkins' tables, this gives a reading ease score of 65.

Columns (2) and (5) of Table 4 show that there are 156 personal words in 75 samples, or 2 per cent of personal words. Of the 519 sentences, 137 are personal sentences, or 26 per cent of personal sentences, giving a human interest score of 15.

Elementary Practical Physics (Book C).-- In this book, designed for use in the eleventh and twelfth grades, 72 samples were analyzed and found to contain a total of 11,181 syllables,^{1/} or an average of 155 syllables in 100 words. There are 7,247 words in 398 sentences,^{2/} or an average sentence length of 18 words. From Farr and Jenkins' tables, this gives a reading ease score of 57.

In 72 samples there are 107 personal words,^{3/} or an average of one personal word in 100 words. Of the 398 sentences analyzed, 73 were personal sentences.^{4/} Dividing 73 by 398 and multiplying the result by 100, this gives 18 per cent of personal sentences, and from the above tables, a human interest score of 9.

High School Physics (Book D).-- In the book High School Physics, the total number of syllables in 64 samples is 9,806,^{1/} or an average of 153 syllables in each sample. There are 6,438 words in the 459 sentences,^{2/} or an average sentence length of 14 words. From the tables, this gives a reading ease score of 63.

^{1/} See Table 3, Columns (2) and (3).

^{2/} See Table 3, Columns (4) and (5).

^{3/} See Table 4, Columns (2) and (5).

^{4/} See Table 4, Columns (3) and (4).

The 64 samples analyzed contain 194 personal words,^{1/} or 3 per cent of personal words. Of the 459 sentences included in the analysis, 123 are personal sentences,^{2/} or 27 per cent personal sentences. From the tables, this gives a human interest score of 19.

Modern Biology (Book E).-- The 70 samples analyzed in Modern Biology contain 11,094 syllables,^{3/} or an average of 158 syllables in 100 words. In 440 sentences, there are 6,944 words,^{4/} or an average of 16 words in a sentence. The reading ease score, from the tables, is 57.

In 70 samples there are 133 personal words,^{1/} or 2 per cent. Of the 440 sentences, 88 are personal sentences,^{2/} or 20 per cent. The human interest score, from Farr and Jenkins' tables, is 14.

Biology in Our Lives (Book F).-- In Biology in Our Lives,^{3/} 50 samples were analyzed and found to contain 7,589 syllables, or an average of 152 syllables per hundred words. Two hundred and seventy one sentences contain 4,967 words,^{4/} which gives an average sentence length of 18 words. From the tables, this gives a reading ease score of 60.

^{1/} See Table 4, Columns (2) and (5).

^{2/} See Table 4, Columns (3) and (4).

^{3/} See Table 3, Columns (2) and (3).

^{4/} See Table 3, Columns (4) and (5).

There are 175 personal words in 50 samples. $\frac{1}{100}$ This is an average of 4 personal words per hundred-word sample. Of the 271 sentences, 55 are personal sentences, $\frac{2}{100}$ or 20 per cent personal sentences. This gives a human interest score of 21.

Chemistry Today (Book G).-- The 70 samples analyzed in Chemistry Today contain a total of 12,075 syllables, $\frac{3}{100}$ or an average of 173 syllables in 100 words. The 468 sentences contain 7,072 words, $\frac{4}{100}$ or an average of 15 words to a sentence. The reading ease score, from the tables, is 45.

There are 52 personal words in 65 samples, $\frac{1}{100}$ or one per cent personal words. There were 468 sentences analyzed, of which 131 are personal sentences, $\frac{2}{100}$ or 28 per cent personal sentences. The human interest score is 12.

Elements of Chemistry (Book H).-- In the book Elements of Chemistry, there are 11,131 syllables in 65 samples, $\frac{3}{100}$ or an average of 171 syllables in a hundred words. The 369 sentences contain 6,600 words, $\frac{4}{100}$ or an average of 18 words per sentence. The reading ease score, from Farr and Jenkins' tables, is 44.

The 65 samples contain 66 personal words, $\frac{1}{100}$ or one per cent personal words. Sixty two of the 369 sentences $\frac{2}{100}$ are personal sentences, or 17 per cent personal sentences. The human interest score is 9.

1/ Table 4, Columns (2) and (5).

2/ Table 4, Columns (3) and (4).

3/ Table 3, Columns (2) and (3).

4/ Table 3, Columns (4) and (5).

Table 5. Summary of Word Length, Sentence Length, and Reading Ease.

Book	Word Length	Sentence Length	Reading Ease
(1)	(2)	(3)	(4)
A...	148	15	66
B...	151	14	65
C...	155	18	57
D...	153	14	63
E...	158	16	57
F...	152	18	60
G...	173	15	45
H...	171	18	44

Summary.-- Tables 5 and 6 summarize the results of the computation of the Flesch scores. Table 5 shows the relation between the word length and sentence length and the reading ease score for each book analyzed, and Table 6 indicates the personal words, personal sentences, and human interest scores.

Table 6. Summary of Personal Words, Personal Sentences, and Human Interest.

Book	Personal Words	Personal Sentences	Human Interest
(1)	(2)	(3)	(4)
A...	5	20	24
B...	2	26	15
C...	1	18	9
D...	3	27	10
E...	2	20	14
F...	4	20	21
G...	1	28	12
H...	1	17	9

CHAPTER V
CONCLUSIONS

Interpretation of the Flesch scores.-- Table 1 on page 13 shows the conversion of the Flesch reading ease scores to approximate reading grades, and Table 2, page 14, shows the conversion of the human interest scores to interest levels. In Table 7, the Flesch reading ease and human interest scores for the eight textbooks analyzed are tabulated and their conversion to reading grades and interest levels indicated.

Table 7. Interpretation of the Flesch Reading Ease Scores for the Eight Textbooks Analyzed.

Book	Used in Grade	Reading Ease	Grade Level
(1)	(2)	(3)	(4)
A...	9	66	8-9
B...	9	65	8-9
C...	10-12	57	10-12
D...	10-12	63	8-9
E...	10-12	57	10-12
F...	10-12	60	10-12
G...	10-12	45	college
H...	10-12	44	college

The validity of the human interest scores is somewhat questionable, since several of the passages analyzed contain lists of questions, or directions for experiments composed

largely of imperative sentences. In the Flesch analysis questions and commands are considered personal sentences, but in the above situations it is doubtful whether they add to the interest of the reading material as they would when included in the text.

Table 8. Interpretation of the Flesch Human Interest Scores for the Eight Textbooks Analyzed.

Book	Used in Grade	Human Interest	Interest Level
(1)	(2)	(3)	(4)
A...	9	24	Interesting
B...	9	15	Mildly interesting
C...	10-12	9	Dull
D...	10-12	19	Mildly interesting
E...	10-12	14	Mildly interesting
F...	10-12	21	Interesting
G...	10-12	12	Mildly interesting
H...	10-12	9	Dull

Science for Better Living (Book A).-- The reading ease score of the ninth grade science book Science for Better Living^{1/} is 66, which lies within the range (60-70) considered suitable for ninth grade reading ability. The human interest score is 24, which Flesch rates as interesting (see Table 2, page 14). It has, however, been noted above that the validity of the human interest scores is questionable.

1/ P. F. Brandwein, L. G. Hollingworth, A. D. Beck, and A. E. Burgess, Science for Better Living, Harcourt, Brace and Company, New York, 1950, p. 643.

Science for a Better World (Book B).-- The ninth grade science book Science for a Better World^{1/} has a reading ease score of 65, or a grade level of 8-9. The human interest score of 15 indicates mildly interesting material.

Elementary Practical Physics (Book C).-- The book Elementary Practical Physics,^{2/} most frequently used in the eleventh and twelfth grades, has a reading ease score of 57, which indicates a reading level suitable for high school (grades 10-12). Its human interest score is 9, which, according to Table 2, is dull.

High School Physics (Book D).-- The reading ease score for the book High School Physics^{3/} is 63, or a reading level suitable for grades eight and nine. Since physics is usually taught in the eleventh or twelfth grades, this book would be effective in teaching physics to students whose reading ability is below average.

The human interest score of 19 indicates a mildly interesting style.

Modern Biology (Book E).-- A reading ease score of 57 indicates that Modern Biology^{4/} has a reading grade level

1/ Morris Meister, Ralph Keirstead, and Lois Shoemaker, Science For a Better World, Charles Scribners' Sons, New York, 1952, p. 748.

2/ Newton Black and Harvey Davis, Elementary Practical Physics, The Macmillan Company, New York, 1949, p. 742.

3/ O. H. Blackwood, W. B. Herron, and W. C. Kelley, High School Physics. Ginn and Company, Boston, 1951, p. 670.

4/ Truman J. Moon, Paul B. Mann, and James H. Otto, Modern Biology. Henry Holt and Company, New York, 1951, p. 698.

suitable for high school (grades 10-12). Since biology is most frequently taught in the tenth and eleventh grades, this indicates a suitable level of reading difficulty. The human interest score of 14 indicates a mildly interesting style.

Biology in Our Lives (Book F).^{1/}-- The book Biology in Our Lives^{1/} has a reading ease score of 60, on the borderline between ninth and tenth grade reading levels. Its human interest score of 21 indicates an interesting style.

Chemistry Today (Book G).^{2/}-- The reading ease score of the book Chemistry Today,^{2/} commonly used in the eleventh and twelfth grades, is 45. This lies within the range (40-50) considered suitable for college (grades 13-16), and would prove difficult for even the superior high school student. Its human interest score is 12, or mildly interesting.

Elements of Chemistry (Book H).^{3/}-- The book Elements of Chemistry,^{3/} with a reading ease score of 44, also indicates a level of reading difficulty suitable for college students. Its style is dull, as indicated by a human interest score of 9.

^{1/} George W. Hunter and F. R. Hunter, Biology in Our Lives. American Book Company, 1949, p. 534.

^{2/} Harry C. Biddle, George L. Bush, and Horace G. Demming, Chemistry Today. Rand McNally and Company, New York, 1949, p. 718.

^{3/} Raymond B. Brownlee, R. W. Fuller, J. E. Whitsit, and W. J. Hancock, Elements of Chemistry. Allyn and Bacon, Boston, 1951, pp. 680 and 28.

Summary.-- From the data obtained in this study, the following conclusions may be drawn:

1. The two ninth grade science textbooks analyzed, with reading ease scores of 65 and 66, would present reading difficulties only to students of lower reading ability. The normal and superior students would find the textbooks of average difficulty.
2. Of the two physics books tested, one (Book C), with a reading ease score of 57, would cause reading difficulty only for students of below-average reading ability. Book D, with a reading ease score of 63, would be better suited to the needs of students of lower reading ability.
3. The two physics textbooks analyzed would not be too difficult for students of average reading ability or better, but would cause difficulty for the below-average students.
4. Both of the chemistry books tested, with reading ease scores suitable for college level, would prove difficult even for superior high school students.
5. With the exception of the two chemistry textbooks, none of the books analyzed would cause reading difficulty for average or superior students. Only one of the books is suited to the needs of the student of below-average reading ability.

APPENDIX

Table 9. Analysis of Science for Better Living, by P. F. Brandwein, L. G. Hollingworth, A. D. Beck, and A. E. Burgess.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences
Page	Syllables in 100 Words	No. of Sentences	No. of Words		
(1)	(2)	(3)	(4)	(5)	(6)
1. 4.....	140	6	90	21	1
2. 14.....	139	9	110	6	1
3. 24.....	133	6	106	9	5
4. 34.....	136	6	95	2	1
5. 44.....	134	2	108	3	0
6. 54.....	162	5	105	6	0
7. 64.....	157	6	112	4	0
8. 74.....	144	6	105	3	0
9. 84.....	142	9	98	3	3
10. 94.....	135	5	100	9	0
11. 104.....	133	5	104	2	0
12. 114.....	138	8	100	1	0
13. 124.....	129	8	99	5	2
13. 134.....	134	5	94	12	1
14. 144.....	128	8	102	10	4
15. 154.....	127	8	99	5	3
16. 164.....	145	4	98	3	0
17. 174.....	169	5	97	10	0
18. 184.....	169	7	101	1	1
19. 194.....	134	6	94	2	0
20. 204.....	133	6	105	6	0
21. 214.....	154	6	105	8	0
22. 224.....	156	9	98	8	3
23. 234.....	185	5	93	3	0
24. 244.....	140	8	95	5	0
25. 254.....	137	9	103	5	1
26. 264.....	122	8	98	2	0
27. 274.....	159	9	102	6	0
28. 284.....	143	9	101	4	0
29. 294.....	175	9	101	8	7
29. 294.....	175	5	105	8	1
30. 304.....	144	9	97	8	1
31. 314.....	144	9	97	1	1
31. 314.....	130	7	104	0	2
32. 324.....	147	7	97	0	5
33. 334.....	134	7	97	15	3
34. 344.....	177	7	97	2	0

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Table 9. (concluded)

Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences
(1)	(2)	(3)	(4)	(5)	(6)
35. 354.....	159	7	89	0	0
36. 364.....	143	7	101	5	1
37. 374.....	125	6	107	10	0
38. 384.....	143	6	117	7	0
39. 394.....	128	4	88	8	2
40. 404.....	147	7	107	4	0
41. 414.....	155	4	105	0	0
42. 424.....	167	12	101	3	12
43. 434.....	142	5	100	1	1
44. 444.....	169	6	98	0	0
45. 454.....	154	7	102	3	0
46. 464.....	137	7	104	11	1
47. 474.....	151	6	98	4	1
48. 484.....	169	7	95	3	2
49. 494.....	146	6	98	6	0
50. 504.....	166	7	94	1	0
51. 514.....	139	4	97	6	0
52. 524.....	134	6	97	12	0
53. 534.....	137	6	99	4	0
54. 544.....	150	8	102	4	2
55. 554.....	148	9	98	4	3
56. 564.....	142	7	106	2	0
57. 575.....	153	6	99	2	0
58. 584.....	152	8	103	4	3
59. 594.....	150	6	101	0	2
60. 604.....	125	11	101	7	6
Totals	9,025	410	6,121	299	81

Table 10. Analysis of Science for a Better World, by Morris Meister, Ralph Keirstead, and Lois M. Shoemaker.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences	
Page	Syllables in 100 Words	No. of Sentences	No. of Words			
(1)	(2)	(3)	(4)	(5)	(6)	
1.	5...	151	7	114	5	1
2.	14...	162	7	99	0	3
3.	24...	130	9	101	2	5
4.	34...	163	5	96	4	0
5.	44...	141	5	91	3	1
6.	54...	164	5	105	0	0
7.	64...	160	8	103	0	7
8.	74...	157	5	99	1	0
9.	84...	134	12	108	4	12
10.	94...	141	7	99	0	0
11.	104...	148	7	100	2	3
12.	114...	147	11	107	0	2
13.	124...	164	8	102	0	0
14.	134...	150	4	92	4	0
15.	144...	141	7	93	0	0
16.	154...	162	5	91	2	1
17.	164...	145	4	100	1	0
18.	174...	141	8	100	3	8
19.	185...	153	8	101	0	0
20.	194...	148	6	103	0	0
21.	205...	148	9	105	0	0
22.	214...	159	6	102	5	0
23.	224...	155	7	96	6	4
24.	234...	148	11	97	14	11
25.	244...	159	9	103	5	1
26.	254...	131	8	99	0	2
27.	264...	175	8	98	0	0
28.	274...	151	5	99	1	0
29.	284...	165	5	96	5	0
30.	294...	167	5	101	0	0
31.	304...	164	8	96	5	3
32.	314...	166	6	102	0	0
33.	324...	179	5	88	3	0
34.	334...	144	7	105	0	3
35.	344...	155	6	101	0	0

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Table 10. (concluded)

Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences	
(1)	(2)	(3)	(4)	(5)	(6)	
36.	354...	169	10	93	2	2
37.	364...	158	9	97	1	0
38.	374...	167	6	98	3	0
39.	384...	156	7	106	1	0
40.	394...	153	6	94	1	0
41.	404...	156	11	103	2	9
42.	415...	165	5	94	0	0
43.	424...	150	6	98	4	3
44.	434...	147	5	98	0	0
45.	444...	169	7	105	0	0
46.	454...	135	8	98	0	5
47.	464...	142	5	102	0	0
48.	474...	134	6	99	10	2
49.	484...	132	6	108	3	3
50.	494...	143	7	93	0	4
51.	504...	152	7	113	1	0
52.	514...	146	7	109	4	3
53.	524...	149	7	103	3	4
54.	534...	146	7	92	1	0
55.	544...	134	7	105	1	0
56.	554...	144	7	101	10	5
57.	566...	169	7	103	0	0
58.	574...	138	8	97	1	4
59.	585...	139	7	97	0	4
60.	594...	141	6	100	7	3
61.	604...	162	9	103	1	4
62.	614...	138	7	91	0	6
63.	624...	140	9	104	6	6
64.	634...	169	6	100	1	0
65.	644...	149	5	94	2	0
66.	654...	140	9	100	0	1
67.	665...	171	7	96	1	1
68.	674...	144	7	102	0	0
69.	684...	151	5	102	3	0
70.	694...	131	8	100	2	0
71.	704...	143	6	98	1	1
72.	714...	175	6	95	0	0
73.	724...	128	6	92	6	0
74.	734...	154	6	93	2	0
75.	744...	163	6	102	1	0
Totals	11,360	519	7,470	156	137	

Table 11. Analysis of Elementary Practical Physics, by Newton Black and Harvey Davis.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences
Page	Syllables in 100 Words	No. of Sentences	No. of Words		
(1)	(2)	(3)	(4)	(5)	(6)
1. 4...	155	6	106	5	1
2. 13...	152	9	101	3	0
3. 23...	137	7	107	8	4
4. 33...	140	5	99	3	0
5. 43...	141	4	95	3	0
6. 53...	138	5	88	3	0
7. 63...	144	6	101	0	3
8. 73...	160	7	103	2	0
9. 83...	166	6	93	0	0
10. 93...	160	3	98	1	0
11. 103...	176	6	102	0	0
12. 113...	163	5	112	0	0
13. 123...	158	6	110	0	1
14. 133...	151	6	105	0	0
15. 143...	182	8	96	3	0
16. 153...	150	5	103	2	0
17. 163...	175	8	103	0	4
18. 173...	140	4	93	0	2
19. 183...	140	4	112	0	2
20. 193...	154	5	99	0	3
21. 203...	139	7	101	2	4
22. 213...	129	4	90	6	0
23. 223...	153	6	95	0	5
24. 233...	135	7	105	4	0
25. 243...	155	5	89	1	0
26. 253...	142	12	101	2	7
27. 263...	170	4	111	1	0
28. 273...	161	4	94	0	1
29. 283...	162	6	92	0	0
30. 293...	158	4	109	1	0
31. 303...	149	6	99	2	5
32. 313...	175	8	100	0	4
33. 323...	156	6	93	0	0
34. 333...	161	5	106	2	0
35. 343...	145	3	88	0	0
36. 353...	177	7	113	3	0

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Table 11. (concluded)

Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences	
(1)	(2)	(3)	(4)	(5)	(6)	
37.	363...	175	5	101	7	0
38.	373...	138	6	96	2	0
39.	383...	160	5	100	0	0
40.	393...	151	6	99	0	0
41.	403...	148	8	100	0	6
42.	413...	161	7	105	0	0
43.	423...	163	6	107	0	0
44.	433...	167	6	99	1	0
45.	443...	189	4	106	1	0
46.	453...	144	6	103	5	1
47.	463...	130	4	94	3	0
48.	473...	158	4	103	0	0
49.	483...	168	5	104	1	0
50.	493...	152	4	94	2	0
51.	503...	142	5	107	3	0
52.	513...	152	6	114	1	0
53.	524...	142	7	99	1	5
54.	533...	141	5	106	0	0
55.	543...	151	6	110	0	0
56.	553...	134	8	91	2	6
57.	564...	154	7	104	0	6
58.	573...	145	6	96	4	1
59.	583...	182	6	107	4	0
60.	593...	142	3	125	2	0
61.	603...	160	5	103	0	0
62.	613...	173	3	107	0	0
63.	623...	154	3	94	1	0
64.	633...	153	6	101	1	0
65.	643...	159	3	93	0	2
66.	654...	170	4	100	4	0
67.	664...	179	3	85	2	0
68.	673...	135	5	95	1	0
69.	684...	148	5	94	0	0
70.	693...	205	6	99	1	0
71.	704...	155	6	101	1	0
72.	713...	152	5	93	0	0
Totals	11,181	398	7,247	107	73	

Table 12. Analysis of High School Physics, by Oswald H. Blackwood, Wilmer B. Heron, and William C. Kelley.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences	
Page	Syllables in 100 Words	No. of Sentences	No. of Words			
(1)	(2)	(3)	(4)	(5)	(6)	
1.	4.....	154	7	107	4	0
2.	14.....	128	7	99	3	1
3.	24.....	127	7	107	4	1
4.	34.....	149	9	103	0	0
5.	44.....	141	7	101	1	3
6.	55.....	135	8	95	0	4
7.	64.....	155	9	97	2	4
8.	74.....	136	8	103	6	7
9.	84.....	155	5	105	5	1
10.	94.....	140	7	96	7	1
11.	104.....	143	11	106	5	10
12.	115.....	142	7	108	3	1
13.	125.....	156	8	97	1	3
14.	134.....	155	6	93	4	0
15.	144.....	170	11	96	3	6
16.	154.....	177	9	101	1	2
17.	164.....	165	7	99	8	1
18.	175.....	161	4	96	1	1
19.	184.....	146	7	103	2	3
20.	194.....	162	9	97	1	4
21.	205.....	144	5	97	2	0
22.	214.....	126	5	92	1	4
23.	224.....	180	8	98	1	3
24.	234.....	145	6	113	5	0
25.	244.....	143	10	99	5	9
26.	254.....	150	7	109	0	5
27.	265.....	162	7	102	2	0
28.	274.....	147	7	105	0	0
29.	284.....	135	6	95	2	0
30.	294.....	158	5	108	4	0
31.	304.....	156	8	101	0	0
32.	314.....	159	8	103	11	1
33.	325.....	158	8	96	0	0
34.	334.....	153	8	95	6	0
35.	345.....	148	6	102	0	3

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Table 12. (concluded)

	Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences
	(1)	(2)	(3)	(4)	(5)	(6)
36.	354.....	154	8	99	0	4
37.	364.....	150	7	114	3	0
38.	374.....	170	6	84	2	1
39.	384.....	144	9	101	2	1
40.	394.....	139	7	101	1	4
41.	404.....	164	6	98	1	0
42.	414.....	156	7	93	4	2
43.	424.....	168	6	105	8	1
44.	434.....	180	8	99	1	1
45.	444.....	160	8	108	1	1
46.	454.....	129	5	99	2	1
47.	464.....	143	6	120	2	0
48.	474.....	195	9	93	0	3
49.	484.....	157	7	99	0	0
50.	494.....	165	5	99	3	0
51.	504.....	164	7	100	3	5
52.	514.....	152	6	104	2	0
53.	524.....	156	8	106	1	3
54.	534.....	136	8	106	3	1
55.	544.....	160	7	103	1	0
56.	554.....	140	5	98	1	1
57.	564.....	164	6	102	8	0
58.	574.....	154	13	98	9	12
59.	584.....	157	5	95	4	2
60.	594.....	160	8	105	4	0
61.	604.....	168	5	91	7	1
62.	614.....	150	7	101	2	0
63.	624.....	168	9	100	12	1
64.	634.....	142	4	93	9	0
	Totals	9,806	459	6,438	194	123

Table 13. Analysis of Modern Biology, by Truman J. Moon, Paul B. Mann, and James H. Otto.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences
Page	Syllables in 100 Words	No. of Sentences	No. of Words		
(1)	(2)	(3)	(4)	(5)	(6)
1. 4.....	162	7	93	3	0
2. 14.....	149	7	111	1	1
3. 24.....	149	6	92	4	6
4. 34.....	147	7	96	0	0
5. 44.....	164	6	97	4	0
6. 54.....	168	5	87	3	0
7. 64.....	151	6	96	10	3
8. 74.....	183	7	95	8	1
9. 84.....	145	7	104	0	2
10. 94.....	137	5	109	2	0
11. 104.....	152	6	95	2	2
12. 114.....	176	4	92	0	0
13. 124.....	157	8	106	0	8
14. 134.....	150	10	102	0	10
15. 144.....	141	6	96	4	0
16. 154.....	150	6	104	0	0
17. 164.....	159	5	95	1	0
18. 174.....	157	5	87	0	0
19. 184.....	158	6	102	0	0
20. 194.....	161	7	104	0	7
21. 204.....	153	6	105	2	0
22. 214.....	148	8	101	2	0
23. 224.....	169	6	92	0	0
24. 234.....	148	5	95	0	0
25. 244.....	170	8	100	0	0
26. 254.....	162	6	107	0	0
27. 264.....	180	9	102	1	9
28. 274.....	156	7	101	0	0
29. 284.....	162	5	113	0	0
30. 294.....	144	5	90	3	1
31. 304.....	156	7	93	0	0
32. 314.....	169	7	106	0	0
33. 324.....	143	5	99	3	5
34. 336.....	169	7	110	7	0
35. 344.....	156	5	95	0	0

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Table 13. (concluded)

Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences
(1)	(2)	(3)	(4)	(5)	(6)
36.	354.....	5	86	0	0
37.	364.....	5	97	0	0
38.	375.....	6	95	0	0
39.	384.....	5	106	0	0
40.	394.....	6	90	0	0
41.	404.....	4	91	0	0
42.	415.....	6	94	0	0
43.	426.....	6	102	6	0
44.	434.....	8	105	0	8
45.	444.....	9	105	2	8
46.	454.....	7	105	0	0
47.	464.....	8	105	3	0
48.	474.....	7	105	1	0
49.	484.....	6	89	5	0
50.	494.....	6	98	2	0
51.	504.....	7	94	1	0
52.	514.....	5	102	7	0
53.	524.....	9	101	0	0
54.	534.....	7	97	6	0
55.	544.....	6	109	6	0
56.	554.....	3	93	1	0
57.	564.....	5	92	15	0
58.	574.....	6	103	0	0
59.	584.....	5	101	0	0
60.	594.....	7	111	1	0
61.	604.....	10	105	10	8
62.	614.....	4	91	2	0
63.	624.....	5	90	0	0
64.	634.....	7	101	0	0
65.	644.....	6	108	2	0
66.	654.....	6	101	1	0
67.	664	5	92	1	0
68.	674.....	7	101	0	0
69.	684.....	9	103	1	9
70.	694.....	5	104	0	0
Totals	11,094	440	6,944	133	88

Table 14. Analysis of Biology in Our Lives, by George Hunter and F. R. Hunter.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences	
	Page	Syllables in 100 Words	No. of Sentences	No. of Words		
(1)	(2)	(3)	(4)	(5)	(6)	
1.	4.....	157	6	105	4	1
2.	14.....	140	5	91	11	1
3.	24.....	144	8	94	7	7
4.	34.....	133	5	95	7	0
5.	44.....	148	5	102	1	1
6.	54.....	150	8	100	1	2
7.	64.....	144	7	96	0	7
8.	74.....	121	5	97	3	0
9.	84.....	147	4	116	0	0
10.	94.....	146	5	100	5	5
11.	104.....	154	6	93	3	0
12.	114.....	166	5	112	3	0
13.	124.....	139	5	99	3	0
14.	134.....	151	5	97	0	0
15.	144.....	157	5	106	3	0
16.	154.....	151	5	107	2	0
17.	164.....	155	6	98	0	1
18.	174.....	141	5	96	1	0
19.	184.....	144	5	106	7	2
20.	194.....	151	6	98	1	0
21.	204.....	167	6	92	0	0
22.	217.....	147	6	91	3	0
23.	224.....	140	4	90	1	0
24.	234.....	152	5	95	7	1
25.	244.....	190	6	95	0	0
26.	254.....	169	5	98	0	0
27.	264.....	148	5	92	0	0
28.	274.....	136	6	94	15	2
29.	284.....	152	4	93	0	0
30.	294.....	172	5	107	0	0
31.	304.....	163	6	94	3	0
32.	315.....	153	5	113	3	0
33.	324.....	151	5	108	6	4

(concluded on next page)

Table 14. (concluded)

Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences
(1)	(2)	(3)	(4)	(5)	(6)
34. 334....	135	5	110	5	1
35. 344....	133	5	113	1	0
36. 354....	156	3	94	3	0
37. 364....	153	7	102	2	6
38. 374....	152	7	103	0	0
39. 384....	161	7	110	0	0
40. 394....	174	8	103	0	4
41. 404....	156	7	108	5	6
42. 414....	172	5	95	0	0
43. 424....	168	3	90	12	0
44. 434....	153	3	97	7	0
45. 444....	174	4	98	0	0
46. 455....	131	6	90	14	2
47. 464....	134	6	95	4	0
48. 474....	152	5	87	9	0
49. 484....	153	5	95	1	0
50. 494....	153	6	107	4	2
Totals	7,589	271	4,967	175	55

Table 15. Analysis of Chemistry Today, by Harry C. Biddle, George L. Bush, and Horace G. Demming.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences
Page	Syllables in 100 Words	No. of Sentences	No. of Words		
(1)	(2)	(3)	(4)	(5)	(6)
1. 4.....	158	3	93	2	0
2. 14.....	179	5	101	1	0
3. 24.....	171	6	107	1	0
4. 34.....	160	4	102	8	0
5. 44.....	181	6	105	5	0
6. 54.....	177	4	91	0	0
7. 65.....	200	10	105	0	0
8. 74.....	165	6	97	0	0
9. 84.....	144	6	99	5	2
10. 94.....	172	7	103	1	0
11. 104.....	154	8	106	0	0
12. 114.....	180	5	81	0	0
13. 124.....	160	5	98	5	2
14. 134.....	165	6	94	0	0
15. 146.....	157	6	101	0	0
16. 154.....	171	10	98	0	8
17. 164.....	186	6	104	1	0
18. 194.....	164	7	97	2	7
19. 186.....	170	5	100	1	1
20. 194.....	177	4	90	2	1
21. 204.....	182	6	101	1	0
22. 214.....	170	7	112	0	0
23. 224.....	215	9	100	0	0
24. 235.....	176	5	94	0	1
25. 244.....	179	5	103	1	0
26. 254.....	181	5	114	0	0
27. 264.....	182	7	100	0	0
28. 276.....	147	6	109	1	0
29. 285.....	155	5	95	0	0
30. 294.....	178	7	106	0	0
31. 304.....	175	6	95	0	0
32. 314.....	188	6	109	0	0
33. 324.....	161	7	100	0	6
34. 334.....	196	8	95	0	5
35. 344.....	169	6	108	0	0
36. 354.....	138	10	105	0	4
37. 366.....	177	7	105	0	0
38. 374.....	160	9	107	0	7
39. 384.....	198	6	97	0	0
40. 396.....	160	5	96	0	0

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Table 15. (concluded)

	Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences
41.	404.....	154	8	100	0	0
42.	414.....	162	8	106	0	5
43.	424.....	172	6	93	0	2
44.	434.....	155	7	106	0	7
45.	444.....	172	4	102	0	4
46.	454.....	162	6	113	0	0
47.	464.....	163	6	107	0	0
48.	474.....	150	13	99	0	13
49.	484.....	178	6	106	0	0
50.	494.....	158	5	114	2	0
51.	504.....	202	7	101	2	1
52.	516.....	174	7	96	2	0
53.	524.....	169	8	96	0	0
54.	534.....	191	7	99	0	0
55.	544.....	165	6	112	2	0
56.	554.....	163	12	98	0	12
57.	564.....	172	8	99	0	8
58.	576.....	198	9	96	0	5
59.	584.....	186	4	101	0	0
60.	594.....	145	10	101	0	10
61.	604.....	191	6	97	0	0
62.	614.....	170	5	111	0	0
63.	624.....	189	7	111	1	0
64.	634.....	183	9	99	1	6
65.	644.....	192	5	101	0	0
66.	654.....	165	8	102	0	0
67.	664.....	168	9	102	5	6
68.	674.....	162	7	95	0	0
69.	684.....	193	7	93	0	0
70.	694.....	175	7	93	0	0
	Totals	12,057	468	7,072	52	131

Table 16. Analysis of Elements of Chemistry, by R. B. Brownlee, R. W. Fuller, J. E. Whitsit, W. J. Hancock, and M. D. Schon.

Sample	Word Length	Sentence Length		Personal Words	Personal Sentences
Page	Syllables in 100 Words	No. of Sentences	No. of Words		
(1)	(2)	(3)	(4)	(5)	(6)
1.	4.....	6	99	7	0
2.	14.....	7	104	0	0
3.	24.....	8	121	0	0
4.	34.....	6	102	0	0
5.	44.....	3	101	5	0
6.	54.....	5	96	5	0
7.	64.....	4	107	4	0
8.	74.....	5	97	0	0
9.	84.....	5	99	4	0
10.	94.....	4	83	0	0
11.	104.....	8	109	0	6
12.	114.....	6	101	0	0
13.	124.....	6	106	3	1
14.	134.....	6	110	3	0
15.	144.....	5	93	0	0
16.	154.....	7	98	1	0
17.	164.....	5	102	0	0
18.	174.....	10	102	0	0
19.	184.....	5	101	0	0
20.	194.....	9	96	0	7
21.	204.....	7	98	0	6
22.	214.....	7	104	0	0
23.	224.....	4	96	2	0
24.	234.....	5	96	0	0
25.	244.....	10	101	0	10
26.	254.....	4	96	0	0
27.	264.....	7	95	0	0
28.	274.....	5	99	0	0
29.	284.....	9	102	0	3
30.	294.....	3	104	0	0
31.	306.....	4	96	0	0
32.	314.....	3	82	1	0
33.	324.....	4	101	0	0
34.	334.....	5	106	1	1
35.	345.....	4	117	1	1

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Table 16. (concluded)

Page	Syllables in 100 Words	No. of Sentences	No. of Words	Personal Words	Personal Sentences
(1)	(2)	(3)	(4)	(5)	(6)
36.	354....	5	125	9	0
37.	364....	5	101	0	0
38.	374....	5	104	1	0
39.	384....	4	93	2	0
40.	394....	6	106	0	0
41.	404....	6	98	1	0
42.	414....	5	118	3	0
43.	424....	6	98	4	0
44.	435....	6	109	0	0
45.	444....	5	108	4	0
46.	455....	6	106	0	0
47.	464....	9	99	1	7
48.	474....	5	96	0	0
49.	484....	5	110	0	0
50.	495....	6	97	1	0
51.	504....	3	107	0	0
52.	514....	7	93	1	0
53.	524....	4	94	0	0
54.	535....	5	110	0	0
55.	544....	6	103	0	0
56.	554....	4	91	0	0
57.	564....	8	103	0	8
58.	574....	6	107	0	0
59.	584....	5	92	1	0
60.	594....	5	97	0	0
61.	604....	6	101	0	0
62.	614....	10	97	0	10
63.	625....	5	99	0	0
64.	634....	4	114	1	2
65.	644....	6	104	0	0
Totals	11,131	369	6,600	66	62

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