Studies of Melody in English Speech.

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With 11 figures in text.

The term »melody« is used here to indicate the rise and fall in pitch of the tone from the vocal cords during spoken words, just as during singing.

The discussions of the melody of speech by linguistic writers have been summarized by Storm[1]). The use of melody as a factor of expression in speech has been treated by Wundt[2]). Very little experimental work, however, has been done.

Attempts have been made to determine the melody by merely listening to phrases. This method is unreliable for several reasons: 1) the speech sounds are generally so brief that the pitch can hardly be detected for a single one; 2) each speech sound comprises many tones and the ear gets a total impression of pitch that is usually different from the lowest tone; 3) the pitch of a vowel is nearly always continually changing and the ear fails to get more than a vague impression of a sort of average pitch or of a succession of steps in pitch. In spite of the careful studies of speech-melody by the ear alone we can rely only on experimental records of the actual voice vibrations.

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1) Storm, Englische Philologie. 2. Aufl. I. p. 205. Leipzig 1892.
2) Wundt, Völkerpsychologie. I. Bd. 2. Th. p. 397. Leipzig 1900.

The experiments of Martens[1]) included a number of German phrases, such as »Vater und Mutter«, »Der Donner rollt«, »Lauf, mein Kind«, etc. The words were spoken into Hensen's phonautograph, and the record on the smoked surface was studied and measured. Schwann and Pringsheim[2]) used a Scott phonautograph to record French words and phrases. With Hensen's phonautograph Pipping[3]) has studied the melody curves of a number of isolated Finnish words. The variations in pitch in German vowels spoken singly into a phonograph and measured by aid of a corneal microscope have been studied by Meyer[4]). Using a laryngeal vibrator and a magnetic marker Rousselot[5]) obtained records that enabled him to give the average pitch of many French vowels. Vietor[6]) has used a Marey tambour to record the vibrations of the voice as it issues from the mouth; he gives results for the word »du« spoken with different expressions. Marichelle[7]) used a phonograph to record various French phrases; his curves of melody, however, seem to have been drawn to represent the impression on his ear and not to have been plotted from measurements. The melody in several examples of I, eye, die, thy, fly, etc. has been determined by measurements of a gramophone record[8]).

In attempting more extensive investigations of the melody of speech I have used two methods.

One method consisted in tracing off the curves of a gramophone plate on to a band of smoked paper in such a way that it could be accurately measured; a full description of this method is given

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1) Martens, Ueber das Verhalten von Vocalen und Diphthongen in gesprochenen Worten. Ztschr. f. Biol. 1889. XXV. p. 297.

2) Schwann und Pringsheim, Der französische Accent. Archiv für das Studium der neueren Spr. u. Lit. 1890. LXXXV. p. 203.

3) Pipping, Zur Phonetik der finnischen Sprache, Untersuchung mit Hensen's Sprachzeichner. Mém. de la Soc. finno-ougrienne. XIV. Helsingfors 1899.

4) Meyer, Zur Tonbewegung des Vocals im gesprochenen und gesungenen Einzelwort. Neuere Sprachen. 1897. IV. Phonet. Stud. 1.

5) Rousselot, Les modifications phonétiques du langage, 40. Rev. des pat. gallo-rom. 1890. IV.

6) Vietor, Elemente der Phonetik. 4. Aufl. p. 293. Leipzig 1898.

7) Marichelle, La parole d'après le tracé du phonographe. Paris 1897.

8) Scripture, Researches in experimental phonetics (first series), Stud. Yale Psych. Lab. 1899. VII. 1.

elsewhere[1]). Of the records obtained in this way only one set has been studied, namely, »Rip Van Winkle's Toast« spoken by the famous actor, Joseph Jefferson[2]).

The other method consisted in speaking into a mouth piece connected with a Marey tambour. The tambour was a very small one with a lever of very light French straw, according to the new model suggested by Rousselot and made by Charles Verdin (Paris). The records were made on a Verdin drum at its fastest speed. A time-line was drawn on the drum just before and just after each phrase (or pair of phrases); this precaution was, however, hardly necessary, as the drum was found to be constant to the ten-thousandth of a second during each set of experiments. The tambour was tested by singing tones of different pitch into it; it was found to respond properly. The records were made in the laboratory of experimental phonetics at the Collège de France (Paris); the apparatus was kindly placed at my service by the director, the Abbé Rousselot.

The curves were measured under a magnifying glass by a ruler divided into half-millimeters, the tenths being estimated by the eye. Owing to the roundness of many curves it was often impossible to decide which tenth to select to indicate the extreme point. Other small variations were introduced by the resonance tones in the vowels; in such cases the wave-lengths were sometimes measured from top to top as well as from bottom to bottom. The wave-lengths in millimeters were turned into time by multiplying by the coefficient obtained from the time-line; the results gave the period of each wave in the cord tone. The frequencies were found by taking the reciprocals of the periods. The results were tabulated and plotted. When the voice fluctuates greatly, or when voices of different pitch are to be compared, it is necessary to use the more accurate method of supposing the speech curve to be laid along the X-axis and the ordinates of frequency to be erected at the beginning of each wave[3]).

1) Scripture, The Elements of Experimental Phonetics. p. 52. New York 1902; also in Researches in experimental phonetics (second series). Stud. Yale Psych. Lab. 1902. X. 50.

2) Scripture, Elements, as before, p. 479; Studies, as before.

3) Scripture, Speech Curves, I. Mod. Lang. Notes, 1901, p. 71. The Elements of Experimental Phonetics, p. 61. New York 1902.

When the voice fluctuates little, there is no noticeable gain in using this latter — very laborious — method. In the original plots in the present case the scale was so selected that distance along the X-axis approximated on the average the horizontal length of the speech tracing; in the printed illustrations this is reduced to one-fifth. The units along the X-axis indicate the serial numbers of the succesive vibrations: first, second, third, etc. In the cases of surds or of sonants with no recorded vibrations a space was left in the plot which was equal to the length of the sound in the original record.

The records were made by the voice of the author, who is of New England birth and parentage (Mason, N. H., U. S. A.) from families of the early English settlers, but whose typical New England pronunciation was modified during a childhood passed in New York City. The phrases spoken were mainly those given by Sweet in his discussion of intonation in English[1]).

The phonetic notation employed here probably needs no explanation; aside from some minor peculiarities (which will be explained as they occur) the symbols are those in common use in phonetics. In the Figures and the Table the phonetic symbol is placed at the beginning of each sound. When two letters occur together, it has been found impossible to assign any limit between the sounds. In connected speech the sounds rarely have any well defined limits; one sound changes more or less gradually to another and any precisely assigned limit must be more or less arbitrary[2]).

In the records of Jefferson's voice[3]) the declarative sentence was found to be regularly of circumflex pitch, that is, the pitch rose during the first part and fell during the last. This fundamental form showed variations in the amount of change, in the position of the highest point, in the general height of pitch, etc., to express various modulations of thought. In commands, questions, exclamations, etc., the fundamental form was modified to a degree increasing with the departure from the simple declarative form. The following cases show variations from the declarative form.

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1) Sweet, New English Grammar. II. p. 39. London 1898.
2) Scripture, Elements, as before, p. 446.
3) Scripture, Elements, as before, p. 479; Studies, as before.

In the record of the general interrogative sentence »Did you see him?« the curve of pitch (Fig. 1) rises from beginning to end with considerable steadiness. The amount of rise is considerably less than an octave; it does not seem to coincide with with any musical interval. The record did not give the vibrations for the first [*d*]. There was no

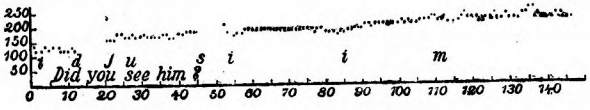

Fig. 1.

interruption of the vibrations during the record for »see'im«; apparently no [*h*] was present in »him«; or, if present, it must have been a sonant [*h*]. This presence of a sonant [*h*] instead of a surd one between two vowels has lately been found to be frequent.

The record of the general interrogative sentence »Is he here?« (Fig. 2) showed an even cord tone of moderately high pitch during

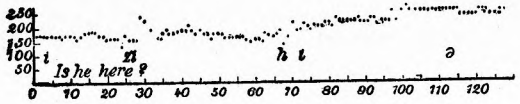

Fig. 2.

the words »Is he«, and a steady rise during the [*i*] of »here« to a tone maintained throughout the [*ə*] at the end. The relation of the tone at the beginning to that at the end was exactly 7 : 8. The [*h*] seems to have been very faint or entirely lacking; the last sound was the indefinite vowel [*ə*] commonly used in English for »*r*«.

It is well known that in general interrogative sentences there is a rise of pitch. The first of the preceding cases indicates that the rise may be a gradual one from beginning to end. The second indicates that it may consist in a change from a lower constant tone to a higher one through a more or less rapid slide.

The record of the special interrogative sentence »Where is he?« gave the curve of frequency shown in Fig. 3. There is a steady

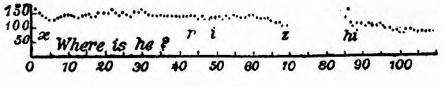

Fig. 3.

fall of pitch of exactly an octave between the beginning and the end. There seems to be a mere trace of the usual circumflexion in an emphatic word at the beginning. The first sounds of »where« do not appear in the record. The record of the vowel [æ] ends in some vibrations that seem to indicate an attempt at [r] instead of the indefinite vowel [ə].

The special interrogative sentence »Where did you see him?« with the emphatic word at the beginning shows (Fig. 4) a circumflex rise

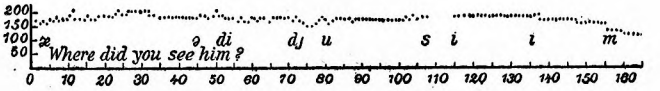

Fig. 4.

for the initial emphatic word, a tone of almost constant pitch thereafter, and a fall at the end. The general form is the same as that of the declarative sentence. The rise and fall do not occur by any simple musical intervals.

The record of the general interrogative sentence with a tag »Did you see him, John?« shows (Fig. 5) a rise in pitch from the begin-

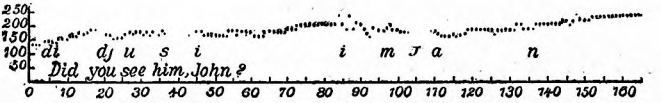

Fig. 5.

ning to the end of the interrogation at »him«, as usual. The tag »John« begins somewhat lower than the end of »him«; it rises as a single interrogative word would, but it starts higher. The whole sentence, including the tag, shows the usual rise of pitch for the general interrogative sentence.

In making the record of »What! what did you say«? the first word was used to express surprise. Such a phrase would be used, for example, by a person to whom a piece of startling news was brought.

The curve of pitch for »What«! (Fig. 6) is of the circumflex form usual in isolated words[1]). The pitch is, however, in general very

1) Meyer, as before; Scripture, Elements, as before, p. 478.

high for the author's voice, and the change is considerable. The highest point is almost exactly an octave above the beginning. In

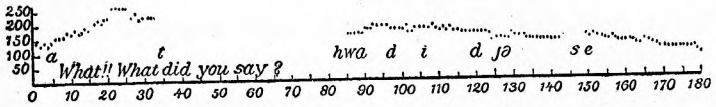

Fig. 6.

general the word shows a rise of pitch. The exclamation was followed by a pause of about one third of a second.

The special interrogative portion »What did you say?« shows (Fig. 6) a general fall with a circumflexion of pitch for the initial emphatic word as in the previous cases (Figs. 3 and 4). The interval between the highest and lowest points is an octave. The vowel of »what« is supposed to resemble [*a*]. The »t« of »what« became in this case fused with the »d« of »did«. The word »you« was pronounced as usual in fluent speech, namely, as the liquid [*j*] followed by the indefinite vowel [*ə*]. The [*e*] of »say« was diphthongized as usual toward [*ei*].

The record for the exclamation of surprise, »Good heavens!« shows (Fig. 7) for »Good« almost exactly the same course of pitch as

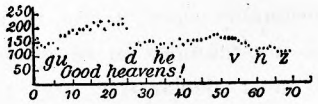

Fig. 7.

that for »What!« (Fig. 6). The word »heavens« seems to share very little in the rise of pitch. When the first and last portions of the phrase are compared roughly as wholes, there is a fall in pitch. This peculiar high circumflex pitch of the initial word »Good« is noteworthy.

The record of the exclamation »How well he looks!« gives a circumflex curve of pitch (Fig. 8), with a sudden rise during the

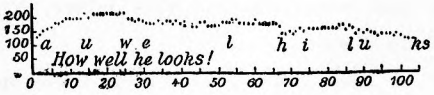

Fig. 8.

word »How«, a constant tone during »well«, and a gradual fall at the end. It is the typical curve of a declarative sentence with the point of emphasis at the beginning.

Sweet states that in single words used to express surprise there is a steady rise in pitch, but that in groups and sentences there is a fall. According to the records just given these apparently different cases are really the same. For single words there is a circumflex rise — that is, a long rise and a small fall; for phrases there is the same circumflex rise for the emphatic word at the beginning, followed by a gradual fall for the rest of the phrase.

The sentence »I've done all I can« was spoken with an expression of resignation, as if everything had been done to avoid an unpleasant result, but in vain; the emphasis was on »all«. The first words »I've done« show a constant pitch (Fig. 9). They thus contribute

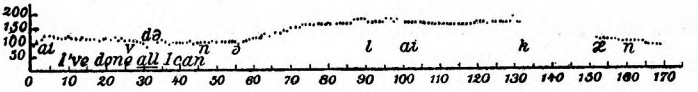

Fig. 9.

to the expression by their monotony; in an ordinary narrative sentence they would presumably show a rise in pitch. The remainder of the sentence shows a circumflexion of pitch. This circumflexion differs from that of most declarative and emphatic sentences in having a slow rise with a rather quick fall. The lowest and highest parts have approximately the relation of 4 to 7 in pitch. The lengthening of the vowel in »all« probably also contributes to the expression.

The sentence just discussed was suggested by Sweet's statement that a sentence like »I've done all I can« spoken appealingly to mean »I've done all I can, have n't I?« would have a rise of pitch at the end. I find it quite impossible to speak the sentence »I've done all I can« naturally with a rising pitch at the end except as an expression of irritation and remonstrance; this latter expression seems to be that intended by Sweet.

The sentence »I wish you'd let me alone« was spoken with an expression of irritation and remonstrance. The emphasis lay on »wish«

and »alone«. The word »wish« shows (Fig. 10) the usual circumflex pitch of an emphatic word, while »alone« shows a riseof pitch. The

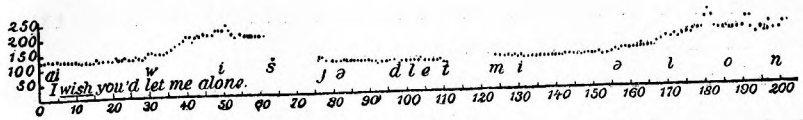

Fig. 10.

voice begins at a slightly higher pitch than usual, rises through an interval of 4 : 5, falls about an octave, and rises about 3 : 5 at the end. The expressiveness seems to depend on the peculiar musical intonation in connection with the greater stress (intensity) at the time of the first elevation in pitch. The same modulation of pitch without the stress at the first elevation occurs in expressions of resigned agreement or reluctant consent, as in »I suppose you can« with some such meaning as »I wish you couldn't do it but I suppose you can«; this phrase when uttered with stress on »suppose« expresses irritation as in the case just discussed.

The sentence »Will you do as you're told!« was spoken to express remonstrance, pleading and command, the stress being on »Will«. It begins at a rather high pitch (Fig. 11), rises through an interval

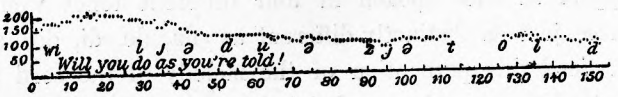

Fig. 11.

of about a major third, and then slowly falls to the end. Sweet is correct in stating that such sentences have a falling pitch, but this is so only because they begin higher than the usual declarative sentences.

All of the preceding records, as well as the Jefferson records mentioned above, show that Aristoxenus[1]) was correct in asserting that in speech, as contrasted with song, the voice is constantly and continuously changing in pitch. The changes are so gradual and so

1) Aristoxenus, Harmoniça, I. §§ 25, 28, p. 8, Meib.

complicated that any attempt to represent the melody of speech by musical notation is thoroughly misleading not only because for each note some one point in the changing pitch must be arbitrarily selected, but also because the most essential characteristics of the expression lie in the form of the change itself.

All these records and also the Jefferson ones show that the changes in pitch are not very great. This has been supposed to be a characteristic of American English as contrasted with Southern British English, but until experimental records have been made of the latter it is impossible to state exactly in what the greater modulation consists.

Further investigations of the melody of speech are highly desirable for the purposes of psychology, phonetics and oratory. In ordinary speech the cord tone — as well as the other tones — rises and falls without any conscious intention on the part of the speaker; it is one of the factors of phonetic expression which has been acquired in learning the language. Changes in the cord tone are used in some languages as a means of distinction among sounds just as explosions, cavity tones, etc. are used in most languages to make different consonants and vowels. The Chinese »tones« are variations in the cord tone that seem quite analogous to the variations in the cavity tones which we use to produce different vowels. The words that to us would appear as »do« spoken in four different tones would be for the Chinese just as distinctly different as »da, de, di, do« are to us. I have noticed this perception of the melody of the cord tone as a component of the speech sound in the case of an infant who for a while used the intonations and modulations of words as they were first learned. In most European languages the cord tone, however, is generally separated from the other factors of the word and is reserved to express emotion; thus, »father`« (with fall), »father´« (with rise), »ˆfather« (with rise and fall), »ˇfather« (with fall and rise), »father$_{\circ}$« (whispered), etc. all refer to the same person but with the addition of an expression of calling, warning etc. $_{\partial}$ We have thus in the melody of speech a partial record of the emotional expression of the speaker.

Table of Measurements.

1. Did you see him?

Sound: ..... *i* .....
Period [or duration] in 0.0001 s: 75 78 81 73 78 73 75 78 78 78 75 78
Frequency: 133 127 123 137 127 137 133 127 127 127 133 127

d .... *j* ..... *u* .....
611... 64 64 67 59 59 62 62 59 62 62 59 62 62 62 62 59 59
154 154 148 168 168 161 161 168 161 161 168 161 161 161 161 168 168

..... *s* ..... *i* .....
62 62 59 59 56 56 56 56 [567...] 48 56 59 56 56 54 54 54 54
161 161 168 168 176 176 176 476 205 176 168 176 176 185 185 185 185

.....
54 54 54 56 54 54 54 54 54 54 54 54 54 54 54 56 54 54 56
185 185 185 176 185 185 185 185 185 185 185 185 185 185 185 176 185 185 176

..... *i* .....
56 56 59 56 56 54 54 54 51 51 51 48 48 51 48 48 48 48 51
176 176 168 176 176 185 185 185 194 194 194 205 205 194 205 205 205 205 194

..... *m* .....
48 48 45 48 45 48 48 45 45 45 43 43 45 45 43 48 48 45 43
205 205 217 205 217 205 505 217 217 217 231 231 217 217 231 205 205 217 231

.....
40 43 43 43 45 45 43 43 40 43 43 43 40 40 37 37 43 40 43
246 231 231 231 217 217 231 231 246 231 231 231 246 246 264 264 231 246 231

.....
43 43 40 40 43 43 43
231 231 246 246 231 231 231

2. Is he here?

Sound: ..... *i* .....
Period in 0.0001 s: 57 57 57 57 57 57 60 57 57 57 60 57 54 54 54
Frequency: 175 175 175 175 175 175 166 175 175 175 166 175 185 185 185

..... *z* ..... *i* .....
54 57 57 60 60 60 60 69 57 60 60 60 42 45 69 51 60 60 54
185 175 175 166 166 166 166 144 175 166 166 166 238 222 144 196 166 166 185

.....
51 54 54 51 51 51 48 51 54 51 54 54 57 54 54 54 57 57 57
196 185 185 196 196 196 208 196 185 196 185 185 175 185 185 185 175 175 175

														h				*i*
57	57	57	63	66	60	60	63	54	57	60	57	51	72	60	45	54	51	45
175	175	175	158	151	166	166	158	185	175	166	175	196	138	166	222	185	196	222
48	51	48	48	48	45	45	48	45	42	45	45	45	45	45	42	45	45	45
208	196	208	208	208	222	222	208	222	238	222	222	222	222	222	238	222	222	222
42	42	45	42	42	42	39	42	39	36	39	42	39	39	39	39	39	39	39
238	238	222	238	238	238	256	238	256	217	256	238	256	256	256	256	256	256	256
39	39	39	39	39	42	42	42	42	42	39	39	39	42	42	42	39	39	
256	256	256	256	256	238	238	238	238	238	256	256	256	238	238	238	256	256	

3. Where is he?

Sound:									*æ*									
Period in 0.0001 s:	63	66	72	72	81	81	75	75	72	69	72	69	75	69	66			
Frequency:	158	151	138	138	123	123	133	133	138	144	138	144	133	144	151			
75	72	66	72	66	66	63	66	69	66	69	72	66	66	63	66	69	69	69
133	138	151	138	151	151	158	151	144	151	144	138	151	151	158	151	144	144	144
										r				*i*				
69	72	72	72	72	72	72	72	72	69	81	78	81	81	78	78	81	78	81
144	138	138	138	138	138	138	138	138	144	123	128	123	123	128	128	123	128	123
																	z	
75	75	78	78	78	75	75	81	81	81	81	84	87	87	93	93	[1170...]		
133	133	128	128	128	133	133	123	123	123	123	129	114	114	107	107			
hi																		
84	63	96	99	93	96	99	93	99	102	93	105	99	108	105	111	114	114	111
119	158	104	101	107	104	101	107	101	98	107	95	101	92	95	90	87	87	90
117	117	117	117	117	120													
85	85	85	85	85	83													

4. Where did you see him?

Sound:									*æ*									
Period [or duration] in 0.0001 s:	62	64	62	64	59	59	56	59	59	56	54	56						
Frequency:	161	154	161	154	168	168	176	168	168	176	185	176						
48	56	56	54	56	56	54	54	54	54	51	48	51	51	48	48	48	48	48
205	176	176	185	176	176	185	185	185	185	194	205	194	194	205	205	205	205	205

													ə				d	
48	51	51	54	54	54	54	54	54	54	54	54	54	51	51	54	51	[83...]	
205	194	194	185	185	185	185	185	185	185	185	185	185	194	194	185	194		
i																		
48	51	51	54	54	54	56	54	56	56	54	54	56	54	54	54	54	54	54
205	194	194	185	185	185	176	185	176	176	185	185	176	185	188	185	185	185	185
			d		ɟ						u							
56	54	56	[149...]		65	65	64	59	56	62	59	56	56	56	56	62	56	56
176	185	176			152	152	154	168	176	161	168	176	176	176	176	161	176	176
56	56	56	56	56	56	56	56	56	56	56	56	56	54	56	51	56	54	54
176	176	176	176	176	176	176	176	176	176	176	176	176	185	176	194	176	185	185
s		i																
[581...]		54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
		185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185
					i													
54	54	54	54	54	59	59	59	59	59	59	59	59	59	59	62	62	62	62
185	185	185	185	185	168	168	168	168	168	168	168	168	168	168	161	161	161	161
					m													
62	62	62	62	70	70	70	70	75	81	81	81	81						
161	161	161	161	142	142	142	142	133	123	123	123	123						

5. Did you see him, John?

Sound:								di										
Period [or duration] in 0.0001 s:								75	75	75	70	70	70	70	67	67	67	64	64
Frequency:								133	133	133	142	142	142	142	148	148	148	154	154
							d		ɟ					u				
64	59	59	56	54	54	[270...]		59	59	62	62	62	59	56	59	56	59	56
154	168	168	175	185	185			168	168	161	161	161	168	176	168	176	168	176
						s		i										
59	56	59	56	59	[405...]			59	54	54	56	56	56	56	56	56	56	54	54
168	176	168	176	168				168	185	185	176	176	176	176	176	176	176	185	185
54	56	54	54	54	56	56	56	54	54	54	54	54	54	51	51	51	48	48
185	176	185	185	185	176	176	176	185	185	185	185	185	185	194	197	197	205	205
											i							
48	48	48	48	48	48	48	48	48	43	48	54	43	51	45	48	54	35	62
205	205	205	205	205	205	205	205	205	231	205	185	231	194	217	205	185	284	161

..... *m* ..... *J* ..... *a* .....
51 54 54 51 48 51 51 54 54 54 [405...] 54 54 56 59 59 59 56
194 185 185 194 205 194 194 185 185 185 185 185 176 168 168 168 176

.....
56 54 54 51 51 51 51 51 51 51 51 54 51 51 51 51 51 48 48
176 185 185 194 194 194 194 194 194 194 194 185 194 194 194 194 194 205 205

..... *n* .....
51 51 51 48 48 48 48 48 48 48 45 45 48 45 43 45 45 45 43
194 194 194 205 205 205 205 205 205 205 217 217 205 217 231 217 217 217 231

.....
43 43 43 43 43 43 43 43 43 43 43 43 43
231 231 231 231 231 231 231 231 231 231 231 231 231

6. What! What did you say?

Sound: ..... *a* .....
Period [or duration] in 0.0001^{s}: 69 72 69 75 72 63 63 60 57 60 54 57
Frequency: 144 138 144 133 145 158 158 166 175 166 185 175

.....
54 51 54 48 45 48 45 45 39 39 39 39 39 45 42 48 45 51 45
185 196 185 208 222 208 222 222 256 256 256 256 256 222 238 208 222 196 222

..... *t* .... ɬ ... *hwa* .....
45 45 42 [4518.....] 63 63 63 63 63 57 57 57 54 54 54 54 57
222 222 238 158 158 158 158 158 175 175 175 185 185 185 185 175

d ..... *i* .....
57 57 57 54 63 63 57 57 57 57 54 57 60 57 60 57 60 60 60
175 175 175 185 158 158 175 175 175 175 185 175 166 175 166 175 166 166 166

..... *d* ..... *ɟə* .....
60 60 60 60 60 60 63 78 69 69 69 69 63 66 66 66 69 69 69
166 166 166 166 166 166 158 128 144 144 144 144 158 151 151 151 144 144 144

..... *s* ..... *e* .....
69 69 72 72 69 69 69 66 [426...] 66 69 63 66 69 72 72 69 72
144 144 138 138 144 144 144 151 151 144 158 151 144 138 138 144 138

.....
78 78 78 81 81 81 84 84 81 84 87 90 93 93 93 93 99 99 102
128 128 128 123 123 123 119 119 123 119 114 111 107 107 107 107 101 101 98

.....
102 102 111 114
98 98 90 87

7. Good heavens!

Sound: ..... *gu* .....
Period in 0.0001 s: 75 72 75 66 66 84 57 57 54 51 54 51 51 48 51
Frequency: 133 138 133 151 151 119 175 175 185 196 185 196 196 208 196

..... *d*..... *h* ..... *e* ....
45 48 45 51 45 48 48 42 48 51 78 63 69 69 66 66 66 75 69
222 208 222 196 222 208 208 238 208 196 128 158 144 144 151 151 151 133 144

.....
69 81 69 78 63 75 66 69 66 66 66 63 60 60 63 63 63 63 63
144 123 144 128 158 133 151 144 151 151 151 158 166 166 158 158 158 158 158

.... *v* ..... *n* ..... *z* .....
63 66 69 69 75 87 93 90 90 90 87 87 90 90 90 90
158 151 144 144 133 114 107 111 111 111 114 114 111 111 111 111

8. How well he looks!

Sound: ..... *a* .....
Period in 0.0001 s: 78 69 66 63 60 57 57 54 51 51 51 51 51 48 51
Frequency: 128 144 151 158 166 175 175 186 196 196 196 196 196 208 196

u ..... *w* ..... *e*
48 48 48 48 48 48 48 48 48 48 51 51 54 51 54 57 57 57 54
208 208 208 208 208 208 208 208 208 208 196 196 185 196 185 175 175 175 185

.....
57 54 54 57 54 57 60 57 60 60 57 57 60 60 60 60 57 57 57
175 185 185 175 185 175 166 175 166 166 175 175 166 166 166 166 175 175 175

l ..... *h* .....
54 54 57 57 57 57 54 57 57 57 57 57 57 63 63 60 69 69 66
185 185 175 175 175 175 185 175 175 175 175 175 175 158 158 166 144 144 151

i ..... *l* ..... *u*
69 66 63 66 60 60 63 63 63 63 63 63 60 60 63 60 63 72 66
144 141 158 151 166 166 158 158 158 158 158 158 166 166 158 166 158 138 151

..... *ks*
69 66 69 72 75 72 72 72 75 72 78 84 84 84
144 151 144 138 133 138 138 138 133 138 128 119 119 119

9. I' ve done all I can.

Sound: ..... *ai* .....
Period [or duration] in 0.0001 s: 116 97 84 78 78 81 84 84 84 84 87 87
Frequency: 86 103 119 128 128 123 119 119 119 119 114 114

..... *v* .....
84 87 87 87 87 89 87 87 87 84 87 84 87 87 89 95 101 104
119 114 114 114 114 112 114 114 114 119 114 119 114 114 112 105 100 95

d ..... *ə* ..... *n* .....
[333 ...] 95 92 92 95 98 95 95 95 95 92 95 98 95 95 95 95 92
105 108 108 105 102 105 105 105 105 108 105 102 105 105 105 105 108

ə .....
95 92 89 89 92 95 101 89 87 87 84 78 78 78 69 75 72 69 72
105 108 112 112 108 105 100 112 114 114 119 128 128 128 144 133 138 144 138

.....
72 69 69 66 66 66 63 63 63 63 63 60 60 60 60 60 58 58 58
138 144 144 151 151 151 158 158 158 158 158 166 166 166 166 166 172 172 172

.... *l* ..... *ai* .....
58 55 55 55 55 58 58 58 58 58 55 55 58 55 55 58 58 58 58
172 181 181 181 181 172 172 172 172 172 181 181 172 181 181 172 172 172 172

.....
58 58 60 60 60 60 60 60 60 60 60 60 60 60 60 60 58 58 58 60
172 172 166 166 166 166 166 166 166 166 166 166 166 166 166 166 172 172 172 166

..... *k* ..... *æ* .....
58 58 58 58 58 58 52 58 58 [1494...] 84 89 92 92 92 95 98 98
172 172 172 172 172 172 192 172 172 119 112 108 108 108 105 102 102

.... *n* .....
104 104 104 104 107 107 110 110 113 113 116
98 98 98 98 95 59 90 90 88 88 85

10. I wish you'd let me alone.

Sound: ..... *ai* .....
Period [or duration] in 0.0001 s: 78 75 72 72 72 72 72 72 72 75 75 72
Frequency: 128 133 138 138 138 138 138 138 138 133 133 133

..... *w* ....
72 72 72 69 72 69 69 72 69 72 69 69 72 69 69 72 69 66 63
138 138 138 144 138 144 144 138 144 138 144 144 138 144 144 138 144 151 158

..... *i* .....
63 63 63 60 58 55 55 52 49 49 52 49 49 46 46 46 43 43 43
158 158 158 166 172 181 181 192 204 204 192 204 204 217 217 217 232 232 232

..... *š* ..... *ɟ* ..... *ə*.
40 43 46 49 46 49 49 49 49 49 49 [1079...] 84 75 75 87 87
250 232 217 204 217 204 204 204 204 204 204 119 133 133 114 114

..... *d* .....
87 87 87 87 89 89 89 92 92 92 95 95 95 95 95 95 95 98 98
114 114 114 114 112 112 112 108 108 108 105 105 105 105 105 105 105 102 102

.... *l* ..... *ə* ..... *t* *m* .....
98 104 104 92 95 98 98 98 98 95 98 101 [911...] 87 89 89 92 92
102 98 98 108 105 102 102 102 102 105 102 99 114 112 112 108 108

..... *i* .....

92 92 92 95 95 95 95 95 95 92 92 89 92 95 95 92 95 92 92
108 108 108 105 105 105 105 105 105 108 108 112 108 105 105 108 105 108 108

..... *ə* .....

92 95 89 89 84 81 87 84 78 81 75 75 75 75 75 72 72 72 72
108 105 112 112 119 123 114 119 128 123 133 133 133 133 133 138 138 138 138

..... *l* .....

72 69 63 60 60 58 60 58 55 55 52 52 52 46 40 46 52 58 58
138 144 158 166 166 172 166 172 181 181 192 192 192 217 250 217 192 192 192

... *o* ..... *n* .....

58 58 58 52 55 46 46 55 60 55 63 60 55 60 60 55 55
192 192 192 192 192 217 217 181 166 181 158 166 181 166 166 181 181

11. Will you do as you' re told!

Sound: ..... *wi* .....

Period [or duration] in 0.0001 s: 60 60 54 54 54 54 54 51 51 51 48 48

Frequency: 166 166 185 185 185 185 185 196 196 196 208 208

..... *l* .....

51 48 45 48 45 51 48 48 48 48 48 48 51 51 51 51 51 54 54
196 208 222 208 222 196 208 208 208 208 208 208 196 196 196 196 196 185 185

.... *j* ..... *ə* .....

54 51 60 60 57 54 57 57 66 66 69 69 69 72 69 72 75 75 75
185 196 166 166 175 185 175 175 151 151 144 144 144 138 144 138 133 133 133

..... *d* ..... *u* .....

75 75 75 75 75 75 75 75 75 75 75 75 75 78 84 78 78 81 81
133 133 133 133 133 133 133 133 133 133 133 133 133 128 119 128 128 123 123

..... *ə* .....

84 84 84 81 81 81 84 84 84 84 84 87 87 87 87 87 87 87 87
119 119 119 123 123 123 119 119 119 119 119 114 114 114 114 114 114 114 114

.... *z* ..... *j* ..... *ə* .....

90 93 93 93 93 112 112 112 96 90 87 84 90 90 90 90 93 90 90
111 107 107 107 107 90 90 90 104 111 114 119 111 111 111 111 107 111 111

..... *t* ..... *o* ..... *l* .....

90 93 90 90 90 [1137...] 90 90 93 90 90 96 96 99 96 96 99
111 107 111 111 111 111 111 107 111 111 104 104 101 104 104 101

..... *d* .....

99 105 111 105 105 111 114 111 114 120 114 111 123 105 108 105 99
101 98 95 98 98 99 93 95 93 83 93 95 81 98 90 81 101