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**Voice register terminology
and standard pitch**

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B. VOICE REGISTER TERMINOLOGY AND STANDARD PITCH

The following is a summary of a literature survey and recommendations which will reappear in greater detail in a later report.

1. Octave terminology and standard pitch

There exists a quite apparent lack of uniformity in the choice of reference frequency for musical scales and the situation is not better with regard to octave notations. Conventions vary from one country to another and often within a country and some authors are not consistent in the application of equally tempered intervals when specifying the pitch of tones within an octave.

Our present international standard $A_4 = 440$ c/s, where the octave notation A_4 has substituted the older notation a^1 , stems from 1955 but it was according to Culver (1956) proposed as early as 1834. A common reference for the tuning of musical instruments which gradually has been replaced by the new standard was $a^1 = 435$ c/s cited e.g. by Luchsinger and Arnold (1949).

Several authors adopt octave values of C, 16, 32, 64, 128, 256, 512, 1024, 2048, etc. c/s as the absolute frame for musical scales, see e.g. Tarneaud (1961) and Trendelenburg (1950). With this reference the A_4 of the equally tempered scale comes close to 430 c/s (430.5). Culver (1956) in the context of a historical review quotes this "physical" scale based on $C_4 = 256$ c/s with an $A_4 = 426.6$ c/s without specifically stating that 426.6 c/s applies to a just interval of a true sixth $C_4 - A_4 = 5/3$ in the key of C-major and not to an equally tempered interval of $C_4 - A_4 = 2^{9/12}$ which would have rendered an A_4 of 430.5 c/s*.

* Tarneaud (1961) also quotes the C = 16, 32, 64, 128, 256, etc. reference but refers to la 3 as 425, la 2 as 217, and la 4 as 870 v.d. which is not consistent with any scale.

At the International Standards Association meeting in Baden-Baden (1962) the standard of $A_4 = 440$ c/s was reinforced by the issuing of a recommendation to follow it. The frequency values of this scale and the octave notations are specified in Table III-1.

Fig. III-6 is intended for a comparative display of octave notations and reference frequencies adopted by various authors. A set of correct frequency values according to the international standard expressed in 3 and 4 digits are given at the bottom below the piano keyboard. These are the same as in Table III-1.

2. Voice registers

The terminology with regard to voice pitch levels, i.e. "registers", suffers from the existence of an abundance of terms and an ambiguity of their use. It is not the purpose of the present report to discuss registers from a physiological point of view. The present knowledge is far from complete. However, specialists appear to agree reasonably well as to the average pitch of the boundaries between registers, i.e. the breaks or voice transitions. In Fig. III-7 we have reproduced the graphical displays of voice registers of Tarneaud (1961) and of Nadoleczny and Preissler, see Luchsinger and Arnold (1949). The former refers to the singing voice and the latter to the physiological span of the voice. The mean pitch of the voice in speech is indicated in both graphs.

From a speech research point of view it is interesting to note that the average boundary between the mid- and high-pitch level varies rather little with the particular kind of voice. It is located at $\#C_4$ (278 c/s) for bass voices and at F_4 (349 c/s) for soprano voices. The transition from low to mid level occurs at the average at D_3 (147 c/s) for a bass voice and at E_3 (165 c/s) for a tenor voice. These data support the findings of Lieberman (1963) on discontinuities in the pitch distribution of male voices

PRESENT INTERNATIONAL STANDARD $A_4 = 440 \text{ c/s}$		AMERICAN INSTITUTE OF PHYSICS HANDBOOK (1957)		JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA (1942)		Mc GRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY (1960)		CULVER MUSICAL ACOUSTICS (1956)		OCTAVE TERMINOLOGY	
		GERMAN	GERMAN	GERMAN	GERMAN	GERMAN	GERMAN	GERMAN	GERMAN	GERMAN	GERMAN
		SWEDISH	SWEDISH	SWEDISH	SWEDISH	SWEDISH	SWEDISH	SWEDISH	SWEDISH	SWEDISH	SWEDISH
		SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943	SCHEMINSKY 1943
		LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951	LUCHSINGER 1951
		J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961	J. TARNEAUD 1961
		STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927	STUMPF 1927
164	C ₀	16350%	16 Hz	16 V.D.	16.17 Hz	16.35 Hz	16.35 Hz	16.35 Hz	16.35 Hz	16.35 Hz	16.35 Hz
27.5	A ₀										
30.9											
32.7	C ₁	32.703	32	32	32.33	32.70	32.70	32.70	32.70	32.70	32.70
36.7											
41.2											
43.7											
46.2											
49.0											
51.9	A ₁										
55.0											
58.3											
61.7											
65.4	C ₂	65.406	64	64	64.66	65.41	65.41	65.41	65.41	65.41	65.41
73.4											
82.4											
87.3											
92.5											
98.0	A ₂										
110											
117											
123											
131	C ₃	130.813	128	128	129.33	130.8	130.8	130.8	130.8	130.8	130.8
147											
156											
165											
175											
185	A ₃										
196											
208											
220											
233											
247											
262	C ₄	261.626	256	256	258.65	261.6	261.6	261.6	261.6	261.6	261.6
294											
311											
330											
349											
370	A ₄										
392											
415											
440		440.000	430		435	440.0	440.0	440.0	440.0	440.0	440.0
494											
523	C ₅	523.251	512	512	517.31	523.3	523.3	523.3	523.3	523.3	523.3
587											
622											
659											
698											
740	A ₅										
784											
831											
880											
932											
988											
1047	C ₆	1046.502	1024	1024	1034.61	1047	1047	1047	1047	1047	1047
1109											
1175											
1245											
1319											
1397											
1480	A ₆										
1568											
1661											
1865											
1976											
2093	C ₇	2093.005	2048	2048	2069.22	2093	2093	2093	2093	2093	2093
2217											
2349											
2489											
2637											
2794											
2960	A ₇										
3136											
3322											
3520											
3729											
3951											
4186	C ₈	4186.009	4096	4096	4138.44	4186	4186	4186	4186	4186	4186
4435											
4699											

EQUALLY TEMPERED SCALE

Marianne Wotter

Fig. III-6. The equally tempered scale and octave notations according to international standard, below. The upper part of the figure shows various other notations and pitch references found in the literature.

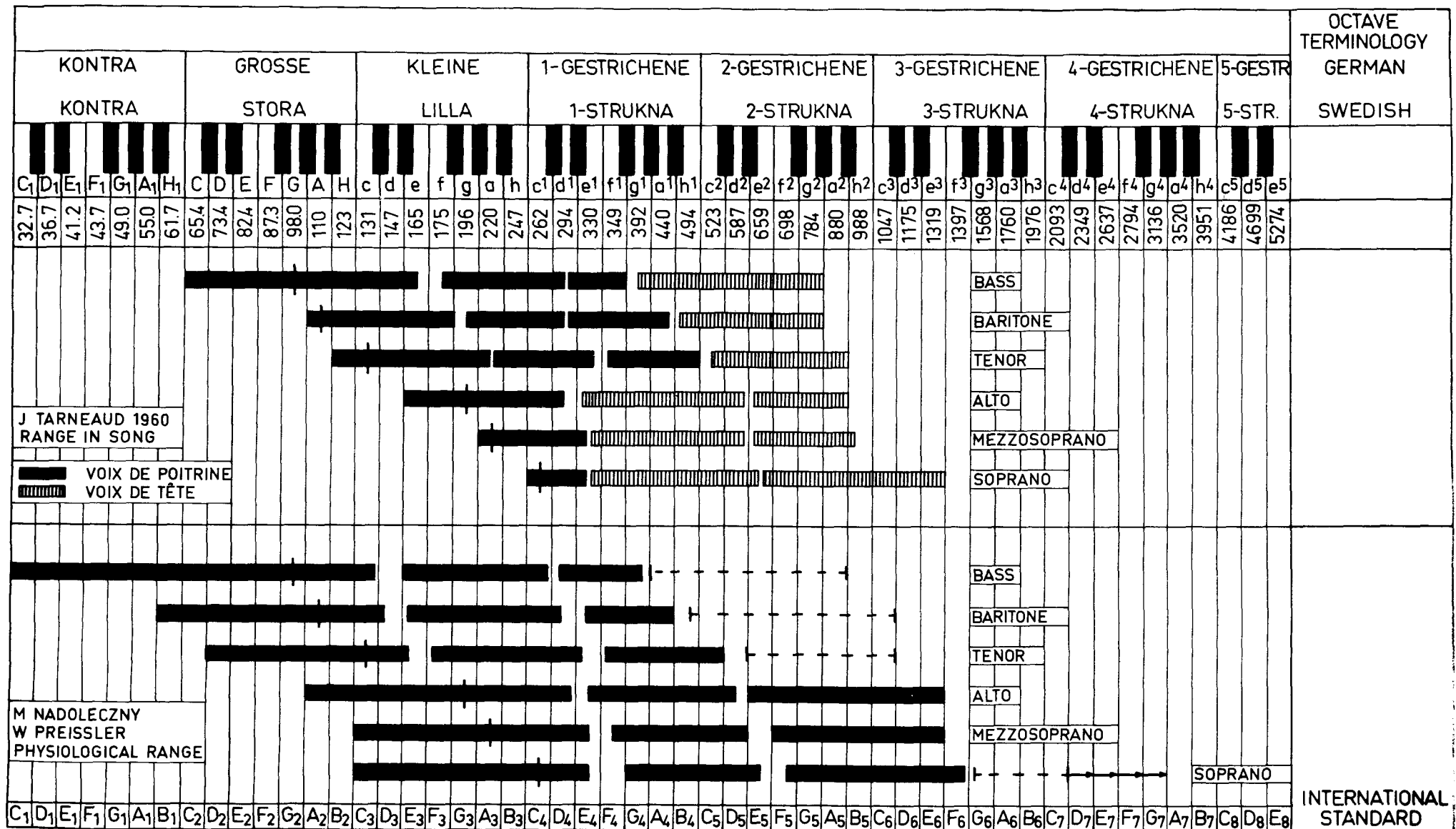


Fig. III-7. The various registers (ranges) of the singing voice according to Tarneaud, above, and the physiological ranges of the voice according to Nadoleczny and Preissler, below. The average fundamental frequency level of the speaking voice according to Luchsinger and Arnold is indicated in both diagrams.

Marianne Mosler 1962

Table III-1. Equally tempered scale according to international standard. Intermediate frequency values refer to semitones.

Zero	First	Second	Third	Fourth	Fifth	Octave
C ₀ 16,4 c/s	C ₁ 32,7 c/s	C ₂ 65,4 c/s	C ₃ 131 c/s	C ₄ 262 c/s	C ₅ 523 c/s	
	17,3	34,6	69,3	139	277	544
D ₀ 18,4	D ₁ 36,7	D ₂ 73,4	D ₃ 147	D ₄ 294	D ₅ 587	
	19,5	38,9	77,8	156	311	622
E ₀ 20,6	E ₁ 41,2	E ₂ 82,4	E ₃ 165	E ₄ 330	E ₅ 659	
F ₀ 21,8	F ₁ 43,7	F ₂ 87,3	F ₃ 175	F ₄ 349	F ₅ 698	
	23,1	46,2	92,5	185	370	740
G ₀ 24,5	G ₁ 49,0	G ₂ 98,0	G ₃ 196	G ₄ 392	G ₅ 784	
	26,0	51,9	104	208	415	831
A ₀ 27,5	A ₁ 55,0	A ₂ 110	A ₃ 220	A ₄ 440	A ₅ 880	
	29,1	58,3	117	233	466	932
B ₀ 30,9	B ₁ 61,7	B ₂ 123	B ₃ 247	B ₄ 494	B ₅ 988	

and also the breaks we have observed in samples of sustained vowels produced at a gliding pitch, Fant et.al. (1963). The cause of these breaks is of course still a matter of controversy. The average pitch of the speaking voice of male voices is located within the low register but in speech the intonation often rises the pitch well into the mid register of the voice.

The only secure common denominator for defining a register is by means of its range on the musical scale. It has therefore been attempted to summarize the terminology used in the literature by placing each author's term within one of the five basic registers which M. Mörner suggests be referred to in English as the deepest range, the deep level, the mid level, the high level, and the highest range. The approximate boundaries between these "registers" are indicated on the top of Fig. III-8. No attempt has been made to translate terms. It is hoped that this display shall contribute to a better understanding of various terminologies and forward the discussion on suitable terms.

Summary

Summarizing we recommend the use of the international standard pitch ($A_4 = 440$) and the octave notations of this standard. Terms for the several pitch levels or registers of the human voice are suggested. Those who would like to make any comments or secure a copy of a later more detailed article should write to one of us. We would also appreciate any comments relevant to the subject.

Marianne Mörner, F. Fransson, and G. Fant

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VOICE REGISTER

F₂ 87 c/s Female F₃ 175 D₄ 294 - F₄ 349 D₅ 587 - E₅ 659 B₅ 988 C₇ 2093
 F₁ 44 c/s Male F₂ 87 D₃ 147 - F₃ 175 D₄ 294 - F₄ 349 B₄ 494

<u>Lågsta (djup) område</u> 29, 35, 39	<u>Djupläge</u> 29, 34, 35, 9, 37, 39	<u>Mellanläge</u> 29, 34, 35, 9, 39	<u>Höjdläge</u> 29, 34, 35, 9, 39	<u>Högsta (höjd) område</u> 29, 32, 35, 39
Bierbass 5	Bassregister (vanligt)	Vollton 18	Headvoice 32	Flageolette 8, 17
Kehlbass 18, 21, 12	Brustreg. 21, 19, 31, 34, 38	Bruststimme 18	Falsettovoice 19	Pfeiffregister 8, 21, 14, 34
Oktavierreg. 5	Knorpelreg. 2	Mittelregister 23, 21	Falsetto II 28	Fistelstimme 21, 11, 18, 23, 20, 31, 38
Strohbas 16, 9, 21, 12, 14, 8, 33, 19 5, 38	Bruststimme 12, 21, 18, 34	Mittelstimme 7, 12*, 21, 9, 18, 14	Zwischenstimme 11	Partialstimme 5
<u>Tiefstes Gebiet</u> 29	Vollstimme 4, 18	Amphotere Töne 9, 10, 11, 17	Kopfreg. 21, 19	Delregister 5
<u>Deepest Range</u> 29	Vollreg. 5	Halbstimme 26	Fistelstimme 12, 18	Kortregister 5, 33, 38
<u>Rayon profond</u> 29	Tiefoktave 9	Falsetto I 28	Hochoktave 9, 37	Falset 18, 19, 32, 36
	Unterreg. 3	Falsett 6, 7, 12, 18, 31	Oberreg. 3	Petit registre 16
	Fuldreg. 5, 38, 40	Kopfregister 1, 33	Dünne Stimme 2	Voix de sifflet 16, 17
	Chestvoice 19	Kopfstimme 1	Mellanstämma	Flöjtestimme 33
	Vollton 18	Bänderstimme 2	Kopftön 26	Grenzoctave 9
	Voix de poitrine 17	Zwischenstimme 6	Kopfregister 23	4 reg. 30
	Djupt register 6	Registermischung 5	Randstimme 4	Pipe register 19
	Contrebasse 6	Mellanregister 6, 5	Randregister 5	Flute 19
	1. reg. 30	Mellanstämma 7	Hochregister 6, 14	Whistle 19
	Long-reed 36	Mischstimme 7	Falsett 11, 18, 14	<u>Höchstes Gebiet</u> 29
	Chest register 33	Midvoice 19	Huvudröst (de flesta)	<u>Highest range</u> 29
	reg. Grave 6	Medium 17, 6, 25	Voix de tête 17	<u>Rayon élevé</u> 29
	<u>Tieflage</u> 29	Voix mixte 17, 14, 25	Kopfstimme 21, 18, 32, 34	
	<u>Deep-level</u> 29, 37	Mitteloctave 9	Falsettregister 21, 12, 33	
	<u>Site grave</u> 29	Fausset-tête 6	Fausset-tête 6, 17	p/s = Hz = c/s
		2. reg. 30	3. reg. 30	fistula =
		Long-reed 36	Short-reed 36	
		reg. Moyen 6	reg. aigu 6	
		Rand register 38	Hovedstemme 38	
		<u>Mittellage</u> 29	<u>Hochlage</u> 29	
		<u>Mid-level</u> 29, 37	<u>High-level</u> 29, 37	
		<u>Site moyen</u> 29	<u>Site aigu</u> 29	

- | | | |
|-------------------|-------------------|-----------------------|
| 1. Rossbach | 13. Sciffert | 25. french expression |
| 2. Seydel | 14. Barth | 26. Stern |
| 3. Hennig | 15. Fröschels | 27. Hollien |
| 4. Scheidemantel | 16. Garde | 28. Chiba |
| 5. Forchhammer V. | 17. Tarneaud | 29. Mörner |
| 6. Garcia | 18. Luchsinger | 30. Hussion |
| 7. Stockhausen | 19. Van den Berg | 31. Musehold |
| 8. L. Mozart | 20. Winckel | 32. Rubin H. |
| 9. Hartlieb | 21. Preissler | 33. S. Schmidt |
| 10. Gutzmann | 22. Thausing | 34. P. Lohmann |
| 11. Merkel | 23. Nadolecany | 35. S. Fex |
| 12. Bottermund | 24. Trendelenburg | 36. M. Mackenzie |
| | | 37. Vennard |
| | | 38. NHR Blegvad |
| | | 39. Sällström F. |

* 12 „Mittelstimme oder Falsett“

Mörner Mörner 1903

Fig. III-8. Voice register terminology of various authors within a frame of five vocal pitch ranges. Terms recommended by M. Mörner are underlined. When necessary the word pitch should be inserted ahead of level in order to avoid confusion with the concept of intensity level.

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