FIGURE 22. PRIMARY AND SECONDARY CONTRACTIONS

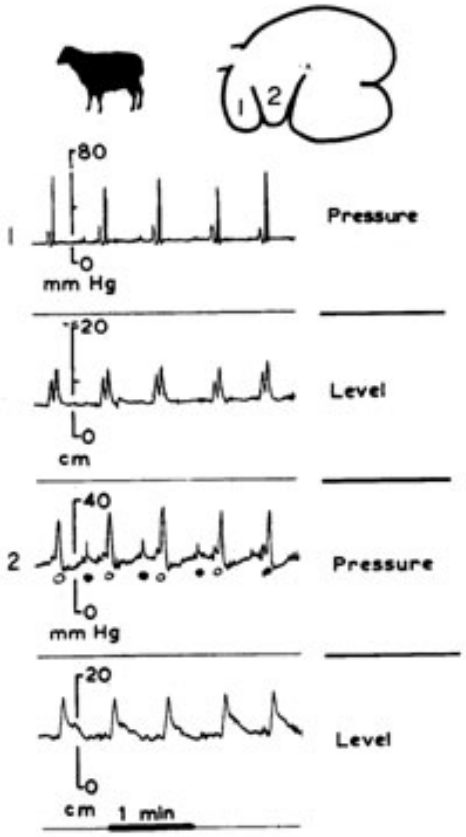


Figure 4-4. Comparison of simultaneous recordings of pressure and vertical displacement of the reticulum and the carnial sac of the rumen during primary (○) and secondary ruminal contractions (●) in sheep. From Reid and Cornwall (16).

FIGURE 23. RUMINAL CONTRACTION SEQUENCE

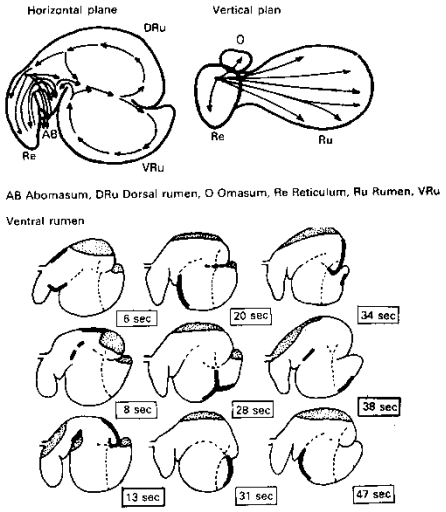


Figure 4-5. Movement of digesta in the reticulo-rumen as seen radiographycally in the horizontal and vertical planes. Top. Arrows indicate direction of movement. Main contraction sequences of the sheep's reticulo-rumen as indicated by X-radiography. Bottom. Time in seconds indicates the interval after the reticular movement and the contracting region of the reticulo-rumen wall is indicated as a heavy line. The gas bubble (stippled area) is brought over the cardiac orifice at 13 sec in the case of a primary contraction and during the secondary ruminal contraction at 38 sec. From Wyburn (32).

From Church, 1988. p. 69.

FIGURE 24. SEQUENCE OF RUMINAL CONTRACTIONS

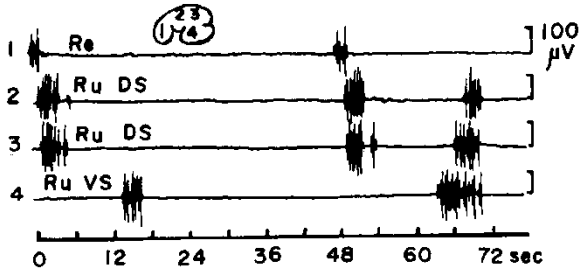


Figure 4-6. Reticulo-ruminal (Re-Ru) contraction as indicated by electromyography and lasting 48 sec. Another cycle, a secondary ruminal contraction, starts on the posterior ventral sac of the rumen (Ru-VS) and spreads forwards over the rumen dorsal sac (Ru-DS) in the sheep at rest. From Ruckebusch (20).

FIGURE 25. CONTRACTION FREQUENCY

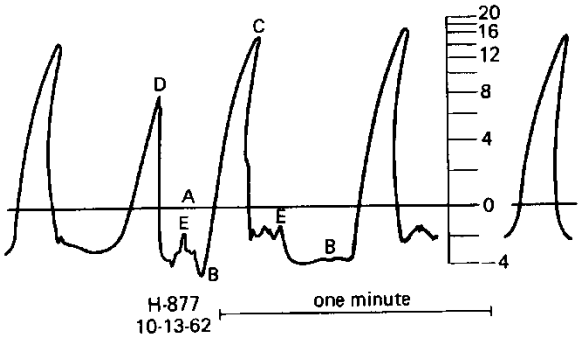


Figure 4-7. Rumen gas pressure of a fasting steer fed on long oat hay. A, atmospheric pressure; B, resting rumen pressure; C, primary rumen contraction; D, eructation contraction; E, deflection caused by movement of the steer. Scale is graduated in cm of water. Courtesy of H.W. Colvin, Univ. of California, Davis. From Church (3).

TABLE 22. INCIDENCE (%) OF PRESSURE WAVES IN THE RUMENS OF COWS AND SHEEP[1]

	Analysis "A"[2]					Analysis "B"		
	D[3]	DV	DSV	DVSV	Others	Primary	Modified primary	Secondary
Cows								
Feeding	1	27	5	56	11	55	4	41
Resting	10	35	25	22	8	41	25	34
Ruminating	22	28	37	6	7	25	43	32
Sheep								
Feeding	0	45	1	46	8	65	1	34
Resting	2	48	4	39	7	64	4	32
Ruminating	4	48	13	30	6	57	12	31

[1]From Phillipson, 1970, as presented by Church, 1988 p. 68.

[2]Percentages under Analysis "A" based on 5,998 patterns – represents sequences of changes; Analysis "B" excludes the 'others' category of Analysis "A" – represents incidence of primary, modified primary (without pressure change in ventral sac), and secondary waves.

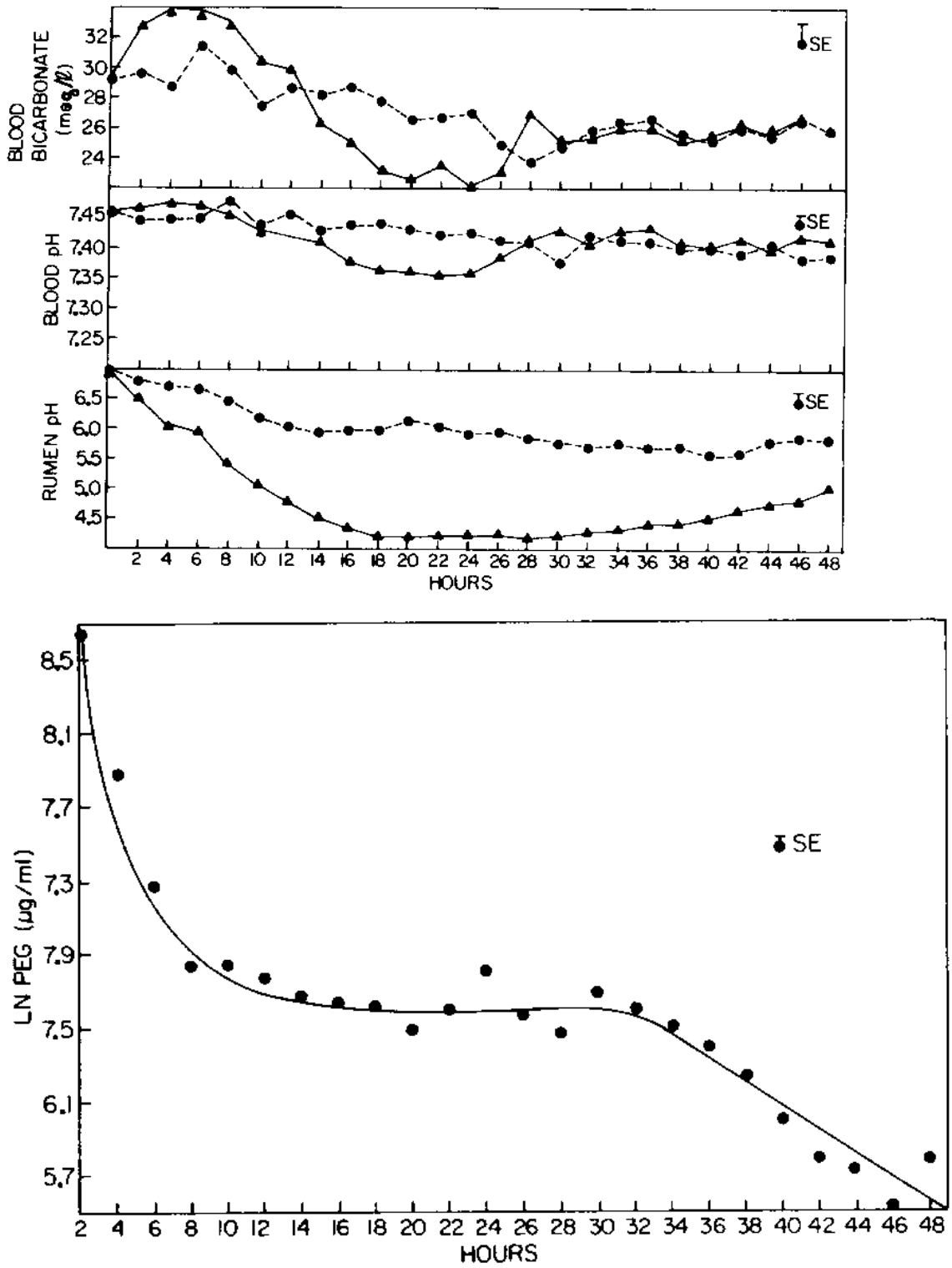
[3]D = primary wave in dorsal sac; V = pressure in ventral sac; S = secondary wave in dorsal sac, usually coincident with pressure spike in anterior and ventral sacs of rumen accompanying eructation.

TABLE 23. EFFECT OF RUMEN FISTULATION ON RUMINAL MOTILITY[1]

	Frequency (min^{-1})	Amplitude (mm Hg)
Resting		
Intact	1.2	18.2
Fistulated	1.4	5.9
Feeding		
Intact	2.0	22.1
Fistulated	2.0	9.4
Ruminating		
Intact	1.1	10.4
Fistulated	1.1	10.9

[1]From Church, 1988 p. 70.

FIGURE 26. RELATIONSHIP BETWEEN MOTILITY AND pH



Changes in pH and ruminal PEG concentrations in steers dosed intraruminally with glucose. Harmon et al.,1985. JAS 60:560-569. In upper series of charts, circles are subacute whereas triangles are acute acidosis. Lower chart shows acute acidosis response only.

TABLE 24. INHIBITION OF RETICULO-RUMINAL MOTILITY IN SHEEP BY VOLATILE FATTY ACIDS[a]

	Acetic	Propionic	Butyric
	Ruminal concentration of undissociated VFA at abolition of motility (mM)[b]		
Reticulum	**90.7**	**58.9**	**36.9**
Rumen			
Primary	**33.5**	**29.3**	**21.1**
Secondary	**98.6**	**71.5**	**43.9**
Intrinsic motility (vagotomized)	**95.1**	**58.6**	**43.3**

[a]Gregory, P.A. 1984. Can. J. Anim. Sci. 64(Suppl.):11-12.

[b]Infused at 5 ml/min of 5 M acetic, propionic or butyric acid.

TABLE 25. EFFECT OF ACIDS ON RUMINAL MOTILITY[1]

Acid	Amount Infused, mmol	Ruminal pH	Total VFA, mM	Free Acid, mM[2]
	Characteristics at abolition of motility			
Hydrochloric	**657**	**4.7**	**53**	**30**
Acetic	**730**	**5.3**	**175**	**42**
Propionic	**1043**	**5.1**	**347**	**116**
Butyric	**543**	**5.0**	**353**	**137**
Lactic	**1570**	**3.4**	**48**	**46**

[1]Leek, B.F. 1983. Clinical diseases of the rumen: A physiologist's view. The Vet. Record. 113:10-14.

[2]Calculated for an organic acid with pKa of 4.8.

TABLE 26. COMPOSITION OF RUMINAL GASES

Author[a], Animal, Diet	Percent Composition					
	CO_2	CH_4	O_2	N[b]	H_2	H_2S
Washburn and Brody (1937)						
Dairy Cow	**49.6**	**30.2**	**3.2**	**14.9**	**2.2**	**--**
Goat	**40.0**	**40.5**	**1.4**	**13.9**	**4.3**	**--**
Kleiber et al (1943)						
Cow fed alfalfa hay	**69.0**		**.5**			**.16**
Cow fed sudan hay	**65.7**	**26.8**	**1.0**	**6.4**		**.10**
Cow fed grain	**66.9**	**22.1**	**.4**	**10.4**		**.12**
Cow fed bloat- provocative alfalfa	**67.8**					
McArthur and Miltimore (1961)						
Cow	**65.4**	**26.8**	**.6**	**7.0**	**.2**	**.01**
Czerkawski and Clapperton (1968)						
Sheep fed at 0900 h						
Sampled 0800-0900	**24.8**	**32.5**	**6.5**	**36.2**	**.01**	
Sampled 0900-1000	**56.0**	**18.8**	**3.1**	**18.0**	**4.12**	
Sampled 1200-1300	**60.2**	**33.5**	**1.3**	**6.0**	**.05**	
Dougherty (1941, 1942)						
Steers dead of Legume bloat						**.14 - .70**

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[b]Presumably includes N_2 and NH_3.

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