

THE ABSORPTION SPECTRA OF STEROIDS IN CONCENTRATED SULFURIC ACID. I. METHOD AND DATA^{1, 2}

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Received March 10, 1953

The literature contains numerous references (5) which pertain to the treatment of steroids with sulfuric acid, either alone or in combination with other reagents. The chromogens so developed were used for purpose of identification or estimation. Special reference is made to the recent noteworthy work of Zaffaroni and coworkers (1 m, n), who have determined the spectra of a number of steroids in concentrated sulfuric acid. Only a relatively small number of compounds, limited in variety of structural features, were examined. Certain aspects such as concentration studies, structural relationships, and the like were not discussed. In view of Zaffaroni's work, and our own experience which indicated that in concentrated sulfuric acid hydrocortisone and its epimer, 11-epi-hydrocortisone, were easily distinguishable (2), we decided to explore further the potentialities of this type of spectral analysis.

The results to-date based on the determination of the spectra of 220 steroids indicate that spectral analysis in concentrated sulfuric acid may prove to be an important adjunct to the tools now available for the identification and characterization of steroids.

Our investigation may be conveniently divided into five sections: (A) concentration studies; (B) spectrograms, and tabulation of quantitative data for each steroid examined under generally uniform conditions; (C) differentiation of epimeric compounds, and time-studies (*i.e.*, change of spectra with time); (D) structural correlations, and (E) analysis of mixtures.

In this paper, we shall confine ourselves to (A) and (B). In regard to the latter, the individual spectrograms will be presented in a future publication.

PROCEDURE

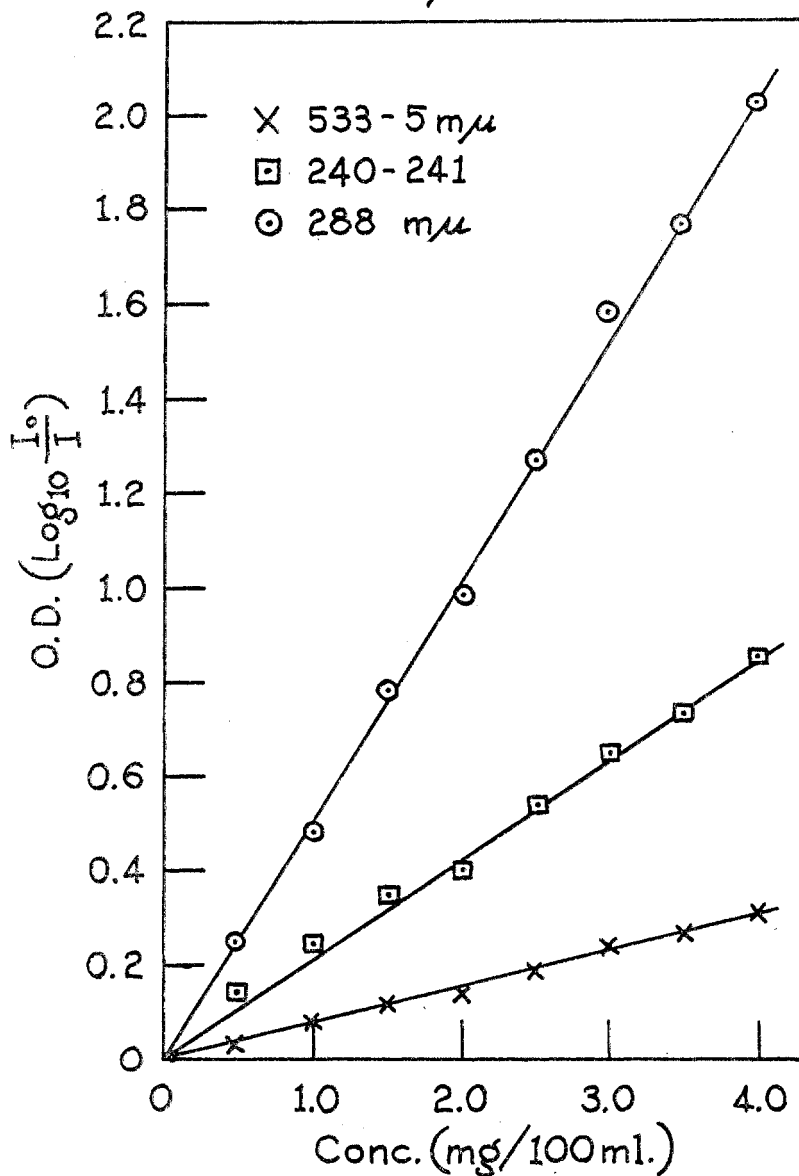
The spectra were determined with a Cary recording spectrophotometer (Model 11S) (Applied Physics Corporation, Pasadena, California). Instrumental details were as follows: slit control at "0"; voltage control at 3; scanning speed: 10 m μ per 10 seconds; 1 division of spectrogram equivalent to 10 m μ ; 10.002-mm. silica cells; hydrogen lamp, 220-360 m μ ; tungsten lamp, 350-600 m μ .

Generally, the solutions for analysis were at a concentration of about 7×10^{-6}

¹ Presented in part before the Organic Discussion Group at the Fifth Annual Meeting-In-Miniature of the North Jersey Section, American Chemical Society, Newark, N. J., January 26, 1953.

² Solutions of steroids in concentrated sulfuric acid exhibit varying degrees of halochromism. A number of compounds give rise to no chromogen at all, *e.g.* Δ^4 -androstene-3,11,17-trione (Compound No. 7) and Δ^4 -pregnene-3,11,20-trione (No. 52). Consequently, it was deemed inadvisable to employ an expression as "sulfuric acid chromogen" in the title of this series of papers.

Fig I
Concentration Study Reichstein's Substance S



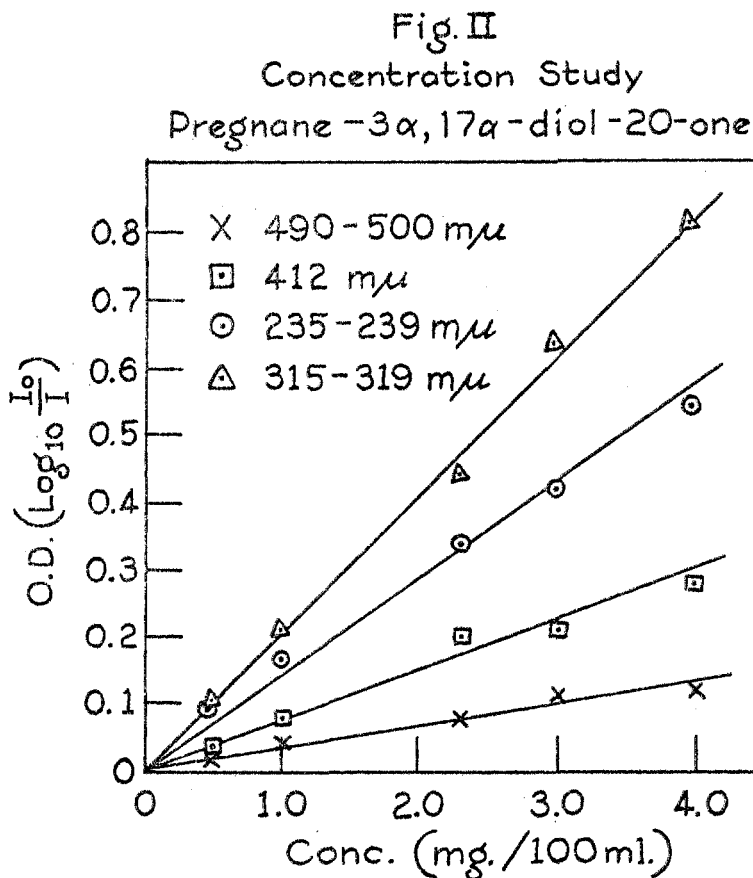
moles of steroid per 100 ml. of concentrated sulfuric acid, and were allowed to stand at 25° for 2 hours prior to examination.

The sulfuric acid used was 'Baker Analyzed' Reagent, and had a 97% content.

The same batch of sulfuric acid was employed throughout the entire investigation with the exception of the studies on the analysis of mixtures.

CONCENTRATION STUDIES

For the purpose of studying concentration effects on absorptivity (Beer's Law) we selected four compounds, Reichstein's Substance S, pregnane-3 α ,17 α -diol-20-one, hydrocortisone, and 11-epi-hydrocortisone. The solutions of various



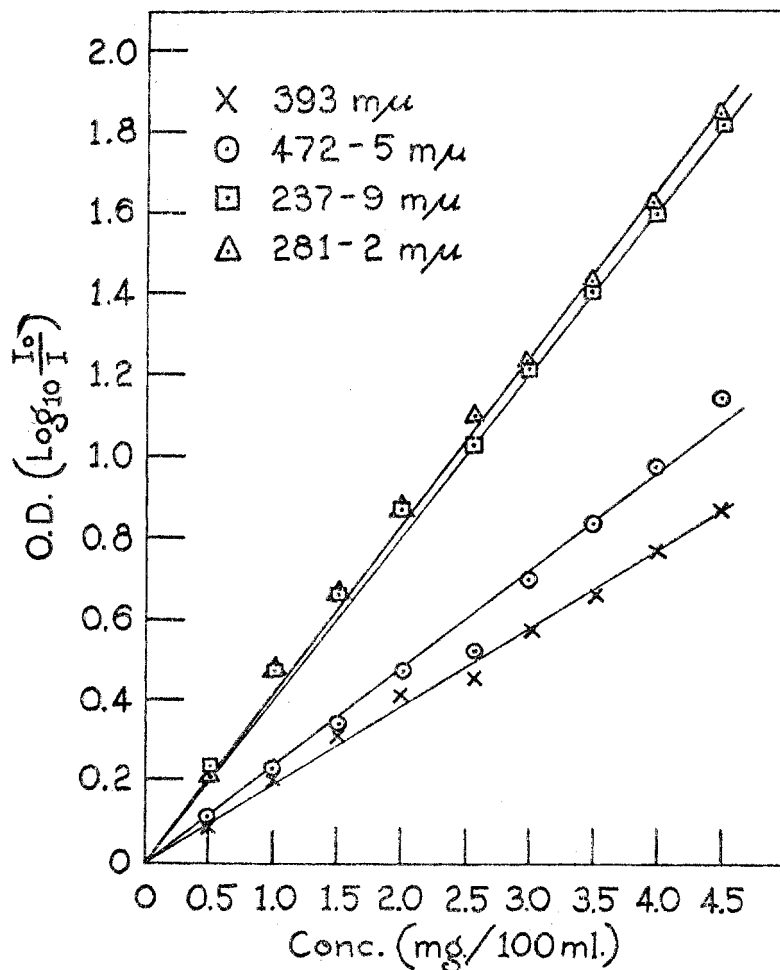
concentrations were allowed to stand at 25° for 2 hours prior to examination. The results are plotted in Figures I, II, III, and IV, and indicate that solutions of these compounds, within the concentration range (<40-45 μ g./ml.) examined, obey Beer's Law. For all practical purposes, it is not unreasonable to assume that this is true for all steroids in concentrated sulfuric acid.

TABULATION OF DATA

In Tables I-XIV, there are recorded in a quantitative manner ($E_{1\%}^{1\text{cm.}}$) the maxima and minima for the spectrum of each steroid. To simplify the tabulation,

it was decided to represent each characteristic absorption band by a single wavelength rather than by a range if such existed. Also, the symbol, I, has been employed to designate an inflection or plateau in the spectrum, and to represent that, also, by a single wavelength. In many cases, the decision to

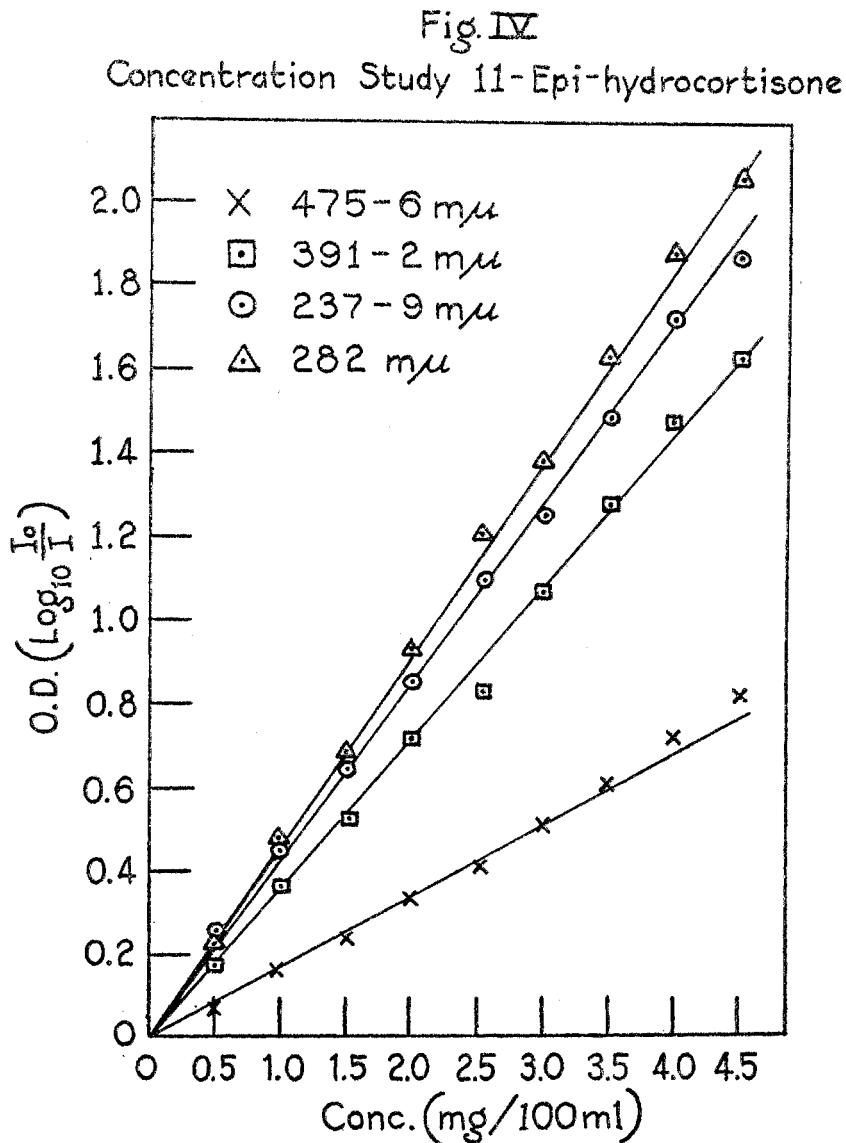
Fig. III
Concentration Study Hydrocortisone



employ single wavelengths resulted in difficulties. However, we feel that the data given will be adequately representative of the spectra, and will fulfill its purpose.

Cholestane was insoluble in concentrated sulfuric acid at room-temperature, and is not included in the Tables.

A duplicate set of data are recorded for 15 compounds for evaluation of the reproducibility of the spectra. The data for Compounds No. 18, 26, 54, 86, 120, 123, 184 and 198 were obtained from analysis of samples of two different sources,



whereas the data for Compounds No. 20, 31, 54, 73, 137, 140, and 141 were obtained from duplicate analyses on the same sample. Generally, the results indicated satisfactory reproducibility.

TABLE I
 ABSORPTION SPECTRA OF C₁₈ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
1	C ₁₈ H ₁₈ O ₂	$\Delta^{1,3,5(10),6,8}$ -Estrapentaene-3-ol-17-one	234 (1315), 280 (216) [I], 289 (263), 301 (268), 319 (247), 395 (168), 472 (384)	265 (184), 295 (237), 311 (232), 355 (84), 416 (142)
2	C ₁₈ H ₂₀ O ₂	$\Delta^{1,3,5(10),7}$ -Estratetraene-3-ol-17-one	232 (370), 353 (895), 459 (155)	264 (60), 419 (90)
3	C ₁₈ H ₂₂ O ₂	$\Delta^{1,3,5(10)}$ -Estratriene-3-ol-17-one	228 (375) [I], 300 (500), 352 (55), 448 (275)	253 (85), 332 (45), 385 (25)
4	C ₁₈ H ₂₄ O ₂	$\Delta^{1,3,5(10)}$ -Estratriene-3,17 β -diol	272 (216), 298 (184), 360 (168) [I], 428 (1015), 449 (1010)	250 (121), 288 (169), 326 (79), 438 (910)
5	C ₁₈ H ₂₄ O ₃	$\Delta^{1,3,5(10)}$ -Estratriene-3,16 α ,17 β -triol	230 (320) [I], 305 (180), 355 (35), 450 (80)	262 (25), 330 (15), 388 (15)

 TABLE II
 ABSORPTION SPECTRA OF C₁₉ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
6	C ₁₉ H ₂₄ O ₂	$\Delta^{5,7,9(11)}$ -Androstatriene-3 β -ol-17-one	291 (224), 350 (252), 413 (500)	270 (186), 319 (181), 367 (224)
7	C ₁₉ H ₂₄ O ₃	Δ^4 -Androstene-3,11,17-trione	283 (524)	230 (62)
8	C ₁₉ H ₂₆ O ₂	$\Delta^{1,4}$ -Androstadiene-17 β -ol-3-one	232 (250) [I], 327 (500), 395 (65), 487 (80)	251 (110), 359 (30), 428 (35)
9	C ₁₉ H ₂₆ O ₂	Δ^1 -Androstene-3,17-dione	299 (653)	230 (182)
10	C ₁₉ H ₂₆ O ₂	Δ^4 -Androstene-3,17-dione	294 (730)	235 (105)
11	C ₁₉ H ₂₆ O ₃	Androstane-3,11,17-trione	321 (18), 400 (18)	300 (9), 352 (0)
12	C ₁₉ H ₂₆ O ₃	Δ^4 -Androstene-11 α -ol-3,17-dione	284 (466), 381 (340), 400 (214) [I], 465 (110)	235 (148), 322 (71), 433 (76)
13	C ₁₉ H ₂₆ O ₃	Δ^4 -Androstene-11 β -ol-3,17-dione	283 (467), 380 (443), 402 (257) [I], 460 (129)	241 (157), 322 (62), 433 (95)
14	C ₁₉ H ₂₆ O ₃	Δ^4 -Androstene-17 β -ol-3,11-dione	285 (563), 350 (41)	230 (105), 330 (36)
15	C ₁₉ H ₂₆ O ₃	Etiocolane-3,11,17-trione	None	None
16	C ₁₉ H ₂₈ O	Δ^4 -Androstene-3-one	296 (416)	None
17	C ₁₉ H ₂₈ O ₂	$\Delta^{5,7}$ -Androstadiene-3 β ,17 β -diol	414 (380), 466 (455), 505 (195) [I]	320 (125), 432 (345)
18	C ₁₉ H ₂₈ O ₂	Androstane-3,17-dione	302 (595) 302 (566)	251 (119) 250 (76)
19	C ₁₉ H ₂₈ O ₂	Δ^4 -Androstene-17 α -ol-3-one	299 (724)	232 (124)

TABLE II—Concluded

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)	MIN. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)
20	$C_{19}H_{28}O_2$	Δ^4 -Androstene-17 β -ol-3-one	298 (850) 299 (837)	236 (150) 235 (150)
21	$C_{19}H_{28}O_2$	Etiocholane-3,17-dione	302 (540)	250 (75)
22	$C_{19}H_{28}O_3$	Androstane-17 β -ol-3,16-dione	294 (109), 372 (736)	258 (55), 318 (64)
23	$C_{19}H_{28}O_3$	Δ^4 -Androstene-11 α ,17 β -diol-3-one	300 (659), 390 (55), 470 (27) [I]	238 (164), 367 (43)
24	$C_{19}H_{28}O_3$	Δ^4 -Androstene-11 β ,17 β -diol-3-one	295 (582), 385 (177)	236 (141), 340 (50)
25	$C_{19}H_{28}O_3$	Etiocholane-3 α -ol-11,17-dione	238 (71) [I], 321 (91), 380 (86) [I], 401 (152), 412 (129) [I]	265 (40), 353 (40)
26	$C_{19}H_{30}O$	Δ^5 -Androstene-3 β -ol	236 (97), 321 (368), 416 (100) 230 (79) [I], 321 (358), 415 (90)	229 (92), 258 (84), 384 (68) 249 (68), 385 (63)
27	$C_{19}H_{30}O_2$	Androstane-3 α -ol-17-one	310 (267), 331 (186) [I], 402 (43), 480 (14)	258 (71), 385 (33), 455 (10)
28	$C_{19}H_{30}O_2$	Androstane-3 β -ol-17-one	310 (260), 331 (185) [I], 407 (25), 490 (15)	252 (55), 389 (20), 450 (5)
29	$C_{19}H_{30}O_2$	Androstane-17 α -ol-3-one	302 (330)	253 (85)
30	$C_{19}H_{30}O_2$	Androstane-17 β -ol-3-one	302 (381)	252 (86)
31	$C_{19}H_{30}O_2$	Δ^5 -Androstene-3 β ,17 α -diol	302 (300), 408 (360), 449 (160) [I], 509 (70) [I] 303 (313), 406 (361), 498 (110)	252 (80), 351 (95) 250 (77), 352 (100), 480 (106)
32	$C_{19}H_{30}O_2$	Δ^5 -Androstene-3 β ,17 β -diol	240 (100), 307 (320), 404 (438), 440 (145) [I], 482 (90), 540 (70) [I]	233 (95), 255 (90), 348 (120), 472 (87)
33	$C_{19}H_{30}O_2$	Etiocholane-3 α -ol-17-one	311 (281), 332 (195) [I], 409 (38), 500 (24)	259 (76), 389 (33), 452 (14)
34	$C_{19}H_{30}O_2$	Etiocholane-17 β -ol-3-one	240 (125) [I], 307 (355), 356 (115), 387 (115), 450 (65) [I], 475 (90)	255 (105), 336 (90), 366 (100), 412 (35)
35	$C_{19}H_{30}O_3$	Etiocholane-3 α ,11 β -diol-17-one	230 (114) [I], 322 (190) [I], 341 (224), 402 (191)	266 (57), 371 (152)
36	$C_{19}H_{32}O$	Androstane-3 α -ol	308 (190)	242 (45)
37	$C_{19}H_{32}O$	Androstane-3 β -ol	312 (200)	242 (40)
38	$C_{19}H_{32}O$	Androstane-17 β -ol	240 (82), 310 (229)	225 (71), 255 (71)
39	$C_{19}H_{32}O_2$	Androstane-3 α ,17 α -diol	343 (260), 410 (55) [I]	257 (85)
40	$C_{19}H_{32}O_2$	Androstane-3 β ,17 β -diol	314 (200) [I], 345 (245), 390 (45) [I], 410 (30) [I]	250 (60)
41	$C_{19}H_{32}O_2$	14-Isoandrostane-3 β ,17 α -diol	235 (105) [I], 305 (280), 391 (115), 412 (85) [I], 445 (60) [I]	252 (90), 378 (100)

TABLE III
 ABSORPTION SPECTRA OF C₂₀ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E _{1 cm.} ^{1%})	MIN. m μ (E _{1 cm.} ^{1%})
42	C ₂₀ H ₃₀ O ₂	17 α -Methyl- Δ^4 -andro- stene-17 β -ol-3-one	298 (605), 497 (24)	235 (143), 365 (5)
43	C ₂₀ H ₃₀ O ₃	3 β -Hydroxy- Δ^5 -etio- cholenic acid	240 (105), 319 (241), 342 (255), 412 (182)	230 (100), 265 (77), 328 (227), 381 (105)
44	C ₂₀ H ₃₀ O ₄	3 α -Hydroxy-11-keto- etiocholanic acid	235 (78) [I], 320 (100), 401 (178)	261 (48), 352 (39)
45	C ₂₀ H ₃₂ O ₂	17 α -Methyl- Δ^5 -an- drostene-3 β , 17 β - diol	235 (141), 309 (155), 355 (136), 390 (168) [I], 438 (373), 497 (209)	226 (136), 258 (105), 335 (123), 372 (123), 478 (145)
46	C ₂₀ H ₃₄ O	17 α -Methyl-andro- stane-17 β -ol	241 (75), 318 (230)	255 (70)

 TABLE IV
 ABSORPTION SPECTRA OF C₂₁ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E _{1 cm.} ^{1%})	MIN. m μ (E _{1 cm.} ^{1%})
47	C ₂₁ H ₂₆ O ₃	$\Delta^{5,7,9(11)}$ -Androsta- triene-3 β -ol-17-one- acetate	292 (200), 349 (250), 412 (508)	270 (167), 317 (175), 368 (208)
48	C ₂₁ H ₂₈ O ₂	$\Delta^{4,11}$ -Pregnadiene- 3, 20-dione	290 (526), 318 (265) [I], 473 (39)	231 (135), 400 (17)
49	C ₂₁ H ₂₈ O ₂	$\Delta^{4,16}$ -Pregnadiene- 3, 20-dione	302 (773), 376 (23)	245 (145), 352 (18)
50	C ₂₁ H ₂₈ O ₂	$\Delta^{5,7,9(11)}$ -Pregna- triene-3 β -ol-20-one	306 (227), 363 (491), 377 (513), 412 (100) [I], 470 (82)	282 (195), 326 (191), 368 (482), 435 (73)
51	C ₂₁ H ₂₈ O ₃	Δ^4 -Pregnene-3, 6, 20- trione	348 (637)	268 (92)
52	C ₂₁ H ₂₈ O ₃	Δ^4 -Pregnene-3, 11, 20- trione	283 (491)	229 (122)
53	C ₂₁ H ₂₈ O ₄	Δ^4 -Androstene-17 β -ol- 3, 11-dione-acetate	285 (496), 360 (16) [I]	229 (84)
54	C ₂₁ H ₂₈ O ₅	Δ^4 -Pregnene-17 α , 21- diol-3, 11, 20-trione	283 (532), 342 (215), 413 (185) [I], 419 (188), 480 (21) [I]	231 (154), 318 (142), 371 (81)
55	C ₂₁ H ₃₀ O ₂	Δ^7 -Allopregnene- 3, 20-dione	283 (527), 343 (219), 413 (170) [I], 420 (173), 480 (19) [I]	232 (181), 318 (148), 373 (85)
56	C ₂₁ H ₃₀ O ₂	Δ^7 -Allopregnene- 3, 20-dione	289 (132) [I], 322 (209)	255 (59)
57	C ₂₁ H ₃₀ O ₂	$\Delta^{4,20}$ -17-Isopregna- diene-17 β -ol-3-one	292 (590), 335 (229) [I], 475 (29)	230 (157), 410 (19)
58	C ₂₁ H ₃₀ O ₂	$\Delta^{5,7}$ -Pregnadiene-3 β - ol-20-one	238 (244), 323 (161), 405 (730)	231 (239), 282 (117), 339 (144)
58	C ₂₁ H ₃₀ O ₂	Δ^4 -Pregnene-3, 20- dione	291 (504) 292 (513)	229 (174) None

TABLE IV—Continued

NO	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_1^{1\%}$ cm.)	MIN. $m\mu$ ($E_1^{1\%}$ cm.)
59	$C_{21}H_{30}O_3$	$\Delta^{5,7}$ -Androstadiene-17 β -ol-3-one-ethylene ketal	302 (735), 386 (117), 495 (48)	235 (144), 344 (65), 436 (30)
60	$C_{21}H_{30}O_3$	Δ^4 -Androstene-17 β -ol-3-one-acetate	296 (558)	231 (96)
61	$C_{21}H_{30}O_3$	Δ^5 -Androstene-3 β -ol-17-one-acetate	304 (283), 404 (626), 482 (17)	250 (57), 344 (74), 456 (13)
62	$C_{21}H_{30}O_3$	Methyl 3-keto- Δ^4 -etiocholenate	292 (513)	236 (127)
63	$C_{21}H_{30}O_3$	Δ^4 -Pregnene-6 β -ol-3,20-dione	290 (296), 344 (343), 465 (38)	245 (133), 309 (222), 397 (17)
64	$C_{21}H_{30}O_3$	Δ^4 -Pregnene-11 α -ol-3,20-dione	290 (404), 318 (254) [I], 473 (38)	232 (108), 380 (13)
65	$C_{21}H_{30}O_3$	Δ^4 -Pregnene-11 β -ol-3,20-dione	290 (337), 318 (221) [I], 474 (29)	231 (92), 380 (8)
66	$C_{21}H_{30}O_3$	Δ^4 -Pregnene-17 α -ol-3,20-dione	289 (570), 431 (230)	337 (13)
67	$C_{21}H_{30}O_3$	Δ^4 -Pregnene-21-ol-3,20-dione	288 (570), 372 (65), 438 (48)	239 (139), 330 (13), 395 (22)
68	$C_{21}H_{30}O_4$	Δ^5 -Androstene-3 β ,14-diol-17-one-3-acetate	240 (246), 317 (129), 402 (517), 500 (125)	227 (217), 272 (100), 342 (117), 452 (88)
69	$C_{21}H_{30}O_4$	Δ^4 -Pregnene-6 β ,11 α -diol-3,20-dione	288 (174), 346 (532), 470 (96)	255 (125), 300 (160), 406 (56)
70	$C_{21}H_{30}O_4$	Δ^4 -Pregnene-11 α ,17 α -diol-3,20-dione	242 (214) [I], 286 (504), 375 (154), 449 (112)	230 (202), 333 (82), 415 (102)
71	$C_{21}H_{30}O_4$	Δ^4 -Pregnene-11 α ,21-diol-3,20-dione	241 (183), 287 (383), 377 (221), 456 (212), 473 (190) [I]	225 (167), 247 (179), 324 (94), 409 (117)
72	$C_{21}H_{30}O_4$	Δ^4 -Pregnene-11 β ,21-diol-3,20-dione	241 (177), 287 (479), 331 (238), 374 (192), 418 (57), 460 (64)	230 (162), 247 (174), 318 (223), 362 (162), 407 (53), 432 (53)
73	$C_{21}H_{30}O_4$	Δ^4 -Pregnene-17 α ,21-diol-3,20-dione	240 (254), 288 (537), 338 (142), 486 (50) [I], 535 (67)	249 (208), 327 (138), 390 (29)
			241 (235), 289 (530), 330 (165) [I], 490 (52) [I], 534 (65)	248 (196), 392 (30)
74	$C_{21}H_{30}O_5$	Allopregnane-17 α ,21-diol-3,11,20-trione	242 (180), 252 (188), 270 (192), 341 (200), 424 (92), 474 (72)	229 (168), 246 (168), 256 (172), 295 (108), 378 (52), 450 (64)
75	$C_{21}H_{30}O_5$	Δ^4 -Pregnene-6 β ,17 α ,21-triol-3,20-dione	237 (182) [I], 286 (208), 343 (450), 398 (65), 430 (76), 475 (84)	252 (156), 302 (192), 383 (60), 403 (64), 438 (74)
76	$C_{21}H_{30}O_5$	Δ^4 -Pregnene-11 α ,17 α ,21-triol-3,20-dione	237 (420), 282 (462), 391 (325), 475 (153)	252 (326), 330 (130), 435 (137)
77	$C_{21}H_{30}O_5$	Δ^4 -Pregnene-11 β ,17 α ,21-triol-3,20-dione	237 (400), 282 (431), 393 (180), 475 (204)	229 (388), 252 (302), 352 (122), 417 (153)

TABLE IV—*Concluded*

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)	MIN. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)
78	C ₂₁ H ₃₂ O	Δ^4 -Pregnene-3-one	294 (409)	None
79	C ₂₁ H ₃₂ O ₂	Pregnane-3,20-dione	237 (159) [I]	None
80	C ₂₁ H ₃₂ O ₂	Δ^5 -Pregnene-3 β -ol-20-one	239 (130) [I], 330 (287), 412 (200)	270 (83), 381 (100)
81	C ₂₁ H ₃₂ O ₃	Allopregnane-11 α -ol-3,20-dione	228 (200) [I], 320 (213)	259 (76)
82	C ₂₁ H ₃₂ O ₃	Pregnane-17 α -ol-3,20-dione	240 (148), 290 (270), 432 (65)	228 (139), 252 (139), 342 (13)
83	C ₂₁ H ₃₂ O ₃	Δ^4 -Pregnene-20 α ,21-diol-3-one	292 (526), 337 (144) [I]	230 (122)
84	C ₂₁ H ₃₂ O ₃	Δ^4 -Pregnene-11 β ,17 α ,20 β ,21-tetrol-3-one (monohydrate)	240 (538), 283 (446), 330 (139) [I], 405 (119), 468 (112), 515 (85) [I]	256 (289), 359 (88), 443 (106)
85	C ₂₁ H ₃₄ O	Δ^5 -Pregnene-3 β -ol	237 (119), 313 (252), 418 (105), 500 (33) [I]	226 (114), 256 (95), 389 (86)
86	C ₂₁ H ₃₄ O ₂	Pregnane-3 α -ol-20-one	233 (130) [I], 331 (227), 396 (18) [I]	267 (75)
			235 (136), 331 (232), 410 (11) [I]	266 (68)
87	C ₂₁ H ₃₄ O ₂	Δ^5 -Pregnene-3 β ,20 β -diol	234 (152) [I], 312 (286), 411 (195), 439 (148) [I], 490 (100) [I]	256 (124), 376 (138)
88	C ₂₁ H ₃₄ O ₃	Allopregnane-3 β ,17 α -diol-20-one	229 (165) [I], 319 (209), 407 (78), 489 (26) [I]	260 (113), 378 (61)
89	C ₂₁ H ₃₄ O ₃	Pregnane-3 α ,17 α -diol-20-one	238 (148), 315 (191), 327 (183) [I], 410 (87), 500 (35) [I]	225 (139), 258 (113), 379 (65)
90	C ₂₁ H ₃₄ O ₄	Pregnane-3 α ,11 α ,17 α -triol-20-one (monohydrate)	239 (176), 300 (196), 379 (106) [I], 408 (156), 431 (128) [I], 520 (40) [I]	226 (168), 258 (132), 363 (88)
91	C ₂₁ H ₃₄ O ₄	Pregnane-3 α ,11 β ,17 α -triol-20-one	234 (181) [I], 321 (169), 347 (185), 415 (150), 440 (146)	262 (119), 328 (165), 401 (142), 429 (142).
92	C ₂₁ H ₃₆ O ₂	Allopregnane-3 α ,20 α -diol	322 (191) [I], 343 (200), 430 (123), 502 (27) [I]	256 (64), 391 (77)
93	C ₂₁ H ₃₆ O ₂	Allopregnane-3 β ,20 β -diol	235 (135), 330 (243), 411 (30)	227 (130), 267 (74), 390 (22)
94	C ₂₁ H ₃₆ O ₂	Pregnane-3 α ,20 α -diol	233 (86) [I], 323 (200) [I], 340 (204), 431 (155), 497 (32) [I]	258 (73), 389 (86)
95	C ₂₁ H ₃₆ O ₂	Pregnane-3 α ,20 β -diol	239 (113), 323 (217), 428 (152), 496 (39) [I]	228 (104), 260 (87), 388 (96)
96	C ₂₁ H ₃₆ O ₃	Allopregnane-3 β ,20 β ?,21-triol	314 (163), 339 (154), 418 (221), 435 (184) [I], 498 (46) [I]	256 (75), 334 (150), 374 (121)
97	C ₂₁ H ₃₆ O ₃	Pregnane-3 α ,11 β ,17 α ,20 β ,21-pentol	239 (273), 290 (146) [I], 360 (146) [I], 378 (165) [I], 414 (340), 446 (279) [I], 500 (208)	225 (250), 323 (125), 489 (204)

TABLE V
 ABSORPTION SPECTRA OF C₂₂ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
98	C ₂₂ H ₃₄ O ₂	Δ^5 -Pregnene-3 β -methoxy-20-one	239 (152), 322 (300), 413 (222)	227 (148), 270 (96), 380 (113)
99	C ₂₂ H ₃₄ O ₃	3 α -Hydroxy- Δ^{11} -bisorocholenic acid	234 (88), 339 (267)	225 (83), 252 (58)

 TABLE VI
 ABSORPTION SPECTRA OF C₂₃ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
100	C ₂₃ H ₃₆ O ₄	16 α ,17 α -Oxido- $\Delta^{5,7,9(11)}$ -pregnatriene-3 β -ol-20-one-acetate	243 (441), 259 (407) [I], 278 (322) [I], 290 (285) [I], 309 (241) [I], 484 (630)	225 (407), 352 (115)
101	C ₂₃ H ₃₀ O ₄	16 α ,17 α -Oxido- $\Delta^{5,7}$ -pregnadiene-3 β -ol-20-one-acetate	230 (350) [I], 410 (300), 428 (273) [I], 475 (242)	343 (115), 462 (235)
102	C ₂₃ H ₃₀ O ₅	Δ^4 -Pregnene-21-ol-3,11,20-trione-acetate	283 (540), 354 (116), 401 (207) [I], 415 (266)	233 (129), 323 (42), 371 (79)
103	C ₂₃ H ₃₀ O ₆	Δ^1 -Allopregnene-17 α ,21-diol-3,11,20-trione-21-acetate	279 (243), 340 (93) [I], 415 (54), 480 (11) [I]	378 (29)
104	C ₂₃ H ₃₀ O ₆	Δ^4 -Pregnene-17 α ,21-diol-3,11,20-trione-21-acetate	283 (486), 342 (193), 415 (164), 486 (18) [I]	228 (146), 319 (125), 371 (68)
105	C ₂₃ H ₃₂ O ₃	$\Delta^{5,16}$ -Pregnadiene-3 β -ol-20-one-acetate	296 (233), 384 (329), 412 (229), 470 (129), 547 (92)	255 (154), 331 (171), 407 (225), 442 (121), 525 (75)
106	C ₂₃ H ₃₂ O ₄	$\Delta^{5,7}$ -Androstadiene-3 β ,17 β -diol-di-acetate	231 (162) [I], 290 (127), 348 (158) [I], 358 (173), 416 (285), 465 (335), 497 (158) [I]	272 (123), 319 (115), 367 (162), 432 (258)
107	C ₂₃ H ₃₂ O ₄	$\Delta^{5,14}$ -Androstadiene-3 β ,17 β -diol-di-acetate	271 (169), 307 (112) [I], 409 (242), 480 (504) [I], 490 (527)	237 (131), 337 (81), 425 (231)
108	C ₂₃ H ₃₂ O ₄	16 α ,17 α -Oxido- Δ^5 -pregnene-3 β -ol-20-one-acetate	313 (115), 334 (114), 405 (408), 471 (289)	275 (104), 327 (112), 346 (96), 436 (239)
109	C ₂₃ H ₃₂ O ₄	Δ^4 -Pregnene-21-ol-3,20-dione-acetate	288 (475), 371 (52), 437 (38)	234 (111), 331 (19), 395 (23)
110	C ₂₃ H ₃₂ O ₄	Δ^{16} -Pregnene-3 α -ol-11,20-dione-acetate	283 (371), 328 (70) [I], 380 (74) [I], 400 (111)	230 (104), 352 (33)
111	C ₂₃ H ₃₂ O ₅	Δ^5 -Androstene-3,11,17-trione-3,17-di-ethylene ketal	293 (459)	235 (74)

TABLE VI—Concluded

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
112	C ₂₈ H ₃₂ O ₆	Δ^4 -Pregnene-17 α , 21-diol-3, 20-dione-21-acetate	241 (259), 289 (478), 328 (196) [I], 490 (63) [I], 535 (100), 550 (93) [I]	251 (204), 385 (26)
113	C ₂₃ H ₃₂ O ₆	Pregnane-17 α , 21-diol-3, 11, 20-trione-21-acetate	233 (164) [I], 242 (150) [I], 251 (136), 270 (135), 342 (198), 421 (165), 475 (43)	248 (135), 257 (126), 292 (83), 372 (72), 463 (41)
114	C ₂₈ H ₃₂ O ₆	Δ^4 -Pregnene-11 β , 17 α , 21-triol-3, 20-dione-21-acetate	240 (382), 285 (486), 392 (150), 460 (75)	252 (243), 358 (107), 434 (71)
115	C ₂₈ H ₃₄ O ₄	Δ^4 -Androstene-3 β , 17 β -diol-diacetate	240 (93) [I], 305 (215), 354 (137), 408 (282), 483 (93), 517 (70) [I]	252 (85), 336 (126), 365 (130), 463 (85)
116	C ₂₃ H ₃₄ O ₄	Δ^5 -Androstene-3 β , 17 β -diol-diacetate	307 (192), 408 (358), 440 (177) [I], 480 (85) [I]	257 (81), 336 (119)
117	C ₂₃ H ₃₄ O ₄	Δ^7 -Androstene-3 β , 17 β -diol-diacetate	233 (100) [I], 308 (142), 411 (327), 431 (277) [I], 497 (85) [I]	259 (62), 350 (96)
118 ₅	C ₂₃ H ₃₄ O ₄	Δ^6 (14)-Androstene-3 β , 17 β -diol-diacetate	233 (96) [I], 308 (139), 411 (327), 432 (269) [I], 491 (89) [I]	259 (58), 350 (96)
119	C ₂₃ H ₃₄ O ₄	3 α , 9 α -Oxido-11-ketonorcholanolic acid	290 (165), 341 (58) [I], 412 (42)	250 (85), 372 (27)
120	C ₂₃ H ₃₄ O ₄	Pregnane-3 α -ol-11, 20-dione-acetate	319 (58), 382 (100) [I], 401 (177), 414 (131) [I], 228 (107) [I], 318 (78), 384 (85) [I], 402 (137), 408 (126) [I]	262 (35), 350 (27), 262 (44), 354 (33)
121	C ₂₃ H ₃₄ O ₆	Δ^5 -Androstene-11 α -ol-3, 17-dione-diethylene ketal	296 (481), 379 (122), 402 (48) [I], 462 (26)	242 (93), 335 (41), 435 (19)
122	C ₂₃ H ₃₄ O ₆	Pregnane-11 β , 17 α , 21-triol-3, 20-dione-21-acetate	238 (207), 291 (234), 341 (93) [I], 395 (88), 490 (43)	229 (198), 256 (136), 368 (71), 452 (41)
123	C ₂₃ H ₃₆ O ₆	Allopregnane-3 β -ol-20-one-acetate	226 (100) [I], 333 (216), 412 (14), 234 (112), 329 (235), 415 (15) [I]	261 (56), 395 (12), 228 (110), 263 (65)
124	C ₂₃ H ₃₆ O ₄	Androstane-3 α , 17 β -diol-diacetate	343 (226), 410 (37) [I], 470 (15) [I]	250 (59)
125	C ₂₃ H ₃₈ O ₆	Allopregnane-3 β , 20 β -diol-3-acetate	237 (102), 314 (188), 421 (160), 430 (156) [I], 492 (52) [I]	227 (98), 260 (76), 380 (96)

TABLE VII
 ABSORPTION SPECTRA OF C₂₄ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
126	C ₂₄ H ₃₈ O ₄	Δ^5 -3 β -Acetoxy-bisnor-cholenic acid	235 (37) [I], 339 (148), 416 (167)	257 (30), 377 (67)
127	C ₂₄ H ₃₈ O ₄	3 α -Hydroxy-12-keto- Δ^9 (11)-cholenic acid	290 (169), 378 (158)	255 (104), 336 (73)
128	C ₂₄ H ₃₈ O ₅	3 α -Acetoxy-11-keto-bisnorcholenic acid	320 (82), 402 (143), 414 (125) [I]	262 (39), 352 (32)
129	C ₂₄ H ₃₈ O ₃	3 α -Hydroxy- Δ^{11} -cholenic acid	235 (73) [I], 307 (289), 430 (27) [I]	255 (62)
130	C ₂₄ H ₃₈ O ₃	3-Keto-cholanic acid	310 (7)	275 (4)
131	C ₂₄ H ₃₈ O ₄	3 α -Hydroxy-12-keto-cholanic acid	231 (143) [I], 315 (168), 389 (257)	263 (82), 346 (93)
132	C ₂₄ H ₄₀ O ₂	Cholanic acid	313 (212)	238 (27)
133	C ₂₄ H ₄₀ O ₃	3 α -Hydroxy-cholanic acid	311 (200)	249 (42)
134	C ₂₄ H ₄₀ O ₄	3 α ,12 α -Dihydroxy-cholanic acid	311 (272), 390 (54) [I]	253 (68)
135	C ₂₄ H ₄₀ O ₅	3 α ,7 α ,12 α -Trihydroxy-cholanic acid	304 (117), 371 (424) [I], 389 (627), 454 (62) [I], 478 (76)	256 (59), 335 (90), 439 (52)

 TABLE VIII
 ABSORPTION SPECTRA OF C₂₅ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
136	C ₂₅ H ₃₄ O ₆	$\Delta^{4,7}$ -Pregnadiene-17 α ,21-diol-3,20-dione-21-acetate-20-ethylene ketal	235 (283) [I], 281 (340), 395 (203), 472 (223)	250 (253), 342 (117), 410 (160)
137	C ₂₅ H ₃₄ O ₇	Δ^4 -Pregnene-17 α , -20 β ,21-triol-3,11-dione-20,21-diacetate	283 (359) 283 (344)	230 (56) 230 (28)
138	C ₂₅ H ₃₆ O ₅	Δ^5 -Pregnene-3 β ,21-diol-20-one-diacetate	314 (141) [I], 339 (152), 378 (183), 406 (193), 476 (103), 533 (55) [I]	255 (76), 352 (145), 390 (162), 437 (93)
139	C ₂₅ H ₃₆ O ₆	Δ^4 -Pregnene-17 α , -20 α ,21-triol-3-one-20,21-diacetate	237 (412), 282 (407), 380 (75) [I], 430 (136), 470 (64) [I]	255 (218), 347 (46)
140	C ₂₅ H ₃₆ O ₆	Δ^4 -Pregnene-17 α , -20 β ,21-triol-3-one-20,21-diacetate	238 (513), 285 (427), 340 (57) [I], 403 (57), 421 (50) [I], 530 (30) 239 (363), 288 (400), 405 (33), 530 (17)	253 (213), 360 (47), 478 (27) 253 (163), 370 (27), 465 (13)

TABLE VIII—*Concluded*

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_1^{1\%}$ cm.)	MIN. $m\mu$ ($E_1^{1\%}$ cm.)
141	C ₂₅ H ₃₆ O ₆	Δ^5 -Pregnene-3 β ,17 α , - 21-triol-20-one- 3,21-diacetate	235 (123) [I], 326 (184), 407 (297), 489 (84), 525 (61) [I] 326 (186), 406 (259), 489 (82), 520 (59) [I]	256 (106), 363 (103), 455 (74) 253 (100), 365 (100)
142	C ₂₅ H ₃₆ O ₇	Pregnane-3 α ,17 α ,21- triol-11,20-dione- 3,21-diacetate	271 (109), 340 (141), 415 (151), 475 (52) [I]	252 (104), 290 (91), 371 (89)
143	C ₂₅ H ₃₆ O ₇	Δ^4 -Pregnene-11 β ,17 α - 20 β ,21-tetrol-3- one-20,21-diacetate	242 (188), 282 (344), 332 (44) [I], 465 (238)	247 (181), 383 (25)
144	C ₂₅ H ₃₆ O ₇	Δ^5 -Pregnene-17 α ,21- diol-3,11,20- trione-3,20-di- ethylene ketal	292 (472), 343 (169), 415 (131), 486 (13) [I]	235 (134), 327 (144), 374 (66)
145	C ₂₅ H ₃₆ O ₄	Δ^5 -Pregnene-3,20- dione-di-ethylene ketal	240 (179), 302 (458)	255 (166)
146	C ₂₅ H ₃₆ O ₆	Δ^5 -Pregnene-17 α ,21- diol-3,20-dione-di- ethylene ketal	238 (290), 295 (438), 339 (197), 500 (97) [I], 540 (152), 566 (155)	251 (184), 329 (184), 405 (39), 553 (148)
147	C ₂₅ H ₃₈ O ₇	Pregnane-3 α ,11 β , - 17 α ,21-tetrol-20- one-3,21-diacetate	332 (190), 405 (255), 506 (68)	275 (110), 365 (107), 488 (65)
148	C ₂₅ H ₃₈ O ₇	Δ^5 -Pregnene-11 α , - 17 α ,21-triol-3,20- dione-di-ethylene ketal	237 (327), 291 (379), 392 (291), 480 (158)	253 (249), 335 (112), 428 (121)
149	C ₂₅ H ₃₈ O ₇	Δ^5 -Pregnene-11 β , - 17 α ,21-triol-3,20- dione-di-ethylene ketal	237 (316), 291 (422), 389 (209), 480 (131)	225 (294), 252 (234), 337 (106), 435 (112)
150	C ₂₅ H ₄₀ O ₄	Methyl 3 α -hydroxy- 12-ketocholanate	315 (125), 389 (196)	265 (68), 345 (61)
151	C ₂₅ H ₄₀ O ₄	Pregnane-3 α ,20 α - diol-diacetate	317 (157), 331 (147) [I], 430 (168), 490 (43) [I]	258 (68), 381 (89)

TABLE IX
 ABSORPTION SPECTRA OF C₂₇ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
152	C ₂₇ H ₃₄ O ₆	$\Delta^{5,7}$ -Pregnadiene-3 β -ol-20-one-acetate-maleic anhydride adduct	240 (328), 261 (175) [I], 309 (81), 403 (31).	295 (75), 356 (22)
153	C ₂₇ H ₃₇ NO ₃	Δ^4 -Jervone	281 (471), 380 (45) [I], 407 (27) [I]	228 (126)
154	C ₂₇ H ₃₃ O ₃	$\Delta^{4,7}$ -22a-Spirostadiene-3-one	287 (403), 403 (66), 468 (55)	236 (121), 343 (41), 431 (48)
155	C ₂₇ H ₃₈ O ₇	$\Delta^{5,7}$ -Pregnadiene-17 α ,21-diol-3,20-dione-21-acetate-di-ethylene ketal	238 (252) [I], 292 (309), 380 (152) [I], 392 (170), 476 (215)	251 (215), 352 (112), 412 (124)
156	C ₂₇ H ₃₃ NO ₂	Veratramine	249 (123) [I], 279 (83), 291 (83), 311 (93), 415 (967), 470 (250), 490 (123) [I]	268 (77), 284 (80), 295 (82), 340 (67), 455 (167)
157	C ₂₇ H ₃₃ NO ₃	Jervine	282 (203), 313 (227), 405 (237), 480 (120)	241 (150), 288 (200), 352 (110), 442 (97)
158	C ₂₇ H ₄₀ O ₃	Δ^4 -22a-Spirostene-3-one	292 (397)	239 (83)
159	C ₂₇ H ₄₀ O ₇	Δ^5 -Pregnene-17 α , -21-diol-3,20-dione-21-acetate-di-ethylene ketal	239 (294), 296 (397), 339 (188), 496 (94) [I], 543 (159), 569 (162)	252 (174), 327 (177), 397 (35), 553 (153)
160	C ₂₇ H ₄₂ O ₄	22a-Allospirostane-3 β -ol-11-one	280 (57), 320 (67), 401 (110)	259 (52), 360 (37)
161	C ₂₇ H ₄₂ NO ₃	Cevine	253 (270), 263 (268), 270 (244) [I], 323 (167), 402 (120), 525 (236)	235 (245), 259 (264), 298 (153), 355 (81), 440 (78)
162	C ₂₇ H ₄₄ O	Δ^4 -Cholestene-3-one	292 (437)	232 (89)
163	C ₂₇ H ₄₄ O	Δ^7 -Cholestene-3-one	240 (86), 317 (189)	228 (79), 263 (68)
164	C ₂₇ H ₄₄ O ₃	22b-Spirostane-3 β -ol	317 (123), 330 (123), 401 (47)	260 (47), 324 (120), 378 (37)
165	C ₂₇ H ₄₆ O	Cholestane-3-one	312 (152)	255 (52)
166	C ₂₇ H ₄₆ O	Δ^5 -Cholestene-3 β -ol	242 (69), 319 (196), 415 (61), 489 (22) [I]	226 (63), 258 (61), 393 (56)
167	C ₂₇ H ₄₆ O	Coprostane-3-one	235 (91) [I], 316 (146), 477 (12)	263 (66), 430 (10)
168	C ₂₇ H ₄₈ O	Coprostane-3 β -ol	240 (54), 320 (117), 410 (27) [I]	224 (48), 260 (43)

TABLE X
 ABSORPTION SPECTRA OF C₂₈ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
169	C ₂₈ H ₄₀ O	$\Delta^{4,7,9(11),22}$ -Ergosta- tetraene-3-one	240 (189) [I], 292 (496), 400 (86), 455 (61) [I]	228 (172), 378 (75)
170	C ₂₈ H ₄₂ O	$\Delta^{5,7,9(11),22}$ -Ergosta- tetraene-3 β -ol	249 (269) [I], 278 (355), 332 (179) [I], 373 (221), 433 (314), 517 (104) [I]	230 (245), 344 (166), 384 (210)
171	C ₂₈ H ₄₂ O	$\Delta^{4,7,22}$ -Ergostatriene- 3-one	294 (504), 444 (29)	233 (111), 396 (18)
172	C ₂₈ H ₄₄ O	$\Delta^{7,22}$ -Ergostadiene- 3-one	238 (103), 312 (272)	225 (97), 258 (90)
173	C ₂₈ H ₄₄ O	$\Delta^{5,7,22}$ -Ergostatriene- 3 β -ol	231 (146) [I], 309 (289), 416 (168), 436 (143) [I], 490 (93) [I]	255 (111), 379 (129)
174	C ₂₈ H ₄₆ O	Chalinasterol ($\Delta^{5,22}$ - 24a-Ergostadiene- 3 β -ol)	240 (117), 314 (221), 421 (117), 440 (107) [I], 499 (69)	229 (114), 255 (103), 387 (97), 483 (66)
175	C ₂₈ H ₄₆ O	$\Delta^{7,22}$ -Ergostadiene- 3 β -ol	238 (93), 319 (224), 419 (81), 441 (66) [I], 469 (48) [I]	229 (90), 256 (79), 400 (76)
176	C ₂₈ H ₄₈ O	Campesterol (Δ^5 -24a- Ergostene-3 β -ol)	242 (80), 318 (220), 415 (71), 500 (29) [I]	226 (71), 258 (68), 387 (59)
177	C ₂₈ H ₄₆ O	Ergostane-3-one	240 (46), 313 (125)	230 (45), 257 (41)
178	C ₂₈ H ₄₈ O	Haliconasterol	240 (82), 317 (207), 415 (64), 442 (43) [I], 500 (25) [I]	226 (75), 257 (71), 392 (54)
179	C ₂₈ H ₄₈ O	Neospongosterol (Δ^{22} -24a-Ergostene- 3 β -ol)	240 (76), 319 (204), 393 (64) [I], 423 (72), 446 (62) [I], 478 (45) [I]	228 (72), 256 (66), 383 (60)
180	C ₂₈ H ₄₈ O	α -Stellasterol ($\Delta^8(14)$ - 24a-Ergostene-3 β - ol)	240 (107) [I], 316 (207), 420 (90), 441 (67) [I], 504 (31) [I]	258 (93), 388 (83)
181	C ₂₈ H ₄₈ O	β -Stellasterol (Δ^{14} - 24a-Ergostene- 3 β -ol)	239 (97), 319 (217), 394 (76) [I], 423 (79), 440 (67) [I], 489 (41) [I]	229 (93), 257 (83), 402 (72)
182	C ₂₈ H ₄₆ O ₂	14,15-Oxido-ergo- stane-3 β -ol	237 (121) [I], 308 (311), 340 (189) [I], 368 (125) [I], 415 (98), 448 (70) [I], 497 (54) [I]	256 (96), 398 (86)
183	C ₂₈ H ₅₀ O	Ergostane-3 α -ol	321 (162), 416 (27) [I], 473 (12) [I]	254 (54)
184	C ₂₈ H ₅₀ O	Ergostane-3 β -ol	321 (164), 410 (29) [I], 480 (14) [I] 321 (165), 406 (31) [I], 470 (15) [I]	255 (54) 254 (55)
185	C ₂₈ H ₅₀ O	Stellasterol (24a- Ergostane-3 β -ol)	240 (72), 320 (171), 415 (33) [I], 478 (17) [I]	227 (66), 259 (62)

TABLE XI
 ABSORPTION SPECTRA OF C₂₉ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
186	C ₂₉ H ₄₆ O ₄	$\Delta^{5,7,9(11)}$ -22a-Spirostatriene-3 β -ol-acetate	245 (244) [I], 347 (359), 409 (81), 474 (50)	279 (100), 383 (59), 458 (47)
187	C ₂₉ H ₄₂ O ₄	$\Delta^{7,9(11)}$ -22a-Allospirostadiene-3 β -ol-acetate	236 (197) [I], 286 (195), 409 (325), 469 (300)	256 (136), 343 (88), 437 (230)
188	C ₂₉ H ₄₂ O ₄	$\Delta^{5,7}$ -22a-Spirostadiene-3 β -ol-acetate	240 (272), 285 (156), 327 (94) [I], 406 (238), 471 (153)	226 (247), 269 (141), 346 (84), 440 (122)
189	C ₂₉ H ₄₄ O ₂	$\Delta^{5,5,7}$ -Cholestatriene-3 β -ol-acetate	291 (336), 373 (81) [I], 460 (106)	230 (126), 390 (47)
190	C ₂₉ H ₄₄ O ₂	$\Delta^{5,7,9(11)}$ -Cholestatriene-3 β -ol-acetate	279 (210), 368 (377), 438 (92)	251 (161), 319 (126), 407 (77)
191	C ₂₉ H ₄₄ O ₄	Δ^7 -22a-Allospirostene-3 β -ol-acetate	239 (109) [I], 325 (105) [I], 409 (397), 469 (44), 500 (26) [I], 537 (5) [I]	270 (71), 458 (41)
192	C ₂₉ H ₄₄ O ₄	Δ^5 -22a-Spirostene-3 β -ol-acetate	320 (94), 339 (86) [I], 412 (319), 490 (28)	265 (44), 358 (78), 458 (25)
193	C ₂₉ H ₄₆ NO ₂	Δ^5 -Solaniidene-3 β -ol-acetate	241 (81), 320 (160), 346 (142), 413 (242)	227 (74), 270 (58), 334 (135), 376 (106)
194	C ₂₉ H ₄₆ O ₂	$\Delta^{5,7}$ -Cholestadiene-3 β -ol-acetate	235 (108) [I], 312 (393), 406 (56) [I], 486 (50) [I]	254 (97)
195	C ₂₉ H ₄₆ O ₂	$\Delta^{8(9),24}$ -Cholestadiene-3 β -ol-acetate	239 (116) [I], 312 (218), 391 (97) [I], 414 (90), 500 (39) [I]	253 (113), 405 (89)
196	C ₂₉ H ₄₆ O ₃	Δ^5 -Cholestene-3 β -ol-7-one-acetate	285 (107) [I], 355 (419), 411 (23) [I], 484 (13) [I]	241 (58)
197	C ₂₉ H ₄₈ O	Chondrillasterol ($\Delta^{7,22}$ -24a-Stigmastadiene-3 β -ol)	238 (103), 313 (271), 440 (100), 494 (45) [I]	230 (102), 255 (91), 390 (79)
198	C ₂₉ H ₄₈ O	Fucoesterol ($\Delta^{5,24(28)}$ -Stigmastadiene-3 β -ol)	234 (113) [I], 317 (200), 431 (177), 500 (97) 238 (113) [I], 318 (187), 431 (198), 500 (103)	258 (93), 388 (107), 488 (92) 260 (93), 389 (112), 486 (97)
199	C ₂₉ H ₄₈ O	Poriferasterol ($\Delta^{5,22}$ -24a-Stigmastadiene-3 β -ol)	240 (107), 315 (257), 428 (127), 498 (63)	229 (103), 259 (97), 387 (82), 486 (60)
200	C ₂₉ H ₄₈ O	$\Delta^{5,22}$ -Stigmastadiene-3 β -ol	233 (117) [I], 314 (259), 425 (115), 498 (48) [I]	255 (97), 385 (76)
201	C ₂₉ H ₄₈ O	$\Delta^{7,22}$ -Stigmastadiene-3 β -ol	235 (93) [I], 314 (260), 446 (114), 496 (55) [I]	256 (83), 390 (79)
202	C ₂₉ H ₄₈ OS	Δ^5 -Cholestene-3 β -thiol-acetate	246 (52), 320 (148), 338 (121) [I], 407 (13) [I]	228 (42), 264 (45)
203	C ₂₉ H ₄₈ O ₂	Δ^5 -Cholestene-3 β -ol-acetate	315 (200), 415 (73), 494 (27) [I]	255 (73), 389 (62)

TABLE XI—*Concluded*

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)	MIN. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)
204	C ₂₉ H ₄₈ O ₂	Δ^8 -Cholestene-3 β -ol-acetate	239 (84) [I], 319 (226), 418 (80), 441 (66) [I], 480 (40) [I]	257 (76), 385 (70)
205	C ₂₉ H ₄₈ O ₂	Δ^7 -Cholestene-3 β -ol-acetate	238 (60) [I], 318 (200), 418 (87), 482 (45) [I]	253 (55), 383 (73)
206	C ₂₉ H ₄₈ O ₂	$\Delta^8(14)$ -Cholestene-3 β -ol-acetate	239 (83) [I], 316 (207), 395 (73) [I], 422 (78), 494 (32) [I]	253 (75), 383 (70)
207	C ₂₉ H ₄₈ O ₃	Cholestane-3 β -ol-7-one-acetate	305 (189), 402 (42), 475 (9) [I]	243 (63), 370 (31)
208	C ₂₉ H ₅₀ O	Palysterol	242 (100), 318 (248), 421 (103), 440 (90) [I], 500 (48)	228 (97), 258 (88), 388 (76), 486 (47)
209	C ₂₉ H ₅₀ O	Δ^5 -Stigmastene-3 β -ol	233 (77) [I], 317 (190), 416 (60), 500 (22) [I]	253 (67), 390 (50)

TABLE XII
ABSORPTION SPECTRA OF C₃₀ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)	MIN. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)
210	C ₃₀ H ₄₈ O ₂	$\Delta^7, 22$ -Ergostadiene-3 β -ol-acetate	311 (265), 395 (79) [I], 418 (84)	252 (76), 382 (76)
211	C ₃₀ H ₄₈ O ₂	$\Delta^8, 14$ -Ergostadiene-3 β -ol-acetate	229 (106) [I], 310 (323), 377 (77) [I], 415 (74)	252 (87), 401 (73)
212	C ₃₀ H ₅₀ O ₂	Δ^7 -Ergostene-3 β -ol-acetate	234 (79) [I], 318 (216), 395 (84) [I], 413 (87), 470 (53) [I]	254 (63), 382 (76)
213	C ₃₀ H ₅₀ O ₂	$\Delta^8(14)$ -Ergostene-3 β -ol-acetate	319 (213), 399 (81) [I], 416 (84), 472 (52) (I)	253 (60), 381 (71)
214	C ₃₀ H ₅₀ O ₂	Δ^{14} -Ergostene-3 β -ol-acetate	318 (223), 392 (82) [I], 418 (87), 478 (53) [I]	252 (61), 381 (74)
215	C ₃₀ H ₅₂ O ₂	Ergostane-3 α -ol-acetate	320 (150), 402 (55), 475 (18) [I]	257 (41), 386 (50)
216	C ₃₀ H ₅₂ O ₂	Ergostane-3 β -ol-acetate	320 (156), 400 (32) [I]	258 (52)

TABLE XIII
ABSORPTION SPECTRA OF C₃₁ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)	MIN. $m\mu$ ($E_{1\text{ cm.}}^{1\%}$)
217	C ₃₁ H ₅₂ O ₂	Clionasteryl acetate (Δ^5 -24a-Stigmastene-3 β -ol-acetate)	241 (76), 318 (194), 415 (73), 440 (49) [I], 497 (27) [I]	228 (70), 255 (67), 386 (58)
218	C ₃₁ H ₅₄ O ₂	Stigmastane-3 β -ol-acetate	233 (61) [I], 320 (161), 402 (48), 474 (19) [I]	255 (52), 389 (45)

The compounds have been tabulated according to empirical formula in the manner of *Chemical Abstracts*.

PURITY OF COMPOUNDS

The ideal situation is to have all of the compounds of analytical purity. However, in a project of this magnitude and scope, it was impractical, and, in many instances, impossible to determine the purity of each steroid. Slight impurities may, obviously, have effects on the spectra. In general, we feel that these alterations will be of a minor magnitude, and that the spectra described, for all practical purposes, are representative of the individual compounds.

All samples received from outside investigators were used as received with the exception of androstane-3,17-dione (Compound No. 18), and pregnane-3 α -ol-20-one (No. 86). These two were purified to constant m.p.

TABLE XIV
ABSORPTION SPECTRA OF C₃₄ STEROIDS

NO.	EMPIRICAL FORMULA	COMPOUND	MAX. m μ (E ₁ ^{1%} cm.)	MIN. m μ (E ₁ ^{1%} cm.)
219	C ₃₄ H ₅₆ O ₂	Δ^5 -Cholestene-3 β -ol-benzoate	262 (429), 312 (212), 414 (56), 440 (40) [I], 495 (19) [II]	284 (147), 391 (47)

Compounds such as progesterone (No. 58), cortisone acetate (No. 104) and the like, were purchased from commercial sources, and were, at least, of U.S.P. purity, and were used as received. In a number of cases where the purity was in doubt, the compound was recrystallized to constant m.p., e.g., Δ^5 -androstene-3 β ,17 β -diol-diacetate (No. 116).

Compounds of Lederle origin were wherever possible from the same batch as the analytical sample.

Zymosteryl acetate ($\Delta^5,24$ -cholestadiene-3 β -ol-acetate) (No. 195) is of doubtful homogeneity. $\Delta^{1,3,5(10),6,8}$ -Estrapentaene-3-ol-17-one (No. 1), Δ^1 -androstene-3,17-dione (No. 9), and $\Delta^{4,11}$ -pregnadiene-3,20-dione (No. 48) possessed a very slight coloration.

Solutions of Δ^5 -24a-ergostene-3 β -ol (No. 176), and Δ^5 -24a-stigmastene-3 β -ol-acetate (No. 217) contained a trace of insoluble material.

Acknowledgment. We are happy to acknowledge the invaluable assistance of Mr. Walter Muller who determined all of the spectra.

Also we wish to thank the following for their generous gifts of compounds for this investigation: Drs. D. H. R. Barton, W. Bergmann, J. Fried, T. H. Gallagher, E. B. Hershberg, M. N. Huffman, P. L. Julian, R. Kapp, S. Lieberman, W. H. Pearlman, D. H. Peterson, G. Rosenkranz, J. J. Schneider, C. R. Scholz, A. St. André, M. Tishler, and D. I. Weisblat.

SUMMARY

The absorption spectra (220–600 m μ) of 220 steroids in 97% sulfuric acid at 25° have been determined after allowing the solutions to stand for 2 hours

at 25°. Data ($E_{1\text{cm.}}^{1\%}$, maxima and minima) for each spectrogram (recording spectrophotometer) are tabulated. Concentration studies on Reichstein's Substance S, pregnane-3 α ,17 α -diol-20-one, hydrocortisone, and 11-epi-hydrocortisone indicate that solutions of these compounds, within the concentration range (<40-45 $\mu\text{g./ml.}$) examined, obey Beer's Law.

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