

# INDEX

- Abundance  
  cosmic, 378–380  
  elemental, 867–869  
  gases in solar nebula, 433, 434  
  general, 93, 107, 115, 139, 142, 143,  
    154, 155, 163, 916  
  isotopic, 891, 892  
  volatiles, 364
- Accretion, 372, 411–413, 633
- Active regions, evolution, 803–806
- Activity  
  cessation, 638–644  
  general, 51–53, 55, 56, 58, 67, 68, 99,  
    113, 646, 647, 652, 653 (at long  
    distances), 657, 659, 691, 705  
  onset, 638–644
- Ag, 1079
- Al, 372, 379, 384 (figure), 401 (table),  
  402, 453, 454, 745, 746; 1081  
  (table), 1083, 1085, 1087
- Alfvén velocity, 923, 924
- Alfvén waves, 1146–1159
- Aphelia, directions, 500
- Apollo-Amor asteroids. *See under Earth-*  
  *crossing objects.*
- Ar, 145, 231, 232 (figure), 233, 430, 431,  
  432 (figure), 434 (table), 435, 739  
  (figure)
- Asteroids, 13, 14, 56–58, 67, 68, 73, 78,  
  338, 378, 411, 415, 522–525, 538,  
  618, 620–622 (comet-like), 630,  
  659 (comet-connection), 692, 697,  
  708, 802, 1260, 1262
- Astrometry, 3, 6, 10–14
- Bias, observing, 11, 12
- Bow shock, 907, 910, 930, 931, 1110  
  (figure), 1127, 1130, 1132–1137,  
  1141, 1145, 1146, 1150,  
  1155–1157, 1159–1164, 1179,  
  1187, 1188 (figure), 1192, 1199,  
  1202 (figure), 1213, 1214–1217,  
  1218 (figure), 1219 (figure), 1222
- Brightness  
  asymmetry, 653–658, 661, 662
- brightening, post-perihelion, 655  
  (figure)
- estimates, 215–218
- general, 20, 26, 29, 32, 36, 41, 44, 46,  
  48, 52, 58, 78, 99, 140, 151, 156,  
  157, 162, 178, 194, 199, 210, 524,  
  629, 632, 651, 726, 782, 795, 825,  
  826, 1062
- profile, 29, 33, 36, 37, 39, 58, 93, 100  
variations, 611–613, 636, 638, 644,  
  645, 650, 725, 728, 980
- C, 120, 121, 125, 126, 244, 261, 263, 315,  
  363, 378, 379 (table), 382, 383,  
  384 (figure), 385, 386, 387 (table),  
  388, 389, 391 (table), 395, 401  
  (table), 419, 449, 862, 883, 889,  
  892, 900, 902, 917, (figure), 928,  
  1047, 1078 (table), 1079, 1080,  
  1081 (table), 1083, 1085, 1086,  
  1097, 1261
- C<sub>–</sub>, 929, 1217
- C<sup>+</sup>, 387 (table), 925 (figure)
- C<sub>2</sub>, 40, 44, 46, 59, 125, 152, 212,  
  313–315, 316–322 (formation),  
  329, 362, 384–386, 387 (table),  
  443, 647, 652, 657, 661 (table),  
  782, 790, 791 (figure), 792, 855,  
  862, 866, 868, 885, 887 (table),  
  888, 890, 908, 909 (figure, table),  
  917, 956, 982, 1261
- C<sub>2</sub><sup>+</sup>, 1079
- C<sub>3</sub>, 46, 313–315, 321–326 (formation),  
  329, 386, 387 (table), 392, 443,  
  647, 652, 657, 661 (table), 855
- <sup>13</sup>C, 385, 856, 867
- Ca, 379 (table), 384 (figure), 387 (table),  
  401, 402, 892, 911, 1048, 1078,  
  (table), 1079, 1081 (table), 1083,  
  1085, 1086
- Ca<sup>+</sup>, 387 (table)
- <sup>12</sup>C/<sup>13</sup>C, 885, 887
- <sup>12</sup>C/<sup>13</sup>C, 384, 386, 387 (table), 440, 866,  
  881 (table), 885, 887 (table), 888,  
  889, 890, 892, 1085, 1086, 1088,

- 1259, 1261, 1274  
 $\text{C}_2\text{D}$ , 320 (figure)  
 $\text{C}_2\text{D}_2$ , 317, 319, 321  
 $\text{C}_6\text{D}_6$ , 248  
 $\text{CD/CH}$ , 882  
 $\text{CF}_3$ , 319  
 $\text{CF}_3\text{C}_2\text{H}$ , 317, 319–321  
 $\text{CH}$ , 152, 251, 315, 317, 321, 325 (figure), 326, 385, 386, 387 (table), 397, 859, 865, 885, 890, 909, 919, 1067  
 $\text{CH}^+$ , 385, 386, 387 (table), 397, 888, 1086  
 $\text{CH}_2$ , 122, 252, 864, 917  
 $\text{CH}_3$ , 122, 252, 930  
 $\text{CH}_4$ , 93, 94 (table), 102, 103, 108, 109, 112 (table), 115, 121, 125, 126, 227, 228, 231, 232 (figure), 233, 244, 247, 248, 251, 255, 278, 362–364, 366, 367, 370, 391 (table), 401, 402, 403 (table), 411, 412 (figure), 413, 414, 431, 434 (table), 440, 739 (figure), 837, 856, 859, 863, 868, 869, 884, 886 (figure), 911, 919, 924 (figure), 925 (figure), 929  
 $\text{CH}_2^+$ , 916 (figure), 917 (figure)  
 $\text{CH}_3^+$ , 387 (table), 925 (figure)  
 $\text{CH}_4^+$ , 387 (table), 925 (figure)  
 $\text{C}_2\text{H}$ , 313, 316–320, 322, 329, 1261  
 $\text{C}_2\text{H}_2$ , 111 (table), 250, 316–319, 321 (figure), 322, 323, 324, 336, 391 (table), 392, 1261  
 $\text{C}_2\text{H}_4$ , 111 (table), 911  
 $\text{C}_2\text{H}_6$ , 111 (table)  
 $\text{C}_3\text{H}^+$ , 323  
 $\text{C}_3\text{H}_2^+$ , 916  
 $\text{C}_3\text{H}_2$ , 313, 322, 323, 326, 329, 363, 391 (table), 392  
 $\text{C}_3\text{H}_3$ , 322, 323, 325, 326  
 $\text{C}_3\text{H}_3^+$ , 123, 387 (table), 443, 916, 922  
 $\text{C}_3\text{H}_4$ , 322, 323 (figure), 324 (figure), 325  
 $\text{C}_8\text{H}_8$ , 858  
 $\text{C}_6\text{H}_6$ , 228  
 $\text{CH}_3\text{CN}$ , 116, 162, 163, 387 (table), 861  
 $\text{CH}_3\text{D}$ , 884  
 $\text{CH}_4 \cdot 7\text{H}_2\text{O}$ , 365  
 $\text{C}_4\text{H}_4\text{N}_2$ , 391 (table), 392  
 $\text{CH}_3\text{NH}_2$ , 113 (table)  
 $\text{CH}_2\text{O}$ , 631  
 $(\text{CH}_3)_2\text{O}$ , 113 (table)  
 $\text{CH}_3\text{O-CH}_3$ , 403 (table)  
 $\text{CH}_2\text{OH}^+$ , 443, 456, 915, 916 (figure), 917 (figure)  
 $\text{CH}_3\text{OH}$ , 113 (table), 403, 925  
 $\text{C}_2\text{H}_5\text{OH}^+$ , 113 (table)  
 $\text{Cl}$ , 1087  
 $\text{CN}$ , 44, 46, 59, 114, 115, 125, 152, 163, 314, 328, 362, 385, 386, 387 (table), 397, 443, 647, 652, 653, 657, 661 (table), 730, 782, 790, 791 (figure), 792, 855, 860, 862, 864–867, 881, 885, 887 (table), 888, 890, 892, 907, 917, 928, 956, 980, 982, 1056, 1069, 1086  
 $^{13}\text{CN}$ , 385  
 $\text{C}_2\text{N}_2$ , 114, 163  
 $\text{CO}$ , 84, 94 (table), 96, 101, 108, 109, 111 (table), 114, 116, 121, 125, 126, 141, 142, 145, 153, 155, 168, 184, 227, 228, 231, 232 (figure), 233, 234, 244, 247, 248, 250, 256, 278, 281, 291, 292, 336, 363–367, 369–371, 379, 381, 384 (figure), 390, 391 (table), 392, 401, 403 (table), 411, 412 (figure), 413, 414, 431, 432 (table), 440, 441, 443, 444, 453, 454, 631, 633, 644, 645, 661 (table), 735, 739, 740, 745, 749, 837, 854, 856, 858, 861 (table), 864, 865, 868, 869, 888, 889, 893, 900, 911, 916 (figure), 917 (figure), 919, 922 (figure), 924 (figure), 928, 929, 1081 (table) 1212, 1261  
 $\text{Co}$ , 387 (table), 911  
 $\text{C}/\text{O}$ , 380, 385, 391 (table)  
 $\text{CO}^-$ , 1248  
 $\text{CO}^+$ , 116, 212, 315, 386, 387 (table), 639 (table), 645, 653, 793, 826, 832, 860, 916 (figure), 917 (figure), 1225, 1262  
 $\text{CO}_2$ , 93, 94 (table), 96, 101, 109, 112 (table), 114, 121, 145, 153, 227,

- 228, 231, 232 (figure), 233–235, 244, 247, 248, 250, 255, 259, 260, 277, 278, 280–288, 290, 291, 299, 307–309, 336, 363–367, 370, 387 (table), 391 (table), 392, 403 (table), 411, 412, 453, 631, 644, 645, 647, 648 (figure), 661 (table), 735, 737, 740, 741, 745, 749, 794, 837, 838, 844, 858, 863 (table), 868, 869, 917 (figure), 922 (figure), 1251, 1252
- $\text{CO}_2^+$ , 114, 386, 387 (table), 392, 527, 654, 661, 663 (table), 832, 856, 858, 916 (figure), 917 (figure)
- $\text{CO}/\text{CH}_4$ , 366, 367, 431
- $\text{CO}_2/\text{CO}$ , 367
- $\text{CO}/\text{H}_2\text{O}$ , 1261
- $\text{CO}\cdot 7\text{H}_2\text{O}$ , 365
- $\text{Cr}$ , 379 (table), 384 (figure), 911, 1081 (table)
- $\text{CS}$ , 115, 144, 315, 403 (table), 404, 792, 856, 858, 861, 915 (figure)
- $\text{Cs}$ , 411, 412
- $\text{CS}^+$ , 387 (table)
- $\text{CS}_2$ , 113 (table), 861, 862, 912, 915 (figure)
- $\text{CS}_2^+$ , 387 (table)
- $\text{Cu}$ , 387 (table), 911
- Captures, 8, 539
- Carbon
- abundances, 107–108, 120–122, 127
  - origin on terrestrial planets, 413, 414
- Carbonaceous compounds, 107–130, 278, 411, 415, 421
- Cavity
- boundary surface, 1235–1238
  - diamagnetic, 1233–1235, 1237 (figure), 1240, 1243, 1244
- Central condensation, 20
- Chemical reactions, gas-phase, 914 (table)
- Chiron, 651, 652, 659–661
- CHON particles. *See under* Dust, grains.
- Chondrites
- bulk density, 598 (figure)
  - CI, 1080–1082
  - carbonaceous, 378, 379, 383, 395, 411–414, 419–421, 429, 441–443, 453, 478, 598 (bulk density) (figure)
- enstatite, 395
- general, 377–379, 393–397, 409, 411, 412, 415, 421
- iron content, 422
- ordinary, 395
- Clathrate hydrates, 227, 231–236, 733
- Collisional processes, 1219–1222, 1229, 1232, 1233, 1240
- Collisionopause, 1137, 1138, 1219, 1221, 1222, 1228, 1229, 1232, 1233, 1241, 1242
- Color, 56, 57, 68, 71, 73, 74 (table), 661
- Coma
- composition, 856–862
  - dust features, 780–781
  - hydrodynamic models, 937–984
  - icy grain halo, 37, 150
  - model, 30–37, 39–41, 44–46, 48, 99, 155, 159, 160, 164, 165, 177, 180, 199
  - morphology, 770–781
  - profile, 36, 38, 39, 41
  - properties, 59, 910, 911
  - size, 661
- Comet
- abundance, elemental, 378–386
  - accumulation, 335–355
  - activity, 209, 538, 691, 705, 707, 762, 764–767, 769, 799, 827, 991
  - age
  - final phases, 615, 618–622
  - general, 58, 629–662
  - asteroid connection, 712
  - composition, 67, 363, 364
  - debris, 267, 268, 557–586, 593–600 (evolution)
  - disappearances, 615–618, 795
  - discoveries
  - general, 210, 213–215
  - 1095 BC, 210
  - extinction, 615–618
  - fading, 48, 611, 612, 634
  - flux, 473–477
  - formation, 243, 245, 336–352, 630, 631
  - heating of, 632, 634

- impact, 450–452, 522–529  
 interstellar, 479, 480  
 Jupiter family, 8, 539–551, 611, 783  
 lifetime, 615–618  
 long-period  
     discovery rate, 488–491  
     end states, 514–576  
     frequency of passages, 488–491  
     general, 463, 472, 488, 525, 526,  
     539, 622, 635, 831, 1259, 1263,  
     1264, 1266, 1268, 1269 (table),  
     1270 (figure)  
 magnetic field, 1107–1123, 1132–1135,  
     1137, 1139, 1140, 1145–1155,  
     1157, 1160 (figure), 1161, 1163,  
     1172 (figure), 1173–1179, 1189,  
     1191, 1200, 1212, 1214, 1216,  
     1217, 1218 (figure), 1221 (figure),  
     1222, 1224, 1230, 1233, 1236  
     (figure), 1237 (figure), 1238, 1239  
     (figure), 1245, 1246  
 mass, 526  
 maximum size, 350–352 (table)  
 microorganisms, 454–456  
 missed apparitions, 619  
 model, 337–341  
     new, 636, 637 (figure), 653, 654, 658,  
     660, 662  
     old, 636, 637 (figure), 658, 660, 662  
 orbital perturbation, 491–496, 502–508  
 orbits  
     distribution, 545, 546, 552  
     general, 4–14, 166, 634–638  
     statistical properties, 496–502  
 origin, 361–372, 417, 443, 449,  
     537–553, 867–869  
     clathrate hydrate model, 367, 368  
     interstellar-ice residue model,  
     368–370  
     quenching model, 365–367  
 outbursts, 614, 615  
 periodic  
     elements, 1281–1308  
     individually listed, 1283–1308  
     number of apparitions, 610 (figure)  
     observing conditions, 1282–1308  
 physical aging, 607–622  
 physical properties, 362  
 population, 520–522  
 reactivation, 615–622  
 recovery, 660, 661  
 short-period  
     family, 516–579, 607, 613–615, 618,  
     630, 632, 651, 653, 659, 660, 692,  
     698  
     general, 748, 785, 797, 805, 812,  
     839, 1259, 1260, 1263, 1264,  
     1266, 1268  
     orbital evolution, 539–553  
 showers, 508–511, 526, 528, 613  
 size, distribution, 525, 526  
 solar wind interaction, 926–928,  
     1125–1141, 1155–1157,  
     1211–1219, 1248  
 splitting, 467, 594, 595, 600, 607, 614,  
     615, 831, 833, 840, 842  
 structure  
     fluffy, 450  
     general, 335–355, 607  
     trans-Neptunian, 539, 550, 553  
     volatile contribution, 526–528  
 Cometopause, 1137, 1138, 1146, 1117,  
     1219, 1225–1229, 1243–1245  
 Comets  
     (1457 I), 210  
     (1457 II), 210  
     (1472), 210  
     (1491 I), 561, 562, 563 (figure), 579  
     (1882 II), 499  
     Abell (1957 VI), 642 (table)  
     Anderson (1963 IX), 499  
     Araya (1972 XII), 642 (table)  
     P/Arend-Rigaux, 27, 28 (table), 125,  
     649 (table), 699, 700, 705, 707,  
     713, 798 (table), 802, 810  
     Arend-Roland (1957 III), 150, 381,  
     382, 386, 1271  
     Austin (1982 VI), 882  
     Austin (1989 c1), 183 (table), 186, 442,  
     649 (table), 659, 661, 900, 1065  
     Baade (1922 II), 639 (table)  
     Baade (1955 VI), 641 (table)  
     P/Barnard 3, 210  
     Barnard (1889 I), 1268

- Bennett (1970 II), 83, 95, 109, 381, 382, 386, 770, 771, 779 (figure), 897, 900  
 Bester (1948 I), 114  
 Bester-Hoffmeister (1959 III), 1274  
 P/Bielo, 614–616, 618, 619 (table), 662  
 P/Blanpain, 620 (figure)  
 P/Boethin, 619 (table)  
 P/Borrelly, 649 (table), 705  
 Bowell (1982 I), 19, 641 (table), 648 (figure), 649 (table), 652, 653, 661, 662, 705, 1263, 1273, 1274  
 Bradfield (1974 III), 163, 857  
 Bradfield (1976 VI), 858  
 Bradfield (1979 X), 882, 900  
 Bradfield (1987 s), 117, 128 (figure), 1025, 1030  
 P/Brooks 4, 614, 649 (table), 801, 827  
 Brooks (1911 V), 1274 (table)  
 P/Brorsen, 616, 618, 619 (table), 810  
 P/Brorsen-Metcalf, 117, 118 (figure), 151, 163  
 Cernis (1983 XII), 640 (table), 648, 649 (table), 650 (figure), 661  
 Chiron, 649 (table), 802  
 P/Churyumov-Gerasimenko, 753 (table), 1065  
 Churyumov-Solodovnikov (1986 IX), 640 (table), 649 (table)  
 P/Comas Solá, 649 (table), 704  
 P/Crommelin, 183 (table), 186, 228, 265, 798, 898  
 P/Daniel, 32, 228  
 P/d'Arrest, 24, 228, 609 (table), 649 (table), 704, 707, 753 (table), 810  
 P/Denning-Fujikawa, 616, 618, 619 (table), 620 (figure)  
 P/de Vico-Swift, 609 (table), 616, 619 (table)  
 de Vico (1846 I), 1274  
 Donati (1858 VI), 215, 771, 779 (figure), 780, 1098, 1099 (figure)  
 Dunlop (1833), 499  
 P/du Toit-Hartley, 614, 616, 842  
 Elias (1981 XV), 642 (table)  
 P/Encke, 6, 25, 27, 28 (table), 45, 226, 454, 538, 561, 563 (figure), 569, 577, 581, 608, 609 (table), 613, 618, 620 (figure), 635 (figure), 649 (table), 704, 705, 707, 713, 753 (table), 769, 773, 778, 779 (figure), 782, 785–792, 796, 798, 799, 781–803, 806–810, 900  
 P/Faye, 228, 609 (table), 810, 827  
 P/Finlay, 618, 619 (table), 620 (figure), 810  
 P/Forbes, 228, 810  
 P/Gale, 616, 619  
 Geddes (1932 VI), 640 (table)  
 P/Gehrels 5, 8  
 Gehrels (1971 I), 640 (table)  
 P/Giacobini, 614  
 P/Giacobini-Zinner, 79, 166, 183 (table), 215, 216, 228, 561, 563 (figure), 649 (table), 704, 798 (table), 800, 801, 810, 905, 992, 995, 1029, 1100, 1101, 1120 (figure), 1121, 1131, 1125, 1145–1147, 1154, 1155, 1157, 1161, 1163, 1164 (figure), 1171, 1175, 1176 (figure), 1178, 1179 (figure), 1180, 1184 (figure), 1185, 1187, 1188 (figure), 1189 (figure), 1195, 1197–1199, 1200–1203 (figure), 1211, 1230, 1233, 1240, 1241, 1242 (figure), 1245, 1246 (figure), 1247 (figure), 1248  
 P/Grigg-Skjellerup, 609 (table), 613, 620 (figure), 649 (table), 798 (table), 801, 827  
 P/Gunn, 649 (table)  
 P/Halley, 6–13, 24, 26, 28 (table), 31, 34, 36–38, 40, 42, 44, 49, 53–57, 59, 67–69, 72, 77, 79, 83–85, 87, 93, 96, 97 (figure), 99–103, 107–109, 114–118, 121, 123–127, 128 (figure), 129, 139, 140, 141 (figure), 143–145, 149, 151, 152, 156, 157, 159, 160, 162–164, 165 (figure), 166–168, 175, 177, 180, 183 (table), 184, 185 (figure), 186–189, 190 (figure), 191, 194–196, 200–203, 211, 215, 216,

- 217 (figure), 218, 220, 227, 228, 247, 259, 264, 265, 277, 278, 281, 290, 291, 293, 299, 300, 306–309, 321, 355, 361–363, 364 (table), 366, 367, 379 (table), 380–386, 388–390, 391 (table), 392, 393, 394 (figure), 395–398, 404 (table), 419–421, 430, 439, 440, 443, 449, 453, 454, 456, 472, 477, 478, 493, 518, 522, 560, 561 (table), 562–564, 572, 573, 577, 583, 594, 597, 600, 608, 621, 630, 631, 634, 638, 645, 647, 649 (table), 650–659, 656 (figure), 657 (figure), 661, 662, 696–698, 700, 703–708, 711 (figure), 713, 723, 724–726, 736, 737, 741, 749–751, 753 (table), 754, 762, 763, 763 (figure), 764, 766, 769, 770–776, 778, 779 (figure), 780, 782, 786, 792, 795–798, 798 (table), 801–804, 810, 825, 831, 832, 835, 836, 838, 832–846, 855–858, 860–862, 863 (table), 865, 868, 867 (table), 868, 869, 879, 882, 885, 886 (figure), 889–892, 899–902, 907, 908, 910, 911, 912, 928, 937–939, 941–943, 953–955, 958 (figure), 960 (figure), 964 (figure), 965, 966 (figure), 970 (figure), 971, 974, 977, 979 (figure), 980, 981 (figure), 983 (figure), 984, 991, 992, 996, 997, 998 (figure), 1000, 1024, 1043, 1044, 1047–1049, 1051, 1057 (figure), 1059–1061, 1063–1066, 1068, 1075, 1077, 1079–1087, 1093, 1096, 1100, 1108, 1112, 1115, 1118, 1122, 1123, 1125, 1127 (figure), 1133–1135, 1137, 1138, 1140, 1141, 1145, 1147, 1154, 1157, 1163, 1164 (figure), 1172, 1175–1177, 1179, 1180, 1181 (figure), 1186 (figure), 1195, 1197 (figure), 1198 (figure), 1199 (figure), 1201 (figure), 1211, 1214, 1216, 1221 (figure), 1225, 1226 (figure), 1227 (figure), 1229–1235, 1237 (figure), 1239, 1241, 1243 (figure), 1244 (figure), 1245 (figure), 1260–1262, 1271, 1272, 1274, 1307–1308 (historical apparitions) (1404 B.C.), 563 (figure), 574 (1835 III), 517 (1986 III), 442, 563 (figure), 574, 639 (table), 655 (figure), 692, 887 (table) Haro-Chavira (1956 I), 641 (table) Hartley (1985 XVI), 641 (table), 649 (table) P/Hartley-IRAS, 1282 P/Holmes, 614, 615, 649 (table), 794, 827, 832, 842 Honda (1955 V), 841 P/Honda-Mrkos-Pajdusakova, 618, 619 (table), 753 (table) Humason (1959 X), 641 (table) Humason (1962 VIII), 639 (table), 645, 653, 829 Ikeya (1963 I), 362, 887 (table) Ikeya-Seki (1965 VIII), 67, 109 Ikeya-Seki (1968 I), 639 (table) IRAS-Araki-Alcock (1983 d). *See under* IRAS-Araki-Alcock (1983 VII). IRAS-Araki-Alcock (1983 VII), 45, 101, 103, 109, 115, 125, 139, 144, 145, 150, 163, 183 (table), 260, 379, 631, 707, 798 (table), 799, 857, 859–861, 882, 914, 927 Jensen-Shoemaker (1987 g1), 640 (table), 649 (table) Jones (1946 VI), 639 (table) P/Klemola, 649 (table) Kobayashi-Berger-Milon (1975 IX), 887 (table) Kohoutek (1973 XII), 83, 109, 115, 116, 150, 152, 155, 156, 163, 362, 385, 386, 442, 635, 635 (figure), 636, 639 (table), 644, 645, 646, 649 (table), 661, 782, 855, 857, 860, 887, 900, 1263, 1271, 1273 P/Kopff, 6, 8, 228, 493, 620 (figure),

- 649 (table), 650, 704, 753 (table),  
798 (table), 801, 921  
 Kopff (1905 IV), 641 (table), 1274  
 P/Kowal 4, 1282  
 Levy (1988 e), 8, 9 (table), 515  
 Liller (1988a), 183 (table)  
 Lovas (1975 VIII), 640 (table)  
 Lovas (1976 XII), 642 (table)  
 P/Machholz, 175, 183 (table), 184, 185  
 (figure), 202, 561, 579, 649  
 (table), 797, 798 (table)  
 Machholz (1988 j), 861  
 P/Mellish, 562, 578  
 Mellish (1915 II), 639 (table)  
 Mellish (1917 I), 561, 563 (figure)  
 Minkowski (1951 I), 640 (table)  
 Morehouse (1908 III), 639 (table), 829,  
1271  
 Mrkos (1959 IX), 1274  
 P/Neujmin 3, 25, 27, 28 (table), 47, 649  
 (table), 650, 699, 707, 713, 798  
 (table), 810  
 P/Neujmin 4, 616, 619 (table)  
 P/Neujmin 5, 8, 9 (table), 515, 614,  
616, 842  
 Okazaki-Levy-Rudenko (1989 r), 152  
 P/Oterma, 8, 616  
 Pajdusakova (1954 II), 827  
 Pajdusakova-Mrkos (1948 V), 639  
 (table)  
 P/Perrine-Mrkos, 616, 619 (table)  
 P/Peters-Hartley, 609 (table), 616  
 P/Pons-Brooks, 228, 832  
 P/Pons-Winnecke, 218, 228, 705, 797,  
798 (table), 799, 810  
 Reid (1921 V), 1274 (table)  
 P/Reinmuth 1, 621  
 Rudnicki (1967 II), 1274  
 Sandage (1972 IX), 641 (table)  
 Sandage (1973 X), 642 (table)  
 P/Schaumasse, 228  
 Schuster (1975 II), 643 (table)  
 P/Schwassmann-Wachmann 3, 51,  
53–55, 221, 433, 614, 638, 642  
 (table), 649 (table), 771, 779  
 (figure), 793, 825, 827–830,  
832–834, 837, 839, 840, 857  
 P/Schwassmann-Wachmann 4, 8, 649  
 (table), 1282  
 P/Schwassmann-Wachmann 5, 222,  
616, 705, 797, 798 (table), 799  
 Sargent (1978 XV), 882  
 Seki-Lines (1962 III), 386  
 Shajn-Comas Solá (1925 VI), 641  
 (table)  
 Shoemaker (1984 XV), 642 (table)  
 Shoemaker (1985 II), 1274 (table)  
 Shoemaker (1985 XII), 47, 640 (table),  
649 (table)  
 Shoemaker (1986 XIV), 642 (table),  
649 (table), 650, 651 (figure)  
 Shoemaker (1988 b), 642 (table), 649  
 (table)  
 Shoemaker-Holt (1988 g), 8, 9 (table),  
515  
 Skjellerup (1920 III), 1274 (table)  
 P/Smirnova-Chernych, 621, 649 (table)  
 Stearns (1927 IV), 641 (table)  
 P/Stephan-Oterma (1980 X), 882  
 Sugano-Saigusa-Fajikawa (1983 V),  
798 (table)  
 Swift (1899 I), 832  
 P/Swift-Gehrels, 620 (figure)  
 P/Swift-Tuttle, 218, 771, 779 (figure),  
797, 798 (table)  
(1862 III), 561, 563 (figure)  
 P/Tago-Sato-Kosaka, 897, 900  
 (1969 IX), 362, 887 (table)  
 P/Taylor, 614  
 P/Tempel 3, 609 (table), 616, 620  
 (figure), 743, 798 (table)  
 P/Tempel 4, 25, 26 (figure), 27, 28  
 (table), 37, 38 (figure), 45, 52, 57,  
59, 228, 609 (table), 635, 636, 649  
 (table), 650, 699, 704, 705, 707,  
713, 753 (table), 778, 779 (figure),  
798 (table), 799, 801, 802, 810,  
1029, 1030, 1060  
 Tempel (1863 IV), 1274 (table)  
 P/Tempel-Swift, 616, 619 (table)  
 P/Tempel-Tuttle, 518, 580, 581  
 (1965 IV), 561  
 Thatcher (1861 I), 561  
 Theile (1906 VII), 1274 (table)

- Thomas (1969 I), 640 (table)  
 Torres (1987 V), 641 (table), 649 (table)  
 P/Tuttle, 144, 212, 228, 1282 (1939 X), 561, 563 (figure), 579  
 P/Tuttle-Giacobini-Kresak, 609 (table), 614–616, 619 (table), 810, 828, 834, 840, 842  
 P/Urata-Niijima, 621, 622  
 P/Vaisala 4, 622  
 P/Van Biesbroeck, 8, 9 (table), 515, 842  
 Van Biesbroeck (1936 I), 641 (table)  
 Van den Bergh (1974 XIII), 643 (table)  
 West (1976 VI), 109, 116, 142, 150, 386, 644, 645, 646, 795, 841, 858, 861, 885, 899, 900, 1027  
 West (1977 IX), 642 (table)  
 P/Whipple, 517, 621  
 Whipple-Fedtke-Tevzadze (1943 I), 841  
 P/Wild 3, 616, 620 (figure)  
 P/Wild 4, 649 (table), 753 (table)  
 Wilson (1987 VII), 93, 97 (figure), 100, 101, 103, 115–117, 118 (figure), 128 (figure), 141 (figure), 163, 166, 175, 183 (table), 186, 187, 188 (figure), 191–194, 196, 197 (figure), 199–203, 264, 266, 639 (table), 649 (table), 654, 656 (figure), 657, 658 (figure), 659–661, 1029, 1262  
 Wilson-Harrington (1949 III), 499  
 Wirtanen (1947 VIII), 640 (table)  
 Wirtanen (1949 I), 640 (table)  
 Wirtanen (1957 VI), 642 (table), 1274  
 Wolf (1917 III), 1274  
 Contact surface, 1146 (figure)  
 Coordinate system, 11  
 Cratering, 839, 840  
 Crustal breakup, 842, 843  
 D, 143  
 DCN, 883  
 D/H, 385, 440, 443, 527, 868, 870, 872–875, 886 (figure), 892, 1261  
 DI, 143  
 Differentiation, 624  
 Discontinuities, 1113–1117  
 Discrete active regions, 775–810  
 Doppler observations, 13  
 Draconids. *See under Meteor streams.*  
 Drawings, 218, 220  
 Dust  
   accumulation, 1000, 1001  
   charged, 1093–1102  
   coma, 1051, 1052–1057  
   Comet Halley, 388–390  
   density, 50, 347–350, 653, 725  
   dust-to-gas ratio, 381, 384, 599, 600, 644, 647, 1265 (table), 1266  
   emission, 292–294, 938, 939  
   flux, 1052  
   general, 29–39, 43–46, 48, 49, 56, 57, 108, 277, 281, 282, 630, 698, 1025–1034, 1043–1069  
 grains  
   accumulation, 335–352  
   carbonaceous, 400  
   charging, 1095–1095  
   CHON, 125, 363, 382, 387 (table), 388, 392, 395, 402, 443, 862, 865, 888, 917, 1048, 1075, 1079, 1081, 1083, 1088, 1259, 1261  
   clumping, 406  
   composition, 278, 388, 390  
   emission, 118, 120, 121  
   general, 58, 59, 278, 293, 369, 394 (figure), 413, 419, 730, 892, 917, 950, 997, 1095  
   heating, 406  
   icy, 82, 150, 261, 278, 293, 299, 945, 950  
   icy mantle, 402–404  
   impact velocity, 341  
   interplanetary, 267  
   interstellar, 130, 243, 246, 259, 267, 404, 407, 413, 631, 1048  
   mantle, 632, 634, 650  
   origin, 420  
   pre-cometary, 246, 268  
   production, 993, 999  
   properties, 67, 68, 261, 264, 953 (optical), 1075–1088

- size, 120, 167, 340, 348 (table), 381, 388, 421, 647, 727, 864 (distribution), 775, 945 solid, 336, 337 source of coma gas, 862–865 interplanetary, 83, 108, 127, 244, 245, 345 (figure), 388, 450, 884, 1048, 1084 interstellar, 108, 118, 127–129, 267, 377, 397, 400 jets, 937, 956 mantle, 277–279, 285–290, 629, 733, 738, 752, 754, 794, 804 release, 292, 293 scattering, 50 size, 49–52, 56, 57, 953–955 (distribution) tail, 34, 381, 645, 795, 1005, 1027–1030 velocities, 977–980
- Dynamical evolution, 632–634
- Earth-crossing objects, 523–525, 537–553, 585, 621, 712
- Electromagnetic radiation, interaction with matter, 1006–1009
- Erosion rates, 799–802
- Eta Aquarids. *See under* Meteor streams.
- Evolution, orbital, 546, 553
- Excitation mechanism, 110, 152–164, 176
- Faint Comet Survey, 646
- Fans, 42, 45
- Fe, 379 (table), 382, 384 (figure), 387 (table), 388, 389, 393, 400, 401 (table), 409, 892, 1048, 1078 (table), 1079, 1080, 1081 (table), 1083–1085
- 56Fe/54Fe, 881 (table), 891
- FeNi, 1086
- FeO, 409
- Fe<sub>2</sub>O<sub>3</sub>, 349 (figure), 413, 443
- Fe<sub>3</sub>O<sub>4</sub>, 412
- FeS, 388, 1086
- Fe/Si, 392, 393, 394 (figure), 395, 419, 420, 1082
- Fluffy particles, bulk density, 598
- (figure), 599
- Fluid equations, 1223, 1224
- Flux density, 22, 32, 40, 72 (table), 156, 157, 178, 179 (figure), 180, 182, 186, 191, 194, 196–199, 202, 290 (figure), 290 (figure)
- Fractals, 341, 342, 345, 352, 1022–1025
- Gas
- dust interaction, 952–957
  - emission, 290–292
  - general, 29, 33, 38–41, 44, 108, 678
  - jets, 862–865
  - outflow, 982–984
  - production, 300, 307, 309, 781–795 (variations), 863, 996, 997
  - velocity, 980–982
- Geminids. *See under* Meteor streams.
- Giacobinids. *See under* Meteor streams.
- Giotto, 13, 38, 141, 142, 164, 184, 265, 281, 299, 306, 355, 659, 692, 693, 710, 711, 724–726, 761, 762, 766, 772, 782, 803, 836, 856, 857, 859, 861, 865, 882, 910, 919, 927, 939, 952, 972, 1000, 1033, 1043, 1047, 1049 (figure), 1050 (figure), 1051–1054, 1055 (figure), 1056–1060, 1067–1069, 1075, 1076, 1112, 1115, 1116 (figure), 1118 (figure), 1121, 1128–1130 (figure), 1137–1140, 1145, 1163, 1164 (figure), 1211, 1212, 1217, 1225, 1226 (figure), 1229, 1231, 1233, 1238, 1239 (figure), 1242, 1244, 1258
- Grain. *See under* Dust.
- Greenstein effect, 177, 196, 198, 200, 788
- H, 46, 99, 125, 143, 248, 264, 315, 316, 322, 323, 327, 363, 378, 379 (table), 382, 384 (figure), 385, 386, 387 (table), 388, 391 (table), 395, 397, 402, 449, 857, 862, 884, 899, 900, 902, 919–921, 928, 941, 944, 958, 959, 1078, 1079, 1080, 1085, 1096, 1213, 1261
- H<sup>-</sup>, 929

- H<sup>+</sup>, 915, 916, 925 (figure), 965, 969, 1226 (figure)
- H<sub>2</sub>, 108, 145, 233, 250, 251, 259, 263, 317, 322, 323, 365, 403 (table), 443, 444, 884, 910, 916, 928, 1081 (table)
- H<sub>2</sub><sup>+</sup>, 925 (figure)
- H/C, 390
- H<sub>2</sub>C<sub>3</sub>C<sub>2</sub>, 916
- H<sub>2</sub>C<sub>3</sub>H<sub>2</sub>, 916, 925 (figure)
- HCN, 94 (table), 101, 109, 112 (table), 114, 115, 121, 153, 162–164, 166, 176, 228, 313, 328–329 (photochemistry), 336, 364, 387 (table), 391 (table), 392, 402, 403 (table), 440, 442, 444, 450, 450, 861, 863 (table), 888, 925 (figure), 928
- HC<sub>3</sub>N, 114, 153, 163, 404, 444, 861
- HCO, 387 (table)
- HCO<sup>+</sup>, 916, 917 (figure)
- HCO<sub>2</sub><sup>+</sup>, 916, 917 (figure)
- H<sub>2</sub>CO, 93, 94 (table), 96, 102, 112 (table), 115, 121, 155, 162, 163, 168, 175, 176, 184, 185 (figure), 202, 250, 260, 363, 364, 387 (table), 391 (table), 392, 397, 402, 403 (table), 404, 440, 442, 444, 450, 860, 861, 863 (table), 864, 865, 868, 869, 915, 916 (figure), 917 (figure), 919, 922 (figure), 925 (figure), 1261
- H<sub>2</sub>CO<sup>+</sup>, 861, 916 (figure), 917 (figure)
- H<sub>2</sub>COO, 925 (figure)
- HCO·OH, 387 (table), 391 (table), 392, 1261
- HCS<sup>+</sup>, 916 (figure)
- H<sub>2</sub>CS, 363
- H<sub>3</sub>CS<sup>+</sup>, 916 (figure)
- HD, 883, 884, 886 (figure)
- H/D, 881 (table)
- HDO, 883
- H<sub>2</sub>DO<sup>+</sup>, 866, 882
- HDO/H<sub>2</sub>O, 882
- He, 145, 231, 248, 365, 397, 1085
- He<sup>++</sup>, 1216, 1225
- <sup>3</sup>He, 882
- HeI, 145
- HeII, 145
- HI, 139, 140, 142, 143, 145
- HNC, 163, 167, 364, 440
- HNS<sup>+</sup>, 916 (figure)
- H/O, 391 (table), 392
- H<sub>2</sub>O, 39, 46, 58, 84, 85, 93, 94 (table), 96, 99–103, 108, 109, 113–116, 121, 125, 140–145, 153, 162, 175, 177, 184, 199, 201, 202, 228, 230, 231, 232 (figure), 233–236, 244, 247, 248, 250, 251, 255, 256, 259, 263, 264, 269, 280–282, 284, 285, 287 (figure), 288, 290, 291, 293, 299, 301, 303 (figure), 304, 306 (table), 307, 308 (figure), 309, 313, 326, 329, 336, 362–369, 370–372, 387 (table), 391 (table), 397, 401, 402, 403 (table), 430, 434 (table), 440–442, 449, 452–454, 488, 526–528, 630, 632–635, 643, 647, 648, 653, 661 (table), 662, 733–742, 748, 749, 751, 773, 774, 782, 792, 831, 832, 835–838, 844, 857–860, 863 (table), 864, 865, 868, 886 (figure), 900, 911, 912 (figure), 915, 916 (figure), 917 (figure), 919, 924 (figure), 925 (figure), 928, 941, 950, 952, 956 (figure), 958, 959, 965, 969, 972 (figure), 980, 993, 1058, 1126, 1131 (figure), 1173, 1175, 1177 (figure), 1178 (figure), 1180, 1181, 1183 (figure), 1187, 1188 (figure), 1190, 1194, 1195, 1197 (figure), 1212, 1213, 1223, 1261, 1264
- H<sub>2</sub>O<sup>+</sup>, 866, 915, 916 (figure), 917 (figure), 915 (figure), 966 (figure), 1096, 1129, 1213, 1223, 1225, 1232, 1233
- H<sub>2</sub>O<sub>2</sub>, 838
- H<sub>2</sub><sup>18</sup>O<sup>+</sup>, 866
- H<sub>3</sub>O, 168
- H<sub>3</sub>O<sup>+</sup>, 387 (table), 866, 872, 915, 916 (figure), 917 (figure), 925 (figure), 965, 966 (figure), 1129, 1213,

- 1223, 1225, 1226 (figure), 1231,  
1232, 1233
- $\text{H}_4\text{O}_2^+$ , 966 (figure)
- $\text{H}_5\text{O}_2^+$ , 966 (figure)
- $\text{H}_7\text{O}_3^+$ , 966 (figure)
- $\text{H}_9\text{O}_4^+$ , 966 (figure)
- $\text{H}_2\text{O}/\text{CO}$ , 371
- $\text{H}_2\text{S}$ , 231, 313, 328, 362, 391 (table)
- Halley. *See under Comets.*
- Halley stream. *See under Meteor streams.*
- Heating, radioactive, 372
- Hydrocarbons, unsaturated, 388, 396
- Hydrodynamic models. *See under Coma.*
- Ice
- alteration processes, 372
  - amorphous, 734, 738, 745, 751, 838, 839, 1262
  - bulk density, 598 (figure)
  - crystalline structure, 371, 372
  - general, 37, 52, 307, 630, 633 (figure), 662
  - irradiated, 440, 441
  - mixtures, 229–234, 277, 280, 282, 285, 286, 289
  - sublimation, 643, 644
  - thermal properties, 370, 371
- Icy conglomerate model. *See under Nucleus.*
- Icy grain halo. *See under Coma.*
- Imaging, infrared, 79–82
- Inner coma
- energetics, 1238–1244
  - plasma processes, 1229–1245
- Instabilities, 1145, 1146, 1172–1201, 1245
- International Halley Watch (IHW), 12, 67, 87, 216, 221, 692, 713
- Ionopause, 1110 (figure), 1117, 1118 (figure), 1119, 1127, 1130, 1138–1141, 1232, 1240
- Ion pick-up, 1212–1215, 1227, 1229, 1244
- Ion tail, 639 (table)
- Irradiation effects, 243–269
- Isotopes, 1084–1087
- Isotopic carbon, 885–890
- composition, 866, 867
- ratios, 384–386, 435, 440, 443, 879–892
- Jets, 42–45, 211, 217, 309, 659, 691, 701, 703, 710, 725–730, 770–775, 780, 805, 910, 917, 939, 940, 942, 973, 974, 982–984, 991, 995–1000, 1056, 1065
- Jupiter encounter. *See under Orbit.*
- Jupiter family. *See under Comet.*
- K, 379 (table), 384 (figure), 387 (table), 401 (table), 911, 1087 (table)
- Kr, 231, 232 (figure), 430, 431, 432 (figure), 434 (table), 435
- Kr/Ar, 430, 431
- Kreutz group. *See under Sun grazers.*
- Kuiper belt, 417, 418, 421, 477–479, 517, 540, 608, 632, 1263–1265
- Laboratory simulations, 245–247, 277–294, 299–309
- Leonids. *See under Meteor streams.*
- Lifetime, 93, 100, 261, 262 (figure), 405, 508, 537, 538, 549, 550, 569, 613, 618, 698, 753, 1200
- Light curve
- Austin, 657
  - P/Encke, 635, 685
  - general, 3, 7, 25–27, 45–48, 52, 54, 55, 493, 644, 645, 650, 654, 662, 691, 699, 703, 706, 708, 709, 713, 782–792, 710, 826
  - P/Halley, 217, 651, 655 (figure), 700
  - Kohoutek, 635
  - P/Tuttle 4, 636 (figure)
  - P/Tuttle-Giacobini-Kresak, 828
- Lyman  $\alpha$  141–145, 728, 857, 882, 910, 930
- Lyrids. *See under Meteor streams.*
- Magnetic cavity, 1117–1121
- field. *See under Comet.*
- turbulence, 1121–1133

- Magnetoplasma, 1113–1117  
**Magnitude**  
 estimates, 210, 211, 636  
 general, 20, 261, 279, 289, 299, 369, 449, 493, 515, 521, 525, 538, 550, 583, 608, 611–613, 644, 1194 (figure), 1198, 1260  
 variations, 1266–1268  
**Mg**, 379 (table), 380, 382, 384 (figure), 388, 389, 400, 401 (table), 453, 891, 892, 1048, 1077, 1078 (table), 1079, 1080, 1081 (table), 1082–1088  
 $^{24}\text{Mg}/^{25}\text{Mg}$ , 881 (table)  
 $^{25}\text{Mg}/^{26}\text{Mg}$ , 881 (table)  
**MgSiO<sub>3</sub>**, 409  
**Mn**, 379 (table), 384 (figure), 387 (table), 401, 911, 1081 (table)  
**Mass extinction**, 509–511  
**Mass loss**, 27, 31, 46, 49, 51, 336, 579, 595 (figure), 596, 607, 696–699, 704, 713, 955  
**Meteor streams**  
 age, 582–584, 802  
 Beta Taurids, 577  
 changing quantities, 596, 597  
 comet associations, 563 (figure)  
 density of particles, 597–600  
 density of parent body, 597–600  
 development from comet debris, 564–582  
 Draconids, 581  
 Eta Aquarids, 577  
 formation, 596, 597  
 Geminids, 576–578, 621  
 general, 557–586, 607  
 Giacobinids, 581  
 Halley stream, 572–575, 583, 585, 596  
 identification with comet, 558–564  
 Leonids, 580–583  
 Lyrids, 581  
 mass, 584, 585  
 northern Taurids, 577  
 orbital parameters, 560–564  
 Orionids, 577  
 Perseids, 581  
 Quadrantids, 577–580  
 radiant, 559, 560  
 recognition, 558, 559  
 Sextantids, 577  
 southern Taurids, 577  
 Taurid complex, 580  
**Meteorite**, 108, 127, 130, 337, 378, 430, 441, 444, 884–886, 889, 891, 1086  
**Molecular clouds**, 401–405, 418, 494, 495, 503, 504 (figure), 505, 509  
**Molecular hydrates**, 233–236  
**Molecules, interstellar**, 397–399  
**Monomers**, 444  
**Morphology**. *See under Coma*.  
**N**, 125, 244, 261, 363, 378, 379 (table), 382, 384 (figure), 385, 386, 388, 391 (table), 392, 395, 401 (table), 419, 449, 862, 928, 1078 (table), 1080, 1080, 1081 (table), 1086, 1087, 1261  
**N<sup>-</sup>**, 929  
**N<sup>+</sup>**, 1217  
**N<sub>2</sub>**, 228, 231, 232 (figure), 233, 250, 315, 364–367, 369, 370, 386, 391 (table), 392, 403, 430, 434 (table), 859, 860, 863 (table), 868, 869, 911, 928  
**N<sub>2</sub><sup>+</sup>**, 260, 387 (table), 860  
**Na**, 212, 379, 387 (table), 911, 1081 (table), 1087  
**Ne**, 145, 231, 233, 430, 434 (table)  
**NH**, 313, 314, 327–329 (formation), 386, 387 (table), 838, 855, 865, 909, 928  
**NH<sub>2</sub>**, 46, 103, 212, 260, 313, 315, 327, 329, 384, 386, 387 (table), 392, 855, 860, 908, 909, 911, 916 (figure), 917 (figure)  
**NH<sub>3</sub>**, 94 (table), 103, 162, 176, 227, 226, 233, 234, 236, 244, 247, 248, 250, 278, 313, 327 (photochemistry), 336, 363, 364, 366, 367, 387 (table), 391 (table), 401, 402, 403 (table), 413, 440, 441, 443, 444, 631, 859, 860, 863 (table), 864, 865, 868, 869, 908, 915, 916

- (figure), 917 (figure), 925, 929
- $\text{NH}_2^+$ , 925 (figure)
- $\text{NH}_3^+$ , 387 (table), 916 (figure), 917 (figure), 925 (figure)
- $\text{NH}_4$ , 387 (table), 1232
- $\text{NH}_4^+$ , 387 (table), 866, 882, 915, 916 (figure), 917 (figure), 925 (figure)
- $\text{N}_2\text{H}_4$ , 250, 260, 391 (table), 392
- $\text{NH}_2\text{CH}_3$ , 925
- $\text{NH}_4\text{COONH}_2$ , 365, 366
- $\text{NH}_4\text{HCO}_3$ , 365, 366
- $\text{NH}_3\text{H}_2\text{O}$ , 233, 365, 366
- $\text{NH}_4\text{N}_3$ , 838
- $\text{N}_2\text{H}_2\text{O}$ , 365, 366
- NI, 145
- Ni, 379 (table), 384 (figure), 387 (table), 401 (table), 911, 1081 (table), 1086
- $^{14}\text{N}/^{15}\text{N}$ , 387 (table), 440, 443, 866, 867, 881 (table), 890, 1261
- $\text{N}_2\text{NH}_3$ , 366, 367
- N/O, 380, 385, 391 (table), 392
- Noble gases
  - abundance, 429–435
  - isotope ratios, 429–434
- Nongravitational
  - accelerations, 2–8, 10, 491, 543, 713, 807, 808
  - effects, 806–810, 1281
  - force, 4–8, 166–168, 291, 492, 493, 550, 593, 618, 635, 691, 692, 696, 704, 713, 725, 730, 806–810, 842, 939, 976, 1265 (table), 1266
- Northern Taurids. *See under Meteor streams.*
- Nucleus
  - composition, 928, 929
  - density, 228, 262–263 (Halley), 338, 597, 600, 697, 725, 801, 802
  - dissipation, 698–700, 712
  - dust component, 731, 732
  - emission, 1037–1039
  - evolution, 692, 743–754, 796–810
  - general properties, 761, 762
  - ice
    - component, 734–741
    - composition of, 145, 369, 372
- icy conglomerate model, 4, 227, 247, 630, 704, 761
- inactive, 699
- model, 5–9, 247, 278, 299–301, 302 (figure), 304, 306 (surface model), 309, 352, 597
- nutation, 695, 696, 700, 704
- observational data, 354, 355
- precession, 696, 697, 705
- properties, 25, 58, 59, 68, 299, 692, 723–725, 1260–1263 (comet)
- rotation rate, 4, 5, 7, 25–27, 43, 44, 53, 55, 140, 355, 691–713, 727–730, 775–781
- shape, 355, 712, 723, 724, 796
- size, 151, 723
- spin axis orientations, 701–706
- splitting, 372, 639 (table), 642 (table), 645, 646, 659, 712, 814
- structure, 352–354, 647, 733–755
- surface, 300, 762–764
- thermal history, 733–755
- torque, 696, 697, 700, 703, 730
- O, 99, 121, 125, 126, 244, 261, 315, 363, 378, 379 (table), 382, 383, 384 (figure), 385, 386, 387 (table), 388, 389, 391 (table), 395, 401, 419, 449, 862, 892, 900, 902, 911, 916 (figure), 917 (figure), 919, 921, 922 (figure), 925 (figure), 1078 (table), 1079, 1080, 1081 (table), 1083, 1085, 1087, 1126, 1212, 1261
- $\text{O}^-$ , 929
- $\text{O}^+$ , 145, 916 (figure), 925 (figure), 966 (figure), 1134, 1213, 1214, 1217, 1225, 1226 (figure)
- $\text{O}_2$ , 231, 232 (figure), 250, 257, 263, 526
- $\text{O}_2^+$ , 966 (figure)
- OII, 145
- O/C, 390, 1080
- OCS, 94 (table), 96, 101, 102, 111 (table), 114, 115, 121, 145, 862
- OD, 143, 882
- $\text{O}^{1\text{D}}$ , 145
- OD/OH, 866, 882

- OH, 46, 54, 85, 94 (table), 95, 99, 100, 140–145, 152–160, 162, 166, 167, 176–182 (emission/absorption), 186, 191, 194, 196, 199–203, 230, 250, 251, 255, 315, 327, 386, 387 (table), 397, 659, 773, 782, 787, 788, 792, 838, 856, 857, 862, 882, 916 (figure), 917 (figure), 921, 928, 941, 958, 959, 1126, 1213, 1223
- OH<sup>+</sup>, 386, 387 (table), 654, 916 (figure), 966 (figure), 1225
- [OI], 39, 140, 141, 787
- <sup>16</sup>O/<sup>18</sup>O, 386, 866, 867, 881 (table), 863
- Observations, last, 1268, 1269
- Occultation
- general, 152
  - observations, 182–184
- Oort Cloud
- dynamic stability, 511–514
  - extra-solar, 479–481
  - general, 100, 117, 129, 244–245, 258, 261, 262, 274 (figure), 267, 269, 337–339, 363, 372, 377, 417, 418, 449, 453, 463–482, 488, 491, 493–579, 608, 628–632, 657, 734, 746, 747, 1263–1265, 1269–1274
- injection rate, 502–508
- inner, 469–471
- irradiation effects, 631, 632
- perturbation, 467–469, 479, 489, 543, 550, 630
- population and mass, 471–473
- processing of comets, 478, 479
- Optical constants, 1005, 1007, 1008, 1010–1015, 1034, 1035
- Orbit dynamics, 3
- Orbital parameters. *See under Meteor streams.*
- Organic
- compounds, 377–422, 440, 450
  - chondrites, 404–419, 439–441
  - comets, 386–397, 404–419, 442, 443
  - interstellar
    - medium, 439–441
    - origin, 404–418
    - space, 397–404
- material, 37, 38, 82, 109, 265–267
- species, 67, 85, 86
- Origin, cometary, 1263–1265
- Orionids. *See under Meteor streams.*
- Outburst
- characteristics, 825
  - general, 51, 53, 54, 55 (figure), 82, 144, 150, 151, 217, 600, 607, 634, 639, 645, 646, 659, 766, 792–795, 804
  - mechanisms, 835–846
- Outgassing, 769–775, 786, 788, 796, 797, 798, 803, 957
- Parent molecules, 39, 93–96, 104, 115, 121, 141, 153, 164, 176, 203, 386, 390, 391 (table), 838, 855–862, 957
- Particles
- fluffy, 345–350, 353, 1022
  - optical properties, 1015–1025
  - size, 46, 57, 151, 347
- Periods
- sidereal, 707, 712
  - synodic, 707
- Perseids. *See under Meteor streams.*
- Phase angle, 24, 35, 36
- Photochemical studies, 313–329
- Photochemistry, 957–960, 992, 1232, 1233
- Photometry, 19–59, 67–87, 647–653 (studies), 700, 708
- Planetary atmosphere, cometary component, 431–435
- Planetesimal
- accretion, 415, 416
  - general, 418, 420, 430, 523, 527
- Plasma
- dynamics, 1215–1219
  - energetics, 923, 924
  - flow, 925–928
  - measurements, 1230
  - production, 923, 924
- Polarization, 77, 78, 1063–1065, 1148, 1152, 1191, 1194 (figure)
- Polymerases, 446, 447
- POM, 364
- Poynting-Robertson effect, 568

- Production rates  
 dust, 782–792, 929  
 dust-to-gas, 995  
 gas, 782–792, 928, 929, 942, 967, 976  
 general, 30, 39–41, 46, 48, 49, 93, 99,  
 100, 115, 120, 140–144, 152–156,  
 159, 160, 164, 166, 167, 177, 184,  
 196, 199–203, 479, 543, 644, 645,  
 647, 652, 654, 655, 657, 661, 707,  
 965, 972, 1130, 1131
- Quadrantids.* *See under Meteor streams.*
- Radar  
 general, 13, 14, 29  
 observations, 51, 149–151
- Radiation pressure, 31–39, 41–44, 46, 57,  
 919–921, 1094, 1095
- Radicals, explosive, 838, 839
- Radio  
 interferometric, 175–203  
 observations, 51, 149–168
- Resonant scattering, 110–114
- Rotation periods  
 P/Arend-Rigaux, 708, 709  
 P/d'Arrest, 707  
 P/Encke, 708, 713  
 P/Giacobini-Zinner, 709  
 P/Halley, 710, 711, 713  
 IRAS-Aracki-Alcock, 712  
 P/Neujmin 3, 707, 707, 710  
 P/Tempel 4, 709, 713
- Rotation rate. *See under Nucleus.*
- S, 248, 363, 378, 379 (table), 382, 383,  
 384 (figure), 385, 387 (table), 386,  
 391 (table), 401 (table), 419, 631,  
 892, 915 (figure), 1048, 1078  
 (table), 1079, 1081 (table), 1086,  
 1087  
 S+, 915 (figure)  
 S<sub>2</sub>, 115, 144, 145, 228, 235, 248, 269,  
 315, 387 (table), 391 (table), 631,  
 861, 862, 912, 1262  
 S<sub>2</sub>+, 387 (table)  
 S<sub>8</sub>, 248  
 SH, 314, 328 (formation)
- Si, 379 (table), 382, 383, 384 (figure),  
 389, 393, 400, 401 (table), 892,  
 1078 (table), 1079, 1080, 1081  
 (table), 1083–1085, 1087
- SiC, 396, 1085
- SiO, 1067
- SiO<sub>2</sub>, 244, 255, 342 (figure)
- SiO<sub>4</sub>, 342 (figure)
- SO, 248, 403 (table), 915 (figure)
- SO<sup>+</sup>, 915 (figure)
- S/O, 380, 385, 391 (table)
- SO<sub>2</sub>, 231, 248, 250, 403 (table), 915  
 (figure)
- SO<sub>3</sub>, 248
- <sup>34</sup>S/<sup>32</sup>S, 866, 867, 881 (table), 863, 1261
- Scale length, 33, 37–40, 114, 184
- Scattering, 30, 31, 39, 57, 58, 143
- Sextantids. *See under Meteor streams.*
- Silicates, 388, 392–395, 400, 406,  
 408–414, 419, 420
- Solar nebula  
 general, 882, 885  
 thermal history, 406–408
- Solar system formation, 244, 336, 377,  
 629, 885
- Southern Taurids. *See under Meteor  
 streams.*
- Species, identified in comets, 387, 911  
 (table)
- Spectral line searches, 161 (table), 168,  
 184
- Spectroscopy  
 general, 80, 82–87, 93–104, 109, 116  
 radio, 152–164  
 ultraviolet, 139–145
- Spin axis orientations. *See under Nucleus.*
- Star formation, 100
- Sublimation, 633, 634, 643, 645, 648,  
 659, 662
- Sun grazers (Kreutz group), 8, 499, 515,  
 1271, 1272, 1332
- Surface, structure and composition,  
 306–309
- Swings effect, 158, 196, 198, 200
- Tail formation, 1117–1121
- Taurid complex. *See under Meteor*

- streams.
- Ti, 379 (table), 384 (figure), 1081 (table)
- Torque.** *See under Nucleus.*
- Trans-Neptunian belt, 517, 521, 522, 538
- Tunguska event, 450, 580
- V, 387 (table), 911
- Variability, 99, 140, 141, 659
- VEGA 3, 13, 176, 299, 306, 355, 380, 396, 443, 456, 723, 726, 729, 772, 801, 856, 859, 1043–1045, 1047, 1052, 1055 (figure), 1069, 1075, 1099, 1102, 1157, 1163, 1172, 1198, 1199, 1244, 1245
- VEGA 4, 13, 299, 306, 355, 723, 726, 729, 762, 801, 1043–1045, 1052, 1055 (figure), 1069, 1075, 1099, 1102, 1128, 1163, 1172, 1198, 1245 (figure)
- Visual
  - discoveries, 210, 218, 219
  - magnitude estimates, 210, 215–220
- observations, 209–221
- VLA
  - imaging, 177–194
  - observations, 182–186, 201
- Volatiles
  - frozen, 227
  - general, 390–392, 733
  - terrestrial, 449
- Water
  - detection, 176
  - ice, 141, 175, 225, 229–231, 233, 257, 277–279, 299, 630, 633, 644
    - (clathrates), 794, 804
  - ortho-to-para ratio, 93, 100, 264, 269, 362, 369, 453, 630, 631
  - photochemistry, 326, 327
  - recondensation, 963–966
- Xe, 231, 232 (figure), 430, 431, 432 (figure), 434 (table)