

INDEX

- Abbe, Cleveland, *Mechanics of the earth's atmosphere*, 56, 61–5, 88, 302
Aberdeen, isopleths of wind, 97 (fig. 15)
 pilot-balloon observations, 172–5 (fig. 38)
Adiabatic relationship in the horizontal, 307
Advection regions, hypotheses and realities, chap. xi, 281–318
 travel of centres, 281 (fig. 74)
 see also Cyclonic depressions
Aeroplane, high vertical velocity, 171
 importance in synchronous observations, 215–6
Agra, diurnal variation of wind, 188–9 (fig. 47)
Ahlborn, Fr., cyclones and anticyclones, 308, 312
Air, transfer from N to S hemispheres, 305, 328 (fig. 78), 331, 334
Air-flow, oscillations, 73–5
 relation to pressure-energy, 73, 299
 see also Wind
Air-masses, in relation to cyclones and anti-cyclones, 292–3
 kinematics, 284–8
 quasi-vitality, 52–4, 81, *see* Spin
Airships, effect of coast-line, 119–20
 effect of vertical velocity, 77, 171
Aitken, John, revolving fluid, 8, 15, 256–61, 306
Åkerblom, F., eddy-viscosity, 67, 131, 140
d'Alembert's principle, 51
Algué, J., cyclones, 316
Anabatic winds, 93
 see also Katabatic
Anemometer, 28–35
 Dines pressure-tube, 29, 93, 143
 in the free air, 142
 Robinson, 28, 92–3
 shape of vane, 24, 149
Anemometer-records, as a dynamical problem, 30–6 (figs. 3–9), 301
 comparison with revolving fluid, 264–70 (figs. 68, 70), 272
 effect of exposure on, 30 (fig. 3), 92–3, 99 (fig. 16), 100–7, 146, 157, 266–9 (fig. 70)
 gustiness, 143–50
 oscillations in, 160
 quick runs, 145–6 (figs. 28–9)
 vector, 149 (fig. 31)
 see also Wind
Angot, A., diurnal variation of wind, 98
Ångström, A., eddy-diffusion, 70
Angular momentum, conservation, 8, 45, 52–3, 58, 73, 253
 definition, 7–8, 52
 effect of friction, 61
 experimental illustration, 256–7
 relation to wind and weather, 289, 303, 343
 see also Rotation of the earth
Anticyclone, accumulation of air in, 304–5, 329
 as regions of divergence, 210–1, 302
 as the débris of cyclones, 307
Anticyclone—(contd.)
 characteristics, 153, 250–2
 creation of, 302–4; by polar air, 283
 gradient winds in, 84, 87–8, 89
 Helmholtz's deduction of position, 58, 335
 loci of origin, 317
 Margules's cycle of operations, 295, 302
 theoretical distribution of pressure in polar cap, 233–4
Antitropic wind, 80
Archibald, E. D., variation of wind with height, 124, 127
Assmann, R., upper air temperature, 216
Atmosphere, conditions of equilibrium, 225–7
 effect of mixing, 58, 61, 62, 63
 equations of motion, 37–86
 laws of motion, 1–36
 operative forces, 3–6
 stratification, 58–61, 192
 structure, foot, 87–160; limb and trunk, 161–206
 working models, 15–17
Atmospheric billows, 61–6
ATMOSPHERIC CALCULUS—TEMPERATURE AND WIND, chap. VII, 193–206
Atmospheric circulation, dynamic and static indicators, 23, 36; 249, 299, 302, 330–1
Atmospheric motion, graphic analysis of, chap. VIII, 207–30
Austausch, 69
Aviation, gustiness in relation to, 159
Baguio, 81; track, 235–6, 281 (fig. 74)
Bairstow, L., resistance of spheres, 26
Balanced forces, laws of motion under, 21–3
 see also Wind, relation to pressure-distribution
Balloon, captive, 149
Balloons, no lift, 158
Bamford, A. J., vertical velocity, 171
Banerji, S. K., effect of mountains on isobars, 222
Baroclinic, barotropic, 298
Barogram, as evidence of revolving fluid, 274–8
 embroidery, 276 (fig. 72)
Beaufort scale of wind, equivalents, 92, 94–5
van Bebber, W. J., types of weather, 284
Ben Nevis, diurnal variation of wind, 97 (fig. 15)
Bergeron, T., analysis of weather, 287–8
 discontinuity, 300
Berlin, s.s., wreck of, 262–3 (fig. 67)
von Bezold, W., thermodynamics, 56
Bigelow, F. H., cyclonic depressions, 293, 311
 equations of motion, 41
Billows, atmospheric, 61–6
Bjerknes, J., discontinuity and polar front theory, 118, 192, 283, 293, 300, 312
 model of a cyclonic depression, 15
Bjerknes, V., analysis of Indian monsoon, 222–4 (fig. 53)
 dynamic meteorology, 37, 207, 210, 211, 218–24

- Bjerknes, V.—(contd.)
 “dynamics of the circular vortex,” 66, 293,
 294, 297–9
 geostrophic relation, 210, 301
 Lagrange’s equations of energy, 54
 origin of cyclonic depressions, 305
 “structure of the atmosphere when rain is
 falling,” 224, 300
 wave-motion, 11, 81, 288
- Blair, W. R., upper air temperature, 216
- Bowie, E. H., travel of depressions, 313
- Brillouin, M., general circulation of the
 atmosphere, 56–62
 isentropic surfaces, 59–60 (figs. 11–12)
Vents contigus et nuages, 62, 294
- Brunt, D., decay of atmospheric motion, 59
 diffusion of temperature, 142
 diurnal variation of cloud, 153
 equations of motion, 42–3
 relation of wind to pressure-distribution,
 51, 75–6
 relation of wind to temperature-distribu-
 tion, 196
 revolving fluid, 255
 turbulence, 135–7
- Burgers, J. M., skin-friction, 25
- Buy's Ballot's law, 57, 87–9
- CALCULUS OF SURFACE-TURBULENCE, THE,
 chap. IV, 121–42
- Calwagen, E. G., discontinuity, 300
- Cannegieter, H. G., upper air temperature,
 216
- Capillarity, 4, 6
- Cave, C. J. P., geostrophic and observed
 winds, 113
 rate of ascent of pilot-balloons, 167
 wind in surface layers, 123
 wind in the upper air, 125, 126, 163, 175–83
 (figs. 39–44), 200, 205
- Centrifugal force, 3, 5, 302, 344
- Chapman, E. H., variation of wind with
 height, 125
- Chinook winds, 155–6
- “Circulation,” conservation of, 253, 298
see also Revolving fluid
- Circumpolar rotation, pressure-distribution,
 233–4
 velocity, 53–4, 313–4, 334
- Clayton, H. H., variation of wind with
 height, 195, 204, 226, 308
- Cliff-eddy, 119, 157–8
- Clothes-line graphs, 186–8 (fig. 46)
- Cloud, association with winds of long fetch,
 153–5
 coast-line, 119
 eddy-motion, as a cause of, 150–60 (Plates
 I–III)
 effect on variation of wind with height, 125
 motion of, in relation to cyclonic depres-
 sions, 311, 315
Vents contigus et nuages, 62
- Cloud-sheets, gustiness and, chap. V, 143–60
- Coast-line, clouds, 119
 irregularities in meteorological elements at,
 91, 96, 114–20
- Coefficients of eddy-diffusion, *see* Eddy-
 diffusion
- Condensation as a source of energy, 296, 306
- Conduction, molecular, effect on temperature,
 58–9
 equation of, 8–9
- Conservation, of circulation, 253, 298
 of mass and energy, 6–7
 of momentum, 7–8
see also Angular momentum
- Continuity equation, 6, 40, 46–8
- Convection, and local circulation, 255–60,
 272, 277, 306, 344
 as a cause of horizontal motion, 303, 382–3
 as an operative force in the atmosphere, 4, 6
 causes, 259–60, 306, 343, 344
 disposal of débris, 259, 278, 307–8, 344
 downward, 227–9, 250, 258, 287, 332,
 339–40
 identification on maps of lines of flow, 224
 in cyclones and anticyclones, 211, 250,
 259, 277–9, 290–2, 304–7, 312, 315–6,
 337–8
 relation to discontinuity, 62–3, 290–2, 344
- Rossby's statistical solution, 71
- seasonal variation of equatorial, 330–1
- transport of heat in latitude by, 69–70
- travel, 282–3
- Convergence, as an index of convection, 306
 effect of travel of cyclone on, 211
 graphic representation, 210, 220–1 (fig. 52)
 in relation to revolving fluid, 255, 310
- Conversion of units and dimensional equa-
 tions, 20
- Cordeiro, F. J. B., travel of cyclones, 246
- Coriolis, G., 325
- Corless, R., irregularities in isobars, 117, 300
 looped trajectories, 270
- Correlation, gradient and observed wind, 113,
 115
 pressure and temperature in the upper air,
 121, 161, 175, 194–5, 202–3, 225–6,
 307
- Crombie, J. E., gustiness, 146
- Cumulus, estimate of turbulence from rate of
 ascent, 140, 141
- Curvature of path, determination of, 231–2
 relation to radius of instantaneous circle,
 247
- CURVED ISOBARS, chap. IX, 231–49
- Cyclonic depressions, analysis of storm of
 10 Sept. 1903, 245, 266–70;
 anemograms, 34–5 (figs. 8–9), 264 (fig. 68)
 as revolving fluid, chaps. IX and X, 231–79,
 282–3, 309, 311–2, 344
 as secondaries to a primary cyclone, 333–5
 barograms, 274–5 (fig. 71)
 “centres,” 240–1, 247
 convection and convergence, 211, 250, 259,
 277–9, 282–3, 290–2, 306–7, 315–6,
 337–8
 conventional characteristics, 250–2, 283–4
 derivation of name, 292
 energy, 294–300
 experimental illustrations and models,
 15–17, 256–61, 291
 gradient wind equation, 84, 87–8
 inclined axes, 261, 308, 338
 isobars, 245, 277
 “normal,” 237, 273
 Norwegian analysis, 117–8, 284–8, 292–3
 occlusion, 285–6, 314, 339

INDEX

349

- Cyclonic depressions—(*contd.*)
 origin and formation, 254, 288–90 (fig. 75),
 302–4, 305–6, 315–8
 rate of filling up, 286
 relation to discontinuity, 63, 117–8, 300–1,
 305, 317
 removal of air, 272, 276, 286, 304–5, 307–8,
 337, 344
 representation on isentropic surfaces, 291,
 340–1
 sectional profiles, 226–7 (figs. 54–5)
 stationary, 315–6
 structure, 198, 205, 307, 310–2
 theories, 293–301
 trajectories of air, 244 (fig. 64), 246 (fig. 65)
 travel, 235–7, 246–7, 281–3 (fig. 74), 287,
 300, 312–7, 336
 travel of deficit, 305
 upper air observations required, 293, 311,
 323–4
 vertical extent, 312; in equatorial and polar
 air, 307
- Cyclostrophic component of pressure-
 gradient, 83, 86, 90, 231–49
- Cyclostrophic wind, *see* Wind
- Davies, E. L., 3-cup anemometer, 28
- Defant, A., eddy-diffusion, 70
- Density of air, relation with pressure and
 temperature, 86
 uniformity at 8 km, 336
 variation from normal, 195, 197
- Devik, O., dynamic meteorology, 207
- Diagnosis and prognosis, 207, 219
- Differential coefficients, total and partial,
 45–6, 79, 209, 282
- Diffusion, law of, 8–13
- Diffusion by eddy-motion, *see* Turbulence
- Diffusive forces, 6
- Dimensional equations, 17–21
- Dines, J. S., forecasting, 285
 gustiness, 145–9
 pilot-balloon observations, 124, 126, 164–7
 rate of ascent of pilot-balloons, 167–9
 relation of observed wind with gradient,
 101, 113, 115, 122
 reversal of wind, example, 203
 travel of secondaries, 315
- Dines, L. H. G., exposure of anemometers, 99
 lapse of temperature in fog, 150
 squalls in NW wind, 155
- Dines, W. H., anemometry, 24, 28, 29, 93, 143
 effect of radiation on cloud, 153
 isobars and isotherms in the upper air, 198
 standard deviations of pressure, 194
 temperature-gradients in the upper air, 204
 temperature in WSW wind, 155
 tornado-model, 15, 16
 upper air correlations, 121, 175, 194–5,
 202–3, 225–6, 307
 wind in the upper air, 88, 197–8 (fig. 49)
- Discontinuity, as the place of origin of
 cyclonic depressions, 63, 300
 energy, 294–7, 300
 evidence for, in the atmosphere, 78, 117–20,
 192, 300–1, 317
 formation by travel of revolving fluid, 301
 Norwegian conceptions, 285, 300–1
 relation of convection to 62–3, 290–2, 344
- Discontinuity—(*contd.*)
 relation of turbulence to, 156–7
 surfaces of, as isentropic surfaces, 192, 290,
 297, 341 (fig. 79)
 surfaces, slope of, 59–60, 192, 292, 297
 theoretical treatment, Bjerknes, 297–9;
 Helmholtz, 59–60; Margules, 295–7,
 300
 vertical extent, 192, 311, 314
- Diurnal variation, cloud in relation to tur-
 bulence, 153, 155
 pressure-gradient, 96
 wind, 96–8 (fig. 15), 124–5 (fig. 23), 135,
 188–9 (fig. 47), 191
- Divective regions, 302–4, *see* Anticyclone
- Divergence of air, 210–1, 302; graphic re-
 presentation, 220–1, 224
- Dobson, G. M. B., errors in pilot-balloon
 observations, 175
 “no lift” balloons, 158
 relation of surface and geostrophic wind, 132
 variation of wind with height, in the tropo-
 sphere, 123, 140, 162–4 (fig. 35), 171;
 in the stratosphere, 184–5 (fig. 45)
- Doldrums, 331, 334–5
- Douglas, C. K. M., cloud-photographs, 152
 isallobars, 75–6
 terms in equations of motion, 51
- Dove, H. W., 57; conflict of currents, 288,
 300
- Downward motion, relation with areas of
 subsidence, 287
see Convection
- Duclaux and Duponchel, 57
- Durand-Gréville, E., *rubans de grains*, 160
- Durst, C. S., gustiness, 147
- Durward, J., diurnal variation of wind, 98
- Dust-particles, rate of fall, 27
- Dynamic centre, 241
- Dynamic meteorology and hydrography*, 207,
 217–24
- Dynamical meteorology, statement of prob-
 lem, 36
- Dynamical similarity, law of, 13–17; applica-
 tions, 26–7, 64–5
- Dynamical theory, assumptions, 77, 78, 79–81
 contribution to meteorology, 77–81, 324–5
 equations of motion, chap. II, 37–86
 applications, 55–76, 293–9
 approach by doctrine of energy, 54
 derivation, 38–52
 expression of forces, 47–9, 68
 hydrodynamical, 45–9, 64, 67
 order of magnitude of terms, 50–1
 laws of motion, chap. I, 1–36, 89, 90
 revolving fluid, 252–6
- Dynamics and the pilot-balloon, 191–2
 “Dynamics of the circular vortex,” 297–9
- Earth, figure of, 5, 44
- Eddy, size, 71, 144–5
- Eddy-conductivity, 69, 70, 141
- Eddy-diffusion, coefficients, 13, 70, 71, 131,
 137, 140–2
 effect of size of eddies, 142
 heat, 128–9, 150–1
 momentum, 131–40
 temperature or potential temperature, 142
- Eddy-motion, *see* Turbulence

350

INDEX

- Eddy-stress, 70
 Eddy-viscosity, *see* Eddy-diffusion
 Egnell, A., variation of wind with height, 195,
 204, 226, 308
 Eiffel, G., resistance of spheres, 26 (fig. 2)
 Eiffel Tower, diurnal variation of wind, 96, 98
 variation of wind with height, 67, 121, 123
 Einstein, A., relativity, 1, 3
 Ekholm, N., isallobars, 75
 Ekman, V. W., wind and drift-current, 67
 Electricity and magnetism, application of
 dimensional equations, 18–20
 Eliot, Sir John, *Atlas of India*, 222
 gradient equation, 83
 Energy, conservation, 6–7
 development at a discontinuity, 300–1
 Lagrange's equations, 54
 Margules's computations, 293–7
 of atmospheric motion, 42, 294
 of eddies, 70
 of waves, 65
 rate of decay, 59
 relation of pressure-energy and air-motion,
 73, 294–5, 299–300
 transformations in the atmosphere, 320–1;
 derived from the earth's rotation, 43;
 in slope-effect, 227–9
 Entropy, air-motion in relation to isentropic
 surfaces, 21–2, 290–2, 297, 306, 343
 as a cause of weather, 343
 as an index of stratification and stability,
 58–61, 192, 295, 299, 320
Austausch, 69–70
 cyclonic depressions as corrugations in
 isentropic surfaces, 283, 340–1
 data required for investigation, 292, 293,
 321
 deformation of isentropic surfaces near an
 obstacle, 230 (figs. 57–8)
 dimension, 21
 discontinuity and isentropic surfaces, 192,
 290–1, 297
 energy at discontinuity of, 296–7, 299, 300
 isentropic surfaces as the basis of graphic
 representation, 207, 217, 321, 323,
 342, 343
 isentropic surfaces as the boundary of the
 underworld, 283, 313–4, 317, 335–7,
 341 (fig. 79)
 relation to cosmical theory, 1, 3
 slope of isentropic surfaces, 59–60 (figs.
 11–12), 323, 336
 turbulence in relation to, 142
 wave-motion in isentropic surfaces, 61–6
 Entropy-temperature surfaces, expression
 of atmospheric structure by, 225–7
 (fig. 55)
 Equations of motion, *see* Dynamical theory
 Eskdalemuir, diurnal variation of wind, 97
 (fig. 15)
 gustiness, 147
 Espy, J. P., diurnal variation of wind, 9, 96
 Euler, L., equations for a rigid body, 52
 Eulerian wind, 80
 Everett, J. D., *Units and physical constants*, 18
 Eviction, 306
 Exner, F. M., cyclones and anticyclones, 308,
 311
 dynamical theory, 41, 49–50, 72–5, 79
 Exner, F. M.—(contd.)
 eddy-diffusion, 70
 experiment on flow of cold air, 16
 flow of polar and equatorial air, 289, 290,
 337, 341 (fig. 79)
 Fairgrieve, J., surface and geostrophic wind,
 101, 105
 Falmouth, diurnal variation of wind, 97
 (fig. 15)
 Ferrel, W., equations of motion and the
 general circulation, 40, 41, 44, 56, 57,
 88
 theory of cyclonic depressions, 293
 Fick, diffusion equation, 8
 von Ficker, Heinz, Föhn winds, 156
 Fog, formation by eddy-motion, 128, 130,
 150–1, 154
 upper air temperature and humidity, 150–1
 (fig. 33)
 Föhn winds, 155–6
 Fontseré, E., vertical oscillations of pilot-
 balloons, 159
 FOOT OF THE ATMOSPHERIC STRUCTURE, THE,
 chap. III, 87–120
 Force, centrifugal, 3, 5
 conception of, 2–3, 54
 evaluation of, on surfaces in air-currents,
 23–7
 expression in equations of motion, 47–9, 68
 operative in the atmosphere, 3–6
 units, 2
 Forecasting, Bjerknes' statement of the
 problem, 218
 development, 284–6
 from lines of flow, 224
 from travel of depressions, 283
 Fourier, J. B. J., law of diffusion, 8
 Friction, as an operative force, 4, 6, 343;
 expression in algebraical form, 132;
 see also Viscosity
 effect on air motion, 61, 66–72, 88, 89; *see*
 also Turbulence
 effect on revolving fluid, 309
 production of rainfall by, 76
 relation to turbulence, 137
 “skin,” 25 (fig. 1)
 Friedmann, A., quoted, 78
 terms in equations of motion, 51, 301
 Fronts, 285–93, 326 (fig. 76)
 Gião's investigations, 76
 refraction of isobars at, 117–8
 Fujiwhara, S., cyclones, 300, 313
 eddy-resistance, 137
 vortices, 14, 72, 256
 Galton, Sir Francis, anticyclones and cyclones,
 250, 252
 Garbett, L. G., upper air observations at sea,
 188
 Gas-constant, 21, 104
 Gauss, J. K. F., dynamical similarity, 13
 Geddes, A. E. M., pilot-balloon observations,
 161, 172–4 (fig. 38)
 turbulence, 158
 General circulation of the atmosphere, a fare-
 well view, 325–45 (figs. 76–7)
 classical papers, 56–66, 298
 effect of orographic features, 58, 234

INDEX

351

- General circulation of the atmosphere—
 (contd.)
 energy in relation to distribution of pressure, 299–300
 general equations of motion, 37–86
 rate of decay, 59
 rotation of the polar canopy, 52–4, 233–5,
 313–4, 318, 333–5
 study by synchronous observations, 318, 334
 transfer of air from N to S hemisphere,
 328–31
- GENERAL EQUATIONS OF MOTION OF A PARCEL
 OF AIR, ETC., chap. II, 37–86
- Geoidal slope, 5
- Geopotential, dimensions, 20
 energy on a tephigram, 228 (fig. 56)
 relation to gravity and height, 45
- Georgii, W., gliding, 230
- Geostrophic component of pressure-gradient, 83, 90, 236
- Geostrophic scales, 82 (fig. 13), 85 (fig. 14)
- Geostrophic wind, *see* Wind
- Geostrophic wind-roses, 101–7 (figs. 17–20)
- Gião, A., dynamics of fronts, 76
- Giblett, M. A., upper air observations in line-squall, 292, 311
 winds of long fetch, 155
- Gibraltar, anemogram, 33 (fig. 7)
 cliff-eddy, 157
- Gliding, 158–9, 229–30
- Gold, E., Norwegian school of weather-study, 224, 285
 pressure on sea and land, 117
 relation of wind to gradient, 84, 88, 89, 161,
 247
 thermal wind, 202
 types of pressure-distribution, 284
- Goldie, A. H. R., gustiness, 147
- Gradient equation, 82–9; effect of curvature, chap. IX, 231–49
- Gradient-wind, *see* Wind
- GRAPHIC ANALYSIS OF ATMOSPHERIC MOTION, chap. VIII, 207–30
 ρv diagrams (Bjerknes), 217–24
 synchronous charts in the free air, 207–16
 $t\phi$ diagrams, 225–9
- Gravitation and gravity, as a cause of weather, 343
 effect of earth's rotation, 5, 44
 effect of motion of air on weight, 49
 modern views, 1, 3
 relation to latitude and height, 5
- Greenland, dépôts of cold air, 289, 341
 effect on general circulation, 234, 332
- Guldberg, C. M., effect of friction on wind, 67, 88
- GUSTINNESS AND CLOUD-SHEETS, chap. V, 143–60
- Gustiness, anemometer-records, 28–35 (figs. 3–9), 145–50
 methods of investigation, 147, 159
 numerical expression, 145–7
 relation to aviation, 159
 relation to wave-motion, 62
 squalls, 159–60
 time-scale, 148
 variation with height, 147
 vector-diagrams, 149–50 (fig. 31)
see also Turbulence, Wind
- Gusts, frequency, 144
- Hadley, G., and Halley, E., general circulation, 56, 57
- von Hann, J., travel of depressions, 313
- Hann-Süring, *Lehrbuch*, 75
- Harries, H., cliff-eddy, 158
 temperature in WSW wind, 155
 track of cyclonic depression, 281
- Hawke, E. L., coastal pressure-gradients, 96
- Heat, diffusion by eddy-motion, 8–9, 128–9
 dissemination in the atmosphere, 58–9, 61
 transfer from equator to pole, 69–70
- Hellmann, G., wind in the surface-layers, 68, 98, 124, 127, 135, 140
- von Helmholtz, H., atmospheric billows, 61–6
 conservation of angular momentum, 53,
 320, 332
 discontinuity and stratification, 53, 58–61,
 78, 217, 288, 291, 294, 313–4, 320
 dynamical similarity, 11, 13, 64
 position of high pressure areas, 58, 313, 335
 theory of turbulence, 66
 viscosity, 58, 89
- Henry, A. J., origin of depressions, 316
- Hergesell, H., rate of ascent of pilot-balloons, 167
- Hesselberg, Th., dynamic meteorology and hydrography, 207
 eddy-viscosity and variation of wind with height, 68, 135, 139, 140
 order of magnitude of terms in equations of motion, 51, 301
 provisional assumptions for mathematical computation, 78
 representation of upper air results, 188
- Heywood, G. S. P., lapse of temperature in fog, 150
- Hobbs, W. H., 318; rôle of glacial anti-cyclone, 107
- Hoffmeyer, N., synchronous charts, 108
- Holyhead, anemometers, 28
 geostrophic and surface wind, 104–5 (fig. 19)
- Horizontal and vertical motion, 79, 278–9,
 293, 323, 343
- Horizontal surfaces, definition, 5, 44
 for graphic representation, 217
- Hudson, W. H. H., anemoids, 238
- Humidity, variation with height in fog, 151;
 on theory of eddy-motion, 129
- Humphreys, W. J., *Physics of the Air*, 311
 travel of cyclones, 313
 variation of wind with height, 125, 139
- Hydrodynamics, equations of motion, 45–9,
 64, 67
 Helmholtz's treatment of discontinuities, 59–66
- HYPOTHESES AND REALITIES ABOUT ADVECTIVE AND DIVECTIVE REGIONS, chap. XI, 280–318
- International Commission for Aerial Navigation, 187
- Isallobars, 75–6
- Isentropic motion, 21–2, 307
- Isentropic surfaces, *see* Entropy
- Isimaru, Y., eddy-motion, 72, 137, 140
- Isobaric motion, law of, 21–2, 90

- Isobaric surfaces, advantages for graphic representation, 217
 Isobars, accuracy of, 91
 centre of, as dynamic centre, 241
 computation from wind-data, 200–2 (fig. 50)
 convergence along great circles, 233
 curved, 231–49
 discontinuity and refraction, 103, 117–20,
 290, 300, 301
 effect of mountain ranges, 222
 normal for December, 280 (fig. 73)
 peculiarities at the surface, 112–20
 relation of paths of air to, 85, 231–2, 280
 (fig. 73), 282
 relation with isotherms in the upper air,
 198, 201–4 (fig. 50)
 travel, 248–9, 251
 types, 232–3, 284
 see also Pressure-distribution
 Isotherms, computation from upper wind,
 200–1 (fig. 50)
 relation with isobars in the upper air, 198,
 201–4 (fig. 50)
 Jeffreys, H., classification of wind, 80
 effect of vertical velocity on pilot-balloon
 data, 170
 equations of motion, 39, 41
 relation of wind to gradient, 109, 114
 viscosity, 68
 Johnson, N. K., gustiness, 147
 3-cup anemometer, 28
 Jones, B. M., skin-friction, 25 (fig. 1), 27
 Katabatic winds, 80, 93, 107, 126, 339
 as a cause of anticyclones, 303, 304
 thermodynamical considerations, 227–9
 Kelvin, Lord, diffusion of heat, 128
 Kepler, J., motion of planets, 8, 77
 Kew Observatory, *see* Richmond
 Kidson, E., rate of ascent of pilot-balloons,
 171
 Kinematic centre, 240
 Kinematics of air-masses, 284–8
 KINEMATICS OF THE LIMB AND TRUNK, chap.
 VI, 161–92
 Kinematics of the surface air, 222–4
 Kinetic energy, *see* Energy
 Kinetic theory of gases, 9
 Kobayasi, T., height of cyclones, 312
 mechanism of cyclones and anticyclones, 301
 Köppen, W., diurnal variation of wind, 9, 96
 Krakatoa dust, direction of motion, 205–6
 Lagrange, J. L., equations of energy, 7, 54
 Lamb, H., viscous forces, 48
 Lammert, L., Föhn winds, 156
 Land and sea breezes, 93, 116
 Laplace, P. S., relation of pressure and
 height, 5
 LAWS OF ATMOSPHERIC MOTION, THE, chap. I,
 1–36
 Lempfert, R. C. K., discontinuity in anemo-
 grams, 300
 line-squalls, 117
 Level surfaces, as a basis of graphic repre-
 sentation, 217
 see also Horizontal
 Limb, kinematics of, chap. VI, 161–92
 Limiting velocity, 22–3
 Line-squalls, 160, 290, 340
 calculation of energy, 295–6
 refraction of isobars, 117
 upper air ascent, 311
 see also Squalls
 Lines of flow, *see* Stream-function
 Logie, John, eddy-motion and surface tem-
 perature, 155
 Loris-Melikoff, M., cyclones and anti-
 cyclones, 304, 329
 Lucretius, 52, 193
 Lunnon, R. G., resistance to spheres, 27
 McAdie, A., paths of cyclones, 235, 281
 Principles of Aerography, 311
 Mallock, A., eddy-motion, 158
 Mapping, *see* Weather-maps
 Margules, M., 79
 anticyclones, 295, 302
 energy of storms, 75, 293–7, 299, 300
 isentropic surfaces, 217
 upper wind and temperature distribution,
 196, 202
 velocity-equivalent of pressure-gradient, 73
 Mass, conservation, 6–7
 equation of continuity, 39, 40, 46–8
 lateral displacement by velocity, 304–8
 Mathematics, contribution to meteorology,
 77–81, 324–5
 Mauritius, perspectives, 189–91 (fig. 48)
 Maury, M. F., *Physical geography of the sea*,
 56, 57
 Mawson, Sir Douglas, gales in Antarctic,
 107
 Maxwell, J. Clerk, capillarity, 6
 conservation of energy, 7
 determination of forces from motion, 324
 dynamical similarity, 13; 18
 Theory of Heat, 323
 viscosity, 58, 66
 Mean values once more, 323–4
 Meldrum, C., cyclones, 316
 Meteorological entities, 81, 309
 Dramatis personae, *see* General summary
 Meteorological theory, achievements of mathe-
 matics, 77–81, 324–5
 revision of the articles of vol. II, 320, 343–5
 see also Dynamical theory
 Meteorology, statement of the problem, 36,
 37, 218
 Meteors, as indicators of wind, 206
 Miller, P. A., vertical velocity, 171
 Mitchell, C. L., tracks of cyclones and anti-
 cyclones, 236, 281–2 (fig. 74), 300,
 316–7
 Miura, E., 3-cup anemometer, 28
 Mixing of air, ascent caused by, 62, 63
 Models of cyclonic depressions, 15–17, 256–
 61, 291
 Mohn, H., wind and surface friction, 67, 88
 Möller, M., general circulation, 57
 Moltchanoff, P., anemometer in the free air,
 142
 Böen, 160
 rate of ascent of pilot-balloons, 171
 Moment of momentum, *see* Angular mo-
 mentum
 Moments, 51–2

INDEX

353

- Momentum, conservation, 7–8; Siemens's application to the general circulation, 58
definition, 2
diffusion by eddy-motion, *see* Turbulence
equations of motion in terms of, 39–40
rate of loss at the surface, 132
see also Angular momentum
- Monsoon, Bjerknes's analysis, 222–4 (fig. 53)
- Moore, Willis, origin of depressions, 316
- Nauen, variation of wind with height, 124
- Newnham, E. V., observed and gradient winds, 113
- Newton, Sir Isaac, laws of motion, 1–3, 7, 21–3, 37–9, 324
“Normal” cyclone, definition, 237
see Revolving fluid
- Normand, C. W. B., meteorological conditions affecting aviation, 159
- North Sea, geostrophic and surface winds, 109
- Norwegian analysis of cyclonic depressions, 284–93
refraction of isobars, 117–8
terminology, 287, 322
- Oberbeck, A., revolving fluid, 13, 57, 293, 311
- Observations, Bjerknes's scheme of organisation, 219
comparison of, on maps, 208
necessity for, 81, 311, 323, 324; over sea and polar regions, 319–20
- Occlusion, 285, 286, 314, 339
- Okada, T., 3-cup anemometer, 28
- Orographic features, effect on air-motion, 58, 87, 146–7, 157–8, 160, 175, 230 (figs. 57–8)
effect on cloud, 110, 154
effect on isobars, 117–20, 222
- Oscillations, horizontal in air-flow, 73–5
periodic in wind-velocity, 160
vertical, with pilot-balloons, 159
- Overworld, as a revolving canopy, 288, 289, 326–7 (figs. 76–7), 334–6
pressure-waves in relation to, 342
see also Underworld
- Paths of air, *see* Trajectories
- Patterson, J., correlation coefficients in the upper air, 307
3-cup anemometer, 28
- Peebles, C. E., vertical velocities, 171
- Pendennis Castle, wind-records and gustiness, 30 (fig. 3), 147
- Peppler, A., cyclones and anticyclones, 311
- Peppler, W., *Vertikalbœn*, 160
- Perspectives for representation of upper wind, 188–91 (figs. 47–8)
- Piddington, H., cyclones, 292
- Pilot-balloons, ascent at core of cyclone, 261
bibliography of data, 161, 187
co-ordination of synchronous observations, 208–16, 221
formulae, 168, 170
results and their representation, 161–92
tail-method, 170
time-unit for observations, 191
vertical oscillations, 159
vertical velocity, 115, 165 (fig. 36a), 167–71, 174 (fig. 38c)
- Pitot tube, 29
- Polar co-ordinates, definition, 42–3
- Polar front, 285–93, 326 (fig. 76)
relation to underworld and overworld, 288, 317, 340
- Potential temperature, diffusion, 69, 128–9,
142
- Potential volume, 225
- Potsdam, diurnal variation of wind, 98
- Precipitation, *see* Rain
- Pressure, accuracy of data, 91, 208
as a force in atmospheric operations, 3–4, 5;
algebraical expression, 47
as a static indicator of atmospheric motion, 23, 36, 249, 299, 329
barograms as evidence of revolving fluid, 274–8
difference at coastal and inland stations, 96, 117
dominance of the stratosphere, 194–5, 202, 206
energy due to discontinuity, 296
minor fluctuations, 276 (fig. 72)
relation with temperature in the upper air, 121, 183, 194–5, 202–3, 307
sea-level or station-level, 293, 321
seasonal variation, 329
standard deviations in the upper air, 194
variations due to wave-motion, 65
- Pressure-distribution, adjustment to wind-velocity, 80, 90, 302–4, 344
analysis into opposite circulations, 288, 335
calculated values for a rotating polar cap, 233–4
calculated values for revolving fluid, 240–3 (fig. 62), 247, 253, 255, 270–1; comparison with observation, 242–5 (figs. 62–3), 262–3 (fig. 67), 272
charts for the sea, 108
classification of types, 284
coastal gradients, 91, 96, 117–20
determination from upper air winds, 199–216
development of circular from linear form, 305–6
difficulties of measurement of gradient, 91–2, 108
discontinuity, 78, 117–20
diurnal variation of gradient, 96
energy, 73, 294, 299–300, 304
geostrophic and cyclostrophic components of gradient, 83, 86, 90, 236
height of zero gradient, 205
relation of travel of air to, 231–2, 280 (fig. 73), 282
relation with wind, *see* Wind
rôle of earth's rotation and of water-vapour, 344
seasonal variation and atmospheric circulation, 328–9, 334
superposition of gradient on a stationary cyclone, 247–9
transmission to the surface, 260, 314
variation of gradient with height and relation to temperature, 115, 193–206, 302
see also Isobars, Wind
- Pressure-volume, diagrams, 225–6 (fig. 54)
- Pressure-waves, of the Antarctic, 342
- Profiles, 225–7 (figs. 54–5)

354

INDEX

- Pyrton Hill, geostrophic wind-rose, 101-2 (fig. 17)
 variation of wind with height, 124 (fig. 23), 164-7 (fig. 36), 172
- Radiation, as a cause of weather, 321, 343
 effect on cloud, 153
 seasonal variation of solar, in relation to air-mass, 328 (fig. 78), 330-1
 slope-effect, 227-9, 332
- Rain, as a cause of air-spin, 258, 277, 306, 315-6
 limiting velocity of drops, 22-3, 27
 production by surface-friction, 76
 production by wave-motion, 65
 seasonal variation, 321, 330-1
- Rankine, W. J. M., vortex-motion, 309
 Rao, P. R. Krishna, upper air temperatures, 336
- Rayleigh, 3rd Lord, dynamical similarity, 13
 revolving fluid, 252-7, 279, 310, 311
- Reboul, G., diurnal variation of wind, 98
- Refraction of isobars, 117-20
- Resistance to surfaces in air-currents, 23-7
- RETROSPECTIVE AND PROSPECTIVE, chap. XII, 319-45
- Revolving fluid, as a meteorological entity, 52-4, 81, 235-7, 309-10, 337-9, 344
 barograms, 274-8
 "centres," 240-1
 effect of rotation of the earth, 255
 experimental illustrations, 256-61
 formation of discontinuity by, 301
 identification in the atmosphere, 36, 242-5, 251, 261-79
 methods of production and dissipation, theoretical and experimental, 255, 258; in the atmosphere, 272, 277, 306, 309-10, 316
 present position, 279, 282, 284-5
 relation of horizontal and vertical motion, 278
 relation to environment, 235-7, 259-60, 309-10
 slope of core, 261, 308
 stability, 235-7, 253-4
 "suction" effect, 260
 theoretical results, 237-49; Rayleigh's analysis, 252-6, 261
 pressure-distribution, 233-4, 240-3, 255, 270-1
 velocity distribution, 262 (fig. 67), 268-9 (figs. 69-70)
- REVOLVING FLUID IN THE ATMOSPHERE, chap. X, 250-79
- Reynolds, Osborne, turbulence, 12, 66
 Reynolds number, 12, 16, 25, 26, 66
 Richardson, L. F., equations of motion and weather-prediction, 39-40, 41, 46, 55, 72, 210, 219
 resistance of spheres, 27
 viscosity and turbulence, 70-1, 140-2, 158, 159, 338
- Richmond, Kew Observatory, anemogram, 32 (fig. 5)
- Robinson, J. T. R., anemometer, 28, 92-3
- Rossby, C. G., turbulence, 66-72, 140
 working models of atmospheric motion, 16, 17
- Rotation of the earth, as a cause of wind, 332, 343
 as a centrifugal force, *q.v.*, 3, 5
 constancy, 234-5
 effect on air-motion, 22, 43, 50, 57, 61, 67-8, 82, 87-90
 effect on measure of kinetic energy, 42
 effect on pressure-gradient, 303, 344
 effect on revolving fluid, 255
 effect on weight, 44, 49
- Rouch, J., diurnal variation of wind, 98
- Ryd, V. H., travelling cyclones, 299, 301
- Sakakibara, S., eddy-resistance, 72
 generation of vortices, 298
- Salmon, S. H. R., kite-observations, 150
- Sandström, J. W., dynamic meteorology and hydrography, 207
 stream-lines, 75, 220
 surface-friction, 67
- Sawyer, L. D., winds in excess of gradient, 120
- Schmidt, W., advance of front of heavy water, 16
Austausch, 69
 eddy-viscosity, 140, 141
 structure of wind, 159
- Schuster, Sir Arthur, balloon-ascents, 323
- Scilly, anemogram, 32 (fig. 6)
 pilot-balloons, 126
- Scruse, F. J., size of eddies, 144-5
- Scud, formation by eddy-motion, 154
- Sea-breezes, 93, 116
- Seasonal variation of elements in the general circulation, 328-31
- Secondaries, 254, 337-9
 formation by rain, 258, 306
 formation from sinuosities in isobars, 269, 289
 travel, 315
see also Cyclonic depressions
- Sen, S. N., wind and pressure-gradient, 107
- Shakespear, G. A., resistance of spheres; 26-7 (fig. 2)
- "Shaw," definition as a mass-unit, 304
- Siemens, W., *Erhaltung der Kraft*, 56, 58
- Simpson, G. C., Beaufort scale, 94-5
 heat-flow and radiation, 334
 pressure-waves, 342
- Sinjin, A., cyclones and anticyclones, 304-5, 329
- Skin-friction, 25 (fig. 1)
- Slope-effect, 332, 339
 graphical representation, 227-9
see also Katabatic winds
- Smyth, Piazzi, trade-wind clouds, 154
- Solberg, H., discontinuity and polar front, 283, 300
- Solenoidal fields, 209-13, 223
- Solid rotation, *see* Revolving fluid
- Sound, velocity, 14, 20
- South Farnborough, variation of wind with height, 124 (fig. 23)
 wind and pressure-gradient, 114
- Southport, anemogram, 31 (fig. 4)
 geostrophic wind-rose, 101, 103 (fig. 18)
 refraction of isobars, 119 (fig. 22)
- Sphere, resistance to moving air, 23, 26-7

INDEX

355

- Spin**, 36, 333
 relation to gustiness, 143
 vitality, 52–4, 81, 235–7, 309–10, 337–9
 see also Revolving fluid
- Spiral of turbulence**, 135–9 (fig. 27), 143–4
- Sprung**, A., *Lehrbuch*, 75, 293
- Squall-line**, 286, 287
 convection, 291–2
- Squalls**, 159–60, 339–40
 anemograms, 32 (figs. 5–6)
 relation to sea and air temperature, 155
 see also Gustiness, Line-squall
- Steering-line**, 287
- Stevenson**, T., wind, 68, 140
- Stokes**, Sir George, cup-anemometer, 28
 fall of water-drops, 27
- Storm**, typical, of 10 Sept. 1903, 242, 244–6
 (figs. 62–5), 264–74 (figs. 68–70)
- Storms**, energy of, 294–7
- Stratification of the atmosphere**, 58–61, 192, 320
- Stratosphere**, in control of surface-pressure, 194–5, 202, 206
 mixing of air in, 185
 variation of wind with height, 183–5 (fig. 45), 204–5
 wind-direction, 314–5
- Stream-function**, construction of maps, 210–3
 (fig. 51), 221, 223 (fig. 53b)
 map for 10 Sept. 1903, 268 (fig. 69)
 stream-line motion, 12
- Streiff-Becker**, R., Föhn winds, 156
- Strophic balance**, 21–2, 89–91, 302–4
 in changing pressure-distribution, 75–6
 see also Wind, relation to pressure-distribution
- Subsidence of air**, 287
- Surface layers**, vertical extent, 121, 160, 161–2
- Surface-tension**, as an operative force, 4, 6
- Surfaces for mapping**, *see* Weather-maps
- Sutton**, L. J., upper winds at Cairo, 187
- Sverdrup**, H. U., eddy-viscosity and variation of wind with height, 68, 135, 139, 140
- Swoboda**, G., analysis of weather, 287–8, 300
- Symbols**, 5, 37–8, 66, 128
- Synchronous charts for the sea**, 108
- Synchronous charts of horizontal motion**, 207–16
- Takaya**, S., eddy-viscosity, 137, 140
 variation of wind with height, 139
- de Tastes**, general circulation, 57
- Tay Bridge disaster**, 28–9
- Taylor**, G. I., eddy-motion, 68–9, 93, 97, 127–35, 140, 153, 164, 166, 243
 relation to formation of cloud, 150–1
 “Turbulence,” 9, 159
 wind in the surface layers, 123
- Teisserenc de Bort**, Léon, 57
 isopleths of temperature, 216
- Temperature**, absolute scale expressed as energy, 20–1
 cause of fluctuations in N. America, 317
 difference of sea and air, as a cause of convection, 289–90, 316; effect on surface-wind, 97, 110–1, 155
 diffusion by conduction, 8–9, 58–9
 diffusion by eddy-motion, 128–30, 142, 150
 diurnal variation in relation to viscosity, 69
- Temperature—(contd.)**
 energy at discontinuity, 295–7
 gradient over the British Isles, 116
 unilateral behaviour at the surface, 274
- Temperature of the upper air**, consecutive observations, 216
 correlation with pressure, 121, 183, 195, 202–3, 307
 distribution over cyclone and anticyclone, 198, 205
 extremes over England, 334
 gradient, 201–5
 relation to pressure and wind, 115–6, 193–206
 level of adiabatic relationship, 307
 of uniformity, 336
- relation of lapse-rate to stratification**, 192
- relation of lapse-rate to turbulence and wind-velocity**, 70, 97, 110–1, 131, 155, 159
- variation with height, in cloud and fog**, 150–2 (fig. 33, Plates I–III)
 on theory of eddy-motion, 129–30 (fig. 24)
- Tephigram**, representation of slope-effect, 227–9
- Terminology**, 287, 321–2
- Thermometer**, graduation in ergs, 21
- Thomson**, James, general circulation, 56, 57
- Thomson**, J. J., 54
- Tornado**, locality of formation, 251
 models, 15–17
 South Wales, 236, 251
- Tornado-centre**, 240
- Trade-wind**, clouds, 154
 seasonal variation, 331
- Trajectories of air**, comparison of actual and calculated, 244 (fig. 64), 246 (fig. 65), 270
 relation to isobars, 85, 231–2, 280 (fig. 73), 282
- Trajectories of cyclonic depressions**, 235–6, 281–2 (fig. 74)
- Treloar**, H. M., rate of ascent of pilot-balloons, 171
- Tropical revolving storms**, as revolving fluid, 312
 defect of air, 305
 loci of origin, 316
 models, 15
 seasonal variation, 331, 334
 travel, 235–7, 281 (fig. 74)
- Tropopause**, 183, 185
- Trunk**, kinematics, chap. VI, 161–92
- Turbulence**, Calculus of, chap. IV, 121–42
- Turbulence in wind**, 66–72, 93, chaps. III–V
 as a cause of fog and cloud, 69, 128, 150–60
 as an example of spin, 53, 143
 as an operative force in the atmosphere, 4, 6, 11–13
 at surfaces in air-currents, 23–7
 coefficients, 13, 70, 71, 131, 137, 140–2
 comparison of horizontal and vertical disturbance, 148–50
 criterion by velocity, Reynolds, 12, 13, 66;
 variation with lapse-rate, Richardson, 70
 dissipation of energy by, 59, 61

INDEX

- Turbulence in wind—(*contd.*)
 effect of obstacles and discontinuities, cliff-eddies, 119, 156–9, 230
 energy, 70–1
 gustiness and, 143–50
 methods of investigation, 158
 mixing produced by, 61, 66
 relation with change of entropy, 142
 relation with lapse of temperature, 70, 125, 128–30, 131, 155, 159
 spiral of, 135–9 (fig. 27), 143–4.
 theoretical investigations: historical résumé, Rossby, 66–72; Taylor, 68–9, 127–35; Brunt, 135–7
 transport of heat by, 69
 vertical extent, 121, 129–30, 153, 155
see also Viscosity, Wind, relation to pressure-distribution
- Typhoons, *see* Tropical revolving storms
- Udden, A. D., cyclones and anticyclones, 311
 Underworld, 335–6
 boundary, 317, 326–7 (figs. 76–7), 336, 337, 341 (fig. 79)
 circulation in, 288–9, 335–6
 expression of polar front in terms of, 283, 288, 317, 339, 340
 relation to Helmholtz's isentropic surfaces, 60, 314
- Units, 2, 322
 dimensional equations, 18–20
- Upavon, variation of wind with height, 162–3 (fig. 35)
- Upper air, circumpolar rotation, 53–4, 313–4, 334
 consecutive records of temperature, 216
 importance of additional data, 191–2, 215–6, 221, 293, 311, 323
 publication of data, 150, 161, 187
 relation of pressure and temperature, 121, 161, 175, 183, 194–5, 201–3, 225–6, 307
 structure of cyclones and anticyclones, 310–2
 synchronous charts of horizontal motion, 207–16
 turbulence in, 142
see also Temperature, Wind, etc.
- Valentia, exposure of anemometers, 99
 seasonal variation of rain, 330–1
- Varney, B. M., dynamical effect of slopes, 230
- Vector quantities, mapping of, 223
 notation, 135
- Vertical, definition, 5, 44
- Vertical motion, as the result of eddies, 119, 157–8, 230
 effect on axis of revolving fluid, 308, 338
 effect on pilot-balloon observations, 115, 170–1, 208–9
 graphic representation of regions of, 222–4 (fig. 53c)
 importance in meteorology, 79, 278–9, 293, 323, 343
 observed values, 165 (fig. 36), 167–71 (fig. 37), 174 (fig. 38c)
 relation to gliding, 229–30
see also Convection
- Vertical oscillations, 159
- Viscosity, as the limit of spin, 338
 effect on surfaces in air-currents, 16, 23–7
 expression in equations of motion, 48, 67, 68
 molecular, 6, 9–11, 58–9, 89
 virtual, 66–72
- Vortex, as the environment of solid rotation, 267–70, 273, 309
 Bjerknes's treatment, 66, 297–9
 comparison of, in water and air, 14
 comparison with motion of a solid, 12–13
 creation of, 298
 growth and decay, 72
 relation to turbulence, 11–13
 working-models, 15–17
see also Revolving fluid
- Walker, G. W., gusts, 144
- Water-drops, rate of fall, 26–7
- Water-spout, 261
- Water-vapour, as a cause of convection, 283, 286, 306, 343, 344
 diffusion by eddy-motion, 69
- Wave-motion, Bjerknes's theory, 11, 298
 Helmholtz's treatment, 61–6
 energy, 65
 length of waves in water and air, 62, 64–5
 relation with turbulence, 11
 representation by lines of flow, 220–1 (fig. 52)
 velocity of propagation, dynamical similarity, 14–15
- Weather, classification, 232–3
 operative agencies, 343
- Weather-maps, as method of graphic representation, 207–16
 choice of surface, 207–8, 217, 293, 321, 323, 342, 343
 classification of types, 232–3, 284
 modern practice, 224, 285, 322–3
- Weickmann, L., 16
- Weight, effect of motion, 49
- Weightman, R. H., travel of depressions, 313
- Weir, James, *The Energy System of Matter*, 43
- Weyher, C. L., eddy-motion, 257
- Whipple, F. J. W., internal friction, 135
 meteors, 206
 motion on a rotating earth, 57
- Whipple, G. M., wind-force and gradient, 95
- White, M., variation of wind with height, 123
- Wind, a dynamical problem, 29–36
 analysis of structure, anemograms, 30–6 (figs. 3–9), 143–50, 159–60, 333
 as an indicator of pressure-gradient in the upper air, 209–16
 Beaufort scale, 92, 94–5
 causes, 58, 73, 120, 303–4, 332–3, 343
 classification, Jeffreys', 80
 cyclostrophic, 80
 direction at high levels: in the empyrean, 205–6; in the stratosphere, 314–5
 discontinuity, 33 (fig. 7), 78, 117, 270, 300
 diurnal variation, 9, 96–9 (fig. 15), 124–5 (fig. 23), 133, 135, 188–9 (fig. 47), 191
 effect of viscosity, 58–9, 89
- geostrophic, 79–80, 85–6, 91, 93; comparison with surface-wind, 95–120, 163–6; variation with height, 196–8

INDEX

357

- Wind—(contd.)
gradient, 82–6, 91
gustiness, 143–60
horizontal motion and vertical disturbance, 278–9
katabatic and anabatic, 80, 93, 107, 126, 227–9, 303, 304, 339
local, coastal, 91, 96, 107, 117–20; Föhn and chinook, 155–6
measurement, at the surface, 28–9, 92–4, 99; in the upper air, 27, 115, 170
motion in isentropic surfaces, 22, 343
periodic oscillations, 31 (fig. 4), 144–50, 160
pressure of, 24
relation of different levels
at the core of a depression, 261
Cave's classification, 177–8
condition for "solid current," 197–8
critical value for automatic turbulence, 70
discontinuity, 192
effect of cloudiness, 125
empirical formulae, 123, 124, 125, 126
observational results: surface layers, 123–7 (fig. 23); 0–2500 m, 161–7 (figs. 35–6), 172–5 (fig. 38); 2500–7500 m, 175–81 (figs. 39–43); above 7500 m, 181–3 (fig. 44); in the stratosphere, 183–5 (fig. 45), 204–5
reversal with height, 180, 205
theoretical conclusions: Egnell-Clayton law, 195–6, 204, 226; on the theory of eddy-motion, 67, 93, 122, 131–42; on the assumption of strophic balance, 193–206
relation to isallobars, 75–6
relation to pressure-distribution, law of isobaric motion—the automatic adjustment of pressure to wind, 22, 80, 89–91, 142, 302–3, 305, 344; theoretical deduction of the gradient equation, 50, 82–8; time of adjustment, 89; assumptions, 79, 89, 90, 91, 223–4; effect of curvature, 82–4, 85, 89, 90, 231–49, 271–4; friction as a disturbing factor, 36, 67–8, 88, 93, 131–9, 243; height of attainment of strophic balance, 84, 126, 132; diurnal variation, 96–8, 101, 110, 166; effect of orographic features and coast-line, 93, 99–107, 112–20; slope-effect, 93, 126, 303, 339
comparison of theory and observation, 87–120; difficulties of measurement, 91–4, 99, 115, 208; wind at the surface and sea-level pressure: over land, 95–107, 122–4, 132; over sea, 108–12; wind at 50 m and sea-level pressure, 166; wind 0 to 2500 m and sea-level pressure, 88, 112–4, 124–7, 163–4; wind in excess of the geostrophic, 107, 110, 120, 302
representation: by components, 172–4 (fig. 38); by velocity and direction, 182–3 (fig. 44); models, 178–81 (figs. 40–3); clothes-line diagrams, 186–7 (fig. 46); perspectives, 189 (figs. 47–8); synchronous charts, 207–16 (fig. 51)
seasonal variation, 97 (fig. 15), 330–1
squalls, 32 (figs. 5, 6), 159–60, 339–40
synchronous maps for SW monsoon, 222–4 (fig. 53), for the free air, 207–16, 221
theory of turbulence, 67, 127–42
variation in the vertical with temperature-distribution, 115–6, 193–206;
"thermal-wind," 202
vector-records, 149
see also Vertical motion
Wind-force, 23–7
as a dynamic indicator of the atmospheric circulation, 23, 36
Wind-vanes, shapes, 23–4
Wing, S. P., wind and pressure-gradient, 99
Wise, J., balloon experiences, 171
Working-models of the atmosphere, 15–17
Yarmouth, geostrophic and surface-wind, 106–7 (fig. 20)
Zeppelins, *afflatus dissipati*, 179, 212–3 (fig. 51)
Zistler, P., wind in the stratosphere, 315