

INDEX

A

- Aberration, chromatic and spherical, 389
of eye, 394
- Absorption, color due to, 408
by dyes, 410
of gases by charcoal, 229
of radiation, 241
selective, of radiation, 239
of sound, 190, 191
in gas, 172
by surfaces, 240
- Absorption coefficients of x-rays, 499
- Absorption spectra, 414, 415, 476
- Acceleration, angular, produced by torque, 70
on balance, 52
of center of percussion, 89
compared by two pendulums, 39
dependent on moment of inertia, 68
of gravity, 38
on horizontal plane, 50
of precession, 87
relative, 46
uniform, 38
- Acceleration machine, angular, 70
- Accelerometer, 47
liquid, 113
- Ackermann, A. S. E., 509
- Acoustic interferometer, 173
- Action, local, in voltaic cell, 331
and reaction, 53
rotary, 73, 74
- Adams, and Page, 340*n.*, 364*n.*
- Addition, of colors, 405, 406
of parallel forces, 23
of potentials, 276
of torques, 23
of waves, 139
- Adhesion of water to glass, 105
- Adlam, G. H. J., 509
- Aeolian sounds, 188
- Air, buoyant effect of, 126
condensation of water from, 213
liquefaction of, at atmospheric pressure, 227
under pressure, 228
liquid, 224
temperature of, 225
pressure of, at low temperature, 225
- Air column, pitch of, 161
resonating, 169, 179
- Air flow made visible, 120
- Air jet, nonresonant, 161
- Air pump, centrifugal, 66
rotary, for ripple tank, 151
- Air stream, pressure and velocity in, 116
- Air thermometer, 233
Galileo's, 194
- Air-conditioning charts, 224
- Airfoil, lift on, 118
pressure on, 118
- Airplane turn indicator, 83
- Alcohol boat, 96
- Alkali metal photocell, 489
- Alpha particles, ionization by, 502
range of, 552
- Alpha-particle scattering, 582
electrostatic model, 473
magnetic model, 472
- Alternating current, wave form of, 344
- Alternating-current generator, 345
- Alternating-current magnetic field, 307
- Alternating-current motors, speed of, 355
- Alternating magnetic field, 348

- Alternator for low frequency, 444
American Physics Teacher, 14, 509
 Ammeter, hot-wire, principle of, 197
 Ammeter, lecture galvanometer as, 313
 Ammonium chloride fumes, 434
 Amoeba, mercury, 96
 Ampère's experiment, 305
 Amplification factor, gas, in photo-cell, 491
 Amplifier, 485
 model of, 486
 Amplifier microphone circuit, 165
 Analogue, hydraulic, of radioactive decay, 503
 mechanical, of electrical resonance, 444
 of triode, 483
 water, of current and potential, 298
 Analytical balance, 28
 Analyzers for sound, 165
 Andrade, E. N. da C., 509
 Angle, critical, 384, 386
 of friction, 31
 of incidence and reflection, 376
 Angular acceleration machine, 70
 Angular acceleration produced by torque, 70
 Angular momenta, combination of, 79
 conservation of, 55, 59, 72, 73, 75
 quanta of, 76
 Angular velocity and moment of inertia, 75
 Aniline drops, 101
 Antenna, directional, 457
 Apparatus, storage of, 9, 11
 Arago's bright spot, acoustic, 174
 disk, 344
 Arc, carbon, 367
 resistance of, 436
 climbing, 435
 nature of, 435
 singing, 436
 as sound source, 175
 temperature of, 193
 tungsten, 368
 Archimedes' principle, 112
 Architectural acoustics, 191
 Area, and capacitance, 279
 of contact and force between magnets, 286
 Argon lamps, 369
 Aspirator, 119
 Astigmatism, of eye, 394
 of lens, 390
 Atmospheric pressure, 124
 Atom, sodium, mass of, 338
 Atomic energy levels, 474
 Atomic force model, 471
 Atomizer, 119
 Attenuation, in medium, 171
 of sound in gas, 172
 Attraction between charges, 253
 Atwood's machine, 50
 tension in, 51
 Audible range of sound, 183
 Audio-frequency amplifier, 485
 Audio-frequency oscillator, 162, 447
 Auditorium, 191
 Aurora borealis, 442
 Automobile skidding, 32
 Autorotation, 117, 189
 Autotransformer, 350
 Axes of rotation, stable, 71
 Axis, constancy of, 72
 of torque, 22
- B
- Bainbridge and Street, 503*n.*
 Balances, 28
 acceleration on, 52
 Cavendish, 13
 electromagnetic, 306
 Galileo's water, 33
 hydraulic, 109
 inertia, 49
 Joly, 92, 93
 magnetic, 282
 Mohr-Westphal, 113
 reaction, 52
 spring, in parallel and series, 18
 series of, 17

- Balance wheel of watch and rotation, 73
- Balanced bicycle wheel, 81
- Balanced gyroscope, 80
- Baldwin, W., Jr., 152*n.*
- Balinkin and Wells, 369*n.*
- Ball, on jet, 115
and ring, expansion of, 198
rolling, in cone, 64
in funnel, 63
- Ballistic galvanometer, 361
- Ballistic pendulum and velocity of bullet, 55
- Balloon electroscope, 250, 497
- Balloons, gas filled, 126
- Balmer series, 476
- Balsa wood, 15
- Band spectra, 413
- Banked curve, motion on, 63
- Bar broken by expansion, 199
- Bars, free vibration of, 182
loaded, vibrations of, 130
vibrations of, 187
- Barkhausen effect, 285
- Barlow's wheel, 306, 343
- Barometer, 125
- Barrier-layer cell, 491
- Barton, R., 483*n.*
- Beams, electron, 441, 443
- Beat notes, 178
- Beat-frequency oscillator, 183, 448
- Beats, from Knipp tubes, 160
from whistles, 158, 171
- Bell, lead, 226
in vacuum, 156
- Bell Telephone Laboratories, 181, 183, 184*n.*, 190
- Bending, 35
- Bernoulli effect, 120
- Bernoulli's principle, 66, 115, 116
- Beta ray counter, 507
- Bicycle to demonstrate torque, 23
- Bicycle rider, gyro, 85
- Bicycle wheel, gyroscope, 75, 81
precession of, 79
- Bimetallic-strip thermostat, 201
- Biplate, quartz, 425
- Biprism, Fresnel, 403
- Bird call, 158
- Bismuth, expansion and freezing of, 200
- Bjerknes' experiment, 116
- Black-body radiation, 240
- Blind spot of eye, 393
- Blood corpuscles, diffraction by, 400
- Blow-gun, 43
- Boat, alcohol, 96
Duco, 96
- Boatswain's chair, 30
- Body, discharge through, 269
- Boiling point, vapor pressure of water at, 216
- Boiling points, 193
- Boiling water at reduced pressure, 217
- Bomb, ice, 210
steam, 217
- Bound charge, 275
- Bouquet, phantom, 378
- Bow wave by ripple tank, 154
- Boyle's law, 123
- Boys rainbow cup, 396
- Box, diffraction, 399
smoke, 372
for sound experiments, 172
for storing apparatus, 11
- Box-office value of centrifugal force, 64
- Brachistochrone, 44
- Bragg, W. H., 509
- Brake, magnetic, 344
- Brake horsepower, 60
- Braun electrostatic voltmeter, 251
- Breaker, circuit, electromagnetic, 307
- Breaking magnet, 285
- Bridge, model showing expansion 198
and truck problem, 22
- Bright line spectra, 413
- Bromine, liquid, 212
- Brownian motion, 463, 464
- Brownian motion model, 460, 461
- Brush Development Co., 362*n.*
- Brush discharge, 265

- Bullet, speed of, 37
 by ballistic pendulum, 55
 by condenser discharge, 362
 trajectory of, 44
- Bull-roarer, 189
- Bumping of boiling water, 219
- Bunsen burner, pitch changes in, 171
 as sensitive flame, 163
- Bunsen photometer, 374
- Buoyant effect of air, 126
- Burning steel wool in liquid air, 230
- Burt, R. C., 337*n.*
- Byerly, W. E., 51*n.*
- C
- Cabbage, purple, as ionic indicator, 336
- Cady, H. P., 224*n.*
- Cage, Faraday's, 264
- Calorimeter, electric, 322
 ice, 206
- Calvert, W. J. R., 509
- Camera, pinhole, 375
- Camphor, effect on surface tension, 95
- Candle flame, rotating, 62
- Cannon, ignited by spark, 271
 liquid air, 229
- Cannon car, 55
- Capacitance, 253, 274
 and area, 279
 and dielectric constant, 277
 laws of, 361
 and potential, 271
- Capacitive reactance, 360
 and inductive reactance, 363
- Capillary phenomena, general, 94
- Capillary rise, 94
- Capillary tubes, 93
- Capital Apparatus Works, 166*n.*
- Capsule for manometric flames, 165
- Car, cannon, 55
 on inclined plane, 12, 20
 momentum, 56
 monorail, 87
 reaction, 54
- Car, relativity, 46
 rocket, 54
- Carbon dioxide, critical temperature of, 222
 solid, 209, 213, 225
 and liquid, 211
- Carbon disulfide, evaporation of, 212
- Card catalogue of experiments, 10
- Carr, and Johnson, 257*n.*
- Cart, inertia, 48
 reaction, 53
- Cartesian diver, 123
- Castor oil, 32
 drop, 102
- Cat, turning in midair, 74
- Catenary, 27
- Catenoid, by soap film, 98
- Cathode, lime spot, 441
- Cathode rays, 438
 bending of, in magnetic field, 439, 442, 443
 deflection of, 477
- Cathode-ray oscilloscope, 169
 for hysteresis, 289
 for measurement of e/m , 477
- Caustics, 379
- Cavendish balance, 13
- Cavendish experiment, 57
- Cell, dry, charges from, 298
 electromotive force of, 315
 photoelectric, 337, 418, 489
 projection, 236, 304
 storage, 333
 elementary, 300
 voltaic, 331
 current from, 300
 polarization of, 332
- Cellophane in polarized light, 429
- Center, of gravity, 25, 26
 and equilibrium, 27
 of oscillation, 88
 of percussion, 88
 acceleration of, 89
- Centrifugal air pump, 66
- Centrifugal force, box-office value of, 64
 bucket of water, 67
 vs. centripetal force, 61

- Centrifugal force, dime and coat hanger, 67
 in pendulum, 64
 puzzle, 67
- Centrifugal governor, 68
- Centrifuge, projection, 66
- Chains, rolling, 62
- Chamber, cloud, Wilson, 221, 434, 503
- Chamber, ionization, 431, 498
- Change of state, 208
 charging by, 260
- Characteristic curves of triode, 482
- Charcoal, absorption of gases by, 229
- Charge, bound, 275
 and current, 360
 detectors of, 249
 electric, from dry cell, 298
 identification of, 261, 329
 motion of, along lines of force, 267
 oscillatory, of condenser, 364
 work and energy of, 255
- Charge distribution on conductors, 263
- Charged student, 258
- Charge-mass ratio of electron, 477
- Charges, forces between, 253
 opposite, equality of, 258
 from rubber band, 259
 at same potential, 274
 separation of, 249
- Charging, by change of state, 260
 by contact, 258
- Charging rod, mercury-glass, 259, 260
- Charging time of condenser, 362
- Charts of melting points, 223
- Chemical activity of liquid oxygen, 230
- Chimes, electric, 266, 273
- Chimney, falling, 89
- Chimney, lamp, convection in, 235
- Chladni figures, 188
- Chlorophyll, spectrum of, 414
- Christiansen filters, 383
- Chromatic aberration, 389
- Circuit breaker, electromagnetic, 307
- Circuits, house lighting, 320
 magnetic, flux through, 311
- Circular motion, projection of, 127
- Circular polarization, model, 419
- Climbing arc, 435
- Closed conductors, 264
- Cloud chamber, Wilson, 221, 434, 503
- Cloud formation, 221
- Cobalt-steel magnets, 281
- Coefficients, absorption, of x-rays, 499
 expansion, of gases, 205
 of restitution, 36
 temperature-resistance, 316
- Cohesion of water column, 105
- Cohesion plates, 104
- Coil, field of, 304
 floating, 308
 Helmholtz, 443
 induced electromotive force in, 339
 induction, 353
 torque on, 308
- Coincidence counter, 508
- Colloidal suspension, 463
- Color, 404
 due to absorption, 408
 due to scattering, 411
 and temperature, 411
 of thin films, 395
 tops, 409
- Color-blindness, 394
- Color disks, 409
- Color matching in pyrometer, 196
- Color pyramid, 405
- Colors, addition of, 405
 complementary, 408
 produced subjectively, 409
 subtraction of, 407
- Colpitts circuit, 445
- Colwell, R. C., 164*n.*, 188*n.*
- Combination of angular momenta, 79
- Combustion, heat of, 208
- Commutator, 310, 346

- Compass, earth inductor, 343
 gyro, 82
 magnetic, 280
- Complementary colors (*see* Colors)
- Components of force, 20
- Compound pendulum, 88
- Compressibility, of air, 123
 of water, 107
- Compression, heating by, 246, 247
- Compton, Van de Graaff and Van Atta, 263*n.*
- Condensation, 212
 effect of nuclei on, 221
 of vapor on ions, 430
 of water from air, 213
- Condenser, charging time of, 362
 elementary, 274
 oscillatory charge of, 364
 discharge of, 365
 parallel-plate, 276
- Condensers, in series and parallel, 276, 361
- Condensing electroscope, 277
- Conduction, and convection, 237
 in electrolytes, 329
 in glass, 317
 of heat in anisotropic bodies, 232
 in gases, 233, 470
 in solids, 230
- Conductivities, relative, of heat, 233
- Conductor, action of current on, 311
 charge distribution on, 263
 heating in, 320
 and insulator, 252
 in magnetic fields, force on, 304
 parallel, forces on, 310
 potential of, 273
 drop in, 296, 313
 resistance of, 321
- Conical pendulum, 68, 134
- Conical resonator, 180
- Conservation, of angular momentum, 59, 72, 73, 75
 of momentum, 55
- Constancy of axis, 72
- Constant-pressure air thermometer, 194
- Constant-volume air thermometer, 194
- Contact, area of, and force between magnets, 286
 charging by, 258
 magnetization by, 280
- Contact potential, 278
- Continuous high-frequency oscillations, 452, 454
- Continuous spectra, 413
- Continuous-wave Tesla apparatus, 454
- Contraction of soap film, 97
- Convection and conduction, 237
 in gases, 234, 242
 in liquids, 235
- Coolidge x-ray tube, 496
- Cooling by evaporation, 214
 by expansion, 213, 221
- Cooling curve, during freezing, 208
- Coop, J. J., 357*n.*
- Copper plating, 331
- Cords, moving, waves on, 139
- Corning Glass Co., 239*n.*
- Corona discharge in air, 434
- Cosmic rays, counter for, 508
- Coulomb's law, 253
 for magnets, 283
- Counter, coincidence, 508
 circuit, 505
 Geiger, 502
 Geiger-Muller, 504
 point, Geiger, 507
 water jet, 507
- Counter electromotive force in motor, 347
- Couple, axis of, 22
 a free vector, 21
- Coupled oscillators, 134, 136
- Courant, R., 99*n.*
- Cream separator, 68
- Critical angle, 384, 386
- Critical temperature, 222
- Crookes' dark space, 438, 442
- Crookes' radiometer, 242
- Crossbow for projectiles, 44
- Crossed gratings, 400, 500
- Cryophorus, 214

- Crystal, conduction of heat in, 232
 diffraction of x-rays by, 500
 double refraction by, 470
 polarization by, model, 419
 in polarized light, 429
- Crystal oscillator, piezoelectric, 327
- Crystalline state, 208
- Crystallization, 208
 heat of, 209
- Cunynghame, H., 509
- Curie point of iron, 292
- Current, action on conductor of, 311
 alternating, wave form of, 344
 and charge, 360
 electric, 296
 heating effect of, 299, 319
 in organic material, 321
 high frequency, 451
 induced by change in magnetic flux, 341, 342
 large, from storage cell, 333
 magnetic field due to, 301
 magnetic field of, in electrolyte, 329
 magnetization by, 281
 model of, 284
 from static machine, 296
 water analogue of, 298
- Current rise, time lag of, 358
- Currents, eddy, 343
 electric, from storage cells, 300
- Curtis, and Smyth, 479
- Curve balls, 116
- Curves, harmonic, in space, 148
- Cycloidal pendulum, 45
- Cycloidal track, 44
- D
- Damped oscillations, 136, 449
- Damping, by eddy currents, 344
 of waves, 141
 model, 140
- Dampier-Whetham, Sir W., 12
- Dancing spring, 311
- Dark-line spectra, 414
- Dark space, in discharge, 438
- d'Arsonval galvanometer, 309
 as voltmeter, 312
- Davis, A. H., 162*n.*
- Davy safety lamp, 232
- Decay, radioactive, 503
- Declination, magnetic, 295
- Deflection of cathode rays, 477
- Deformation under stress, 36
- Degrees of instability in gyroscopic stabilizer, 85
- Delta connection, 355
- Demagnetization of iron sample, 280, 303
 by heating, 296
- Demonstration, methods of, 4
 principles of, 2
 purpose of, 3
 tools of, 7
- Density and flotation, 112
 of liquid air, 227
 of water, 203, 204
- Depth, dependence of pressure on, 109
- Detectors of sound, 162
- Dew point, 223
- Dewar flask, 207, 209, 224, 242
- Diagrams, electron configuration, 474
 triple point, 223
- Diamagnetism, 290
- Diamonds, reflections from, 386
- Diaphragms, vibrations of, 188
- Diatonic scale, by tuned sticks, 182
- Dichromatism, 410
- Dielectric, charges on, 275
- Dielectric constant, 277
- Differential expansion, 201
 of liquid and container, 204
- Differential thermoscope, 207, 241
- Diffraction, by blood corpuscles, 400
 by circular object, 400
 by crossed gratings, 400
 by double slit, 401
 of electrons, 500
 by feather, 398
 Fresnel, 399
 by ripple tank, 153
 by single slit, 398, 401

- Diffraction, of sound, 176
 by straight edge, 398
 of x-rays, 500
 Diffraction box, 399
 Diffraction gratings, 403
 Diffusion, of gases, 466
 of liquids, 105
 and osmosis, 105
 photometer, 373
 Diode rectifier, 482
 Dip needle, 280, 295
 Direct-current generator, 345
 Direct-current motor, 309
 Direction judgment by ear, 192
 Directional antenna, 457
 Directional sound source, 259, 174,
 177
 Discharge, through body, 269
 corona in air, 434
 energy in, 271
 electrodeless, 440
 by flame, 277
 glow, 437, 438
 potential required for, 439
 high frequency, 451
 hot cathode, 440
 by ions, 270
 oscillatory, of condenser, 365
 from point, 264, 434
 potential during, 273
 Schuler, 439
 spark, 435
 Townsend, 431
 Discharge tube, 229, 354
 spectra of, 412
 Displacements, vector addition of,
 38
 Display of experiments for student
 operation, 14
 Dispersion by prism, 386
 Dissectible Leyden jar, 275
 Dissectible transformer, 351
 Distortion, dynamic, stroboscopic
 illumination of, 64
 by lens, 390
 Distribution of charge on conduc-
 tor, 263
 Dod, W. C., 149*n*.
- Doppler effect, mechanical analogue
 of, 192
 by ripple tank, 154
 with sound, 191
 Dorsey, H. G., 166*n*.
 Double Atwood's machine problem,
 51
 Double cone, 26
 Double refraction, 420, 429
 induced, 427
 Doublet, electric, 268
 Drop, aniline, 101
 castor oil, 102
 equidensity, 101
 on liquid surface, 103
 mercury, 102
 oil, 101
 orthotoluidine, 100
 potential, in conductor, 296
 on wire, 313
 Prince Rupert, 202
 in tapered tubes, 94
 Drop formation, large model, 100
 stroboscopic illumination of, 104
 Drop size, variation with surface
 tension, 101
 Droplets, refracting, 387
 water, 102
 Dropper, water, Kelvin, 261
 Drums, vibrations of, 188
 Dry cells, electric charges from, 298
 Dry ice, 209, 213, 224, 225, 234
 fog from, 120
 temperature of, 225
 Duco boat, 96
 Dunoyer and Smith, 468*n*.
 Dwight, and Kersten, 106*n*.
 Dyes, absorption of light by, 410
 Dynamic vs. static forces, 49
 Dynamics of liquids, 113
- E
- e/m*, measurement of, 477
 Ear, direction judgment by, 192
 Earth, flattening of, 64
 Earth inductor, 342
 Earth-inductor compass, 343

- Earth-moon system, model, 71
 Earth's magnetic field, 295
 magnetization in, 281, 343
 Eastman Kodak Co., 404*n*.
 Echo, 190
 Eddies in air, 189
 Eddy currents, 343
 Edison battery, 333
 currents from, 301
 Efkalin Co., 231*n*.
 Eguchi, X., 257*n*.
 Eickhoff, and Schilling, 44*n*.
 Einstein relation, 501
 Eisenbeis, and Williamson, 157*n*.
 Elasticity, 34
 of lead at low temperatures, 226
 Electret, 255
 Electric breeze, 434
 Electric charges from dry cell, 298
 Electric chimes, 266, 273
 Electric current, from static machine,
 296
 from cells, 300
 Electric doublet, 268
 Electric field, extent of, 270
 motion of charges in, 267, 268
 rotation of plane of polarization
 in, 428
 Electric forge, 336
 Electric pendulum, 249
 Electric potential, 271
 Electric production of ripples, 151
 Electric shielding, 264
 Electric thermometers, 318
 Electric waves, radiation and polariza-
 tion of, 456
 Electric welding, 351
 Electric whirl, 266
 Electric wind, 265
 Electricity, current, 296
 static, 249
 Electrocalorimeter, 322
 Electrodeless discharge, 440
 Electrolysis, lead tree, 208
 of sodium through glass, 336
 of water, 332
 Electrolyte, ions in, 329
 rotation of, 330
 Electrolytic conduction, 329
 Electrolytic rectifier, 338
 Electromagnet, 303
 Electromagnetic balance, 306
 Electromagnetic circuit breaker, 307
 Electromagnetic inertia, 358
 Electromagnetic swing, 305
 Electrometers, 252
 Electromotive force, of cells, 315
 counter, in motor, 347
 induced, 339, 357
 motional, 340
 in voltaic cell, 331
 Electron, charge of, 480
 focusing, 443
 measurement of e/m of, 477
 secondary emission of, 495
 Electron beams, 441, 443
 Electron configuration, diagrams of,
 474
 Electron diffraction, model of, 500
 Electron multiplier, 495
 Electrophorus, 355
 Electroplating, 330, 331
 Electroscopes, 249
 charging by contact, 259
 by induction, 261
 condensing, 277
 hair, 269
 large scale, 497
 as potential indicator, 273, 296
 protection of, 251
 Zeleny, 251, 431, 480, 483, 488, 502
 water analogue of, 298
 Electrostatic control of triode, 484
 Electrostatic induction, 253, 254,
 257, 265
 Electrostatic machine, 262
 Electrostatic model of alpha particle
 scattering, 473
 Electrostatic motor, 299
 Electrostatic shutter, 428
 Electrostatic voltmeter, 251
 Electrostatics, 249
 Elementary motor, 308
 Elements, magnetic, maps of, 295*n*.
 Ellipsoidal top, 88

- Elliptic motion and conservation of angular momentum, 59
 Emission spectra, 413, 476
 End correction for pipe, 180
 Energy, of charge, and work, 255
 in discharge, 271
 kinetic vs. potential, 68
 potential, of pile driver, 59
 rotatory, kinetic, transferred by friction, 78
 translational vs. rotational, 135
 transmission of, 352
 and work, 59
 Energy levels, atomic, 474
 Energy transfer in coupled oscillators, 134
 Engines, model, 248
 run by liquid air, 228
 pulse glass, 216
 reaction, 78
 Epsom salt, mapping field of force with, 268
 Equal-arm balance, 28
 Equality of opposite charges, 258
 Equidensity drops, 101
 Equilibrium, conditions for stable, 26
 configuration model, atomic, 471
 dynamic, of conical pendulum, 68
 of forces, 18
 of geometrical shapes, 25
 of moments, 24
 neutral, 27
 and position of center of gravity, 27
 Equipotential surfaces, 273
 Erikson, H. A., 66*n.*
 Ethyl chloride, critical temperature of, 222
 Evaporation, cooling by, 212, 214
 free and retarded, 219
 freezing water by, 215
 heat of, 212
 volume change by, 228
 Ewing, M., 257*n.*
 Ewing model of magnetization, 284
 Expansion, 197, 201
 of carbon dioxide, 225
 cooling by, 213, 221, 247
 differential, 204
 forces involved in, 199
 on freezing, 210
 of gases, 204
 of glass, 202
 of liquids, 202
 of quartz, 202
 of rubber, 200
 of water, 203
 Expansion coefficients of gases, 205
 Explosion, gas, 333
 Extent of electric field, 270
 Eye, 383
 Eyeglasses, 395
- F
- Fabry-Perot interferometer, acoustic, 174
 Fall of potential, 315
 Fall, rate of, and horizontal motion, 43
 Falling chimney, 89
 Falling spool, 69
 Falling target, 43
 Faraday, M., 2, 12*n.*, 509
 Faraday cage, 264
 Faraday effect, 426
 Faraday's bag, 263
 Faraday's dark space, 438, 442
 Faraday's experiment, 341
 Faraday's ice-pail experiment, 257
 Field, alternating current, tuned
 wire in, 307
 of coil, 304
 earth's, magnetization in, 281
 electric, extent of, 270
 electrostatic, motion of charges in, 267, 268
 of force, mapping, 268
 magnetic, 283
 alternating, 348
 due to current, 301
 force on conductor in, 304

- Field, potential, mapping, 272
 model of, 272
 resultant, 304
 of solenoid, 302
- Filament transformer, 497
- Films, monomolecular, 465
- Filtering liquid air, 227
- Filters, Christiansen, 383
 for radiation, 239
 for tone quality, 184
 transmission by, 418
- Fire by friction, 243
- Fire syringe, 246
- Fizeau's toothed wheel, 169
- Flame, discharge by, 270
 maintaining vibration, 161
 manometric, 165, 185
 sensitive, 162, 172, 178
 showing standing waves, 185
 singing, 159
- Flasher circuit, 362
- Flattening of earth, 64
- Fleming, J. A., 509
- Flettner rotor ship, 117
- Float, submerged, 93
- Floating and density, 112
- Floating coil, 308
- Floating magnet, 21
- Floating metals on water, 93
- Flotation, instability in, 113
- Flow, of fluids past obstacles, 121
 of gases, 122
- Fluids, distinguished from solids, 107
 friction in, 32
- Fluorescence, 417
 of retina, 393
 showing ultraviolet spectrum, 414
 by x-rays, 498
- Flux, magnetic, through circuit, 311
 changing, and induced current,
 341, 342
 shunting, 293
- Focal length of lens, 390
- Focusing of radiation, 238
- "Fool's tackle," 30
- Foot as lever, 29
- Force, between charges, 253
 effect of medium on, 266
- Force, between magnets, 282
 and area of contact, 286
 components of, 20
 on conductor in magnetic field, 304
 on core of solenoid, 303
 inverse square law of, 59
 law of, for magnets, 283
 lines of, motion of charge on, 267
 mapping field of, 268
 on parallel conductors, 310
 restoring, and periodic motion,
 130
 in two directions at once, 67
- Force apparatus, inexpensive, 19
- Force board, 18
- Force frame, 19
- Forced vibration, 179
 Rayleigh's, pendulum for, 137
 and resonance, 132, 136
- Forces, addition of, 17, 18, 23
 equilibrium of, 18
 involved in expansion, 199
 magnitude of, 15
 parallelogram of, 19
 resolution of, 16, 17
 static vs. dynamic, 49
- Forge, electric, 336
- Foucault pendulum, 90
 model of, 92
 projection of motion of, 91
- Fountain, illuminated, 385
 liquid air, 228
 siphon, 111
 vapor pressure, 220
- Frames for soap films, 98
- Franklin, W. S., 510
- Free fall, 40, 41
 paradox of, 89
 pendulum timed, 41
- Freely falling candle, 46
- Freezing, cooling curve during, 208
 expansion on, 210
- Freezing mixtures, 214, 224
- Freezing substances in liquid air, 225
- Freezing water by evaporation, 215
- Frequency and pitch, 183
 and response in forced vibrations,
 133

- Fresnel biprism, 403
 Fresnel diffraction, 399
 Frick, J., 510
 Friction, 30
 angle of, 31
 charging by, 258
 fluid, 32
 and heat, 243
 negative acceleration due to, 50
 and pressure, 31
 sliding, 31
 starting, 31
 Friction pendulum, 32
 Frictional transfer of rotatory kinetic energy, 78
 Friend, and Wilkins, 507*n.*
 Frost, formation of, 213
 Fuses, 320
 Fusion, heat of, 210
- G
- Galileo, 40
 Galileo's air thermometer, 194
 Galileo's inclined plane, 42
 Galileo's lever, 22
 Galileo's pendulum board, 59
 Galileo's water balance, 53
 Galton whistle, 158
 Galvanometer, ballistic, 361
 d'Arsonval, 309
 as voltmeter, 312
 human, 313
 lecture, as voltmeter and ammeter, 313
 tangent, 302
 Gas, attenuation of sound in, 172
 compared with vapor, 220
 discharge by ions in, 270
 heating by compression, 246, 247
 ignited by spark, 258, 271
 kinetic theory analogue of, 244
 Gas engine, model, 248
 Gas explosion, 333
 Gas pressure, analogue of, 53
 Gas siphon, 123
 Gas thermometers, 194
 Gas-filled balloons, 126
 Gas-filled photocells, 490
 Gas-filled tubes, 486
 Gases, 122
 absorption of, by charcoal, 229
 coefficient of expansion of, 205
 conduction of heat in, 233, 470
 convection in, 234
 cooling, by expansion, 213
 diffusion of, 466
 distinguished from liquids, 107
 expansion of, 204
 refraction by, 381
 viscosity in, 33, 468
 Gasoline engine, model, 248
 Gauge, Pirani vacuum, 237
 Gauze screen, 373
 Geiger counter, 502
 Geiger point counter, 507
 Geiger-Muller counter, 504
 Geiger-Scheel, 510
 Geissler tubes, 439
 General Electric bulletins, 488*n.*
 General Electric X-Ray Corp., 496
 Generator, model, 344, 345
 Van de Graaff, 262
 Geyser, artificial, 218
 Glass, charged with mercury, 259
 conduction in, 317
 electrolysis of sodium through, 336
 expansion of, 198, 202
 flashed opal, for projection, 8
 Glass rod, standing waves in, by
 polarized light, 428
 Glasses, eye, 395
 Globar heater, 320, 471
 Glow discharge, 437, 438
 potential required for, 439
 Glower, Nernst, 316
 Gold-leaf electroscope, 250
 Good, W. M., 257*n.*
 Grapevine, magnetic, 305
 Gratings, crossed, 400, 500
 diffraction, 403
 for ripple tank, 153
 Gravitation, 57
 Gravity, acceleration of, 38
 Gray, Andrew, 510

- Grease-spot photometer, 374
 Greenhouse effect, 238
 Grid control of gas-filled tubes, 487
 Gridiron pendulum, 201
 Grimsehl, E., 510
 Guillemin, A. V., 510
 Guinea-and-feather tube, 39
 Gun, blow, 43
 liquid air, 229
 spring, 46
 Gyro bicycle rider, 85
 Gyro drunken man, 86
 Gyroacrobat, 84
 Gyrocompass, 82
 Gyropendulum, 87
 Gyroscope, 72
 balanced, 80
 bicycle wheel, 75
 precessional instability in, 86
 stroboscopic illumination of, 80
 walking, 81
 Gyroscopic motion, 79
- H
- Hagenow, C. F., 210*n.*
 Hair electroscope, 269
 Halo, 401
 Halowax Corp., 427*n.*
 Hammer Laboratories, 501*n.*
 Hand drill as rotator, 61
 Harmonic curves in space, 148
 Harmonics, by organ pipes, 184
 and tone quality, 184
 of tuning fork, 157, 184
 Harmonograph for Lissajous figures, 147
 Harnwell and Livingood, 376*n.*, 468*n.*, 478*n.*
 Harper, and Neher, 505*n.*
 Heart, mercury, 97
 Heat, of combustion, 208
 of condensation, 212
 conduction of, in anisotropic bodies, 232
 in gases, 233, 473
 in solids, 230
 Heat, of crystallization, 209
 from friction, 243
 of fusion of ice, 210
 generated by spark, 271
 lost by conduction and convection, 237
 mechanical equivalent of, 244, 245, 322
 motor, magnetic, 294
 of solution, 209
 transfer of, 230
 and work, 243
 Heat insulation, 232
 Heater, Globar, 320
 Heating by compression, 246
 Heating effect of current, 299, 319
 in organic material, 321
 Heating system, model, 236
 Height, pressure due to, 125
 Heilemann, J. J., 406*n.*
 Helmholtz coil, 443
 Henney, K., 448*n.*
 Hero of Alexandria, 78
 Herold, E. W., 447*n.*
 Hertz, H., 489
 High-frequency current, 451
 High-frequency oscillations, 449
 continuous, 452, 454
 modulation of, 458
 High-pitched whistles, 172, 183
 producing beats, 171
 High-speed chains, 62
 High temperature, electric conductivity in glass at, 317
 High velocity, measurement of, 37
 High-voltage generator, Van de Graaff, 262
 Hitchcock, R. C., 66*n.*
 Hoag, J. B., 468*n.*
 Hoffmann electrolysis apparatus, 332
 Hooke's law, 20, 34
 Hoop, equivalent simple pendulum of, 88
 Hope apparatus, 204
 Hopfield, J. J., 260*n.*
 Horn gap, 435

- Horns, radiation from, by ripple tank, 190
- Horsepower, brake, 60
of student, 60
- Hot-cathode discharge, 440
- Hot-dog cooker, 321
- Hot wire, showing standing waves, 185
- Hot-wire ammeter, principle of, 197
- House-lighting circuit, 320
- Hoxton, L. G., 347*n.*
- Hull, A. W., 500
- Humidity, 223
and attenuation of sound, 172
- Huygens' construction, by ripple tank, 154
- Hydraulic balance, 109
- Hydraulic jack, 112
- Hydrogen, speed of sound in, 171
- Hydrographic Office, 295*n.*
- Hydrometers, 112
- Hygrometer, 223
- Hysteresis curves, 287, 289
- I
- Ice, heat of fusion of, 210
- Ice bomb, 210
- Ice calorimeter, 206
- Ice lens, 238
- Ice stove, 226
- Ice-pail experiment, 257
- Identification of charges, 261, 329
- Illuminated fountain, 385
- Illumination, intensity of, 372
- Illuminometer, 374
- Images formed by lens, 388
- Impact, elastic and inelastic, 36, 57
and momentum, 55
- Impact pendulums, 56
- Impulse-driven mechanical resonator, 134
- Incandescent glass, 317
- Incandescent lamps, 368
- Incidence, angle of, and reflection, 376
- Inclination, magnetic, 295
- Inclined plane, car on, 12, 20
- Inclined plane, Galileo's, 42
rolling sphere on, 68
self-timing, 38
timed interval, 39
velocity on, 40
- Inclined wire and car, 39
- Incompressibility of water, 107
- Index of refraction, 383
- Indicator of magnetism, 280
- Induced current and magnetic flux, 341, 342
double refraction, 427
electromotive force, 339, 357
magnetic pole, 281
- Inductance and Wheatstone bridge, 358
- Induction, charging electroscope by, 261
electrostatic, 253, 254, 257, 265
magnetic, 283
in earth's field, 295
- Induction coil, 353
- Induction machine, 262
- Inductive reactance, 360
- Inductive and capacitive reactance, 363
- Inductor, earth, 342
oscillatory charge of condenser through, 364
- Inertia, 46
balance, 49
cart, 48
electromagnetic, 358
of liquids, 43
moment of, 68
and angular velocity, 75
rope broken by, 47
tricks, 47
- Inertial reaction, 46
and weight, 47
- Influence machine, 262
- Infrared radiation, focusing of, 238
- Infrared spectrum, 415
- Infrared transmission, 239
- Ingersoll, L. R., 14*n.*
- Instability, in flotation, 113
in gyroscopic stabilizer, 85
and precession in gyroscope, 86

- Insulation, heat, 232
 Insulators and conductors, 252
 Intensity of sound, 191
 Interference, acoustic, 174
 by ripple tank, 153
 of sound, 177, 328
 in thin films, 395
 in tuning fork, 179
 Interferometer, acoustic, 173
 Michelson, 381, 398
 Internal-combustion engine, model, 248
 Inverse square law, of force, 59
 for illumination, 372
 Invisibility of light, 369
 Iodine vapor, diffusion of, 467
 resonance radiation of, 475
 Ionization, in air, 431
 by alpha particles, 502
 by x-rays, 497
 Ionization chamber, 431, 498
 Ionization potential, 474
 Ions, condensation of vapor on, 434
 discharge by, 270
 in electrolysis, 329
 formed in flame, 270
 mobilities of, 432
 recombination of, 433
 speed of, 334, 335
 Iron, recalescence of, 197, 292
 magnetism of, effect of temperature on, 292
 Isolated magnetic pole, 281, 306
- J
- Jet, air, nonresonant, 161
 ball on, 115
 liquid, 103
 sensitive, 162, 164
 water, effect of charge on, 266
 Johnson, B. K., 510
 Johnson and Carr, 257*n.*
 Joly balance, 92, 93
 Joly photometer, 373
 Jones, A. T., 32*n.*
 Joule's equivalent, 245
 Jumping ring, 349
- K
- Kelvin, Lord, 326
 Kelvin water dropper, 261
 Kelvin wave apparatus, 140
 Kenotron rectifier, 481
 Kerr effect, 428
 Kersten and Dwight, 106*n.*
 Kinetic energy, frictional transfer
 of rotatory, 78
 Kinetic theory of gases, 243
 models, 459
 Kirchhoff's radiation law, 411
 Knipp cloud chamber, 503
 Knipp tubes, 160
 Kreider, D. A., 123*n.*
 Kretschmar, C. G., 167*n.*
 Kundt's tube, 170
- L
- Ladder problem, 24
 Lag, time, of current rise, 358
 Lamp chimney, convection in, 235
 Lamp filament, vibrating, 307
 Lamps, glow, 309
 incandescent, 368
 vapor, 369
 Lantern, projection, 367
 Larynx, artificial, 181
 Laue spots, 500
 ripple tank analogue of, 154
 Lead bell, 226
 Lead spring, 226
 Lead storage cell, 300
 Lead tree, 208, 330
 "Leaning tower," 26
 Lea's salt, 231*n.*
 Lecher wires, 455
 Lecture room, equipment of, 8
 Lecture table, movable, 10
 Lecture thermometer, 195
 Lemon, H. B., 14*n.*, 57
 Lens, action of, 388
 combinations of, 393
 focal length of, 390
 ice, 238
 sound, 176

- Lens, spherical, 238
 telephoto, 392
 Leslie cube, 239, 241
 Lever, applications of, 29
 classes of, 29
 Galileo's, 22
 optical, 34
 Leyden jar, 275
 discharge of, through loop, 358
 Lichtenberg figures, 275
 Lift on airfoil, 118
 on rotating cylinder, 116
 Light, invisibility of, 369
 pressure of, 470
 rectilinear propagation of, 374
 scattering of, 387
 sources of, 367
 diffuse, 9
 speed of, 376
 transmission of sound by, 493
 Light paths made visible, 369
 Lime spot cathode, 441
 Line spectra, 413
 Linear expansion, 197
 of metals, 198
 of rubber, 200
 Lines of force, motion of charge on,
 267
 Liquefaction of air, at atmospheric
 pressure, 227
 under pressure, 228
 Liquid accelerometers, 113
 Liquid air, 224
 temperature of, 225
 Liquid jets, 103
 sensitive, 164
 Liquid oxygen, chemical activity
 of, 230
 paramagnetism of, 291
 Liquid vortex rings, 103
 Liquid-air fountain, 228
 Liquid-air gun, 229
 Liquids, convection in, 235
 diffusion of, 105
 distinguished from gases, 107
 dynamics of, 113
 expansion of, 202
 inertia of, 113
 Liquids, pressure in, 108
 at rest, 107
 surface of, drops on, 103
 vapor pressure of, 218
 velocity of efflux of, 121, 122
 viscosity in, 32
 Lissajous figures, 131, 146, 147
 for hysteresis, 290
 Livingood, and Harnwell, 376*n.*,
 468*n.*, 478*n.*
 Livingston, M. S., 504*n.*
 Lloyd's mirror, acoustic, 174
 Loaded disk, 26
 Loaded wire, resonance of, 135
 Local action in voltaic cell, 331
 Lodestones, 280
 Longitudinal vibrations, of rod, 161
 in strips, 178
 Longitudinal waves, 144
 vs. transverse waves, 144
 Loops of standing waves, 185
 Loop-the-loop, 67
 Loudness of sound, 191
 Loudspeaker as phonodeik, 167
 Low temperatures, 224
 Low velocities, observation of, 37
 Low-frequency alternator, 444
 Low-frequency oscillator, 445
 Lummer-Brodhun photometer, 374
- M
- Machines, 29
 electrostatic, 262
 McLeod gauge, 468
 MacNutt, B., 510
 Magdeburg hemispheres, 124
 Magie, W. F., 169*n.*
 Magnaflex powder, 283
 Magnet, moving, induced electro-
 motive force from, 339
 rotating, 340
 Magnetic balance, 282
 Magnetic brake, 344
 Magnetic circuit, changing, and in-
 duced current, 342
 Magnetic compass, 280
 Magnetic elements, maps of, 295*n.*

- Magnetic field due to current, 301
 Magnetic fields, 283
 alternating, 348
 bending of cathode rays in, 439, 442, 443
 of current in electrolyte, 329
 force on conductor in, 304
 resultant of, 304
 rotating, 355
 rotation of plane of polarization in, 426
 Magnetic flux, changing, and induced current, 341, 342
 through circuit, 311
 shunting, 293
 Magnetic grapevine, 305
 Magnetic heat motor, 294
 Magnetic induction, 283
 in earth's field, 295
 Magnetic meridian, 295
 Magnetic model of alpha-particle scattering, 472
 Magnetic pole, induced, 281
 Magnetic properties of liquid oxygen, 228
 Magnetic screening, 292
 Magnetic shunt, 352
 Magnetism, 280
 terrestrial, 295
 Magnetization, by contact, 280
 by current, 281
 detection of, 282
 in earth's field, 281, 343
 of iron, 303
 theory of, 284
 Magnetization curves, 287
 Magnetometer, 287
 Magnetostriction, 293
 Magnets, breaking, 285
 floating, 21
 forces between, 282
 natural, 281
 permanent, 281
 pulling, 286
 thermoelectric, 324
 Manometric flames, 165, 185
 Mapping field of magnet, 284
 Mapping potential field, 272
 Maps of magnetic elements, 295*n*.
 Marblette Co., 427*n*.
 Marvin, C. S., 223*n*.
 Mass, 46
 of gas, 122
 and rate of fall, 39
 of sodium atom, 338
 typical, table of, 15
 Massa, and Olsen, 162*n*.
 Maxwell's rule, 311
 Maxwell's top, 82
 Measurement of centripetal force, 61
 Mechanical advantage of wheel and axle, 29
 Mechanical analogue of electric circuits, 142
 Mechanical equivalent of heat, 244, 245, 322
 Medium, attenuation in, 171
 change of, reflection at, 138
 effect of, on focal length, 390
 on force between charges, 266
 on speed of sound, 171
 necessary for sound transmission, 155
 Megaphone and whistle, 177
 Melde's experiment, 143
 Melting, effect of pressure on, 211
 specific heat by, 206
 Melting points, 193
 charts of, 223
 low, 208
 of tin, 208
 Membranes, osmosis through, 106
 Meniscus effects, 94
 on tumbler of water, 95
 Mercury, charged with glass, 259
 surface tension of, 93
 Mercury amoeba, 96
 Mercury bubble, 100
 Mercury droplet, 102
 Mercury hammer, 226
 Mercury heart, 97
 Mercury mirror, 63
 Mercury vapor lamps, 269
 rectifier, 486
 Meridian, magnetic, 295
 Metallic reflection, 386

- Metals, charged by contact, 258
 conduction of heat in, 231
 linear expansion of, 198
 specific heats of, 205
 speed of sound in, 170
 transmission of light by, 410
- Meter, wave, 453
- Meter stick, as lever, 24
- Meters, electric, for projection, 8
- Mica in polarized light, 429
- Michelson interferometer, 381, 398
 acoustic, 174
- Microphones, 165
- Microscope, 391
- Miller, D. C., 166*n.*
- Millikan, R. A., 41*n.*, 71*n.*, 480*n.*
- Millikan oil-drop experiment, 480
 model of, 479
- Mills, J., 295*n.*
- Minimal surfaces, 98
- Mirage, 381
- Mirror, concave, 378
 convex, 380
 curved, for sound, 175
 ellipsoidal, 379
 mercury, parabolic, 63
 parabolic, 238
 plane, 376, 378
 rotating, 129, 166, 365
 sound, 173
- Mixture, freezing, 214, 224
 specific heats by method of, 206, 207
- Mobilities of ions, 432
- Model, of amplifier, 486
 atomic equilibrium, 471
 current, for magnetization, 284
 electrostatic, of alpha-particle scattering, 473
 Ewing, for magnetization, 284
 of eye, 394
 kinetic theory, 459
 magnetic, of alpha-particle scattering, 472
 of nuclear disintegration, 473
 of oil-drop experiment, 479
 of polarization, 418
 of potential field, 272
- Model, of refraction, 381
 of thermodynamic surfaces, 224
 of voltaic cell circuit, 331
 of wave motion, 138
 of x-ray spectra, 501
- Model bridge, to show expansion, 198
- Model centrifuge, 67
- Model engines, 248
 run by liquid air, 228
- Model generator, 344, 345
- Model heating system, 236
- Model microscope, 391
- Model motor, 346
- Model swing, work up in, 77
- Model transmission line, 352
- Models, stresses in, by polarized light, 427
- Modulation, of high-frequency oscillations, 458
 of light beam by sound, 493
- Mohr-Westphal balance, 113
- Molecular dimensions, 465
- Molecular velocities, distribution of, 462
- Moment of inertia, 68
 and angular velocity, 75
- Moments, equilibrium of, 24
- Momentum, angular, combination of, 79
 conservation of, 55, 59, 72, 73, 76
 quanta of, 76
 linear, conservation of, 55
- Momentum cars, 56
- Monkey and coconut problem, 52
- Monomolecular layers, 465
- Monorail car, 87
- Motion, relative, 46
 in two dimensions, 43
- Motional electromotive force, 340
- Motor, alternating current, speed of, 355
 counter electromotive force in, 347
 direct current, 309
 electrostatic, 299
 elementary, 308
 heat, magnetic, 294
 model, 346

- Motor, rotator, 61
 speed control for, 347
 synchronous, 355
 unipolar, 306
 Mouzon, J. C., 508*n.*
 Multiplier, electron, 495
 Museums, 13
 Musical resonators, 179
 Musical sounds, 182

 N
 Natural magnets, 280
 Negative acceleration due to friction, 50
 Negative temperature-resistance coefficient, 316
 Neher and Harper, 505*n.*
 Neon discharge, with mercury, 260
 from static charge, 259
 Neon glow lamp, 439
 Neon lamps, 369
 Neon wand, 255
 Nernst glower, 316
 Newton, second law of, 50
 Newton's laws of motion, apparent departure from, 48
 Newton's rings, 397
 Nichols, E. F., 12
 Nicholson hydrometer, 112
 Nickel, magnetism of, effect of temperature on, 291
 Nicol prism, 421
 Nitrogen, liquid, 227
 solid, 228
 Nodes of standing waves, 185
 Nonresonant air jet, 161
 Nörrenberg polariscope, 421
 Nuclear disintegration model, 473
 Nuclei, effect of, on condensation, 221

 O
 Oersted, 107
 Oersted's experiment, 301
 Oil, castor, 32
 drop, 101
 method of coloring, 120*n.*
 Oil-drop experiment, model, 478
 Olsen and Massa, 162*n.*
 Open-tube resonator, 181
 Optical disk, 370
 Optical lever, 34
 Optical osmometer, 106
 Optical pyrometer, 196
 Optical system for phonodeik, 168
 Optical tank, 371
 Organ pipes, 184
 as sound source, 157
 tuned to harmonics, 184
 Organic material, heating by current in, 321
 Orthotoluidine drop, 100
 Oscillating circuit, mechanical analogue of, 142
 Oscillating-leaf electroscope, 251
 Oscillation, center of, 88
 Oscillations, continuous, high frequency, 454
 damped, 449
 high frequency, 449
 continuous, 452
 modulation of, 458
 ultra high frequency, 454
 Oscillator, audio frequency, 162, 447
 beat frequency, 448
 low frequency, 445
 piezoelectric, 327, 328
 Oscillator tube, mechanical analogue of, 165
 Oscillators, coupled, 134, 136
 Oscillatory charge of condenser, 364
 Oscillatory circuits, phase relations in, 364, 366
 Oscillatory discharge of condenser, 365
 Oscilloscope, cathode ray, 169
 for hysteresis, 289
 for measurement of e/m , 477
 Osmometer, optical, 106
 Osmosis, and diffusion, 105
 through membranes, 106
 in roots, 106
 Oxygen, liquid, 227
 chemical activity of, 230
 magnetic properties of, 228, 291

P

- Page and Adams, 340*n.*, 364*n.*
 Paint, temperature indicating, 231
 Pan pipes, 184
 Paper, temperature indicating, 225, 231
 Parabola, water-stream, 43, 122
 Parabolic mercury mirror, 63
 Parabolic path of projectile, 45
 Parabolic reflectors, 238
 Paraboloid of revolution, 62
 Paradox, of free fall, 89
 Pascal's, 110
 of rotation, 78
 two-bubble, 99
 Parallel conductors, forces on, 310
 Parallel resonance, 450
 and series resonance, 322
 Parallel waves, generator for, 150, 151
 Parallelogram of forces, 19
 Parallel-plate condenser, 276
 Paramagnetism, 290
 Partial pressure, 221
 Particle vs. wave motion, 138
 Pascal's law, 108, 112
 Pascal's paradox, 110
 Patterson Screen Co., 498*n.*
 Peep-show experiments, general, 13
 Peltier effect, 323
 and Seebeck effects combined, 324
 Pendulum, ballistic, and velocity
 of bullet, 55
 centrifugal force in, 64
 for comparing accelerations, 39
 compound, 88
 conical, 68
 cycloidal, 45
 electrical, 249
 equivalent simple, of hoop, 88
 Foucault, 90-92
 friction-driven, 32
 gridiron, 201
 gyro-, 87
 impact, 56
 momentum, 56
 period and field of force, 58
 Pendulum, Rayleigh's, for forced vibrations, 137
 resolution of forces on, 16
 resonance, 136
 rubber-driven, 200
 sand, 92, 146
 simple, for simple harmonic motion, 128
 support for, 90
 timing, for free fall, 41
 torsion, 33, 71
 gravitational, 57
 of variable period, 132
 vibrating in water stream, 188
 Wilberforce, 135
 Pendulum board, Galileo's, 59
 Pendulum model of polarization, 419
 Penetration of x-rays, 499
 Percussion, center of, 88
 acceleration of, 89
 Periodic motion and restoring force, 130
 Permalloy, 281, 283, 296
 Permanent magnets, 281
 Perry, J., 510
 Phantom bouquet, 378
 Phase of forced vibrations, 133
 Phase relations near resonance, 136
 in oscillatory circuits, 346, 366
 Phoneoscope, 157, 166, 346
 Phonodeik, 166
 Phosphorescence, 417
 Photocell, 372
 alkali metal, 489
 gas filled, 490
 for infrared, 417
 vacuum type, 490
 Photocell-thyratron relay, 493
 Photochemical reaction, 494
 Photoconductivity bridge, selenium, 318
 Photoelasticity, 35, 422, 427
 Photoelectric cell, 337, 418
 Photoelectric effect, discovery of, 489
 surface, 488

- Photoelectric exposure meter, 374
 Photoelectric relay, 491
 Photoelectric siren, 493
 Photoelectric threshold, 489
 Photoelectrons, velocity of, 490
 Photoflood lamp, 369
 Photometry, 372
 Photon counter, 506
 Photovoltaic cell, 491
 Piezoelectric effect in Rochelle salt, 326
 Piezoelectric oscillator, 328
 Piezoelectricity, 323
 Piezometer, 107
 Pijper, A., 401*n.*
 Pile driver, 59
 Pinhole camera, 375
 to demonstrate arc, 435
 Pipe, end correction for, 180
 organ, 184
 as sound source, 157
 standing waves in, 185
 tuned to harmonics, 184
 Pirani vacuum gauge, 237, 318
 Pirouette, 75
 Pitch, of air column, 161, 179
 effect of medium on, 171
 and frequency, 183
 of rubber band, 186
 Pitot tube, 121
 Plane, horizontal, acceleration on, 50
 inclined, Galileo's, 42
 of polarization, rotation of, 425
 in electric field, 428
 Plateau's liquid, 92
 Plateau's spherule, 101, 104
 Plates, polarizing, 421
 stack of, 423
 vibrations of, 187
 Platform balance, 29
 Plating, electric, 330, 331
 Pohl, R. W., 510
 Point counter, Geiger, 507
 Point source of light, 368
 Point source of sound, 161
 Points, discharge from, 264, 434
 Polariscopes, Nörrenberg, 421
 Polarization, of electric waves, 456
 model of, 418
 by reflection, 421, 422, 423
 rotation of plane of, 425
 by scattering, 424
 stresses shown by, 422
 of voltaic cell, 332
 Polarizing plates, 421
 Pole, magnetic, 280
 induced, 281
 isolated, 281, 306
 Pole strength, magnetic, and law of force, 283
 Polished rounds, 39
 Polonium, 501, 502
 Positive and negative charges, 261
 Positive rays, 438
 Potential, and capacitance, 271
 charges at same, 274
 of conductor, 273
 contact, 278
 fall of, 315
 ionization and radiation, 474
 stopping, 489
 water analogue of, 298
 Potential required for glow discharge, 439
 Potential difference in voltaic cell, 331
 Potential divider, rheostat as, 314
 Potential drop in conductor, 296
 on wire, 313
 Potential energy of pile driver, 59
 Potential field, mapping, 272
 model of, 272
 Potential multiplier, 277
 Potentials, addition of, 276
 Potentiometer, 314
 Powder in roller, 69
 Power developed by person, 60
 Power bicycle, 60
 Precession, acceleration of, 87
 by bicycle wheel, 79
 fundamental equation for, 80
 and stability in gyroscope, 86
 Precipitation of smoke, 434

- Pressure, of air at low temperatures, 225
 on airfoil, 118
 of atmosphere, 124
 in bubble, 99, 100
 and depth, 109
 and diffusion, 466
 fall of, in pipe, 33
 and friction, 31
 and height, 125
 light, 470
 in liquid, 108
 and melting, 211
 partial, 221
 reduced, boiling water at, 217
 by condensation of vapor, 125
 in siphon, 111
 transmission of, in water, 107
 vapor, 216
 of liquids, 218
 of solutions, 221
 and temperature, 217
 and velocity in air stream, 116
 and viscosity, 468
- Primary circuit, reaction of secondary on, 351
- Prince Rupert drops, 202
- Prism, dispersion by, 386
 Nicol, 421
 sound, 176
 Wollaston, 421
- Projectile, 45
- Projection, of circular motion, 127
 of diffraction patterns, 402
 of ripples, stroboscopic, 152
 of simple harmonic motion, 128
- Projection cell, 236, 304
- Projection centrifuge, 66
- Projection electroscope, 250
- Projection lanterns, 367
- Projection meters, 8
- Projection screens, 8
- Proof plane, 250, 261-263, 354
- Propagation, rectilinear, of heat, 237
 of light, 374
- Pulleys, 30
- Pulling magnet, 286
- Pulsating air bubble, 97
- Pulse glass, 216
- Pump, air, centrifugal, 66
 model, 112
 rotary, for ripple tank, 151
- Purple cabbage as indicator of ions, 336
- Pyroelectricity, 323, 328
- Pyrometer, optical, 196
 thermoelectric, 323
- Q
- Quality, of tone, 183
 of voice changed by hydrogen in lungs, 171
 and wave form, 184
- Quanta of angular momentum, 76
- Quartz, expansion of, 202
- Quartz biplate, 425
- R
- Racing rollers, 68
- Radiation, absorption of, 241
 black-body, 240
 of electric waves, 456
 focusing of, 238
 of heat, 237
 intensity of, 411
 Kirchoff's law of, 411
 reflection of, 237
 resonance, 475
 selective absorption of, 239
 of sound, 190
 from surfaces, 239
- Radiation potential, 474
- Radio receiver as detector of changes in field, 270
- Radio transmission and reception, 453
- Radioactive decay, 503
- Radioactive sources, 501
- Radiometer, 416, 469
 Crookes, 242
- Radiometer effect, 242
- Radon seeds, 501, 502
- Rainbow, 387
- Rainbow cup, 396

- Rainbow top, 409
Ramsey, R. R., 162*n.*
Range, of alpha particles, 502
 of projectile, 45
Rate of fall, independent of horizontal motion, 43
 of mass, 39
Rayleigh, Lord, 164
Rayleigh's forced vibration pendulum, 137
Reactance, capacitive, 360
 and inductive, 363
 inductive, 360
Reaction, of circuits, 351
 inertial, 46
 and weight, 47
 photochemical, 494
Reaction balance, 52
Reaction cars, 54
Reaction carts, 53
Reaction engine, 78
Reaction principle in sprinkler, 78
Reaction swings, 54
Reaction track, 55, 78
Recalescence of iron, 197, 292
Reception, radio, 453
Recombination of ions, 433
Rectifier, diode, 482
 electrolytic, 338
 mercury vapor, 486
 thermionic, 481
 Tungar, 440
Rectifier cell, 491
Rectilinear propagation, of heat, 237
 of light, 374
Reflection, and angle of incidence, 376
 of electric waves, 457
 laws of, 378
 metallic, 386
 polarization by, 421, 422, 423
 of radiation, 237
 by ripple tank, 153
 of sound, 173
 from curved mirrors, 175
 total internal, 384, 386
 of waves, 144
 on cords, 138
 of sound, 176
Refraction, 380
 double, 420, 429
 model of, 420
 by gases, 381
 index of, 383
 model of, 381
 by ripple tank, 153
 of sound, 176
Refrigeration diagrams, 224
Regelation, 211
Relative acceleration, 46
Relative humidity, 223
Relative motion, 46
Relativity car, 46
Relay, photocell-thyratron, 493
 photoelectric, 491
Repulsion between charges, 253, 265
Resistance, 311
 of carbon arc, 436
 of conductors, 321
 electric, at low temperature, 226
 in parallel and series, 322
 and temperature, 315, 316
 with voltmeter and ammeter, 313
Resistance thermometer, 318
Resolving power, 404
Resonance, electrical, mechanical
 analogue of, 444
 and forced vibrations, 132, 136
 multiple, 135
 parallel, 450
 series, 450
 at sixty cycles, 447
 of strings, 181
 from timed impulses, 134
 of tuning fork, 181
 of vocal cavities, 181
 of watch and balance wheel, 73
Resonance radiation, 475
Resonance top, 134
Resonant circuit, 364, 366
Resonating air column, 169
Resonator, closed tube, 180
 conical, 180
 mechanical, 134
 musical, 179
 open tube, 180

- Response vs. frequency in forced vibrations, 133
 Restitution, coefficient of, 36
 Restoring force and periodic motion, 130
 Resultant magnetic fields, 304
 Retentivity, 286
 Retina, fluorescence of, 393, 417
 image on, 393
 Reverberation, 190
 Rheostat as potential divider, 314
 Richardson, E. G., 164
 Richtmyer, F. K., 241*n.*
 Ripple tank, 149
 showing radiation, 190
 showing scattering, 191
 Ring, and ball, expansion of, 198
 jumping, 349
 Ritchie's experiment, 241
 Ritz formula, 476
 Rochelle salt, piezoelectric effect in, 326
 Rocket car, 54
 Rod, longitudinal vibration of, 161
 rolling in magnetic field, 305
 Roller, D., 41*n.*, 71*n.*
 Roller, powder in, 69
 weary, 69
 Rollers, racing, 68
 Rolling spheres on inclined plane, 68
 Rolling spool, 23, 69
 Rolling wedge, 21
 Rope, broken by inertia, 47
 Rotary action and reaction, 73, 74
 Rotating cylinder, lift on, 116
 Rotating magnet, 340
 Rotating magnetic fields, 355
 Rotating mirror, 129, 166, 365
 Rotating stool, 61
 Rotation, 61
 of electrolyte, 330
 paradox of, 78
 of plane of polarization, 425
 in electric field, 428
 in magnetic field, 428
 speed of, by manometer, 66
 stable axes of, 71
 Rotational energy vs. translational, 135
 Rotator, hand drill as, 61
 motor, 61
 Rotatory kinetic energy, transfer of, by friction, 78
 Rotor ship, Flettner, 117
 Royal Institution, Christmas Lectures, 12*n.*, 509
 Rubber, expansion of, 200
 frozen, 225
 Rubber band, charges from, 259
 heat from, 244
 pitch of, 186
 Rubber-driven pendulum, 200
 Rug scuffing, charges from, 259
 Rumford photometer, 373
 Rutherford, scattering experiment of, 502
- S
- Safety lamp, Davy, 232
 Sailboat, forces on, 16
 Sand pendulum, 146
 on rotating stand, 92
 Saturation of ion current in air, 431, 432
 Savart wheel, 183
 Saw, paper, 62
 Scale, diatonic, by tuned sticks, 182
 Scattering, of alpha particles, 502
 electrostatic model of, 473
 magnetic model of, 472
 color due to, 411
 of light, 387
 polarization by, 424
 of sound, 191
 Schilling, H. K., 44*n.*, 170*n.*, 173*n.*
School Science and Mathematics, 509
 Schriever, W., 49*n.*
 Schuler discharge, 439
 Screen, gauze, 372
 Screening, magnetic, 292
 Searle's apparatus, 245
 Secondary circuit, reaction of, on primary, 351
 Secondary emission of electrons, 495

- Seebeck effect, 323
 and Peltier effects combined, 324
- Seismograph, 47
- Selenium photoconductivity bridge, 318
- Self-inductance, 357
 causing time lag, 358
- Semimusical sounds, 182
- Sensitive flames, 162, 172, 178
 and supersonic beats, 178
- Sensitive jets, 162
 liquid, 164
- Separation of charges, 249
- Series and parallel resistance, 322
- Series resonance, 450
- Shadow, sound, 176
- Shadow photometer, 373
- Shadow projection of circular motion, 127
- Shearing, 35
- Shielding, electric, 264
 magnetic, 292
- Ship, Flettner rotor, 117
- Ship stabilizer, 83, 84
- Shot tube, 244
- Shrieker, 161
- Shrink fit, 199
- Shunt, magnetic, 352
- Shunting magnetic flux, 293
- Shutter, electrostatic, 428
- Silver plating, 331
- Simple harmonic motion, 127
 by pendulums, 128
 plotting, 129
 from tuning fork, 155
- Simple pendulum and simple harmonic motion, 128
- Singing arc, 436
- Singing tubes, 159
- Siphons, 110, 111
 gas, 123
- Siren, photoelectric, 493
- Siren disk, 183
- Skidding automobile, 32
- Sky, color of, 411
- Slide-wire Wheatstone bridge, 313
- Sliding friction, 31
- Slip speed of motor, 355
- Slits, diffraction by, 398-402
 tool for ruling, 402
- Smith, and Dunoyer, 468*n.*
- Smoke, precipitation of, 434
- Smoke box, 372
- Smyth and Curtis, 479*n.*
- Snow crystals, 208
- Snubbing, 31
- Soap bubble, interference in, 396
 solution for blowing, 92
- Soap film, catenoid, 98
 contraction of, 97
 frames for, 98
 solution for, 92
- Sodium, electrolysis of, through glass, 336
- Sodium atom, mass of, 338
- Sodium photocell, 489
- Sodium spectrum, 414
- Sodium vapor lamps, 369
- Solenoid for demagnetization, 280
 field of, 302
 force on core of, 303
- Solid carbon dioxide, 225
- Solids, conduction of heat in, 230
 distinguished from liquids, 107
- Solution, heat of, 209
 for soap films, 92
 vapor pressure of, 221
- Sonometer, 185
- Sound, 154
 absorption of, 190, 191
 attenuation of, in gas, 172
 audible range of, 183
 diffraction of, 176
 directional source of, 174
 intensity of, 191
 interference of, 328
 loudness of, 191
 point source of, 161
 radiation of, 190
 reflection of, 173
 refraction of, 176
 scattering of, 191
 sources of, 157
 directional, 159, 177
 speed of, in air, 169
 effect of medium on, 171

- Sound, speed of, effect of temperature on, 170
 in metals, 170
 standing waves of, 177
 transmission of, 169
 by light, 493
 in solids, 171
 from vibrating body, 154
 wave properties of, 172
- Sound analyzers, 165
- Sound box, 172
- Sound detectors, 162
- Sound shadow, 176
- Sound waves in auditorium, 191
- Sounding board, 146
- Sounds, aeolian, 188
 musical, 182
 semimusical, 182
- Sources, of sound, 157
 directional, 174, 177
 point, 161
 radioactive, 501
- Space-charge sheath, 441
- Spark, gas igniting, 271
 length of, and voltages, 270
- Spark discharge, 435
 and oscillations, 449
- Sparking distance, 299
- Specific heat, 205
- Spectra, 413
 absorption, 476
 emission, 476
 x-ray, model, 501
- Spectroscopes, 412
- Spectrum, formation of, 387
- Speed, of alternating-current motors, 355
 of bullet by condenser discharge, 362
 of ions, 334, 335
 of light, 376
 of rotation by manometer, 66
 of sound, in air, 169
 effect of medium on, 171
 effect of temperature on, 170
 in metals, 170
- Speed control, for motor, 347
- Spherical aberration, 389
- Spherical top, unevenly loaded, 88
- Spheroidal state, 227, 234
- Spinning disk, 73
- Spool, falling, 69
 rolling, 23, 69
- Spring, dancing, 311
 lead, 226
 simple harmonic motion of, 128
 for transmitting sound, 156
 waves in, 144
- Spring gun, 46
- Stability of jet, 103
- Stabilizer, gyroscopic, 85
 ship, 83, 84
- Stable axes of rotation, 71
- Standing waves, 137
 in cord, 132
 in glass rod, by polarized light, 428
 in hot wire, 144
 in pipes, 185
 shown by flames, 185
 by hot wires, 185
 of sound, 177
 on strings, 143
- Starting friction, 31
- State, change of, 208
 charging by, 260
- Static vs. dynamic forces, 49
- Static machine, 262
 current from, 296
 as motor, 299
- Steam bomb, 217
- Steam engine, model, 248
- Steel wool, burning in liquid air, 220
- Stopping potential, 489
- Storage cell, 333
 elementary, 300
- Strains, in Prince Rupert drops, 202
 and stress, 35
- Streamline apparatus, 119
- Streamline experiments, 120
- Streamline flow, 121
 velocity distribution in, 120
- Street, and Bainbridge, 503*n.*
- Stress, deformation under, 36
 shown by polarization,
 and strain, 35
- Striations in discharge, 438

- Strings, longitudinal vibrations in, 178
 resonance of, 181
 standing waves on, 143
 transverse waves on, 137
 vibrating, 186
 Stroboscopic demonstration of dynamic distortion, 64
 Stroboscopic illumination, of drop formation, 104
 of gyroscope, 80
 of tuning fork, 155
 of vibrating cords, 144
 strings, 186
 wire, 307
 of water jet, 165
 Stroboscopic projection of ripples, 152
 Stupakoff Laboratories, 316*n.*
 Sublimation, 209
 Submerged float, 93
 Subtraction of colors, 407
 Suction, 124
 Sugar, rotation of plane of polarization by, 425
 Summers, R. D., 507*n.*
 Sun, temperature of, 193
 Sunset experiment, 387
 Supersonic beats by sensitive flame, 178
 Supersonic sounds, production of, 157
 Surface, drops on liquid, 103
 equipotential, 273
 minimal, 98
 Surface absorption, 240
 Surface distribution of charge, 264
 Surface photoelectric effect, 488
 Surface radiation, 239
 Surface tension, 92
 and drop size, 101
 effect of camphor on, 95
 of mercury, 93
 by ring method, 92
 and surface conditions, 95
 variation of, with temperature, 104
 Suspensions, colloidal, 463
 Sutton, R. M., 79*n.*, 114*n.*, 474*n.*, 494*n.*
 Swing, electromagnetic, 305
 reaction, 54
 workup in, 76
 Swinging on the halyards, 20
 Synchronous motor, 347, 348, 355
- T
- Tachometer, vibration, 134
 Tangent galvanometer, 302
 Tank, optical, 371
 Tantalus cup, 110
 Taylor, Wilson, 104*n.*
 Tears of wine, 102
 Telephoto lens, 392
 Telescope, 391
 Temperature, change of, in expansion and compression, 347
 and color, 411
 critical, 222
 effect of, on magnetism of iron, 292
 on magnetism of nickel, 291
 on speed of sound, 170
 on viscosity, 32
 high, conduction in glass at, 317
 low, 224
 air pressure at, 225
 of liquid air and dry ice, 225
 of recalescence, 197
 and resistance, 315, 316
 and vapor pressure, 217
 variation of surface tension with, 104
 Temperature diagram, 193
 Temperature-indicating paint, 231
 Temperature-indicating paper, 225, 231
 Tension in Atwood's machine, 51
 Terman, F. E., 453*n.*
 Terrestrial magnetism, 295
 Tesla apparatus, continuous wave, 454
 Tesla coil, 450
 Thermionic effect, in air, 480
 in vacuum, 481

- Thermionic rectifier, 481
 Thermocouple, 323
 demonstration, 165, 215, 217, 221,
 223, 225, 240, 242, 244
 Thermodynamic surfaces, models of,
 224
 Thermoelectric effect, 196, 323
 in one metal, 325
 Thermoelectric magnet, 324
 Thermojunction, 213
 Thermometers, 193
 air, 233
 electric, 318
 lecture table, 195
 Thermometry, 193
 Thermopile, 237, 239, 247
 showing infrared, 411, 416
 Thermoscope, air, 194
 Dewar flask, 209
 differential, 207, 241
 Thermostat, 201, 238
 Thin films, color of, 395
 interference in, acoustic, 174
 Thompson, S. P., 510
 Thomson, G. P., 500
 Thomson effect, 326
 Three-phase current, 355
 Threshold, photoelectric, 489
 Thyatron-photo cell relay, 493
 Thyatron tube, 441, 487
 for ionization potentials, 474
 Time, charging, of condenser, 362
 of evaporation, 219
 Time lag of current rise, 358
 Tin tree, 331
 Toepler-Holtz machine, 262
 Toggle-joint, 20
 Tone quality, 183
 Tool for ruling slits, 402
 Tops, 87
 color, 409
 ellipsoidal, 88
 Maxwell's, 82
 resonance, 134
 spherical, 88
 Toroidal magnet, 286
 Torque, action of, 23
 addition of, 23
 Torque, axis of, 22
 on coil, 308
 producing angular acceleration, 70
 Torricellian vacuum, 125
 Torricelli's theorem, 121
 Torsion, 35
 Torsion pendulum, 71
 egg, 33
 gravitational, 57
 Tourmaline, pyroelectric effect in,
 328
 Townsend discharge, 431
 Toy transformer, 351
 Trajectory, of alpha particle, 472
 of bullet, 44
 of liquid jet, 103
 Transfer, of energy in coupled
 oscillators, 134
 of heat, 230
 Transformer, 348, 352, 354
 dissectible, 351
 filament, 497
 hysteresis in, 289
 step-down, 349, 350
 toy, 351
 Translational energy vs. rotational,
 135
 Transmission, by dyes, 410
 by filters, 418
 radio, 453
 and reflection, 386
 of sound, 169
 by light, 493
 medium required for, 155
 in solids, 171
 Transmission line, model, 315, 352
 Transverse vs. longitudinal waves
 144
 Transverse wave on strings, 137
 Transverse-wave machine, 141
 Trevelyan rocker, 202
 Tribometer, 30
 Triode, characteristics of, 482
 electrostatic control of, 484
 fresh air, 483
 mechanical analogue of, 483
 Triple point of water, 215
 Trivelli, A. P. H., 404*n*.

- Tubes, Geissler, 439
 glow discharge, 437
 thyatron, 441
 Tungar rectifier, 440
 Tungsten arc, 368
 Tuned wire in alternating current field, 307
 Tuning fork, controlling jet, 164
 electrically driven, 157
 excited with dry ice, 225
 generating simple harmonic motion, 155
 harmonics of, 157, 184
 interference in, 179
 for kinetic theory model, 460
 producing ripples, 150
 resonance of, 181
 as sound source, 157
 and stability of liquid jet, 103
 wave form of, 184
 Turbine, model, 248
 Turbulent flow, 121
 Turn indicator, airplane, 83
 Two-bubble paradox, 99
 Two-phase current, 356
 Tyndall, John, 12*n.*, 164, 510
- U
- Ultra high-frequency oscillations, 454
 Ultraviolet light and photoelectric effect, 489
 Ultraviolet spectrum, 414
 Undercooling, 209
 of water, 215
 Unipolar motor, 306
 U. S. Navy Department, 295*n.*
 U. S. Radium Co., 501*n.*
- V
- Vacuum, bell in, 156
 thermionic effect in, 481
 Vacuum cups, 124
 Vacuum gauge, Pirani, 237, 318
 Vacuum photocells, 490
 Vacuum system, 467
 Vacuum tubes, 482
 circuit for driving tuning fork, 157
 Van Atta, Van de Graaff and Compton, 263*n.*
 Van de Graaff generator, 262
 Vapor, compared with gas, 220
 condensation of, on ions, 434
 heavier than air, 122
 water, condensation of, 213
 Vapor lamps, 369
 Vapor pressure, 216
 fountain, 220
 of liquids, 218
 of solutions, 221
 and temperature, 217
 Vaporization, heat of, 212
 Vector, components of, 16
 free, couple, 21
 Vector addition, of displacements, 38
 of velocities, 38
 Vector diagrams, 20
 Vectors, independence of, 43
 Velocities, molecular, distribution of, 462
 vector addition of, 38
 Velocity, 37
 angular, and moment of inertia, 75
 of bullet, by ballistic pendulum, 55
 by condenser discharge, 362
 distribution of, in streamline flow, 120
 of photoelectrons, 490
 of sound by toothed-wheel method, 169
 typical, table of, 37
 Venturi meter, 119
 Verwiebe, F. L., 224*n.*
 Vibrating lamp filament, 307
 Vibrating strings, 186
 Vibrating wire in alternating current field, 307
 Vibration tachometer, 134
 Vibrations, of bars, 182, 187
 loaded, 130
 of bowls, 188
 forced, 179
 Rayleigh's pendulum for, 131
 and resonance, 132, 136

- Vibrations, longitudinal, in strings, 178
 piezoelectric, of crystal, 327
 of plates, 187
 of rod, longitudinal, 161
 of sounding body, 154
 Vibrator, mechanical, 131
 Vibrograph, 47
 Violin pegs to support cords, 20
 Viscosity, of alcohol at low temperature, 226
 in gases, 33, 468
 in liquids, 32
 Visual fatigue, 394
 Vocal cavities, resonance of, 181
 Voice, quality of, changed with hydrogen in lungs, 171
 Voltage and length of spark, 270
 Voltaic cell, 331
 currents from, 300
 polarization of, 332
 Voltmeter, 312
 electrostatic, 251
 lecture galvanometer as, 313
 water analogue of, 298
 Volume change by evaporation, 228
 Vortex rings of liquid, 103
- W
- Walking gyroscope, 81
 Wand, charging, mercury-glass, 260
 Warburton, F. W., 285*n.*
 Ward's Natural Science Establishment, 328*n.*
 Water, adhesion of, to glass, 105
 boiling, at reduced pressure, 217
 compressibility of, 107
 condensation of, from air, 213
 density of, 203, 204
 electrolysis of, 332
 expansion of, 203
 freezing, by evaporation, 215
 heat conductivity of, 233
 incompressibility of, 107
 transmission of pressure in, 107
 vapor pressure of, 206
 Water analogue of current and potential, 298
 Water bubble, 104
 Water column, cohesion of, 105
 Water droplets, 102
 Water dropper, Kelvin, 261
 Water hammer, 115
 Water jet, effect of charge on, 266
 Water parabolas, 122
 Water waves, 137
 Water-drop resonator, 134
 Water-jet counter, 507
 Water-stream parabola, 43
 Watertight sieves, 94
 Watson, E. C., 41*n.*, 71*n.*
 Watson, F. R., 144*n.*, 160*n.*
 Watt's regulator, 68
 Wave form, of alternating current, 344
 and quality of sound, 184
 by sand pendulum, 146
 from tuning fork, 157
 Wave machine, 144
 Wave meter, 453
 Wave models, 138
 Kelvin, 140
 Wave motion, 137
 and particle motion, 138
 and sound, 156
 Wave properties of sound, 172
 Wave trough, 137
 Waves, addition of, 139
 electric, radiation and polarization of, 456
 longitudinal, 144
 on moving cords, 139
 parallel, generator for, 150, 151
 radiation of, 190
 reflection of, 138
 and ripples, 150
 sound, in auditorium, 191
 in springs, 144
 standing, 137
 in cord, 132
 in glass rod, by polarized light, 428
 in hot wire, 144
 in pipes, 185
 shown by flames, 185
 by hot wire, 185

- Waves, standing, of sound, 177
 on strings, 143
 transverse, on strings, 137
 on water, 137
 Weary roller, 69
 Weather Bureau, 223
 Weather maps, 224
 Wedge, rolling, 21
 Weighbridge, 29
 Weight, error in judgment of, 15
 vs. inertial reaction, 47
 supported by magnet, 286, 325
 variation of, with height, 58
 Weinhold, A. F., 510
 Welding, electric, 351
 Wells, and Balinkin, 369*n.*
 Westinghouse Electric Co., 368*n.*
 Wheatstone bridge, 247, 312, 313
 effect of inductance on, 357
 Wheel and axle, 29
 Whirl, electric, 266
 Whispering gallery, 175
 Whistles, beat note, 171
 blown with gas, 171
 high pitched, 158, 172, 183
 as sound source, 157
 Whitson, and Schilling, 173*n.*
 Wilberforce pendulum, 135
 Wilkins and Friend, 507*n.*
 Williams, S. R., 92*n.*
 Williamson and Eisenbeis, 157*n.*
 Wilson cloud chamber, 221, 434, 503
 Wimshurst machine, 262
 Wind, electric, 265
 Wind note, 189
 Windlass, 29
 Wine, tears of, 102
 Wire, hot, showing standing waves,
 185
 standing waves in, 144
 Wire, loaded, resonance of, 135
 vibrations of, in alternating-cur-
 rent field, 307
 yield point of, 35
 Wollaston prism, 421
 Wood, A., 510
 Wood, R. W., 383*n.*
 Wood, conduction of heat in, 232
 Wood's metal, 208
 Work, and energy, 59
 of charge, 255
 and heat, 243
- X
- X-rays, absorption coefficients of,
 499
 burns by, 497
 diffraction of, 500
 model, 500
 pattern, 401
 ionization by, 497
 and fluorescence, 498
 penetration of, 499
 produced in discharge, 438
 spectra of, model, 501
 tubes, 495
 Xylophone, 182
- Y
- Yerkes Observatory, 413*n.*
 Young's modulus, 34
- Z
- Zeleny electroscope, 251, 431, 480,
 483, 488, 502
 water analogue of, 298
 Zone plates, acoustic, 174