

INDEX

- Abegg, Richard, 342
Abraham, Max, 89, 153, 155
and development of the theory of spin, 428–429
Aether and Matter, 115
Anderson, Carl, 317
Annalen der Physik, 314
Armstrong, H. E., 103, 114
Arndt, Fritz, 349
Arnold, Harold, 328
Aston, F. W., 62, 215
AT&T, 328
Atombau und Spektrallinien, 237
Atoms, 2. *See also* Particles
appropriation by chemists, 367–369
and chemical bonds, 385–386, 454
and chemical valence, 342–345, 352–353
and composition of matter, 201–202
and Coulomb's law, 371
discovery of, 38–39, 202–203
and electron bonds, 345–348, 371–372
and group theory, 376–379
ionic charge of, 57–58
and J. J. Thomson, 141, 204–206
and Joseph Larmor, 183–184
and mechanical resonance, 350–352
in metals, 491
and molecular orbitals, 386–390
nuclear, 308–310
Owen Richardson on, 245–247
and Pauli exclusion principle, 454
and Paul Villard, 137–138, 141
plum-pudding model of, 22–23
and polyelectronic molecules, 376–379
research on structure of, 22–23, 38–40, 245
and Schrodinger equation, 457
and the theory of resonance, 381–386
vibration of, 176
and the vortex atomic theory, 199–200
Audions, 328
Avogadro's number, 49
Ayrton, W. E., 119
Baedeker, Karl, 263, 274–275
Bardeen, John, 327, 331, 332–336
Beketov, Nikolai, 210
Bell Laboratories, 327, 330, 331
Benzene, 349–352, 382
Berichte, 339
Berzelius, Jons, 196
Bethe, Hans, 310
Biological electron microscopy, 471–483
and physics, 493–495
Bjerrum, J., 370
Blackbody radiation, 270–273, 278
Blackett, P. M. S., 317
Bloch, Felix, 279, 330
Bodlander, Guido, 342
Bohr model, 62, 63–64, 215, 227, 245, 247–248
Bohr, Niels, 236, 237
and chemical bonds, 454
and development of the theory of spin, 434–435
and electron gas theory of metals, 265–266
on free electrons, 269
and Hall effect, 276
and nuclear atoms, 308
and the periodic table, 343–344
Boltzmann, Ludwig, 256, 258, 266
Bond, W. G., 108
Born, Max, 352, 378, 393–394

- Bose electron, 311–312
Bragg fringes, 489–490
Bragg, W. H., 244
Branch, Gerald, 341, 351
Brattain, Walter, 327, 332–335
Braun, Ernest, 491–492
Braun, Ferdinand, 65
Brillouin, Marcel, 268
Broca, M., 113, 147–148
Brown, F. C., 233
Bucherer, Alfred, 208
Burton, H., 347, 349–350
Bush, Vannevar, 332
Butlerov, A. M., 385
- California Institute of Technology
(Caltech), 341, 374
Calvin, Melvin, 341
Canalstrahlen, 152
Carnelley, Thomas, 206
Cathode Rays, 21
Cathode rays, 21
and discovery of the electron, 404, 415–416
early research on, 27–28, 110–111
and electrons, 43, 92, 204–206
French scientists' research on, 147–150, 158–159
and Goldstein rays, 143
J. J. Thomson's work on, 36–45, 65, 112–115, 419
Lord Kelvin on, 28–29
and *m/e* value, 36–45
Oliver Lodge's work on, 79–80
oscilloscope, 119–120
Paul Villard's work on, 138–139, 140–145
research on structure of, 22, 40–45, 135, 139
response to research by Paul Villard on, 148
response to research on, 109–112, 157–160
structure of, 147–151
wave-like nature of, 42
and wireless telegraphy, 118–119
and x-rays, 105–106
- Cavendish Laboratory, 21, 30, 35, 102, 110, 124–125, 144, 158, 235–236, 490–491
Chadwick, James, 307
Chemical News, 110
Chemical Reviews, 348, 375
Chemistry, organic, 339–354
and chemical affinity, 339–340
and chemical bonds, 339–340
and chemical valence, 342–345, 352–353
and discovery of the electron, 340–342
and electron bonds, 345–348
and mesomerism, 348, 350–351
and the periodic table, 343–344
and physics, 363–365
reductionist, 352, 364–365
structural formulas, 340(figure)
- Chemistry, quantum, 363–365
and chemical valence, 367–369, 376–379
and Coulomb's law, 371
development of, 373–376, 394
and development of the theory of spin, 429–436
and electrons, 367–369
and group theory, 376–379
and molecular orbitals, 386–390
and the Pauli exclusion principle, 372–373
and the periodic table, 376
and physics, 365–367, 379–381
and polyelectronic molecules, 376–379
and quantum mechanics, 368–369, 369–371
and relativity, 439–446
and scientific realism, 366
- Clark, G. L., 379
Claude, Albert, 472–478
Clausius, Rudolf, 202
Cohn, Emil, 212
Comparative methodology, 495–496
Comptes Rendus, 138, 144, 157
Compton cross-section, 319
Compton, Karl T., 234
and development of the theory of spin, 428
- Conduction of Electricity through Gases*, 23–24, 34, 37, 61, 63, 147

- Confinement of nuclei, 309
Corpuscles, 3–6, 22, 37
acceptance of early theories on, 101–102
and discovery of the electron, 404
versus electrons, 83, 85, 86, 115–118,
145, 159–160
J. J. Thomson's work on, 57–59, 77, 89
John Ambrose Fleming on, 116–118
and Paul Villard, 140–141
and the proutean theory, 203–210
and wireless telegraphy, 118–119
Corpuscular Theory of Matter, The, 58, 62, 123
Cosmic rays, 314–317
Coulomb's law, 343–344, 371
Coulson, Charles, 353, 384
Crookes, William, 27, 28–29, 103, 105
and discovery of the electron, 403–404
and electrical discharge of gases, 117
and proutean hypothesis, 197–198
Cross-section formulae, 319–320
Crystal sets, 329–330
Crystal structure, 484–491
- D'Albe, Edmund E. F., 105, 120–121
Dampier-Whetham, William C. D., 125
Darwin, Charles G., 267, 272
Davisson, Clinton, 329
Davydov, Boris, 330–331
Davy, Humphry, 196
de Broglie, Louis, 329, 374
Debye, Peter, 266
de Forest, Lee, 328
Dickinson, Roscoe, 374
Dictionary of Scientific Biographies, 373
Different contributions view, 411
Dirac, Paul, 195, 216, 352, 365, 454, 456
and development of the theory of spin,
437, 439
and relativity, 439–442
and structure of the electron, 457–459
Discovery. *See also* Electrons, discovery of
contrasting views of, 408–414
definitions of, 405–408
different contributions view of, 411
important classification view of, 409–410
manipulation-and-measurement view
of, 409
social constructivist view of, 410–411
strong, 418–420
true belief view of, 411–412
Drude, Paul, 115, 255, 257–260, 268–269
and blackbody radiation, 270
Duddell, W. Dubois, 119
Duhem, Pierre, 467
Dumas, Jean-Baptiste, 196
Dynamical Theory of The Electric and Lu-
miniferous Medium, A, 201
- Ebert, H., 81
Ecole Normale Supérieure, 144
Ehrenfeld, Richard, 211
Ehrenfest, Paul, 258, 271, 272, 432
Ehrenfest, Tatiana, 258, 272
Einstein, Albert, 211–212, 243
and degenerate gas, 278
and electron gas theory of metals, 269
and quantum theory, 277
and radiation law, 271
Electrical discharges. *See also* Electricity
in gases, 51–52
in ionization, 47–49
J. J. Thomson's work on, 62
of matter in general, 58
positive, 62
research on, 27–28
Electrical engineering, 119–121
Electrical Review, The, 111
Electrician, The, 36, 90
and acceptance of corpuscles, 115–117
commentaries on J. J. Thomson's work,
110–111
and discovery of electricity, 105–109
Electricity. *See also* Electrical discharges
and discovery of the electron, 415
early research on, 103–105
and electromagnetic theory, 207–208
and electrons, 211–214
and invention of the transistor, 332–336
John Ambrose Fleming on, 123–124
and Joseph Larmor, 181–182
and Owen Richardson, 229–236
and positive electrons, 206–209
and the vortex atomic theory, 206
Electricity and Matter, 62, 206

- Electromers, 343
Electronic Interpretations of Organic Chemistry, 341
Electronic Theory of Valency, The, 345, 368–369
Electrons, 78, 121
Electrons. *See also* Nuclear electrons; Particles
acceptance of early theories on, 86–91, 102–103, 115–118, 120–124, 216, 453–461
appropriation by chemists, 363–365, 367–369
and Arnold Sommerfeld, 215
asymmetry of, 24
audiences for various theories of, 144–145
beams, 307
and benzene, 349–352
and blackbody radiation, 278
bonds, 345–348, 371–372
Bose, 311–312
and cathode rays, 90
charged particles within, 261–262, 315, 319–320
and chemical bonds, 385–386
and chemical valence, 342–345, 352–353
and composition of matter, 239–242
and contrasting views of discovery, 408–414
versus corpuscles, 83, 115–118, 145, 159–160
and Coulomb's law, 343–344, 371
credit for discovery of, 124–126, 187–188, 412, 414–418, 420–422, 451–453
and development of the theory of spin, 427–436
discovery of, 2–9, 21–27, 37–38, 64–66, 110–111, 124–126, 187–188, 403–404
displacement, 346–347
early motivations for research on, 6–9, 86–91
early research on, 9–12, 82–85, 112–115, 195–196
and electricity, 211, 229–236
and electromagnetic theory, 207–208, 215–216, 256–260
and electron gas theory of metals, 280–281
and electron microscopy, 471–478
free, in gases, 51–52, 241, 266–267, 269, 273
free nuclear, 313–314
and group theory, 376–379
Hamiltonian of, 456–457
and Heisenberg's n-p nuclear model, 310–312
J. J. Thomson's work on, 3–6, 24–27, 77, 110–111, 403–404, 414–418, 451 and Joseph Larmor, 181–188
and Langrangian density, 459–460
and light, 176–177
and mechanical resonance, 350–352
mass/charge (*m/e*) values, 106–107, 110–112, 145–146, 179–180, 185, 213
in metals, 260–263, 266–267
and molecular orbitals, 386–390
negative, 313
nuclear, 307–320
and the nucleus, 319–320
Oliver Lodge's work on, 78–80
operational reality of, 327–329
Owen Richardson on, 238
Paul Villard's work on, 155
as philosophical objects, 12–15
and polyelectronic molecules, 376–379
positive, 206–208, 260
and the proutean theory, 201, 203–210
and quantum chemistry, 363–365
and quantum mechanics, 350–352
and relativity, 439–446
and Schrodinger equation, 457
and spin, 427–446, 457–458
stable properties of, 453–455
structure of, 183–184, 455–461
and the theory of resonance, 381–386
thermal emissions of, 229–236
and Tolman-Stewart experiment, 266–267
unshared, 387
usefulness of, 327
vapor theory, 263–265

- velocity of ions in, 271–272
and the vortex atomic theory, 198–200
Electron, The, 124
Electron Theory of Matter, The, 236–249
Electron Theory, The, 120
Elements of Chemical Philosophy, 196
Emerson, Benjamin, 210
Emission of Electricity from Hot Bodies, The, 236
Encyclopaedia Britannica, 123
Endoplasmic reticulum (ER), 472–478
Equipartition theorem, 268–270
Ether, 1–2, 211, 213, 237–238
Ewing, J. Alfred, 108
Experiments
 and cathode ray oscilloscope, 119–120
 and comparative methodology, 495–496
 on existence of electrons, 112–115
 and extended working hypotheses, 55–60
 on ionic charge, 47(figure), 47–49
 by J. J. Thomson, 109–112, 142–143
 and metaphysics, 425–427
 not supported by theory, 24–25
 and observable versus unobservable entities, 173
 by Owen Richardson, 229–233
 by Paul Villard, 143–144, 154
 by Pieter Zeeman, 174–176
 and realism versus unrealism, 171–172, 425–427
 and scientific discovery, 171–173
 and use of instruments, 467–497
- Fairbank, W. M., 373
Faraday's laws of electrolysis, 79
Faraday tube, 30–32, 62, 84–85, 342
Fermi, Enrico, 278, 307–308, 318, 454
FitzGerald, George, 86, 181–183
 on corpuscles, 110–111, 116
 on electrons, 116
Fleming, John Ambrose, 102, 104, 328
 on corpuscles, 114–115, 116–118
 on electricity, 123–124
 and wireless telegraphy, 114, 118–119
 work on cathode rays, 105–106
Fowler, Ralph Howard, 278
Frankland, Edward, 339, 353
Free radicals, 349
Frenkel, Yakov, 216
Fry, Harry S., 343, 380
Gans, Richard, 263
Gases
 and blackbody radiation, 270–273
 degenerate, 277–278
 electric discharge through, 27–28, 31–32, 51, 81, 107–109, 260
 electrification of, 23–24, 31–32, 261–263
 and electron gas theory of metals, 280–281
 and electron vapor theory, 263–265
 and equipartition theorem, 268–270
 and free electrons, 273–274
 ionization and electrical conduction in, 21, 33(figure), 45–47, 55–60, 88–89, 147, 229–236, 256–260
 and *m/e* value, 36–45
 and osmotic pressure, 258
 specific heats of, 349
 structure of, 106, 152
 thermal emissions of electrons in, 229–236
 and vacuum tubes, 328–329
velocity of ions in, 46, 51
Geissler, Heinrich, 27
 and the different contributions view of discovery, 411
General Chemistry, 341
Germer, Lester, 329
Glazebrook, R. T., 121, 125
Goldstein, Eugen, 27
Goldstein rays, 138–139
Goudsmit, Samuel, 427–436, 454
Graham, Thomas, 201
Grassmann, Robert, 203
Group theory, 376–379
Guthrie, Frederick, 118
Haga, Hermann, 263
Hall, Edwin Herbert, 256, 273
Hall effect, 256, 260–261, 273–277
Hamiltonian, 456–457

- Hanson, Jean, 478–483
Harkins, William, 214
Heaviside, Oliver, 108, 255
Heilbron, J. L., 247
Heisenberg, Werner, 279–280, 307–308
and cosmic rays, 314–317
and development of the theory of spin, 429, 432–436
and free electrons, 312–314
n-p nuclear model of, 310–312
Heitler, Walter, 319–320, 349, 370–372
and Fritz London, 390–395
and group theory, 376–379
and the Heitler-London paper, 373–376, 380–381, 387–389
and Robert Mullikan, 387–389
Hertz, Heinrich, 29, 80–82, 255
Hertz, Paul, 263
Herzberg, Karl, 370
History of Science in its Relations with Philosophy and Religion, 125
Hittorf, J. W., 27
and the different contributions view of discovery, 411
Holes, 327
early research on, 329–332
and postmodern technologies, 336
Holman, Silas, 199–200
Houston, William, 279
Houtermans, Fritz, 310
Hückel, Erich, 351
Hughes, Edward D., 348
Hund, Friedrich, 351, 386, 389
Hunt, Sterry, 206
Huxley, Hugh, 478–483
Hydrogen, 213, 370, 371–372
and chemical valence, 376–377
and group theory, 376–379
and Humphry Davy, 196
and the Pauli exclusion principle, 372–373
and Paul Villard, 140–141, 148, 155
and Pieter Zeeman, 180

Important classification view of discovery, 409–410
Incandescent filament electrical dis-
charges, 52–55, 118, 265. *See also Light*
Ingold, Christopher, 341, 345, 347–348, 349–352
and the Ingold notation, 348(figure)
Ingold, Hilda Usherwood, 345, 347, 349
Instruments, scientific
and circularity problem, 469–470
and endoplasmic reticulum (ER) study, 472–478
justification for use of, 470
and muscle physiology, 478–483
positivistic view of, 467, 468–469
and realism versus unrealism, 468
and solid-state physics, 483–491
theory-dependent view of, 467–468
Introduction to Quantum Mechanics with Applications to Chemistry, 341
Ions
and electrons, 177–180
and H. A. Lorentz, 176–180
Ions, Electrons, Corpuscles, 153
Isomers, 343
Iwanenko, Dmitri, 313

Jaumann, G., 105
Jeans, James, 266
and positive electrons, 206–207
Jessup, A. C., 206
Jessup, A. E., 206
Jewett, Frank, 328
Jones, Harry, 331
Jordan, P., 458
Journal de Physique, 150, 154, 157

Kaufmann, Walter, 22, 44, 77, 78, 187, 203, 259–260
and acceptance of the electron, 86–91
and the proutean theory, 208, 209–210
research on electron activity, 80–82
Keesom, Willem Hendrik, 264, 277
Kelly, Mervin J., 331, 332
Kelvin, Lord, 28–29
and the true belief view of discovery, 411–412
and the vortex atomic theory, 198–200
Kermack, W. O., 346

- Kerr effect, 174
Kirrmann, Albert, 346
Kleeman, R. D., 244
Klein-Nishina formula (K-N), 314–315
Koenigsberger, Johann, 276
Kronig, R., 432
Kruger, Friedrich, 263
Kuhn, Thomas, 467
- Langevin, Paul, 146–147, 153–154
Langmuir, Irving, 234, 343
Langrangian density, 459–460
Lapworth, Arthur, 346–347
Larmor, Joseph, 38, 77, 86–91, 201, 408
on corpuscles, 204
on electrons, 83–84, 181–188, 255
ether theory of, 110–111, 115
and Pieter Zeeman, 181–187
Le Bon, Gustave, 145
Le Journal de Physique et Le Radium, 154
Lenard, Phillip, 29, 45, 88, 415
and cathode rays, 201
and discovery of the electron, 404, 418
and ionic charge, 107
Lennard-Jones, John E., 341, 393–394
Le Radium, 154
Lewis, Gilbert N., 344–345, 368
Light, 176–177, 244. *See also* Incandescent filament electrical discharges
and solid-state physics, 487–488
Linstead, R. P., 352–353
Lockyer, Norman, 113–114, 196, 204
Lodge, Oliver, 1–2, 78–80, 102, 113
and discovery of the electron, 106–107,
121
and Pieter Zeeman, 179–180
and positive electrons, 206–207
London, Fritz, 349, 351, 369–373
and group theory, 376–379
and the Heitler-London paper, 373–376,
380–381, 387–389
and Robert Mullikan, 387–389
and Walter Heitler, 390–395
Lorentz, H. A., 77, 81–82, 408
and acceptance of the electron, 86–87
and development of the theory of spin,
445
- and electromagnetic theory, 238–239
and electron gas theory of metals,
260–263, 274
on electrons, 83, 255
and electron velocity, 271–272
and free electrons, 270
on ionic charge, 106
and Pieter Zeeman, 177
and *Theory of Electrons*, 237
theory of ions, 176–180
and Tolman-Stewart experiment, 267
Losanitsch, Sima, 210
Lowry, Thomas, 345–346
Lucas, Howard, 341
- Magnetic spectrum, 42, 332–334
and electromagnetic theory, 207–208,
210–211
experiments by Pieter Zeeman, 174–176
and free electrons, 273–274
and Joseph Larmor, 181–182, 183–185
and oscillation of the ion, 178–179
Manipulation-and-measurement view, 409
Marconi, Guilelmo, 114, 117, 118–119
Marignac, Jean, 196
Massachusetts Institute of Technology
(MIT), 332, 478
Matter, composition of, 196–198
and corpuscles, 203–210
and electromagnetic theory, 210–211,
237–239, 315
and molecules, 201–202
and positive electrons, 206–208
Maurer, Robert J., 276
Maxwell equations, 238
Maxwell, James Clerk, 104, 105, 181
on gases, 265–266
McClelland, J. A., 35, 51, 229
McLaren, Samuel Bruce, 270
Meitner-Hupfeld anomaly, 318
m/e (mass/charge) values
and discovery of the electron, 416–417
in incandescent filaments, 52–55
J. J. Thomson's work on, 36–45, 60–61,
109–112, 145–146
and Pieter Zeeman, 179–180, 185
research on, 44–45, 213

- Mendeleev, Dmitri, 196
Menter, James, 484–491, 493
Mesomerism, 348, 350–351
Metallernes Elektrontheori, 237
Metals
and blackbody radiation, 270–273, 278
charged particles within, 261–262
conduction in, 278–279
electric behavior of, 258–259
and electron gas theory of metals, 265–266, 274, 280–281
and equipartition theorem, 268–270
and free electrons, 266–267
and Tolman–Stewart experiment, 266–267
Metaphysics, 425–427
Meyer, Victor, 197
Microscopes, transmission electron, 471
and endoplasmic reticulum (ER) study, 472–478
and muscle physiology, 478–483
and solid-state physics, 483–491
Mie, Gustav, 212–214
Millikan, R. A., 60–61, 124, 328
and discovery of the electron, 453–454
Molecular orbitals, 386–390
Mott, Nevill, 330, 331
Mulliken, Robert, 351, 370
early work, 386–387
and the Heitler–London paper, 387–389
and molecular orbitals, 386–390
Muscle physiology, 478–483
Nature, 36, 113, 236, 237, 390
Nature of the Chemical Bond, The, 381, 383
Nernst, Walther, 267, 278
Neutrons, 310, 312. *See also* Nuclear electrons
Nichols, Ernest Fox, 267
Nobel Prize, 121, 263
Clinton Davisson and, 329
J. J. Thomson and, 24, 62
Philip Lenard and, 88
Notes on Recent Researches in Electricity and Magnetism, 27–28
Nuclear electrons. *See also* Electrons; Neutrons
early research on, 308–310
free, 316
Nuclei, 307
confinement, 309
and electrons, 319–320
energy non-conservation, 309
magnetic moments of, 309
spin and statistics of, 309, 311–312
structure of, 317
Observable versus unobservable entities, 173, 406–407
Occhialini, G. P. S., 317
Ohl, Russell, 330
Onnes, Kamerlingh, 174, 268–270, 277
On the Charge of Electricity carried by the Ions produced by Rontgen Rays, 21
On the Masses of the Ions in Gases at Low Pressures, 21
Orbitals, molecular. *See* Molecular orbitals
Organic Chemistry, 341
Organic chemistry. *See* Chemistry, organic
Osmotic pressure, 258
Pais, Abraham, 216
Palade, George, 472–478
Parson, Alfred, 215
Particles. *See also* Atoms; Electrons
and cathode rays, 413
and discovery of the electron, 416–417
electrons as, 328–329
positively charged, 330
Pauli exclusion principle, 372–373, 376, 454. *See also* Pauli, Wolfgang
Pauling, Linus, 341, 350, 351, 368
and group theory, 376–379
and the Heitler–London paper, 392–393
on quantum chemistry, 374–376
and the theory of resonance, 381–386
Pauli, Wolfgang, 216, 278–279, 307–308, 317, 330. *See also* Pauli exclusion principle
and development of the theory of spin, 427–432, 436–438
Pearson, Gerald, 333
Peierls, Rudolf, 279, 327, 330
Pellat, H., 152–154

- Periodic table, 342, 376
and Niels Bohr, 343–344
- Perrin, Jean, 35, 36, 148–148, 263
- Perrot, Adolphe, 33–34
- Perspectives in Organic Chemistry*, 383
- Pessimistic metainduction, 452, 461
- Pfander, Alexander, 369
- Philosophical Magazinen*, 42, 144, 186
- Philosophical Transactions*, 181
- Photoelectric effect, 234–235, 244, 314–317
- Physics, 363–365
and biology, 493–495
and chemistry, 365–367, 379–381
and development of the theory of spin, 426–427
solid-state, 483–491
- Physiology, muscle, 478–483
- Planck, Max, 211–212, 234, 242–243, 259
and radiation law, 272
- Plucker, Julius, 27
- Plum-pudding model, 22–23, 26, 62
- Poincaré, Henri, 263
- Popper, Karl, 467
- Porter, Keith, 472–478
- Poynting, John Henry, 107
- Practical Electrical Engineering*, 124–125
- Preece, William, 122
- Prevost, Charles, 346
- Protons, 195, 307, 310–314
- Protyle, 195–196
- Proutean theory, 197–203
- Prout, William, 196–197
- Quantum chemistry. *See* Chemistry, quantum
- Quantum mechanics, 329, 330, 341, 353
and benzene, 349–352
development of, 368–369, 451
and development of the theory of spin, 434
early research on, 369–371
and molecular orbitals, 386–390
and reductionism, 365
and the theory of resonance, 381–386
- Quantum theory, 242–245
and development of the theory of spin, 439–442
of solids, 331
- Quantum Theory of Radiation, The*, 319–320
- Radiation, 244–245
electromagnetic, 315
- Radioactivity, 62
- Ramsay, William, 210
- Rayleigh-Jeans law, 270, 271
- Rayleigh, Lord, 30, 112
- Rays of Positive Electricity*, 62
- Realism versus unrealism, 171–172, 425–427
- and use of instruments, 468
- Recent Researches*, 30–31, 33(figure), 34
- Reductionism
and chemistry, 364–367
and physics, 142
- Reinganum, Max, 268–269
- Relativity, 439–446
and Paul Dirac, 439–442
- Remick, Edward, 341
- Resonance, mechanical, 350–352, 381–386
- Rice, Francis, 352
- Richardson, Owen, 208
and Bohr's theory, 245, 247–248, 273
and composition of matter, 239–242
early work, 227–228
and *The Electron Theory of Matter*, 236–249
and electron vapor theory, 263–264
and J. J. Thomson, 241–242
and quantum theory, 242–245
research on electricity, 229–236
research on radiation, 228–229
and Richardson's law, 229
and the structure of the atom, 245–247
- Richarz, F., 81
- Riecke, Eduard, 256–257, 276
- Riemann, Bernhard, 203
- Roberts, John D., 341
- Robinson, Robert, 346–347
- Rodebush, Worth, 379–380
- Rontgen rays, 45, 200. *See also* X-rays
- Rontgen, Wilhelm, 34–35
- Rowland, Henry, 274
- Rucker, Arthur, 113

- Rutherford, Ernest, 35, 46, 51, 54, 62
on corpuscles, 146
and hydrogen nucleus, 307
and nuclear atoms, 308–309
- Rydberg, Janne, 210
- Schmitt, Francis, 478–483
- Schottky, Walter, 330, 333
- Schrödinger equation, 457
- Schrödinger, Erwin, 278, 370–371, 380
- Schuster, Arthur, 103, 113, 202, 260
and composition of matter, 197
and discovery of the electron, 404
- Science: The Endless Frontier*, 332
- Scientific discovery method, 171–173
- Semiconductors, 276, 329, 330, 333
- Sidgwick, Nevil, 341, 344–345, 368–369
- Silicon, 330
- Slater, John, 331
- Social constructivist view of discovery, 410–411
- Sodium, 174–176, 232
- Sommerfeld, Arnold, 215, 237, 279, 330, 331, 374
- Spin and statistics of nuclei, 309, 311–312, 373, 454, 457–458
development of the theory of, 426–427
and relativity, 433–434, 439–446
- Stas, Jean-Servais, 196
- Stewart, Balfour, 198
- Stewart, Thomas Dale, 267
- Stoney, G. Johnstone, 37, 79, 81
and electrons, 180–181
and structure of gases, 106
- Strache, H., 211
- Structure and Mechanism in Organic Chemistry*, 348
- Structure of Matter, The*, 352
- Strutt, R. J., 42
- Stuhlmann, O., 244
- Sutcliffe, Brian, 339
- Sutherland, William, 51, 204
- Swinton, Campbell, 110, 145
- Tait, Peter G., 198
- Telephones, 328–329
- Teller, Edward, 352
- Temperature and energy, 256–257
- Tetrode, Hermann, 277
- Theoretical history, 426
- Theory of Electrons*, 89, 237
- Theory of Organic Chemistry, The*, 341
- Theory of Resonance, The*, 341, 382
- Thermal emission of electrons, 229–236
- Thompson, Silvanus Phillips, 102, 110
on corpuscles, 121–124
and J. J. Thomson, 121–124
- Thomsen, Julius, 197
- Thomson cross-section, 319
- Thomson, Elihu, 102, 111, 112
- Thomson, G. P., 404
- Thomson, J. J., 3–6
and acceptance of corpuscles, 101–102, 115–118, 121–124
and atoms, 36–37, 204–206
and cathode rays, 21–22, 30–32, 36–45, 65, 77, 80, 112–115, 419, 453
and corpuscles, 22, 37, 57–59, 77, 101–102, 141, 145–146
and discovery of the electron, 21–27, 64–66, 84, 89–92, 403–404, 414–418
and electrical discharge of gases, 107–109
on electrification of gases, 31, 33(figure)
and electromagnetic theory, 207–208
and electron vapor theory, 263
experiments on cathode rays, 30–32, 40(figure), 40–45, 109–115
extended working hypotheses of, 55–60
on Faraday tubes, 30–32
on free electrons, 269
and H. Pellat, 152–154
and the important classification view of discovery, 409–410
and incandescent filaments, 52–55
on ionic charge, 45–50, 56–57
later years, 124
and the manipulation-and-measurement view of discovery, 409
and *m/e* value, 27–28, 36–45, 40(figure), 60–61, 145–146
and Nobel Prize, 24, 62, 121
and Owen Richardson, 241–242
and Paul Villard, 139–145, 148–152, 156–160

- and Pieter Zeeman, 179–180
plum-pudding model of the atom by,
22–23, 26, 62, 342
and positive electrons, 206–208
and the proutean theory, 203–204
and reductionist physics, 142
research style, 25–26, 109–115
response to research by, 109–112, 145
significance of early work by, 23, 26–27,
420–422
and Silvanus Phillips Thompson,
121–124
and the social constructivist view of dis-
covery, 410–411
and structure of atoms, 245
and the true belief view of discovery,
412
and use of instruments, 470
and the vortex atomic theory, 198–200
on x-rays, 35–576
Thomson, William. *See* Kelvin, Lord
Thorpe, Jocelyn, 345, 352
Tolman, Richard Chase, 267
Tolman-Stewart experiment, 266–267
Townsend, John, 35, 54, 112
on ionization and electrical conduction
in gases, 147
Transistor, 327
invention of the, 332–336
Treatise on Electricity and Magnetism, 104,
105
True belief view of discovery, 411–412
Turner, Edward, 196
- Uhlenbeck, G., 427–436, 454
Unseen Universe, The, 198, 212
Usherwood, Edith Hilda. *See* Ingold,
Hilda Usherwood
- Vacuum tube amplifier, 327, 329–330
*Valence and the Structure of Atoms and Mole-
cules*, 345
Valence, chemical, 342–345, 352–353,
367–369, 391–392
and polyelectronic molecules, 376–379
and the theory of resonance, 381–386
van der Waals forces, 370, 373
van't Hoff, Henricus, 258
van Vleck, John, 373–374, 375–376,
394–395
Vapor theory, electron, 263–265
Varley, W. Mansergh, 119–120
Velocity of ions, 46, 51
Villard, Paul
and atoms, 137–138
on cathode rays, 138–139, 140–145
on corpuscles, 154–155
early work, 135–138
on Goldstein rays, 138–139
and H. Pellat, 152–154
and J. J. Thomson, 139–145, 148–152,
156–160
response to research by, 148, 152–156
Vine, Benjamin H., 276
von Laue, Max, 374
von Neumann, Carl, 203
Vortex atomic theory, 198–200
- Weber's electromagnetic theory, 80, 255
Weber, Wilhelm, 202
Weyl, Hermann, 213
Wheaton, Bruce R., 243–244
Wheland, George, 341, 382–386
Wiechert, Emil, 21–22, 44, 77, 203
and acceptance of the electron, 86–87
and discovery of the electron, 418
and the important classification view of
discovery, 409–410
Wiedemann-Franz law, 271
Wien, Wilhelm, 45, 152, 270
and electron velocity, 271
Wigner, Eugene, 331, 374, 452, 458
and development of the theory of spin,
444
and group theory, 376–379
Wilde award, 153, 154
Wilson, C. T. R., 35, 46, 54, 112
Wilson, E. Bright, Jr., 214, 341
on quantum chemistry, 374
Wilson, Harold, 51, 60, 233–234
and electron vapor theory, 263–264
and positive electrons, 208
Wireless telegraphy, 114, 118–119
Wooldridge, Dean, 331

- X-rays, 35, 45–46
and cathode rays, 105–106
Elihu Thomson's work on, 112
and the proutean theory, 200
and solid-state physics, 486–488
- Y-rays, 314–317, 318
- Zeeman effect, 7–8, 202, 455. *See also*
 Zeeman, Pieter
and development of the theory of spin,
 429–430
- Zeeman, Pieter, 37, 38, 82, 103. *See also*
 Zeeman effect
early work, 174
on electrons, 83
experiments on magnetism, 174–176
and H. A. Lorentz, 176–180
and J. J. Thomson, 179–180
and Joseph Larmor, 181–187
and the Kerr effect, 174
and *m/e* value, 179–180, 185
and structure of gases, 106
- Zeleny, John, 51
- Zermelo, Ernst, 258
- Zollner, Friedrich, 203