
Index

- Aberdeen Proving Ground, 25, 26, 32, 45, 69, 131, 280. *See also* Army Ballistic Research Laboratory
- Access mechanism. *See* Magnetic-disk storage, access mechanism and actuator
- Accounting machine. *See* Tabulator
- Accumulator register, 4, 17–18, 23, 27, 117, 154–156, 590–597
- ACE (Automatic Computing Engine), 92, 318–319, 652n20
- Address
defined, 78
relative form, 326–327
symbolic form, 328, 331, 351–352, 353
- ADF (Advanced Disk File), 304, 306, 307–309, 474–475, 477
- Advanced RAM (ADF progenitor), 301–302
- Ahlin, Jack T., 357, 358
- Aiken, Howard H., 25–26, 29–32, 47, 48, 524
- Airborne Computer Laboratory, 300
- Albers-Schönberg, E., 242
- Allen, Charles W., 678n100
- Amdahl, Gene M.
EDPM designer, 178–179, 420, 423, 670n65
- IBM LARC proposal, 425–426
- joins IBM, 179
- open addressing method, 649n61
- resigns from IBM, 431, 670n43
- returns to IBM, 581
- Stretch planning, 431
- American Airlines, 516–522, 557–558
- American Bankers Association, 498–501
- American Society of Mechanical Engineers, 647n35
- Analog-to-digital conversion, 274
- Analog vs. digital devices, 25, 240
- Anderson, Arthur G., 533–535, 553, 554–555
- Andrews, M. Clayton, 261–262, 549, 686n79
- ANelex company, 490
- Applied Programming department, 347, 357–358
- Applied Science department formation, 85
- Magnetic Drum Calculator, 95, 96–97, 100
- mathematical planning groups, 100, 143–144, 165–166, 170
- programs for Defense Calculator, 326–327, 332
- Scientific Computing Service, 338–339, 340, 350
- Technical Newsletters, 85–86, 618n42
- TPM, 122–123
- Army Ballistic Research Laboratory, 45–46, 58, 59, 280, 626n19. *See also* Aberdeen Proving Ground
- Army Ordnance Department, 626n18, 626n19, 651n3, 652n4, 653n24
- Arthur D. Little, Inc., 569
- Artificial intelligence, 558–559
- ASCC (IBM Automatic Sequence Controlled Calculator), 27–33, 45–47, 316–317, 319–320
- ASDD (Advanced Systems Development Division), 306, 553–554
- Assembly programs. *See also* Autocoder; SOAP; SPS
for 650 computer, 351–352, 353

- Assembly programs (cont.)
 for 701 computer (Defense Calculator), 325-332, 347-348
 for 702 computer, 344, 345
 for 704 computer, 352, 354
 for 705 computer, 346, 347, 355-356
 for 709 computer, 359-360, 361
 for 1401 computer, 366
 for 1620 computer, 366
 for 7090 computer, 367
 component of FORTRAN compiler, 356
 purpose, 325-326, 652n20
- Association for Computing Machinery, 340
- Astrahan, Morton M., 142, 159, 678n96
- Astronomical Computing Bureau, 24
- Atomic Energy Commission (AEC), 311, 422, 430, 432, 445, 450
- Atrubin, Allan J., 678n100
- AT&T (American Telephone and Telegraph Corporation), 6, 513-514.
See also Bell Telephone Laboratories
- Auto-abstracting, 556-557
- Autocoder, 345, 346-347, 355-356, 362, 366
- Automatic group control, 8-9, 11
- Automation research, 547-548
- Automatic Sequence Controlled Calculator. *See* ASCC
- B47 bombing and navigation system, 130, 625n1
- B52 bombing and navigation system, 625n1
- Babbage, Charles, 2-3, 21, 30, 316
- Backus, John W.
 FORTRAN, 339-342, 356, 358, 361, 530
 joins IBM, 335
 NORC performance study, 419
 Speedcoding, 336
 SSEC programmer, 335-336, 530, 614n54
- Bald Peak programming conference, 368-370
- Bank of America, 254, 499
- Bank check mechanization, 498-500
- Bardeen, John, 372-373
- Barrier-grid tube, 251
- Bauer, Edward W., 641n61, 642n87, 669n36
- Beattie, H. S.
- 407 accounting machine, 481-482
- circuit standardization, 406
- joins IBM, 481
- to Poughkeepsie laboratory, 59
- Poughkeepsie laboratory manager, 423, 463, 543
- Selectric typewriter, 482, 521
- small accounting machine, 381
- stick printer, 296, 467, 482-483
- Beckman, Frank S., 350, 352, 358, 360-361, 614n54
- Beeby, Patrick A., 681n138
- Bell Telephone Laboratories
 ferroelectric research, 538, 539
 relay calculators, 593, 620n64, 626n8
 semiconductor patents, 415
 transistors, 372-375, 380, 382, 393, 417, 426, 428
 wire wrap, 408
- Bendix Aviation Corporation, 490, 508
- Bergfors, Carl A., 612n25, 649n70, 662n12
- Berkeley, Edmund C., 190, 621n1, 621n3, 634n15
- "Betsy" calculator of Northrop Aircraft, Inc., 70, 84
- BINAC (Binary Automatic Computer), 59, 115, 615n61, 627n27
- Binary-coded decimal representation, 39, 137
- Binary counter, 36-37
- Binary search, 289
- Biquinary code, 95-96, 620n64
- Birkenstock, James W.
 Defense Calculator planning, 130-131, 133-136, 143-144, 146
- Engineering Research Associates contract, 81
- Forrester patent negotiations, 269-271
- joins IBM, 81
- printer test, 489
- product planning and market analysis head, 174
- Rabinow disk, 646n17
- San Jose involvement, 282
- transistor purchase agreement, 402
- Bistable circuit. *See* Flip-flop circuit
- Blaauw, Gerrit A., 433, 443, 449, 578, 582, 671n63
- Bland, George F., 625n59
- Blenderman, Louis H., 637n75
- Bloch, Erich, 175, 237-239, 248-250, 255-256, 444, 446, 454, 540-541

- Bloch, Richard M., 195
 BMEWS (Ballistic Missile Early Warning System), 260, 447
 Boehm, Elaine M., 649n61, 671n65
 Bombing and navigation systems, 130, 625n1
 Boolean algebra, 41, 433
 Booth, A. D., 690n153
 Bouricius, Willard G., 336, 347-348, 657n91, 686n79
 Branch instruction, 77, 139, 316-317, 362-363, 451, 627n27
 Branscomb, Charles E., 469, 472-473
 Brattain, Walter H., 372-373
 Brillouin, Leon, 531
 Bristol University, 539
 Brookhaven National Laboratory, 551
 Brooks, Frederick P., Jr., 433, 443, 449, 578, 580, 582, 671n63
 Brown, E. A., 670n36
 Brown, Theodore H., 25
 Brownlow, James M., 262-264
 Bruce, George D., 663n36
 Brunschweiger, A., 637n78
 Brush Development Company, 76
 Bryant Computer Products, 308, 650n91
 Bryce, James Wares
 Aiken contact, 25-26
 chief engineer, 10, 35-36
 invention record, 35-36, 610n3
 joins CTR, 8
 magnetic recording investigations, 189
 Patent Development department, 35, 373, 377-378
 product contributions, 11, 13, 14, 23, 27, 30, 31
 relations with laboratory, 35-36, 610n3
 Buchholz, Werner
 Datatron studies, 420, 423-424, 426
 Defense Calculator planning, 142, 158
 joins IBM, 109
 Stretch project, 434, 440, 443, 449, 456, 457
 Test Assembly planning, 112
 TPM planning, 117, 132
 TPM program, 328
 TPMII (IBM 702) planning, 127-128, 173, 174-175, 184
 Buck, Dudley A., 538, 568
 Buffer storage, 90, 175, 177-178, 181, 185, 236-239, 248-250, 296
 Bull Gamma 3 computer, 461, 465
 Burks, Arthur W., 319, 627n26
 Burroughs Corporation, 475, 483, 490, 497, 499, 583, 651n103
 Bury, Roger M., 626n6
 Buslik, Walter S., 203-204, 207
 Byte, 435
 CADET computer. *See* IBM 1620 computer
 Calculation control switch, 23-24
 Calculator vs. computer, 52, 611n11, 613n40
 Calling sequence, 321-322, 323, 324, 652n17
 Cambridge University, 59, 321, 338
 Capacitor storage, 167-168
 Cape Cod System, 246
 Carlson, Bengt G., 446, 454
 Carroll, Fred M., 8, 10, 16
 Carrying in arithmetic operations, 37-41, 42, 43, 154
 Cathode-ray-tube memories. *See* CRT memories
 Census Bureau, 5, 174, 574-575, 615n61, 627n27
 CERN (European Organization for Nuclear Research), 535
 Chaining method of search, 298. *See also* Record addressing
 Channel. *See* Input-output channel
 Character recognition, 495-505, 558
 Checking. *See* Error detection and correction
 Chien, G. K., 680n123
 Christiansen, Carl L., 225, 637n75
 Chu, Chuan, 271-272
 CIA (Central Intelligence Agency), 310
 Circuit packaging. *See* SMS; Vacuum tube circuits
 Clark, H. Kenneth, 614n50
 Class selection, 13
 Cline, Richard L., 363
 COBOL language, 364-365. *See also* Compilers, for COBOL
 Cocke, John, 433, 442-443, 445, 449, 581
 Codd, Edgar F., 335, 370-371, 614n54, 671n63
 Codes, 76, 82, 86, 95-96, 112, 114, 170, 173, 593, 620n64
 Coincident-current selection, 234-235, 248-249. *See also* Ferrite-core memories; Magnetic-core memories
 Collator, 20, 174, 632n119

- Collector in transistors, 374
 Columbia Machine (IBM Difference Tabulator), 22-23
 Columbia University, 2, 22, 24, 27, 523-524, 530, 607n2. *See also* Watson Laboratory
 Commercial Translator language, 363-365. *See also* Compilers, for Commercial Translator
 COMPACT project, 415
 Compilers
 for COBOL, 365-366, 367
 for Commercial Translator, 365-366, 367
 concept, 340-341
 for FLOW-MATIC, 364
 for FORTRAN, 342, 356-357, 358, 361, 366-367, 658n116
 PACT, 349
 UNIVAC A-series, 340, 656n72
 for Whirlwind algebraic language, 341, 656n79
 Complementation, 12, 41, 44, 139-140, 590-593
 Components Division, 566-567
 Computer (use of the word), 22, 52, 611n11
 Computer architecture, defined, 31
 Computer Research Corporation, 99
 Computer science, 556, 566, 688n114
 Computer Usage Company, 655n66
 Comrie, Leslie J., 22, 24, 30
 COMTRAN language, 363-364. *See also* Commercial Translator language
 Conduction electrons, 372
 Consent decree, 271, 575, 674n2
 Consolidated Engineering Corporation, 99
 Consolidated Vultee Aircraft Corporation, 74-75, 163
 Constantine, Gregory, Jr., 257-258
 Control Data Corporation, 583
 Control Instruments wire printer, 483-484
 Control panel, 17, 18, 19, 85-86, 89, 315-316, 320, 333-334, 352, 462, 468. *See also* Plugboard
 Control programs, 358-359, 360-361, 367, 370-371, 521
 Coombs, John M., 639n34, 686n79, 688n122
 Counihan, Richard G., 638n13
 Counter, 3, 4, 36-44
 Courant, Richard, 560
 CPC (IBM Card-Programmed Electronic Calculator), 68-72, 84, 333-334, 576
 Crago, Robert P., 114, 174, 194, 199, 244
 Craner, Edward, 662n13
 Crawford, David J., 148, 152, 251-252, 257, 259, 669n36
 Crawford, Perry O., 240, 517-518
 Cray, Seymour R., 685n57
 Credit-card transaction accounting, 495-496, 502
 Critchlow, Arthur J., 277-281, 283, 290, 646n25
 Crowe Cell, 569
 CRT memories
 barrier-grid tube, 251
 in Whirlwind, 243-245
 Williams-tube (*see* Williams-tube memories)
 Cryotron computer project, 568-570
 CTR (Computing-Tabulating-Recording Company), 1, 6-10
 Current-switch circuits, 395-398
 Customer Assistance department, 347, 350, 354
 Cypress, 311
 Dahlgren Naval Proving Ground, 47, 183, 673n112
 Daly, George F., 9, 14, 23, 202, 610n3
 Data communications, 513-516, 519-522
 Data Processing Test Assembly. *See* Test Assembly
 Data Synchronizer Input-Output Package, 363
 Data Transceiver, 515-516
 Datamatic Corporation, 219, 490
 Datamatic 1000 computer, 219-221
 Datatron 220 (ElectroData), 475
 Datatron studies (in IBM), 420-421, 423-424, 669n23
 Dayger, Jonas E., 70, 488, 491
 DCA (Digital Computer Association), 348
 DeCarlo, Charles R., 349-350, 352, 357, 449, 451
 Deerhake, William J., 518-519, 557, 625n59
 Defense Calculator, 135-158. *See also* IBM 701 computer
 cost estimate, 96

- early planning, 136-147
 engineering model, 156-158, 160
 first IBM computer to be produced, 97
Havens delay unit, 153-156
 impact on TPM, 123
 influence of IAS computer, 136, 138-140, 156
 influence of TPM, 129
 start of project, 95, 130-136
 subroutine linkage, 323, 324
 testing and demonstration, 157-158
 training program, 157
de Forest, Lee, 65
DeLano, Ralph B., 684n50
Deltamax, 233, 241-242
Demer, Fred M., 489
 Demonstration programs, 333, 344
 Design automation, 411, 547-548
DeWitt, David, 666n81
 Diagnostic programs, 157, 171
Dickinson, A. Halsey, 36, 46, 373-378, 611n8
Dickinson, Wesley E., 678n100
 Differential analyzer, 24-25, 32
 Digital Computer Newsletter, 137, 138
 Digital vs. analog devices, 25, 240
DiMarco, Henry A., 643n110
 Diodes, semiconductor, 118-121, 147-148, 151-153, 374, 375, 379
 Disk. *See* Magnetic-disk storage
Domenico, Robert J., 668n110
Dorrell, Carter E., 663n32
 DO statement, 342, 343
Doty, Charles R., 514-515
 Douglas Aircraft Company, Inc., 163, 332-333, 339, 348
DPD (Data Processing Division), 302, 306, 435, 449, 576-577
 Drift transistors, 390-395, 425, 433, 436, 437, 444, 446, 447
 Drum. *See* Magnetic-drum auxiliary storage; Magnetic-drum memories
DSD (Data Systems Division), 306, 449, 451, 577-578
 Dunham, Bradford, 664n53, 686n78
Dunwell, Stephen W.
 604 calculator planning, 61
 CPC specifications, 70-71
 Datatron and LARC, 420, 423, 426
 Future Demands department, 61, 418
 joins IBM, 28
 joins Poughkeepsie laboratory, 418
 Magnetic Drum Calculator, 78, 80-83, 86, 88, 91, 92-95, 97, 99-100
 magnetic tape studies, 109
 scientific computing bulletins, 85
 Stretch project, 430-441, 443-444, 448-450, 456-458, 547, 669n36
 on tape rewinding, 214
 TPM early planning, 116-117, 130-131
 on TPM requirements, 121-122
 World War II service, 61, 418
Durfee, Benjamin M., 9, 10, 26, 30, 31
 EAM (Electric Accounting Machine), 18, 630n77
Eccles, W. H., 37
Eckert, J. Presper, Jr.
 BINAC, 59, 627n27
 EDVAC, 110-111
 EDVAC subroutines, 318
 ENIAC, 57, 58
 LARC, 430, 436
 magnetic tape for EDVAC, 189
 memory proposal, 271-272
 mercury delay line, 110
 patent on revolver, 166-167, 621n79
 UNIVAC, 59, 627n27
Eckert, Wallace J.
 calculation control switch, 23-24
 on card-instructed sequence
 calculator, 69
 Director of Nautical Almanac, 47
 on government support in electronics, 525-526
 at Harvard 1947 symposium, 78
 joins IBM, 47, 523-525, 527-528
 Magnetic Drum Calculator planning, 73-74
 memory requirements, 231
 NORC plans, 132
 punched card proponent, 22-24
 pure research management committee, 531-533
 on relay calculators, 69
 Scientific Computation Forum, 75, 83-84
 SSEC activities, 47-50, 55
 SSEC programming staff, 341
 on technological dilemma, 525-526
 Watson Laboratory, 527-533, 536
Eckert-Mauchly Computer
 Corporation, 80, 102, 103, 115, 129, 130, 194, 574
EDPM (Electronic Data Processing Machines), 162, 179, 342, 417, 630n77

- EDSAC (Electronic Delay Storage Automatic Calculator), 59, 92, 321–322, 615n61, 627n27
- EDVAC (Electronic Discrete Variable Automatic Computer), 58–59, 77–78, 102–103, 110–111, 189–190, 615n61
- Edwards, Nathan P., 107, 113, 223, 245, 414, 544, 547, 669n36
- Eidenössische Technische Hochschule (ETH), 550–551
- 8000 series proposal, 578, 580–581
- Einstein's theory verified, 536
- ElectroData Corporation, 171–172, 669n23
- Electroluminescent photoconductors (ELPC), 540
- Electron conduction, 36, 372
- Electron tubes. *See* Vacuum tubes; Thyratrons
- Electron tunneling, 560–561
- Electronic multiplier, 44–46. *See also* IBM 603 electronic multiplier
- Electrostatic clutch, 203–204, 489–490, 491
- Electrostatic storage. *See* CRT memories; Selectron storage tube; Williams-tube memories
- Emitter-coupled logic (ECL), 398
- Emitter-follower logic, 390
- Emitter in transistors, 374
- Endicott IBM laboratory
- 1400 series computers, 468–479
 - ASCC project, 26–33
 - centralized in new building, 16
 - character recognition, 496–498, 502, 558
 - early electronics projects, 37–45
 - electrical laboratory, 34–35
 - Magnetic Drum Calculator project, 75–77, 83, 165
 - magnetic-tape project, 102, 191–194
 - management change, 543
 - NORC project, 182
 - postwar hiring, 103
 - printer development, 480–495
 - rivalry with Poughkeepsie laboratory, 93, 100, 464–465, 470
 - SSEC project, 47–54
- Engineering computation. *See* Scientific computing
- ENIAC (Electronic Numerical Integrator and Computer), 27, 39, 45, 57, 58, 162, 316, 614n57
- ERA (Engineering Research Associates, Inc.), 76–77, 81–82, 86, 88, 575, 617n10, 619n44
- ERMA (Bank of America check reader), 499
- ERMETH (Elektronische Rechen Machine of the ETH), 550–551
- Error detection and correction codes for, 225–226, 620n64 effect on machine operation, 128 longitudinal check character on tape, 215
- in NORC, 181, 183, 212 parity check, 121, 217–219 programmed, 54, 142, 216, 325, 335–336, 362–363
- in Stretch, 453
- two-gap tape head, 216–217
- two-level tape sensing, 217
- Esaki, Leo, 270, 560–561
- Eschenfelder, Andrew H., 261–262, 669n36
- Estrems, Eugene, 675n24
- Evans, Bob O., 163, 473, 475–477, 479, 544, 580–582
- Every, Maurice A., 642n89, 642n90
- Ewing, Alton E., 646n25
- Excess-three code, 593
- Extraction algorithm, 558
- FAP (FORTRAN Assembly Program), 361, 367
- Farrington Manufacturing Company, 496, 497, 502
- Federal Systems Division, 306, 310, 450, 625n1
- Fellowship program, 456
- Femmer, Max E., 60, 147, 174, 194, 199, 544, 547, 548, 555, 557, 635n39, 667n90
- Fernekees, James E., 97
- Ferrite-core memories, 231–272. *See also* Magnetic-core memories
- in 700 series computers, 178, 180–181, 185, 250–254
 - in 7090 and Stretch, 257–258, 448, 452
 - array wiring methods, 265–267, 268
 - buffers, 185, 236–239, 248–250, 296
 - candidate for 650 computer, 167
 - coincident-current selection, 233–234, 249
 - commercial use decision, 250–253
 - cooling, 258, 261
 - demand for, 255
 - diode matrix selection, 234, 249
 - electrical noise, 250, 252, 259

- first main memory, 245
inhibit current defined, 249
load-sharing matrix switch, 257-258
megabit memory, 255-256
MIT versus IBM early experiments, 242-243
patents and litigation, 267-272
prices and profitability, 256, 272
reliability, 245, 253, 255
in SAGE, 245-248
staggered read, 250
switch-core matrix selection, 249, 252, 254, 255
two cores per bit, 259-260
time delays in, 255-256
transistor support circuits, 255, 256-258
Watson, Jr., urges use, 251
Ferrite cores. *See also* Magnetic-core memories
composition, 236, 263-264
fabrication and testing, 261-265
Ferroxcube, 262-263
first use at IBM, 286-289
General Ceramics, 242, 252, 261-264
initial materials effort, 242
magnetostrictive ringing, 259-260
patents, 263-264
Philips corporation, 259, 263-264
production quantities, 270
for SAGE, 262-263, 264
size reduction, 239, 245, 259, 260, 261, 265
three-hole cores, 258-259
wiring of, 265-267, 268
Ferroelectric devices, 537-540
Ferroxcube company, 262-263, 264
Field, defined, 6
Field selection in punched-card operations, 13
Fleisher, Harold, 663n32, 682n17
Flip-flop circuit, 36-44, 51, 376, 378
Floating-point arithmetic, built-in
650 computer, 186
704 computer, 179, 419, 431
7030 computer, 453
certain relay calculators, 626n8
computer at University of Wisconsin, 179
LARC proposals, 427, 432
NORC, 132-133, 181-183, 419, 421
Stretch, 431, 432, 435-436, 453
Floating-point arithmetic, programmed for 650 computer, 165, 351
for 701 computer, 143, 335, 336
for 1620 computer, 366
for CPC, 333-334
for EDSAC, 334-335
for Whirlwind, 335, 656n79
Flowcharts in programming, 327-328
FLOW-MATIC language and compiler, 364
Flute memory project, 270
FMS (FORTRAN Monitor System), 361, 367
Ford, Eugene A., 5, 7-8, 10
Ford Motor Company, 254
Forrester, Jay W., 104, 145, 164, 240-243, 245, 250, 262, 269-271, 272, 391
FORTRAN language, 341-342, 343, 357, 358, 367. *See also* Compilers, for FORTRAN
Foss, Ernest D., 633n127, 642n77
Fox, Philip E., 104-107, 111, 147, 161, 250-251, 257, 669n36
Fox Hill study on research, 544-545
Fraser, James H., 624n46
Freitag, Harlow, 686n81
French IBM laboratory, 461, 465-467, 470
Fritz, Elliott L., 399-403
Frizzell, Clarence E., 112, 147, 160-161, 224
Furman, Frank J., 483, 494
Future Demands department
on computers for accounting, 108
Defense Calculator, 135, 143, 144-145
Magnetic Drum Calculator, 78, 80-81, 86, 88, 93, 94-95, 96-98, 99
magnetic tape studies, 109, 193-194
product-development role, 73
punched-card era, 17
reorganized, 282
TPM, 121, 128
Gardner-Denver machines, 411
Garvey, Edward J., 407-411
Garwin, Richard L., 533, 535, 568-569
General Ceramics Corporation, 236, 239, 242, 252, 261-264
General Electric Company, 6, 339, 344, 354, 375, 382, 490, 499, 583
General Motors Research Laboratories, 359
Georgetown University, 565
German IBM laboratory, 461, 465-467, 470

- Germanium, 118-119, 151, 372, 374, 375, 378, 379, 380, 382, 414-415
- Giaever, Ivar, 561
- Gibbon, John H., Jr., 523
- Gibson, John W., 262-265, 549, 566-567
- Gill, Stanley, 322
- Glenco Gulton Corporation, 262, 538
- Glenn L. Martin Company, 352
- Goddard, William A., 282, 283, 301, 646n25
- Goetz, John A., 615n76, 624n41
- Goldfinger, Roy, 364
- Goldstine, Herman H., 58, 319-320, 321, 560, 627n26, 653n27, 689n133
- Gomory, Ralph E., 560
- Gonder, Warren, 646n25
- Goto, E., 568
- GOTRAN language and interpreter, 366
- Gould, G., 690n147
- GPD (General Products Division), 306, 449, 475, 577, 578, 581
- Greanias, Evon C., 497, 498-499, 503-504, 679n101
- Greenstadt, John L., 352, 354
- Griffith, John E., 671n63, 671n65
- Grosch, Herbert R. J., 616n6
- Grounded-emitter circuits, 382
- GUIDE organization, 357, 363, 364-366, 368
- Gunther-Mohr, G. Robert, 683n26, 686n68
- Haanstra, John W., 277, 282-283, 285, 293-295, 301, 303-304, 306-307, 647n48
- Haddad, Jerrier A.
at corporate headquarters, 543
Defense Calculator project, 136-163
passim
division general manager, 435, 519, 553
joins IBM, 60
magnetic-tape engineering project, 194
RAMAC name, 297
Stretch project involvement, 422-426, 669n36
TPM development, 118-122
vacuum tube tester, 66
- Hagopian, Jacob J., 649n68
- Hahn, Erwin L., 533
- Hamburgers, Arthur, 678n100, 679n101
- Hamilton, Francis E.
ASCC project, 26, 30, 31, 47-48
Endicott laboratory manager, 543
at Harvard 1947 symposium, 78
joins CTR, 26
Magnetic Drum Calculator project, 58, 73-74, 75-101 *passim*, 165-172
passim
magnetic-tape project, 102, 189-192
SSEC project, 47-50, 52, 54
- Hamming, Richard W., 225
- Hankam, Eric V., 682n15
- Harding, William E., 400, 404-406
- Harker, John M., 302-304, 306, 478
- Harmon, Alvin L., 365, 366
- Harper, L. Roy, 97
- Harper-Fernekees machine, 97, 169
- Harvard University
1947 symposium, 76, 77-78, 652n20
1949 symposium, 92, 234
Business School, 645n16
Mark I, 26-33, 47, 316-317, 319-320.
See also ASCC
- Mark II and Mark III computers, 103, 626n8
- Harvest project, 225, 259, 260, 437-439, 443, 445, 456
- Haug, Roy L., 647n48
- Havens, Byron L., 132, 153-154, 181, 212, 528-530, 535-536, 544, 567-568
- Havens delay unit, 153-156, 599-601
- Haynes, Munro K., 233-239, 250, 272, 537, 538, 540, 669n36
- Heising, William P., 350-352, 354, 358, 361, 647n41
- Hellerman, Leo, 666n80
- Henle, Robert A., 378-379, 381, 383-386, 396, 414, 436
- Hermes, R. Manning, 649n70
- Herrick, Harlan L., 340-341, 342, 614n54
- Hoagland, Albert S., 305, 306, 307, 554
- Hogan Laboratories, 632n113
- Hole conduction, 372-373
- Hollerith, Herman, 2-7
- Honeywell (Minneapolis-Honeywell Regulator Company), 219, 490, 583
- Hood, James D., 645n10, 646n17
- Hopner, Emil, 637n78
- Hopper, Grace M., 340, 364
- Horwitz, L. P., 679n108
- Hotham, Geoffrey A., 646n19, 646n25

- Howard, P. H., 678n100
 Hughes, Ernest S., Jr.
 on 1410 computer, 477
 Fox Hill study on research, 544
 at Harvard 1947 symposium, 78
 joins IBM, 51-52
 latch circuit invention, 98
 Magnetic Drum Calculator project,
 75, 96, 98, 165
 SSEC assignment, 52, 54
 Hunter, Lloyd P.
 assignment at IBM, 378, 380, 537
 drift transistors, 391-395
 ferrite-core fabrication, 261
 on Palmer's management style, 541
 Stretch technology, 417, 425, 669n36
 three-hole-core proposal, 258
 Hurd, Cuthbert C.
 at 701 computer unveiling, 162
 Applied Science Department head,
 85, 421
 automation research, 435, 510, 511,
 512
 comparison of 704 and 705
 computers, 421
 Defense Calculator, 131-151 *passim*,
 628n53, 630n86
 director of EDPM, 179-180, 349, 423
 FORTRAN, 340
 joins IBM, 84-85
 LARC and Stretch proposals, 392,
 423-430, 432
 Magnetic Drum Calculator, 90, 93,
 95, 98-101, 165, 170-171
 Scientific Computing Service, 338
 on TPM, 122-123
 Hursley IBM laboratory, 579
 Hydraulic actuator for disk storage,
 304, 308, 313
 Hydraulic carriage for printers, 486
 Hydraulic logic, 552
 Hypertape (IBM 7340), 228-230
 Hysteresis loop, 233
 IBJOB operating system, 367
 IBM 26 keypunch, 482, 483
 IBM 40 tape-controlled card punch,
 514
 IBM 57 card-controlled tape punch,
 514
 IBM 66 data transceiver, 515-516
 IBM 80 sorter, 10, 21
 IBM 83 sorter, 460
 IBM 84 sorter, 460
 IBM 285 printing tabulator, 17-18, 21
 IBM 305 RAMAC, 185, 297, 299-300,
 303, 308
 IBM 402 accounting machine, 70-71
 IBM 405 accounting machine, 18-19,
 21, 22, 69-70
 IBM 407 accounting machine, 59-60,
 125, 481-482, 484, 489, 491
 IBM 417 accounting machine, 70-71
 IBM 600 multiplying punch, 14
 IBM 601 multiplier, 14-15, 21-23, 69
 IBM 602 calculating punch, 62, 74-75,
 460
 IBM 602A calculating punch, 89, 460
 IBM 603 electronic multiplier, 46,
 61-62, 70, 75, 216, 571, 615n69
 IBM 604 electronic calculating punch,
 59-68, 70-71, 73-74, 109, 112-114,
 316-317, 416, 460, 461, 462, 463,
 572
 IBM 607 electronic calculator, 460,
 461, 462, 463
 IBM 608 transistor calculator, 386-387,
 463-464, 474
 IBM 610 Auto-Point computer,
 506-507, 508, 530, 610
 IBM 650 computer, 165-172. *See also*
 Magnetic Drum Calculator; Magnetic
 Storage Calculator
 announcement, 101, 170-171
 assembly program, 351-352, 353
 competitive computers, 171-172, 508,
 632n113
 computation seminar, 351
 first customer installation, 171, 351
 at New York Data Processing Center,
 351-352
 product enhancements, 172, 185-186,
 297
 success in the marketplace, 470-471,
 575
 IBM 701 computer, 158-164. *See also*
 Defense Calculator
 application program, 333, 654n42
 assembly programs, 325-328,
 331-332
 computation seminar, 348
 engineering model, 332
 first customer installation, 162
 list of instructions, 606
 machine units, 158, 161
 manufacture, 145-146, 151, 159-161,
 162-163
 name, 161-162, 630n77

- IBM 701 computer (cont.)
 at New York headquarters, 57,
 338-339
 operating costs, 339
 PACT compiler, 348-349
 pricing, 135-136, 146, 159, 162,
 630n78
 Speedcoding, 336-338, 341, 655n63
 summary of system, 605
 user meeting at Douglas Aircraft, 339,
 348
 user meeting at Poughkeepsie, 332,
 333, 348
 using organizations, 630n86
 weather-prediction competition, 351
 IBM 702 computer, 176-178, 342-347,
 417, 633n127, 633n128. *See also* TPM
 II
 IBM 704 computer, 178-180, 348-349,
 352, 354, 358-359, 417, 419, 421,
 423-424, 431, 446
 IBM 705 computer, 180-181, 346, 417,
 421
 IBM 705 Model III computer, 185,
 362-363
 IBM 709 computer, 184-185, 358-361,
 367, 446-448
 IBM 1401 computer, 311, 366, 367,
 465-474, 492-493, 578, 675n57
 IBM 1410 computer, 474-477, 479,
 578, 580
 IBM 1440 computer (11LC; 14LC),
 477-479, 581
 IBM 1460 computer, 581
 IBM 1620 computer, 366, 508-510,
 512, 578, 581
 IBM 1710 control system, 512-513
 IBM 1720 control system, 512
 IBM 7010 computer, 581
 IBM 7030 computer, 449-451, 455,
 457, 578. *See also* Stretch
 IBM 7040 computer, 581
 IBM 7044 computer, 581
 IBM 7070 computer, 465, 473, 474
 IBM 7074 computer, 578
 IBM 7080 computer, 449, 578
 IBM 7090 computer, 361, 367,
 447-449, 450, 451, 474, 578
 IBM 7094 computer, 449, 581
 IBM 7094 II computer, 449, 581
 IBM AN/FSQ-7 computer, 243, 244.
See also SAGE
 IBM auxiliary and file storage products
 350 disk storage, 218, 288, 297, 299,
 647n35, 648n55
 355 disk storage, 186, 648n55
 726 tape unit, 211
 727 tape unit, 185, 215
 729 tape unit, 217, 221-224, 452
 1301 disk storage, 308-309
 1302 disk storage, 310
 1311 disk-storage drive, 312-313
 1316 disk pack, 312-313
 1405 disk storage, 310, 477, 677n66
 7320 drum storage, 310
 7340 tape unit (Hypertape), 228-230
 IBM Difference Tabulator (Columbia
 Machine), 22-23
 IBM document reading machines
 1210 MICR sorter reader, 500
 1282 OCR reader card punch, 502
 1418 OCR numeric reader, 502
 1428 OCR alphanumeric reader, 502
 IBM input-output channels and control
 units
 766 data synchronizer, 184
 767 data synchronizer, 185
 777 tape record coordinator, 181
 IBM memory products
 706 electrostatic storage, 231
 737 magnetic-core storage, 253
 738 megabit magnetic-core storage,
 255-256
 760 tape buffer and printer control
 unit, 484-485
 775 record storage unit, 181, 250
 776 tape buffer, 250
 7302 oil-cooled memory, 260
 7302A air-cooled memory, 260-261
 IBM printer products
 370 stick printer, 299
 719 wire printer, 484
 730 wire printer, 484
 760 control unit and tape buffer,
 484-485
 1403 chain and train printers, 472,
 474, 480, 489-493, 494-495
 1443 bar printer, 478, 479, 493-494
 1445 MICR bar printer, 494, 678n92
 IBM relay calculators, 26-27, 32, 45, 69
 IBM System/360, announced, 410, 415,
 457, 477, 583
 IBM World Trade Corporation, 461
 IBSYS operating system, 367, 581
 IMPACT project, 415
 Index registers, 165, 179, 180, 181,
 186, 337-338, 339-340, 452, 655n62
 Indirect addressing, 184-185
 Information research, 556-557

- Ingram, James J., 675n35, 676n50
 Inhibit current, 249
 Input-output channel, 184, 185, 362
 Input-output control, 140–141, 173,
 174–175, 359, 362–363, 452
 Input-output conversion, 137, 141–142,
 421, 453
 Input-output programs, 137, 140–142,
 362–363. *See also* IOCS
 Input-Output System, 359
 Institute for Advanced Study, 57–59,
 103, 136–140, 156, 162, 319, 626n8,
 627n26, 627n27, 651n3, 652n4,
 653n24
 Instruction. *See also* Program step
 counters and registers for, 77, 140,
 337
 in Defense Calculator, 139
 in EDSAC, 92
 vs. line of sequence, 52
 in Magnetic Drum Calculator, 77, 78,
 82
 modification, 48–49, 52–53, 55, 58,
 77–78, 587
 in NORC, 133
 in SSEC, 52–53
 stored (*see* Stored program)
 Integer linear programming, 560
 International Telemeter Corporation,
 246, 252
 Interpreter (punched-card machine), 14
 Interpretive programs, 334–335,
 336–338. *See also* GOTRAN language
 and interpreter; SHACO language
 and interpreter; Speedcoding
 language and interpreter
 IOCS (Input-Output Control System),
 362–363
- Jackson, Philip W., 638n15
 Jeenel, Joachim, 614n54
 John Hancock Mutual Life Insurance
 Company, 171, 351
 Johnniac, 246–248, 628n53
 Johnson, Alfred H., 413, 667n101, 102
 Johnson, Donald D., 646n25
 Johnson, J. R., 678n96
 Johnson-Rahbeck effect, 203
 Johnson, Reynold B., 275–283, 296,
 301–303, 305–306, 310–311,
 482–483, 496, 553
 Johnson, Walter H., 84, 342, 344, 347
 Jones, Fletcher, 349
 Jones, Gilbert E., 674n14
 Jordan, F. W., 37
 Josephson, Brian, 561
 Junction transistors. *See also* Transistors
 current gain in, 382
 drift transistors, 391–395
 early fabrication, 382
 for IBM 608 calculator, 387–389, 399
 for memory driver, 404
 planar process precursor, 404–406
 post-alloy-diffused devices, 402–404
 saturation in, defined, 395
 shift to silicon, 404–406, 414
 for Stretch and 7000 series, 402–404
 surface-barrier devices, 391
 Juretschke, H., 563
 Kean, David W., 646n25
 Keller, Seymour P., 684n52, 686n78
 Kenyon Estate. *See* Poughkeepsie IBM
 laboratory
 Kernel in performance measurement,
 441–443
 Key in record identification, 290
 Keyword in Context (KWIC), 557
 Khrushchev, Nikita, 565
 Kilburn, Tom, 104, 338
 Killian, James R., 549
 King, Gilbert W., 559–560, 565, 566,
 570, 691n156
 Kingston IBM laboratory, 302, 310
 Kinslow, Hollis A., 614n54
 Knight, Geoffrey, Jr., 661n10
 Koenig, Seymour H., 683n26
 Kolsky, Harwood G., 442, 445, 452
 Kornei, Otto, 678n100
 Krömer, H., 391–392, 393
 Kubie, Elmer C., 100, 165–166, 167,
 351, 655n66
- Label, program, 327–328, 331, 344,
 351
 Label record, 362, 363
 Laboratories, IBM. *See location or name*
 early engineering shops, 7–10, 14–16
 Lake, Clair D., 8–11, 16–18, 26, 30, 34
 Lamb Estate (IBM laboratory), 555
 LaMotte, Louis H.
 701 computer announcement, 159
 702 computer announcement,
 173–174, 176
 on computer development, 102–103
 data communication, 514
 Data Processing Division head, 184
 executive vice-president, 422–423

- LaMotte, Louis H. (cont.)
 Magnetic Drum Calculator, 101
 supercomputer involvement, 424,
 426-427, 429
 Landauer, Rolf W., 538-539, 563
 Language translation, 565, 566
 Laning, J. Halcombe, Jr., 656n79
 LARC (Livermore Automatic Research Computer), 392-393, 425-427, 430, 436, 673n104
 Larner, Ray A., 361
 Lasers, 563-565, 690n147
 Latch circuit, 98, 99, 620n76
 Lawhead, Robert E., 634n10
 Lawless, William J., 661n162
 Lawrence Radiation Laboratory (LRL), 450-451
 Lawrence, William W., Jr., 641n61, 669n36
 Lazarus, Peter, 678n100
 LCF (Low Cost File) project, 312-313
 Leach, Thomas J., 403, 666n86
 Learson, T. Vincent
 on 608 announcement, 674n14
 Defense Calculator planning, 143, 145-146
 director of EDPM, 179, 342, 416-417, 419
 ferrite-core decision, 251-253
 group staff established, 580
 programming conference, 369
 sales vice-president, 349, 422
 on Social Security page reader, 503
 on supercomputers, 424, 426
 on WWAM program, 467-468
 Leary, Thomas G., 646n25, 647n48
 Lederman, Leon M., 535
 Lee, T. D., 535
 Lentz, John J., 505-506, 528-530
 Lesser, Murray L., 647n48
 Library mechanization. *See* Walnut Librascope, Inc. (LGP-30 computer), 508, 510
 Lightning project, 569
 Lincoln Laboratory. *See* MIT and Lincoln Laboratory
 Literal operand, 356, 366
 Little, John B., 546-547, 643n103
 Lockheed Aircraft Corporation, 162, 349
 Logistics Research, Inc., 632n113
 Logue, Joseph C.
 assignment to transistor group, 383-384
 diode-clamp patent, 395-396
 Fox Hill study on research, 544-545
 germanium to silicon transistors, 414
 junction transistors, 383-386, 541
 SMS development, 406, 408, 411
 Stretch project, 433-434, 438
 transistorized calculator, 384-387
 Lookahead principle, 438, 440-442, 445
 Los Alamos Scientific Laboratory (LASL)
 701 computer installation, 162
 assembly programs, 332, 354
 need for high-speed computers, 181, 422
 SHACO and DUAL interpreters, 335, 336, 347-348
 Stretch computer, 452-453, 456
 Stretch contract, 430, 432, 435-436, 437, 445-446
 Love, Charles E., 79, 81
 Lowkrantz, Gunne, 611n4
 Luhn, Hans Peter, 266, 290-293, 298-299, 311, 496, 517-518, 556-557
 Lynott, John J., 646n25, 646n29
 MAC (Modular Accounting Calculator), 256, 462-464, 465, 466, 467
 McClelland, William F., 323, 325-327, 328, 332, 614n54
 McDowell, W. Wallace
 on airline reservation systems, 517
 corporate staff function head, 184
 Defense Calculator planning, 131, 135, 143, 146-147
 director of engineering, 88-89, 274, 377, 526
 electronic multiplier suggestion, 44
 ferrite-core memories, 252, 255
 Fox Hill study on research, 544-545
 joins IBM, 16
 laboratory manager, 17, 273
 large-computer plans, 423-430, 454
 Magnetic Drum Calculator, 78, 86, 88-89, 96, 101
 NORC recommendation, 183
 on post-World War II hiring, 103
 pure research management committee, 531-533
 San Jose laboratory inception, 273-276
 tape handling study, 202
 transistors, 387, 402

- vice-president for research and engineering, 422, 543
on WWAM program, 468
Zürich laboratory, 550-552
- Machine organization
binary vs. decimal, 136-138, 439-440, 626n20
serial vs. parallel, 59, 132, 136, 435-436
- McPherson, John C.
business programming language, 363-364
on computer compatibility, 579
director of engineering, 33
EDPM planning, 423, 424, 435
engineering expansion, 273-274
Future Demands department, 17
on government support in electronics, 525-526
joins IBM, 17
on long-range research, 377
Magnetic Drum Calculator, 73-74, 79-80, 81-82, 86, 88, 89, 99
magnetic-tape project, 102
magnetic-tape studies, 190-194
memory requirements, 231
NORC contract, 133
programming research, 355, 357
pure research management committee, 531-533
relay calculator and electronic multiplier, 46
SSEC planning, 47-50
on transistor use, 380-381
Macro instruction, 355, 362, 363, 366
Magnetic-core memories. *See also*
Ferrite-core memories
early metallic cores, 242
first work at IBM, 232
patents on, 267-270
proposal of Eckert and Chu, 271-272
proposal of Forrester, 241-242, 249
proposal of Haynes, 233-234
proposal of Thomas, 232
proposal of Viehe, 267, 269, 271
proposal of Wang, 232-233, 267, 269, 271
Magnetic-disk storage, 280-314. *See also* IBM auxiliary and file storage products
access mechanism and actuator, 286, 301, 304, 307, 308, 648n55
advanced disk file, 304-309, 474-477
air-bearing technology, 282-283, 300-303, 307-308, 312
on RAMAC, 287-288, 297, 299
disk sector addressing (*see* Record addressing)
first described and produced, 287-288
low-cost disk file, 305, 312-313
recording method, 287
removable disk pack, 312-314
on Stretch, 301, 306-307, 650n90
Magnetic-drum auxiliary storage, 125, 134, 141, 157, 281, 288, 297, 310
Magnetic Drum Calculator (MDC), 86-101, 137. *See also* Magnetic Storage Calculator; IBM 650 computer
Magnetic-drum memories
in 610 Auto-Point computer, 506
in 650 computer, 75-101 *passim*, 165-167, 169-170, 186
access time, 76, 90-91, 169-170, 172
drum surface treatments, 77, 80, 87
in Test Assembly, 112, 622n28
Magnetic films, 551-552
Magnetic logic, 234, 272, 444, 540-541
Magnetic Storage Calculator, 73-79.
See also Magnetic Drum Calculator; IBM 650 computer
Magnetic-tape storage, 187-230
on Defense Calculator, 134, 141
in EDVAC plans, 189-190
in Endicott IBM laboratory, 102, 191-194
label records, 362, 363
on NORC, 182, 212
NRZI (non-return-to-zero-IBM)
recording, 200-202
phase encoding, 228
plastic vs. metal, 188, 195-196
in Poughkeepsie IBM laboratory, 109, 194, 195-230
vs. punched cards, 80, 109-110, 190-194
recording methods, 121, 196-202, 228
skew effects, 121-122, 212, 227
Society of Actuaries study, 176-177, 632n123
starting and stopping, 202-210
on Test Assembly and TPM, 111, 113-114, 121-122, 124

- Magnetic-tape storage (cont.)
 vacuum column, 124, 206–210
- Maiman, T. H., 564
- Manufacturing
 CRT for Williams-tube memory, 126–127
 Defense Calculator, 145–146, 151, 159–161, 162–163
 electromechanical skills applied, 573
 ferrite-core arrays, 265–267, 268, 270
 ferrite cores, 262–265, 270
 project transfer into, 546–547
 transistor circuit packaging, 406–411
 transistors, 387, 399–406
- Marchant Research Corporation, 632n113
- Marcy, H. Tyler, 680n115
- Mark-sensing reproducer, 275
- Mark I. *See* Harvard University, Mark I.
- Maron, Melvin E., 646n25
- MARS (Modular Access Random Storage), 311
- Martin, Harold F., 645n10
- Mason, Daniel R., 338, 339, 340, 347, 350
- MIT and Lincoln Laboratory
 differential analyzer, 24
 ferrite-core memory, 241–248, 262–263, 380
- Hollerith, 2
- MIT Radiation Laboratory, 108
- SAGE project, 243–248
- transistors, 380–381, 391
- Whirlwind project, 108, 111, 240–241, 243, 245, 335, 341, 656n79
- Masterson, J. L., 678n100
- Mauchly, John W.
 BINAC, 59, 627n27
 EDVAC, 110
 EDVAC subroutines, 318
 ENIAC, 57, 58
 at Harvard 1947 symposium, 77–78, 652n20
 magnetic tape for EDVAC, 189
 patent on revolver, 166–167, 621n79
 UNIVAC, 59, 627n27
- MDC. *See* Magnetic Drum Calculator
- Meagher, Ralph E., 454
- Memory. *See also* CRT memories; Ferrite-core memories; Magnetic-core memories; Magnetic-drum memories; Selectron storage tube; Williams-tube memories
- early proposals, 231–233, 271–272
 mercury-delay-line, 58, 92, 110–111
 Selectron, 113, 622n31
 spin-echo, 533, 534
- Memory protection in Stretch, 453
- Mercury-delay-line memories, 58, 92, 110–111
- Merwin, Richard E., 633n127, 671n64
- Metropolitan Life Insurance Company, 364
- Michelson-Morley experiment, 536
- MICR (magnetic-ink character recognition), 494, 498–502
- Microwave logic, 567–568
- MIFD (Materiel Information Flow Device), 279, 281, 283
- Military Products Division, 441, 569
- Minneapolis-Honeywell Regulator Company, 219, 490, 583
- Minority charge carriers, 374
- Missile program, 130, 134
- Mitchell, George E., 613n38
- Mitchell, Grace E., 351
- Mohansic IBM laboratory, 555–556
- Monroe Calculating Machine Company, 25, 632n113, 645n16
- Monsanto Chemical Company, 633n128
- Monte Carlo analysis, 398–399, 422
- Moore School of Electrical Engineering. *See* University of Pennsylvania
- Mork, Ralph G., 468–469
- Mullard Company, 259
- Multiprogramming, 181, 370–371, 453
- Mussell, Howard A., 112, 147, 174, 671n64
- Mutter, Walter E., 126, 404, 537, 558, 678n96
- NAND circuit, 41
- National Bureau of Standards, 103, 168, 280, 525
- National Cash Register Corporation (NCR), 1, 172, 499, 583
- National Physical Laboratory (U.K.), 92, 318, 652n20
- National Security Agency. *See* NSA
- Naval Ordnance Laboratory, 132–133, 181
- NCR 304 computer, 475
- Noell, Newton G., 667n100
- Nolan, John J., 647n48
- Noll, A. R., 682n22
- NOR circuit, 41, 42

- NORC (IBM Naval Ordnance Research Calculator), 132-133, 137, 181-183, 212, 419, 421, 422, 423-424, 633n133
- Nordyke, H. William, Jr., 635n39, 678n99
- North American Aviation, Inc., 349, 356-357, 359, 361
- Northrop Aircraft, Inc., 69-71, 74, 615n61
- Norton, J. M., 650n88
- NRZI (non-return-to-zero-IBM) recording, 200-202, 287
- NSA (National Security Agency) ferrite-core memory from ERA, 246-248
- Harvest system, 225, 227, 260, 437-439, 443, 456
- Lightning project, 569
- magnetic logic, 540-541
- Plantation task, 428-429, 437
- N-type semiconductors, 373
- Nutt, Roy, 342, 354
- OCR (optical character recognition), 495-497, 502-505
- Office of Naval Research (ONR), 137, 614n57
- Olsen, Kenneth H., 249, 255
- Open method of search, 351-352, 648n61. *See also* Record addressing
- Operating systems, 358-361, 367, 581, 583
- Operation code, 78, 324, 325, 328, 331, 353, 592, 594, 655n63
- Oppenheimer, J. Robert, 162
- Optimum programming, 91-92, 165-166
- Organizational changes in IBM EDPM director, 179-180, 251, 416-417
- product divisions, 306, 449, 475, 512, 576-577
- research as separate function, 301, 431, 544-550
- Williamsburg conference, 183-184, 435, 510, 548, 576
- PACT (Project for the Advancement of Coding Techniques), 348-349, 359
- Page, Ralph E., 9, 20, 59, 615n66
- Paley, Maxwell O., 462-463
- Palmer, Ralph L.
- 604 calculator, 59-63, 66-67
- 608 calculator and MAC program, 462-463
- on 1410-1401 compatibility, 474-476
- 7090 computer, 446-447
- advanced development, 454, 572
- area manager system, 472
- Defense Calculator project, 130-136, 161, 626n17
- early magnetic recording investigations, 189
- early transistor use, 385-387
- EDPM role, 417-418, 422
- electronic multiplier and cross-footing keypunch, 44
- electronics experiments, 34-35, 37
- ferrite core fabrication, 261
- Harvard 1949 symposium, 234
- IBM Fellow appointment, 456
- influence on IBM engineering and technology, 212, 414, 476
- intermediate-speed printer study, 489
- joins IBM, 34
- Magnetic Drum Calculator evaluations, 86, 94
- management roles, 34, 122, 133, 184, 301, 377, 462-463, 526, 543, 548
- management style, 117-118, 541-542
- NORC recommendation, 133
- pure research management committee, 532
- research in Poughkeepsie, 536-544, 544-550 *passim*
- SMS development, 406-414
- storage requirements task force, 304
- Stretch project role, 392-395, 426-430, 454
- TPM role, 117-118, 126, 130-131
- transistor application, 223, 255, 256, 384
- transistor production automation, 399
- Williams-tube memory, 104, 111
- World War II service, 59, 61
- on WWAM program, 468, 470
- Paper-tape storage, 49-53, 506-507, 510
- Papian, William N., 242
- Papo, Maurice, 675n24
- Paris, Robert E., 678n88
- Partridge, Ralph S., 642n77, 643n95
- Patent Development department, 35, 36, 373-378 *passim*
- Patents
- awards program, 271
- consent decree, 271

- Patents (cont.)
 ferrite-core memories, 267-272
 Forrester patent litigation, 269-271
 IBM policy, 271, 526, 573
 in Poughkeepsie laboratory, 118
 TDB (Technical Disclosure Bulletin), 271
- Peirce, J. Royden, 9-10, 14
- Pendery, Donald W., 618n36
- Perkins, Glen E. (Ed), 645n12
- PERM (Parallel Elektronische Rechen Machine), 551
- Personal automatic calculator, 185, 505-507, 530
- Phelps, Byron E.
 electronic cross-footing punch, 44-45
 electronic multipliers, 44-46
 flip-flops and counters, 37-44
 joins the Poughkeepsie laboratory, 60-61
 magnetic-tape project, 110-114, 194-200, 206
 magnetic-tape sorter, 126
 NORC assessment, 419
 NRZI recording invention, 200
 SSEC project, 51
 transistor development, 541
 TPM project, 118, 121-123, 126
- Philco Corporation, 391, 392, 417, 428, 490, 583
- Philips Corporation (N.V. Philips' Gloeilampenfabrieken), 259, 263-264
- Phosphor research, 540
- Photocopier technology, 554
- Phototransistors, 376
- Piore, Emanuel Ruben
 basic research thrust, 549-550, 553-556 *passim*
 joins IBM, 435, 548-549
 on project selection, 567
 Research mission defined, 566
 on Social Security page reader, 503
 vice-president for research and engineering, 565, 570
- Plantation project, 428, 437
- Plugboard, 6, 8, 13, 17, 62, 71, 296, 462, 468, 469. *See also* Control panel
- Pluggable unit. *See* Vacuum tube circuits, pluggable units for
- Plugged program, 58, 62, 71, 169, 316-317, 333-334, 462, 464, 467-469, 507
- Plugwire, 13, 17
- Point-contact transistors. *See also* Transistors
- bistability of, 379
 current gain in, 378-379
 early circuits, 373-374, 376, 378-379, 381
 fabrication, 374-376, 379-380
 forming, 375-376
 invention, 372, 373
 multifunction devices, 388-390
- Pointers (IBM publication), 618n41
- Poley, Stanley, 351
- Pomerene, James H., 443, 688n122
- Potter Instrument Company, 490
- Poughkeepsie IBM laboratory
 atmosphere and growth, 59-61, 118, 194, 275, 541-542
 bank check mechanization, 498, 499-500
 Defense Calculator project initiation, 95, 131-136
- Magnetic Drum Calculator evaluations, 86, 93-94
- magnetic-tape projects, 194-230
- NORC project, 182
- research in, 536-544, 545-548
- rivalry with Endicott laboratory, 93, 100, 464-465, 470
- Poughkeepsie IBM plant, 96, 98, 145-146, 151, 159-161, 162-163, 346
- Poulsen, Valdemar, 187-188
- Powers Accounting Machine Company, 6, 12
- Powers, James, 6, 7, 10, 14
- Printing and printers, 480-495
 bar, 478, 489, 493-494
 chain, 452, 472, 473, 480, 489-495
 CRT-microfilm, 488-489
 ferromagnetographic, 487
 IBM Selectric typewriter, 482, 521
 MICR, 494, 498, 500
 stick, 296, 467, 482, 483
 train, 480, 491, 494-495
 wheel and drum, 481-482, 490-491
 wire matrix, 482-487
- Process control, 510-513
- Product announcement practice, 163-164
- Proebster, Walter E., 551-552, 687n96
- Program step, 316, 317, 327-328
- Programmed Component Inserter (PROSERT), 407-408
- Programming languages. *See* COBOL language; Commercial Translator language; COMTRAN language;

- FLOW-MATIC language and compiler; FORTRAN language; Interpretive programs
- Programming Research department, 344, 345, 346, 354-355, 357, 363, 417
- Programs, 315-371. *See also* Assembly programs; Compilers; Control programs; Demonstration programs; Diagnostic programs; Input-output programs; Interpretive programs; Operating systems; RPG; Simulator programs; Sort programs; Subroutines; Utility programs
- complexity, 316-317
- development organization and procedures, 354-355, 357-358, 371
- estimating and scheduling, 350, 360-361
- for evaluation of computers, 89, 142-143, 143-144, 162-163, 165, 169-170, 442
- evolution, 316-317
- shared use and development, 317-318, 347-349
- technology development, 355, 369, 371
- Progressive digitizing, 22, 608n32
- Project High. *See* SAGE
- Prudential Insurance Company, 80, 190, 194
- P-type semiconductors, 373
- Punched card, 2, 3, 5-6, 11-12, 192-193
- Quade, Edward, 646n25
- Quarles, Donald A., Jr., 614n54
- Rabenda, Edward J., 14, 59, 236-238
- Rabi, I. I., 528, 533
- Rabinow, Jacob, 279-280
- Radio Receptor Corporation, 400
- Radio tubes. *See* Vacuum tubes; Thyratrons
- Rajchman, Jan A., 249, 269-270, 623n31
- RAMAC. *See* IBM 305 RAMAC
- Ramo-Wooldridge Company, 490
- Ramshaw, Walter A., 336, 342
- RAND Corporation, 181, 246, 255-256, 349, 430, 628n53
- Raytheon Manufacturing Company, 103, 195
- RCA, 269, 270, 475, 488, 583, 623n31
- Record addressing, 288-295, 298-299, 648n61
- Red Oaks Mill location, 346
- Reich, Herbert J., 37
- Relay calculators of IBM, 26-27, 32, 45, 69
- Relays, wire contact, 18, 29, 34, 51
- Remington Rand Inc.
- 409 electronic calculator, 99
 - acquisition of Eckert-Mauchly Computer Corporation, 129, 130, 574
 - acquisition of Engineering Research Associates, Inc., 575, 617n10
 - acquisition of Powers Accounting Machine Company, 12
 - early UNIVAC installations, 174, 339, 575
 - ERA 1103 computer, 162, 246, 248
- ferrite-core memory, 239, 246, 248, 253
- file computer, 297
- magnetic logic, 540-541
- merger with Sperry Corporation, 428
- revolver patent, 166-167
- Removable disk pack, 305, 312-314, 573
- Reproducer, 14
- Research, 523-570
- annual planning conferences, 549-550, 551
 - basic research emphasis, 531-532, 535-536, 545, 550-551, 553-554
 - vs. development, 532, 544-550
 - evaluation of, 567, 570
 - Fox Hill study, 544-545
 - management philosophies on, 527, 536, 545
 - missions of, 524-525, 527, 530-531, 536, 549, 566
 - move to Yorktown, 437, 555-563
 - organization and management, 526-527, 541-544, 546-547, 549, 686n79
 - Ph.D.s in IBM, 525, 559
 - in Poughkeepsie, 536-548
 - in San Jose, 301, 305, 553-555
 - selection of new projects, 567-568
 - Watson Laboratory, 527-536
 - Watson, Sr.'s, views on, 523-524, 527 in Zürich, 550-552
- Research Center, Thomas J. Watson, 556, 561-563
- Revolver in drum storage, 82, 100, 165-167, 621n79

- Reynolds, A. C., 690n154
 Rhodes, William H., 642n90
 Richards, Richard K., 675n18
 Roberts, Gordon A., 73-74, 108, 121,
 129, 135, 146, 174, 176, 193-194
 Rochester, Nathaniel
 assembly program, 325, 328, 331,
 332, 351
 automation research, 547-548
 character recognition, 496, 678n96
 on checking circuits, 128
 Defense Calculator planning, 134,
 136-138, 140, 142-143, 144, 158,
 159, 604
 EDPM manager, 417
 flowcharting, 327-328
 joins IBM, 108
 memorized logic, 509
 research responsibilities, 547, 558,
 686n79, 688n122
 Test Assembly, 110, 111, 113-114
 Test Assembly subroutine loader,
 322-323, 325, 328, 330
 TPM, 116-117, 122-123, 128,
 130-131
 Wheeler calling sequence, 323, 324,
 652n17
 Rockefeller, Nelson A., 563
 Rohland, William S., 679n104
 Rosen, Saul, 220
 Rosenheim, Donald E., 683n30
 Ross, Harold D., Jr., 147
 Roth, J. Paul, 688n124
 Rowley, Russell A., 613n38, 675n35
 RPG (Report Program Generator),
 479-480
 Russell, Louis A., 642n90
 Rutz, Richard F., 388-390, 391-393,
 394, 539
- Saarinen, Eero, 456, 561, 562
 SABRE system for American Airlines,
 310, 516-522, 554, 557-558, 573
 SAGE, 240-248, 262-263, 264, 419,
 423, 573
 Sampling oscilloscope, 551-552
 Samuel, Arthur L.
 checkers playing machines, 559
 consultant on research, 547
 ferrite-core fabrication, 261
 joins IBM, 234-236, 526
 open method of search, 648n61
 pure research management
 committee, 531, 532-533
- solid-state research, 377, 378, 380,
 388, 536-537
 on transistor effort outside IBM, 380
 Zürich laboratory established, 550
 San Jose IBM laboratory, 276-282,
 300-303, 305-306, 310, 553-555
 Sayre, David, 368-369
 Scaling in computation, 333, 334
 SCAMP computer, 579
 Schawlow, A. L., 563, 564
 Schick, John F., 677n80
 Schlaeppi, Hans P., 687n97
 Schuenzel, Ernest C., 643n108
 Schwartz, Robert, 667n90
 Scientific computation forum and
 seminars (IBM), 83-85, 348, 351,
 616n6, 618n42
 Scientific computing, 21-27, 74-75,
 83-86, 130, 133-134, 421-422
 Scientific Computing Center, 350, 352,
 354, 357
 Scientific Computing Service, 338-339,
 340, 350
 SCRAM (Strip Circular Random Access
 Memory) project, 303, 304
 SEAC (Standards Eastern Automatic
 Computer), 103
 Seeber, Robert R., Jr., 48-49, 52, 54,
 57, 73, 333, 335, 612n32
 Selective Dissemination of Information
 (SDI), 557
 Selective Sequence Electronic
 Calculator. *See* SSEC
 Selectron storage tube, 114, 623n31
 Semiconductors, 372-373, 415. *See also*
 Diodes; Transistors
 Sequence control, in SSEC, 52-53,
 585-587
 Service Bureau Corporation, 357
 70AB computer proposal, 578
 SHACO language and interpreter, 335,
 336, 347-348
 SHARE organization
 709 System Committee, 359
 assembly program for 704 computer,
 354
 assembly program for 709 computer,
 359-360
 formation and function, 347-349,
 357, 368
 FORTRAN committee, 361
 Sheldon, John W., 333-334, 335-336,
 338, 351, 352, 654n42, 655n66
 Shell, Donald L., 359, 360

- Shelton, G. L., 677n100, 679n108
 Shepard Laboratories, 490, 646n17
 Shockley, William, 372, 374, 382, 393
 Shugart, Alan F., 307, 311
 Shultz, Gerald L., 678n96
 Sigma arithmetic unit, 438-440, 443
 Silicon transistors, 414-415. *See also*
 Transistors
 Silkwowitz, Bernard R., 677n70
 Silo project, 257, 428-429
 Silvey, Gene A., 667n90
 Simulator programs, 346
 Slade, Bernard N., 399-400, 402-404
 Slider, 300-304, 307-308, 312
 Smith, C. R., 517
 Smith, R. Blair, 348, 517, 681n138
 Smith, William V., 686n78, 690n148
 SMS (Standard Modular System),
 406-414, 444, 449, 573
 Snyder, Samuel S., 227
 SOAP (Symbolic Optimal Assembly
 Program), 351-352, 353
 Social Security Administration, 489,
 502-504
 Society of Actuaries, 176-177, 632n123
 Solid state, 373-374, 378. *See also*
 Diodes, semiconductor; Ferrite cores;
 Transistors
 Sorokin, Peter P., 563-565
 Sort programs, 344-346, 355, 367
 Sorter, 6, 10, 20-21, 174, 420,
 632n119
 Sorting, 10-11, 191
 SOS (SHARE Operating System),
 359-361, 367
 Source recording project, 277-282
 SPACE computer, 471-473, 474. *See*
 also IBM 1401 computer
 Spatz, Peter K., 641n66
 Spaulding, Donald T., 475-477, 577,
 580, 582
 Speedcoding language and interpreter,
 336-338, 339-340, 341, 655n63
 Speiser, Ambrose P., 550-551
 Sperry Gyroscope Company, 625n1
 Sperry Rand Corporation, 428, 430,
 435, 439, 499. *See also* Remington
 Rand Inc.
 Spin-echo memory, 533, 534
 SPREAD task force, 583
 Spring Street IBM laboratory, 555-556
 SPS (Symbolic Programming System),
 366
 SSEC (IBM Selective Sequence
 Electronic Calculator), 47-59,
 585-587
 applications, 57, 84, 320
 checking by dual sequencing, 54,
 335-336
 operation of, 57, 339
 programming, 54, 57, 316, 320, 323,
 325, 334, 335-336
 subroutines, 319-320
 Stanford Research Institute, 498-500
 Stevens, Louis D.
 Defense Calculator project, 147
 disk project manager, 287
 drum for Test Assembly, 112, 622n28
 headquarters assignment, 307
 joins IBM, 112
 laboratory manager, 302, 305, 306
 product engineering, 296, 300,
 647n48
 technical assistant manager, 276, 282
 Walnut II and Cypress, 311
 Stevenson, M. J., 690n150
 Stewart, Elizabeth, 614n54
 Stibitz, George R., 593
 Storage. *See* Buffer storage; Magnetic-
 disk storage; Magnetic-drum
 auxiliary storage; Magnetic-tape
 storage; Memory; Vacuum tube
 circuits, for storage
 Storage allocation, 91-92, 325-328,
 331, 356, 370
 Stored program, 52-53, 58-59, 77-78,
 109-110, 316, 462, 468, 611n11
 Stretch, 416-458
 assessments, 453-456
 computer description, 452-453
 control program experiment, 370-371
 deliveries, 456, 673n112
 disk file, 301, 307, 432, 446, 450, 451,
 452, 650n90
 fast memory proposal, 258-259, 428,
 432, 446
 memory, 256-261, 445, 448, 452
 origin of name, 429
 transistors and circuits, 392-398,
 402-404, 437
 word-length considerations, 434-435
 Stromberg-Carlson company, 488-489
 Subroutine library, 319-322, 340, 344,
 358, 652n20
 Subroutines, 317-326, 330, 652n17
 Subtraction, 12-13, 41-44, 590-593
 Summary punch, 11, 23
 Superconductivity, 568-570
 SWAC (Standards Western Automatic
 Computer), 628n53

- Swanson, Robert E., 667n90
 Sweeney, Dura W., 671n63
 Switch cores, 249, 252-254, 255
 Switching circuits, 41-42, 384,
 393-398, 471, 680n118
 Sylvania Electric Products Company
 Inc., 378, 447-448
 Symbol table, 331, 648n61
 Systems engineering, 661n162
- Table lookup, 50, 75, 79-81, 90, 184,
 331
 Tabulating Machine Company (TMC)
 4-6
 Tabulator, 3-5, 8-10, 17-21
 Tape. *See* Magnetic-tape storage;
 Paper-tape storage
 Tape Processing Machine. *See* TPM
 Tape sorter-collator, 174, 420, 632n119
 Teal, Gordon K., 546
 Technical Computing Bureau, 84, 85,
 333-338 *passim*
 Telecomputing Corporation, 278, 304
 Teleprocessing, 521
 Teleregister Corporation, 516-517
 Teletype Corporation, 514
 Teller, Edward, 392, 424
 Test Assembly, 108-114, 137, 144,
 322-323, 325, 328, 330
 Test Scoring Machine, 275
 Texas Instruments, Inc., 402, 414, 447,
 448
 Thomas J. Watson Astronomical
 Computing Bureau, 24
 Thomas J. Watson Research Center,
 556, 561-563
 Thomas, Llewellyn H., 57, 232, 528,
 563, 690n154
 Thompson, Leonard H., 637n78
 Thyatron, 36
 Toben, Gregory J., 69, 169
 Townes, Charles H., 535-536, 563, 564
 TPM (Tape Processing Machine),
 114-129, 131-132, 137, 173,
 589-598
 TPM survey teams and application
 studies, 128-129, 174
 TPM II, 127, 129, 173-176. *See also*
 IBM 702 computer
 Tractor tape system, 220, 225-228
 Transistor circuits. *See also* Transistors
 corporate policy on, 387
 current-switch, 395-398, 437
 early flip-flops or triggers, 376,
 378-379, 381
 emitter-coupled logic (ECL), 396-398
 emitter-follower logic, 385-386
 in experimental calculator, 384-385
 grounded-emitter, 382
 for IBM 608 calculator, 386-388
 packaging, 385, 406-414
 in small accounting machine, 381
 statistical design criteria, 398-399
 for Stretch and 7000 series, 395-398
 training course on, 384
 Transistors, 372-415. *See also* Junction
 transistors; Point-contact transistors;
 Transistor circuits
 automated manufacture of, 399-402,
 403, 406, 446, 573
 corporate policy on, 387
 early public perception of, 417
 early reliability problems, 537
 first device work at IBM, 373-378
 first fully transistorized IBM product,
 386-387
 IBM X-4 thyratron, 387-388, 389
 invention, 372-373
 junction vs. point-contact, 382-384,
 390, 541
 for memory support circuits, 255,
 256, 404
 for Stretch and 7000 series, 393-395,
 402-404, 437, 447, 448
 Tremelling, Keith, 646n25
 Triebwasser, Sol, 683n26, 684n50,
 685n53
 Trigger circuit. *See* Flip-flop circuit
 Trillion-bit file project, 311
 Troy, James J., 52, 75, 96, 470, 543,
 676n51
 Tub file, 278, 289, 295
 Tucker, Gardiner L., 392-393, 394,
 533, 544, 547, 549, 554
 Tunneling spectroscopy, 561
 Turing, Alan M., 92, 318-319, 355
 Typewriter, electric, 60, 482, 521
- Underwood, Francis O., 468-469
 Underwood Corporation, 99, 172
 United Aircraft Corporation, 336, 354,
 658n116
 UNIVAC (Universal Automatic
 Computer)
 accepted by Census Bureau, 574,
 615n61
 addressing, 627n27
 branch instruction, 627n27
 compilers for, 340, 364, 656n72

- deliveries, 575
 early publicity, 102
 Eckert and Mauchly venture, 59
 at General Electric Company, 339, 344
 influence on IBM, 102-103, 114-115, 116, 129, 130, 174, 416, 418-419, 574-575
 Prudential Insurance Company order, 80, 638n125
 speed compared to TPM, 132
 Univac File Computer, 297
 University of California Radiation Laboratory (UCRL), 422-427, 658n116. *See also* Lawrence Radiation Laboratory
 University of Manchester, 104, 337
 University of Pennsylvania, 27, 39, 45, 57-59, 103, 319, 321, 614n57, 626n19
 U.S. Air Force (and Army Air Corps), 279, 300, 447, 513-514, 645n16
 U.S. Department of Defense, 364
 U.S. Department of Justice, 357
 Utility programs, 332, 347, 352
- Vacuum tube circuits
 cathode follower, 119
 circuit design manual, 147-148
 for counting, 36-44
 pluggable units for, 62-63, 98, 99, 121, 148-151, 168
 for storage (*see* Capacitor storage; Flip-flop circuit; Havens delay unit; Latch circuit)
 for switching, 41-42
 symbolic representation, 42, 148
 using diodes, 118-119, 147-148, 168
- Vacuum tubes. *See also* Thyratrons
 in digital vs. linear circuits, 65
 pentagrid tube, 66-67
 pentode, 41
 quality problems, 65-66
 triode, 36, 65
- Valley Committee, 240
 Valley, George E., 240
 Variable field and record length
 in 305 RAMAC, 675n37
 in 702 computer, 675n37
 in 1401 computer, 469-470
 in Stretch, 453
 in TPM, 116-117, 589, 595, 675n37
 in WWAM, 466
- Verifier, 7
- Very Large Capacity Memory, 305, 311
 VIDOR program, 497
 Viehe, Frederick W., 267, 269, 271
 Vinson, Thomas L., 636n72, 636n73
 von Neumann, John
 on binary representation, 137
 consultant to IBM, 100, 421, 422
 EDVAC, 58, 137, 319, 323, 626n19
 explanatory column in coding, 653n27
 flowchart, 327-328
 IAS computer, 59, 103, 111, 137, 626n20, 627n26
 microwave logic, 567-568
 NORC dedication, 421-422
 SSEC use, 57
 subroutine loader, 319-320
 Wheeler calling sequence, 323
 Walker, Robert M., 679n110, 682n11, 683n30
 Walker, William J., 643n111
 Walnut, 310-311
 Walsh, James L., 668n110
 Wang, An, 232-233, 267, 269, 271
 Watson, Arthur K., 461
 Watson Laboratory, 69, 132, 181, 300, 505, 524, 526, 527-536. *See also* Research Center, Thomas J. Watson
 Watson, Thomas J., Jr.
 603 electronic multiplier, 46
 650 computer announcement, 170
 702 computer announcement, 176
 702 computer at Monsanto Chemical Company, 638n128
 appoints EDPM director, 179, 416
 on customer dissatisfaction, 254-255
 on complacency in business, 584
 Defense Calculator, 130-131, 134-136, 143, 145
 electronics emphasis, 526
 ferrite-core decisions, 251, 254-255
 joins IBM, 46
 Magnetic Drum Calculator, 79-80, 88-89, 101
 on magnetic-tape program, 193-194
 on management committees, 531
 management roles, 79, 101, 130, 183, 369, 416, 584
 on patent negotiations, 267
 policy on using transistors, 387
 on post-World War II hiring, 103
 at programming conference, 369
 Research Center dedication, 563

- Watson, Thomas J., Jr. (cont.)
 research policy, 531-532
 Stretch involvement, 451-452, 455,
 457-458
 at Williamsburg conference, 183-184
 on WWAM program, 470
- Watson, Thomas J., Sr.
 701 computer announcement,
 158-159
 at 701 computer unveiling, 162
 Astronomical Computing Bureau, 24
 CEO post relinquished, 183
 Government project priorities in
 wartime, 45, 180
 on increased-capacity card, 193
 interest in electronics, 45-46
 joins CTR, 1
 at magnetic drum demonstration, 83
 management philosophy, 7, 16, 34,
 571, 573
 NORC dedication, 421-422
 patent negotiations, 267
 post-SSEC directive, 73
 priority given Government projects,
 45
 product development, 8, 10, 16
 relations with laboratories, 34
 science support, 523-524, 527, 571
 scientific computation support, 22-23,
 24, 27, 30-31, 55, 57
 SSEC, 47, 54, 55-57
 Watson Laboratory established, 524,
 527-528
 Weather Bureau, 162-163
 Weaver, Warren, 690n153
 Weidenhammer, James A., 202-206,
 227-228, 498, 646n17
 Wellburn, J. Henry, 677n80, 678n87
 Wesley, F. J., 173-174, 176, 296,
 681n136
 Westinghouse Corporation, 544
 Whalen, Richard J., 159
 Whalen, Robert M., 642n90
 Wheeler, David J., 321-322, 323
 Wheelock, L. Truman, 169
 Whirlwind computer, 108, 111,
 240-241, 243, 245, 335, 341,
 656n79. *See also* MIT and Lincoln
 Laboratory
 Whitney, Gordon E., 638n13, 639n40
 Wilkes, Maurice V., 59, 92, 321-322,
 323, 331, 334, 627n27
 Williams, Albert L., 422-423, 429, 432
 Williams, Frederic C., 104-105, 132,
 337-338
- Williams-tube memories. *See also* CRT
 memories
 in 704 computer plans, 180
 in Defense Calculator, 132, 134, 157,
 161-162, 603-604
 early work in IBM, 107-108, 231-232
 vs. ferrite-core memories, 250-251,
 253
 IBM design and manufacture,
 126-127
 in NORC, 127, 132-133, 181, 182
 in Test Assembly, 111-113, 231
 in TPM, 117, 122, 124, 126-127
 read-around ratio, 107, 383, 604
 special tube requirements, 108, 113,
 126-127
- Williamsburg conference, 183-184,
 302, 510, 548, 576
- Wilson, Lawrence A., 478, 493
- Winger, Wayne D., 174-175, 199, 248,
 508-509
- Wire wrap, 408-411 *passim*
- Witt, Victor R., 210-211, 306, 307,
 547, 642n90
- Wittenberg, W. M., 669n36
- Wolensky, W., 671n63
- Wood, Barbara L., 677n70
- Wood, Benjamin D., 22, 275
- Wood, M. Loren, 373-378, 531
- Woodbury, William W., 169, 647n48
- Wooden Wheel, 169-170
- Word (unit of data), defined, 78
- Wu, Chien-Shiung, 535
- WWAM (Worldwide Accounting
 Machine), 466-470
- Wyma, Edward, 667n100
- X-punch control, 13
- Yang, C. N., 535
- Yorktown Heights IBM laboratory. *See*
Research Center, Thomas J. Watson
- Young, Donald R., 537-540, 547, 569
- Yourke, Hannon S., 395-398
- Zierler, Neal, 656n79
- Ziller, Irving, 340, 342, 350, 369
- Zürich IBM laboratory, 550-552
- Zuse, Konrad, 551, 626n8, 687n94