

moderate income families in large cities, with base 1935-9=100, using the adjusted basis in 1950ff., from *Stat. Abstract*. Salaries of professional researchers rose faster than this index; so these plottings of Govt. and commercial R&D funds are not used in our further computations.

Solo, N 670, p. 52, uses a special price index from E. A. Johnson & H. S. Milton: *A Proposed Cost of Research Index*, 1961.

59. U.S. NSF: *Methodological Aspects of Statistics on R&D, Costs and Manpower*, based on papers before Amer. Stat. Assn.; 1959, 132 pp., esp. W. H. Shapley: Problems of Definition, Concept, and Interpretation of R&D Stat. This book shows the shortcomings of our statistics hitherto, but provides no better.

60. Research personnel of professional grade in industrial laboratories. 1920-38 data from Geo. Perazich and P. M. Field: *Indus. Research and Changing Technology*, U.S. Work Projects Adm., Nat. Research Project on Reemployment Opportunities & Rec. Changes in Indus. Techniques, Report M-4, 1940, 81 pp., pp. 65 and 78; figures were increased by 20% to 1931 and 10% to 1943, acc. to the recommendation of Yale Brozen; The Econ. Future of Research and Development, in *Indus. Laboratories* v. 4, December 1953, 8 pp.; appendix used and his Trends in Indus. R&D, *Jol. of Bus.*, U. of Chicago, 33:204-17, 1960. 1920-52 data are given for indus. labs. on first p. The Perazich and Feld data were also decreased by half the employees shown as on part time in their table A-4, and by the percentages shown as nonprofessional in table A-19. 1940 data est. from Nat. Research Council's successive reports on *Indus. Research Labs. of the U.S.*; 1946 and 1950 from *Personnel in Indus. Labs.*, 1950, by U.S. Nat. Scientific Register from Nat. Acad. of Sci.—Nat. Research Council, 1952, 13 pp. 1952 and 1954 from *Stat. Abstract*. The Govt. study (N 59, its p. 13) prefers personnel to funds data. Our 1920 figure is 5,760 professional employees.

61. Chemical Researchers. Professional personnel in Chem. and allied industries, Petroleum and Rubber, here added; 1938 and 1950 data from G. Perazich: Research: Who, Where, How Much; in *Chem. Wk.*, Oct. 27, 1951, p. 22. 1938 had 11,962. 1927 est. from U.S. Nat. Resources Planning Bd.: *Research a Nat. Resource, II, Indus. Research*, 1941, 370 large pp., a good general source. P. 180 used, classifies Research Personnel by industries, for 1927 and 1938. Jan. 1954 est. from U.S. Bur. of Lab. Stat., Nat. Sci. Studies: *Sci. and Engg. in Am. Indus.*, 1955, p. 22. 1927 figure, 3,740.

62. Organized Research Professionals. Having counts only of commercial research professional grade workers at certain years. (N 60), where there are angles in our graph, we have estimated the workers in the noncommercial laboratories according to the money put up by each in the same years, before 1939, and the amounts used by each after that. Our sources listed in N 56, preferring *Sci. Pers. Resources* and N 57, and inserting our own estimates for early missing minor items. The Industrial funds before 1939 were raised according to a later paper by Y. Brozen: Trends in Indus. Research & Devmt., *Jol. of Bus.*, U. of Chgo. 23:204-17, 1960 for underrepresentation, and with an addition of 20% to have them conform to the post-1940 data. The Govt. funds were not increased for military personnel as in chart 3, until 1940 ff. The revised basis of 1959ff. was not used. Omitted from Bush were the Research Institutes which spent 5-4 millions in 1930-40. One may cf. also *Sci. & Pub. Policy*, by Jn. R. Steelman and the President's Scientific Research Bd., 1947, 1:10, quoted by Forman in *JPOS*, p. 395 (N 208). From 1940 on we used *Fed. Funds for Sci.*, and *Stat. Abstract* for the amounts of university and comrl. research performance, and the professional counts of 1941 and 1952 from *Sci. Pers. Resources* N 85, p. 15. The 1954, 1958 and 1960 counts are from U.S. NSF: *Revs. of Data on R&D*, Apr. 1962, table 6. This divides the 1960 prelim. estimates acc. to place of employment, as Fed. Govt. 41,800; Indus. 286,200; Univs. 52,000; other nonprofit instns. 7,000. Counting workers avoids the need for an appropriate historical price index. This graph is not based on those in chart 3, nor on quite the same data. The 1960 figure is the full-time equivalent of 387,000 professional grade research employees.

63. U.S. NSF: *Scientific & Tec. Personnel in Indus.*, 1960. 58 pp., pp. 1 and 36.

65. Melman, Seymour: *The Impact of the Pat. Sys. on Research*; Study No. 11 of the present ser., 1958, 62 pp., pp. 27-31.

67. *Chemical Abstracts*, American papers. Our earlier data, to 1907, were counted from *Chemisches Zentralblatt*, taking the papers of apparently American authorship abstracted in this compendium of international coverage. Our rough sampling (authors beginning with H) should give results within a few percent of correct. For 1880 the international total was 2,662 papers, of which 5.9% were