

or more of newer, more specialized engineering societies may make our index of engineers too gentle in slope during the present century, although one survey of the total engineers in the country found them to have the same rate of increase as our members of the five basic societies.⁸² Blank and Stigler find the rise of censused engineers to have been 4% higher than our ratio, and the censused chemists twice as high, to 1950.⁷⁷ Comparison of our data on potential inventors with various governmental counts⁸⁴ of employment in science and technology (reaching back to 1870), scientists, Ph. D's under 70 years of age, etc., shows full conformity with our slopes, and with each other, except that the engineers increased slowest, and the Ph. D's fastest.

[63] It would be desirable to know whether the proportion of engineers and scientists engaged in invention or research has remained the same. There are various recent data,⁸⁵ as that in 1954 among the scientists and engineers employed by private industry, the proportions in R&D were of the engineers 25.7%, chemists 44.6%, metallurgists 30.6%, and physicists 63.4%.⁸⁶ In the four years ensuing the percentage of all engineers and scientists to be engaged in R&D rose from 27 to 33%⁸⁶; and by 1959 those primarily in R&D in industry had come to be 36%,⁸⁷ 277,100, helped by 56% as many technicians, who were 28% of their craft. For a longer view and perhaps greater significance we may resort to our chart 4. It shows that the ratio of the professionals in organized research, to the number in the major societies, as reckoned in the graph superweighting the physicists and chemists, (§ 74) rose from 17% to 52% between 1920 and 1941, then fell to 31% in 1946 and closed at 57%. Or taking the unweighted count, mostly engineers, the number in R&D rose from 28% to 89%, then declined to 46% and closed at 94%. Any accuracy as to the percentage of their time given to invention by the pertinent professions seems unattainable; but this need hardly disturb us. For those scientists and technologists probably had much to do with invention in the decades before they joined the laboratories, in business firms, or even if they were working only in pure science, or designing engineering structures, or educating future inventors. Our index of society members is only 1 of 4 subtotals, is given a weight of one-fifth among the inputs since 1924, and its graph is quite parallel to the rest, both before and after the start of laboratory statistics in 1920.

[64] Still there is here, in the apparently rising proportion of the scientists and engineers to be found in the laboratories, a consideration that should lead to steeper slopes than we have drawn, just as would also the rising ratio of assistants helping them (§ 58).

[65] All our indices of input are based on the general idea that invention has become a business, an industry like others, whose marginal output may be expected to have a regular even if not unchanging, relation to its marginal input and its publications. We repudiate the old idea, not so remote from the truth in former and ancient times as now, that invention is an unforeseeable series of lucky accidents, springing from the inscrutable genius of a few individuals. But we admit in later pages various weaknesses in our theory, and probably a considerably greater rise in inputs than in output of invention.

[66] Our 14 charted *indicia* on invention yield strikingly parallel graphs, steeply rising throughout the years each covers, except for the few electrical engineering abstracts, and for minor irregularities,