just what it is that we have measured and found increasing something like 105-fold (Output, Abstracts) or to 345-fold for Inputs.

Can the Growth of Inventing Have Been so Great?

[80] The complex we have measured has been chiefly Inventive Effort, or Inputs; only the Abstracts have represented Output, successful invention and discovery. So we should now ask what is the quantity relation here of input to output. There is no reason to suppose that a unit of effort would in all decades produce an unchanging number of units of invention and discovery. Machlup [96] and especially Sanders [97] have discussed this extensively from the theoretical point of view, with hypothetical calculations indicating that the availability of capable inventors, and the amount of invention obtainable per dollar expended, is likely to fall off greatly, with much of the money spent going as a "rent" in the shape of bid-up pay to inventors so employed, and most of the rest going to engage new men of inferior talent, interest in invention, and/or training for it. This theory is supported by the fact that the labor of 100 professionals in the laboratories was pieced out by 35 subprofessional-grade workers in 1921, which supplement rose to 180 per 100 in 1953–4. R&D has come to occupy 32% of industry's scientists and engineers, 90% of them full time, and 27% of its 594,000 technicians in industry, or 53 per 100 of the higher rank.[63] Technicians of course are only part of the sub- and extra-professional workers for invention. Professional men and students will be drawn into the inventive field from the life sciences, teaching, and all the professions, as Machlup demonstrates.[177]

[81] Another principle of diminishing returns might also operate, that most of the easy pickings, the mechanical inventions that any ingenious talent might think up—have by now been mostly picked up, so that chiefly hard ones are left to struggle for. Again, some think the modern regimentation in laboratories, with their assigned tasks, is irksome and sterilizing to inventive genius, and that the laboratory hires many a time-waster. Possibly so; but if the laboratory system is on the whole less productive than the old, less organized invention system of the 1880's, why do the corporations and government not discover this, and stop wasting 13 billion good 1961 dollars a year on the laboratories, and stop increasing their R&D real budget at a phenomenal 2½-fold per decade? Certainly it is the author's own experience that he accomplishes more under an intelligent and suitably aloof paymaster than when left entirely to his own devices. We shall charge later (¶ 622–41) that the collegiate training and traditional life scheduling of our engineers has a stultifying effect upon inventive talent, but never deny that technological training nevertheless becomes ever more necessary for invention. Sanders finds engineers today contributing 90 times their per capita share of patents, and Schmookler that 64% of patents are signed by technologists, plus 17% by executives who might also be such; [99] and Carr, although arguing in favor of the lone inventor, found similarly.[100]

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[99] Correlating the pat. scores of the Amer. States with their respective censused numbers of graduate engineers, chemists, assayers, and metallurgists, Schmookler gets an r^2 (coefficient of determination) that indicates hardly any relation (0.08) between the 2 variables in 1900, but which has risen steadily to 0.83 by 1950, indicating a very strong, almost inseparable causal connection. Adding to those technologists other, less pertinent classes, of civil engineers, architects, designers-draftsmen-and-inventors, and surveyors, reduced the rise to only 0.37→0.76