

Copy in Brillouin file

MAR 26 1945

✓ In MIT Differential
Analysis file

EB - 224 D
MIT

Differential analysis

There is a still more disturbing field, that of mathematical machines and automatism. The large newspapers announced, almost a year ago, the construction of a new machine at Harvard, and invented the epithet "mechanical brain". This Harvard machine is one of numerous examples of automatic mathematical instruments, the family of which is now numerous and powerful. The respectable and still lively ancestor is the Differential Analyzer of Massachusetts Institute of Technology. Invented and constructed by the scholar Vannevar Bush, this miraculous instrument solves with great ease highly intricate mathematical problems: differential or integral equations are solved by ingenious coupling systems between integrators. You set the machine going, and it gives you the answers in the form of curves, and tables of figures. Even before the war, the M.I.T. ancestor already had several descendants, some of them mechanical, others electro-mechanical, built in America or England. Since then, the family has grown by leaps and bounds. Certain pieces of apparatus are extremely expensive but they reach a practically unlimited degree of precision; others gain in rapidity what they lose in exactness. There are some that are entirely mechanical, other systems are electrical, pneumatic or electronic. In this field of skilful construction American inventive genius has revealed all its creative power. These examples also show how much can be accomplished by team-work: mechanic, electrician, scientist must collaborate in working out new models. No one mind is capable of accumulating all the scientific and technical knowledge necessary for the working out of one of these complex mechanical devices.

You will say this is a scholarly game, very amusing to the mathematician. Yes, of course, but it is also a disturbing robot, a mechanism with mysterious possibilities, capable of unknowingly overturning the social order!

Automatism in industry was the rule of modern times, but it had its limitations. Since the time of Watt we have known about the fly-ball governor,

which keeps the speed of a steam engine constant. Innumerable models of automatic governors have been constructed since then - their principles have developed, their precision has been prodigiously augmented, but their purpose remained always very simple: to keep a certain quantity constant: the speed of a machine, the voltage of an electrical system or the frequency of a radio station. The automatic apparatus in general had no sense organ, or rather, had only one. In consequence, its functions were very restricted and its applications were limited.

Recent discoveries have multiplied the mechanical sense organs. The machine can measure pressure or electric current, it can also acquire vision, thanks to the artificial eye represented by a photoelectric cell. To these sense organs, add a mechanical brain: there you have means for calculating, a method for registering memory, and coupling parts capable of carrying out all the operations involved in integral-differential equations. Here we have a tool which is really wonderful but terribly dangerous, because this machine feels, calculates and can command, this mechanical brain is capable of directing a whole factory, without human weakness and without fatigue.

The machine may break down, but it can be repaired. It requires a doctor and nurses to look after its delicate works. Well kept up, it is inhumanly relentless. It can become the mechanic who never sleeps, the engineer who never suffers from loss of memory, the director with no heart and without heartaches.

It would be indiscreet to reveal, even by allusion, the manifold applications of these mechanisms to the problems of warfare. They are already innumerable. The engineers who have built these tools have thus acquired practical experience and a disturbing virtuosity. Beware of tomorrow! Let us be on our guard against the scientific and technical revolutions which these machines may breed. In that, I am expressing not only my personal opinions, but the misgivings of my best colleagues and American friends, such as Professor N. Wiener of M.I.T.

Tr. from French
3/16/45 - LS