The Usefulness of Useless Knowledge

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Abraham Flexner

With a companion essay by
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Published by Princeton University Press,
41 William Street, Princeton, New Jersey 08540

In the United Kingdom: Princeton University Press,
6 Oxford Street, Woodstock, Oxfordshire OX20 1TR

press.princeton.edu

Jacket design by Amanda Weiss

Library of Congress Control Number 2016960697
ISBN 978-0-691-17476-1

British Library Cataloging-in-Publication Data is available

This book has been composed in Miller

Printed on acid-free paper. ∞

Printed in the United States of America

1 3 5 7 9 10 8 6 4 2

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The Usefulness of Useless Knowledge

The World of Tomorrow

ROBBERT DIJKGRAAF

Remarkably, the very beginnings of both technologies could be found at an institution that had been Einstein's academic home since 1933: the Institute for Advanced Study in Princeton, New Jersey. The Institute was the brainchild of its first director, Abraham Flexner. Intended to be a "paradise for scholars" with no students or administrative duties, it allowed its academic stars to fully concentrate on deep thoughts, as far removed as possible from everyday matters and practical applications. It was the embodiment of Flexner's vision of the "unobstructed pursuit of useless knowledge," which would only show its use over many decades, if at all.

However, the unforeseen usefulness came much faster than expected. By setting up his academic paradise, Flexner unintentionally enabled the nuclear and digital revolutions. Among his first appointments was Einstein, who would follow his speech at the World's Fair with his famous letter to President Roosevelt in

August 1939, urging him to start the atomic bomb project. The breakthrough paper by Niels Bohr and John Wheeler on the mechanism of nuclear fission appeared in the *Physical Review* on September 1, 1939, the same day World War II started.

Another early Flexner appointee was the Hungarian mathematician John von Neumann, perhaps an even greater genius than Einstein, of almost extraterrestrial brilliance. Von Neumann was one of the "Martians," an influential group of Hungarian scientists and mathematicians that also included Edward Teller, Eugene Wigner, and Leo Szilard, the physicist who helped draft Einstein's letter to Roosevelt. A well-told story in physics is that when a frustrated Enrico Fermi asked where were the highly exceptional and talented aliens that were meant to find Earth, an impish Szilard replied, "They are among us, but they call themselves Hungarians."

Von Neumann's early reputation was based on his work in pure mathematics and the foundations of quantum theory. Together with the American logician Alonzo Church, he made Princeton a center for mathematical logic in the 1930s, attracting such luminaries as Kurt Gödel and Alan Turing. Von Neumann was fascinated by Turing's abstract idea of a universal calculating machine that could mechanically prove mathematical theorems. When the nuclear bomb program required large-scale numeric modeling, von Neumann gathered a group of engineers at the Institute to begin designing, building, and programming an electronic digital computer—the physical realization of Turing's universal machine. As von Neumann observed in 1946, "I am thinking about something much more important than bombs. I am thinking about computers."

In his spare time, von Neumann directed his team to focus these new computational powers

on many other problems aside from weapons. With meteorologist Jule Charney, he made the first numerical weather prediction in 1949—technically it was a "postdiction," since at that time it took forty-eight hours to predict tomorrow's weather. Anticipating our present climate-change reality, von Neumann would write about the study of the Earth's weather and climate: "All this will merge each nation's affairs with those of every other, more thoroughly than the threat of a nuclear or any other war may already have done."

A logical machine that can prove mathematical theorems or a highly technical paper on the structure of the atomic nucleus may seem to be useless endeavors. In fact, they played important roles in developing technologies that have revolutionized our way of life beyond recognition. These curiosity-driven inquiries into the foundations of matter and calculation led to the development of nuclear arms and digital com-

puters, which in turn permanently upset the world order, both militarily and economically. Rather than attempting to demarcate the nebulous and artificial distinction between "useful" and "useless" knowledge, we may follow the example of the British chemist and Nobel laureate George Porter, who spoke instead of applied and "not-yet-applied" research.

Supporting applied and not-yet-applied research is not just smart, but a social imperative. In order to enable and encourage the full cycle of scientific innovation, which feeds into society in numerous important ways, it is more productive to think of developing a solid portfolio of research in much the same way as we approach well-managed financial resources. Such a balanced portfolio would contain predictable and stable short-term investments, as well as long-term bets that are intrinsically more risky but can potentially earn off-the-scale rewards. A healthy and balanced ecosystem would support

ratory school to implement his revolutionary ideas based on a deep confidence in the creative powers of the individual and an equally deep distrust of the ability of institutions to foster such talent.

Flexner first rose to public attention in 1908 with his book *The American College: A Criticism* with a strong appeal for hands-on teaching in small classes. His main claim to fame was his 1910 "bombshell report," commissioned by the Carnegie Foundation, on the state of 155 medical schools in North America, branding many of them as frauds and irresponsible profit machines that withheld from students any practical training. He didn't hesitate to label institutions as disgraceful, shameful, or even fictional. Chicago was characterized as "the plague spot of the country." The effectiveness of the *Flexner Report* is the stuff of advisory committee dreams. It led to the closure of almost half of the medical schools and the wide