instant and where also the pressure driving the gas particles past the piston rings will be the greatest.

This in no way militates against the work done by A. G. Williams[3] on cylinder wear; he came to the conclusion that corrosion was the principal factor in cylinder wear. Corrosion goes on all along the surface of the cylinder exposed to the exploded gases, but the chemical effects produced by the CO_2 when it goes into solution with the water of combustion corrodes the surface of the cylinder and make the material of the surface of the cylinder just that much easier to pick off by the rapidly moving gas particles as they speed past the piston rings at the upper end of the stroke.

Shadow photographs of the rush of gases from the muzzle of a revolver show the gases escaping ahead of the projectile. This means that around the bullet, *i.e.,* between it and the inner wall of the barrel, gas is being forced at high speed in a fashion like that of the exploding gas around the piston and rings of the internal combustion engine. Here again the principle of Bernoulli operates to tear out the particles composing the inner wall of the barrel of the gun.

The "Big Bertha" started with an inner diameter of 8.2 inches to its detachable steel lining. After 66 shots had been fired, the inner diameter was 9.2 inches. If the principle of Bernoulli was effective the inner diameter of the lining should have been eroded more at the breech than at the muzzle. No data are available on this point, but Mr. P. A. Shepherd, an official of the J. Stevens Arms Company of Chicopee Falls, Mass., tells me that any rifle manufacturer knows that the erosion at the chamber end of a rifle barrel (throat erosion) is greater than at the muzzle. This substantiates the idea that the principle of Bernoulli is an important factor in this wear of a rifle barrel as well as that of an engine cylinder.

As a physicist I can see possibilities in this point of view, but there may be other phases to the problem which have not been considered and which might rule the Bernoulli concept completely out of court by the automotive engineers.

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ANOTHER VALUE OF A NATIONAL POLICY OF RESEARCH

MR. FRANK[1] has set down several excellent values that would accrue from having a national policy of research. However, he does not mention the greatest value of all, that of providing a rigorous concept of what is meant by the term research. As concepts of this sort need defining in terms of operational procedure, Mr. Frank's committee might well attempt to submit to the scientists of this country an outline of the basic steps and logical implications that underlie all modern research. This is no small undertaking, but is surely one that is basic to a national policy of research. The term research, if we are to continue to use it, should have a greater meaning than simply critical thinking or systematic examination.

Furthermore, if we are to urge research upon the members of society as a panacea for their ills we should be able to explain, very definitely and precisely, what constitutes research. If research is to be accepted as a fourth pillar of the state, at least the scientists, let alone the layman, should clearly understand how research is both related to and distinct from common-sense investigation. Modern usage of the term "research" is beginning to smack of faith-healing—a miraculous but mysterious process.

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SCIENTIFIC BOOKS

ELECTRONICS

An Introduction to Electronics. By RALPH G. HUDSON. x + 97 pp. New York: The Macmillan Company. 1945. $3.00.

IT seems to the present reviewer that this little book should serve a very useful purpose. It is written in extremely elementary language, but the author has succeeded in describing in relatively few words the essentials underlying the operational principles of a number of important electronic devices. The book will be useful to one who knows practically no physics because it will enable him to get a bird's-eye view of the operation of the essential devices. It will also be useful to the very advanced physicist because frequently he has not had time to acquaint himself with the devices which exist. A few words of elementary description is all that he needs to call the devices to his attention, and his own knowledge of physics will supply him with the remainder of the possibilities of understanding to a degree of detail, of course, much greater than is given in the book itself.

The book contains a well-balanced distribution between diagrammatical and pictorial material. Naturally it does not contain any appreciable amount of fundamental theoretical matter, but is essentially descriptive.

One does not demand very high logical accuracy in

[3] A. G. Williams, *Jour. Inst. Auto. Engrs.,* London, June, 1933, Vol. I.

[1] L. K. Frank, SCIENCE, 101: 433, 1945.