

The Importance of Highway Research During the War

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Research is always important—important to finding ways to deal maximum destruction to the enemy; important to preserving and enhancing the arts of civilization.

The importance of research beyond that needed for war purposes is so great that, although it is inevitable in war-time that some slowing down must take place, it must not be allowed to stop.

However, there is slight danger of stoppage. There are many evidences of continued scientific activity. The past year has been one of activity and achievement in highway research. The remarkable program of research results that was presented at the recent meeting of the Highway Research Board and the program of this Road School are evidences of that fact. And no less interesting is the fact that an increase in highway research activity of more than 50 percent has been indicated for 1943 as compared with 1942.

While perhaps not consciously to have been expected, it is easy to see, in retrospect, why this was so. We went through a shaking-down period in which we were all seeking to find our place in the war-time work of our country; and during that time, a lessening of interest and activity in the intricate work of technical research, except that strictly applicable to getting on with the war, was unavoidable.

Now, a great many of us, who have found that the privilege of service with the armed forces is not for us, have come to realize that we have a job to do even in our accustomed setting. We have to help keep the Nation functioning so that the support the Army and Navy needs for conclusive victory may be provided. And research men, particularly, have the duty also of looking ahead and getting ready to pick up the pieces of our stricken civilization and get them assembled again.

To keep the country functioning and to prepare for the future, it is not enough to hold what we have. Progress must not only be maintained, it must be accelerated.

WHAT IS RESEARCH?

Since the beginning of the world and mankind, we have been studying the phenomena of nature to discover the laws of physical and human relations, which were laid down at the creation but not disclosed to man except as he has used his intellectual endowment to decipher them for himself.

This endeavor comprises the sum total of research.

Civilization has progressed haltingly in accordance with the intensity of the endeavor to discover the natural laws and apply them to the benefit of mankind. When research stopped, such effects have been seen as the decline of the Roman Empire, in which civilization gradually ran down, culminating in the dark ages when man forgot most of what he knew of natural laws and lived by superstition and almost forgotten remnants of knowledge, the true meaning of which he did not know.

The application of natural laws can promote destruction or progress toward better life.

Through all the historical period the research endeavor to find more thorough ways of destroying each other and our works has gone hand in hand with the endeavor to enrich human life.

That the preponderance of result is in favor of the latter is evinced by the fulness of modern civilization, but past events have shown that civilization can be submerged for a time, and that the road back is a long and painful one.

With the preservation of modern knowledge and the will to increase knowledge and understanding, there is no need this time for a backward slip.

To be more particular, research has been variously defined. In a broad sense it is any study aimed at the acquisition of new knowledge and new ways of using old knowledge. Even the rediscovery of things others already know may be research to the individual, although perhaps his time could be better spent in the search for sources of existing information before he starts his research.

The mere assembly of statistical data to support a preconceived conclusion, or indeed for any purpose, is not research as we interpret it, although it is often called that.

Perhaps I should be more specific with the meaning of research to the highway field. What we do in highway research is better described as the *systematic* search for new knowledge and better ways of using what we know.

The sum of highway progress through research is the integration of innumerable investigative studies. Very seldom is a big jump ahead made through a single brilliant achievement. This fact was well described by Herbert Hoover when he said:¹

Discovery and invention do not spring full-grown from the brains of men. The labor of a host of men, great laboratories, long, patient, scientific experiment build up the structure of knowledge, not stone by stone, but particle by particle. This adding of fact to fact some day brings forth a revolutionary discovery, an illuminating hypothesis, a great generalization, or a practical invention.

Since this is so it is as necessary that research studies be integrated as that they be made. To do the research work, men must be trained in scientific methods, funds must be found, and opportunities for creative work must be provided. Integration comes through correlation of effort and information, and through field trial. The circulation of research information among research agencies, discussion and crystallization of thought through committee work and meetings, and the presentation and discussion of results at meetings are requisite activities to this end.

WAR-TIME RESEARCH

Work in highway research in this country is nowhere near so closely integrated as would be desirable. On that account our multifold research agencies had no opportunity to lay out a plan for co-ordinated activities during the war.

In England, where there is only one highway-research institution, the Road Research Laboratory of the Department of Scientific and Industrial Research, it was decided "at the outbreak of the war that the resources available for road research should be assigned to: (1) Continuing observations of long-term experiments where the fruits of years of valuable effort would otherwise be wasted; (2) maintaining co-operative researches with industry where this was desired by the participating trades and where the research objectives were linked with war requirements; and (3) studying problems directly arising from war-time road maintenance and construction."

In spite of our own lack of co-ordination, the progress of research in this country since the start of the war has been along these same general lines. This is evidenced by the reports presented at the two war-time meetings of the Highway Research Board.

¹ *Science and Appliance*, November, 1943.

Particularly notable with respect to "problems directly arising from war-time road maintenance and construction" is the large amount of war-time research work relating to the design of flexible-type pavements, and to foundation problems incident to their design. This activity was largely stimulated by the huge demand for runways to be built to carry the much heavier than highway loads imposed by military airplanes.

Of the 74 research reports presented at our two wartime meetings, at least 45 can be considered to be of timely importance. How necessary these may have been to the prosecution of the war is one of the imponderables that cannot be precisely evaluated, but at least it is invaluable work and could in no way detract from the war effort. Indeed, a great deal of it was of direct interest to the War and Navy Departments.

RESEARCH FOR PEACE TIME

This war will be followed by a roadbuilding era that will far surpass the between-wars highway development, great as that was. Rehabilitation alone will necessitate a huge program, to say nothing of the bound-to-come regional and metropolitan area increases in highway-transportation facilities; and airport construction, which depends upon the same physical facts as road building, will enlarge the picture. To take care of the responsibilities that this development will devolve upon highway technologists, research must go forward now. We can't afford to wait until the big job is on us. The work of the Indiana Joint Highway Research Project here at Purdue is a shining example of preparedness in our field.

In fact, the present time offers a golden opportunity for carrying on certain types of research. Present emergency traffic conditions, coupled with the difficulties in providing adequate maintenance, are accelerating many effects that cause deterioration in the pavements, and now is the right time to evaluate designs, materials, construction methods, and maintenance methods so that research can pay off when the new highway development and rehabilitation programs come upon us. A typical example of a kind of work that should be done now is that being done by your Joint Highway Research Project on the problem of what to do to prevent and cure the pumping of concrete pavements.

In the past 25 years a huge mileage of improved roads has been built which, through many years, has experienced all the vicissitudes of climate and traffic, of use and abuse. These roads constitute the greatest laboratory imaginable for the study of all the forces that

attack the durability and usefulness of road improvements. As Mr. Hadden so aptly said at the Highway Research Board meeting:

We now have a very important mileage of highways reaching every year the age of 20 years, which is a rather dangerous and delicate age in the life of almost any kind of pavement. What are we going to do with them? I want you to regard these present highway systems as state-wide experimental highways. You know the loads that have passed over them. You know how the highways have performed. You know that some have been successful and others have failed. Before we start on our next great cycle of highway development, let us try to evaluate these various factors.

The present facilities for highway research, integration of results, and translation into terms for practical use are not adequate for the needs of the highway plans that can be reasonably foreseen for the not-far-distant future.

I cannot say—I wish I could—how means for research commensurate with the size of the coming highway job may be provided; but I can point out what is necessary:

1. Train more research technologists.
2. Do more research work.
3. Provide for more complete correlation through dissemination of progress information, by a system of interagency reports and personal contacts.
4. Greatly enlarge the facilities for conferences and committee work on both research and utilization of research.
5. Make the results of research more widely known in practical, usable form.

The last item, "make the results of research more widely known in practical, usable form" needs more discussion, because it is of particular importance during the war.

We all know that the lag between development of new ideas and methods through research and their application in engineering practice is too great. Of course, the usable results of research do make their marks in time. A glance at a modern through highway as compared with its progenitor of 1920 gives indisputable evidence of that fact. But just the same, the gap is too great and definite arrangements for closing it up should be made.

The situation was truly analyzed by Frank Sheets. He said:²

However, in spite of the benefits which would follow such reforms in report writing [research reports written from the practitioner's point of view], the fact remains that in many cases after the researcher has gone as far as he can toward grasping the need of the practitioner and presenting his findings from that point of view, and after the practitioner has gone as far as he can in entering the realm of the researcher, there still remains a "No Man's Land," a missing link between research and practice. In such cases, we badly need an interpreter.

Recent experience has developed a practical procedure for useful work in this "No Man's Land".

When the organization of the Highway Research Board for its work in war-time was being considered, it was early realized that a need of the time was for practical statements which would put the most up-to-date and proved developments in many phases of highway engineering into simple, easily understandable terms.

The procedure adopted was to have a series of bulletins on war-time road problems prepared by committees composed of researchers and practitioners of recognized authority. To date, eight such bulletins have been published, and the widespread demand for them indicates a reasonable degree of success in attaining the objective. Several more are being written.

Although conceived and carried out as a war-time measure, such work is no less important to the advance of highway technology in normal times; and it is hoped that the activity can be continued and enlarged as a very important feature of our work.

The first duty of all United States citizens is the prosecution of the war with unflagging vigor. The second duty for thoughtful men and women is to prepare for the needs of the trying period to follow the war.

Research workers have important functions in both. May we measure up!

² Sheets, Frank T.—"A Challenge—Shorten the Lag Between Research and Practice," *Journal, American Concrete Institute*, May-June, 1938, Vol. 34, *Proceedings, American Concrete Institute*.