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NATIONAL PRESTIGE IN SCIENTIFIC ACHIEVEMENT[1]

IN our development and application of scientific principles, the intensive factor of publicity is by no means to be ignored. It may be magnanimous to give others full credit for what they have done and to belittle our own achievements, but it is hardly fair to the nation as a whole so long as public opinion continues to be so strongly influenced by publicity. We are familiar with the prestige in pure and applied science enjoyed by Germany prior to the war and many of us are familiar with her methods, some of them entirely legitimate by every standard, others entirely indefensible by any standard. We envied Germany her diligent, productive scientists, smiled at her many false claims to superiority and originality, contributed rather freely to German scientific literature, with some qualms of conscience and pretty generally despised German technologists for their piratical methods. "How do they ever get away with it?" we asked ourselves and let it go at that. It never occurred to many of us to assert our scientific independence as a matter of national duty and Germany was rapidly attaining the leadership she craved. In penance we now burn our German books and studiously avoid reading anything in that language. We are surprised to find how well we can get along without anything in that language and for how little we are really indebted to that nation.

Still it is well worth while to trace out the underlying principles and to apply them to the enhancement of our national welfare. In her

[1] Since this article was prepared (in September) there has appeared in SCIENCE a letter by Professor E. B. Wilson on "Insidious Scientific Control." It appears highly desirable to give this matter immediate and careful consideration to the end that our technical and scientific societies may take effective action in the near future.

good, bad and indifferent activities, Germany attracted a great deal of attention and we are fortunate in having for study a case so well developed and (now) so well understood.

It can not be claimed that scientific ability per capita was higher in native-born Teutons than among other civilized races, yet it is doubtless true that the scientific and technical output was greater in proportion to population in Germany than in any other country and that the prestige she attained in science, technology and in her industries was truly remarkable. In this discrepancy between native ability, achievement and reputation lies the key to the whole problem of securing national prestige in achievement.

More than that of any other nationality perhaps, the Teuton mind had the faculty of intensive application. A specific problem occupies it to the exclusion of almost everything else. While we are prone to work a few hours, then turn to something else or run off to play, the Teuton eats and sleeps with his problem, takes little interest in anything else, talks shop with his colleagues and does not completely relax even in his limited recreation. Our own most eminent scientists, although by no means our most richly endowed, are men who have continued in one line of work year after year and who carry a group of problems with them everywhere.

We Americans are as ready as any to see and to attack difficult and important scientific problems. Nor do we lack the incentive and application necessary to obtain results. What we do lack is the "follow through" to thoroughly search out and master a problem in all its details, generalities and side issues before turning our attention to new problems. To minds teeming with ideas all clamoring for attention, it is not easy to ignore the many that a few may receive fuller attention. However it is obviously necessary to correct this tendency to scattered effort if we are to attain our full measure of national prestige.

The Teutons were further the most prolific writers of scientific and technical literature in recent years. Our libraries were filled with their journals and reference books, and, being available in such profusion, our chemists and physicists constantly consulted them and grew to regard them as authoritative and indispensable. From our own point of view, printing was simply less expensive in Germany, new journals were easily started and books were readily accepted for publication on a narrow margin of profit. Many a struggling scientist eked out a meager salary by compiling and writing reference books when such would not be attempted in this country by men of equal ability. Our publishers require a far greater margin and our experts are too busy to do much writing. Our few good journals are crowded with material for publication months in advance. However distasteful it may be, publish we must if we are to be regarded as leaders.

Alien students, university professors and technical men working in Germany have added greatly in building up her scientific prestige. These aliens in Germany represented fully ten per cent. in each class—clear "velvet" to her and a corresponding loss to their own countries. The alien students came in about equal numbers from Russia, England and the United States with a scattered representation from Scandinavia, Switzerland and Japan but there were hardly any French or other Latins. No special inducements were offered alien students but matriculation was easy while fees and living expenses were very moderate—hardly half those at Cambridge or Oxford. The instruction itself was hardly worth any special effort but it was accessible and it differed from the home product. This country has drawn quite a number of students of engineering and science from Latin America, Japan and China with a few from Russia, Germany and Holland, but with inflexible entrance requirements and moderately high living expenses, alien attendance at our universities has not been large.

German universities drew freely upon foreign countries for their instructors. Their budget system is extremely flexible compared with ours and they drew men freely from Russia,

Holland and Switzerland. It is said that Nernst found Einstein living in a garret in Switzerland and had little difficulty in engaging him for the University of Berlin. It has been estimated that a third of the more noted German scientists were foreign born. Nearly all of these aliens soon become Teutonized and were thereafter regarded as German. No small fraction of the prestige enjoyed by German universities was due to imported talent and to that of the Jews who were treated almost as aliens. The faculties of our universities are undoubtedly too immobile. A freer transfer of instructors from one university to another and from foreign universities to our own will undoubtedly lead to better instruction in them and enhanced prestige for them.

Technical men of ability of all nationalities found in Germany a welcome and a rich field of endeavor. Facilities for working out processes were good and capital for developing manufacturing possibilities not difficult to obtain. A large fraction of the better known German manufactures originated in France, Italy, England or America, the inventor having gone to Germany to secure the opportunity for development not available at home or foreign process having been adopted and developed. We have neither the cheap capital nor the cheap labor in this country but we have the raw material, cheap power and the market, with unequaled opportunities for industrial research in a wide variety of lines of manufacture. What we most need perhaps is a more perfect mobilization of our industrial resources to the end that fewer industrial prospects of value are left unworked. With such we should be able, with improved processes and machinery to compete with cheaper capital or labor anywhere in almost any line of manufacture.

So much for those factors in Germany's scientific and technical prestige more or less worthy of our consideration. There have been many other factors which we need only know to guard against. Plagiarism and piracy were common practises, and from personal knowledge I doubt whether a third of even the more eminent German scientists were free from this taint. Further, work of foreigners was taught as the work of Germans in both literature and science. Neither fairy tale nor scientific discovery, if in an obscure publication, was safe from adoption as their own while the misleading of the young student was easy and common. Our own faults are quite the reverse of these. If anything, in our own work we pay too little regard to the work of others and in our teaching we are rather inclined to magnify the work of foreigners and disparage our own.

In short Germany's scientific and industrial prestige was due chiefly to a better mobilization of forces; freer publication, better opportunities for research, to ideas and talent imported from other countries and plenty of push and pride in achievement. What we need in America is a better mobilization all along the line. We possess plenty of talent, as a rule not well directed nor given much encouragement. We have plenty of universities and industrial research laboratories of the highest grade, operating as uncoordinated individual units with very little team work to achieve large ends. We have many strong scientific and technical organizations each holding regular meetings and supporting one or more journals. These organizations, like our universities, are strongly individualistic and exhibit very little team work or cooperation to achieve broad purposes. Science is only just beginning to be popular in our schools and in the public press; we need to advertise and popularize not only scientific and technical work, but especially deep broad fundamental principles in every line of effort. Finally and most important of all we need vastly increased effort in living up to our possibilities. In habitual effort the Teutons excelled us by at least 30 per cent. and at least equalized their deficiency in originality. We might easily double our stress of achievement without detriment to ourselves.

For some of these problems in securing our prestige and independence through achievement, we have no solutions to offer; for others

the solutions are obvious. Our government has already made a tremendous stride in the promotion of national welfare by drafting our young men and sending them to colleges and universities for their higher mental, physical and moral training. If continued, this policy should yield a plentiful supply of well selected material for our higher scientific, professional, technical and administrative positions, imbued with proper habits and principles.

In the mobilization of our man power already developed, much could be accomplished by our great engineering and scientific societies if but given a freer hand in directing affairs affecting national welfare and in working our broad fundamental problems. They are already providing fairly well for the development and publication of scientific and technical literature and could undoubtedly take care of this and of the writing and publication of reference books. Many very valuable pieces of work have been done by individuals and committees for their organizations which would never have been undertaken by the individual alone. The societies mentioned stand between our great educational institutions and the national welfare which is the objective of higher education and it is very gratifying that they are gaining in influence in both.

The popularizing of organized knowledge and fundamental truths and vital principles of all kinds lies with our individuals of accomplishment and refined judgment. Let these be given every possible encouragement and inducement to pass on their knowledge to those less favored and less advanced.

Finally the increase of our total output all along the line through greater incentives to achievement can only come from the habitual emphasizing of those factors in productive achievement which every individual recognizes in himself. Whenever the question of whether to undertake or not to undertake arises, let us put ourselves under contract to produce certain results. To many of us the strife to increase our income or to secure the praise and respect of others are powerful factors. If we live up to but fifty per cent. of our possibilities we shall at least double our effective output and as a nation, state or individual command the respect of others.

P. G. Nutting

THE CRITERIA IN THE DECLARATION OF CHEMICAL INDEPENDENCE IN THE UNITED STATES[1]

The funds and knowledge and experience of every branch of scientific activity, every ounce of our strength and every grain of our intelligence have been drawn upon in the defense of our firesides and our ideals.

It was a real epoch in the history of chemistry in warfare when the Chemical Warfare Service Section was created as one of the components of our military organization. By its inception the government acknowledged and proclaimed its appreciation of science—entirely too long withheld—for never before has this country realized how indispensable a chemist is in the fabric of our modern economic conditions.

Chemistry is the criterion of a country's very existence. It is the "science of the transformation of matter" underlying all the activities of our complicated social system ever changing, and as well the untold wonders of to-morrow. This fundamental science looks into everything, focuses her light upon everything, directs our paths when the light of nature fails and "allures to brighter worlds" and leads the way. The chemist leads on—harnessing the forces of the universe to his ends, for, in the words of Kipling, "his is the earth and all that is in it." Indeed, for this reason arises the conception that national preeminence in chemical industry means a national world supremacy.

The chemists of America never concerned themselves with the prostitution of science, but called upon to provide our nation with the new diabolic arms of modern scientific warfare developed by a militaristic autocracy, they served ably and completely. Our eminent success is a cause of pride to every American. In

[1] Address delivered at the annual meeting of the Alabama Section of the American Chemical Society in Birmingham, December 7, 1918.