

**V. I. Vernadskii, “War and the progress of science,” *Ocherki i rechi* (Petrograd, 1922), 129-140.**  
(from the 1915 collection *What Awaits Russia from the War*)

The time humanity has been going through on the verge of the twentieth century scarcely has any analogy in all previous history. And scarcely anytime has anyone had to undergo so quickly in the course of a few years changes so great as those through which our generation is fated to pass. Doubtless the great war has been in the making for decades, if not centuries, in certain of its parts; the future and even the contemporary historian can indicate even now some of the aspects of its connection with the past. There is hardly any doubt as well that the bloody clash underway is a consequence of diverse historical processes simultaneously reaching their completion, and this war, one way or another, having given an outlet to the forces of the past, will start a new future. It is clear to all that after the greatest upheaval experienced by mankind in history, those trends and perspectives that once seemed current to us and might have gone on without a striking change for years and decades can no longer continue unchanged.

After this war so much new will unavoidably come to life that it won't be possible to extend the old, quietly and with impunity, as if nothing had been interrupted. That which is now being experienced by humanity is a phenomenon broader in its consequences than what was brought into human life by the year 1789 and its awful echoes.

In a strange fashion there is one aspect of human life, where a historical breakthrough bearing a catastrophic character, grand in its scope and amazing in its vistas, began much earlier and has barely attained its apogee even now. The end of the nineteenth century and especially the beginning of the twentieth century in the history of science is an amazing and unprecedented era of catastrophic change, an era of the greatest scientific revolution. Prepared without a doubt by the past, this breakthrough has still seized us like a whirlwind and forced us to change and keep changing our views and perspectives exceptionally quickly and hastily, and this, it would seem, in the most solid and completed domains of thought. Of course it is not possible here to go into any considerations about the character or content of these changes that have been introduced into our scientific thought and into our exact science [*znanie*] by means of mathematical and physical sciences [*nauki*] in the first few years of the twentieth century. It is only important to pause at what has been obtained with regard to this change, a curious psychological result which is analogous in many ways to that now being experienced in world political life. We have learned in the last few years not to be surprised by anything in science, to regard the impossible as possible, to boldly and calmly approach scientifically the kinds of problems which until recently only scientific imagination or philosophical speculation stepping outside the bounds—and then only rarely—would even get close to. A huge change in the psychology of the scientist has come about in the last few years, a change whose influence is still far from accounted for and has only begun to tell itself in scientific creativity and in problems which are audaciously beginning to be posed by researchers and their organizations. For anyone acquainted with the history of ideas it is becoming indubitable that in the wake of such a change in the psychology of the scientific environment a new creative course must follow in religious and philosophical domains of human thought.

And at this moment the great world war brings to the political setting and to the broad popular masses creating modern history elements of those very attitudes which have already been experienced for years in the scientific setting and in this way slowly penetrates the budding youth. That feeling of profound attention which the ongoing war summons in every man accustomed to thinking in scientific life is

therefore understandable, even apart from those attitudes and feelings which it summons in him as a citizen of his country.

But besides this the great war of 1914 is reflected in the global scientific movement by other aspects as well. Foremost, in this war we see more than ever the application of scientific tactics to the solution of problems of a military character. The dispassionate character of exact science in its aid to military destruction is telling. The novelty introduced into the war consists not only in the organizational details that permit setting in motion completely unprecedented armies of millions, but also in an application of scientific knowledge unseen earlier. The war in the air with airplanes, zeppelins, and hydroplanes, the new artillery devices of unheard-of power or accuracy, the various applications of electric waves [i.e., radio] or electric current, the new explosive materials, all are doing their baneful work here for the first time. Without a doubt, despite the bloody consequences full of anguish, all this stimulates scientific creativity, directs the powers and thought of researchers in new domains of scientific efforts. And along with this one cannot deny that comparing the results obtained with the development of military destructive or defensive activity which is being sketched out as possible to the scientific researcher, we find ourselves still at the very beginning of the attainable scientific applications to the military art. Those natural forces which already concern scientific thought now, whose conquests have been started by us and doubtless will not stop, but will go further to the end, are barely starting to register in this war and bode still greater disasters for the future, if they are not limited by the powers of the human spirit and of more perfect social organization. There is hardly any doubt, though, that however the war ends, both the victors and the conquered will be forced to direct their thought to the further development of scientific applications to military and naval affairs. A spirit of elevated patriotism will push both of them toward this as well, and a correctly or incorrectly conceived consciousness of state necessity. There is hardly any doubt that individual creative and inventive work in this direction is ever increasing now amidst humanity; everything that is being clarified in the war is taken into account as a lesson or problem of the near future. On the field of battle those very human societies have clashed in whose midst the scientific work of humanity is now being forged, and whichever may be defeated, in its midst an elevated creative work in this direction will ineluctably rise, and out of a feeling of self-preservation there must run counter to it work of a different sort.

Scientific development will not stop war, which is a consequence of multifarious causes inaccessible to the influence of scientific workers. Let there be no illusions. The war now raised will not be the last; it will awaken human creativity for further perfection in this direction. But since this creativity coincides with an epochal flowering of exact science unprecedented in human history and with an ever increasing high enthusiasm of scientific audaciousness, of consciousness of power, of faith in the attainment of the nearly impossible, one has to think that the domain of application of exact science to military art will expand in the immediate postwar years, and a new war will be met with the kinds of weapons and means of destruction that will leave far behind them the disasters of military life in 1914-1915. For now, despite the exceptional significance of scientific technology in military affairs in comparison with the past, we see here less change than that achieved, for example, in scientific thought or scientific apparatuses in the same period.

*[There follows a separate section in which Vernadskii essentially extends his plea that scientific creativity can also be channeled against the destructive forces it has so successfully unleashed. By this he means both working politically against militarism, but also developing defensive technologies (e.g., gas masks).]*

Along with stimulating scientific thought and scientific creativity the war of 1914-1915 has also laid its heavy hand on the development science. It has drawn away resources going to peaceful cultural scientific work, has torn away her workers for long months from scientific work. Thousands of talented people have fallen on the fields of battle and in the field hospitals, and among them were those who in the normal course of life would be great scientists. It must be that among them there were also the kind that are born only once in a generation. [For example, Henry Moseley and Karl Schwarzschild were both already doing world-class work in physics before they died in battle.]

But the break in scientific relations is probably the heavier blow brought by the war. Science, like art and religion, and even more than art and the majority of religious systems, is a cultural organization, little dependent on governmental or tribal limits. Science is one. Its aim is the search for truth for the sake of truth, and that truth which is obtained by the effort of centuries-long scientific work far from the historical circumstances of the moment, general and one to all without distinction.

Indeed in science as in the world religions there is neither Greek nor Jew.

In recent decades the ideal of scientific unity has begun to acquire wide bounds, starting to take the form of a global organization. Beginning in the sixteenth century—and if you like, even earlier—since the time of the single science of the Western Middle Ages, in the scholarly setting communication existed beyond the bounds of government alliances. The petty bickerings of the political interests of the day, it seemed, fell silent before the interests of scholarship [science]. In the scholarly setting it seemed that man, if only in one aspect of his culture, lived in the ideal future order of unified mankind. Since the second half of the nineteenth century the international organization of scientific work has joined the age-old practice of the scholarly setting and its custom of amicably traveling in different countries and among different tribes and peoples toward a single goal general to all humanity, having taken a variety of ever-growing forms. It is now difficult even to list the international initiatives concerning the most varied issues and feeding a gradually more intimate ideological [*ideinoe*], personal, and working proximity of scientific workers around the world.

All of this was immediately and suddenly broken off with the beginning of the war. Now for many months already scientific life is going on almost independently in different scientific centers; we know nothing about what is being done in Germany or Austria. Neither the scientific publications issued there nor the results of individual scientists or laboratories are reaching us. Our connection with our allies is better, but still far from the normality of the usual communications. Scientific work everywhere is continuing on its own and in general has barely noticeably faltered from the war. As we know, science in Russia is going at the earlier tempo, developing and expanding now as it developed earlier; we know that it has also not been interrupted or diminished in the years of our other national upheavals—not in the years of the Japanese war, not in the years of the revolution [of 1905].

One can scarcely speak of scientific work in Belgian territory or in the precincts of Polish ethnicity; for a time the war was strongly reflected in French scientific work, but there life has largely already returned to normal in this regard.

Undoubtedly scientific work has not changed tempo at all in the neutral states and in England. For Germany and Austria we have very unclear information, but apparently the external bounds (scientific journals) remain for the time being generally untouched by the war.

But in any case the external interruption of scientific relations has already been reflected more strongly on the scientific front than in any other aspect of human life besides perhaps commerce. It will be reflected even more in the future, thanks to the profound changes which will take place in the psychology of the scientific environment. With the rapidity of international communications scientific work was always proceeding with an intensive exchange of the results obtained. In this exchange German scientists and German scientific literature constituted until recently the binding international cement and one had to reckon with it in current work more than any other scientific literature. On the European continent not a single country could compete with the Germans in this regard. They founded the tradition of this kind of communication, and since the middle of the eighteenth century, at least, they have worked unswervingly in this direction. Undoubtedly since attaining national unity this form of scientific activity of German scientists for the past forty years has achieved—with the huge cooperation of foreign scientists using the German language—high development and is an important element of scientific progress. It is possible that the Germans have done more for science with this organizational work than with any other aspect of their scientific creativity. The war sundered this longstanding work and it will hardly be rejoined again in the previous forms, for the hatreds brought on by the war will not soon heal. Even now—after forty years—memories are alive of 1870-1871 in the mutual relations of German and French scientists, and we felt them constantly at international congresses and in international enterprises. What is happening now is an even greater event, one penetrating rather more deeply into life than the Franco-Prussian War, still very much alive. The tactless speeches of German scientists, their attempts to justify and excuse inexcusable barbarities, their insolent, dismissive attitude toward the scientific work of other nations, crudely laughably exaggeration of their importance in the general global scientific work of mankind can hardly soon be forgotten and smoothed over. Unfortunately the war has brought into the scientific environment of mankind grave creations of the spirits of spite and hatred. Now and in the coming years, at least, German scientists will hardly be able to reestablish the high standing they have lost in science, a standing founded by the amicable, persistent labor of previous generations.

We can't wait until then. The end of the war is not yet in sight. A general exchange of global scientific work must be founded in a neutral setting, far from the immediate experiences of the shadows of the war of 1914-15 in the future, too.

One's gaze turns involuntarily to the work being done in recent years by the trans-Atlantic Anglo-Saxons, mainly in the United States of America. Here, especially in the last ten years, one observes a colossal growth of scientific work, and in addition the Americans, with the help of English-speaking scientists, have recently founded—for their own needs—independent journals analogous to the German ones, indexes, and compilations. In the last few years these publications have begun a bloodless contest with the analogous work in German. And now we will have to use them, the more so because they give a fuller picture of what is being done in the New World, where it just so happens that there is powerful growth of organizational work in the domain of natural science and mathematics. Undoubtedly old Europe will thereby lose a notable share of its significance—the global reins of scientific organization are passing to the New World. Maybe this would not be so if it were not for the world war, although even earlier the growth of scientific literature in English was noticeably faster than the growth of scientific literature in German. And in this growth the work of the citizens of the American states has advanced to the lead position.

*[A separate section on the economic damage caused by the war, and the importance of science for a future recovery. The struggle with nature raises ethical questions for the dispassionate scientist, for*

*“in a strange way, the scientist seeking truth in his activity, striving to comprehend his surroundings, at the same time constitutes a definite factor of an ethical character in [social] life. In striving to penetrate nature, he is striving to master its forces and thus always increases mankind's productive forces.” Europe is still in an advantageous position for the postwar era, “since 70-80% of all mankind's scientific creative work is still done in European states and in their colonies, by her races.”]*

All these considerations concern science as a global cultural force, beyond any relation to an individual country. But apparently all of this can be carried over in its entirety to our country, to the society in which our scientific work is proceeding.

Each of us clearly recognizes that from all the viewpoints indicated above the growth of scientific knowledge, the increase of efforts for the support and flowering of scientific creativity, the increase of material means for this is one of the important tasks which will arise after the war in Russian life.

Increasing and expanding our scientific organization, its more intensive work and its greater material power is one of the most effective means for the struggle with the grave consequences of the great war that has fallen the lot of our motherland.

But for Russia the tasks of such work can be posed in a more concrete fashion. For us much has become clear during the war and above all it became clear to everyone what was earlier clear only to a few—our economic dependence on Germany, which had a completely unacceptable character under proper government management. The fact that this has been made clear to Russian society is obviously a fact of the greatest importance, for a change in the state of affairs will unavoidably be a consequence of this recognition.

One of the more important factors for such a liberation is the utilization of our possessions by our powers. But for this we need to solve a purely scientific problem, to produce an account of the productive forces of our country. We must know what there is in the depths and on the surface of our country, we must be able to utilize them technologically. Neither of these is possible without the broadest scientific research and without great, in part preliminary, research work.

Russia has expended exceptionally little up to now for the study of its riches, for mastering its natural forces. Other great states have acted otherwise. Right now a lively example of a country comparable to ours in size is the United States of America. It becomes embarrassing when we compare their knowledge and our knowledge about the riches and resources for our country's use. And by the way, we began our work in this direction nearly a century earlier. The matter is easily explained. The work here has gone by bits and pieces, in large part by voluntary efforts of private societies and individuals doing these researches in their free time. There was all of this in America, too, perhaps even more than here. But there was something else there—the colossal aid for this work both from the whole union and from the individual states—especially for the past forty years. The resources which have been expended by the [federal] state there for this work were never available in similar measure to Russian natural scientists. I leave aside even those resources which were given by wealthy private individuals, not comparable in America and here, but speak only about state resources.

And this expenditure was via the regular use of state resources. It has long recouped itself, since it brought the productive forces of America, by way of data, into an active state. Here these productive forces, probably greater than those that have fallen the lot of the States, lie as dead capital, in large

measure inaccessible to their owner.

This example is instructive, and it should be used. And research work on productive forces should be done in Russia like it was by America after the civil war.

After the war of 1914-1915 we must raise awareness and account for the natural productive forces of our country, i.e., the first order of business should be finding resources for the broad organization of scientific researches of our nature and for the creation of a network of well-equipped research laboratories, museums, and institutes, which will give bearings to the growth of our creative force in the domain of technical utilization of the riches given us by nature. This is no less necessary than the improvement of our civil and political living conditions, so clearly recognized by the whole country.

Translation: KH