World's Scientists in Life-and-Death Race: Allies Now Outstripping ...
By FRANK PARKER STOCK BRIDGE.
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World's Scientists in Life-and-Death Race

Allies Now Outstripping Teutons in Discovery and Invention, Which Have Been Speeded Up to Greater Progress in the Last Four Years Than in Previous Four Decades

Escadrille of French Biplanes, Each Armored and Armed with Rapid-Fire Machine Guns.

The Morane-Saulnier Machine, a French Bimotored Biplane, One of the Latest Aircraft Inventions.

By FRANK PARKER STOCKBRIDGE.

THESE pictures are six months old, so the devices they show are, of course, perfectly obsolete," was the comment of an army officer who was recently describing the use of searchlights in war.

The remark is a commentary on the speed with which scientific knowledge, as expressed in the practical application of science to the myriad uses of war, is advancing to new pinnacles of achievement. The war is very definitely, in its material aspects, a test of the relative scientific resourcefulness of the powers involved. Apart from the psychological elements that will play the ultimate deciding rôle, victory, if the war is fought to a finish, will go to the side that commands the higher quality of trained intellectual ability and mobilizes this brain power most efficiently. Upon this resource, rather than upon reserves of money, materials, or men, depends the success of the allied arms.

Progress of science in the last four years has been faster than in the preceding forty-year period, which began with the electric light and telephone and culminated in the airplane and submarine boat. It is probable we would have had to wait a generation or two, without the stimulus of war, for the development of the airplane into a safe and practical vehicle, or for a satisfactory method of utilizing the antiseptic properties of chlorine, or for a feasible process of fixing atmospheric nitrogen—to mention only a few outstanding advances in the fields, respectively, of physics, medicine, and chemistry.

"Chemistry will win," was a popular slogan in Berlin in the early days of the war. To the German mind this meant that Germany would win, for Germany through forty years had been one huge physico-chemical workshop. In the first year and a half of the war the German mastery of applied science constituted a tremendous advantage against the Allies. Not that Germany had a monopoly of scientific genius; quite the contrary. It is susceptible of demonstration that Germany's vaunted scientific superiority consisted merely of the commercialization of the principles discovered by the scientists of the more idealistic nations. But the question whether the inventive ability of the Allies—the term has included America from the beginning of the German advance into Belgium so far as matters of science and invention are concerned—could be organized and speeded so as to set up an effective defense against the enemy's scientific onslaught, while at the same time marshaling the scientific resources of the rest of the world for an overwhelming counter-offensive, was one that only hope could answer affirmatively. Upon an affirmative answer depended the chance of an allied victory. It was not until the war was nearly two years old that that answer came.

Today it is true, as in the beginning, that chemistry—using the word as a symbol for all scientific knowledge—will win the war, just as Berlin boasted. But it will be allied chemistry, the application of the scientific and inventive genius of the great scientific and inventive nations, Great Britain, France, Belgium, Italy, and America. Of that there is no longer a doubt.

The Allies caught up with Germany long ago; now we have overtaken and outstripped her. The science of the Allies is no longer on the defensive, but vigorously on the offensive. Invention has succeeded invention, application has followed application, with a speed that is bewildering. What was standard practice yesterday goes to the scrap-heap today, to be succeeded tomorrow by yet another device or method evolved by the most highly specialized brain power ever mobilized.

The Biggest Gun in All France.

American scientists and inventors have contributed greatly from the start, though as a nation in arms we have not yet reached the stage of scientific mobilization reached in England and France. To quote Professor Joseph S. Ames, head of the Department of Physics of Johns Hopkins University, who was one of a special scientific commission sent to Europe immediately upon America's entrance as a belligerent:

"All the scientific work of the country is organized: there is no lost motion. There is complete co-operation between the staff, the men of science, and the manufacturers. The officer in the army or navy states his problem; he wishes to be able to locate the position of a battery of guns or a submarine; the scientific advisers instantly set to work. A geologist thinks his science can be of use to the General at the front; at once an opportunity is given to him to prove the correctness of his idea. An airplane pilot thinks he can improve his machine; a manufacturer, without a day's delay, makes the alteration desired. It is wonderful. A whole nation at war is an awe-inspiring sight."

There is still somewhat lacking in our American war organization this instantaneous response to the changing need. Although we have made long steps toward scientific mobilization, our science is not yet entirely mobile. True, we established a Naval Consulting Board eighteen months before we entered the war, and after the war is over the story of the truly wonderful applications of science to naval necessities, for which that board is responsible, may be told in detail. Both the army and the navy have called to the service of the nation tens of thousands of scientists and technical specialists, a large proportion of whom are serving, and observing, abroad, while our principal allies maintain in this country scientific missions, constantly augmented by new arrivals fresh from the scene of action, to co-operate with our own men of science and practical production engineers. We are still badly hampered, however, by our deadly American habit of overorganization, the natural outcome of our passion for system; the tendency to erect a general scheme and make everything conform to a standard, regardless of whether it is susceptible of standardization or not.

Too much of our earlier efforts at the application of science to war was under the control of boards of the type that General Goethals described as "long and narrow and made of wood." Under the scheme of standardization proposed by the original Shipping Board, for example, there was no place whatever for the concrete ship, in many respects one of the most marvelous manifestations of applied science the war has developed. But we are now doing better, moving faster, loosening the fetters of tradition, and, in many lines of scientific advance, keeping pace with, if not leading, our allies. Best of all, the combined efforts of the allied scientists are beating the boche at his own game.

A few days ago the cables from the American sector on the Lorraine front told about the capture of a German rifle having an ingenious device for protecting the breech mechanism and nozzle against the mud of the trenches. The dispatch went on to say that this had been forwarded to the Army Intelligence Service at Paris, with the request that similar devices be provided for our own rifles. In itself trivial, the incident indicates not only that we have established a definite connection between the need of the man at the front as he sees it and the machinery for supplying that need, but that we—the Allies as a whole—have not ceased to learn from Fritz and take a leaf out of his book whenever it contains anything more than a scrap of paper.

In the beginning the scientific advantage was all on the German side, and in no phase more completely so than in aeronautics. No other nation had anything even approximately matching the Zeppelin; nowhere was there a fleet of fighting airplanes comparing either in numbers or in speed and military usefulness with those of Germany. It is a safe assertion that before the war there had never been built outside of the Central Empires two airplanes exactly alike. Aviation elsewhere was still merely an extremely hazardous form of sport. Every airplane builder was also an inventor, who strove to embody in each succeeding machine, painstakingly turned out by hand, all the improvements he had dreamed of while building the last one.

England and France learned how to build military airplanes by the intensive study, to the minutest detail, of every German machine brought down within the allied lines. As fast as the Allies produced planes swifter or more powerful than the German, the Teutons came forward with new types, which in turn had to be overmatched. Nothing more dramatic than the race for air supremacy has occurred in all the history of applied science. Designs decided upon to the point of actual construction were discarded overnight.

Four years ago the aviation service was regarded as the limit of extra-hazardous risks. Today it is so much safer than any other form of warfare that the men in the trenches facetiously call the aviators "slackers." Altitudes, speeds, and endurance undreamed of in 1914 are daily commonplaces. With engines lighter and more powerful than had ever been devised, the military aviator of today could fly on a tea-tray, almost. In 1914 he was content to try to imitate the birds; today a sane bird would not attempt the nose-dives, loops, and tail-spins that are part of every fighting flier's necessary bag of tricks.

A year ago the Allies had definitely gained supremacy in the air. There have been probably a hundred important improvements in fighting planes since then; types have been discarded and later revived as the designs and tactics of the Germans have changed. To hold our advantage means constant progress and continual change. Washington dispatches last week announced that on cables from General Pershing extensive plans for the manufacture of single-seated scout planes had been abandoned

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in favor of two-seaters. Before these are ready for shipment, conditions may again change and render the two-seaters obsolete; so difficult is it to standardize anything so essentially flexible as an aviation program. It is quite possible that we may have to reconcile ourselves to abandoning the idea of stamping "Made in America" on everything our army and navy use, as we have already done in the case of the 75-millimeter field gun, and do some real team work with our allies by letting them apply their tremendous manufacturing facilities and vastly greater experience to the production of fighting planes for all of us, while we concentrate on quantity production of training planes and engines. If the war were to end tomorrow, however, the world would find itself as far ahead in the science of aeronautics and its practical application as it would have been after fifty years of peace.

When the British Navy first tackled the U-boat, everything that would float served as a submarine chaser. In that emergency there was developed in America a standardized motor launch, 80 feet long, of which 550 were built for the British. So long as submarines were small and operated close inshore, these little boats did splendid service. Today the big seagoing submarines find their Nemesis in the new type of flush-deck destroyers built by our navy, the last word in naval construction. They have not been photographed, these new craft; no description of them has been published. Like the secret of the depth bomb, another achievement of applied science, this is a story which must wait until after Germany is defeated.

The policy of silence and mystery with which the whole war on the submarine has been shrouded is deliberate on the part of the British Navy and our own working in co-operation with it. Nothing could be better calculated to disturb the German morale than to have a large percentage of submarines disappear, with no clue as to the method of their capture or destruction or even the time and place. It is not violating confidences to say that this process is going on. The ablest exponents of applied physics on both sides of the Atlantic have contributed devices and processes which, when finally disclosed, will furnish thrills aplenty.

Still in the domain of physics, where the achievements of applied science are always most spectacular because the most readily observed, but bordering on the field of medicine, is the advance made in the art of orthopedic prothesis —in plain English, artificial limbs. France, with 50,000 amputations in the first twenty months of the war, had to find some means besides the peg-leg and the Cap'n Cuttle hook to enable her cripples to return to industry. Dr. Jules Amar and other French surgeons took the lead. British, Canadian, and American surgeons followed. Men who have lost both arms now write, dress themselves, even operate the typewriter, with artificial hands miraculously articulated, while a whole new art with its accompanying literature has developed out of the successful efforts to re-educate and restore to usefulness every disabled soldier of all the allied armies. A staff of the ablest specialists in America is attached to our own Surgeon General's office for this particular work.

Of Dr. Dakin's discovery that chlorine is the most efficient antiseptic for deep wounds and Dr. Carrel's technique for its application, whereby the control and healing of the deepest and most seriously infected wounds is reduced to mathematical precision, leaving nothing to chance or the individual judgment of the surgeon, volumes have been written. "The only actual advance in surgical science in fifty years," it was characterized recently by a leader of the medical profession. Closely approximating this in importance is the discovery by another physician of the Rockefeller Institute, Dr. William Townsend Porter, that traumatic shock is caused by the entrance into the circulatory system of globules of fat from the bone marrow and the subcutaneous fatty tissues, a discovery that was quickly followed by a method of treatment which has saved thousands of lives in a few months.

Out of the psychological tests applied to the soldiers of our national army is developing a new method of wide application for the determination of the mental capacity and status of the entire population. Through the work of the Public Health Service in establishing sanitary conditions in the extra-cantonment zones, new ideas in public health control have been evolved. These achievements in war science will have permanent application to peace conditions.

Winning the war, of course, is the main object of scientific research today, and the laboratory of the war scientist is as close to the battle front as conditions will permit. Every unexploded shell fired by the Germans contains a possible clue to some new way of defeating them. The chemical analysis of German gas shells enabled the Allies not only to devise the type of gas mask that would afford complete protection, but to invent a deadlier gas to use in reprisal. Five times as much gas is now being discharged against the Germans as by them, and new methods of producing chlorine and other ingredients are being applied in the chemical industries of America.

Wars cannot be fought without nitrogen, the basis of all explosives. The world's supply of fixed nitrogen comes from Chile in the form of nitrates. Germany is getting hers from the air—a method that was little more than a laboratory experiment until the war began. We are importing double our normal supply from Chile, but we need the ships for other things, so the Nitrate Division of the Ordnance Department is building in Alabama two plants, costing about $50,000,000, to extract nitrogen from the air. By July 1 these plants will be getting nitrates at the rate of 100,000 tons a year. It took the chemical and electrical experts of the War and Agricultural Departments nine months to work out from the camouflaged German patents the essential steps of the latest German process. After the war is over our farmers will get nitrate fertilizer cheaper than ever before.

There are thousands of scientific applications of which we do not hear and will not hear until the war is over. There are thousands of other inventions of which we will hear only through the howls of rage reverberating through the hotel corridors of Washington, emanating from disgruntled inventors who say they are the victims of "favoritism," "red tape," or "the system," whatever that may be. Probably many meritorious inventions have had chilly receptions in the departments and bureaus; certainly every impractical visionary with a plan to end the war overnight has knocked at the doors. But Washington is getting more receptive by the day. The Bureau of Standards is overworked, testing new devices and processes, and down in the Patent Office history is performing its familiar repetition. The civil war covered the period of the greatest activity and expansion in the Patent Office up to that time. More patents were granted in 1862-66 than in the entire previous history of the department. Today the Patent Office is fairly swamped. Only a few days ago the Commissioner of Patents sent out a frantic appeal to every one who had ever been a patent examiner to come back to work for the rest of the war period.

The war will not be won by any one invention or application of science. Science, in the aggregate, will win, just as Berlin predicted.