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THE CHEMIST IN THREE WARS—II

By OTTO EISENSCHIML

PRESIDENT, SCIENTIFIC OIL COMPOUNDING COMPANY, CHICAGO

THE PRESENT WORLD WAR

Now that we are in the midst of the second World War, what is the set-up among chemists for support of the war effort? Have we organized our forces so that they can be and are being utilized in the best possible manner?

I wish I could answer this question in the affirmative.

The top government agency created for scientific war work is the Office of Scientific Research and Development, headed by Dr. V. Bush, president of the Carnegie Institution of Washington. This office can both initiate war projects or solve them; in practice it also functions in an advisory capacity. Much actual work is being performed under the direction of the National Defense Research Committee, of which Dr. James B. Conant, president of Harvard University, is chairman. This committee has two chief divisions pertaining to our line of work, that of chemistry and physics; organic problems are in charge of Dr. Roger Adams, of the University of Illinois, inorganic and industrial chemical matters are under the direction of W. K. Lewis, of the Massachusetts Institute of Technology. The National Inventors Council, under C. F. Kettering, is designated to sift novel thoughts submitted to it. Some problems, which are military secrets, have been assigned to government controlled laboratories; there is no doubt that these tasks are being handled well, and under fine leadership.

So far, so good. What we need next is a complete roster of all chemical talent in the country; such a

roster would make the over-all picture look promising. Right here, however, is where the first flaw begins to show. Our national roster is not complete, nor nearly so; yet, without a complete card index, our top agencies are like an army without an inventory of its manpower. An incomplete list of our chemical talent is about as useful as a telephone directory with half its pages missing. In our directory, I am afraid, even the information that has been listed is not sufficiently accurate.

The preparation of a complete roster to cover our entire chemical brainpower must be based on two indispensable conditions. For one, we must have a questionnaire which is worded right; second, this questionnaire must reach everyone who has useful knowledge or ability. I regret that, in my opinion, neither of these two conditions has been met by the national questionnaire nor any other I have seen.

The questionnaire sent out by the American Chemical Society in October, 1940, to form part of a "National Roster of Scientific and Specialized Personnel," and sub-titled "Jointly Administered by National Resources Planning Board and United States Civil Service Commission," inquired thoroughly into routine qualifications; in fact, it bore a close resemblance to an application blank. Much stress was put on scholastic background, publications and similar matters, when it might have been advisable to go more deeply into qualities particularly useful in war, such as chemical work performed during the last war and, still more essential, into the type of mind possessed by the registrant, whether inventive, inquisitive, supervising or routine. The statistical information derived from a roster compiled by present methods is scarcely adequate to allow an opinion of a man's capacity in a national emergency. We may learn from it that a man's height is five foot eight, but we do not learn if he is resourceful; we may find that he can read French, but we wonder if he is persevering or tires easily. We are informed how old he is, but not whether he is an organizer or a routine worker. At a time when speedy chemical action may be as decisive as in a commando raid, the questionnaire digs into positions held in the past, instead of asking, "What can you do *now,* and where do you think you fit in best?"

All in all, the picture of the registrant that emerges from this national questionnaire is far from illuminating.

The gravest fault I find with this questionnaire, however, is that it did not reach and was not designed to reach every one willing and able to render chemical service. Neither the American Chemical Society nor other organized groups of chemists comprise all members of the profession. Some independent thinkers—and they are not the least valuable—shy away from membership in any group; others are staying on the sidelines for reasons which do not matter. Fact is that many chemists do not belong to existing groups, and so long as they are not included in questionnaires, our rosters will remain incomplete. A close coordination of all our mental resources means regimentation, voluntary and temporary, but regimentation, nevertheless; and unless regimentation is thoroughgoing it is a failure. I believe therefore that a special effort should be made at once to add to our home front all men of chemical training or ability who do not belong to organized chemical groups. Their patriotism is as unquestioned as ours, and they will no doubt cheerfully join us, if and when approached.

Furthermore, we can not afford to overlook those who have no chemical degrees or formal schooling. Some of our best inventive minds received little or no college training, but have within them that spark which no amount of education can supply. Heaven help us if we close our doors to the Thomas Edisons and William Hoskinses, who never saw the inside of a college. In wartime the emphasis is on achievement, not on learning and degrees. When we need a war song, we turn to the man who can write a tune, whether or not he has a diploma from a musical academy. On the battlefield a sergeant who can move a gun across a swamp is worth ten officers who know Napoleon's Egyptian campaign by heart. One of the finest chemists with whom I have worked graduated from a little-known pharmaceutical college; and I have two men on my staff who never had more than high-school training, but whose tangible achievements have made history in their particular field. One of our partially trained chemists has worked out a special oil which increases its technical value manifold. Yet, he has no college degree, and for obvious reasons his work has not been and probably will not be published. If he were to fill out a questionnaire, the column "Publications" would remain blank, thus creating an erroneous impression. Incidentally, none of the three men I have mentioned belongs to the American Chemical Society or to any other chemical organization; their names are on no roster, local or national, nor have they been given any opportunity to register.

This leads us to another weak spot in our armor. A tendency prevails in some circles to undervalue our collateral artisans. Nevertheless, without them the industrial chemist would be helpless. I once had a foreman who could take a few pipes and couplings and turn them into almost any kind of apparatus I needed. I would like to see him on the roster. Perhaps we ought to enlarge the circle of our coworkers still further. I have known ordinary laborers, whose power of observation and interest in their work have been responsible for vast improvements. These élite

of workmen are potential shock troops of industry, and in war-time should be placed where they can do the most good. They should no more be allowed to work in non-essential lines than a chemist should be permitted to drive an army truck.

A new questionnaire, recently prepared by the Defense Committee of the Chicago section, American Chemical Society, contains two questions that intrigue me:

1. Are you of an inventive turn of mind? What have you invented? List even little improvements you have sponsored.
2. Give names and addresses of people you know (not members of the Chicago section) with unusual ability in any collateral work.

At last we are getting somewhere. Not only will Chicago obtain essential information from its own members by asking these pertinent questions, but it will create a real census of many other worthwhile minds in our line of work. Chicago will be able to put its fingers on those who possess unusual ability in collateral fields, whether it be glass blowing, mechanics, photography, repair work or any of the other talents and skills that are called into play in industrial war work.

Nothing that I have said should be misconstrued into an expression of disrespect for pure chemistry. Many problems, if they are to be solved, call for the highest kind of chemical training and require large, well-equipped laboratories. Cracking processes or condensation plastics could not have been developed by poorly trained chemists in basement workshops. Germany never would have achieved her early superiority in dyes and pharmaceutical products without an army of well-schooled men; nor could we have accomplished what we have done in the last twenty-five years without equally fine research chemists and organizations. On the other hand, we should recognize that many problems can well be attacked by practical men with the meager means at their disposal and by simple and direct methods. With the growth of chemistry, subdivisions among chemical workers have developed both vertically and horizontally; horizontally—in different fields; vertically—different grades of men in each field. As in our armed forces, there should be no feeling of superiority or jealousy between different branches of the service, or between the officers and soldiers in each of them. Just as the Army, Navy and the Air Force, and within them all personnel from generals to kitchen police, must cooperate to the fullest extent, so pure scientists, industrial chemists and practical workers in all chemical lines must join wholeheartedly in their efforts to achieve the best results. To disregard this principle is to nullify everything we are trying to accomplish.

It is highly regrettable that we have not proceeded very far beyond the creation of the Office of Scientific Research and Development and the National Inventors Council. What we need badly are local organizations throughout the United States to supplement those of national character so as to put a broad foundation under them.

In this respect remarkable work has been done by Robert C. Brown, Jr., a patent attorney of Chicago. He recognized the need of technical organization for our war effort as early as 1940 and, almost single-handed, translated his ideas into accomplishments, by founding the Associated Defense Committees of the Chicago Technical Societies, in which twenty-three technical and engineering bodies are represented. Over seven thousand scientists, technologists and production engineers in the Chicago area now cooperate through a committee of delegates. A working plan for complete cooperation between the local office of the War Production Board, the Chicago ordnance district and other Government agencies on one side and the Associated Defense Committees on the other is already partially in operation, with Mr. Brown furnishing the connecting link through his appointment as consulting director of the Technical Development Section of the Chicago Region of the War Production Board. This gives the Associated Defense Committees at least a semi-official status and means an important step in the right direction.

Milwaukee and South Bend also have organized Associated Defense Committees, and plans are under way to form similar committees all over the United States. Eventually a National Associated Defense Committee will assume leadership of the entire movement and coordinate the efforts of the local sections.

That all this important work should have been left to the unselfish patriotism, the vision and the energy of one man, is something I admire, but do not understand. While he has accomplished a Herculean task, we as a country still find ourselves far from our goal. We do not want to achieve a perfect national organization of chemists and other scientific or technical brains after the war is over. We want it now and should have wanted it yesterday and the day before yesterday. No matter how well single localities may be functioning, their numbers are puny when we consider the picture as a whole. Wars are won by armies, not by isolated units.

Why no national organization of this kind has been formed to extend fully into local spheres, I do not know. We have before us the example of the Army with its local draft boards and of our political parties with networks covering each precinct in every district. Unless we bring cooperation of all technicians likewise down to the grass roots, we shall have fallen

short of the primary requisite of our duty: we shall have failed to mobilize our full power, and this means that we shall be unable to put it to concentrated use when most needed.

Local boards must be created immediately, if we are not going to be too late, and they should be organized after a standard pattern. Uniform rules must necessarily be worked out at headquarters. Questionnaires should be drawn up with the utmost care and with appeal to our three distinctive groups, the scientific chemist, the industrial chemist and the practical man. I would hold each local group responsible for enrolling all workers within its district. I further recommend that government inspectors call at all plants to insure complete enrolments. So far as chemists are concerned—I am using the word in its widest sense—we are still trying voluntary cooperation; but in every previous war voluntary systems have given way to enforced draft, because the voluntary systems have never worked satisfactorily in the long run. Had we not best anticipate the inevitable? Time is getting short.

The present war has not yet produced anything startlingly new from the chemist's point of view. Nevertheless, there is plenty of chemical work in sight. Among many other things we must now, strangely enough, do what German chemists had already learned to do in the last war—work out substitutes. Twenty-five years ago we had command of the seas and the world's resources, while Germany was blockaded. To-day it is we who are blockaded in regard to some vital war materials. Hence, American chemists are called upon to use their ingenuity to supply the country with substitutes.

I use the word "substitutes," because it is generally used; but it is not a desirable expression, smacking as it does of the German word *Ersatz;* it carries with it an overtone of disdain, an implied apology, an intimation that what we are offering is something to be used only until something better is developed. Yet, a substitute may be better than the original article, as when we use silver in place of copper. What we are really looking for are not substitutes at all, but replacements. This word carries no stigma, and we all understand that a replacement article may be inferior, equal to, or better than the standard material.

This replacement question needs much clarifying. Most of all, it should be generally understood that a replacement product need not be identical with, or even similar to the article it replaces; all it is expected to do is to answer the same purpose.

"Is Oiticica oil a substitute for tung oil?" I have been asked time and again.

"Is a detective story a substitute for a movie?" I have countered. "If you want a couple of hours of light entertainment, yes; if you want to hold a girl's hand, no."

A pair of cotton stockings is not a substitute for silk hosiery, but a replacement, better in some respects, worse in others. As dessert, apple pie may be a replacement for ice cream, unless you are looking for something to cool your insides. I think all chemists have a clear picture of the issue, but the general public needs enlightenment; for once this elementary analysis of the substitution problem is understood, many questions, now hazy in the public mind, will lend themselves to more intelligent discussion. Take the subject of "rubber substitutes," for instance. The daily press is full of it and treats the question as if rubber substitutes, meaning the duplication of natural rubber by synthesis, were the sole answer to the problem. We hear that the total consumption of rubber in the United States is 800,000 tons, and therefore it is taken for granted that 800,000 tons of synthetic rubber must be produced to reestablish the normal balance between production and consumption; even the Baruch-Conant-Compton report apparently takes this view. Yet, I wonder if events will not prove that those who subscribe to it have missed a salient point. If every one understood that what we must do is replace rubber, not duplicate it, many of our experts might revise their figures. Rubber is used for any number of purposes, from bathroom mats and dress shields to the inner tubes of tires. But every one knows that a bathroom mat can be replaced—not substituted—by a cotton rag; in dress shields oiled silk will do very well; but for inner tubes we probably will need natural or synthetic rubber.

What becomes of our 800,000 tons of synthetic rubber when we look at the situation with a view of replacement instead of substitution? Let us assume for argument's sake that normally one per cent. of all rubber goes into bathroom mats and one per cent. into dress shields and other sanitary accessories; by replacing it with cotton rags and fabric impregnated with drying oils, respectively, we already have cut these 800,000 tons by 16,000 tons a year. Does it not seem reasonable to think of replacement in other lines where rubber is used now, before burying ourselves in a statistical avalanche?

Here is where our chemical organization could function rapidly and successfully. The mere breaking down of the rubber question into components, emphasizing replacement rather than substitution, would make the whole problem appear at once much less formidable. The National Defense Research Committee, with the help of all local committees, should separate all uses of rubber into special groups, with a clear analysis of the purposes for which each

article serves. The more thorough the subdivision, the more useful it will be. We know that rubber is by no means an all-around perfect material. It is affected by sunlight, heat, air, oil, steam. Many of its good qualities do not matter at all for some purposes; neither bathroom mats nor dress shields have to snap back when stretched—and there is no reason why they should be stretched. Rubber has been used for many articles as a matter of habit or on account of price. For purposes of replacement all that is necessary is to draw up intelligent and thorough specifications for the proper material wanted, without mentioning rubber at all, and many problems that look difficult will become simple. What we need for dress shields, for instance, is not rubber, but a waterproof material that can be used to impregnate a fabric without damaging it; it must be light in weight, reasonable in price and resistant to the excretions of the human body. That is all. A properly oiled fabric will not only answer these specifications, but may outperform rubber. I am willing to go on record that when this war is over, rubber will not come back into many fields in which it has reigned supreme up to now. Like other undisputed champions, it may lose its crown, once its supremacy is seriously challenged.

An intelligent and minute subdivision of the uses to which rubber is put and for which replacement is desired, is essential. Take the subject of rubber gaskets, for example. Entirely different specifications will have to be drawn up for gaskets used in plumbing and those used on fruit jars; but even the specifications for fruit-jar gaskets will differ according to what is inside the container. A jar containing pickles will call for a type of gasket different from a jar containing mayonnaise. The great advantage of a thorough subdivision is that each replacement material need only cover a small range, and that within this small range it may easily be better than rubber, without possessing any of the qualities for which rubber is unique. Let us remember that a good shortstop need only be a good fielder and batter; it does not matter whether he is also a good golfer, or whether he can speak Portuguese.

The proper subdivision of our replacement problems is one of the principal tasks for our organized chemical forces, wherever a replacement problem must be attacked. After that it is a matter of distributing the problems into small fractions that are not unwieldy. Each subdivided problem will naturally go to those specialists whose knowledge seems most adaptable for any particular goal. The development of a genuine rubber substitute, in the sense of a synthetic duplication, calls for highly trained research chemists commanding big resources; but the development of replacement products calls for chemists of all kinds, in fact, for technical men of all kinds. Once the rubber question is broken into fragmentary problems which can be easily understood by laymen, it would also be criminal folly to underestimate the service that can be rendered by the intuition, experience and skill of those who are versed in related arts. Excellent solutions may easily spring from individuals who have no knowledge at all of rubber itself.

What holds good for the rubber problem holds, of course, equally for many other shortages with which we are beset; but as the parallelism is obvious, a detailed discussion of other materials is superfluous.

Considerable dissatisfaction exists among many American chemists, because their energy and patriotism has not been harnessed to obviously pressing national needs. Chemists are aquiver to use their ability in the war effort; I am as sure of it as I am that our soldiers are eager to get into battle. Yet, many capable chemists are standing by with nothing worthwhile to furnish them an outlet for their enthusiasm. Is everything chemical in so perfect a condition that we can afford to leave all this potential ability and experience idling around?

Perhaps more problems would be available if we were allowed to hunt them up ourselves rather than wait for the military men to bring them to us. If we chemists were better informed about what is going on at the front, we might be able to initiate new ideas, possibly even one as revolutionary as the first German gas attack. The trouble as I see it is not that we chemists will fail the Army men when they come to us asking questions; the trouble is that they may not know what questions to ask us, and we, ignorant of the situation, are too uninformed to help them.

Let us assume that certain important war materials are being affected by the heat of the Sahara or the fog of the Aleutians. The Army sends out an SOS call; it goes to our National Defense Research Committee, which in turn will immediately formulate the problem into chemical terms and—after completion of the proper set-up—will send it to local boards for urgent action. But meanwhile much time will have elapsed and considerable damage may have been done; for most likely the Army's call will not be sent out until a serious fault has already developed.

In order to expedite the work, or perhaps prevent harm before it has made much headway, why not have chemical observers at our fronts? We have press correspondents, why not chemical scouts? It would be their duty to note the conditions under which military equipment is used in the tropics or in the arctic, and they may advise preventive rather than remedial steps. Even with a complete organization of our chemical forces at home we must, under

existing conditions, cross each bridge when we reach it—if we have a bridge. By receiving advance notice of impending trouble, however, outlined to us by trained observers, we could save considerable time and, conceivably, even prevent a military disaster.

Admittedly, complete confidence in military matters can only be given to a select few; but there is no reason why chemists should not be included among them. The more we chemists know about military matters, the more readily we can cooperate. The German professor who suggested the gas attack at Ypres was not asked for it; but he saw for himself that trench warfare was tending toward an interminable stalemate, and he offered chemical means to overcome it. Presumably, our chemical scouts may likewise originate by themselves chemical measures of either an offensive or defensive nature, which could have a decisive influence on the outcome of the war. So long as we are satisfied to do no more than supply chemical first aid, we shall play a secondary part. Chemists can do better than that, but in order to do so, they must be given an opportunity to be more than advisers.

When and if our organization is functioning smoothly, problems will be submitted to our local boards. Some of these problems will be of a confidential nature, and care will have to be taken that only men are put to work on them whose loyalty is beyond question. I can visualize many other problems, though, which are not secrets and could be posted publicly, so as to give everyone an opportunity to put his brain and skill to work. Let these notices appear in thousands of places, in laboratories, factories, post offices. Or are we too proud to let people know that we are in need of certain improvements? Everybody knows now that we are short of chromium, tungsten, rubber. We are not too proud to call for money in form of bonds; why shy at technical contributions? Cooperation between workers and managements has already produced splendid results. Is there any reason why this cooperation should not be put on a broader basis, including not only working conditions, but also matters of warfare?

This, then, is the set-up I envision to accomplish a complete mobilization of our chemical strength.

First, a supreme chemical council to govern all war work. It should have representatives from all chemical branches, scientists, industrial chemists, practical men, and be subordinated only to a national board of directors, provided such a board exists or will be created.

Second, a large number of trained chemical scouts, keen, imaginative and experienced. They are to gather at the source whatever war problems present themselves, offensive, defensive or remedial.

Third, a nation-wide roster to include all chemical talent, college-trained or not, both inside or outside existing chemical organizations.

Last, chemical groups covering each territory, modeled after a uniform pattern worked out by the national supreme council; these local boards to be in contact with each other as well as with headquarters and to be associated in turn with working groups in collateral fields.

With such a set-up the handling of all chemical problems will be greatly simplified and their solutions hastened. We shall then not only answer questions asked of us, but our scouts at the front will originate questions and formulate them better than would be the case if the reports came to us through military channels.

I have so far spoken mainly of problems submitted to chemists for solution and not of ideas that may originate in chemists' minds. Ideas of this kind are now being taken care of through the National Inventors Council and need not concern the National Council or the local boards.

It is now nearly a year since we were forced into war. An organization of all chemical ability in the country is an urgent necessity. Many chemists are convinced that organization has not proceeded far enough and are unhappy because they feel they are not being given an opportunity to put their shoulders to the wheel. It is for these reasons that I am submitting my suggestions; they may not be the best approach to the goal, but they should furnish a basis for a discussion on how to best utilize our tremendous chemical power, second to that of no other country on the globe, but one which must, like all our other resources, be fully employed.

The Civil War was Business, the first World War was Big Business, and the present war is Super Business of such gigantic proportions that it almost surpasses comprehension. But it is still business. The Germans have learned their lesson, and they have a board of directors, whether or not it functions under that name. That shrewd businessman, who would have used poison gas properly in 1915 to win the first World War, is no longer absent from their council tables. Who else would have suggested building cardboard tanks to be left stranded on the Austrian roads and in the streets of Prague so as to entrap the gullible governments of England and France into a belief that all German equipment was of inferior quality? It is he who has set up an advertising (propaganda) department that works with diabolical ingenuity. His handiwork is visible in a thousand little tricks, none of them calling for genius or even learning, but all calling for shrewdness and cunning.

In this war, for instance, the Germans did not waste their surprise weapons on small objects; when they played their parachute trump, it took Holland.

Some day our over-all management of this war will meet the well-nigh perfect German business machine with a wholly perfect American counterpart. Then everything will be well; as an integral part of the nation's organized brainpower we shall know where we fit in and how we can do our share to achieve victory.

In the Civil War three chemists kept the South in the running until the end; one chemist in the North made the United States independent of the most critical foreign material. In the first World War, a German chemist almost decided the issue in favor of his country through one brilliant thought. Can we, at this critical time, afford to toy with our chemical potentialities and act as if we were preparing for a war five years hence? Our enemies have had the initiative in every theater of this war so far, for reasons that may or may not have been beyond our control. But we have no excuse whatever for letting the initiative slip from our hands in the chemical field; it is an even race, unless we choose to handicap ourselves by dawdling or undue optimism.

We American chemists are quantitatively superior and qualitatively at least equal to the chemists of Germany. If we let them beat us through better organization, we shall have no one to blame but ourselves.

OBITUARY

NORRIS JONES

NEWS of the sudden death of Norris Jones on September 17 causes sorrow to his friends and associates. On account of the variety and excellence of his talents, their influence was much larger than his modest disposition would indicate.

Norris Jones graduated from Swarthmore College in 1926, and was an architect by professional training. His interest subsequently led him to the use of drawing for biological description, and he and his wife, Ruth McClung Jones, were members of the staff in biology of Swarthmore College.

As an architect, Norris Jones knew the proper use of material and, as a scientist, he appreciated how buildings could be adapted to the use of their occupants. His skill and taste are recorded in the suitability of the Edward Martin Biological Laboratory at Swarthmore College for the biologists who work there. The same skill and good taste were used in the projection of plans for reconstruction and for new buildings at the Marine Biological Laboratory at Woods Hole, Massachusetts.

In his work on drawings for scientific use, Norris Jones has illustrated a number of books and biological studies of others as well as his own. The drawings which he made are workmanlike, true and clear. They pick the essential pattern to be presented and show it graphically, but without leaving chance for distortion. His work is true art serving science.

The qualities of clear observation and truthful presentation made Norris Jones a fine associate to work with. Those who penetrated through his modest exterior found in him delightful qualities for friendship. Students who worked with him followed the direction of his fine personal qualities as well as his art and science. The result was a valuable influence upon their characters, which was so strong as to surprise those who had seen only his modesty.

The work of Norris Jones was cut off while in the full strength of development and opportunity. That loss to his colleagues is a great one, for they have come to depend upon his advice and help. But in the buildings which he has projected, the fine illustrations which he has made and in his clear and pleasant influence upon his associates, he has left a recorded accomplishment sufficient to do honor to a long career.

LAURENCE IRVING
EDWARD MARTIN BIOLOGICAL LABORATORY,
SWARTHMORE COLLEGE

RECENT DEATHS

DR. CYRUS F. TOLMAN, professor emeritus of economic geology of Stanford University, died on October 13 at the age of sixty-nine years.

DR. ARTHUR D. HIRSCHFELDER, professor of pharmacology at the University of Minnesota, died on October 11. He was sixty-three years old.

DR. GILMAN D. FROST, emeritus professor of medicine of Dartmouth College, died on October 8 at the age of seventy-eight years.

DR. J. C. SCHOUTE, emeritus professor of botany of the University of Groningen and president of the sixth International Botanical Congress, has died at the age of 65 years. He is known for his numerous contributions to plant anatomy and morphology.

SERGEI CHAPLYGIN, chief of the laboratories of the Aero-Hydrodynamics Institute of Moscow, a member of the Russian Academy of Sciences, died on October 8 at the age of seventy-four years.