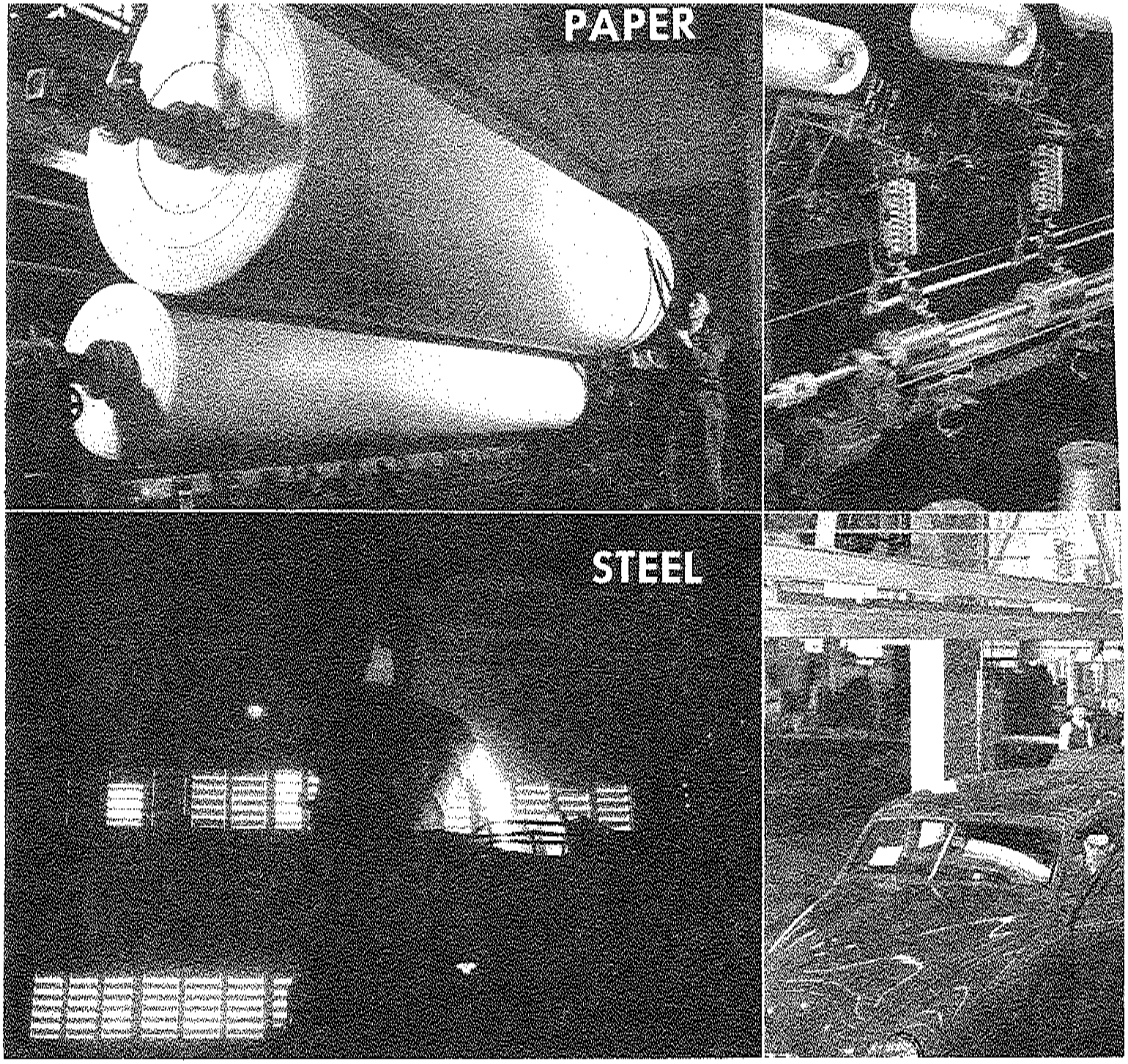


CCDA—CMRA Symposium on

INDUSTRY NEEDS

C&EN here begins the publication of a symposium representing a new high in consumer-producer liaison . . . Sponsored by the Commercial Chemical Development Association and the Chemical Market Research Association, the series is designed to give a picture of the needs and problems of four of the great industries served by the chemical industry

Chemical Engineering News

WALTER J. MURPHY, *Editor*

A Tough Job of Public Relations

Every reader of this publication is urged not only to read but to study and analyze most carefully the report of the Scientific Manpower Advisory Committee of the National Security Resources Board (page 456).

We will not describe the proposals. The report is clear, concise, and realistic. The more salient points are summarized in the news story of Charles A. Thomas' appearance before the subcommittee on manpower to the Senate Armed Services Committee (page 462).

The NSRB committee, headed by Dr. Thomas, is not composed exclusively of scientists and technologists. Very wisely Dr. Thomas included industrialists, educators, the former head of the Army Ground Forces, Gen. Jacob L. Devers, and Gordon Gray, president of the University of North Carolina and previously Secretary of the Army.

A definite workable plan has been evolved, recognizing both the paramount manpower requirements of the armed forces and the essentiality of adequate scientific manpower resources to produce munitions, materiel, and other needed civilian goods.

If the plan is sound, can we not then expect immediate wholehearted acceptance by the public and Congress? Unfortunately we cannot assume that the public and Congress will endorse the NSRB proposals. It is apparent that a gigantic education task must be undertaken.

The American public has an enduring memory. It recalls draft scandals of the Civil War. It believes strongly in the principle of universal liability for military service. It is antagonistic to the establishment of what has been described as an "elite group" and a "silk stocking aristocracy."

The public has not been conditioned to a full appreciation of the true meaning of *Selective* Service. We have talked too much on deferment of scientists and technologists, too little on the valid reasons why such individuals must be deferred, if we are to provide the sinews of modern warfare.

The scientific and technical societies can put forth one statement after another supporting their plea that scientific and technical manpower must not be depleted or we court disaster, but these statements will be largely ignored. The public has been misled again and again to believe that we are pleading a selfish cause. In the eyes of the public we are largely suspect.

What then is the answer? The public must be told by one in high authority, such as the President of the United States, or the Secretary of Defense, Gen. George C. Marshall, that an intelligent approach to the scientific manpower problem is vitally essential, if we are to meet successfully the threat of Soviet aggression.

We must enlist the services of every scientist and technologist if we are to embark on a program of public education of the real issues involved. We need the services of those who have an intelligent understanding of the fact that we are not pleading to save scientists and technologists from military service, but are deeply concerned about the problem of supplying the many and varied materiel and weapons essential to the successful prosecution of a third world war, should it be forced on us by an aggressor. It will do no good to have men in the field unless they have the food, clothing, medical supplies, equipment, and weapons that modern science and industry can produce.

There are many ways and means at our disposal to educate the public. Scientists and technologists should appear before service clubs to present the true picture for deferment of scientists and technologists. Letters to Congressmen and Senators, to newspapers and news magazines, discussions with neighbors and friends, are some of the opportunities that are ours for the asking.

We must make it unmistakably clear we do not plead for special draft consideration for a man because he possesses a degree in science or engineering. We must make it plain to the public we are not requesting blanket deferments. We must show that local draft boards are just as apt to defer a slacker posing as an essential element in research and production as they are to draft an individual who can make a solid contribution to the war effort. We must express complete agreement with the premise that the armed services be furnished all the technically trained personnel it needs for specialized fields; we must convince the public by demonstrable facts and figures the armed services will meet certain defeat if they lack the vital materiel supplied only by scientists and technologists. The individuals involved are a very small fraction of the population, a number insignificant in any military consideration, but vitally essential to research and production.

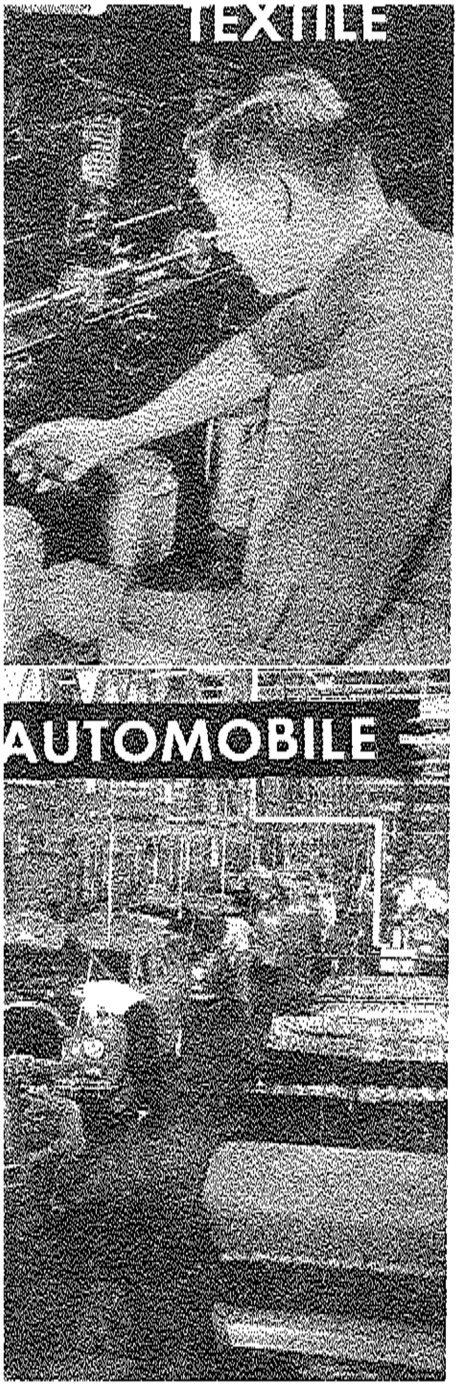
Winston Churchill has stated that the A-bomb and our ability to deliver it is the only deterrent to immediate Russian aggression. The A-bomb was developed by scientists and technologists, many of whom would have served in the armed forces if the scientific and technical societies of this country had not been outspoken in their criticism of Selective Service. Those who developed and produced the A-bomb risked physical disability and death. This is the most dramatic example that can be explained to the American public. It is by no means the only major contribution of scientists and technologists.

American scientists and technologists are not slackers. Far from that many young scientists and engineers volunteered for active duty in the last war. Because the public was not fully educated to their contributions they felt the stigma of being in civilian garb while so many of their generation were in uniform.

It is more important from the nation's standpoint that they serve where they are best fitted. Actually in both World Wars I and II it was necessary to pull some technically trained men back from the front to help man the production lines.

Scientists and engineers happen to possess certain technical training and skills that our country needs. They must be properly utilized, if we are to survive.

This is the story that must be told to the American public.



Symposium Chairman Advocates Setting Targets for...

Diversification Research

N. W. FLODIN, *Electrochemicals Dept., E. I. du Pont de Nemours & Co., Wilmington 98, Del.*

WITH this symposium we throw light on a side of our market research and commercial development activities that has been largely neglected in the past, namely, the setting of targets for diversification research, that is, the kind of industrial research that produces a diversification of sales and manufacturing activities.

Diversification research is concerned with the creation, development, and commercial establishment of entirely new products. This type of research is more than just insurance for the future. It is the lifeblood of the chemical industry. Without it, a chemical company cannot survive in this day of rapid technological change.

In order that we may have a common understanding of what we mean by this kind of research, an outline is shown below in which diversification research is broken down into two main divisions and several subclassifications.

Diversification Research

- I. Exploratory Research
  - A. Study of phenomena and techniques
  - B. Exploratory synthesis
- II. Satisfaction-of-Needs Research
  - A. Industry specialization
  - B. Technology specialization
  - C. Work on selected needs without specialization

The exploratory type of diversification research is aimed at the acquisition of potentially *useful* new knowledge, with at least the *hope* that salable products will be discovered. As indicated, exploratory research can be broken down into research on phenomena and techniques and exploratory synthesis. Practically all companies continually explore the chemistry of their raw materials and products in the hope of uncovering valuable new products.

The main job of the commercial development man in connection with exploratory research is to help find uses for the new chemicals produced. It will sometimes be found that the new products are "made to order" for existing needs. At other times new products may be produced which are "naturals" from a manufacturing standpoint, but for which nobody can think of a use. Then the commercial development man is in for a real headache.

Although exploratory research may occasionally prove a direct source of salable new products, it serves more importantly as a fountainhead of new intermediates, techniques, and synthetic routes which foster the development of research programs aimed at the satisfaction of industrial needs.

In satisfaction-of-needs research the objective is to determine what the customer needs or wants and then make it for him. Systematically applied, it involves study of our economy, or segments of it, to determine problems and needs that correspond to potential markets for new chemicals. It is the commercial development specialist, well trained technically but possessing a sales and business viewpoint, who can best accomplish this job. After he has obtained an accurate statement of the need, together with other important information such as potential dollar volume, competitive factors and marketing problems involved, it then becomes the job of the laboratory man to make a technical study of the problem. This will involve conversion of the "need" statement into the properties of the chemical required and, if possible, into a concrete goal expressed as a specific chemical structure or type of compound. If a practical technical approach to the problem is conceived, a research program may be launched.

Once a satisfactory product has been developed, a process for its manufacture established, and sufficient product for field evaluation produced, market research and commercial development again step in. Development of outlets can now proceed along well planned lines, since the size and location of the potential market are already known with fair precision.

As indicated in the outline, needs research can be carried out in three ways, depending on whether there is specialization in needs of a consumer industry or a field of technological interest, or whether research goals are set up without restriction as to industry or technology. Of course, a mixture of all three approaches is common. Many concerns, for example, have established paper, textile, or other industry sections in their chemical research laboratories to achieve thorough coverage of opportunities in those industries. At the same time they may seek to exploit and expand fields of technology in which they are interested, such as bleaching, dyeing, ceramics, adhesives. However, if a worthwhile need is perceived and an attractive technical approach to its solution is devised, an alert research organization will add this item to their program even though it does not fit their previous patterns of industry or technology specialization.

What are some of the present trends in diversification research? We note that the simpler aliphatic and aromatic compounds have been pretty thoroughly explored, and most of them made commercially available. The same holds true for inorganic compounds. Accordingly, it is becoming more and more difficult for exploratory research to uncover salable new products directly. In the future, therefore, I believe we shall see less reliance on exploratory research as a direct source of new products, and more emphasis on research whose objective is the satisfaction of specific needs. It follows that determination of the needs of our economy and setting of research targets will become increasingly important functions of the men in these associations.

From teaching chemistry, N. W. Flodin shifted to research when he joined the electrochemicals department of Du Pont in 1940 where he worked on acetylene chemistry, vinyl monomers, and polyvinyl plastics. Since 1945 he has been engaged in market research and the development of sales outlets for the new products of his department.

Besides More Chlorine . . .

. . . there is much the paper industry needs from the chemical industry

K. A. TAYLOR, *Director of Research, International Paper Co., Glens Falls, N. Y.*

IN ORDER to limit this discussion to a reasonable scope, we will consider the pulp and paper industry to begin with the arrival of wood and/or other raw materials at the mill and to end at the finishing room, including only those converting operations such as supercalendering, slitting, cutting, and trimming, which are considered as normal operations in a paper mill.

In nearly every operation of the paper industry where chemistry is involved at all, we are dealing with the chemistry of high polymers and with reactions taking place at interfaces in a heterogeneous system. It is not necessary for me to point out that such reactions are complicated and that answers to many of the problems involved in such a system cannot be predicted from the fundamental sciences involved but have to be worked out on the basis of trial and error which can be a very slow and tedious way of getting answers.

On the other hand, the paper industry is the fifth largest industry in this country and, when a chemical does find general use in this industry, the tonnage involved is likely to be substantial. We don't have to go any further than soda ash, chlorine, alum, and rosin to illustrate this point. In spite of this, it is doubtful that more than a small fraction of the potential use of chemicals in the paper industry has been realized or will be realized until we get on a sounder fundamental basis.

To illustrate this point, let us consider one of the greatest needs of the paper industry. We need what we might term "greater flexibility of action" in building into any grade of paper the combinations of physical properties which will make it satisfactory in use or which will make it suitable for a new use which we cannot now meet.

In the present state of our knowledge, how can we describe these specific needs for specific grades in terms which make it possible for you to go back to your research laboratories and say "we need such and such a chemical, and it should have such and such properties" and for your research laboratories to be able to interpret this information in such a way as to predict the chemicals which should be developed.

Instead of going into infinite detail on this problem, it will be simpler to give a list of some of those paper properties which are more or less important, depending on the grade and the use. Such a list would include:

Tensile strength
Stretch under tensile strain
Tearing strength
Bursting strength
Folding endurance
Stiffness
Softness
Surface smoothness
Brightness
Opacity
Water resistance
Water repellency
Resistance to oils and organic liquids
Absorbency
Dimensional stability under changing relative humidities
Controlled receptivity to various printing inks

Any material which, when added to the furnish, will substantially influence any of these properties in the right direction without destroying other necessary properties and, without increasing the cost per ton of paper to a prohibitive extent, will eventually find some use in the paper industry.

Part of the stock in trade of any research laboratory in the paper industry is a collection of samples of materials which experience has shown will modify paper properties to some degree when incorporated into the furnish under the right conditions. As we get a specific problem to improve a grade of paper in certain respects or to develop a new grade of paper with a new combination of properties, we go as far as we can with the conventional furnishes and processing already in use in the paper industry. When this is not enough, then we go over the list of samples in the storeroom and review our experience with each with respect to its effect on paper properties. Too often we find that the material which would do the job is not there and needed improvements in a standard grade of paper or expansion of paper into a new use has to be deferred. A few examples which might be cited are:

(1) Substantial increases in tensile strength without losing softness and flexibility.

(2) Substantial increases in softness without loss in strength properties.

(3) Improvements in formation and surface smoothness without too much loss in tearing strength.

These examples could be multiplied almost indefinitely but they illustrate the point that, if we are to jointly progress more rapidly, we must describe our requirements in language more intelligible to research departments and they must meet us part way and learn more about the basic fundamentals involved in our operations and how to influence them with added materials.

The paper industry is an old industry based on arts—some of them over 2,000 years old but research developments have been catching up with it rapidly, the gap between fundamentals and application is getting narrower and we may be nearing the point where the application of chemical additives in papermaking could accomplish some revolutionary results. A good deal of this fundamental work is being carried on at the Institute of Paper Chemistry in Appleton.

So much for the papermaking end of the industry. Let us now consider the pulping and bleaching operations, starting with the wood supply. Here, again, I am going to suggest the desirability of a broad basic approach.

In the mechanical and semichemical

K. A. TAYLOR is director of research at International Paper Co., Glens Falls, N. Y. "Paper work" has been his stock in trade and his career ever since his origin in New Brunswick, on whose heavily forested peninsula the raw materials of the paper industry flourish. Before taking a Ph.D. in organic chemistry at McGill University in 1929 he was employed with the Abitibi Color and Paper Co. in Ontario. From 1929 to 1934 he worked as a research chemist at the Oxford Paper Co. He then joined International Paper Co. as assistant director of research.

processes, the major part of the wood weight is utilized in the finished paper. However, in the sulfite, kraft, and soda processes, about half of the wood weight is dissolved. In the kraft and soda processes, the liquors are evaporated and burned to recover heat value and chemicals. In the sulfite process, there is some recovery of by-products, some burning of the evaporated liquor to recover heat value and chemicals but the bulk of sulfite spent liquor is discharged as waste into the streams. In 1949, over three million tons of dissolved material from the pulping processes were discharged into the streams and about eight million tons were burned.

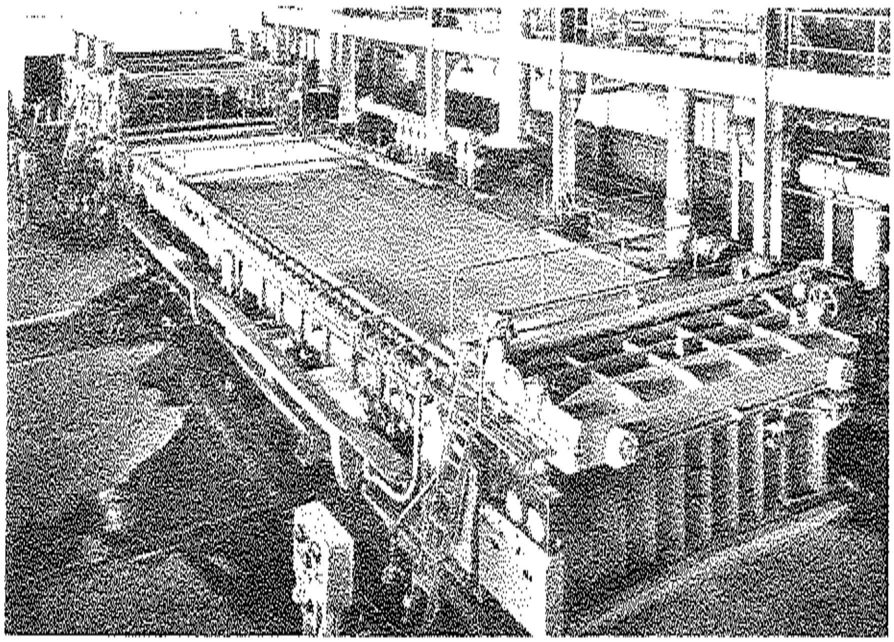
I am going to suggest the possibility of the chemical industry utilizing as a chemical raw material those portions of the wood dissolved out in the pulping processes. From the long range viewpoint, either this is going to happen or all of the pulp producing mills will be in the chemical business. It is unlikely that such a high percentage of the weight of a basic raw material like wood will continue to be wasted or utilized for fuel value only.

What I am suggesting is that we consider wood as a basic chemical raw material from which we recover cellulose fiber and various other products which can be utilized as chemical raw materials. I realize that we cannot expect the chemical industry to do this just as a favor to the pulp and paper industry but I think it is obvious that wood, as a raw material, has certain basic advantages. In the first place, nature has already carried out a complicated chemical synthesis in producing wood from carbon dioxide, water, and sunlight, all of which are free. In the second place, with any reasonable program of conservation, a perpetual supply of wood, as a raw material, is ensured long after many other natural raw materials are exhausted.

Shortened Reaction Time Needed

When we come to the chemical pulping processes, we find that substantial savings could be made if the reaction time could be shortened or if the reaction could be carried out at lower temperatures and at atmospheric pressure. Even if these objectives could be only partially reached, it would be desirable. If a catalyst or a combination of catalyst and penetrating agent could be found, there would be a tremendous market for it, always assuming that the cost of using it would not be prohibitive.

When we come to the bleaching of chemical pulps, especially those which have been cooked down to where most of the lignin has been removed, we find that it is already possible in the most modern installations to produce pulp with 90% or more of the theoretical whiteness. There is probably not much to be gained by going higher than this. On the other hand, these modern bleaching plants involve heavy investments and treatment in as many as seven stages. If simpler bleaching could be accomplished in fewer stages with no increase in chemical cost, it would be desirable.



Wet end of Pusey & Jones paper machine for making kraft paper. Stock reaches the 120-foot wire through flow spreader and pressure inlet which eliminates the conventional headbox

With the bleaching of groundwood and high yield semichemical pulps, the chemical industry has already helped, particularly in the development of peroxide bleaching. However, there is still a demand for greatly improved results. In addition to higher brightness or whiteness, it would be desirable to treat these pulps chemically to stabilize them against color reversion and discoloration when exposed to light and aging. Chemicals which would do this would have a large market, again assuming the cost was not prohibitive.

The problems I have just given seem to be the broad general ones which would justify long range research by the industry. However, on reviewing them, it seems that they may be too broad and long range and that a few problems which are more specific and immediate might help round out the picture. On discussing this point with a friend of mine, he said, "Why don't you just tell them that what the paper industry needs from the chemical industry is more soda ash and chlorine?" This did not seem quite the answer either.

However, recently I was attending a meeting of the Committee on Coordination of Research of the American Pulp & Paper Association. The purpose of this meeting was to review the answers to a questionnaire which had been circulated to all the technical directors or directors of research in the paper industry. The subject of this questionnaire was "What are the basic problems of the paper industry on which we should promote work at public institutions?" We did not get replies from all of the people to whom the questionnaire was sent but we did get enough replies to get a cross section of industry opinion.

With the help of the committee, I selected from these replies those suggested problems which would seem to be of most interest to the chemical industry. This list follows:

1. Further work on ammonia base sulfite pulping.

I believe that the bulk of this work should be done within the paper industry but there seems to be a trend toward ammonia base sulfite pulping and this trend should be of considerable interest to certain segments of the chemical industry since the amount of ammonia involved would be substantial.

2. Recovery of chemicals from ammonia base sulfite pulping.

One of the factors which is holding back the expansion of ammonia base sulfite pulping is the high cost of the ammonia base as compared with calcium. Anything which the chemical industry could do to help work out problems of ammonia recovery would help to promote the trend towards ammonia base pulping.

3. Recovery of chemicals from neutral sulfite semichemical spent liquors.

The semichemical process is of extreme interest because of high yields of pulp obtained and further expansion of this process is being held up because of the problems involved in recovery of chemicals from spent liquor. It is not only the cost of chemicals but there is a stream pollution problem involved as well.

4. Cheap effective germicide and insecticide treatments to prevent the deterioration of pulpwood in storage.

5. Control of insect blights which destroy large areas of potential pulpwood.

6. Better dispersing agents for fibers to promote better formation, especially with long-fibered stocks.

7. Better and/or more economical fire retarding and flameproofing materials.

Each one of these problems was considered important enough by at least one paper company to be included in their replies to our questionnaire as being one of the basic problems of the industry.

Paper Problems Have Not Been Neglected . . .

. . . by the chemical industry as it seeks to anticipate and meet the needs of its third largest customer

HARRY F. LEWIS, *The Institute of Paper Chemistry, Appleton, Wis.*

THE pulp and paper industry is one of the largest industries of the country. In the year 1948 almost 13 million tons of pulp and better than 22 million tons of paper were produced in the United States. When we divide the very large production figures for paper on a per capita basis in these United States, we find that each individual used on the average in 1948 about 356 pounds of paper; of the 356 pounds approximately 145 pounds represented the average per capita use of board; about 72 pounds were used as newsprint; 41 pounds as coarse paper; almost 32 pounds as book paper; 16 pounds as tissues; and 15 pounds as fine paper. The remaining pounds are divided among a number of uses.

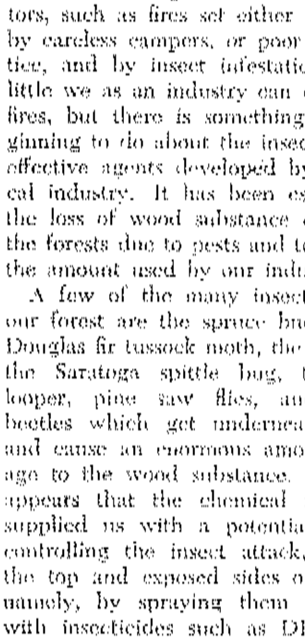
The production of all this material calls for large quantities of chemicals; in fact, the paper industry is the third largest consumer of chemicals, with only fertilizers and rayon showing a higher consumption in 1948. If we take the 1935 index of consumption of chemicals as 100, the same index for 1948 becomes 217.02. Of this figure fertilizers account for 49.60, rayon for 27.15, and pulp and paper for 23.30. The chemicals used in volume by our industry include heavy chemicals, such as lime, soda ash, caustic soda, sodium silicate, sulfur, salt cake, sodium sulfide, chlorine, clay, calcium carbonate, talc, gypsum, and titanium oxide, and organics such as the paraffin waxes, rosin, glue, casein, starch, formaldehyde, and the dyestuffs. In addition to these we use a variety of chemicals in smaller amounts in the regular pulp and papermaking operations, in producing specialty papers, and in converting.

The supply and demand data for the chief nonfibrous raw materials used by the industry have been thoroughly reviewed by my colleague, Ruth Shallcross, in the November and December 1949 and January 1950 issues of *Tappi*. When the consumption index is separated into its most important components and we then calculate the percentage of each chemical consumed by the pulp and paper industry based on the total production, we find the industry consuming in recent years 10% of the sulfur, 7.7% of the caustic soda, 4.8% of the soda ash, 16% of the chlorine, 75% of the sodium sulfate, 55 to 60% of the clay, 7% of the titanium dioxide, 36% of the sodium silicate, 38% of the alum, 29% of the rosin, 27% of the cornstarch, a little over a third of the animal glue, half of the domestic production of petroleum waxes, and large amounts of casein. In terms of tons and dollars and percentages, the chemical industry truly has made great progress in producing chemicals for the pulp and paper industry.

Our first and most important supply problem is that of our fibrous raw material. The amount of good wood substance we bring out of the forests is dependent not only on the factors influencing growth but on what might be called exterior factors, such as fires set either by lightning, by careless campers, or poor woods practice, and by insect infestation. There is little we as an industry can do about the fires, but there is something we are beginning to do about the insects—thanks to effective agents developed by the chemical industry. It has been estimated that the loss of wood substance each year in the forests due to pests and to fires equals the amount used by our industry.

A few of the many insect enemies of our forest are the spruce bud worm, the Douglas fir tussock moth, the gypsy moth, the Saratoga spittle bug, the hemlock looper, pine saw flies, and the bark beetles which get underneath the bark and cause an enormous amount of damage to the wood substance. However, it appears that the chemical industry has supplied us with a potential means for controlling the insect attack, at least at the top and exposed sides of the trees—namely, by spraying them from planes with insecticides such as DDT. This is still what might be called the "pilot plant" stage. Following are a few examples of "pilot plant" experiments. In July of 1950 over one million acres of Douglas fir and white pine forests in eastern Oregon were sprayed with DDT for control of the spruce bud worm, with a reported kill of 97%. In 1947, 400,000 acres in Idaho were sprayed with DDT for the control of the Douglas fir tussock moth at a cost of about $1.57 per acre. In 1948, 200,000 acres of eastern woodland were likewise treated for gypsy moth. Obviously if the program of insecticide spraying were to be expanded on a large scale, it would call for a considerable quantity of insecticides. There is, of course, the unhappy possibility that DDT-resistant strains of insects may develop, resulting in a series of incidents between the inherent instinct of the insects and man's ingenuity.

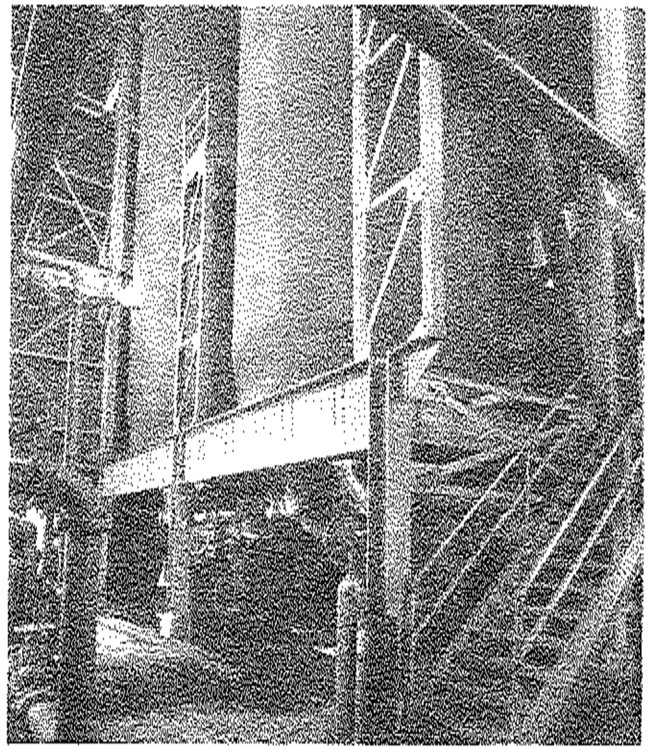
One of the most active locations for insect damage and rot in cut wood is under the bark. Removal of the bark is therefore one good method for prevention of rot. From a practical standpoint, the bark is hard to peel in the woods except in the spring when the sap is running, and so the wood cut during the remainder of the year is left with the bark on. A chemical method has been developed which makes it possible to debark at almost any time; this involves the application to the tree of arsenic trioxide, sodium arsenate, ammonium sulfamate, sulfamic acid, or sodium chlorate. The arsenic compounds also discourage insect and fungus attack. In applying the chemical, a strip of bark of about 2½ inches wide is removed from around the base of a



HARRY F. LEWIS, dean and research associate at the Institute of Paper Chemistry in Appleton, Wis., claims as his particular field of interest the chemistry of plant products, particularly wood chemistry, and on this subject can claim authorship of about 45 published papers, as well as 25 patents and a book, along with chapters in others. His hobby still keeps him among the plants, as it is gardening. Before joining the staff at Appleton he had taught at Ohio Wesleyan University, Maine, and Cornell College (Iowa). His education he received from Wesleyan University and the University of Illinois, from which latter he took a Ph.D. in 1916.

tree in the spring, and the chemical in paste form is spread on a strip of kraft paper and fastened in place. The materials thus applied dissolve in the sap in the spring and are carried up through the cambium layer. It is estimated that the chemical cost for such a treatment runs to about a cent a tree. This treatment is presently in the early pilot plant stage.

The wood is delivered to the pulp mill either peeled or with the bark on, by river, truck, or train, wet, green, or partly dry. Here it is stored in conical piles or in rows until it has reached the right condition of seasoning for pulping or until it is needed. An enormous amount of wood substance is lost in storage due to insect and microbiological attack. A part of this loss might be saved by treating the logs with some agent of the type of DDT or the chlorinated phenols. No large-scale operation of this kind is currently being followed, although experiments have been carried out which show that such a treatment of the logs would cut down the loss in wood substance to a significant degree.



Two 12 feet by 45 feet 4 inch digesters where a portion of the lignin which binds the fibers together in the wood is removed

We must move along, however, with the wood through the chipper, the chip bins, and into the digester where the chips are converted to pulp by cooking with either alkaline or acid delignifying agents. The purpose of pulping is the removal of a portion of the lignin which binds the fibers together in the wood. Unfortunately, at the same time the cooking liquors degrade some cellulose and bring about the solution of this cellulose and valuable hemicelluloses to the extent of a third to a quarter of such materials originally in the wood. The particular pulping process employed in any given mill will depend in part upon the wood supply and in part on the earlier history of the mill, as well as on the end product in itself. The conventional acid cooking chemical is the well known calcium-base sulfite liquor, a solution of calcium bisulfite and uncombined sulfurous acid. When the process is carried out so as to get the best product for certain purposes in the shortest time, we have "quick-cook" sulfite. When the conditions are less drastic and the time consequently longer, we produce Mitscherlich pulp. Unfortunately, the spent liquor which results from the pulping operation contains partially hydrolyzed solubilized carbohydrates which are easily fermented and consume oxygen together with dissolved lignin in the form of calcium lignosulfonate. These characteristics make spent sulfite liquor an unpopular addition to any waterway.

Recovery of Calcium Base Liquor Components

The technical difficulties involved in recovering the components of the calcium-base liquor on a break-even basis have not yet been completely solved in the United States. One way to get around the situation would be to use some other base than calcium, and both magnesium- and ammonium-base liquors are being used in the United States, as is sodium-base in Sweden. Magnesium base is attractive provided we can develop the recovery operation so as to get a high recovery of both magnesium oxide and sulfur dioxide. The pilot plant tests on which the process is based indicated that the loss of magnesium oxide should not be more than 15 pounds per ton of pulp and the loss of sulfur not more than 25 pounds per ton. This has not yet been achieved in commercial practice. The magnesium oxide used in the process is obtained from sea water by precipitating magnesium hydroxide with flake lime and heating the precipitated magnesium hydroxide to make so-called caustic magnesia. The one magnesium-base sulfite mill is being operated by the Pulp Division of the Weyerhaeuser Timber Co. at Longview, Wash. It is still in the experimental stage but on a commercial scale.

The disposal of ammonia-base spent liquor is an easier operation provided we do not attempt to recover the chemicals, for we can evaporate the liquor without scaling and burn the products thus obtained to yield B.t.u.'s. Apparently the pulp produced by the ammonia-base process is somewhat superior in quality to that obtained in the calcium-base process. The ammonia-base cooking operation is currently being practiced in at least two mills in the United States and is being seriously considered in others—thanks to the availability of ammonia and its relatively low price. If all the calcium-base sulfite mills were to convert to ammonia base, it is estimated that it would require about 166,000 tons per year of anhydrous ammonia, assuming no ammonia recovery and assuming the production of sulfite pulp to be 2,800,000 tons per year. The total production of anhydrous ammonia in 1949 was a little less than 1.3 million tons.

At least two other means of converting wood to fibers should be mentioned. One is the groundwood or mechanical process which is commonly used in the manufacture of pulp for newsprint, poster papers, and the like. We made in this country in 1948 about 2 million tons of groundwood pulp. The pulping operation is relatively simple. Here the wood is ground wet on a rotating stone under pressure. The other process referred to is called "semichemical" pulping; this involves a partial chemical delignification or softening of the wood followed by a mechanical separation of the fibers. The groundwood process gives us yields of pulp of about 95% or better. The pulp yields by the semichemical processes will run between 60 and 80% and by the full-chemical processes between 40 and 50%. The quality of ordinary semichemical pulp is intermediate between that of the groundwood and the full-chemical pulp when measured by conventional tests; for certain purposes, such as corrugating medium, it is much better.

More and more pulp is being made by the semichemical process. As an illustration of one semichemical operation, presoaked wood chips are cooked with an alkaline solution under pressure in a continuous unit, and the precooked wood is fed directly into an Asplund mill where it is defibered. The pulp thus produced goes into roofing papers, corrugating medium, and has many other applications. We may also use conventional digesters for semichemical pulping with a buffered solution of sodium sulfite as the cooking agent in one process. Still another

In the beater are added many of the additives that determine some of the characteristics of the finished product, such as wet strength and water repellency

semichemical process uses the kraft chemicals in low chemical ratio. In either case the pulps produced go through a mechanical refinement. With a neutral sulfite semichemical process we get good yields of good color pulps. The spent liquors from the neutral sodium sulfite process provide us with still another problem in waste disposal for, although the relative weight of liquor solids is lower for the neutral sulfite process due to higher yields of pulp, they contain the sodium salts of the lower organic acids which, together with some carbohydrate material, have a relatively high oxygen demand. The oxygen requirement of the effluent is fairly high. The development of a process for chemical recovery would alleviate this situation.

Unbleached pulp in large volume goes directly into the papermaking process; this is particularly true of the sulfate pulp where 80% is used in the unbleached state, as compared with about 30% of the sulfite pulp and only a small fraction of the groundwood pulp.

In the bleaching process pulp substance is dissolved to some degree and cellulose is degraded with consequent reduction in strength. For some time we have been looking for chemicals which will permit us to delignify wood and produce a pulp of high brightness without hydrolyzing and dissolving cellulose and other related materials. There are two closely related chemicals which are available and which do have these characteristics—sodium chlorite and chlorine dioxide. Sodium chlorite in the presence of acetic acid will delignify wood almost completely before it begins to attack the polysaccharides. The reaction takes place at atmospheric pressure. As a result we can get a yield of pulp of about the theoretical content of a carbohydrate material in the wood which, in the case of Douglas fir, would run in the neighborhood of 67% as compared with a pulp yield of 45 to 50% by the conventional sulfate process. In fact, this has been suggested as an analytical method for determining the total carbohydrate or holocellulose content of wood.

The pulp produced has many of the desirable properties we need in the manufacture of glassine paper. It beats quickly and gives a product of high strength and good quality. In order to convert it into pulp for other papermaking uses, all that is necessary is to remove first the easily soluble carbohydrates by means of dilute alkaline washing. This gives us a conventional papermaking pulp of good appearance and high yield. If we then treat the product after the dilute washing stage with stronger caustic, we recover a high yield, good quality alpha pulp which finds its way into the plastics industry and the rayon industry, and for special purposes of papermaking. Sodium chlorite currently is too expensive to use for the entire delignifying operation. It has been used, however, as the final stage in specialty bleaching. A low cost source of sodium chlorite would be of real interest, since it would give a high yield pulp and would eliminate the use of pressure equipment which is associated with wood conservation. The other chemical, chlorine dioxide, is currently being used as a final stage in the bleaching process for sulfate pulp in at least one mill in Canada and in Sweden. Its use in the United States is apparently a matter of time. The chlorine dioxide thus used is generally produced from potassium chlorate in the mill consuming it. So here are two chemicals in which we in the paper industry are really interested.

Sodium Peroxide Use

Still another material which has already developed wide acceptance is currently used in bleaching groundwood and mixtures of groundwood and sulfite pulp at an estimated 700 tons per day of groundwood pulp. This is sodium peroxide. Sodium peroxide solutions suitably buffered to a pH value between 10.0 and 10.5 by means of sulfuric acid, sodium silicate, or caustic soda or mixtures of sodium peroxide and hydrogen peroxide or hydrogen peroxide alone suitably buffered give bleached groundwood pulp of desirable brightness. The operation proceeds without greatly reducing the weight of the pulp (1% loss or less). Peroxide-bleached groundwood finds application in a variety of papers, such as book, magazine, catalogue, tissue. It has also a definite advantage in the manufacture of raw stock for coated papers.

One competitor of sodium peroxide in the field of bleaching groundwood is zinc hydrosulfite. The action of zinc hydrosulfite is just the opposite to that of the peroxides in that it bleaches by reduction instead of by oxidation. This is particularly important in the case of mechanical pulps made from woods which contain constituents which consume relatively large volumes of peroxide such as the case of pulps made from western hemlock, to cite just one example.

Many Additives Enter in Beater

The next step in the process of converting wood to paper takes place in the beater room. The operation known as stock preparation is an important one. Pulp fibers discharged to the beater are relatively long (3 to 5 mm.) and have relatively smooth surfaces; after circulating between the beater roll and bedplate or between the knives of the plug and shell of the jordan, they are shortened in length, somewhat swollen in diameter, and the erstwhile smooth outer wall is partially ruptured and is covered with minute threads termed "fibrillae." In addition to its action on the structure of the fiber, the beater offers a very useful place to add other materials to the stock before it goes in the form of a thin slurry to the wet end of the paper machine. It is in the field of beater additives that the chemical industry has been particularly active in recent years.

In the beater we put the rosin size and alum necessary to give the sheet its desired degree of resistance to water. The rosin acids are at least partially saponified and/or are modified by the addition of waxes, proteins such as soya alpha protein, and the like. Reference might be made in this connection to the beater addition of Bitusize, an emulsified asphalt.

In addition to water repellency of the type known as sizing, the desired sheet may be required to be strong when wet, and so we may put resins in the beater to produce this wet strength. The most common wet strength resins are of the melamine- and urea-formaldehyde types, although phenol-formaldehydes are also used. Neoprene also appears to be an attractive additive for wet strength. The newer beater resins of the type of the Snyder resins which can be flocculated by lowering the pH in the beater with high retention of partially condensed resin in the wet sheet are said to show good retention. Somewhat related to the development of wet strength is the improvement in dry strength which results from the addition in the beater of starch, the modified starches, the mannogalactan gums, and melamine resin.

Dyes of many types are added to the stock in the beater to give paper of specified colors; large amounts are also used at the calender stacks, either alone or in conjunction with beater dyes to impart a surface coloring. Several hundred paper dyes are available to the papermaker. In themselves they represent a very substantial contribution to the chemical requirements of the pulp and paper industry, particularly in the field of specialty chemicals.

A fairly recent type of beater additive is that used in order to prevent flocculation or clumping of the fibers as they form the sheet on the wet end of the paper machine. This is normally accomplished by reducing the size of the fibers by beating; uniform sized fiber fragments thus produced tend to give an even structure to the sheet. However, the smaller the fiber size the slower the removal of the water—or, as we say, the slower the stock—and consequently the machine must be slowed down if the desired amount of water is to be removed through the wire. If the fibers are only slightly refined (very little cutting), water can be removed more readily and greater machine speeds are possible; however, fibers which are only slightly refined form fiber flocs and a sheet made from such fibers normally has a wild formation. To prevent flocculation when long fibered stocks are run, small amounts of such agents as deacetylated karaya gum, locust bean gum, and guar are added to the stock which reduce the tendency of the fibers to form flocs. With sufficient reduction in the degree of flocculation, a significant improvement in formation and strength is normally obtained.

Use of Toxicants

To the beater and to other places in the system we may add toxicants in order to control the growth of slime organisms in the stock suspension in pipes and chests. These slime organisms are capsulated with a jelly-like outer coating. They accumulate until a slimy mass breaks off and ultimately gets into the sheet of paper, forming slime spots. The chemical industry has furnished us with a number of effective slime-control agents. The list includes the fully or partially chlorinated phenols, the various phenylmercury salts such as the lactates, acetates, benzoates, etc., the ethylmercury derivatives, the pyridylmercury derivatives, mixtures of the mercury compounds with partially chlorinated phenols or with salts of o-phenylphenol. The old standby, chlorine, likewise furnishes a good method for controlling certain types of slime, although in this case it is not added to the beater. Quaternary ammonium compounds are effective but expensive. It should be pointed out that the causes of slime are not the same in all mills, nor is the slime in any one mill the same from day to day. Organisms adjust themselves to one type of an agent, and it becomes necessary to change the treatment to another type, so it's a continuous battle in any paper mill to keep slime under control.

When fillers are used, they may be added in the beater. A large amount of clay is put into the sheet to produce opacity and printability. More expensive fillers have in part replaced the clay where high brightness and light weight papers are to be made such as catalog papers. The high opacity fillers include lithopone and titanium dioxide.

The refined stock suitably prepared flows in the form of a thin slurry from the stock chest onto the wet end of the paper machine. The wet end of the machine is a fast-moving continuous wire designed to permit water to drain from the stock, partly under the force of gravity and vacuum. Although the greater amount of paper produced goes directly without treatment over the wet end of the paper machine to the press section and driers, an increasing amount is machine-coated. This involves the application of a coating to the sheet at some place along the machine between the headbox and reel, the coating consisting of a suspension of pigment such as clay suitably colored and adhesives of the type of casein, glue, or starch or their modified derivatives. Machine-coated papers have become extremely popular in recent years for uses which require a lower priced quality product than is produced in the normal coated paper processes.

The wet sheet couched off the end of the wire by a felt then goes by normal stages to the press section of the machine where additional water is removed by pressure. There is one modification of this process, the so-called Novak process, in which the wet sheet goes through part of the press section, then into a vat in which it picks up resins, latices, or some other additive from an aqueous solution or suspension; it then goes through the last end of the press section and into the driers. The Novak process is used to some extent in the manufacture of resin-containing sheets which are later to be laminated under heat and pressure. This particular application is not an important one from the standpoint of amount of paper thus produced, but it does represent an interesting approach to the problem of introducing resins into the sheet.

Finishing the Surface

The sheet from the press section (now containing about 60 to 70% water) is run into the driers. A typical drier section of a paper machine is made up of a series of cast iron cylinders driven by gears and heated by low-pressure steam. In general, a drier felt or canvas is employed both to carry the sheet and to keep it in contact with the surface of the drier. The principal function of the drier section of the paper machine is to bring the moisture content of the sheet from the 60 to 70% it still retains as it leaves the press section down to 6 to 8% as it leaves the drier. The weight of water removed in the drier is extremely large. For example, one ton of dry fiber furnish loses almost 2 tons of water in the drier section as the moisture content is reduced from 66% to 7%. Halfway down the drier section, surface sizes of casein, starch, glue, or even some specific resin may be put on the partially dried sheet by means of a size press set in between drier sections. This same coating may be put on the dried sheet by running it through a size tub after the sheet comes out of the drier. The moisture thus added to a writing paper sheet in the surface sizing agent is removed by air drying in a loft to give the "cockle" finish to the sheet. The finished paper may be used as is or after some further converting operation.

Paperboard Container Manufacture

The manufacture of containers from paperboard is an enormous business. During the war there was developed a V-board container which could be used for shipping products to the four corners of the world. These containers are given wet strength treatments, and the adhesives used are special starch urea-formaldehydes, polyvinyl alcohols, and certain forms of asphalt developed for water resistance. A recent development has been that of producing a corrugated sheet which is stiff when wet. This involves the application of sulfur at the time of corrugating under conditions which will drive the sulfur into the corrugating medium, leaving the surface relatively free to take up the adhesives required for the preparation of the final corrugated board. This treatment gives rigidity in both dry and humid atmospheres and makes a shipping container which is much more useful. Vast amounts of paperboard of a specific type go into the manufacture of paper milk bottle stock and paper milk bottles. The early bottles used paraffin wax; in the present bottles modifications of paraffin wax are employed which give better stiffness and durability. The number of such containers runs into the millions per day.

There are a large number of chemical materials which have specific uses either in the processing or in the final product. For example, we are troubled in our systems with foam, and we often use 2-ethylhexanol and also di-isobutylcarbinol as antifoaming agents. We have frequent use for adhesives, and among the adhesives we might list cellulose acetate, polyvinyl alcohol combined with resins, di-isobutylene, the copolymers of styrene and butadiene, and butadiene acrylonitrile copolymers. Among the chemicals which have shown an expanding use is carboxymethylcellulose which has developed into a very satisfactory size for greaseproof papers. The flameproofing of paper has been studied, and among the suggested compounds for use are the alkyd resins, the borates, sulfonates, antimony oxides, and the like, and the highly chlorinated hydrocarbons. The conventional flameproofing mixtures of the ammonium salts have some use, but these tend to degrade the cellulose in the sheet. We have specific problems, such as how to develop waterproofness and scuff resistance in returnable paperboard containers; alkyd resins are used for this purpose. Saran resin has a wide use as a greaseproofing agent and for improved moisture-vapor permeability.

THESE are the first in a series of four pairs of papers dealing with the needs of four major industries and what the chemical industry is doing about them. The papers were originally presented before a combined meeting of the Chemical Market Research Association and the Commercial Chemical Development Association held in Washington, D. C., Oct. 4, 1950.

Plans for the Development and Use of Scientific Manpower

A recommendation to the nation for assuring a continued supply of scientific manpower for military, industry, research, and civilian needs

Foreword . . .

It is of paramount importance to the security of the United States that the nation maintain in peace and in war an adequate supply of scientifically and technically trained manpower to carry on progressive research in basic science; to design and develop devices and equipment for both military and civilian use; to sustain, broaden, and increase mass production by scientific and engineering methods; and to serve the armed forces in applied science research, technical maintenance, and the use of modern weapons.

The Scientific Manpower Advisory Committee has considered the needs of the armed forces, the manpower requirements of essential industry, and the necessity of maintaining essential civilian services. The responsibilities of the Committee relate to scientists, engineers, and other technical personnel. Throughout this report the words "scientific manpower" are intended to include persons in each of these three categories. Although no recommendations are made with reference to technicians, the Committee recognizes their extreme importance in support of work at the professional levels.

It is the considered opinion of the Committee that the PLANS FOR THE DEVELOPMENT AND USE OF SCIENTIFIC MANPOWER which follow serve the combined needs of the nation best . . . no matter how severe the immediate emergency becomes or how long it is protracted. In the case of a total war the details of the plan would undoubtedly be altered, but the main features will provide machinery that may be adjusted to circumstances.

THE objective of the committee is to propose a method by which an adequate supply of scientific manpower can be maintained and channeled most effectively into the armed forces, industry, education, and government.

In terms of gross numbers of men, the United States is inferior to its potential enemies. The last war, however, proved that weapons incorporating the latest developments in science and engineering, combined with fruitful research and mass production, gave this nation a marked advantage. The present problem, then, is to create a plan that will assure a continuing supply of men with special training, and to devise a method that will secure the best use of them as well as those who are already trained. The committee recognizes the following needs for scientific personnel:

1. Military
Scientific manpower is needed for research, training, operations, and maintenance in the many phases of technological warfare.

2. Industry
Scientific manpower is necessary for research relating to the design and development of products for both military and civilian use, and for the rapid translation of new weapons, materials, and equipment into mass-produced finished products.

3. Research
To be in the forefront of scientific advancement, the nation depends upon highly trained people for research, both basic and applied—in industry, in government, in colleges and universities, and in research institutes.

4. Civilian
Scientifically trained manpower is needed to further the work of education, agriculture, public health, civilian defense, and public welfare.

In preparing its plan, the committee recognized that the morale and productivity of the men concerned could best be protected by aggressive prevention of misuse of their services rather than regimentation.

After study and deliberation, the committee believes that the following plan fulfills the purposes cited. While taking into account the military needs for an active force of more than three million men, the plan also establishes a means of creating, conserving, and using scientific manpower with the greatest over-all effectiveness—one of the most important factors in making the quality of American armed forces superior in strength to numerically greater forces.

The Basic Principles

The two principles upon which any plan for obtaining the best use of scientific manpower should be based are:

1. Available scientific manpower should be judiciously distributed among those activities in which scientifically trained men can make the most effective contribution to the strength of the nation.

2. A continuous flow of adequately trained scientific manpower should be maintained from colleges and universities.

If these basic principles are violated, both the immediate build-up of strength and the nation's long-range mobilization potential will be jeopardized. At present these principles should be applied—particularly to the induction of men through Selective Service and to the recall to active duty of reservists.

The recommendations have to do with both of these matters and are based upon the premise of universal military service for all young men as they attain the age of eighteen. It is the belief of the committee that the needs of the armed forces are such that, except to meet the minimum requirements of the nation for specially trained people, these young men should serve in the armed forces for approximately a two-year period and then be free to continue their schooling or to enter vocations as they choose in the manner to which this country is accustomed.

The recommendations attempt to provide a means by which those minimum needs for trained manpower may be met, for a smooth transition into the period when this universal military service may become fully operative, and for the utilization of those trained in science, engineering, and technology, in such a manner as to give maximum strength to the nation.

Recommendation No. 1

Assuring a Continuous Flow of Students under Military Service

Part 1—Long-Range Plan

Approximately a million youths reach the age of 18 each year. The number will increase substantially during the coming 10 years. At present, young men reaching 18 are required to register with Selective Service but are not subject to induction until the age of 19.

Of the million per year reaching 18, it is estimated that under presently proposed standards approximately 800,000 will be found physically and mentally qualified for service in the military organization.

Any satisfactory universal training and service plan must provide that a reasonable proportion of young men continue their training to attain the higher scientific skills which are essential to the national strength. Only about 110,000 were graduated last year (all-time high) in all fields of science and engineering. Unless

Dr. Al. B. Garrett, '28

Presents Five of the World Problems of Our Day

(Excerpts from an address made to the faculty and students at a college assembly in Brown Chapel and to a faculty meeting in Montgomery Hall.)

As we stand at the half-way point of the 20th century, we begin to feel that a clear cut analysis of the basic world issues is becoming more understandable to us laymen. Today we are realizing the significance of several major world problems as their impact upon national and international stability is becoming alarmingly real to us all. I shall identify five of these problems as:

1. The unrestricted production of atomic fuels
2. The effects of population pressure
3. The maldistribution of natural resources.
4. The conflicting philosophies of the state, the race or the class versus the sacredness of human personality, and
5. The adjustment of civilization to a dynamic world.

Other problems could be added to this list but it is becoming more and more evident that these form much of the basis for the present world conflict and the barrier to world accord through the United Nations. The first three of these problems are more or less independent ones, but the fourth is the direct result of the other three, particularly of the second and third. The last one is a problem arising out of our great technological progress.

Unrestricted Production of Atomic Fuels. The United States has been concentrating atomic fuels since the latter part of the second world war. We, no doubt, have the largest stock pile of these fuels of any nation in the world. These fuels—uranium-235 the plutonium-239—have many peace time uses but their possession by any nation, without the assurance of international control, is a serious cause for international unrest, suspicion and feeling of insecurity. We realize this all too well; in fact, the major impetus of our present Civil Defense Program results primarily from a fear of an atomic attack.

We know, from direct experience, what magnitude of disaster can be achieved with such a super-weapon as an atomic bomb—a war weapon, which, even in its most primitive form, is equivalent in energy to 20,000 tons of TNT. We know that there is probably enough atomic fuel already concentrated to destroy all the major centers of civilization overnight. We know that if a rocket or a plane loaded with an atomic weapon gets over a target, there is then no defense—all that can be done is to minimize the damage done and curb the hysteria and panic that may be even more disastrous than the physical damage. These are cold facts and

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Holding the rank of professor in the University's department of chemistry, he is in charge of the division of general chemistry which includes seven senior staff members and 35 teaching assistants.

In addition, he lectures in physical chemistry and advanced organic chemistry, and has an active research program with nine Ph. D. candidates now engaged in thesis work.

Noted for his research studies, Dr. Garrett is the author of fifty articles, based on his scientific investigations, which have appeared in professional journals. He is the co-author of eight books on chemistry and a manual on radiological defense, published in January, 1951, by the Office of the Adjutant General of the state of Ohio.

At the present time he is radiological defense coordinator for the state of Ohio, and heads a University committee on Civil Defense.

His advancement in rank at Ohio State has been rapid. He graduated from Muskingum College, New Concord, Ohio, in 1928 with the degree of bachelor of science. He took a graduate assistantship at Ohio State the following year, secured his master's degree there in 1931 and his doctor's degree the following year. He returned to Ohio State in 1935 as an instructor and advanced to the rank of assistant professor in 1937, associate professor in 1940 and professor in 1944.

Born at Glencoe, Ohio, Professor Garrett took an active part in extra-curricular affairs while an undergraduate at Muskingum. He was captain of the track team, president of the Y.M.C.A., member of the honor court, member of the scholastic honorary society, and a fellow in the Muskingum Academy of Science.

He is a member of the American Chemical Society serving the Columbus section of the organization as treasurer, secretary, vice-chairman, chairman and councilor respectively from 1938-45. He also was secretary of Sigma Xi in 1939.

Professor Garrett married in 1934 and is the father of two daughters and one son. His hobbies include travel, fishing, gardening, photography and astronomy. His favorite sport is golf.

conservative estimates. A courageous citizenry must, however, face the issue.

The problem which is posed for us is unmistakable. We Americans are faced with the facts that we have developed atomic fuels on a wholesale basis, and we have been the first to use them as a war weapon. These facts stand out in the minds of the peoples of the other nations even though we have supplied the great research laboratories of our country and of the world with almost unlimited quantities of radioactive isotopes, a very important by-product of atomic fuel production, and even though we have been making a great effort to develop power units to utilize atomic fuels in the place of the conventional fuels.

We are now beginning to face the additional facts that our security does not depend upon a stock pile of atomic weapons, nor does the solution to the present world crisis depend upon an overt act on our part to make immediate use of these weapons. In fact it is possible and perhaps probable that in a certain sense atomic bombs are already obsolete—for they cannot be used in fighting a cold war. This implies that we have already moved into a new era of and a new method of international conflict—that there have been developed more potent methods of conquest than those that depend upon the mechanical weapons of warfare. I refer to the methods of cold war or psychological warfare. Russia is now making great use of such methods.

The presence of unrestricted amounts of atomic fuels have developed two serious problems, (1) an international suspicion and an unrest that borders upon hysteria in some areas, and (2) a misunderstanding as to what are the basic elements of our security. Both of these are dangerous to our continued stability as a nation and as a leader of nations.

The Effects of Population Pressure. The passing of the colonial period of empires has left a high concentration of masses of people in agricultural areas too small to feed these people. At the same time the population in these areas has continued to increase. This has raised and intensified the problem of making it possible for many peoples of the world to feed themselves—a problem of population pressure. In this age this problem has serious political effects because we find that coupled with this situation is the gradual evolution of empires from monarchial government and the world wide sweep of the feeling of the individual to his right to a voice in the government. Hence, the masses have become more vocal in their interests and demands today than in that day when their interests were suppressed and submerged.

We can now identify the problem of population pressure as one of the elements dangerous to the stability of a nation and to world order. In the last thirty years we have observed repeatedly how, regardless of the form of government, the height of culture, or the form of religious organization, hunger or the fear of hunger has brought about the development of unrest, hysteria, revolution, or aggressive war (in the demand for "Lebensraum"). Low living standards prepare the seed bed for change and that change is usually in the direction of a degrading quality—it is the normal condition for a despotism or for the spread of Communism.

We can now clearly recognize the effects of population pressure on many nations—the crisis in Italy, Germany, and Japan in the past 20 years have stemmed from that factor—these nations cannot feed themselves. England is in a similar position today. India and China have been in this condition for centuries. This is the world's **first** problem today—survival is still the first law of nature.

In the face of these facts we can take a cue for the solution of the problem from the Salvation Army whose **sequence** of services to the hungry is **first** soup, then soap—then salvation. Soup is not enough but you cannot save a hungry people without first seeing to it that they are fed, and furthermore it is only after their self-respect has been developed that they are interested in salvation.

But a dole alone is not the answer—it may be an expedient. It is not enough to feed a man; we must make it possible for him to take care of himself—he must have something to do for himself and for others; this raises his self-respect. This leads to the world's **second** problem today; it is the problem of the availability of natural resources.

The Maldistribution of Natural Resources. In order to develop a stable economy a nation should have available natural resources for industry and for agriculture. Only a few nations are so favored; we are among the favored few. The United States has 40 per cent of the mineral resources of the world. We have 65 per cent of the petroleum production of the world, a half of the world's coal supply and twice the iron ore deposit of all Europe. We have 1,000,000 square miles between the Rocky Mountains and the Appalachian Mountains in favorable climate for agriculture and more on each side of the mountain ranges. Our economic security is based upon variety and abundance of natural resources coupled with a "know how" to organize them and develop them. Our weakness is that, too often, we are prone to look at the problems of other nations through our "eyes of plenty."

But many nations are severely limited in the variety and amounts of natural resources; furthermore, the modern methods of efficient production of food have not gone far beyond the borders of our own country.

Couple this situation with the population-pressure problem of an aggressive nation—like Japan or Germany with 70,000,000 people, the British Isles with 40,000,000 people, or Italy with 45,000,000 people and you have the two basic issues that can lead to world conflict. Then add to these issues the threat or the possibility of the use of atomic weapons which can destroy a national economy or threaten survival and we have the situation of today. That leads us directly to our next problem.

The Conflicting Philosophies of the State or the Race or the Class versus the Sacredness of Human Personality. The lack or the fear of the lack of food causes masses of people to grow restless and frequently to blame their leaders or their government. Unless the government can suppress this rising current or reaction these masses will grasp, as a drowning man grasps, for any fragment that seems to offer salvation, for any form of government that seems at the moment to better their condition. This usually resolves itself into a dictatorship under the guise of the principles of socialism or communion. We have ample evidence of this reaction — first Russia, then Italy, then Germany, and finally China; and now we can see England going through the agony of facing this possible trend of events in her country. It is true that there are other reasons for a free people turning to the principles of communism such as those that result from the many psychological complexes like inhibition, frustration, paranoia, and schizophrenia or even a stubborn determinism to appear to be independent thinkers (pseudo-independent).

In the past we have seen how the form of government may emphasize several different factors as the solution to their national problem. In Italy Mussolini developed the theory that the state is all important and that the individual must be secondary; in Germany Hitler emphasized the superiority of a **race**, whereas, in Russia Stalin emphasizes the **class**. It may be summarized as the **state**, the **race** or the **class** versus the **sacredness of human personality**. Thus we arrive at a situation that is more to be feared than hunger—it is the fear (or the fact) of the loss of one of the basic elements of the democratic way of life and of Christianity itself.

The Adjustment of Civilization to a Dynamic World. The sweep of the research efforts and of the application of science and technology over the last forty years has made this a fast changing world of facts, ideas, machines, conditions, and events. This is illustrated by the following:

"Before the steel plow was invented it required eight men working from dawn to dusk six days a week to make a living for ten; now in this scientific age, two men can do the same amount of work in a forty-hour week.

"During the time of the Civil War, fifty per cent of the deaths were of children under five years of age. Now only twelve per cent of the deaths are in this age group; only seven per cent of the deaths in that area were of people above fifty years of age; now fifty-seven per cent of the deaths are of persons above fifty years of age. In other words, the life expectancy of a newborn child has changed in the last eighty years from 35 to almost 70 years of age.

In 1492 it required three months to cross the Atlantic Ocean; now it can be done in less than ten hours.

A few years ago we imported most of our nitrate fertilizers from Chile and our rubber and silk from the Far East; now we can synthesize all of them if necessary.

Only a few years ago there was no definite cure for gas gangrene, osteomyelitis, peritonitis, pneumonia, and blood poisoning; now penicillin, streptomycin, aureomycin, and the 'sulfa' drugs offer a cure for those dreaded infections. These are but a few of the many accomplishments of science. There are many others.

Science has harnessed waterfalls for the generation of electric power and electric lights.

Science has converted mountains of iron ore into factories, ships, and machines.

Science has improved on many of nature's materials and has made many new products such as synthetic rubber, plastics, drugs, and alloys.

The power of science has given us better living conditions and has created many new jobs." ("Essentials of Chemistry" by Garrett, Haskins and Sisler. Ginn and Co., Boston, Mass. - 1951).

Each of these contributions of our great research laboratories has brought to us new economic, social, political, and psychological problems —old age pensions, social security, leisure time activity, slum clearance, race relations and the many others we find every day. Actually these are not new problems—they are old ones intensified by the new situations.

These facts of progress are thrilling ones—but now consider what it means to add to them the additional one, namely, the fact that there is every indication that new and even greater discoveries are yet to come from our laboratories—that in many areas of scientific and technological development we have just scratched the surface.

This all points to the dynamic world in which we live—and we can expect it to continue to be that. In all probability the events of the last fifty years have made it a more rapidly changing world than have the events of many previous centuries. We must school ourselves to ac-

Muskingum Debate Teams Have Successful Season

The Muskingum debaters closed a successful season recently by winning five of six debates in a tournament at John Carroll university, taking second place in a field of 15 colleges.

In 44 contests this year, Muskingum debaters won 26. Only one member of the team, Robert Thoburn, had had previous experience in varsity debate.

Prof. Charles R. Layton returned to his position as head of the speech department and director of debate activities after having served several years as dean of the college. Muskingum debate teams have won more state championships under Prof. Layton than any team in Ohio.

Topic under debate this year was: Resolved, that the non-communist nations should form a new international organization.

Members of the Muskingum squad are Robert Thoburn, Cadiz, Ohio; Arnold Plum, McKeesport, Pa.; Dale Scott, Cuyahoga Falls, Ohio; Robert Larson, Dearborn, Mich.; Rosemary Sweet, Durham Center, Conn.; and Rees Dilger, Dover, Ohio.

cept the fact, to enjoy the drama, and to plan for the consequence of change—that

"New occasions teach new duties
Time makes ancient good uncouth.
He must upward still and onward
Who would keep abreast of truth."

The events of the world of today are not those which should surprise, or shock or frustrate us; rather they are the ones we ought to expect in such a dynamic world as ours. When we understand this simple fact we can face the modern day problems with understanding and hopes which are stripped to a large extent of the confusion that results from static minds in a whirlwind world.

Other problems. To be sure there are other basic problems in our world, many of them are inherent in the nature of man himself—jealousy, pride, selfishness, lust, and intrigue. Then there are the problems of power politics as these personal problems are exercised through national group dynamics. These are inherent human nature problems that will always be with us, to a degree at least, regardless of the height of our culture, our government or our religious forms. But their effect is felt more disastrously as the sordid conditions which foster them are allowed to exist or develop. If those conditions can be removed or minimized, we will have set the stage for raising the level of human personality and minimizing the inherent defects in human nature through the joint efforts of the instruments of education and religion.

The Solution. A solution to our problems is not an easy one to find and it may not be a particularly pleasant one to face. But we can start with the premise that a correct diagnosis is the first step toward a solution. It also seems that a second premise is necessary; if so, it would be that, for a solution of such problems of elemental but of world wide nature, some type of a strong world wide organization is the necessary instrument to apply the prescription. Today we have founded the United Nations for this very purpose. That organization has as one of its basic sections the Economic Council that was devised to help solve the problems of food, shelter and means of productive activity of the citizens of the world. It has the International Commission for the Control of Atomic Fuels; it has the UNESCO branch for the stimulation of the intellectual growth of the scholars of the world.

The service that the United Nations can perform in the solution of world problems came to me in a contrasting significance several years ago in an experience I had in New York City. I had been the guest of the director of the largest atomic pile in the world—at Brookhaven, Long Island. We had climbed over the pile one morning inspecting the work that was being done on it and finally came to the control room of that great power source. As we stood there and looked westward toward the Statue of Liberty and New York City, this question came to me, "What can this mean to civilization?" That evening I looked out of my hotel window down at the grounds that were being cleared for the United Nations buildings; again I asked, "What can this mean to civilization?"—I got the same answer as before—it can mean much.

A third premise that we must accept is that elimination of intellectual and spiritual illiteracy can raise the level of the spiritual and intellectual insight of humanity so as to free the world of the bonds imposed by these great problems. In this fast moving world we must recognize the urgency of this issue. Much more emphasis must be placed on the duty of education and religion to raise the intellectual and spiritual insight of mankind. That is the long term program toward which we must work. This premise becomes basic to all of the problems.

This fact was brought home to me in a dramatic manner by a bit of symbolism I observed while working on the problem of the defense against atomic warfare at the Institute of Nuclear Studies at the Atomic Energy Center at Oak Ridge, Tennessee. One afternoon we had a heavy thunder storm, but in the evening the skies cleared and we observed a beautiful rainbow in the east. As we watched it, we saw that one end of it came down over the roof of the Institute of Nuclear Studies; as our eyes followed the arch of the bow we found that the other end of the rainbow was over the roof of a little white chapel on the hillside on the other side of the valley. Those two institutions are symbolic of the intellectual and the spiritual. In one, man had learned the secret of the source of the energy of the sun and the stars and had tapped the hearts of the building blocks of matter to release that energy; in the other, the priest, the rabbi, or the pastor tapped the hearts of men and released a force that could control this other force. Symbolism to be sure—but also very real!

Conclusion. We should consider these great areas of intellectual and spiritual problems as the new frontier that can now be clearly described on our immediate horizons. Pioneering these frontiers can be a great and noble adventure. If we have a confidence and faith in what we believe to be the basic elements of our culture and our religion we can approach the adventure with courage and optimism. That optimism, enthusiasm, and vision is well expressed in the words of the poet:

"Oh! Wonderful is God's earth
And it is wonderful to be a man
upon that earth."

1951 FOOTBALL *Schedule*

Sept. 29	At Baldwin-Wallace	
Oct. 6	Heidelberg at New Concord	(night)
Oct. 13	At Slippery Rock, Pa.	
Oct. 20	At Wooster	
Oct. 27	**Denison at New Concord**	**(Homecoming)**
Nov. 3	At Marietta	
Nov. 10	Ohio Wesleyan at New Concord	(day)
Nov. 17	Otterbein at New Concord	(day)